

AECOM Imagine it. Delivered.

Gökırmak Copper Project

Environmental Impact Assessment Report

Acacia Maden İşletmeleri A.Ş.

September 2017

PUBLIC

Quality information

Prepared by	Checked by	Approved by
AECOM Turkey	Burcu Yazgan Kayabalı, Senior Project Manager Dr. Hande Yükseler, ESIA and EDD Section Manager Yusuf Topçu, Mining Section Manager	Uygar Duru, CIS Region Environment BL Director

Revision History

Revision	Revision date	Details	Authorized	Name	Position
0	03.05.2017	Initial draft	03.05.2017	Dr. Hande Yükseler	ESIA and EDD Section Manager
1	22.09.2017	Final	22.09.2017	Dr. Hande Yükseler	ESIA and EDD Section Manager

Prepared for:

Acacia Maden İşletmeleri A.Ş.

Prepared by:

Ahmet Korkmaz, *GIS and Modelling Expert*
Başak Şentürk, *BSc Biologist*
Esmanur Selçuk, *BSc Environmental Engineer*
İrem Kayıran Bozoğlu, *BSc Chemical Engineer*
Kaan Düz, *BSc Geological Engineer*
Mertcan Özbakır, *MSc BSc Hydrogeological Engineer*
Taylan Aşkın, *MSc BSc Geological Engineer*

Aecom Turkey Danışmanlık ve Mühendislik Ltd. Şti
Mustafa Kemal Mahallesi Dumlupınar Bulvarı Tepe Prime
No:266 B Blok
No:50-51 06800
Çankaya
Ankara
Turkey

T: +90 312 4429863
aecom.com

© 2017 Aecom Turkey Danışmanlık ve Mühendislik Ltd. Şti. All Rights Reserved.

This document has been prepared by Aecom Turkey Danışmanlık ve Mühendislik Ltd. Şti (“AECOM”) for sole use of our client (the “Client”) in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client. Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.

Table of Contents

1. INTRODUCTION 21
2. LEGAL FRAMEWORK 22
2.1 Turkish Environmental and Social Legislation 22
2.1.1 Environmental Impact Assessment 25
2.1.2 Environmental Permits and Licenses 27
2.2 International E&S Standards 27
2.2.1 EBRD Environmental and Social Policy and Performance Requirements 27
2.2.2 European Union Legislation 29
2.2.3 International Conventions and Protocols 31
3. PROJECT DESCRIPTION 33
3.1 Project Overview 33
3.2 Project Area 34
3.3 Project Units 43
3.3.1 Open Pit 43
3.3.2 Process Plant 46
3.3.3 Bağdere and Kepezkaya Tailings Storage Facilities and the Tailings Pipeline 49
3.3.4 Waste Rock Dump Area 51
3.3.5 Roads 52
3.3.6 Other Project Units and Supporting Infrastructure 53
3.3.7 Associated Facilities 54
3.4 Project Background 57
3.4.1 National EIA Studies 57
3.4.2 Permits and Licenses 58
3.4.3 Additional E&S Studies 62
3.5 Project Schedule and Workforce Requirements 63
4. PROJECT ALTERNATIVES 68
4.1 Technology Alternatives 68
4.1.1 Mining Method Selection 68
4.1.2 Ore Processing Alternatives 69
4.1.3 Tailings Disposal Alternatives 71
4.2 Location Alternatives 73
4.2.1 Waste Rock Dump Alternatives 74
4.2.1.1 Gelberi WRD 74
4.2.1.2 Küpeli WRD 75
4.2.1.3 Other WRD Related Alternatives 75
4.2.2 Tailings Storage Facility Alternatives 76
4.3 No Project Alternative 80
5. BASELINE CHARACTERISTICS 83
5.1 Topography 83
5.2 Land Use and Soil 83
5.2.1 Land Use 83
5.2.2 Major Soil Groups, Land Use Capability Classes and Erosion Degrees 86
5.2.2.1 Major Soil Groups 86
5.2.2.2 Soil Capability Class 89
5.2.2.3 Erosion Degree 91
5.2.3 Soil Quality 93
5.3 Geological Characteristics 100
5.3.1 Project Site Geology 100
5.3.2 Structural Geology 102
5.3.2.1 Tectonics and Seismicity 104

5.3.2.2 Structural Features in the Project Units 106
5.4 Climate and Meteorology 108
5.4.1 Meteorological Data Sources 108
5.4.1.1 Devrekani Meteorological Station 108
5.4.1.2 Kastamonu Meteorological Station 112
5.4.1.3 On-site Meteorological Model Data 115
5.5 Air Quality 119
5.6 Noise and Vibration 124
5.6.1 Noise 124
5.6.2 Vibration 127
5.7 Water Resources 131
5.7.1 Basin Characteristics 131
5.7.2 Study Area 134
5.7.3 Calculated Hydro-Meteorological Parameters for the Study Area 134
5.7.4 Drinking Waters 135
5.7.5 Project's Water Supply 138
5.7.6 Hydrogeological Characteristics 142
5.7.6.1 Water Bearing Units 142
5.7.6.2 Groundwater Levels 143
5.7.6.3 Aquifer Parameters 144
5.7.7 Water Quality 149
5.7.7.1 Sampling and Monitoring Methodology 150
5.7.7.2 Drinking Waters 153
5.7.7.3 Groundwater 164
5.7.7.4 Surface Waters 175
5.7.7.5 Gökırmak River Water Quality 184
5.7.8 Overall Summary on Surface Waters and Groundwater 186
5.8 Mining Waste Characteristics 187
5.8.1 Geochemical Characterization of the Mining Lithologies 187
5.8.1.1 Geochemical Testing Program 188
5.8.1.2 Static Testing 190
5.8.1.3 Kinetic Testing 190
5.8.1.4 Conceptual Design of Waste Rock Lithology Storage 195
5.8.1.5 Summary of the test results 195
5.9 Biodiversity 197
5.9.1 Terrestrial Flora 202
5.9.1.1 Floristic Analysis 207
5.9.2 Terrestrial Fauna 208
5.9.2.1 Amphibians (Amphibia) 208
5.9.2.2 Reptiles (Reptilia) 209
5.9.2.3 Birds (Aves) 209
5.9.2.4 Mammals (Mammalia) 210
5.9.3 Aquatic Flora and Fauna 211
5.9.3.1 Freshwater Algae 211
5.9.3.2 Zooplankton 211
5.9.3.3 Benthic Organisms 212
5.9.3.4 Fish 212
5.9.4 Naturally Protected Areas 212
5.9.5 Habitat Assessment 218
5.9.5.1 Critical Habitat Assessment 221
5.9.6 Invasive Alien Species 227

5.9.7 Ecosystem Services 227
5.10 Cultural Heritage 229
5.10.1 Immovable Cultural Heritage 229
5.10.1.1 Baseline Survey Methodology 229
5.10.1.2 Archaeological and Historic Background 230
5.10.2 Intangible Cultural Heritage 240
6. ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION MEASURES 243
6.1 Impact Assessment Methodology 244
6.2 Visual Impact Assessment 247
6.2.1 Study Area 247
6.2.2 Methodology 249
6.2.3 Impact Assessment 250
6.2.3.1.1 Distance and Horizontal Analysis 250
6.2.3.1.2 Viewpoints for Visual Assessment 250
6.2.3.1.3 Assessment of Key Project Activities 266
6.2.4 Mitigation 274
6.3 Land Use and Soil 277
6.3.1 Impacts 277
6.3.1.1 Impacts on Land Use 277
6.3.1.2 Impacts on Soil 279
6.3.2 Mitigation 282
6.4 Air Quality 287
6.4.1 Emission Sources 287
6.4.1.1 Dust Emissions 288
6.4.1.2 Emissions of Exhaust, Stationary Sources and Blasting 289
6.4.2 Emission Calculations (dust, PM_{10} and gaseous emissions) 290
6.4.2.1 Dust Emissions 290
6.4.2.2 Emissions from Blasting 293
6.4.2.3 Dust Emissions from Haul (Unpaved) Roads (Transportation) 294
6.4.2.4 Exhaust Emissions 297
6.4.2.5 Other Emission Sources 299
6.4.3 Emission Calculations ($PM_{2.5}$ Emission Estimation) 299
6.4.4 Air Quality Modelling Study 300
6.4.5 Impact Assessment 307
6.4.6 Air Quality Monitoring Program 307
6.4.7 Mitigation 310
6.5 Greenhouse Gas Emissions 314
6.5.1 Construction Phase 316
6.5.2 Operation Phase 319
6.5.3 Closure Phase of GCMP 321
6.5.4 Results and Assessment 321
6.5.5 Mitigation 322
6.6 Noise and Vibration 324
6.6.1 Project Standards 324
6.6.1.1 Noise 324
6.6.1.2 Vibration 325
6.6.1.3 Sensitivity of Noise Receptors 325
6.6.2 Noise Assessment 326
6.6.2.1 Construction Phase 327
6.6.2.2 Operation Phase 328
6.6.2.3 Blasting 332

6.6.3 Vibration Assessment 332
6.6.4 Mitigation 337
6.7 Water Resources 340
6.7.1 Modeling 340
6.7.1.1 Conceptual Model of the Study Area 340
6.7.1.2 Numerical Model 341
6.7.2 Impacts on Water Resources 343
6.7.2.1 Impacts on Groundwater Quantity 343
6.7.2.1.1 Open Pit Dewatering 343
6.7.2.1.2 Pit Lake Formation 345
6.7.2.1.3 Groundwater Extraction for Water Supply 351
6.7.2.1.4 Tailings Storage Facilities and Waste Rock Dumps 351
6.7.2.1.5 Project (GCP) Water Balance 356
6.7.2.2 Impacts on Water Quality 365
6.7.2.2.1 Impact of Diversion Tunnel Construction on the Gökırmak River during Construction Phase 365
6.7.2.2.2 Transport of Sediments due to Top Soil Disturbance 367
6.7.2.2.3 Discharge of Mine Waters during Operation Phase 367
6.7.2.2.4 Impacts of Mining Wastes during Operation and Post-Operation Phases 367
6.7.3 Mitigation 375
6.7.3.1 Mine Water Monitoring Plan 382
6.7.3.1.1 Surface Waters 382
6.7.3.1.2 Groundwater 387
6.7.3.1.3 Process Waters and Operational Structures 388
6.8 Mining Waste 389
6.8.1 Çorakoğlu Waste Rock Dump 389
6.8.1.1 Potential Impacts of WRD Drainage on Surface Drainage 389
6.8.1.2 Potential Impacts of WRD Leachate on Groundwater beneath the Waste Rock Dump 390
6.8.1.3 Potential Impacts of WRD Operations on Underlying Soil/Overburden 391
6.8.1.4 Potential Impacts Related to Capacity, Transportation Management and Erosion 392
6.8.1.5 Conclusions of Impact Assessment of WRD 393
6.8.1.6 Application of Engineered Cover at the WRD 394
6.8.1.6.1 WRD Cover Design 394
6.8.1.6.2 Cover Design Modeling 395
6.8.1.6.3 Assessment of Residual Impact after Mitigation (i.e. Application of Engineered Cover at Çorakoğlu WRD) 395
6.8.2 Open Pit Lake 397
6.8.2.1 Potential Impacts of Pit Lake Water on the Gökırmak River 397
6.8.2.2 Potential Impacts of Open Pit Operations on Soil/Overburden 398
6.8.2.3 Conclusions of Impact Assessment for Open Pit Lake 399
6.8.3 Tailings Storage Facilities 400
6.8.3.1 PHREEQC Modeling Results of TSF Leachate/Bedrock Pore Water and Bedrock Geochemical Interaction 400
6.8.3.2 Potential Impacts of TSF on Underlying Soil/Overburden 402
6.8.3.3 Conclusions of Impact Assessment for Kepezkaya TSF 402
6.8.4 Process Plant 403
6.8.5 Mitigation 403
6.9 Wastewater 404
6.9.1 Construction Phase 404
6.9.2 Operation Phase 405
6.10 Non-Mining Waste 407
6.10.1 Hazardous Waste 407
6.10.1.1 Construction Phase 407

6.10.1.2 Operation Phase 408
6.10.1.3 Closure Phase 409
6.10.2 Non - Hazardous Waste 409
6.10.2.1 Construction Phase 409
6.10.2.2 Operation Phase 409
6.10.2.3 Closure Phase 409
6.11 Biodiversity 414
6.11.1 Impacts 414
6.11.2 Mitigation 424
6.12 Health and Safety 434
6.12.1 Occupational Health and Safety 434
6.12.1.1 Occupational Health and Safety Setting in Turkish Mining Sector 434
6.12.1.2 Project OHS Management and Existing Conditions 437
6.12.1.3 Construction and Closure Phases 438
6.12.1.4 Operation Phase 442
6.12.2 Community Health and Safety 447
6.12.3 Infrastructure, Building and Equipment Design and Safety 448
6.12.4 Hazardous Materials Safety 449
6.12.5 Product and Services Safety 449
6.12.6 Traffic and Road Safety 450
6.12.7 Natural Hazards 450
6.12.8 Exposure to Disease 450
6.12.9 Emergency Preparedness and Response 450
6.13 Cultural Heritage 461
6.13.1 Immovable Cultural Heritage 461
6.13.2 Intangible Cultural Heritage 461
6.13.3 Mitigation 462
6.14 Closure and Rehabilitation Impacts 465
6.14.1 Physical Stability of Project Units 465
6.14.1.1 Open-Pit and Çorakoğlu WRD Stability 465
6.14.1.2 Kepezkaya TSF Stability 467
6.14.2 Chemical Stability of Project Units 467
6.14.3 Land Use and Visual Amenity 467
6.14.4 Other 468
6.14.5 Development of Completion Criteria 468
6.14.6 Closure Implementation 472
7. CUMULATIVE ENVIRONMENTAL IMPACT ASSESSMENT 473
7.1 Approach to Undertaking Cumulative Impact Assessment 473
7.2 Limitations of the Cumulative Impact Assessment 474
7.3 Identified Projects 474
7.3.1 Existing Projects 475
7.3.2 Reasonably Foreseeable Future Projects 475
7.4 Valued Environmental and Social Components 478
7.5 Assessment and Management of Cumulative Impacts 479
8. PROJECT SPECIFIC ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM 482
8.1 Project Standards and Requirements 482
8.2 Overall ESMS Approach and Implementation Documents 483
8.3 Roles and Responsibilities 484
8.4 Monitoring 487
8.5 Review and Update of the ESMS 490
8.6 Stakeholder Management and Information Disclosure 491

Appendix A Species List 492
Appendix B Visual Impact Assessment 586

Figures

Figure 2-1 The Full National EIA Process 26
Figure 3-1 Flow Chart for Operation Phase 35
Figure 3-2 Project Location Map 36
Figure 3-3 Panoramic View of Open Pit and Çorakoğlu WRD Area 37
Figure 3-4 Gökırmak Derivation Structures from Sepetçioğlu Neighborhood 37
Figure 3-5 Project Layout (Focused on Main Units) 38
Figure 3-6 Project Layout with the ETL 39
Figure 3-7 Project Layout, License Areas and EIA areas 41
Figure 3-8 ESIA Study Areas 42
Figure 3-9 Open Pit Ultimate Design (GCP FS Report, June 2017 44
Figure 3-10 Process Plant Flowsheet 48
Figure 3-11 River Diversion System Layout Plan 56
Figure 3-12 Project Construction Phase Schedule (AMI, 2017) 64
Figure 3-13 Construction Phase Personnel Requirement in 2017 and 2018 65
Figure 3-14 Construction Phase Personnel Requirement for Different Project Units in 2017 and 2018 66
Figure 4-1 Preliminary Buttress Design 72
Figure 4-2 Assessed TSF Alternatives (Hidromark, 2013) 77
Figure 4-3 Relation Between Growth of Industrial Production and Copper Consumption 80
Figure 4-4 Copper Mine Production Requirement by 2030 80
Figure 5-1 Land Use Map of the Project Area (GDRS, 2013) 85
Figure 5-2 Major Soil Groups of the Project Units 88
Figure 5-3 Land Use Capability Classes of Soils within the Project Area 90
Figure 5-4 Erosion Degree Map of the Project Area 92
Figure 5-5 Soil Sampling Points 94
Figure 5-6 Core with MCU and SMCU Mineralization (SDD-44) 101
Figure 5-7 Geological Map and Major Structural Features of the Project Area 102
Figure 5-8 Geology of the Gökırmak Fold and Thrust Belt (Okay et al., 2006) 103
Figure 5-9: Cross-Section through the Gökirmak Fold and Thrust Belt (Okay et al., 2006) 104
Figure 5-10 Earthquake Zones Map of Kastamonu Province 105
Figure 5-11 Active Fault Map of Region 105
Figure 5-12 Earthquake Locations in Regional Scale with respect to the Project Area (Asya Maden, 2015) 106
Figure 5-13 3D View of the Dividing and Sub-Dividing Faults in the Open Pit Area 107
Figure 5-14 Long Term Temperature Data of Devrekani Meteorological Station 109
Figure 5-15 Long Term Precipitation Data of Devrekani Meteorological Station 109
Figure 5-16 Long Term Evaporation Data of Devrekani Meteorological Station 110
Figure 5-17 Long Term Humidity Data of Devrekani Meteorological Station 110
Figure 5-18 Annual and Seasonal Wind Roses Prepared for Devrekani Meteorological Station 111
Figure 5-19 TLong Term Temperature Data of Kastamonu Meteorological Station 112
Figure 5-20 TLong Term Precipitation Data of Kastamonu Meteorological Station 113
Figure 5-21 Long Term Evaporation Data of Kastamonu Meteorological Station 113
Figure 5-22 Long Term Humidity Data of Kastamonu Meteorological Station 114
Figure 5-23 Annual and Seasonal Wind Roses Prepared for Kastamonu Meteorological Station 115
Figure 5-24 5-Year Temperature Data of on-site MM5 Meteorological Model 116
Figure 5-25 5-Year Precipitation Data of on-site MM5 Meteorological Model 117
Figure 5-26 5-Year Humidity Data of on-site MM5 Meteorological Model 117
Figure 5-27 Annual and Seasonal Wind Roses of on-site MM5 Meteorological Model 118
Figure 5-28 Air Quality Measurement Locations 123
Figure 5-29 Noise Measurement Locations 126
Figure 5-30 Drainage pattern of the Kızılırmak River 131
Figure 5-31 Locations of the Planned Taşöprü Dam, Demirci HEPP and Gökçeağaç Pond 133
Figure 5-32 Location Map for the Study Area 134
Figure 5-33 Water Depots and Springs Sampling/Monitoring Locations and Water Transmission Lines 137
Figure 5-34 Water Supply Wells and Caisson Wells 140
Figure 5-35 Regional Groundwater Level Map of the Study Area 144
Figure 5-36 Previously-Tested Monitoring Wells Prior to AECOM's involvement to the GCP 146
Figure 5-37 Locations for the Monitoring Wells Completed by AECOM 147
Figure 5-38 Summary of the GCP Water Quality Surveys 149
Figure 5-39 Drinking Water Monitoring Locations 155

Figure 5-40 Piper Diagram for the May 2016 Drinking Water Samples 157
Figure 5-41 Piper Diagram for the August 2016 Drinking Water Samples 157
Figure 5-42 Piper Diagram for the November 2016 Drinking Water Samples 158
Figure 5-43 Schoeller Diagram for the May 2016 Drinking Water Samples 158
Figure 5-44 Schoeller Diagram for the August 2016 Drinking Water Samples 158
Figure 5-45 Schoeller Diagram for the November 2016 Drinking Water Samples 159
Figure 5-46 Wilcox Diagrams for the Drinking Water Samples 160
Figure 5-47 Groundwater Monitoring Locations 166
Figure 5-48 Piper Diagram for the May 2016 Monitoring Wells 169
Figure 5-49 Piper Diagram for the August 2016 Monitoring Wells 170
Figure 5-50 Piper Diagram for the November 2016 Monitoring Wells 170
Figure 5-51 Piper Diagram for the GK-Series Wells (December 2016) 171
Figure 5-52 Schoeller Diagram for the May 2016 Monitoring Wells 171
Figure 5-53 Schoeller Diagram for the August 2016 Monitoring Wells 172
Figure 5-54 Schoeller Diagram for the November 2016 Monitoring Wells 172
Figure 5-55 Schoeller Diagram for the GK-Series Wells (December 2016) 172
Figure 5-56 Wilcox Diagrams for the Groundwater Monitoring Wells 173
Figure 5-57 Surface Waters Monitoring Locations 178
Figure 5-58 Piper Diagram for the May 2016 Surface Water Samples 180
Figure 5-59 Piper Diagram for the August 2016 Surface Water Samples 180
Figure 5-60 Piper Diagram for the November 2016 Surface Water Samples 181
Figure 5-61 Schoeller Diagram for the May 2016 Surface Water Samples 181
Figure 5-62 Schoeller Diagram for the August 2016 Surface Water Samples 182
Figure 5-63 Schoeller Diagram for the November 2016 Surface Water Samples 182
Figure 5-64 Wilcox Diagrams for the Surface Waters (2016) 183
Figure 5-65: Water Quality Sampling Locations along the Gökırmak River 185
Figure 5-66 Distribution of the principal parameters (SO4, Ca and pH) for the humidity cell tests 193
Figure 5-67 Location of the Project Area According to Grid Square System 203
Figure 5-68 Statutory Designated Protected Areas 214
Figure 5-69 Internationally Designated Areas 217
Figure 5-70 EUNIS Habitat Map (Level 2) of the Project Area and its Vicinity 219
Figure 5-71 Habitat Map of the Project Area and its Vicinity 220
Figure 5-72 Archaeological and Immovable Cultural Heritage Sites Located in Gokırmak Copper Project Area and its Vicinity 234
Figure 5-73 General Views of Project ETL and Pompeipolis 235
Figure 5-74 Cultural Assets in the Vicinity of the Project Area 237
Figure 5-75 Kupeli House No: 1 238
Figure 5-76 Küpeli House No: 5 238
Figure 5-77 Küpeli House No: 9 238
Figure 5-78 Küme Houses in Sepetçioğlu Quarter 239
Figure 5-79 Graves and Gravestones dated to the 19th century 239
Figure 6-1 Study Area 248
Figure 6-2 Zones of Theoretical Visibility of Open Pit 251
Figure 6-3 Zones of Theoretical Visibility of Corakoglu WRD 252
Figure 6-4 Zones of Theoretical Visibility of Process Plant 253
Figure 6-5 Zones of Theoretical Visibility of Kepezkaya TSF 254
Figure 6-6 Zones of Theoretical Visibility of Bagdere TSF 255
Figure 6-7 Zones of Theoretical Visibility of Kupeli Storage Area 256
Figure 6-8 Zones of Theoretical Visibility of Ore Transport Road 257
Figure 6-9. Viewpoint Locations 259
Figure 6-10 Watering Control Effectiveness for Unpaved Roads 294
Figure 6-11 The Flowchart of Haul Road Emission Calculations 295
Figure 6-12 Receptor Points Map 302
Figure 6-13 Wind Rose of MM5 Based Data Station for the Period 01/01/2010-/31/12/2015 303
Figure 6-14 Wind Rose of MM5 Based Data Station for the Period 01/01/2013-31/12/2015 (Modelled Period) 304
Figure 6-15 Selected Air Quality Sensitive Receptors 306
Figure 6-16 GHG Sources 314
Figure 6-17 Predicted Daytime Noise Levels of Operation Phase 330
Figure 6-18 Predicted Nighttime Noise Levels of Operation Phase 331
Figure 6-19. Vibration Sensitive Receptors 336

Figure 6-20 Conceptual Model of the Study Area..... 341
Figure 6-21 Model Domain and Boundary Conditions..... 342
Figure 6-22 Groundwater Flow Rates into the Pit and Elevation of the Pit Bottom versus Time 344
Figure 6-23 Open Pit Area Cone of Depressions for Specific Yields of 0.05 and 0.075 (End of Operation)..... 344
Figure 6-24 Conceptual Closure Conditions for Scenario 1 346
Figure 6-25 Pit Lake Level Change within Time for Scenario 1..... 347
Figure 6-26 Conceptual Closure Conditions for Scenario 2 348
Figure 6-27 Pit Lake Level Change within Time for Scenario 2..... 348
Figure 6-28 Conceptual Closure Conditions for Scenario 3 350
Figure 6-29 Pit Lake Level Change within Time for Scenario 3..... 350
Figure 6-30 Proposed Design of the Composite Liner System beneath the TSFs 352
Figure 6-31 Potential Seepage Pathways for the Kepezkaya TSF..... 354
Figure 6-32 Potential Seepage Pathways for the Bağdere TSF..... 355
Figure 6-33 Potential Seepage Pathways for the Çorakoğlu WRD 356
Figure 6-34 Schematic Mine Water Balance..... 364
Figure 6-35 Facies Types and Total Suspended Solid (TSS) Values along the Gökırmak River..... 366
Figure 6-36 Graphical representation of the dissolution of calcite (orange line) and the volume of rapidly precipitating mineral phases with time (seconds) after mixing of TSF leachate and bedrock/bedrock pore water. The grey line shows the available volume of pore space within the bedrock host lithology 375
Figure 6-37 Groundwater (Monitoring Wells, Sprigs and Water Depots) Monitoring Locations for the Project Area383
Figure 6-38 Groundwater (Monitoring Wells, Sprigs and Water Depots) Monitoring Locations for the Open Pit 384
Figure 6-39 Surface Water Monitoring (Pit Lake, Streams and Sedimentation Ponds) Locations for the Project Area 385
Figure 6-40 Proposed WRD Cover Design 394
Figure 6-41 Effectiveness of Engineered Cover for Base Case As 396
Figure 6-42 Effectiveness of Engineered Cover for Base Case B..... 396
Figure 6-43 Graphical representation of the dissolution of calcite (orange line) and the volume of rapidly precipitating mineral phases with time (seconds) after mixing of TSF leachate and bedrock/bedrock pore water. The grey line shows the available volume of pore space within the bedrock host lithology 402
Figure 6-44 Schematic Diagram Showing the Implementation of the Mitigation Hierarchy..... 424
Figure 6-45 Number of Deaths Occurred in the Mining Industry (2002- 2013) (Union of Turkish Bar Associations, 2014)..... 436
Figure 6-46 Number of Work Days Lost in Metal Ore Mining Sector Occupational Accidents (2008-2015) (Social Security Institution, Statistics Yearbooks)..... 436
Figure 6-47 Conceptual closure scenario for the open pit to be flooded by the Gökırmak River..... 466
Figure 7-1 Cumulative Impact Assessment Map..... 476
Figure 7-2 Project-centered perspective of ESIA and VESC-centered perspective of CIA 478
Figure 7-3 Focusing on Effects on VECs 478
Figure 8-1 ESMS Implementation Hierarchy..... 484
Figure 8-2 GCP Management Structure..... 486

Tables

Table 3-1 Mineral Resources for GCP 33
Table 3-2 Open-Pit Stage Design Content Summary 43
Table 3-3 Open-Pit Mine Schedule 45
Table 3-4 Tailings Production by Years 49
Table 3-5 Waste Dump Design Criteria 51
Table 3-6 Gökırmak River Diversion Technical Specifications 54
Table 3-7 Permits, Approvals and Agreements 58
Table 3-8 Forestry Permits 60
Table 3-9 Environmental and Social Studies Conducted for GCP 62
Table 3-10 Operation Phase Personnel Requirement 66
Table 4-1 Comparison of Environmental Issues for Open Pit and Underground Mining Methods 69
Table 4-2 Summary Results of WRD Optimization Study 74
Table 4-3 Rank and Severity for TSF Alternatives 78
Table 4-4 TSF Alternatives Score Table 79
Table 5-1 Land Use Distribution of the Project Area 84
Table 5-2 Distribution of Soils within the Project Area According to Major Soil Groups 86
Table 5-3. Soil Capability Classes and Arability 89
Table 5-4 Distribution of Soils within the Project Area According to their Land Use Capability Classes 89
Table 5-5 Distribution of Soils within the Project Area According to their Erosion Degrees 91
Table 5-6 Coordinates of Soil Sampling Points 93
Table 5-7 Soil Quality Comparison with Limit Values specified by Regulation on Control of Soil Contamination and Point Source Contaminated Lands (1/2) 96
Table 5-8 Soil Quality Comparison with Limit Values specified by Regulation on Control of Soil Contamination and Point Source Contaminated Lands (2/2) 97
Table 5-9 Soil Quality Comparison with Dutch Limits for Soil / Sediment Samples (1/2) 98
Table 5-10 Soil Quality Comparison with Dutch Limits for Soil / Sediment Samples (2/2) 99
Table 5-11 Major Rock Units 100
Table 5-12 Meteorological Parameters 116
Table 5-13 PM10 Monitoring Results 119
Table 5-14 Settled Dust Monitoring Results during the Construction Phase 120
Table 5-15 Ambient Air Quality Standards and Project Standards 121
Table 5-16 Mean Values of Baseline PM10 Measurement Results with Project Limits 122
Table 5-17 Noise Level Measurement Results and Applicable Limits 125
Table 5-18 Maximum Permissible Values of Ground Vibrations 127
Table 5-19 Ongoing Vibration Monitoring Results 128
Table 5-20 Water Supply Aquifer Sample (ST-1A) Quality Comparison with Turkish WPCR 139
Table 5-21 Water Supply Aquifer Sample (ST-1A) Quality 141
Table 5-22 Summary Table for the Estimated Aquifer Parameters 148
Table 5-23 Parameters analyzed within the scope of the Hydrogeological Impact Assessment Study 150
Table 5-24 Coordinates and Descriptions for Drinking Water Samples 154
Table 5-25 Comparison of Drinking Water Samples with EU Drinking Water Quality Criteria and WHO Drinking Water Guidelines 162
Table 5-26 Comparison of Drinking Water Samples with Drinking Water Standards specified in Turkish Ministry of Health (RWIFHC) and Turkish Standards Institution (TSE-266) 163
Table 5-27 Coordinates and Descriptions for Groundwater Samples 165
Table 5-28 Coordinates and Descriptions for Surface Water Samples 177
Table 5-29 Total Suspended Solids along Gökırmak River* 185
Table 5-30 The List of Abbreviations Used in Geochemical Characterization 187
Table 5-31 Number of samples based on the sample type 188
Table 5-32 Number of samples based on lithology 188
Table 5-33 Turkish Regulatory Parameters (Regulation on Waters Intended for Human Consumption (RWIHC), Chemical Parameters and Indicator Parameters – Turkish Ministry of Health, 2005) 189
Table 5-34 Canadian Regulatory Parameters 189
Table 5-35 Sample Characteristics for SSFE Testing 191
Table 5-36 SSFE Summary Statistics 191
Table 5-37 Biodiversity Field Surveys 197
Table 5-38 IUCN Red List Categories 198
Table 5-39 Red Data Book for Birds of Turkey Categories 198

Table 5-40 Distribution Areas of Tree/Forest Types of Kastamonu Province 204
Table 5-41 Land Cover Assessment due to Terrestrial Habitat Loss 205
Table 5-42 Forest Land to be Cleared per Project Unit and the Status of the Forestry Permits 205
Table 5-43 Endemic Plant Species within and the Vicinity of the Project Area 207
Table 5-44 Conservation Status of the Vertebrate Species in the Project Area 210
Table 5-45 CORINE Land Cover Code Classification 221
Table 5-46 Potential Critical Habitat Trigger Features ..... **Error! Bookmark not defined.**
Table 5-47 Archaeological Sites in Taşköprü District 231
Table 5-48 The Settlements Covered in the Study 240
Table 6-1 Typical Descriptors for Sensitivity/Value/Importance of Receptors/Resources 244
Table 6-2 Typical Descriptors for Magnitude of Impacts 245
Table 6-3. Significance Assessment Matrix 245
Table 6-4 Significance Levels 246
Table 6-5 Significance Rating Matrix with Significance Color Scale for Negative Ratings 249
Table 6-6. Public and private receptor audiences 258
Table 6-7 Representative Viewpoint Assessment 260
Table 6-8. Key Sources of Potential Visual Impact 266
Table 6-9. Summary of Impacts, Mitigation and Residual Impacts for Visual Impacts 275
Table 6-10 Area of Affected Lands According to Land Use Type (CORINE, 2016) 278
Table 6-11 Land Use Capability Classes of the Affected Soils 281
Table 6-12 Summary of Impacts, Mitigation and Residual Impacts for Land Use and Soils 283
Table 6-13 Air Emissions from Mining Operations 287
Table 6-14 Project Standards for PM10, PM 2.5 and Settled Dust 288
Table 6-15. Project Standards for Emissions from Exhaust, Stationary Sources and Blasting 289
Table 6-16.Controlled Dust Emission Factors 290
Table 6-17.Controlled Dust Emissions from Waste Rock Movement for Y2 291
Table 6-18.Controlled Dust Emissions from Ore Movement for Y2 292
Table 6-19.Controlled Dust Emissions from Wind Erosion of Corakoglu WRD for Y2 292
Table 6-20.Emission Factors for Detonation of ANFO 293
Table 6-21.Emission from Detonation of ANFO 293
Table 6-22. Emission Calculations of Haul Roads 296
Table 6-23. Estimated Equipment List for Construction and Operation Period[1] 297
Table 6-24 Exhaust Emission Calculations of Fuel Usage 298
Table 6-25 Emission Factors of Coal Usage for Heating 299
Table 6-26 Emission Calculation Results of Coal Usage for Heating 299
Table 6-27 Multipliers to estimate $PM_{2.5}$ from PM_{10} in the EPA National Emissions Inventory I (Cowherdand Kuykendal 1996) 299
Table 6-28 Hourly Meteorological Parameters 301
Table 6-29 Sensitivity Criteria 304
Table 6-30 Selected Sensitive Receptors 305
Table 6-31 Emission Estimates from Dispersion Modeling 308
Table 6-32. Proposed Air Quality Monitoring Locations 310
Table 6-33. Summary of Impacts, Mitigation and Residual Impacts for Air Quality 312
Table 6-34 Global Warming Potentials 315
Table 6-35 Vegetation Area of the Project to be cleared 316
Table 6-36 Greenhouse Gas Emissions in Construction Phase 318
Table 6-37 Greenhouse Gas Emissions in Operation Phase 320
Table 6-38 Greenhouse Gas Emissions in Rehabilitation Phase 321
Table 6-39 Total GHG Emissions 321
Table 6-40 Summary of Impact, Mitigation and Residual Impact for GHG Emissions/ All Phases 323
Table 6-41 Noise Limits of Project at Sensitive Receptors 324
Table 6-42 Maximum Permissible Values of Ground Vibrations for Project 325
Table 6-43 Sensitivity Criteria 325
Table 6-44 Noise Monitoring Results for Construction Phase 327
Table 6-45 Equipment List for Operation Phase 328
Table 6-46 Calculated Operation Phase Noise Levels 329
Table 6-47. Measured Noise Levels during Blasting 332
Table 6-48 Measured Vibration Monitoring Results 333
Table 6-49. Proposed Noise and Vibration Monitoring Locations 337
Table 6-50. Summary of Impacts, Mitigation Measures and Residual Impacts for Noise and Vibration 338

Table 6-51 Estimated Monthly Discharge Rates from the Pit Lake According to Scenario 1 347
Table 6-52: Estimated Monthly Discharge Rates from the Pit Lake According to Scenario 2 349
Table 6-53 Calculated leakage rates for hydraulic head above the liner equals to 0.11 m 353
Table 6-54 Calculated leakage rates for hydraulic head above the liner equals to 0.5 m 354
Table 6-55: Information on Nearest Receptors, Their Distance and Estimated Travel Times for the Potential TSF Seepages 355
Table 6-56 Information on Nearest Receptors, Their Distance and Estimated Travel Times for the Potential WRD Seepages 356
Table 6-57 Yearly Groundwater Inflow Rates to the Open Pit 357
Table 6-58 Pit Catchment Areas and Average Annual Rainfall Runoff Inflow Rates for Operation Period 358
Table 6-59 Çorakoğlu WRD Sedimentation Ponds 359
Table 6-60 Daily Water Demand for Dust Suppression during the Operational Phase (RPS, 2015) 360
Table 6-61 Calculated Net Inflow Rates for the Kepezkaya TSF for Average Annual Rainfall 362
Table 6-62 Calculated Net Inflow Rates for the Bağdere TSF for Average Annual Rainfall 362
Table 6-63 Calculated Net Inflow Rates for the Kepezkaya TSF for Wettest Annual Rainfall 363
Table 6-64 Calculated Net Inflow Rates for the Bağdere TSF for Wettest Annual Rainfall 363
Table 6-65 Modelled Maximum and Minimum Concentrations in the Gökirmak River for Base Case and Worst Case Loading Rates, Compared to Turkish, EU and Canadian Water Quality Standards 368
Table 6-66 Calculated Base Case and Worst Case Total Mg/Quarter Entering the Gokirmak River from Year 79 to Year 179 after WRD Construction 370
Table 6-67 Pertinent Gökırmak River Exceedances 372
Table 6-68 PHREEQC calculated masses and volumes of dissolved and precipitated minerals as TSF leachate mixes with bedrock and bedrock pore water. Yellow highlighted minerals indicate those known to react rapidly from a kinetic perspective 374
Table 6-69 Summary of Impacts, Mitigation and Residual Impacts for Water Resources 376
Table 6-70 Water Monitoring Plan for the GCP 386
Table 6-71 Monitoring Plan for the Operational Water Structures 387
Table 6-72 Modelled Maximum and Minimum Concentrations in the Gökirmak River for Base Case and Worst Case Loading Rates, Compared to Turkish, EU and Canadian Water Quality Standards 390
Table 6-73 Calculated Base Case and Worst Case Total Mg/Quarter Entering the Gokirmak River from Year 79 to Year 179 after WRD Construction 391
Table 6-74: Predicted Increase in Overburden Concentrations of Exceedant Parameters below the Corakoglu WRD after 100 Years of Percolation of Worst Case WRD Pore Water 392
Table 6-75 Percent Reduction in PCoC Toe of Dump Leachate Concentrations Effected by the Engineered Cover for The Base Case 27 Years after the Cover is Installed 395
Table 6-76 Percent Reduction in PCoC Toe of Dump Leachate Concentrations Effected by the Engineered Cover for the worst case, 27 years after the Cover is Installed 396
Table 6-77 Summary Statistics for the Mass Balance/Phreeqc Models Toe of Dump Maximum and Minimum Concentrations for the Period of Cover Installation Compared To Turkish, EU and Canadian Water Quality Standards 397
Table 6-78 Pertinent Gökırmak River Exceedances 398
Table 6-79: Summary of Gökırmak River Exceedances (Compared to Turkish and EU Drinking Water Regulatory Standards) for all Three Pit Lake Flooding Scenarios 399
Table 6-80 PHREEQC calculated masses and volumes of dissolved and precipitated minerals as TSF leachate mixes with bedrock and bedrock pore water. Yellow highlighted minerals indicate those known to react rapidly from a kinetic perspective 401
Table 6-81 Applicable Limits for Domestic Wastewater Discharge 404
Table 6-82 Wastewater Quality Analysis 405
Table 6-83 Domestic Wastewater Discharge Impact Summary for Construction Phase 406
Table 6-84 Domestic Wastewater Discharge Impact Summary for Operation Phase 406
Table 6-85 Non-Mining Waste Generation Impact Summary for Construction and Closure Phases 410
Table 6-86 Non-Mining Waste Generation Impact Summary for Operation Phase 412
Table 6-87 Potential Impacts on Biodiversity of Mining Activities on Various Stages 415
Table 6-88 Conditions to Operate in an Area Covering Priority Habitat Features 417
Table 6-89. Conditions to Operate in a Critical Area 417
Table 6-90 Potential Biodiversity Impacts per Mining Activities 418
Table 6-91 Impact Assessment for Biodiversity and Living Natural Resources 420
Table 6-92 Land Cover Assessment due to Terrestrial Habitat Loss 420
Table 6-93 Mitigation Measures for Biodiversity Impacts 426
Table 6-94 Occupational Accidents in Turkey (1995-2014) 435

Table 6-95. Deaths due to Occupational Accidents by Economic Activities in Turkey (2014) 435
Table 6-96 OHS Impacts and Mitigation for Construction and Closure Phases 439
Table 6-97 OHS Impacts and Mitigation for Operation Phase 443
Table 6-98 Summary of Impacts, Mitigation and Residual Impacts for Health and Safety / Construction and Closure Phases 451
Table 6-99 Summary of Impacts, Mitigation and Residual Impacts for Health and Safety / Operation Phase 455
Table 6-100 Summary of Impacts, Mitigation and Residual Impacts for Cultural Heritage 463
Table 6-101 Gökırmak Copper Mine Compliance Criteria 469
Table 7-1 Criteria for Determining Significance of Cumulative Impacts 474
Table 7-2 Overlapped Schedule of Projects/Activities that may contribute to Potential Cumulative Impacts 477
Table 7-3 Valued Environmental and Social Components in the scope of the CIA 479
Table 7-4 Potential Cumulative Interactions 481
Table 8-1 EMS Roles and Responsibilities 484
Table 8-2 Environmental Monitoring Plan for Construction and Operation Phases 488

ABBREVIATIONS

AMI	:	Acacia Maden İşletmeleri A.Ş.
An	:	Annex
App	:	Appendix
ARD	:	Acid Rock Drainage
BAP	:	Biodiversity Action Plan
BAT	:	Best Available Techniques
BFA	:	Bench face angle
BMP	:	Biodiversity Management Plan
CIA	:	Cumulative Impact Assessment
CD	:	Conservation Dependent
CH	:	Critical Habitat
CHC	:	Central Hunting Commission
CITES	:	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CORINE	:	Coordination of Information on the Environment
CR	:	Critically Endangered
dBA	:	Decibels
DD	:	Data Deficient
DEM	:	Digital Elevation Model
DO	:	Dissolved Oxygen
DSİ	:	State Hydraulic Works
EC	:	Electrical Conductivity
EBRD	:	European Bank for Reconstruction and Development
EDGE	:	Evolutionarily Distinct and Globally Endangered
EIA	:	Environmental Impact Assessment
EMP	:	Environmental Management Plan
EMRA	:	Energy Market Regulation Authority
EN	:	Endangered
EPA	:	Environmental Protection Agency
ERL	:	European Red List
ESIA	:	Environmental and Social Impact Assessment
ESMP	:	Environmental and Social Management Plan
ESMS	:	Environmental and Social Management System
ETL	:	Energy Transmission Line

EU	:	European Union
EUNIS	:	European Nature Information System
EW	:	Extinct in the Wild
EX	:	Extinct
E&S	:	Environmental and Social
FDDA	:	Four-Dimensional Data Assimilation
FEL	:	Front-End Loader
FI	:	Financial Intermediary
GCL	:	Geosynthetic Clay Liner
GCP	:	Gökırmak Copper Project
GHG	:	Greenhouse Gases
GIS	:	Geographical Information Systems
GWP	:	Global Warming Potential
GIIP	:	Good International Industry Practices
GIP	:	Good International Practice
GMOs	:	Genetically Modified Organisms
GN	:	Guidance Note
Ha	:	Hectar
HDPE	:	High-density polyethylene
HEPP	:	Hydroelectric Power Plant
HFC	:	Hydrofluorocarbon
HSE	:	Health, Safety and Environment
H&S	:	Health and Safety
IAPCR	:	Industrial Air Pollution Control Regulation
IBA	:	Important Bird Area
ICMM	:	International Council of Mining and Metals
IFC	:	International Finance Corporation
IFI	:	International Finance Institution
ILO	:	International Labour Organization
IPA	:	Important Plant Area
IPCC	:	Intergovernmental Panel on Climate Change
KBA	:	Key Biodiversity Area
KPI	:	Key Performance Indicator
LC	:	Least Concern

LR	:	Lower Risk
ML	:	Metal Leach
MLA	:	Mining Lease Applications
MoEU	:	Ministry of Environment and Urbanization
MoFWA	:	Ministry of Forestry and Water Affairs
MP	:	Management Plan
Mt	:	million tonnes
MVA	:	Mega volt amperes
NCEP	:	National Centre for Environmental Protection
NE	:	Not Evaluated
NSR	:	Noise Sensitive Receptors
NT	:	Near Threatened
N/A	:	Not applicable
OHS	:	Occupational Health and Safety
OSA	:	Overall slope angle
PAX	:	Potassium Amyl Xanthate
PBF	:	Priority Biodiversity Feature
PCBs	:	Polychlorinated Biphenyls
PCTs	:	Polychlorinated Terphenyls
PFC	:	Perfluorocarbon
PM	:	Particulate Matter
POPs	:	Persistent Organic Pollutants
PPE	:	Personal Protective Equipment
PR	:	Performance Requirement
PS	:	Performance Standard
RAMAQ	:	Regulation on Management of Air Quality
RAMEN	:	Regulation on Assessment and Management of Environmental Noise
ROM	:	Run of Mine
RSPB	:	Royal Society for Protection of Birds
SCI	:	Sites of Community Importance
SIA	:	Social Impact Assessment
SMBS	:	Sodium metabisulphite
SEP	:	Stakeholder Engagement Plan
SPAs	:	Special Protection Areas

Spp	:	Species
Subsp	:	Subspecies
TSF	:	Tailings Storage Facility
TMP	:	Traffic Management Plan
TSF	:	Tailings Storage Facility
TSS	:	Total Suspended Solids
TUBITAK	:	Scientific and Technological Research Council of Turkey
UKMO	:	United Kingdom Meteorological Office
US EPA	:	United States Environmental Protection Agency
Var	:	Variety
VIA	:	Visual Impact Assessment
VMS	:	Volcanogenic Massive Sulphide
VSD	:	Variable Speed Drive
VU	:	Vulnerable
WB	:	World Bank
WBCSD	:	World Business Council on Sustainable Development
WFD	:	Water Framework Directive
WHO	:	World Health Organization
WIA	:	Wildlife Improvement Area
WPCR	:	Water Pollution Control Regulation
WRD	:	Waste Rock Dump
WRI	:	World Resources Institute
WWTP	:	Wastewater Treatment Plant
ZTV	:	Zone of Theoretical Visibility

1. INTRODUCTION

Acacia Maden İşletmeleri A.Ş. (hereinafter referred to as “AMI”, “Acacia”, “the Company”) was established in 2007 under the name Asya Maden İşletmeleri A.Ş. In 2011 a partnership was formed with İlbak Madencilik Sanayi ve Ticaret A.Ş. Following a partnership deal with Akfen Mühendislik A.Ş. in 2016, the Company is currently conducting its operations under its current name, Acacia Maden İşletmeleri A.Ş.

AMI is planning to operate an open-pit copper mine within the scope of Gökırmak Copper Project (“GCP”, “the Project”), located in Hanönü district of Kastamonu province of Turkey. The copper (Cu) will be mined from a volcanogenic massive sulphide (VMS) deposit and a total of approximately 22 Mt of ore reserve of 1.50% Cu will be produced according to the results of detailed estimation studies. The construction phase of the Project is currently ongoing, and operations are estimated to commence in Q2 2018.

Since 2011, AMI has conducted various surface and underground explorations to characterize the grade and geometry of ore body, as well as site and desktop studies regarding identification of environmental and social baseline conditions of the wider Project area and identification and management of environmental and social impacts associated with the Project.

AMI is considering International Finance Institutions (IFI) financing for the development of the Project. For this purpose, the Project requires preparation of an Environmental and Social Impact Assessment (ESIA) Disclosure Package (incl. ESIA Report, Non-Technical Summary, etc.), selected to be in compliance with the standards of European Bank for Reconstruction and Development (EBRD) and therefore, the European Union (EU) standards and legislation. In line with the EBRD’s Environmental and Social Policy (2014), and its associated Performance Requirements (PRs), a project of this type and scale requires a fit for purpose Environmental and Social Impact Assessment (ESIA). Following a review of the previous environmental impact assessment (EIA) reports prepared for the Project to meet national requirements, additional supplementary environmental and social studies have been developed to meet the EBRD PRs and international good practice.

AECOM and SRM have been retained by AMI to develop a fit for purpose ESIA disclosure package of the Project in line with EBRD requirements, which is independent of the permitting process as required by the Turkish Competent Authorities.

The ESIA Disclosure Package includes:

- ESIA Report (provided separately as EIA and SIA reports)
- Environmental and Social Management and Monitoring Framework Plan (ESMMFP)
- Stakeholder Engagement Plan (SEP)
- Non-technical Summary (NTS)

In addition to the ESIA package, an Environmental and Social Action Plan (ESAP) will be developed in order to address specific issues associated with the Project construction works and AMI operations, and it will be disclosed in due course.

The ESIA Report includes the assessment of environmental and social impacts of the Project in line with EBRD PRs and is compiled in four volumes as below:

Volume I – EIA Report prepared by AECOM (including occupational health and safety assessments, cultural heritage assessments, cumulative impact assessments and a summary of community health, safety and security assessments compiled from Volume-II)

Volume II – SIA Report prepared by SRM

Volume III – Technical Reports supporting the EIA and SIA Reports

Volume IV – Management Plans

2. LEGAL FRAMEWORK

2.1 Turkish Environmental and Social Legislation

The Environmental Law (No. 2872), published in Turkish Official Gazette No. 18132 dated August 11, 1983 and lastly revised with Constitutional Court Decision dated July 3, 2014 and numbered 2014/116 provides the national legislative framework for regulation of industries and their potential impact on the environment. Industrial projects are subject to varying levels of review that begin while projects are in the development phase. Additional regulations apply to facilities once they are in operation.

The Environmental Law authorized the promulgation of a number of regulations. Those that pertain to mining activities include, but are not limited to, the following:

General

- Regulation on Environmental Impact Assessment, Official Gazette No. 29186 dated November 25, 2014
- Regulation on Environmental Permits and Licenses, Official Gazette No. 29115 dated September 10, 2014
- Regulation on Environmental Audit, Official Gazette No. 27061 dated November 21, 2008
- Regulation on Permission to Mining Activities, Official Gazette No. 25852 dated June 21, 2005
- Regulation on Implementation of Mining Activities, Official Gazette No. 27751 dated November 06, 2010

Waste

- Regulation on Control of Excavation, Construction and Demolition Waste, Official Gazette No. 25406 dated March 18, 2004
- Regulation on Waste Management, Official Gazette No: 29314 dated April 2, 2015
- Regulation on Mining Wastes, Official Gazette No. 29417 dated July 15, 2015 (will be in force as of July 15, 2017)
- Landfill Regulation, Official Gazette No.27533 dated March 26, 2010,
- 2011/12 numbered Circular on Landfilling of Mining Wastes and Technical Arrangement of Other Landfills dated October 11, 2011
- Communique on Recovery of Some Non-Hazardous Wastes, Official Gazette No. 27967 dated June 17, 2011,
- Communique on Transportation of Wastes by Highway, Official Gazette No. 29301 dated March 20, 2015
- Regulation on Control of Waste Oils, Official Gazette No. 26952 dated July 30, 2008
- Regulation on Control of Waste Vegetable Oils, Official Gazette No. 29378 dated June 6, 2015
- Regulation on Control of Packaging Waste, Official Gazette No. 28035 dated August 24, 2011
- Regulation on Control of Waste Batteries and Accumulators, Official Gazette No. 25569 dated August 31, 2004
- Regulation on Control of Waste Tires, Official Gazette No. 26357 dated November 25, 2006
- Regulation on Control of Medical Waste, Official Gazette No. 29959 dated January 25, 2017
- Regulation on Control of End-of-Life Vehicles, Official Gazette No. 27448 dated December 30, 2009
- Regulation on Control of Waste Electrical and Electronic Equipment, Official Gazette No. 28300 dated May 22, 2012

Water

- Water Pollution Control Regulation, Official Gazette No. 25687 dated December 31, 2004
- Regulation on Urban Wastewater Treatment, Official Gazette No. 26047 dated January 08, 2006
- Regulation on Quality of Surface Water, Official Gazette No. 28483 dated November 30, 2012
- Regulation on Monitoring of Surface Water and Groundwater, Official Gazette No. 28910 dated February 11, 2014
- Regulation on Protection of Groundwater against Pollution and Deterioration, Official Gazette No: 28257 dated April 07, 2012
- Regulation on Control of Pollution Caused by Hazardous Substances in the Aquatic Environment and Its Surroundings, Official Gazette No. 26005 dated November 26, 2005
- Regulation on Water Intended for Human Consumption, Official Gazette No. 25730 dated February 17, 2005
- Regulation on Aquaculture, Official Gazette No. 22223 dated March 10, 1995
- Regulation on Quality of Drinking Water to be obtained or planned to be obtained from Surface Water, Official Gazette No. 28338 dated June 29, 2012

Air

- Regulation on Control of Industrial Air Pollution, Official Gazette No. 27277 dated July 03, 2009
- Regulation of Control of Air Pollution Originated from Heating, Official Gazette No. 25699 dated January 13, 2005
- Regulation on Assessment and Management of Air Quality, Official Gazette No: 26898 dated June 06, 2008
- Regulation on Control of Exhaust Gas Emission and Diesel Fuel and Gasoline Quality, Official Gazette No. 28837 dated November 30, 2013
- Regulation on Monitoring of Greenhouse Gas Emissions, Official Gazette No. 29003 dated May 17, 2014
- Regulation on Control of Odour Causing Emissions, Official Gazette No. 28712 dated July 19, 2013
- Regulation on Reduction of Sulphur Rates in Certain Types of Fuels, Official Gazette No. 27368 dated October 06, 2009
- Regulation on Minimization of Ozone-Depleting Substances, Official Gazette No. 27052 dated November 12, 2008

Noise

- Regulation on Assessment and Management of Environmental Noise, Official Gazette No. 27601 dated June 04, 2010
- Regulation Related to Noise Emissions by Equipment for Outdoor Use, Official Gazette No. 26392 dated December 30, 2006

Soil

- Regulation on Reclamation of Land Deteriorated by Mining Activities, Official Gazette No. 27471 dated January 23, 2010
- Regulation on Soil Pollution Control and Contaminated Sites by Point Source, Official Gazette No. 27605 dated June 8, 2010

Chemicals

- Regulation on Classification, Labelling and Package of the Materials and Mixtures, Official Gazette No. 28848 dated December 11, 2013
- Polychlorinated Biphenyls (PCBs) and Polychlorinated Terphenyls (PCTs) Control Regulation, Official Gazette No. 26739, dated December 27, 2007

In addition to the Environmental Law and its associated regulations, there are other laws and regulations that directly or indirectly include an environmental review, therefore applicable to the Project. These can be listed as follows:

- Mining Law (Law No: 3213), Official Gazette No. 18785 dated June 15, 1985;
- Forestry Law (Law No: 6831), Official Gazette No. 9402 dated September 08, 1956;
- Groundwater Law (Law No: 167), Official Gazette No. 10688 dated December 23, 1960;
- Law on National Parks (Law No: 2873), Official Gazette No. 18132 dated August 11, 1983;
- Law on Protection of Cultural and Natural Properties (Law No: 2863), Official Gazette No. 18113 dated July 23, 1983;
- Pasture Law (Law No: 4342), Official Gazette No. 23272 dated February 28, 1998;
- Highways Traffic Law (Law No: 2918), Official Gazette No. 18195 dated October 18, 1983;
- Implementation Regulation of Article 16 of Forestry Law, Official Gazette No. 28976 dated April 18, 2014;
- Regulation on Highway Traffic, Official Gazette No. 23053 dated July 18, 1997;
- Regulation on Work Place Establishment and Operating Licenses, Official Gazette No. 25902 dated August 10, 2005;
- Regulation on Structures in Disaster Areas, Official Gazette No. 26582 dated July 14, 2007;
- Regulation on Buildings Constructions in Earthquake Zones, Official Gazette No. 26454 dated March 06, 2007;
- Regulation on the Conservation of Wetlands, Official Gazette No. 28962 dated April 04, 2014;
- Regulation on the Transportation of Hazardous Substances by Road, Official Gazette No. 28801 dated October 24, 2013;
- Regulation on Facilities To Be Established Adjacent to Highways, Official Gazette No. 22990 dated May 15, 1997;
- By-Law on Principles and Procedures Production, Importing, Transportation, Storage, Stocking, Selling, Usage, Assessment of Explosive Materials which are Unmonopolised, Official Gazette No. 19589 dated September 29, 1987;

Labor issues on the other hand, are mainly governed by the Labor Law (No. 4857), which was published in Turkish Official Gazette No. 25134 dated June 10, 2003. The law provides the legislative framework for the regulation of industries and their potential impact on the human health and safety. Additionally, the OHS Law (No. 6331), published in Turkish Official Gazette No. 28339 dated June 30, 2012, provides the framework for the health and safety at work. Industrial projects are subject to varying levels of review that begin while projects are in the development and operation phases. Related legislation stemming from these two laws are listed below:

- Regulation on Occupational Health and Safety, Official Gazette No. 25311 dated December 09, 2003;
- Regulation on Occupational Health and Safety in Mining Sites, Official Gazette No. 28770 dated September 19, 2013;
- Regulation on Health and Safety Regarding Temporary and Time Limited Works, Official Gazette No. 28744 dated August 23, 2013;
- Regulation on Protection of Workers from Risks Created from Noise, Official Gazette No. 28721 dated July 28, 2013;
- Regulation on Protection of Workers from the Risk of Explosive Media, Official Gazette No. 28633 dated April 30, 2013;
- Regulation on Protection of Workers from the Risks of Vibration, Official Gazette No. 28743 dated August 22, 2013;
- Regulation on Health and Safety Precautions Regarding Working with Chemicals, Official Gazette No. 28733 dated August 12, 2013;
- Regulation on Personal Protective Equipment, Official Gazette No. 26361 dated November 29, 2006;

- Regulation on Use of Personal Protective Equipment in Workplaces, Official Gazette No. 28695 dated July 02, 2013;
- Regulation on Material Safety Data Sheets on Hazardous Materials and Mixtures, Official Gazette No. 29204 dated December 13, 2014;
- Regulation on Health and Safety Signs, Official Gazette No. 28762 dated September 11, 2013;
- Regulation on Management of Dust, Official Gazette No. 28812 dated November 05, 2013;
- Regulation on Health and Safety Conditions Regarding Use of Work Equipment, Official Gazette No. 28628 dated April 25, 2013;
- Regulation on Suspension of Work in Workplaces, Official Gazette No. 28603 dated March 30, 2013;
- Regulation on Emergency Situations in Workplaces, Official Gazette No. 28681 dated June 18, 2013;
- Regulation on Risk Assessment for Occupational Health and Safety, Official Gazette No. 28512 dated December 29, 2012;
- Regulation on Vocational Training of the Employees Working in Dangerous and Highly Dangerous Workplaces, Official Gazette No. 28706 dated July 13, 2013;
- Regulation on Subcontractors, Official Gazette No. 27010 and dated September 27, 2008;
- Regulation on Health and Safety at Construction Works, Official Gazette No. 28786 dated October 05, 2013;

2.1.1 Environmental Impact Assessment

Article 10 of Environmental Law sets out the general scope of the Environmental Impact Assessment (EIA) procedure in Turkey and according to this article, any establishment that may lead to environmental problems as a result of its planned activities is obliged to prepare an Environmental Impact Assessment report or a Project Description Report.

Based on this broadly defined requirement, the EIA Regulation was put into force for the first time after being published in the Official Gazette numbered 21489 and dated February 7, 1993. Since this date, several amendments were made and new EIA regulations were published in 2008, 2013 and finally in 2014, repealing their predecessors. The latest and currently in force EIA Regulation was published in the Official Gazette dated November 25, 2014, numbered 29186.

Under its annexes, the EIA Regulation categorizes investments as projects subject to full EIA process (Annex-1) that shall prepare an EIA Report and projects subject to screening-elimination criteria (Annex-2) that shall prepare a Project Description Report. This categorization is done based on the type of activity and/or capacity. The cases that require a full EIA Report or a Project Description Report are summarized below and the full EIA process for is summarized in the following flow chart presented in Figure 2-1:

- Preparation of a full EIA Report is required in case the planned investment is defined as an activity under Annex-1 of the EIA Regulation
- Preparation of a full EIA Report is required in case the investment is listed under Annex-2 of the EIA Regulation, and an “EIA Required” decision is given by the related Provincial Directorate of Environment and Urbanization, following the evaluation of the Project Description Report submitted by the Project Owner to the Directorate.
- Preparation of a full EIA Report is not required in case the investment is listed under Annex-2 of the EIA Regulation, and an “EIA Not Required” decision is given by the related Provincial Directorate of Environment and Urbanization, following the evaluation of the Project Description Report submitted by the Project Owner to the Directorate.

Mining projects with a total study area of and above 25 ha (including both excavation and dump sites) are included in Annex-I Item 27 (a) of the Environmental Impact Assessment Regulation, whereas mining projects not covered by Annex-I of the regulation are included in Annex-II Item 49 (a).

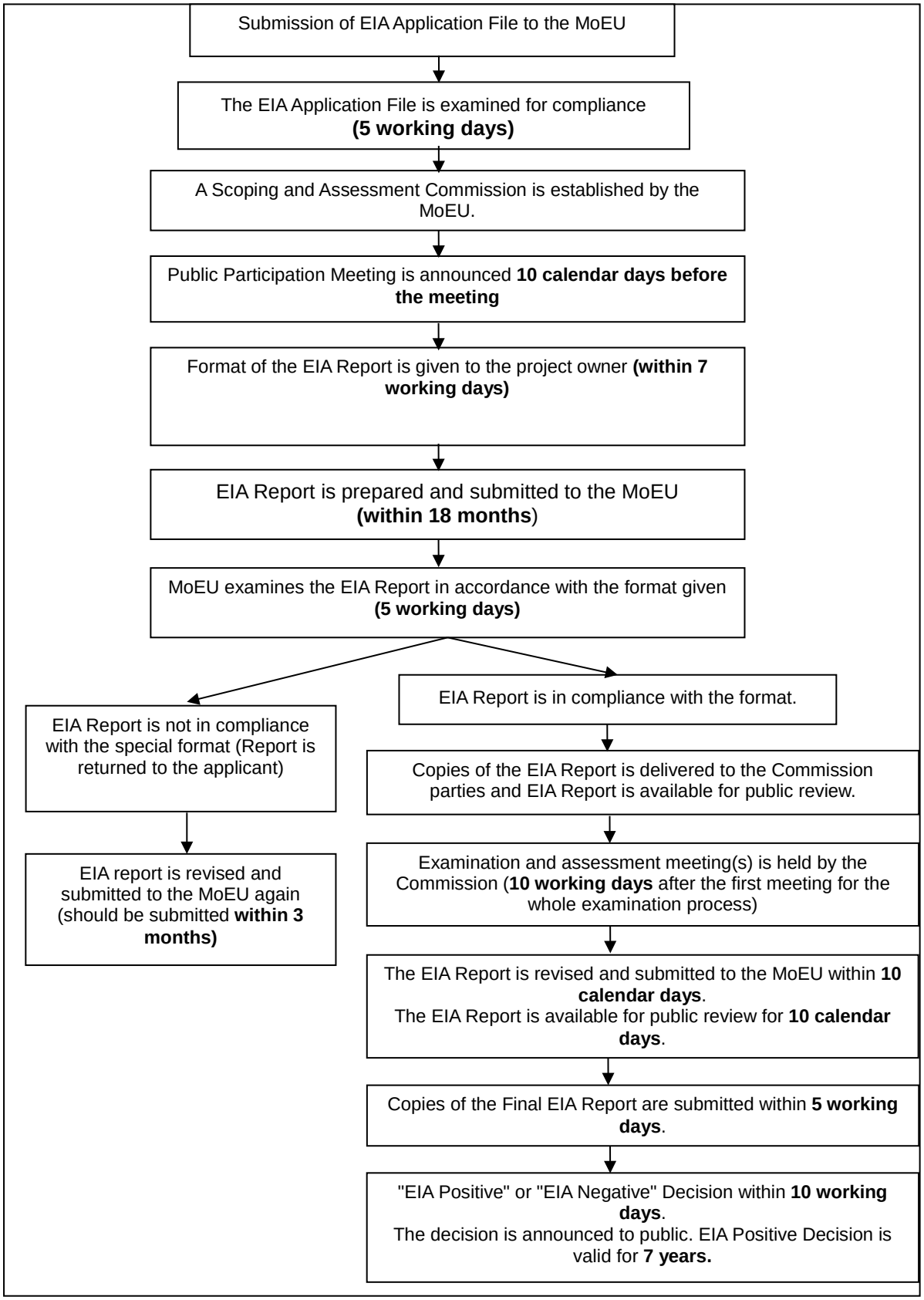


Figure 2-1 The Full National EIA Process

2.1.2 Environmental Permits and Licenses

The Environmental Permits and Licenses Regulation was published in the Official Gazette No. 29115 dated September 10, 2014. According to the Regulation, all facilities included in Annex I and Annex II of the regulation shall apply for an Environmental Permit. After the facility applies for an Environmental Permit with the required information, documents and reports required by Annex 3A and 3B of the Regulation, a Temporary Operation Certificate is obtained. Environmental permit applications can only be prepared and submitted by an Environmental Management Unit, Environmental Officer or consultancy companies licensed by the MoEU. The environmental consultant is responsible to carry out, coordinate and monitor environmental management studies in compliance with the environmental regulation, to monitor regularly and confirm if the liabilities are met according to the regulations.

Copper mine projects are included in;

- Article 2.18 (Pits of the mines included in Mining Law (Law No. 3213) 1st Group a and b, 2nd Group (including limestone), 4th Group and 5th Group and with production capacity 200 tonnes/day and above.
- Article 2.20 (Coal and/or mineral processing plants) of Annex 2 of the Regulation. Therefore, the Project is required to obtain an Environmental Permit.

2.2 International E&S Standards

The scope of the international E&S standards provided here is limited to EBRD Performance Requirements (PRs), applicable EU legislation and international conventions Turkey is a party of. However, it should be noted that other International Finance Institutions' (IFIs) guidance and Good International Industry Practices (GIIP) is referenced in general in other chapters of this report, where any such guidance provides standardized good practice for the implementation of the Project.

2.2.1 EBRD Environmental and Social Policy and Performance Requirements

Throughout their life phases, EBRD financed projects are required to be realized in compliance with the Bank's Environmental and Social Policy to ensure environmentally and socially sustainable development. In this regard, the projects are expected to meet the key environmental and social requirements outlined by the PRs set by the Bank. The EBRD PRs are listed below:

- PR 1: Assessment and Management of Environmental and Social Impacts and Issues
- PR 2: Labour and Working Conditions,
- PR 3: Resource Efficiency and Pollution Prevention and Control
- PR 4: Health and Safety
- PR 5: Land Acquisition, Involuntary Resettlement and Economic Displacement
- PR 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- PR 7: Indigenous Peoples
- PR 8: Cultural Heritage
- PR 9: Financial Intermediaries
- PR 10: Information Disclosure and Stakeholder Engagement.

Direct investment projects must meet PRs 1 to 8 and 10; financial intermediary (FI) projects must meet PRs 2, 9 and the occupational health and safety requirements of PR 4. A project will be categorized as "FI" if the financing structure involves the provision of funds through FIs whereby the FI undertakes the task of sub-project appraisal and monitoring (FIs include, inter alia, private equity funds, banks, leasing companies, insurance companies and pension funds).

Each PR defines, in its objectives, the desired outcomes, followed by specific requirements for projects to help clients achieve these outcomes. Compliance with relevant national law is an integral part of all PRs.

Of the PRs, PR 7 is not relevant to the Project, since there are no indigenous people; and PR9 is not applicable.

It should also be noted that since the proposed Project involves mining of Cu minerals via open-pit mining method, the Project could result in potentially significant adverse future environmental and social impacts which cannot readily be identified or assessed and therefore, will require a comprehensive Environmental and Social Impact Assessment (ESIA) study. Therefore, the Project is categorized as Category A.

EBRD PR 1: Assessment and Management of Environmental and Social Impacts and Issues

EBRD PR 1 covers integrated assessment to identify the environmental and social impacts and issues associated with projects and management of the environmental and social performance throughout the life of the project. EBRD PR 1 also outlines the responsibilities of the client in the process of assessing the potential environmental and social impacts and issues associated with the project, and developing and implementing procedures for managing and monitoring these impacts and issues.

EBRD PR 2: Labour and Working Conditions

EBRD PR 2 consists of general requirements on human resources policies, working relationships, child labour, forced labour, non-discrimination and equal opportunity, workers' organizations, wages, benefits and condition of work, Occupational Health and Safety (OHS), worker accommodation, retrenchment and grievance mechanism, non-employee workers, supply chain, security personnel requirements which are applicable to the Project. The PR requires the clients to respect and protect the fundamental principles and rights of workers and protect and promote the safety and health of workers, especially by promoting safe and healthy working conditions.

EBRD PR 3: Resource Efficiency and Pollution Prevention and Control

EBRD PR 3 consists of general requirements on resource efficiency, pollution prevention and control, greenhouse gases, water, waste and safe use and management of hazardous substances and materials which are applicable to the Project. The PR requires the clients to identify project-related opportunities for energy, water and resource efficiency improvements and waste minimization, adopt the mitigation hierarchy approach to addressing adverse impacts on human health and the environment arising from the resource use and pollution released from the project and promote the reduction of project-related greenhouse gas emissions.

EBRD PR 4: Health and Safety

This PR addresses the client's responsibility to identify and to avoid or minimize the risks and adverse impacts to community health, safety and security that may arise from project activities. General requirements for health and safety management (occupational health and safety, community health and safety) and specific requirements for health and safety management (Infrastructure and equipment design and safety, hazardous materials safety, traffic and road safety, natural hazards, exposure to disease and emergency preparedness and response are discussed in this PR.

EBRD PR 5: Land Acquisition, Involuntary Resettlement and Economic Displacement

This PR outlines the requirements related to involuntary resettlement (physical and economic displacement) that can be full, partial, permanent, or temporary as a result of project-related land acquisition and/or restrictions on land use. The objectives of this PR are to avoid or, when unavoidable, minimize, involuntary resettlement by exploring alternative project designs, to mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons' use, restore or, where possible, improve the livelihoods and standards of living of displaced persons8to pre-displacement levels and improve living conditions among physically displaced persons through the provision of adequate housing, including security of tenure at resettlement sites.

EBRD PR 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

This PR outlines the biodiversity conservation requirements, legally protected and internationally recognized areas of biodiversity value, invasive alien species and sustainable management of living natural resources, crop and livestock production, fisheries and aquaculture, natural and plantation forestry, supply chain and genetically modified organisms (GMOs). The objectives of this PR are to protect and conserve biodiversity using a precautionary approach, to adopt the mitigation hierarchy approach, and to promote good international practice (GIP) in the sustainable management and use of living natural resources.

EBRD PR 8: Cultural Heritage

This PR outlines the requirements related to cultural heritage for present and future generations. The aim of this PR is to protect cultural heritage and to guide clients in avoiding or mitigating adverse impacts on cultural heritage in the course of their business operations. The client is expected to be precautionary in their approach to the management and sustainable use of cultural heritage.

EBRD PR 10: Information Disclosure and Stakeholder Engagement

This PR outlines the requirements related to an open and transparent engagement between the client, its workers, local communities directly affected by the project and, where appropriate, other stakeholders. The client is expected to outline a systematic approach to stakeholder engagement, to promote improved environmental and social performance of clients through effective engagement with the project's stakeholders and to ensure that grievances from affected communities and other stakeholders are responded to and managed appropriately.

2.2.2 European Union Legislation

The EBRD, as a signatory to the European Principles for the Environment, is committed to promoting the adoption of EU environmental principles, practices and substantive standards (as contained in EU secondary legislation, for example, regulations, directives and decisions) by EBRD-financed projects, where these can be applied at the project level, regardless of their geographical location. When host country regulations differ from EU substantive environmental standards, projects will be expected to meet whichever is more stringent.

Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe

This Directive aims defining and establishing objectives for ambient air quality designed to avoid, prevent or reduce harmful effects on human health and the environment as a whole; assessing the ambient air quality on the basis of common methods and criteria; obtaining information on ambient air quality in order to help combat air pollution and nuisance and to monitor long-term trends and improvements resulting from national and Community measures; ensuring that such information on ambient air quality is made available to the public and maintaining air quality where it is good and improving it in other cases.

Limit values for the protection of human health are provided in Annex XI of the Directive, as well as other limits such as critical levels for protection of vegetation and reduction targets in other annexes.

Directive 91/271/EEC concerning Urban Wastewater Treatment

This Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. The objective of the Directive is to protect the environment from the adverse effects of the abovementioned waste water discharges.

Limit values for discharges from wastewater treatment plants are provided in Annex I of the Directive.

Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (EU Habitats Directive)

The Habitats Directive ensures the conservation of a wide range of rare, threatened or endemic animal and plant species. Some 200 rare and characteristic habitat types are also targeted for conservation in their own right.

All in all, over 1.000 animal and plant species, as well as 200 habitat types, listed in the directive's annexes are protected in various ways:

- Annex II species (about 900): core areas of their habitat are designated as sites of Community importance (SCIs) and included in the Natura 2000 network. These sites must be managed in accordance with the ecological needs of the species.
- Annex IV species (over 400, including many annex II species): a strict protection regime must be applied across their entire natural range within the EU, both within and outside Natura 2000 sites.
- Annex V species (over 90): Member States must ensure that their exploitation and taking in the wild is compatible with maintaining them in a favorable conservation status.

Directive 2009/147/EC on the Conservation of Wild Birds (EU Birds Directive)

The Birds Directive aims to protect all of the 500 wild bird species naturally occurring in the European Union.

The 500 wild bird species naturally occurring in the European Union are protected in various ways:

- Annex 1: 194 species and sub-species are particularly threatened. Member States must designate Special Protection Areas (SPAs) for their survival and all migratory bird species.
- Annex 2: 82 bird species can be hunted. However, the hunting periods are limited and hunting is forbidden when birds are at their most vulnerable: during their return migration to nesting areas, reproduction and the raising of their chicks.
- Annex 3: overall, activities that directly threaten birds, such as their deliberate killing, capture or trade, or the destruction of their nests, are banned. With certain restrictions, Member States can allow some of these activities for 26 species listed here.
- Annex 4: the directive provides for the sustainable management of hunting but Member States must outlaw all forms of non-selective and large scale killing of birds, especially the methods listed in this annex.
- Annex 5: the directive promotes research to underpin the protection, management and use of all species of birds covered by the Directive, which are listed in this annex.

EU Water Framework Directive (2000/60/EC)

The objective of the Water Framework Directive (WFD) is to achieve good ecological and good chemical status for surface waters as well as good quantitative and good chemical status for groundwater. As signalled by its title, the WFD sets the “framework” for an integrated and comprehensive approach to water protection. Accordingly, it addresses a variety of water-related matters – improving aquatic ecosystems, promoting sustainable water use, tackling pollution, mitigating floods and droughts. The main objectives of the WFD are to prevent deterioration and to achieve good status for all water bodies by 2015.

Directive 2006/21/EC on the Management of Waste from Extractive Industries – the Mining Waste Directive

Waste from extractive operations (i.e. waste from extraction and processing of mineral resources) is one of the largest waste streams in the EU. It involves materials that must be removed to gain access to the mineral resource, such as topsoil, overburden and waste rock, as well as tailings remaining after minerals have been largely extracted from the ore.

Some of these wastes are inert and hence not likely to represent a significant pollutant threat to the environment save for smothering of river beds and possible collapse if stored in large quantities. However, other fractions, in particular those generated by the non-ferrous metal mining industry, may contain large quantities of dangerous substances, such as heavy metals. Through the extraction and subsequent mineral processing, metals and metal compounds tend to become chemically more available, which can result in the generation of acid or alkaline drainage. Moreover, the management of tailings is an intrinsically risky activity, often involving residual processing chemicals and elevated levels of metals. In many cases tailings are stored on heaps or in large ponds, where they are retained by means of dams. The collapse of dams or heaps may have serious impacts on environment and human health and safety. Other likely significant impacts relate to the physical footprints of waste disposal facilities and resulting loss of land productivity, effects on ecosystems, dust and erosion.

These impacts can have lasting environmental and socio-economic consequences and be extremely difficult and costly to address through remedial measures. Wastes from the extractive industries have therefore to be properly managed in order to ensure in particular the long-term stability of disposal facilities and to prevent or minimise any water and soil pollution arising from acid or alkaline drainage and leaching of heavy metals.

Directive 2012/18/EU on the Control of Major-Accident Hazards Involving Dangerous Substances

This Directive lays down rules for the prevention of major accidents which involve dangerous substances, and the limitation of their consequences for human health and the environment, with a view to ensuring a high level of protection throughout the Union in a consistent and effective manner.

Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities

This document covers activities related to tailings and waste-rock management of ores that have the potential for a significant environmental impact. Mining techniques and mineral processing are only covered as relevant to tailings and waste-rock management. The main aim of the document is to specify activities that can be considered as examples of “good practice” and to raise awareness of such practices and promote their use across all activities in this sector.

2.2.3 International Conventions and Protocols

The international conventions and protocols related to the Project and to which Turkey is a party are listed below.

Environmental Issues

- International Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR Convention) enforced on December 21, 1975 and ratified by Turkey in 1994
- Bern Convention on the Conservation of European Wildlife and Natural Habitats enforced June 01, 1982 and ratified by Turkey in 1984
- Vienna Convention on Protection of Ozone Layer enforced on September 22, 1988 and ratified by Turkey on September 20, 1991
- Montreal Protocol on Substances Depleting Ozone Layer enforced on January 01, 1989 and ratified by Turkey on December 19, 1991
- Bucharest Convention for the Protection of the Black Sea Against Pollution enforced in 1994 and ratified by Turkey on January 15, 1994 and its protocols including the Protocol for the Protection of Black Sea Against Land-borne Pollutants (1992), Protocol for the Protection of Biological and Landscape Diversity in the Black Sea (2004)
- Convention on the Protection of the World Cultural and Natural Heritage enforced on December 17, 1975 and ratified by Turkey on February 14, 1983
- Convention on Biological Diversity enforced on December 29, 1993 and ratified by Turkey in 1996
- Convention on International Trade in Endangered Species of Wild Fauna and Flora enforced on July 01, 1975 and ratified by Turkey December 22, 1996
- European Landscape Convention enforced in 2000 and ratified by Turkey in 2003
- United Nations Framework Convention on Climate Change enforced on March 21, 1994 and ratified by Turkey May 24, 2004
- Kyoto Protocol enforced on February 16, 2005 and ratified by Turkey on August 26, 2009
- United Nations Stockholm Convention on Persistent Organic Pollutants (POPs) enforced on May 17, 2004 and ratified by Turkey on January 12, 2010

Social Issues

- ILO Right to Organize and Collective Bargaining Convention enforced on July 18, 1951 and ratified by Turkey on January 23, 1952
- ILO Forced Labour Convention enforced on May 01, 1932 and ratified by Turkey on October 30, 1998
- ILO Freedom of Association and Protection of the Right to Organize Convention enforced on July 04, 1950 and ratified by Turkey July 12, 1993
- ILO Equal Remuneration Convention enforced on May 23, 1953 and ratified by Turkey on July 19, 1967
- ILO Abolition of Forced Labour Convention enforced on January 17, 1959 and ratified by Turkey on March 29, 1961
- ILO Discrimination (Employment and Occupation) Convention enforced on June 15, 1960 and ratified by Turkey on July 19, 1967
- ILO Minimum Age Convention enforced on June 19, 1976 and ratified by Turkey on October 30, 1998

- ILO Worst Forms of Child Labour Convention enforced on November 19, 2000 and ratified by Turkey on August 02, 2001
- ILO Employment Policy Convention enforced on July 15, 1966 and ratified by Turkey on December 13, 1977
- ILO Unemployment Convention enforced on July 14, 1921 and ratified by Turkey on July 14, 1950
- ILO Social Security Convention enforced on April 17, 1955 and ratified by Turkey on January 29, 1975
- ILO Worker's Representatives Convention enforced on June 30, 1973 and ratified by Turkey on July 12, 1993
- ILO Human Resources Development Convention enforced on July 19, 1977 and ratified by Turkey on July 12, 1993
- ILO Occupational Safety and Health Convention enforced on August 11, 1983 and ratified by Turkey on April 22, 2005
- ILO Safety and Health in Construction Convention enforced on January 11, 1991 and ratified by Turkey on June 18, 2015
- ILO Safety and Health in Mines Convention enforced in June 05, 1998 and ratified by Turkey on June 18, 2015

Turkey is not yet party to the following international conventions on environmental matters:

- The Convention on Environmental Impact Assessment in a Transboundary Context (Espoo)
- The UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus)

3. PROJECT DESCRIPTION

This section of the report provides description of the Project including main units, supporting infrastructure and associated facilities, the Project area, Project background, status of relevant permits and licenses, Project schedule and workforce requirements.

3.1 Project Overview

The Gökırmak Copper Project ("GCP", "the Project"), located in the Hanönü District of the Kastamonu Province in Northern Turkey, is an open-pit copper mine project. The Project's construction phase is planned to be ended in 2018 Q2, followed by an estimated mine production of 11.3 years. The reclamation and mine closure period on the other hand will take 2 years. Considering the time period for active construction activities, the operation phase and the closure phase, the lifetime of the Project is estimated as approximately 16 years.

AMI holds two separate Mining Licenses, numbered 20064276 and 201000713 for GCP. Mining License 20064276 covers an area of 1950 ha and Mining License 201000713 covers an area of 1997 ha, making up a total licensed area of 3947 ha.

The copper will be mined from a Volcanogenic Massive Sulphide (VMS) deposit, located entirely within the metallogenic belt of the Central Pontides in northern Turkey (Okay and Tüysüz, 1999). The belt hosts numerous other VMS deposits as well.

For GCP, the resource is reported as 24.45 Mt at an average 1.64% Cu. At a cut-off grade of 0.3% Cu, of the 24.45 Mt, measured resource is 3.33 Mt at 2.04% Cu or 68,000 tons of Cu, indicated resource is 20.34 Mt at 1.58% Cu or 321,000 tons of Cu and inferred resources is 0.78 Mt at 1.7% Cu or 13,000 tons of Cu (see Table 3-1).

Table 3-1 Mineral Resources for GCP

Classification	Cu (%)	Resource (tons)	Metal (Cu) (tons)
Measured	2.04	3,330,000	68,000
Indicated	1.58	20,340,000	321,000
Measured + Indicated	1.64	23,670,000	388,000
Inferred	1.7	780,000	13,000
M+I+I	1.64	24,450,000	401,000

According to the June 2017 dated Feasibility Report, the Project includes the following main units (see Section 3.3 for details):

- Open Pit
- Çorakoğlu Waste Rock Dump (WRD)
- Process Plant
- Tailings Pipeline
- Kepezkaya Tailings Storage Facility (TSF)
- Bağdere TSF (subject to confirmation after additional review whether it is needed)
- Other auxiliary units/facilities (haulage roads, administrative buildings, warehouse etc.)

The associated facilities within the scope of the Project are (see "Section 3.3.7" for details):

- Gökırmak Diversion System
- Energy Transmission Line (ETL).

Brief descriptions of main activities related to the Project are provided below and a simplified flow sheet for operation phase activities is provided in Figure 3-1.

- The selected mining method is open pit mining.
- A total of 22 million tones (Mt) of ore at 1.50% Cu is planned to be produced.
- As a result of ore production, 2 Mt per annum ore will be fed to the processing plant. The processing plant is expected to operate at 85% recovery, having a total production of approximately 1,278,703 tonnes of dry concentrate with a copper grade of 22.0% throughout the life of the mine.
- The tailings from the processing plant will be transferred via a 3.8 km tailings pipeline to be stored in the Kepezkaya TSF, which is located on the northern side of the Gökırmak River, east of Hanönü district. The Kepezkaya TSF has a maximum capacity of 5,150,000 m^3 and will be operated during the first 4 years, 9 months of production. From that point on, the Bağdere TSF located approximately 350 m south of Kepezkaya TSF will be utilized for tailings storage. Bağdere TSF's capacity is slightly above 8 million $m^{3.}$
- Approximately 122.5 million LCM of wasterock will be generated as a result of open pit activities and the wasterock will be deposited at Çorakoğlu WRD.
- Other/associated activities of the Project include; the diversion of Gökırmak River, since a section of the open pit of the Project coincides with this river; construction of an approximately 28.8 km ETL (construction completed), construction and operation of access roads, haulage roads and auxiliary facilities such as administrative buildings, camp site etc.

3.2 Project Area

The Project is located approximately 5 km southeast of Hanönü District, which itself is located 70 km west of the Kastamonu Province center. The Project Location Map is provided in Figure 3-2, a panoramic photograph of the current situation of the open pit and the WRDs area shot from Yukarıküreçay neighborhood towards S/SE is provided in Figure 3-3, current situation of the Gökırmak derivation structures is provided in Figure 3-4, the Project layout focusing on the main Project units is presented in Figure 3-5 and the Project layout including the ETL is presented in Figure 3-6.The layout that constituted the basis for this EIA study is based on the layout presented by the most recent feasibility report of the Project (June, 2017, AMI).

The main land use type in the Project area is forest, with very limited agricultural lands. The Gökırmak River runs through the Project area in a W/E-NE direction. The Project location presents a generally hilly/mountainous topography and elevation at the northernmost section is 425 m, whereas the elevation rises towards western sections to about 800 m. The maximum altitude is reached at the Kuğla Mountain (1,170 m), which is located adjacent to the southern border of the license area (License No. 20064276).

Currently, access to site is provided via an approximately 2.5 km long, 12 m wide road, starting from the D-30 State Highway connecting Kastamonu and Sinop south of Hanönü Village.

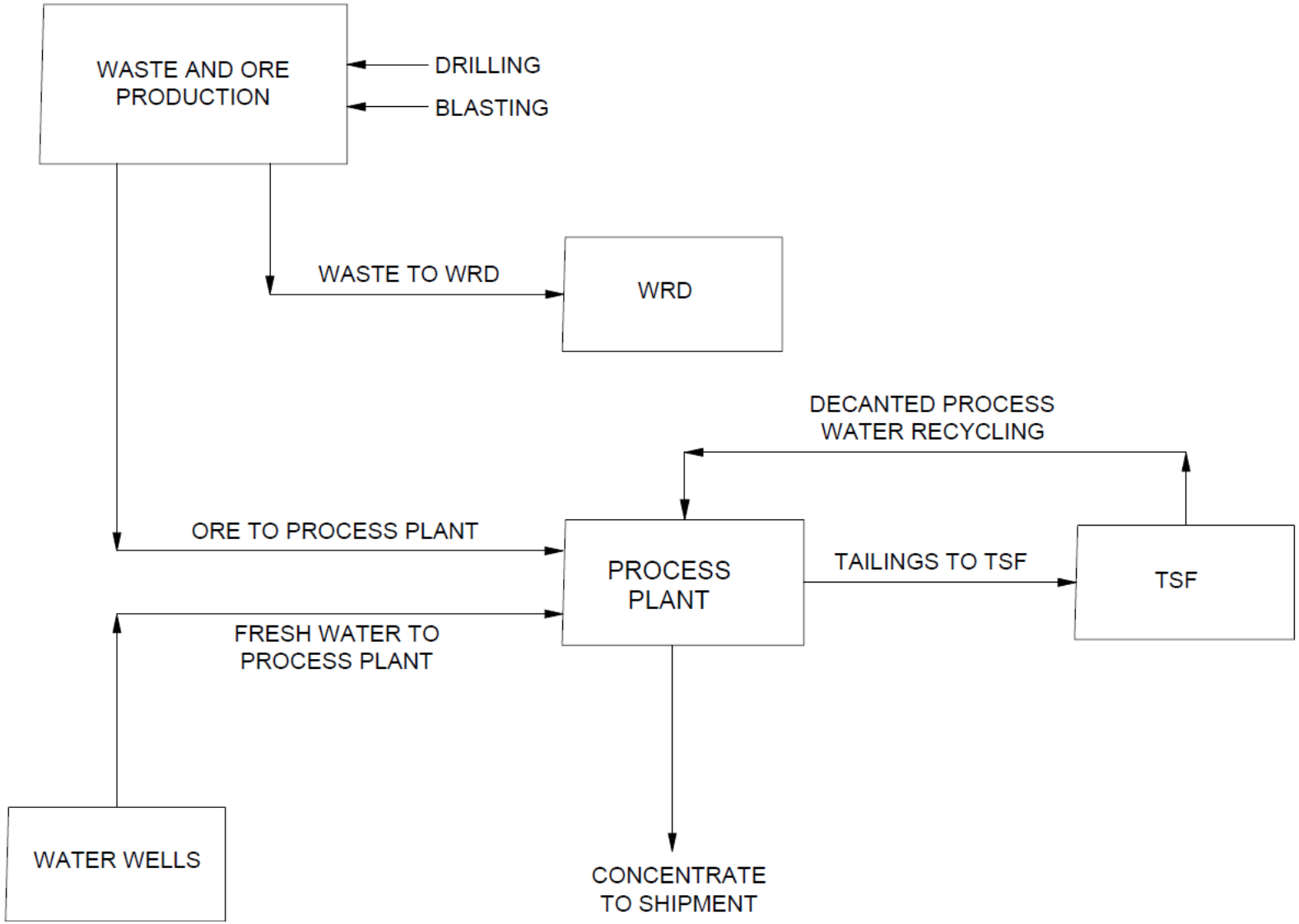
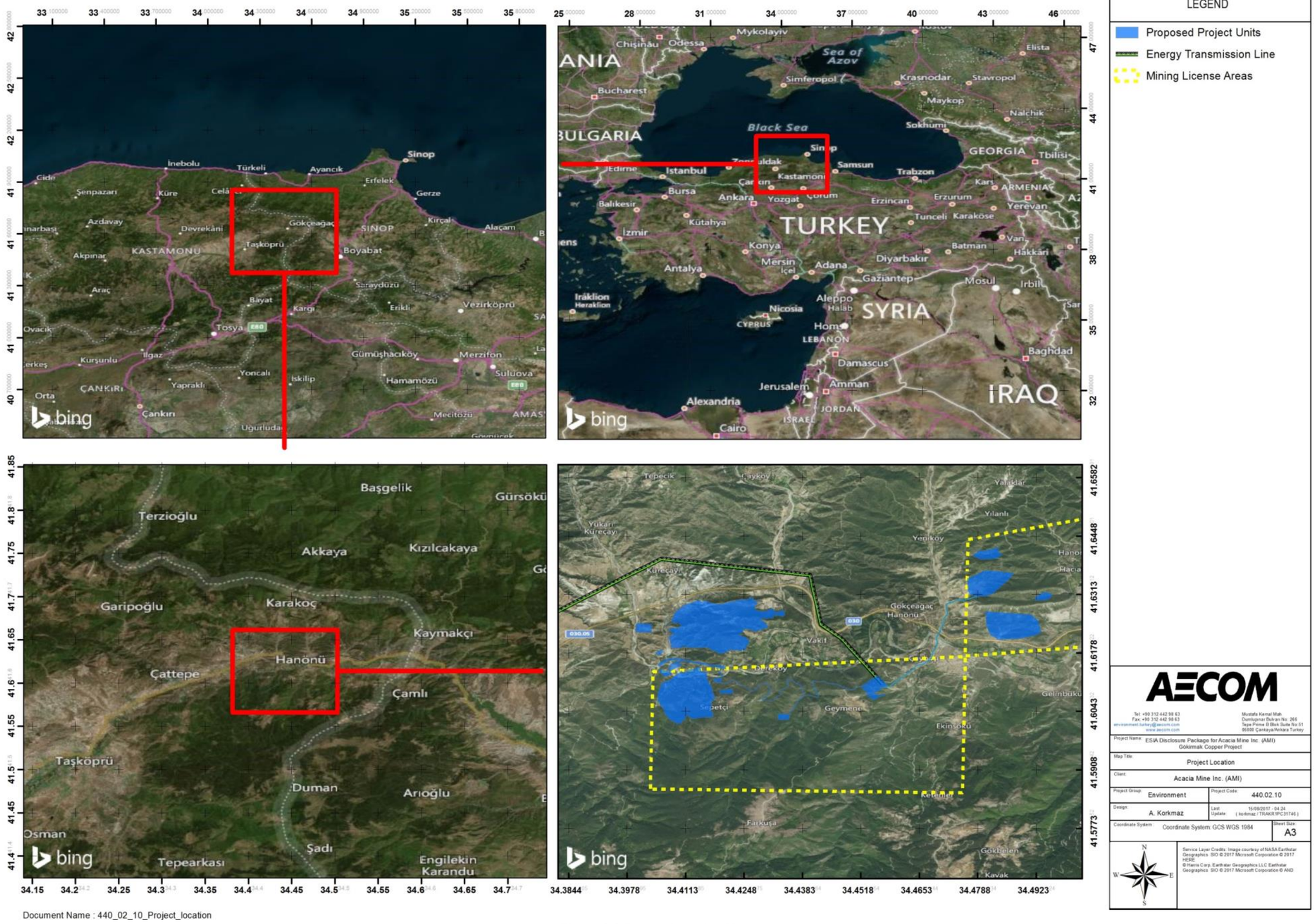


Figure 3-1 Flow Chart for Operation Phase

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



Document Name : 440_02_10_Project_location

Figure 3-2 Project Location Map

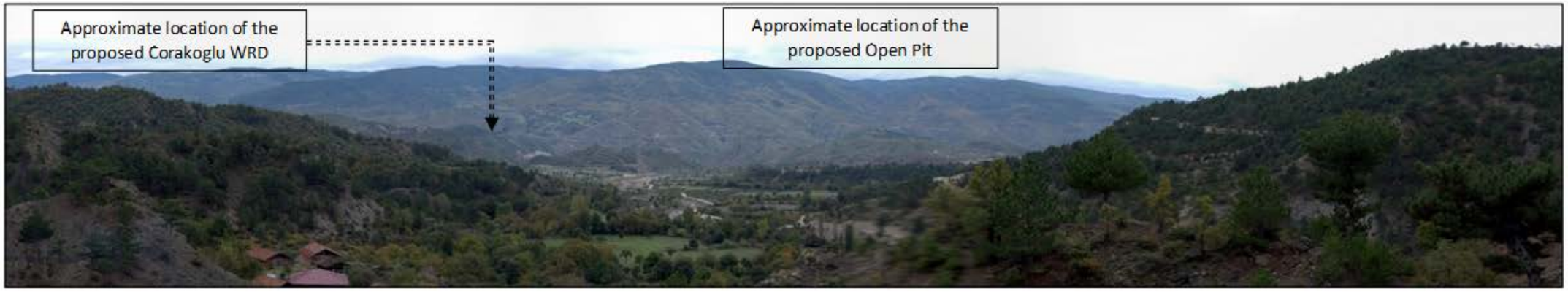
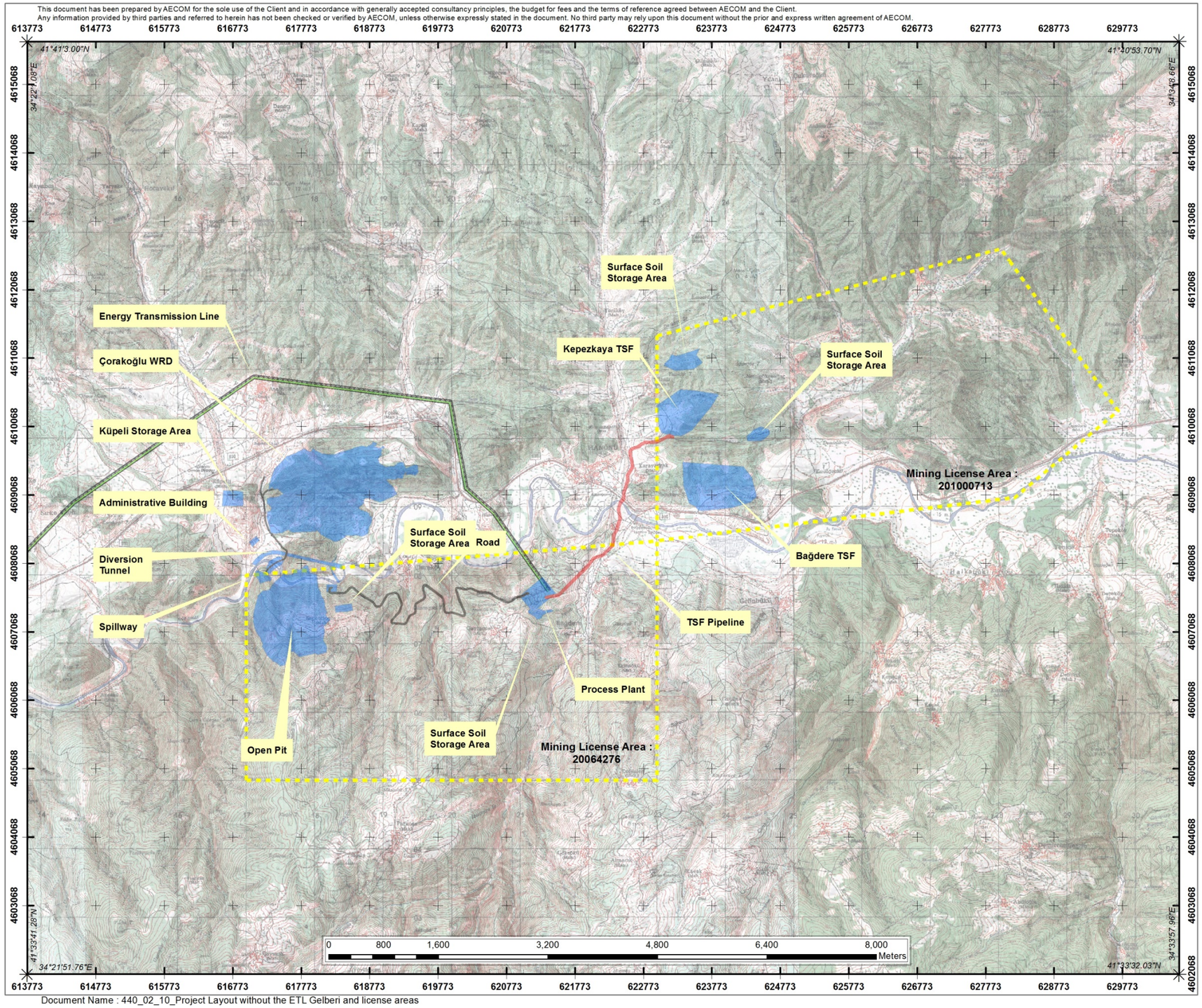


Figure 3-3 Panoramic View of Open Pit and Çorakoğlu WRD Area



Figure 3-4 Gökırmak Derivation Structures from Sepetçioğlu Neighborhood

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



Document Name : 440_02_10_Project Layout without the ETL Gelberi and license areas

LEGEND

- Mining License
- Proposed Project Units
- Roads
- TSF Pipeline
- Energy Transmission Line

AECOM

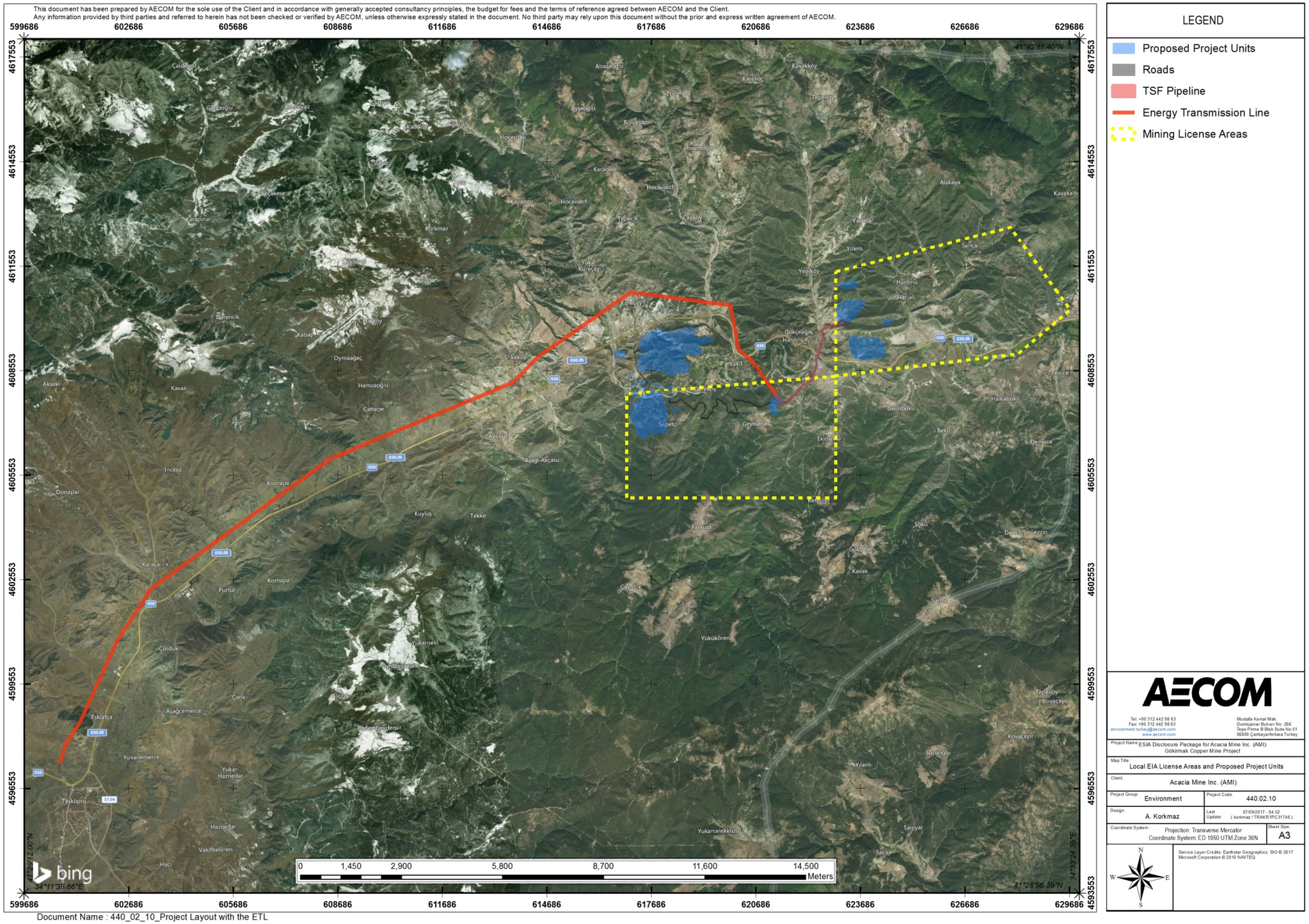
Tel. +90 312 442 98 63
Fax. +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com

Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime B Blok Suite No:51
06800 Çankaya/Ankara Turkey

Project Name:	ESIA Disclosure Package for Acacia Mine Inc. (AMI) Gokirmak Copper Project
Map Title:	Proposed Project Units
Client:	Acacia Mine Inc. (AMI)
Project Group: Environment	Project Code: 440.02.10
Design: A. Korkmaz	Last Update: 07/09/2017 - 04:53 (korkmaz / TRAKR1PC31746)
Coordinate System: Projection: Transverse Mercator Coordinate System: ED 1950 UTM Zone 36N	Sheet Size: A3
	Service Layer Credits:

N W E S

Figure 3-5 Project Layout (Focused on Main Units)



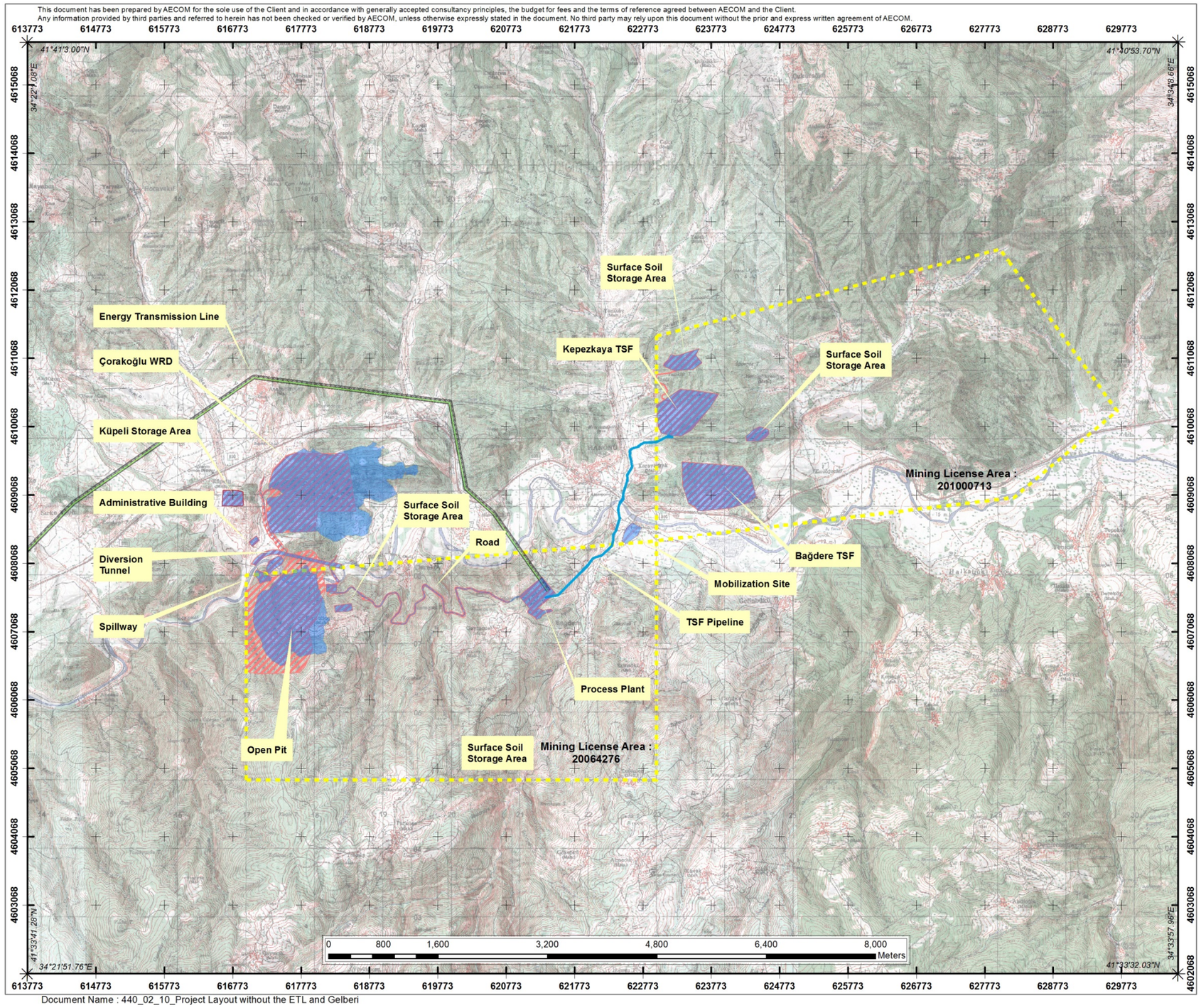
Document Name : 440_02_10_Project Layout with the ETL

Figure 3-6 Project Layout with the ETL

As can be seen in Figure 3-5, where the Project units and the mining license areas are presented together, some units are located outside the licensed areas. These units and their current status in terms of licensing and permitting is described in detail in “Section 3.4.2”.

A map showing various ESIA study areas is presented in Figure 3-8. It should be noted that since the cumulative impact assessment study area is significantly larger than other environmental subjects’ study area, it is described in its own chapter in Volume-1 of the ESIA Disclosure Package.

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



LEGEND

- Proposed Project Unit
- Energy Transmission Line
- Mining License
- Local EIA License

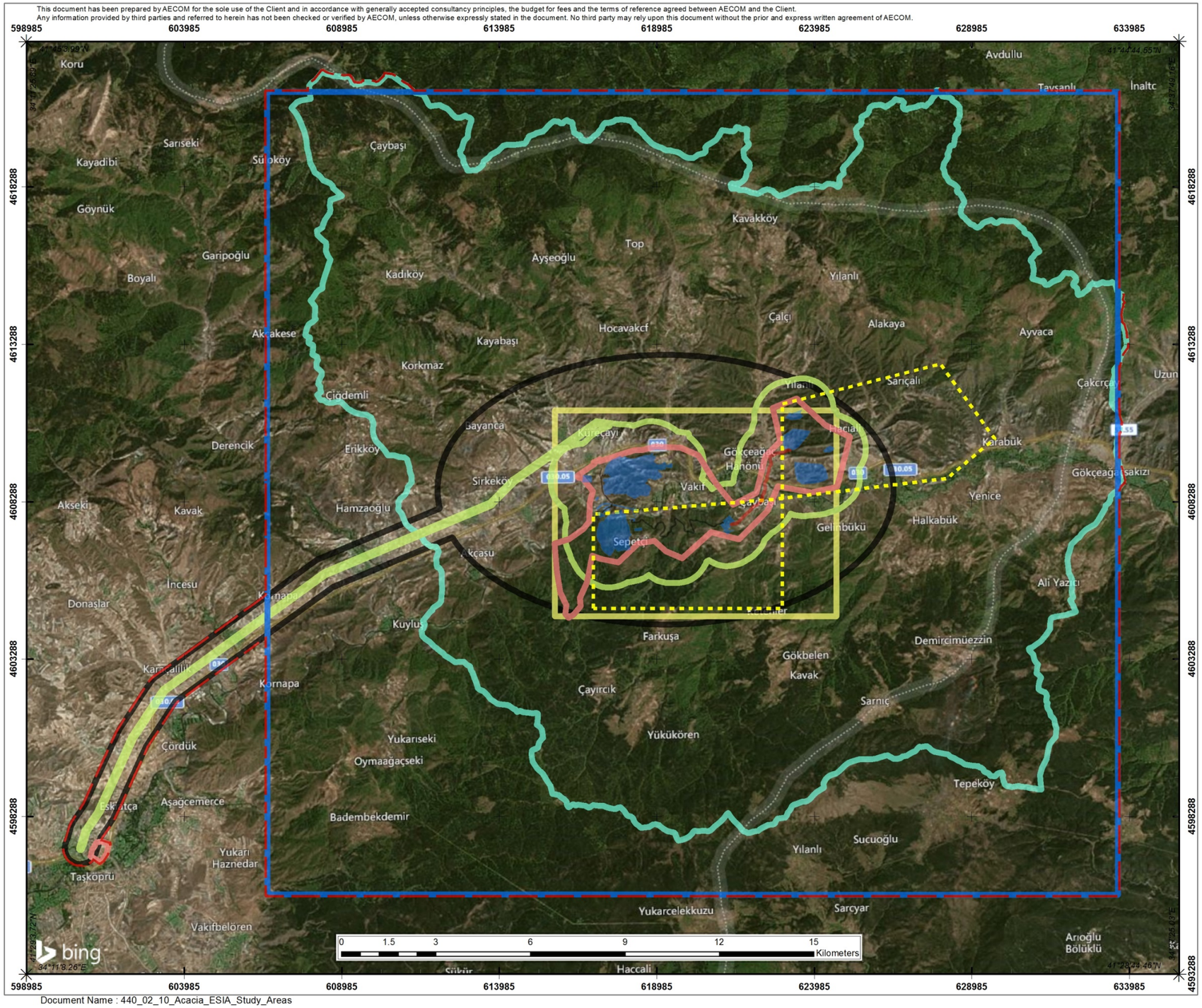
AECOM
Tel: +90 312 442 98 63
Fax: +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com
Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime B Blok Suite No:51
06800 Çankaya/Ankara Turkey

Project Name:	ESIA Disclosure Package for Acacia Mine Inc. (AMI) Gökırmak Copper Project
Map Title:	Local EIA License Areas and Proposed Project Units
Client:	Acacia Mine Inc. (AMI)
Project Group: Environment	Project Code: 440.02.10
Design: A. Korkmaz	Last Update: 07/09/2017 - 05:14 (korkmaz / TRAKR1PC31746)
Coordinate System: Projection: Transverse Mercator Coordinate System: ED 1950 UTM Zone 36N	Sheet Size: A3
Service Layer Credits:	

Document Name : 440_02_10_Project Layout without the ETL and Gelberi

Figure 3-7 Project Layout, License Areas and EIA areas

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



LEGEND

- Proposed Project Units
- Roads
- TSF Pipeline
- Mining License

Study Areas

- EIA Study
- Air Qaulity
- Cultural Heritage
- Biodiversity
- Hydrogelogy
- Noise
- Visual

AECOM

Tel: +90 312 442 98 63
Fax: +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com

Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime B Blok Suite No:51
06800 Çankaya/Ankara Turkey

Project Name:	ESIA Disclosure Package for Acacia Mine Inc. (AMI) Gokirmak Copper Project
Map Title:	Study Areas
Client:	Acacia Mine Inc. (AMI)
Project Group: Environment	Project Code: 440.02.10
Design: A. Korkmaz	Last Update: 07/09/2017 - 04:51 (korkmaz / TRAKR1PC31746)
Coordinate System:	Projection: Transverse Mercator Coordinate System: ED 1950 UTM Zone 36N
Sheet Size	A3

Service Layer Credits: Earthstar Geographics SIO © 2017 Microsoft Corporation © 2010 NAVTEQ

Document Name : 440_02_10_Acacia_ESIA_Study_Areas

Figure 3-8 ESIA Study Areas

3.3 Project Units

The mining method selected for the Project is mechanized open-pit mining, with the application of conventional drill-and-blast, excavator-and-truck operations. Following the mining of the ore, the excavated run of mine (rom) ore will be transferred via the haulage road to the processing plant, where crushing/screening and flotation methods will be used for mineral processing or to the ore stockpile to be stored before feeding. Main Project units are described in this section.

3.3.1 Open Pit

Open Pit Design

The Updated Project Feasibility Report states that the design of the ultimate pit was optimized in consideration of the metal price and exchange rates, discount rate, slope angles, mining costs, mining dilution and mining recovery, processing inputs, selling costs and cut-off grade. The optimization process aims to fulfill the corporate goals as net present value which contains ounces, an appropriate level of risk, and the geotechnical parameters of pit design investigated by AMC (AMC, 2015). In addition to the feasibility studies, multiple other studies were conducted for pit optimization, as listed in “Section 3.4.3”.

The total footprint of the open pit area will be approximately 115 ha and the pit will be mined in 4 phases. Mining activities will begin from the Southwest of the ultimate pit, progressing towards the Southeast initially and then towards the North later. The ultimate pit design is presented in Figure 3-9. The haul ramp varies between 16 m and 18 m width depending on the geotechnical design sector on which the ramp is crossing. The haul ramp was designed highest at gradient 10%, includes safety berms and allows for 2 way in pit traffic.

Following the pre-stripping activities, produced ore will be hauled to the primary crusher. Adjacent to the open pit, the excess of produced ore will be used to build up a 250 kt capacity overflow stockpile. The total material movement over the estimated 11.3 year operating life of mine is 304.2 Mt resulting in an average strip ratio of 12.8:1 (t:t). Open pit design content summary is presented in Table 3-2 and the mining schedule is presented in Table 3-3.

Table 3-2 Open-Pit Stage Design Content Summary

Stage	Volume				Tonnes				
	Total (kBCM[1])	Waste (kBCM)	Ore (kBCM)	Strip Ratio (W BCM:O BCM)	Total (kt)	Waste (kt)	Ore[2] (kt)	Strip Ratio (W t:O t)	Ore Grade (Cu %)
Stage_1	2,597	2,301	296	7.8	7,475	6,431	1,044	6.2	1.42
Stage_2	22,374	21,086	1,289	16.4	62,729	58,307	4,422	13.2	1.27
Stage_3	40,330	38,880	1,450	26.8	114,543	109,370	5,173	21.1	1.70
Stage_4	42,004	38,815	3,189	12.2	119,608	108,258	11,349	9.5	1.51
TOTAL	107,304	101,081	6,223	16.2	304,354	282,367	21,987	12.8	1.50

[1] Bank Cubic Meter
[2] Measured and Indicated
Source: GCP FS Report, June 2017

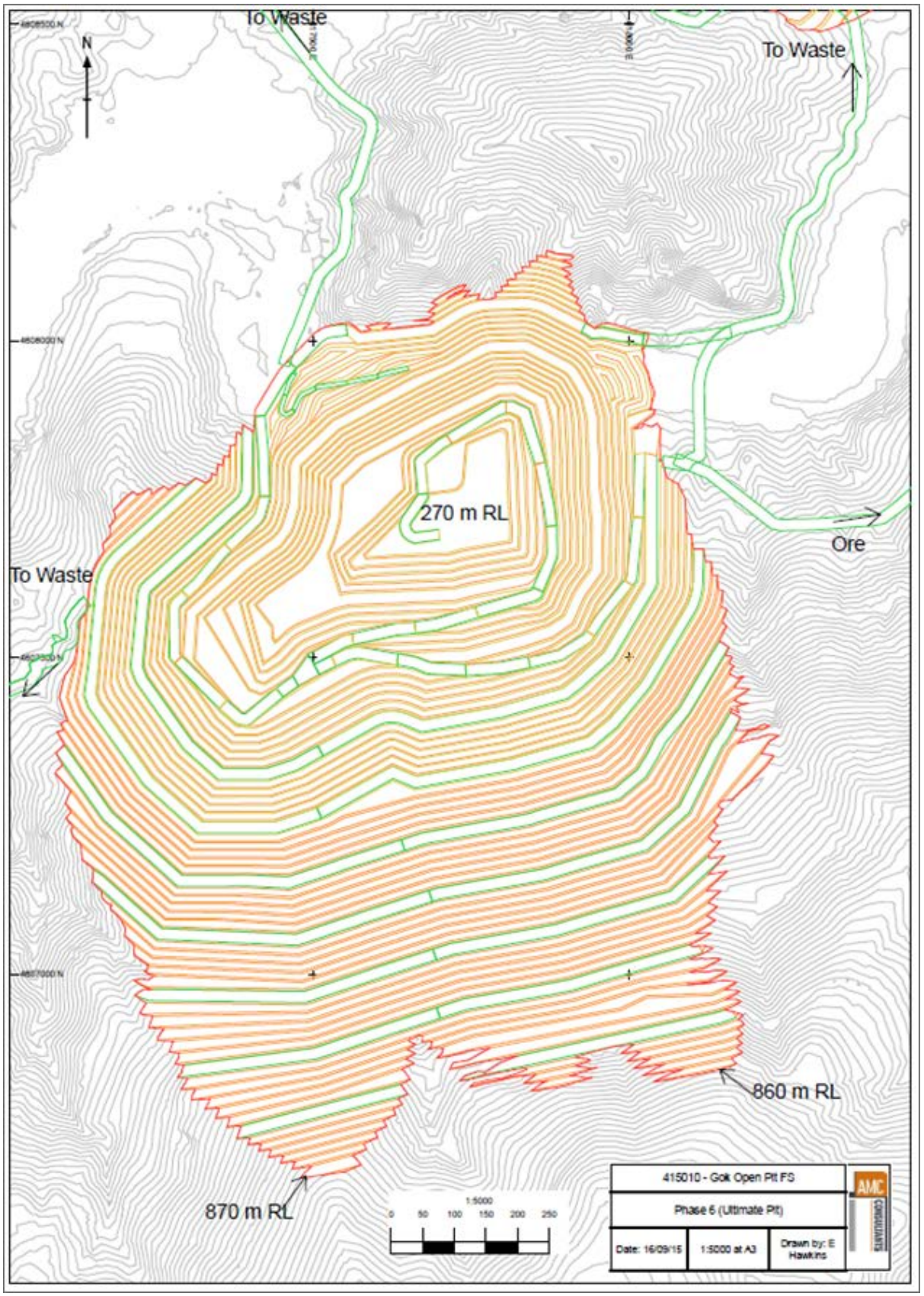


Figure 3-9 Open Pit Ultimate Design (GCP FS Report, June 2017

Table 3-3 Open-Pit Mine Schedule

Item	Unit	Totals	Y-1[1]	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12[2]
Ore	Mt	22.0	0.0	1.2	2.0	1.9	2.1	1.9	1.9	2.0	2.2	2.0	1.9	2.1	0.8
Cu Mined Grade	%	1.50	0.00	1.29	1.11	1.46	1.55	1.85	1.44	1.06	1.42	1.66	1.75	1.78	1.66
Contained Cu	kt	330	0	16	22	28	32	36	27	21	31	33	34	37	14
Waste	Mt	282.2	19.5	42.5	41.6	41.6	38.2	37.6	26.7	15.5	7.6	4.7	4.8	1.2	0.4
Total Material	Mt	304.2	19.5	43.8	43.6	43.5	40.3	39.6	28.6	17.5	9.8	6.7	6.7	3.3	1.3
Strip Ratio[3]	T w:t o	12.8	–	34.9	20.7	21.9	18.5	19.3	14.0	7.9	3.5	2.4	2.5	0.6	0.5

[1] *Year - 1 consists of nine months*
[2] *Year 12 consists of six months*
[3] *Strip ratio = tonnes waste/tonnes ore*
Source: GCP FS Report, June 2017

The pit sections consist either of alluvium or fresh rock. In the scope of the FS studies of the Project, 2D limit equilibrium and finite element modelling were applied on a series of sections through the pit and slope design recommendations for the alluvium and for fresh rock were provided. According to the results, overall slope angle recommended for the alluvium is 18°, whereas overall slope angles recommended for the fresh rock units are 34°, 36° and 41° and 43° for various design sectors.

Stockpile Management

Two stockpiles, namely the ROM stockpile and the overflow stockpile, are included in the scope of the Project, in order to provide constant rom ore feed to the processing plant during the night shift when open pit operations are halted or in case the mined ore is insufficient at any time of the day and also to provide alternative dumping locations in case of crasher equipment failure and/or damage to mine haulage road. The ROM stockpile located at the crusher site is planned to have a total capacity of 30 kt, and the overflow stockpile adjacent to the open-pit area is planned to have a total capacity of around 250 kt.

Pit Operations

Operation phase activities to be conducted in the open pit and related units are listed below:

- Topsoil removal and stockpiling
- Open-pit supervision
- Drill-and-blast/ ore material
- Drill-and-blast/ wasterock material
- Load-and-haul/ ore material
- Load-and-haul/ wasterock material
- Haul-roads maintenance
- Stockpile and waste dump maintenance
- Pit dewatering

3.3.2 Process Plant

The ore produced during the Project lifetime will be fed to the processing plant (Bağdere processing plant). Located approximately 3 km east of the open pit, the processing plant will have a throughput of 2 Mt per annum, according to the Feasibility Report provided by AMI. The overall process plant flow diagram is presented in Figure 3-10.

The processing plant consists of the following main circuits:

- Three-stage crushing and screening circuit;
- Grinding and classification circuit;
- Flotation circuit;
- Regrinding and Classification Circuit
- Concentrate dewatering circuit;
- Tailings thickening and disposal systems; and
- Reagent preparation and distribution plant
- Lime preparation and distribution plant

Brief descriptions and technical specifications of the above stated main circuits are provided in the following paragraphs.

Crushing and screening circuit

ROM (run off mine) ore is delivered to the ROM pad which provides for several stockpiles of various grade ore types to be dumped to as required. Ore is discharged from the ROM bin is crushed to -12 mm with three staged crushing system (with integrated screens in between). The ore is first crushed with the primary jaw crusher to -150 mm. Then it is transferred to secondary cone crusher to get crashed to -45 mm and then to tertiary crusher to end up with -12 mm diameter. undersize material from the tertiary crusher represents the final crushing circuit product and is directed via belt conveyor to twin 1,500 m^3 (3,000 t) capacity fine ore bins (FOBs) providing 24-hours of mill feed storage.

The circuit is equipped with, grizzlies, conveyors, feeders, metal detectors, tramp magnets, tramp metal bunkers, overhead cranes, and dust collection systems.

Grinding circuit

Crushed ore is withdrawn from the FOBs by variable speed belt feeders and directed to the primary ball mill

Primary mill discharge is trommel screened, diluted with process water and pumped to the primary mill cyclone cluster. Cyclone overflow gravitates to the rougher flotation circuit and the cyclone underflow stream is returned to the mill as circulating load. The trommel oversize stream gravitates to a bunker for periodic collection and disposal or recycle to the mill feed system.

Flotation circuit

Primary mill cyclone overflow gravitates to conditioning tanks for slurry pH adjustment and dosing of Potassium Amyl Xanthate (PAX). Conditioned slurry gravitates to the rougher flotation train.

The rougher flotation tails represent the first tails stream and is directed to the tailings thickening area.

Rougher concentrate is pumped to the concentrate regrind circuit along with the Cleaner 1-scavenger concentrate stream. The combined stream is pre-classified by the regrind mill cyclone cluster. Cyclone overflow gravitates to the cleaner flotation conditioning system.

Regrind cyclone underflow is directed via slurry pump to the concentrate regrind mill. Sodium metabisulfite (SMBS) is dosed and the product is transferred to the cleaner conditioning system

There are a total of 2 cleaner conditioning tanks. Combined regrind mill cyclone overflow and regrind mill discharge gravitates to cleaner conditioning tanks for slurry pH adjustment with lime and further Sodium metabisulfite addition.

Concentrate dewatering circuit

Cleaner 3 concentrate is directed to the concentrate thickener. Here, the concentrate is thickened and pumped to the concentrate filter press to produce a final concentrate filter cake. This cake is discharged to the concentrate stockpile

Tailings thickening and disposal

The sampled rougher tails, T1, and Cleaner 1-scavenger tails, T2 streams report to the tailings thickener. The tailings thickener produces an underflow stream which is transferred to the tailings management facility (TMF) via the tailings pipeline. Tailings thickener overflow is introduced to the process water tank.

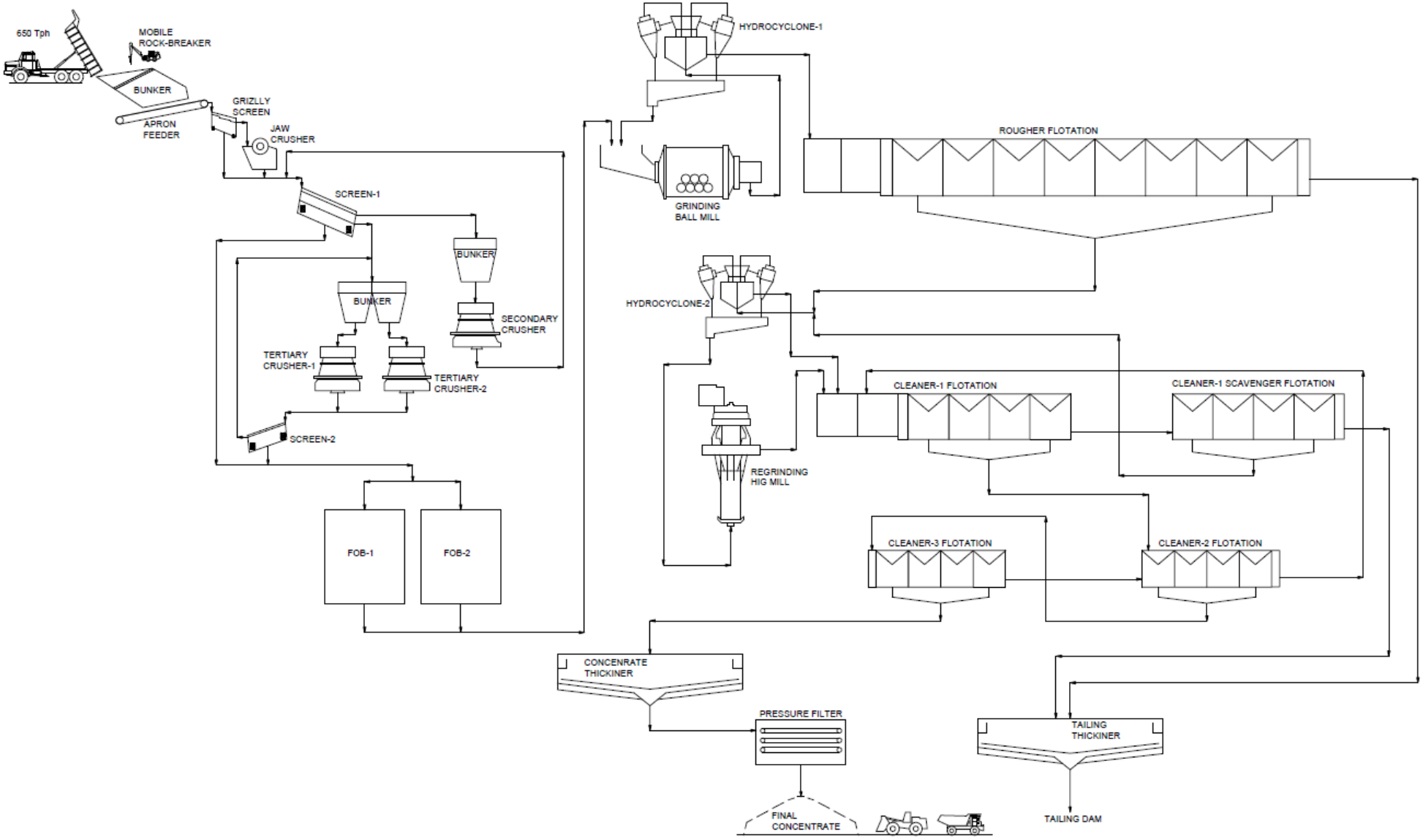


Figure 3-10 Process Plant Flowsheet

3.3.3 Bağdere and Kepezkaya Tailings Storage Facilities and the Tailings Pipeline

Information provided in this section is compiled from the Feasibility Report of the Project, the TSFs Siting Study prepared by Hidromark and the TSF Design Study prepared by Hidrodizayn.

A siting study was completed in 2013 by Hidromark in order to determine and select the best location for the tailing storage facility (TSF) required for storing tailings generated from the tailing thickening circuit. The outputs led to the conclusion that the Kepezkaya and Bağdere TSF sites, which are located at the north-east of the mine and process plant areas, adjacent to the town of Hanönü, were the best alternatives. The annual tailings production and the total volume of proposed tailing storage facilities are provided in Table 3-4.

Table 3-4 Tailings Production by Years

Years	Processed Ore (1000 t)	Head Grade (1000 t)	Concentrate (1000 t)	Process Waste (1000 t)	Tailings Volume (1000 m^3)	Reservoir Volume (1000 m^3)
1	1,002	1.31	51	1,442	874	874
2	2,000	1.09	84	1,898	1,151	2,025
3	2,006	1.45	112	1,911	1,158	3,183
4	2,000	1.49	115	1,841	1,116	4,299
5	1,954	1.90	144	1,901	1,152	5,451
6	2,000	1.49	115	1,900	1,151	6,602
7	1,993	1.05	80	1,862	1,129	7,731
8	1,991	1.42	109	1,886	1,143	8,874
9	1,996	1.63	126	1,874	1,136	10,010
10	2,000	1.74	135	1,865	1,130	11,140
11	2,006	1.77	138	1,795	1,088	12,228
12	1,039	1.70	68	–	–	–
Total	21,987	1.50	1,276	20,177	12,228	–

Source: GCP FS Report, June 2017

The sites of the proposed TSFs are located in valleys to the east of the Hanönü District. Preliminary assessments indicate that these two locations have sufficient capacity to store over 13 million m^3 of tailings. Detailed studies were completed for the Kepezkaya site, which has a 5.15 million m^3 reservoir capacity and will provide for Project TSF storage needs for 4 years 9 months of production period. This requires that the construction of the Bağdere TSF commences approximately in Q3, year 3 of production. The preliminary studies showed that the Bağdere TSF reservoir capacity will be slightly above 8 million m^3. In total, the tailings storage requirements of the GCP are met.

Tailings will be transferred to TSFs via open-ended discharge points, spigots connected to a 3.8 km slurry pipeline that will be constructed routed across the main embankment and around the west side of the TMF, together with its own maintenance roads.

The Kepezkaya TSF will have a maximum height of approximately 53 m from the foundation. The main embankment will be constructed from rockfill with a central interface drainage layer and a clay wedge on the upstream side, where the facility will be equipped with a composite liner. Foundation improvement measures consisting of a series of Continuous Flight Auger (CFA) piles were installed below main TSF embankment. (Risk Assessment for the Kepezkaya Tailings Storage Facility, April 2017, Golder).

The reservoir surfaces and the upstream face of the TSF dam and closing dyke embankments will be lined from top to bottom with a drainage geocomposite layer, a geomembrane layer, a Geosynthetic Clay Liner (GCL) layer and a drainage composite layer to ensure impermeability:

- Drainage Geocomposite: for the upper drainage system, consisting of a geonet core and a protective geotextile on the tailings side, which resists clogging of the geonet by soil particles. This material also protects the adjacent geomembrane from being damaged.
- Geomembrane: A 2 mm thick HDPE geomembrane for impermeability is selected.
- GCL: Consisting of a layer of sodium bentonite between a woven and a non-woven geotextile, which is needle-punched together.
- Drainage Geocomposite: The lower drainage system will utilize the same drainage geocomposite as the upper drainage system, but with the protective geotextile on the soil side.

The linings listed above will be laid over a minimum thickness of 0.5 m support layer.

Drainage systems planned for Kepezkaya TSF include the following:

- A total of six intermittent stream collection structures and diversion channels around the reservoir are planned to divert the rainfall runoff within the valley catchment. The diversion channels will discharge the flows to the downstream side of the TSF with the aid of chute channels and energy dissipaters.
- The upper drainage system was designed to collect the contact waters leaching from the waste. All applied impermeable layers and dam embankment upstream face will be layered with a drainage geocomposite with the above mentioned specifications, as well as an additional mesh type drainage system. In addition, at least a 3° inclination will be ensured from the upstream side to the downstream side and also from left and right banks to the centre. The collected water will be diverted by the drainage geocomposite and drainage system to the high strength HDPE perforated pipes installed at the bottom, below respective filters. These pipes will transfer the water to the upper drainage collection pond.
- The lower drainage system will collect and divert groundwater flow, especially increasing seasonally by melting of snow and/or heavy rain events, from below the impermeable layers to prevent any such flow's damage to the dam and installed impermeability structures. The system will consist of drainage trenches, which will also serve the purpose of anchorage for fixing the geosynthetics. The collected water will be transferred to lower drainage collection pond. The water in the pond will be tested and sent to the TSF in case it is determined to be contaminated, or will be discharged in case it is determined to be in compliance with discharge standards.

All materials for the impervious linings and drainage systems were selected by considering the chemical contents of the tailings and underground waters, which includes 100% polypropylene and HDPE geosynthetics and pipes.

The facility will be equipped with a concrete lined storm water management system which has been designed to collect a 1:500 year 24 hour event.

A total of 4 and a total of 5 monitoring wells have been constructed around Kepezkaya and Bağdere TSF locations. A map showing these and other groundwater monitoring wells is provided in "Section 5.7.7.3".

Regarding a chance of dam break, Risk Assessment for the Kepezkaya Tailings Storage Facility Report (April 2017, Golder) states the following in its conclusions section:

- The TSF has a sufficient factor of safety based on the conservative geotechnical parameters used in the stability analysis and the risk assessment for the operational phase is satisfactory;
- The addition of the stabilising buttress, has reduced the risk associated with slope failure of the TSF during all phases by 2 orders of magnitude (for both the Operating and Post Closure phases);
- The buttress addition also reduces the risk associated with tailings release from the TSF during all phases by between 77% (Operating Phase) and 88% (Post Closure);

- Annual probability of tailings release is 1/110,194 ($9.07x10^{-6}$) during operation phase, 1/32,928 ($3.04x10^{-5}$) during post closure prior to capping, 1/ 679,462 ($1.47x10^{-6}$) during post closure after capping, and 1/761,202 ($1.13x10^{-6}$) during post closure after capping together with Emergency Drainage System.
- The lack of an Emergency Drainage System for the TSF during the Post Closure Phase, is considered problematic particularly prior to capping. Golder therefore recommends equipping the TSF with either an Emergency Drainage System or a facility to pump surplus water from the facility as the cap is being installed, and an EDS once the cap has been installed to allow the cap to drain and remove clean runoff from the cap surface.

It should be noted that Golder's risk assessment states that $1x10^{-6}$ probability of dam failure means almost impossible or negligible and 1x10-5 probability of dam failure means highly improbable. As stated above, the highest dam failure probability identified for Kepezkaya TSF is $3.04x10^{-5}$, which corresponds to highly improbable.

Following closure of the Kepezkaya TSF, the facility will be capped with a system consisting of a geomembrane and a crest capping layer which will be equipped with a drainage collection system. The cap is some 1.8 m thick and would infill the majority of the operational freeboard. Therefore, at closure, there is only a limited capacity for the facility to retain water, however, if this water is not allowed to drain, it could overtop the dam resulting in erosion which if not dealt with, could result in exposure and release of tailings (Risk Assessment for the Kepezkaya Tailings Storage Facility, April 2017, Golder).

It should be noted that design studies for Bağdere TSF has not been initiated yet, as its construction is not required to be started until approximately Q3 of production year 3. However, although definitive design and parameters are subject to change, Bağdere TSF will also utilize similar impermeability and drainage measures.

Final options for Kepezkaya and Bağdere TSFs will be determined following additional technical revisions. In case potential environmental and/or social impacts from the final design alternative are identified, a supplementary Final TSF environmental and social impact assessment document will be prepared and disclosed additionally.

3.3.4 Waste Rock Dump Area

The 122.5 million LCM waste rock (with the swell factor in consideration) generated during the lifetime of the Project as a result of stripping operations is planned to be stored at the Çorakoğlu WRD, which is designed with a total capacity of 122.5 million LCM to cover the Project's entire WRD storage requirement. The WRD is planned towards North of the pit, in close proximity since the main criteria for site selection of the waste rock dump areas is minimization of impacts caused by haulage distance such as extent of topography alteration and air emissions, as well as economic factors associated with fuel consumption and time. Çorakoğlu WRD will cover approximately 199 ha area and the haulage distance from the pit to this area will be approximately 2 km in average.

For waste dump design, the Turkish mining regulations require that the final waste dump landform be stable in long term. Final design criteria are shown in Table 3-5.

Table 3-5 Waste Dump Design Criteria

Item	Value
Bench face angle	37°
Bench height	10 m
Catch bench width	6 m
Overall slope angle	28°
Haul ramp width	18 m
Maximum Height	240 m

Source: GCP FS Report, June 2017

Interception channels will be constructed around the WRD to divert runoff and prevent surface runoff interaction with stored waste rock. This non-contact water will be drained to downstream surface waters.

Impervious sedimentation ponds will also be constructed and runoff that is in contact with waste rock and open pit walls will be captured and diverted to these ponds for further treatment. Water collected in sedimentation ponds will be discharged after treatment, only in case in the case its quality meets discharge criteria defined by EU Directive on Urban Waste Water Treatment (91/271/EEC), IFC Effluent Discharge Criteria for mine waters and National Discharge Standards specified in Turkish Water Pollution and Control Regulation – Table 7.1. No additional lining or acid drainage measure below the WRD was proposed, since Geochemico's modelling and other acid rock drainage studies' results do not require additional measures for WRD management (see "Section 6.7.2".

The proposed cover design for the closure phase is formed of a 'sandwich' of a lower layer of gravel (nominal thickness 15 cm), itself covered by a layer of clay (nominal thickness 0.5 m) with an additional upper layer of gravel (nominal thickness 10 cm). On top, the gravel layer is covered by soil/overburden to facilitate re-vegetation. Rainfall on the WRD will pass through the upper vegetated soil layer, some of it evaporating and a portion of the rainfall will be transpired into the atmosphere.

3.3.5 Roads

The rom ore will be transported from the open pit to the ROM pad located adjacent to the processing plant via an approximately 5.5 km haulage road. Construction of this road is planned to coincide with open pit pre-stripping activities and to be completed prior to plant start-up. In addition, a 1.8 km haulage road will provide access between the open pit and the Corakoğlu WRD. Construction of these haulage roads have already been completed.

In addition to the haulage roads, the Project will also utilize a 10.2 km network of access roads network, consisting of 5.8 km of existing village roads and 4.4 km of the Kastamonu-Sinop state road. These roads include the following:

- Main access to the site will be provided form a point on Kastamonu-Sinop state road, located just north of the northwest border of Çorakoğlu WRD. The Project office is located on the said Kastamonu-Sinop state road and the distance from the office to the main access junction is 4.4 km (towards west of the office). From this point, an existing 1.7 km village road will be used for access to the on-site administrative building, located north of open pit and south of Çorakoğlu WRD (see Figure 3-5).
- A 1.8 km existing road will be used for access between the Kepezkaya TSF and the Kastamonu-Sinop state road located southwest of the TSF. This road was completely improved for Project activities.
- 3.3 km of existing village roads, consisting of a 2.3 km road and a 1 km road the former one connects to, will be used for access between the Process Plant and the Kastamonu-Sinop Road. Of these, the 2.3 km road connecting the Process Plant to the remaining 1 km road was improved for Project activities. The remaining 1 km road lies inside the mobilization area of the Project.

In addition to the above mentioned roads, the 3.8 km route of tailings pipeline will be used as a service road for construction and maintenance of the pipeline.

Community consultation will be conducted during the closure to determine the fate of larger roads. In the case the communities relay potential interest in using these roads after the Project operation activities are finalized, the roads will be left. If no such interest is relayed, the roads will be included in the scope of the rehabilitation program.

3.3.6 Other Project Units and Supporting Infrastructure

Other Project units and supporting infrastructure are listed below:

- Utility Water Supply Structures: A total of 5 wells, 4 with 75 to 78 m depths and one with 140 m depth, located inside the mobilization site adjacent to Gökırmak River will supply for water needs of the Project. The pumped water will first be stored in a 150 m^3 freshwater tank located in the mobilization area and later be pumped and transferred via a steel pipeline to the 1800 m^3 freshwater reservoir located adjacent to the Rom pad. The water collected in this reservoir will directly be used as utility water by Project facilities and the fire-water system. Water recovered from tailings pond will be collected in a 150 m^3 storage tank and will be pumped through an approximately 3.7 km steel pipeline to the process water reservoir. Water recovered from the overflow of concentrate and tailings thickeners will be pumped to the plant again for reuse as process water. For the most part, the main water pipeline route lies parallel to the TSF pipeline route (i.e. from the mobilization site towards the Process plant and towards the Kepezkaya TSF). The additional pipeline routes that will direct the water to other Project unit locations from the Process Plant are not finalized as of August, 2017. In case potential environmental and/or social impacts related with the routes are identified, a supplementary impact assessment document will be prepared, and related mitigation will be provided, as necessary.
- Potable Water Supply Structures: The water collected in the freshwater reservoir will be transferred to an intermediate tank and will undergo treatment for use as potable water. The potable water will be distributed to various Project facilities by a separate piping system. The route design for potable water piping network is not finalized as of August 2017. In case potential environmental and/or social impacts related with the routes are identified, a supplementary impact assessment document will be prepared,, and related mitigation will be provided, as necessary.
- Surface Soil Storage Areas: All of the stripped topsoil will be stored in these designated areas. Currently, some of the topsoil stripped during construction activities is stored in temporary storage areas and these will also be moved to the permanent storage areas.
- Waste Management Facility: The facility, which will be constructed in compliance with national waste management legislation, will be used for temporary storage of domestic and process related waste.
- Wastewater Treatment Plant: The Project will utilize a sewage piping system to collect domestic wastewater and this water will be treated at package wastewater treatment plants to meet discharge limits set by related legislation for discharge to receiving environments.
- Fuel Supply: Fuel supply and storage for mining activities will be handled by the mining contractor, under supervision of AMI. A fuel station is planned in the administrative area, 100 m southwest of Çorakoğlu WRD. The fuel station will be constructed and operated in full compliance with the Turkish Standard “TS 12820 – Fuel Stations Safety Requirements Standard”, the fuel station requirements provided by the Turkish Regulation on Soil Pollution and Control of Point Sourced Contamination and the European Parliament and Council Directive 94/63/EC on the Control of Volatile Organic Compound (VOC) Emissions Resulting from the Storage of Petrol and its Distribution from Terminals to Service Stations. Single walled, vented, aboveground fuel storage tanks with necessary secondary containment will be used for fuel storage.
- Vehicle Maintenance: A truck wash-down facility will be constructed adjacent to the concentrate handling facility (processing plant) and the contact water sourced from this facility will be pumped back to the processing plant for reuse.
- Explosives Storage Area: Although stated as a Project unit by the feasibility study, the Project will not use its designated explosives storage area, since the Company stated that the amount of explosives required for use in a single day will be delivered daily and that this decision is final (note that this area is shown on some of the maps prepared for this EIA Report). The decision was taken on the basis that employment of 4 security personnel, construction of additional access roads and fencing the area would have been necessary if this unit was to be used and in consideration of the fact that explosives will be brought in from Çankırı

province, a province located immediately south of Kastamonu province and in sufficient enough proximity to the Project area for the explosives to be transported on a daily basis.

- Mobilization Area: The mobilization area is located 1 km northeast of the Process plant and hosts the drilling core storage, the 5 water supply wells that will provide for the Project water need, the meteorological station and a small scale construction personnel amenities site.
- Other supporting infrastructure and buildings include; workshops, lubricants storage, generator building, administrative building, technical office, cafeteria, medical building, laboratory, warehouse and security and gatehouse.

3.3.7 Associated Facilities

Gökırmak River Diversion

The planned open-pit corresponds to the original Gökırmak river bed and therefore, a river diversion system was planned as shown in Figure 3-11, which diverts a former 1.5 km stretch of the river through 2 parallel 700 m tunnels. The discharge capacity of the diversion system is based initially on 100 year peak flow (Q100), which is in excess of DSİ's discharge capacity advice of 50 year peak flow. The related "Gökırmak – Hanönü Diversion Planning Report" was prepared and submitted to DSİ and this report was approved by the Head of DSİ Survey, Planning and Allocations Department. However, DSİ Dams and HEPPs Department requested the protection of upstream cofferdam against flood events based on Q10,000. Due to this requirement, a spillway was added to the design, the upstream cofferdam was altered to raise five meters and the embankment was equipped with proper instrumentation. An emergency warning system was also provided for the safety of the personnel and equipment in the mine, as well as the local communities residing downstream of the Project. The Final Design was reviewed and approved by DSİ 23rd Regional Directorate on 11 November 2014 and by DSİ General Directorate, Dams and HEPPs Department on 14 November 2014.

The main diversion structures consist of two cofferdams, two concrete-lined diversion tunnels, each with 700 m length and 7.5 m inner diameter, connecting the upstream and downstream sides of the river and a spillway. The total discharge capacity of the river diversion is 2,836 m³/s (Q10,000). During flooding, the upstream reservoir elevation level will rise to 455.5 masl. The tunnels will be discharged at a rate of 1,318 m³/s and a spillway was designed as an emergency measure to discharge the remaining flows.

The construction activities of the river diversion are completed and a Temporary Approval Contract was signed by DSİ 23rd Regional Directorate and AMI, which states that the Directorate concluded that all derivation structures were built in compliance with the approved design. The river currently runs diverted to these tunnels. As the owner of the river diversion system, DSI will be responsible of its maintenance and operation, whereas AMI is responsible for financing any such maintenance work.

Technical details for Gökırmak River Diversion system are presented in below in Table 3-6.

Table 3-6 Gökırmak River Diversion Technical Specifications

Item	Specification
Upstream Cofferdam	
Type	Clay Cored (Zoned) Rockfill (Arched)
Crest elevation level	456.0 masl
Crest length	316.9 m
Crest width	10.0 m
Thalweg elevation level	430.0 masl
Height from thalweg	26.0
Height from foundation	27.5 m

Item	Specification
Downstream Cofferdam	
Type	Clay Cored Rockfill
Crest elevation level	431.0 masl
Crest length	166.1 m
Crest width	10.0 m
Thalweg elevation level	427.0 masl
Height from thalweg	4 m
Height from foundation	5 m
Diversion Tunnels	
Number of tunnels	2 parallel tunnels
Type	Reinforced Concrete Lined, Horseshoe
Discharge capacity for Q100	1,191 m³/s
Discharge capacity for Q10,000	1,318 m³/s
Inner diameter	7.5 m
Length (each)	700 m
Inlet elevation level	427 m
Outlet elevation level	426 m
Spillway	
Type	Uncontrolled, frontal intake
Discharge capacity	1,518 m³/s
Crest width	70 m

Source: GCP FS Report, June 2017

Energy Transmission Line

Power will be supplied from the national grid at the Taşköprü step-down transformer station through two feeders from the two 20 MVA transformers dedicated to AMI. The 34,500 V overhead transmission line is 28.75 km long and links the step-down transformer to the transformer station which is located at the plant site. Power is transferred to the main substation, which is located adjacent to the process. The power available at the main substation is 22.5MVA and will be distributed to the process plant facilities via underground cables. A total of 122 pylons have been constructed for the ETL. The expropriation data shows that the total area expropriated for the construction of ETL pylons is around 3,900 m^2.

Construction of the ETL is complete and a contract regarding provisional acceptance and transfer of the ETL is signed between AMI and Baskent Electricity Distribution Co. on 03 March, 2017.. It should be noted that, as the owner of the ETL, TEIAS will be responsible of its maintenance and operation, whereas AMI will be responsible of financing any such maintenance work.

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.

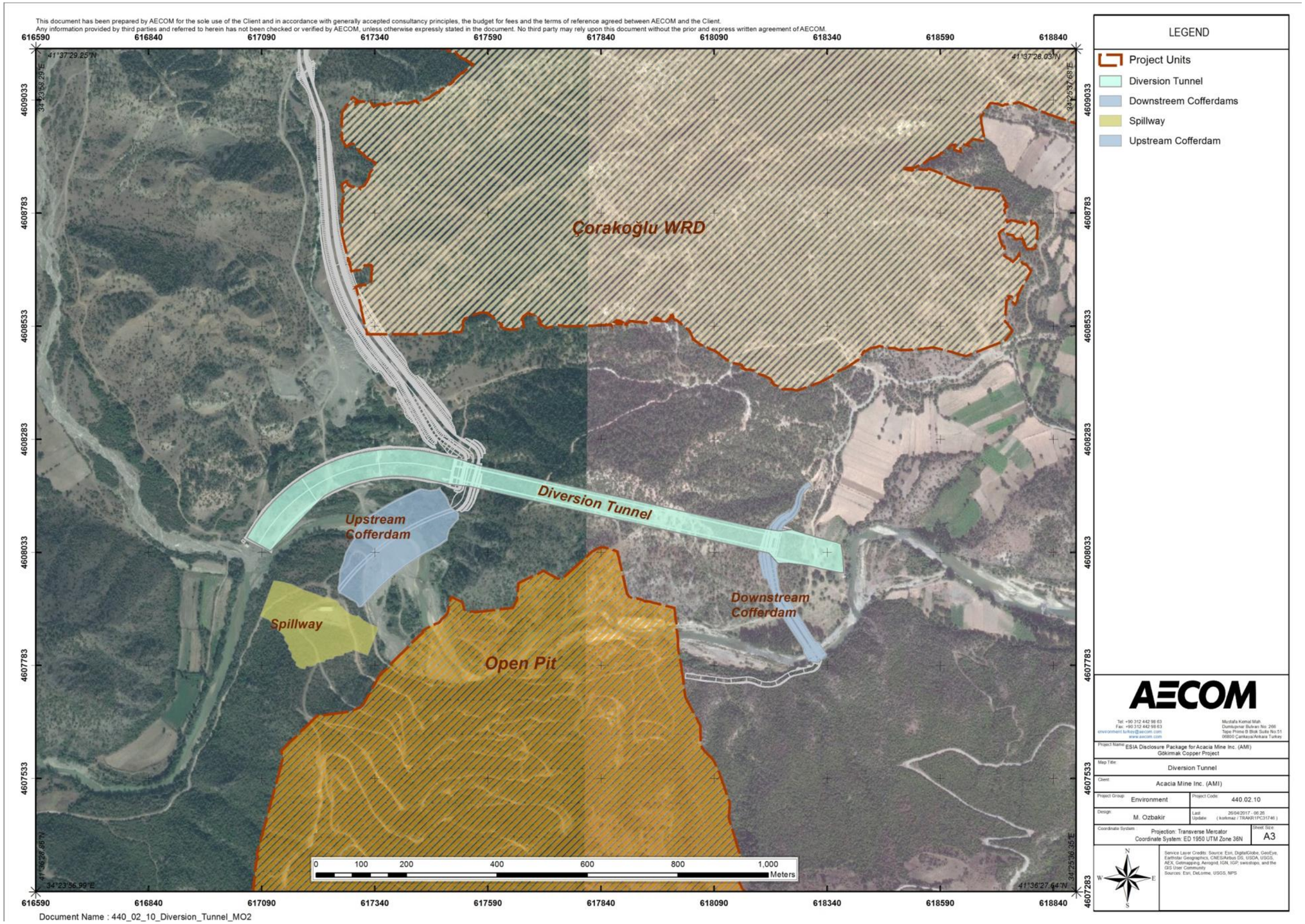


Figure 3-11 River Diversion System Layout Plan

3.4 Project Background

3.4.1 National EIA Studies

As stated in “Chapter 2”, preparation of a full EIA Report is required in case the planned investment is defined as an activity under Annex-1 of the EIA Regulation, whereas the projects categorized under Annex-2 are required to prepare a Project Description Report and the related Provincial Directorate of Environment and Urbanization evaluates if the Project requires a full EIA Process or not. If the latter decision is made, the project in question is provided an “EIA Not Required Certificate”. Mining projects with a total study area of and above 25 ha (including both excavation and dump sites) are included in Annex-I Item 27 and therefore require a full EIA process.

The proposed Project was initially planned as an underground mining project due to the fact that Taşköprü Dam, which will be constructed by State Hydraulic Works (DSİ) for irrigation purposes, was proposed in the same area. Afterwards, DSİ re-assessed the location of the Taşköprü Dam and revised the location of the dam due to the high economic potential and public interest of the GCP Project. The Taşköprü Dam was then shifted 2.0 km away from the mining site and AMI re-applied to the Provincial Directorate of Environment and Urbanisation so as to continue the mining activities in line with open-pit mining methods.

EIA studies conducted in compliance with national EIA Regulation for the Project’s current and former designs are listed below:

- AMI secured an “EIA Not Required Certificate” for “the Copper Mine Project”, which had a 24.09 ha study area, on October 03, 2011 from Kastamonu Provincial Directorate of Environment and Forestry.
- A capacity increase was planned for the Project and an Environmental Impact Assessment Report was prepared for “the Copper Mine Capacity Increase, Mineral Processing Plant, Waste Storage Facility and Concrete Plant Project” (Envy, 2013). An EIA Positive Certificate was secured for the capacity increase on July 03, 2013 with Decision No. 3065. The project included two process plants with a total annual production capacity of 3 Mt. This is the national EIA that is currently applicable for the Project Process Plant.
- A change in operation type was planned within the scope of the Project as open-pit mining instead of underground mining and therefore, a new Project Description Report was prepared. EIA Not Required Certificate was secured for this “Open-Pit Copper Mine Project”, which covers a total 23.90 ha area, on April 15, 2014 from Kastamonu Provincial Directorate of Environment and Urbanization.
- A capacity increase was planned for the Open-pit Copper Mine and this final version of the Project is included in Annex-I of the EIA Regulation. It is indicated in Article 7, Clause (c) of the Regulation that in case of capacity increase and/or expansion of the projects which are included in Annex-II of the regulation, if the total capacity is above the threshold value indicated in Annex-I, the projects are subject to preparation of an Environmental Impact Assessment Report. Therefore an EIA Report was prepared and an EIA Positive Certificate was secured for “Open-pit Copper Mine Capacity Increase Project” (Envy, 2014) on February 04, 2015. It should be noted that this EIA does not cover the Process Plant and production capacity and therefore, this is the national EIA that is currently applicable for the Project, except for the Process Plant and the Küpeli Storage Area.
- The national EIA Regulation states that Energy Transmission Lines (ETL) with voltage above 154 kV and lengths of and over 15 km require a full EIA process, whereas ETLs with voltage above 154 kV and lengths between 5 km-15 km require preparation of a Project Description Report. ETLs with voltage below 154 kV and/or lengths below 5 km are out of scope of the Regulation and require no EIA process. Since the voltage of the of 28.8 km long, overhead Project ETL is 34.5 kV (which is less than the 154 kV limit defined in the EIA Regulation), no EIA process was carried out for the ETL.
- Gökırmak River Diversion’s scale and type of projects are not included in the project types listed in the annexes of the national EIA Regulation. Therefore, AMI consulted the Ministry of Environment and Urbanization, with regards to Gökırmak River Diversion’s EIA status. In its opinion letter dated 25 June, 2014, the Ministry states that the river diversion system is not in the scope of the Regulation and that DSİ’s opinion and approval is required. DSİ 23rd Regional Directorate provided the first design approval on 11 November, 2014 and DSİ provided the Gökırmak River Diversion Final Project approval on 14 November, 2014. It should be noted that Gökırmak River System has been acknowledged in Taşköprü Dam’s Final EIA Report (the report is the basis for the EIA Positive Decision issued for the dam project in January 2017), which is a project planned at the upstream of the GCP. This EIA Report, assessed Gökırmak River

Diversion as a project planned at the downstream of the Taşköprü Dam and approved by the competent authority, the State Hydraulic Works-DSI. Taşköprü Dam's EIA Report also states that the operation of the dam will provide benefits to the River Diversion System in terms of flood protection, flow regulation, etc.

In summary, the following EIA Positive certificates and the EIA Not Required Decision are all currently applicable for Project units:

- EIA Positive Certificate secured on February 04, 2015 is applicable for all Project units, except the Process Plant and Küpeli Storage Area.
- EIA Not Required Certificate secured on April 15, 2014 is applicable for Küpeli Storage Area.
- EIA Positive Certificate secured on July 03, 2013 secured on July 03, 2013 is applicable for the Process Plant.

3.4.2 Permits and Licenses

The applicable national legislation and required permits and licenses to construct and operate a mine are given in Chapter "2" of this report.

Required permits and approvals for earthworks/construction/operation activities of all main units and associated facilities of the Project are given in Table 3-7 and forestry permits, covering all Project units except Bağdere TSF and its topsoil storage area, are given in Table 3-8.

Table 3-7 Permits, Approvals and Agreements

Permit	Related Authority / Entity	Status	Comments
Mining Exploration License (License ER: 3287515)	General Directorate of Mining Affairs	Obtained on: 28.05.2015	-
Mining Operation License (License ER: 3104771)	General Directorate of Mining Affairs	Obtained on: 27.01.2011	-
Special Permit for use of Çorakoğlu WRD area	General Directorate of Mining Affairs	Obtained on 22.04.2014	This permit was obtained since Çorakoğlu WRD area is not included in the scope of a mining license.
EIA Positive Certificate	Ministry of Environment and Urbanization	Obtained on 04.02.2015	Does not cover process plant and Küpeli Storage area.
EIA Not Required Decision	Kastamonu Provincial Directorate of Environment and Urbanization	Obtained on 14.04.2015	Applicable for Küpeli Storage Area.
EIA Positive Certificate	Ministry of Environment and Urbanization	Obtained on 03.07.2013	Applicable for process plant
Waste Storage Project Approval for Kepezkaya TSF	Ministry of Environment and Urbanization	Obtained on 16.12.2015	
Waste Storage Project Approval for Bağdere TSF	Ministry of Environment and Urbanization	Not in place.	Will be obtained after design studies for Bağdere TSF completed and the design submitted (see "Section 3.3.3" for TSFs)
Temporary Activity Permit (for Domestic WWTP)	Provincial Directorate of Environment and Urbanization	Obtained on 18.11.2016	Will expire on 18.11.2017
Environmental Permit	Ministry of Environment and Urbanization	Will be obtained prior to 18.11.2017	Temporary Activity Permit (for Domestic WWTP) will expire on 18.11.2017. Environmental permit needs to be obtained prior to this date.

Permit	Related Authority / Entity	Status	Comments
Workplace Opening and Operating Permit	Special Provincial Administration	Trial Permit for 1 year Obtained on 06.01.2017, requires Environmental Permit to be permanent	Will be obtained after the Environmental Permit is in place (between the date Environmental Permit is obtained and 06.01.2018)
Permit for Use of Agricultural Land for Non-Agricultural Purposes	Provincial Directorate of Food, Agriculture and Livestock	Applied on 01.03.2017	-
Gökırmak River Diversion Project Approval	State Hydraulic Works (DSI) General Directorate and 2^{3}rd Regional Directorate	Final design approved by the DSI 23rd Regional Directorate on 11.11.2014 and by the DSI General Directorate on 14.11.2014	
Groundwater Use Permits	State Hydraulic Works (DSI)	Obtained on 15.03.2017	
Surface Water Use Permit	State Hydraulic Works (DSI)	Positive opinion obtained on 14.12.2016, a protocol needs to be signed between DSİ and AMI	
Positive Opinion of Ministry of Culture and Tourism	Ministry of Culture and Tourism	Obtained on 23.10.2012	
Permit for Purchasing and Using Explosives	Governorship of Kastamonu	Obtained on 04.01.2017	
Packaging Waste Disposal Agreement	Beste Geri Dönüşüm LTD	22.11.2016	
Protocol Approval for crossing of tailings pipeline section located under the 030-05 numbered state road	General Directorate of Highways (KGM) - 15th Regional Directorate	Obtained on 15.04.2015	Required for the section of tailings pipeline located outside the mining license areas and to ensure all permitting is in place for the section of the pipeline that cross under the state road.
Positive Opinion Letter for the tailings pipeline sections that coincides with Demirci HEPP drainage channel and with Gökırmak River	State Hydraulic Works (DSİ) - 23rd Regional Directorate	Obtained on 08.01.2014	Required for the sections of tailings pipeline that cross under Demirci HEPP drainage channel and with Gökırmak River
Protocol for the tailings pipeline section that coincides with Demirci HEPP drainage channel	Demirci Enerji Yatırım Üretim İnşaat ve Ticaret A.Ş.	As required by DSİ, a protocol will be in place prior to initiation of pipeline construction activities	DSİ's Positive Opinion Letter for the tailings pipeline sections that coincides with Demirci HEPP drainage channel and with Gökırmak River states that a protocol is required to be signed with Demirci Enerji Yatırım Üretim İnşaat ve Ticaret A.Ş.
Right of Way Agreements for the ETL	Energy Market Regulation Authority (EMRA)	Obtained on 28.04.2015	
Electricity License	BEDAŞ	Obtained on 28.06.2013	

Table 3-8 Forestry Permits

Project Unit	Status of Forestry Permit
Administrative buildings	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4120200070, dated 16.07.2014)
Closed Ore Storage	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4210200109-110, dated 30.06.2015)
Çorakoğlu WRD	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4120200119, dated 12.01.2016)
Gökırmak Diversion System	Forestry permit issued by Kastamonu Provincial Directorate of Forestry No:5220200095,Dated:17.02.2015
Downstream Coffer Dam	Forestry Permit obtained for DSİ 23rd Regional Directorate (No. 5220200095, dated 17.02.2015)
Upstream Coffer Dam	Forestry Permit obtained for DSİ 23rd Regional Directorate (No. 5220200095, dated 17.02.2015)
Spillway	Forestry Permit obtained for DSİ 23rd Regional Directorate (No. 5220200111, dated 10.06.2015)
Explosive Storage Area	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4120200108 , dated 10.07.2015) (Note that explosives will be transported daily and this area will not be used for explosive storage purposes)
Kepezkaya TSF and Kepezkaya TSF Surface Soil Storage Area	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4210200064, 4120200118, 4120200125, dated 16.07.2014, 19.11.2015, 28.10.2016)
Tailings Pipeline	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4120200077, dated 17.11.2014.
Küpeli Storage Area	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4210200109-110, dated 30.06.2015)
Open Pit and Related	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4210200109-110, dated 30.06.2015)
Ore Storage Area	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4120200123, dated 18.10.2016)
Process Plant	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4120200070, dated 18.07.2014)
Process Plant – Surface Soil Storage Area	Not required – Topsoil stripped from process plant was transported and stored in open pit surface soil storage area.
Bağdere TSF	Not obtained - Unit will be needed until year 4, month 9 of production. This requires that the construction of the Bağdere TSF commences approximately in Q3 of year 3 of production.
Bağdere TSF – Surface Soil Storage Area	Not obtained - Unit will be needed in year 4, month 9 of production. This requires that the construction of the Bağdere TSF commences approximately in Q3 of year 3 of production.
ETL	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4120200070, 4120200074, 4120200088, 4120200115; dated 18.07.2014, 18.07.2014, 31.07.2014, 30.09.2015 respectively)

A revised feasibility study for the Project was finalized in June 2017. According to the latest and most feasible design of the major units, final borders of some units extend outside EIA permitted boundary. Such capacity extensions can be integrated into the existing permits through provincial and national level EIA processes. As known, depending on the market conditions and advancement of the mine, the production strategy and scheme of mining projects change frequently. Thus, such capacity increases are inherently part of this industry. To date, within the scope of the Project, approvals from the regulatory authorities have been issued within a couple of months upon submission of necessary documentation.

According to the final design, the open pit and Çorakoğlu WRD require additional permitting. AMI commits that permit applications for these areas will be done after the construction is completed and in line with national legislation:

Currently, AMI holds required permits and approvals to initiate earthworks/construction/operation activities of the open pit and construction activities are ongoing. Currently, 999,139 m^2 of the open pit is included in the EIA permitted area. Following additional feasibility and design studies, the open pit design was modified. Accordingly, a portion of the ultimate pit will exceed the EIA permitted area and permitting will be required for an additional area of 133,276 m^2.

- Similarly, AMI holds all required permits and approvals to initiate earthworks/construction/operation activities of the Çorakoğlu WRD site and construction phase is currently ongoing. Following additional feasibility and design studies, the open pit design was modified. The current total footprint area of Çorakoglu WRD is 1988932 m2 and of this, 828,457 m2 is located outside of the EIA permitted area.

The Company holds a 22 April, 2014 dated special approval provided by General Directorate of Mining Affairs (MİGEM) for use of Çorakoğlu WRD site, as the site is not included in the scope of a mining license. Therefore, in order to obtain the above mentioned EIA permitting, MİGEM's approval for use of the additional 828,457 m2 area for WRD purposes must also be obtained.

According to the national EIA Report (Envy, 2014), the Project's annual ore production capacity is 1.6 Mt, whereas the FS report states a production capacity of 2 Mt. Regarding this issue, AMI obtained a special approval from the Ministry of Environment and Urbanization on 29.03.2017 that allows a production capacity of up to 3 Mt (as 2Mt+1Mt). The Ministry states in its approval letter that the revision is in compliance with the EIA Regulation.

A section of tailings pipeline is also located outside of the mining license areas. For construction and operation of this section, AMI obtained the following approvals from related authorities:

- Protocol Approval for crossing of tailings pipeline section located under the 030-05 numbered state road is obtained from General Directorate of Highways (KGM) - 15th Regional Directorate on 15 April, 2015.
- Positive Opinion Letter for the tailings pipeline sections that coincides with Demirci HEPP drainage channel and with Gökırmak River obtained from State Hydraulic Works (DSİ) - 23rd Regional Directorate on 08.01.2014.
- A Protocol to be signed with Demirci Enerji Yatırım Üretim İnşaat ve Ticaret A.Ş. for the tailings pipeline section that coincides with Demirci HEPP drainage channel will be in place, as required by DSİ.

3.4.3 Additional E&S Studies

Starting from 2015, AMI has completed or is currently conducting multiple environmental and social studies, some of which are in line with IFI requirements. These studies are listed below in Table 3-9 (note that a list of policies and Management Plans developed by AECOM, SRM, AMI and 3rd parties is presented in "Section 8.2"):

Table 3-9 Environmental and Social Studies Conducted for GCP

Company	Technical Documents Produced
Project Owner – AMI	(1) Asya Maden İşletmeleri Gökırmak Copper Mining Project Local Recruitment Procedure (2015) (2) Asya Maden İşletmeleri Gökırmak Copper Mining Project Grievance Procedure (2015) (3) Gökırmak Copper Project Feasibility Study (2015) (4) AMI Gökırmak Copper Mining Project Local Procurement Procedure (2016) (5) Gökırmak Copper Project – Feasibility Study (May 2017) (6) Gökırmak Copper Project – Updated Detailed Feasibility Study (July 2017)
AECOM	(1) Gökırmak Copper Project Preliminary Mine Closure Plan (2015) (2) Gökırmak Copper Project Environmental and Social Assessment and Management Review (2015) (3) Environmental and Social Management Plan for Gökırmak Copper Project (2015) (4) Progress Report for the Gökırmak Copper Mine Water Supply Project (2015) (5) Hydrochemical Characteristics and Water Quality Assessment Study for the Gökırmak Copper Project (2015) (6) Flora and Habitat Assessment Report for Gökırmak Copper Project (2015) (7) Visual Impact Assessment Report for Gökırmak Copper Project (2015) (8) Mine Water / Stormwater Management Plan for the Gökırmak Copper Project (2016) (9) Hydrogeological Characterization for the Gökırmak Copper Mine Project (2017) (10) Hydrogeological Impact Assessment Report (2017)
AMC	(1) Gökirmak Copper Project Pit Design and Schedule Optimization Report (2017) (2) Updated Detailed Feasibility Study of Gökirmak Copper Project (2017)
Discworld	(1) Operational Geology Standard Operating Procedures for Gökirmak Copper Project (2016-2017)
Envy	(1) Hanönü Copper Mine Capacity Increase, Mineral Processing Plant, Waste Storage Facility and Concrete Plant Project EIA Report (2013) (2) Hanönü Open-Pit Copper Mine Project, Project Description Report (2014) (3) Hanönü Open-pit Copper Mine Capacity Increase Project EIA Report (2014) (4) Hanönü Copper Mine Project Environmental and Social Impact Assessment Report (2015)
Geochemico	(1) Interim Assessment Report of Geochemical Aspects of The Hanönü Gökirmak Copper Project (2016) (2) ARD/ML Characterization of Rock Samples By Static Testing, Gökırmak Copper Project, Kastamonu (December 2016) (3) Final Report on Geochemical Characterization by Kinetic Testing of Lithologies at the Gökırmak Copper Project, Kastamonu, Turkey (December 2016) (4) Results of Mass Balance / PHREEQC Modeling of the Open Pit Sump and Lake at the Gökırmak Copper Project, Kastamonu, Turkey (July 2017) (5) Results of Mass Balance / PHREEQC Modeling of the Waste Rock Dump at the Gökırmak Copper Project, Kastamonu, Turkey (May 2017) (6) PHREEQC Modeling of the Kepezkaya Tailings Storage Facility Seepage at the Gökırmak Copper Project, Kastamonu, Turkey (June 2017)
Golder Associates	(1) Risk Assessment for Kepezkaya Tailings Storage Facility (2016) (2) Emergency Preparedness Plan for the Kepezkaya Tailings Storage Facility (2017) (3) Risk Assessment for Kepezkaya Tailings Storage Facility (April 2017) (4) Scoping Study for Alternative Disposals for TSF (May 2017)
MineRP	(1) Geotechnical Aspects for Gokirmak Copper Project, Volume I of III (2017)

Company	Technical Documents Produced
	(2) Technical Report for Gokirmak Copper Project, Ground Control Management Plan, Volume II of III (2017) (3) Geotechnical Standard Operating Procedures for Gokirmak Copper Project, Volume III of III (2017)
REGIO	(1) Gökırmak Copper Project Archaeological and Immovable Cultural Heritage Current State Impact Assessment Report (2017) (2) Gökirmak Copper Mine Project Intangible Cultural Heritage Report (2017)
RPS Aquaterra	(1) AMI Gökırmak Copper Project, Mine Water Management Report (2015)
SRM	(1) Asya Maden İşletmeleri Gökırmak Copper Mining Project Social Impact Assessment Report (2015) (2) Asya Maden İşletmeleri Gökırmak Copper Mining Project Stakeholder Engagement Plan (2015) (3) Asya Maden İşletmeleri Gökırmak Copper Mining Project Cumulative Impact Assessment Report (2015) (4) Asya Maden İşletmeleri Gökırmak Copper Mining Project Human Rights Policy (2015) (5) Asya Maden İşletmeleri Gökırmak Copper Mining Project Human Resources Policy (2015) (6) AMI Gökırmak Copper Mining Project Land Acquisition Procedure (2017) (7) AMI Gökırmak Copper Mining Project Livelihood Restoration Plan (2017) (8) AMI Gökırmak Copper Mining Project Influx Management Plan (2017) (9) Hanonu Development Workshop I (March 2016) (10) Hanonu Development Workshop II (June 2016)

3.5 Project Schedule and Workforce Requirements

The pre-commissioning period of the Project is estimated to take approximately 32 months and the operation period is anticipated to last a total of 11.3 years. The rehabilitation works/closure period on the other hand is expected to take 2 years, following the completion of mine operations. The Construction phase Project schedule is presented in Figure 3-12.

As of April, 2017, construction of all river diversion system structures (2 tunnels, and upstream and downstream cofferdams), waste haulage roads and the ETL are completed, whereas construction of the processing plant and overburden stripping operation are ongoing.

GCP’s construction phase personnel (incl. AMI and contractor personnel) numbers peaked at 432 and 406 in the years 2015 and 2016; whereas its estimated peak construction phase personnel number for 2017 will be 797 in December, 2017 and its ultimate peak construction phase personnel will be 798 in January, 2018. Change in construction phase personnel requirement from 2017 to end of the phase is presented in Figure 3-13.

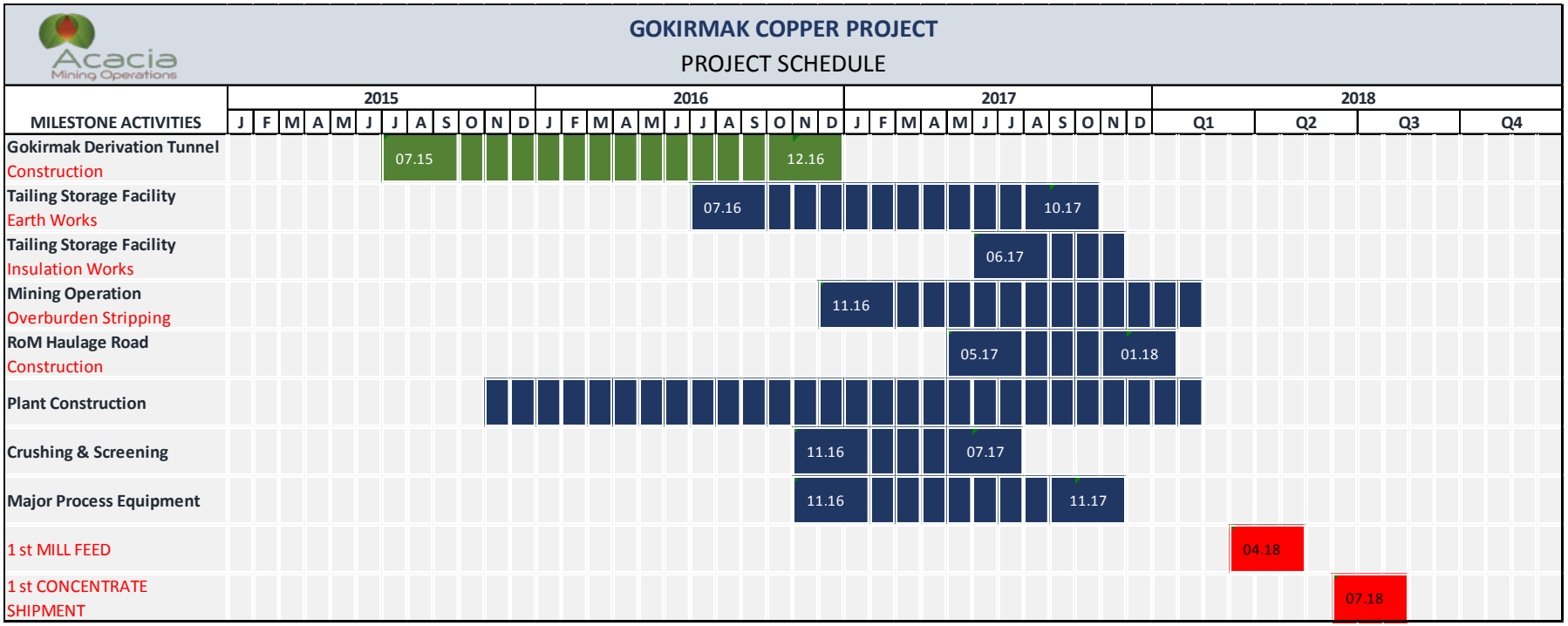


Figure 3-12 Project Construction Phase Schedule (AMI, 2017)

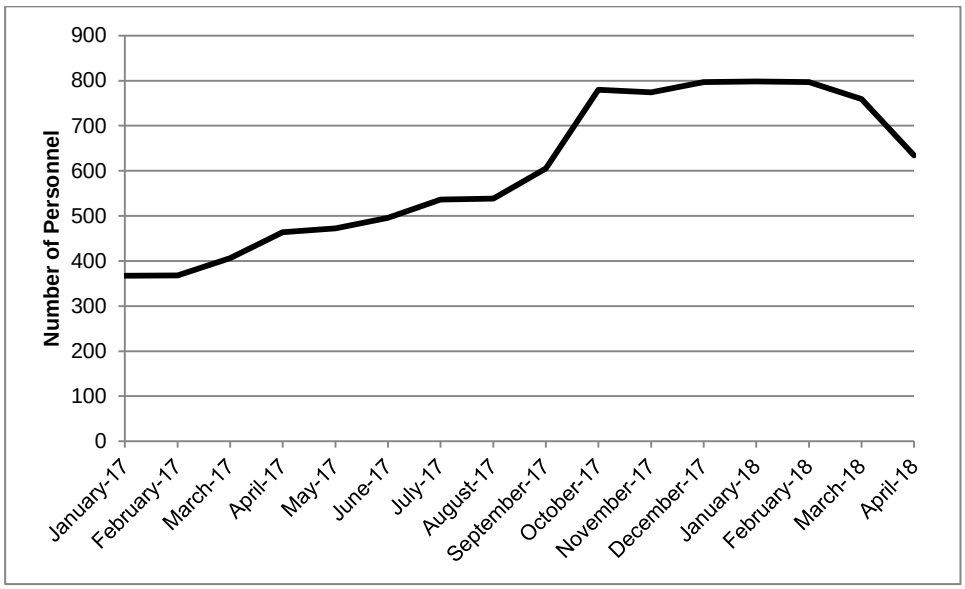


Figure 3-13 Construction Phase Personnel Requirement in 2017 and 2018

In addition, change in numbers of AMI's own employed personnel involved in construction of various Project units/components are provided in Figure 3-14 for the years 2017 and 2018. Peak worker numbers for construction of these Project units are as follows:

- Mine (open pit, WRD and related): 276 in April, 2018
- Process Plant: 532 in October, 2017
- TSF: 46 from November, 2017 to March, 2018
- Tailings Dam: 106 from March 2017 to April, 2017
- Ancillary Facilities: 14 from August, 2017 to March, 2018

It should be noted that number of contractor personnel is not included in this chart, since contractor personnel is employed for construction activities of various Project components in a temporally changing basis.

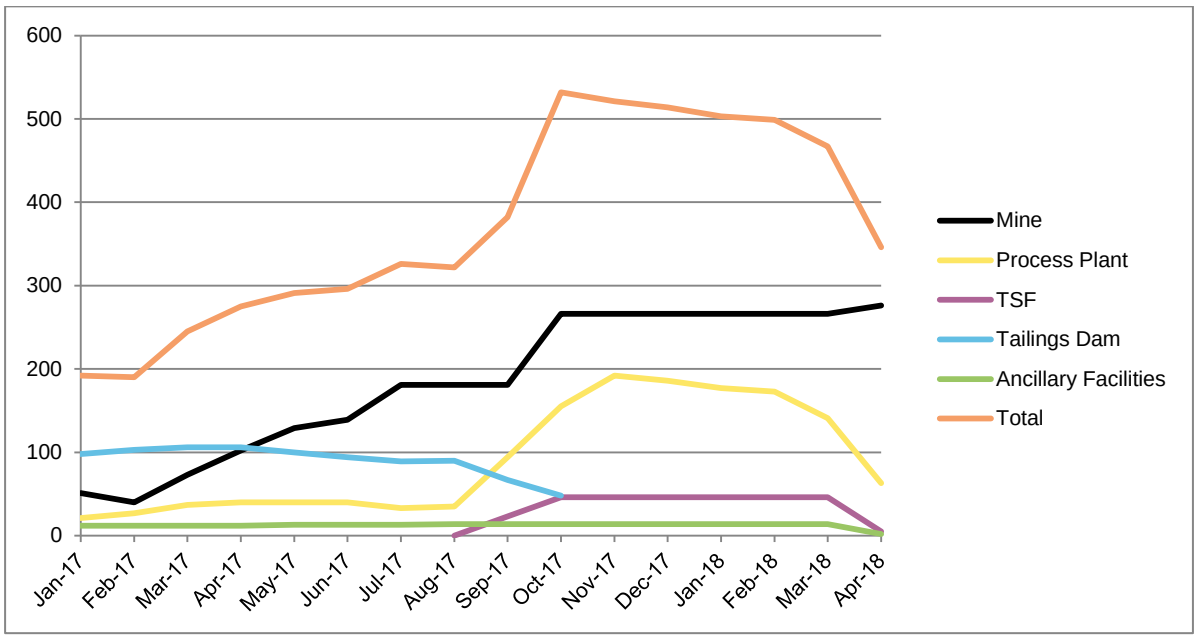


Figure 3-14 Construction Phase Personnel Requirement for Different Project Units in 2017 and 2018

As can be seen in Table 3-10, the peak personnel requirement during the operation phase of the Project will be 496, consisting of a total of 160 AMI personnel and 336 mining contractor personnel.

The mining operations at GCP are planned to be conducted approximately 338 days per year on a two-shift system with an 11-hour dayshift and an 7.5 hour nightshift in a 24 hour period, whereas the process plant operations are planned to be operated on a 24/7 basis, for approximately 49 weeks per annum with equal 8-hour shifts.

Table 3-10 Operation Phase Personnel Requirement

Department	Number of Employees
AMI Personnel	
General Management	8
Finance	7
Supply Chain	18
HR	20
HS & Environment	13
Community Relations	5
Mining Operations	32
Process & Maintenance	57
Acacia Mining Operations Total	160
Mining Contractor Personnel	
Management and supervision	15
Operators	250
Maintenance	41

Department	Number of Employees
OHS	7
Survey	4
Blasting	5
Support services	14
Mining Contractor Total	336
Project Total	496

Source: AMI HR Dept., 2017

4. PROJECT ALTERNATIVES

Project alternatives assessed during the planning and design stage of the Gökırmak Copper Project are described in this section. The Project alternatives assessment was based on the following sources:

- Project ESIA Report (Envy, 2015)
- Project Feasibility Report (AMI, 2015)

Appearance and therefore location of orebodies at a certain geological time are controlled by various regional and local geological factors such as tectonism, volcanism, lithology, alteration conditions and geomorphology and consequently due to requirement of conducting mining activities at that certain pre-established location, location alternative assessment is beside the point for the open pit.

The scope of alternative assessments consisted of the following subjects:

- Technology Alternatives (mining method selection, ore processing alternatives, tailings storage disposal alternatives)
- Location Alternatives (Waste Rock Dump alternatives, Tailings Storage Facility Alternatives)
- No Project Alternative

4.1 Technology Alternatives

Mining method and process alternatives comprise the scope of technology alternatives for a mine and alternative selection process considers technical aspects, environmental impacts and economical factors in a relative manner to determine the most feasible, environmentally sound and socially beneficial option.

4.1.1 Mining Method Selection

Open pit mining and underground mining are the main two alternatives for mining. The main determining factor for selection of mining method is the depth of the orebody from the topographical surface, in addition to the following other factors:

- Ore geology
- Ore structure (orientation)
- Ore grade and tonnage
- Geotechnical characteristics and quantity of the overburden material and surrounding wasterock
- Topography
- Mining operations economy

Comparison of environmental issues sourced from open pit and underground mining activities are presented in Table 4-1. As can be seen from this table, the main differences causing environmental concerns are the relatively large land use requirements of open pit mining, due to both impacts caused by the open pit area itself and the larger amount of waste rock and tailings generated by this method and management of closed, underground working spaces for underground mining, due to management difficulties of air ventilation, support and groundwater.

Table 4-1 Comparison of Environmental Issues for Open Pit and Underground Mining Methods

Environmental Aspect	Open Pit Mine	Underground Mine
Land Disturbance	Relatively large area	Smaller disturbed area than open pit mines
Waste Rock Disposal	Can require large area; involves trucking, runoff and leachate management, dusting and aesthetic considerations	Less waste rock than open pit mines, but may involve similar management considerations
Tailings	Tailings volumes generally larger due to large volume of ore processed	Tailings volumes generally smaller
Acid Drainage	May be associated with both mine and waste rock areas	May be associated with both mine and waste rock areas
Reclamation	Both mine and waste rock area can represent major concerns due to the extent of the waste rock and pit	Waste rock can be a concern, as can seepage or overflow of water from the mine workings
Land Subsidence	Not a concern	Can be a concern
Truck Noise	Truck traffic between pit and waste rock dumps and mill can be a serious noise problem	Normally not a concern
Vent Fan Noise	Not a concern	Requires careful consideration/mitigation
Blasting Effects	Noise and vibration can be a concern requiring careful management	Noise and vibration could also be a concern at underground mines, particularly when the mine workings are relatively shallow
Dust	Can be a concern due to pit operations, haulage roads and waste rock piles	Can be a concern due to haulage roads and waste rock piles
Mine Water	Mine water volume influenced by precipitation, surface and groundwater ingress. Elevated ammonium levels from blasting can be a concern. High sediment loadings are common. Mine water may contain metals and may have a low pH.	Mine water volume normally quite stable. Elevated ammonium levels from blasting can be a concern. High sediment loadings are common. Mine water may contain metals, and may have a low pH.

Source: Environment Canada, 2009.

The alternatives analysis for mining method selection for Gökırmak Copper Project was first limited by the existence of Taşköprü Dam and HEPP Project to be constructed by State Hydraulic Works (DSİ), which was formerly located closer to the Project mining operation areas. In order to facilitate construction and operation of this dam, underground mining method was determined as the first method for the Project. However, following studies proved that the ore potential in the area is considerably high and therefore, DSİ re-assessed the location of the Taşköprü Dam and revised the location of the dam due to high economical profit expected from mining activities. The Taşköprü Dam was then relocated 2 km away from the mining site, towards Gökırmak River's upstream. As a result, in consideration of the above listed criteria, especially the relatively shallow orebody, open-pit mining was determined as the mining method for the Project.

4.1.2 Ore Processing Alternatives

Ore Processing alternatives includes crushing, grinding, washing, filtration, sorting, sizing, gravity concentration, flotation, ion exchange, solvent extraction, electro-winning, precipitation, amalgamation, roasting, autoclaving, chlorination as well as heap, dump, tank and in situ leaching and most suitable alternative is selected based on assessment of ore characteristics, mining operations, metallurgy, environmental concerns and feasibility.

Production of a flotation concentrate containing the majority of copper mineralization generally represents the most cost-effective means for recovery of the primary copper sulphide minerals, whereas acid leaching using heap or agitated tanks can be successful on oxidized copper ore types and some secondary minerals. The predominant mineralization type of the Project deposit is chalcopyrite copper mineralization with minimal oxide or secondary copper minerals and therefore, production of a flotation concentrate using a concentrator has been selected as the overall process flowsheet.

In addition, options for on-site downstream concentrate treatment to produce a refined copper product were also considered in the initial assessment, with alternative techniques such as smelting, roasting, pressure and bacterial oxidation and specialized leaching processes. The overall copper resource characteristics and proximity to suitable established smelters in the general area limit the attractiveness of capital intensive downstream on-site processing facilities.

Some precious metal content, including Au and Ag, within the copper ore was also identified. However, these are considered to be of insufficient grade and therefore, specific and separate recovery techniques were not assessed.

In consideration of various characteristics of the ore and processing economy, following process stage alternatives were selected.

Comminution Circuit Flowsheet Components

- Three-stage crushing and screening circuit with both secondary and tertiary crushers operating in closed-circuit with screens.
- Crushed ore storage in twin fine ore bins equipped with reclaim feeders.
- Primary milling using a ball mill operating in closed-circuit with hydrocyclones.
- Rougher concentrate milling using a ball mill operating in closed-circuit with hydrocyclones.

Flotation Circuit Flowsheet Components

- Rougher conditioning using twin agitated tanks arranged in series.
- Rougher-scavenger flotation using a single train with the rougher concentrate reporting to the concentrate regrind circuit and the scavenger concentrate recycled to the rougher conditioning circuit. The rougher-scavenger tail stream represents the T1 tails and is directed to the tails thickener.
- Reground rougher concentrate conditioning using twin agitated tanks arranged in series.
- Cleaner 1 flotation and Cleaner 1-scavenger flotation is undertaken within a single flotation train. Cleaner 1 and Cleaner 1-scavenger flotation concentrates are directed to the Cleaner 2 and concentrate regrind circuits, respectively. The Cleaner 1-scavenger tail stream represents the T2 tails and is also directed to the tails thickener.
- Cleaner 2 and Cleaner 3 flotation is conducted within a single train, where the Cleaner 3 tail gravitates directly to the Cleaner 2 feed. Cleaner 2 concentrate is pumped to the Cleaner 3 feed box and Cleaner 3 concentrate represents the final concentrate stream.

Flowsheet Selection for Other Process Sections

- The concentrate dewatering flowsheet is comprised of concentrate thickening followed by filtration of the concentrate thickener underflow.
- A high-rate tailings thickener has been included in the overall flowsheet to promote better tailings consolidation characteristics and reduce the quantity of return water to be recycled from the relatively remote TMF.
- A “Spare” flotation reagents preparation and distribution system has been allowed for pending finalization of the flotation reagents addition regime and to allow for full-scale plant trials in the future.
- TMF return water is pumped to the process water reservoir via a rising main to which the overflow streams from both the concentrate and tailings thickeners are added.

4.1.3 Tailings Disposal Alternatives

A Scoping Study has been conducted by Golder Associates (May, 2017) to identify tailings disposal alternatives mainly in terms of cost effectiveness and to review the stability of the existing Kepezkaya TSF. The following tailings disposal alternatives were evaluated:

Co-disposal of the tailings Slurry within the Available Waste Rock Facility:

Co-disposal of tailings and waste rock is sometimes used to provide an integrated storage solution for mine waste, consisting of waste rock and tailings. In an idealised situation, the waste materials will be deposited in such a way that the tailings will fill some of the voids between the waste rock material, with an outer rockfill berm providing containment for the tailings. Although relatively simple in concept, from a practical perspective this poses a number of challenges for mining operations, including managing material transportation (tailings and waste rock), the safe placement thereof, the interfaces between the waste streams and management of supernatant water and seepage.

Based on the CAPEX and OPEX cost estimates, the cost for tailings and waste rock co-disposal is estimated at approximately USD 3.41 / t. Due to this high cost, the disadvantages associated with safeguarding the RSFs long term slope stability on composite lines cells in a highly active seismic region, the need for storm water and seepage management ponds, Co-disposal alternative is considered to be the least suitable of the mine waste disposal options investigated as part of this study.

Filtration of the Tailings and Stacking within the Kepezkaya TSF

This scoping level study was undertaken to provide a preliminary capital and operating cost estimate to produce filter cake by dewatering the tailings from GCP. The alternative assessed here is that the thickener underflow (thickened tailings) rather than being pumped out to the tailings storage facility would now be pumped to an agitated storage tank that would act as the filter feed tank. High pressure pumps would pump the tailings to two pressure filters.

The cycle time of a filter press can be broken down in three main phases. The first is the filling cycle, where the chambers (plates covered with filter cloths) are filled using the high pressure pumps. This is followed by an air blow cycle where compressed air is blown through the solids for final dewatering. The final phase is the cake discharge and re-start cycle (often referred to as technical time) where the pressure filter opens up to allow the cake to drop onto a conveyor. Before the filter press is closed and the cycle can re-start it is often necessary to wash the filter cloths and plates. The cloth wash water and filtrate are directed to a collection sump where this water which contains suspended solids is recycled back to the tailings thickener.

The filter cake conveyor below the pressure filters, transfers the filter cake to a second conveyor that discharged the material into a storage dome. The storage dome provides of two days of storage capacity, eliminating the need to transport and place the filter cake in the tailings storage during adverse weather conditions.

Based on the CAPEX and OPEX cost estimates,the cost for filtered tailings disposal is estimated at approximately USD 4.21 / t, which includes the cost for construction of an additional facility for filter cake storage).

Reinforcing the Dam Wall of the Kepezkaya TSF

A stability analyses was conducted, seismic settlement estimations were provided and the preliminary design of a stabilizing buttress downstream of the embankment on the southwestern side of the Kepezkaya TSF was investigated.

The section analysed is located within the centre of the valley along the southwestern embankment wall and is based on the section presented in the Hidrodizayn TSFdesign report. This represents the highest section of the embankment at approximately 55 m. The preliminary buttress design consists of a benched sections as shown in green in Figure 4-1, with an interbench slope of 2.2H:1V, similar to the current embankment downstream slope.

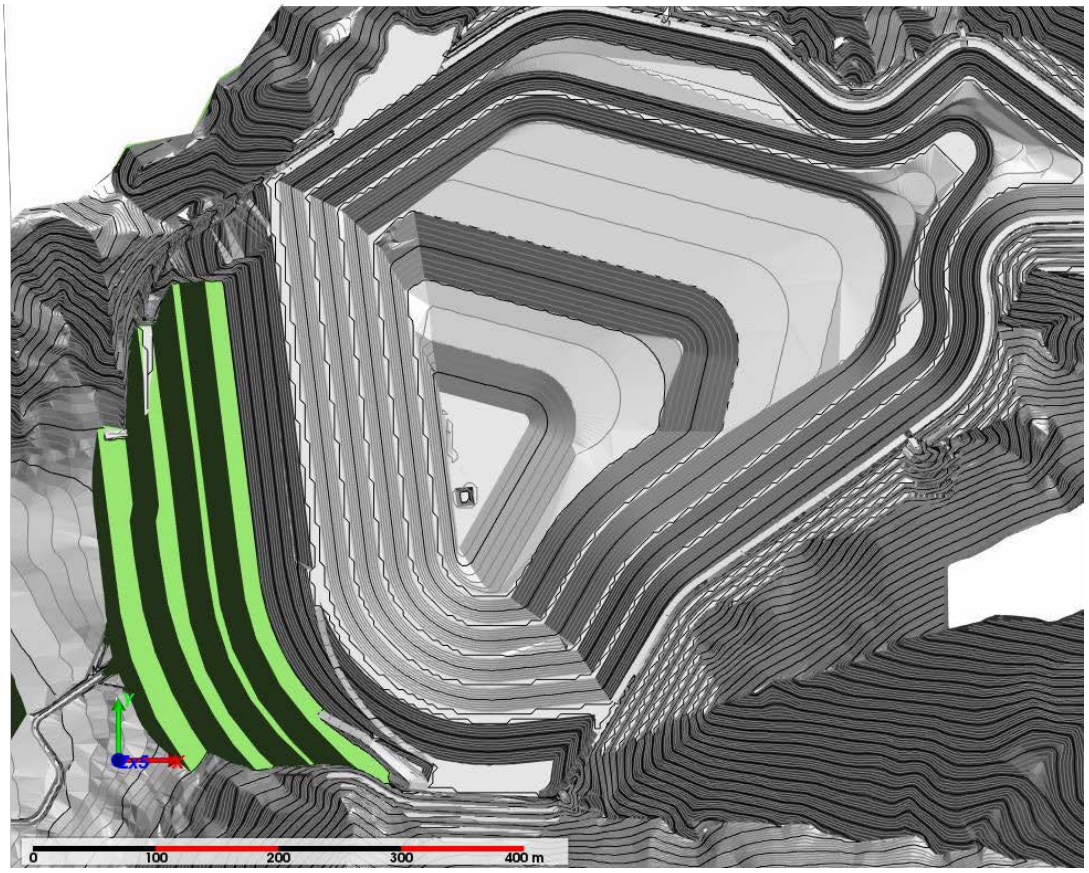


Figure 4-1 Preliminary Buttress Design

Based on the CAPEX and OPEX cost estimates, the cost for buttress construction and conventional tailings disposal is estimated at approximately USD 1.15 / t.

As this is a preliminary study, Goller suggested that during the detailed design stage for the buttress, further review of the material strength parameters, use of as- built embankment section for the analyses, and the sensitivity of an increase in phreatic surface to the FoS to undertaken. It is stated that additional seismic deformation analysis may also be undertaken to confirm the potential crest settlement.

Summary Results of the Scoping Study

Following general findings are reported by Golder, regarding RSF management alternatives assessed:

- From a CAPEX perspective, the most cost effective option is buttressing of the existing Kepezkaya TSF with conventional tailings disposal (at approximately USD 18.6 million, which includes construction of an additional TSF). This is followed by tailings and waste rock co-disposal (at a cost of approximately USD 33.8 million) and then filtered tailings disposal (at a cost of approximately USD 42.2, which includes the cost for construction of an additional facility for filter cake storage);
- From an OPEX perspective, the most cost effective option is conventional tailing disposal (at approximately USD 5.3 million). This is followed by tailings and waste rock co-disposal (at a cost of approximately USD 37.0 million) and then filtered tailings disposal (at a cost of approximately USD 45.4);
- The Northern and Western Rock Storage Facilities are from a topographical perspective unsuitable for co-disposal, due to the need to composite line the cells, the steep topography and the high seismic activity in the region;

From the stability work completed by Golder for the buttressed TSF, it will meet the necessary stability requirements as discussed.As a result of Golder's related studies including this scoping study for disposal alternatives and through consultation between the EBRD, Acacia Mining and Golder; the alternative of buttressing of the existing Kepezkaya TSF was selected. With this decision, results of the scoping study were used in the update of the Risk Assessment for the Kepezkaya Tailings Storage Facility (April 2017, Golder). The related report states on its conclusion that "the TSF has a sufficient factor of safety based on the conservative geotechnical parameters used in the stability analysis and the risk assessment for the operational phase is satisfactory".

4.2 Location Alternatives

The main layout alternative assessment conducted for the Project involves the TSF sites, whereas layout alternative assessment for the waste rock dump sites considered a more direct approach, mainly based on Project WRD requirements and the distance between the proposed waste rock areas and the open pit, since larger distances require longer haulage roads that result in more severe impacts and higher costs throughout the mine life.

Location selections of other Project units were mostly based on topographical inclination conditions and optimization of haulage and access roads routes. Explosives storage area on the other hand was located at an area where its potential impacts on other Project units and environmental and social receptors have the least significance. However, as stated previously, the Project's explosive need will be delivered daily and therefore, the explosive storage area will not be used.

4.2.1 Waste Rock Dump Alternatives

4.2.1.1 Gelberi WRD

In addition to the main WRD of the Project (i.e. Çorakoğlu WRD), a second WRD area located southwest of the open pit, namely the Gelberi WRD, was also considered within the scope of alternative assessment studies, as Çorakoğlu WRD's potential capacity was thought to be less than Project's total WRD requirement. The Gelberi WRD area has a footprint of approximately 85 ha and the haulage distance from the pit to this area is approximately 3 km.

In order to ensure the highest level of stability and economy, MineRP Eurasia, in collaboration of Middindi Consulting, conducted an optimization study for Çorakoğlu WRD and Gelberi WRD (Mine RP Eurasia, 2017). The main aim of this study was to optimize the WRD overall slope angles from 22° as per AMC's feasibility report (2015) to a steeper geometry. Prior to the optimisation, a desktop study on seismicity in Turkey was carried out. The findings indicated that the Project area is located in the vicinity of the North Anatolian Fault, with severe earthquakes that took place in the past. Thus, it was decided that a seismic coefficient must be included in all finite element and limit equilibrium analyses.

The WRD optimization included the following tasks:

- Desktop study of previous reports and design files to determine the original WRD geometry, derive WRD foundation properties and determine the natural topography at the dump sites.
- Derivation of an appropriate seismic coefficient to account for potential instability caused by earthquakes.
- Characterization of the waste material using empirical methods.
- Numerical modelling using the program Roscience *Phase2* to determine the maximum height of the WR.
- Limit equilibrium analysis using the program Rocscience *Slide* to determine the optimum WRD geometry and overall slope stability.

The summary of the study is presented in Table 4-2.

Table 4-2 Summary Results of WRD Optimization Study

Item	Unit	Çorakoğlu WRD				Gelberi WRD	AMC (2015)
		Option-1	Option-2	Option-3 (a)	Option-3 (b)		
Maximum Height	m	290	240	290	240	380	-
Bench face angle (BFA)	Degrees	37	37	37	37	37	27
Lift height	m	10	10	10	12	10	10
Step width	m	6.5	6	5	5	6.5	5
Overall slope angle (OSA)	Degrees	27	28	29	30	27	22

Source: Geotechnical Report For Waste Rock Dump Optimization at the Gökirmak Copper Project, Mine RP Eurasia, 2017

Of the assessed alternatives, Option-2 was selected for application, since its height is smaller and it does not require any additional toe reinforcement structures to ensure slope stability, unlike option-3 (a) and option-3 (b), which include gabion structures at toe. Option 2 also eliminates the requirement for an additional WRD for the 11.3 year mine life; i.e. it is established with this study and the Feasibility Report (June, 2017) that Çorakoğlu WRD's capacity is sufficient for the entire waste rock to be generated during the 11.3 years production period of GCP. Therefore, all environmental and social impacts associated with this WRD are also eliminated. Aspects regarding some of the more prominent impacts avoided are listed below:

- There will be no land use change and no vegetation clearing in the 85 ha footprint area and related impacts such as loss of habitats and loss of carbon capture capacity will not occur.
- Seepage and failure potential is limited to Çorakoğlu WRD. Avoidance of any potential seepage is especially important since Gelberi WRD area is located adjacent to the reservoir of the Taşköprü Dam, which will be built by DSİ.
- Air emissions will be more limited since the haulage distance between Gelberi WRD and the open pit is higher than the distance between Çorakoğlu WRD and the open pit. This will also contribute to less GHG emissions from haulage.

4.2.1.2 Küpeli WRD

Located approximately 350 m west of Çorakoğlu WRD, another assessed WRD alternative was the Küpeli WRD. As described in “4.1.1”, in order to facilitate construction and operation of Taşköprü dam, underground mining method was the first selected mining method for GCP. However, additional studies proved that the ore potential in the area is considerably high and therefore, DSİ reassessed and revised the location of Taşköprü Dam. Following this decision, open-pit mining was determined to be the more feasible option and as described in “3.4.1”, a Project Description Report was prepared for submission to MoEU. As a result, an EIA Not Required Certificate was secured on April 15, 2014. The area of this WRD is included in the scope of this Project Description File.

Since its entire footprint area is only 7 hectares (i.e only 3.52% of Çorakoğlu WRD), the decision of using this area as a WRD was reversed. The aim of this decision was to keep the entire WRD requirements limited to a single area, where any potential environmental impact or stability problem can also be limited to that area. The area formerly reserved as Küpeli WRD is now planned to be used as a storage area, highly likely as topsoil storage as stated by AMI, in the coming years of the Project, in which case its environmental impacts will be much more limited in scope and extent, as opposed to it being used as a WRD.

4.2.1.3 Other WRD Related Alternatives

An alternative not opted for the Çorakoğlu WRD was extending this WRD towards west in order to increase its capacity. The main purpose of this alternative was to completely eliminate the use of Gelberi WRD for further reduction of environmental impacts that will mainly be caused by land disturbance and by other issues to an extent, such as dust generation on the haul roads. However, design modifications to Çorakoğlu WRD proved that its final capacity is sufficient for the Project WRD needs.

Currently, the General Directorate of Highways is considering construction of a state highway in the region. AMI is assessing the potential of using the Project’s waste rock as fill material for the highway Project and therefore will consult with the Directorate. For this alternative to be realized, the acid rock properties, currently being assessed by Geochemico, and the geotechnical parameters to be assessed by the Directorate must ensure that the waste rock is appropriate for use as fill material. In the case this alternative is implemented, the Project’s WRD storage area requirements will be greatly reduced and the need for a stone pit, which would have provided for the filling material needs of the highway will either be smaller or will completely be eliminated.

4.2.2 Tailings Storage Facility Alternatives

In order to determine possible mine tailing storage facility locations, a siting study was conducted by Hidromark in 2013. The process followed for selection of the most appropriate site for mine tailings storage included the following:

- The locations which are regarded as the most likely to be appropriate for storage, are marked on a 1/25,000 scaled map;
- The locations are pre-assessed through detailed field surveys which involve a series of foot traverses and the location alternatives which were decreased to 5; and
- These 5 alternatives were assessed considering environmental, economic and technical issues.

The items used to assess the alternative locations for mine tailings storage areas include the following:

- Appropriate topography to provide the desired storage capacity;
- Convenient geological structure to establish safe structures;
- A highly impermeable base;
- Low groundwater table;
- Small catchment area;
- Low environmental impacts;
- Distance from residential areas;
- Suitable areas within the vicinity for the construction of mining facilities;
- Close proximity to the mining area so as to provide economic transportation;
- Accessibility;
- Appropriate side slopes so as to economize in site preparation through stripping and impermeability activities by balancing cut and fill;
- The ability for rehabilitation and safe abandonment once mining activities cease; and
- To ensure that the selected area does not have potential for the purpose of a future water resource, mining area, settlement area etc.

The alternative locations for mine tailing storage facility areas were determined by using a score table which was obtained by multiplying the rank and severity of the alternative appointed as one to four in the order of importance. First, the rank and severity are applied across all alternatives and then the score of the alternative is calculated. The evaluations were made on a basis of 100 total scores. The alternative which has the maximum score is preferred as the mine tailings storage area.

Assessed tailing storage facility area alternatives are shown in Figure 4-2, the rank and severity criteria for the alternatives is presented in Table 4-3 and the score table of the alternatives is represented in Table 4-4.

According to Table 4-4, selected TSFs of the Project will be Alternative 4 and Alternative 5 (Bağdere and Kepezkaya TSFs as described in section “3.3.3”).

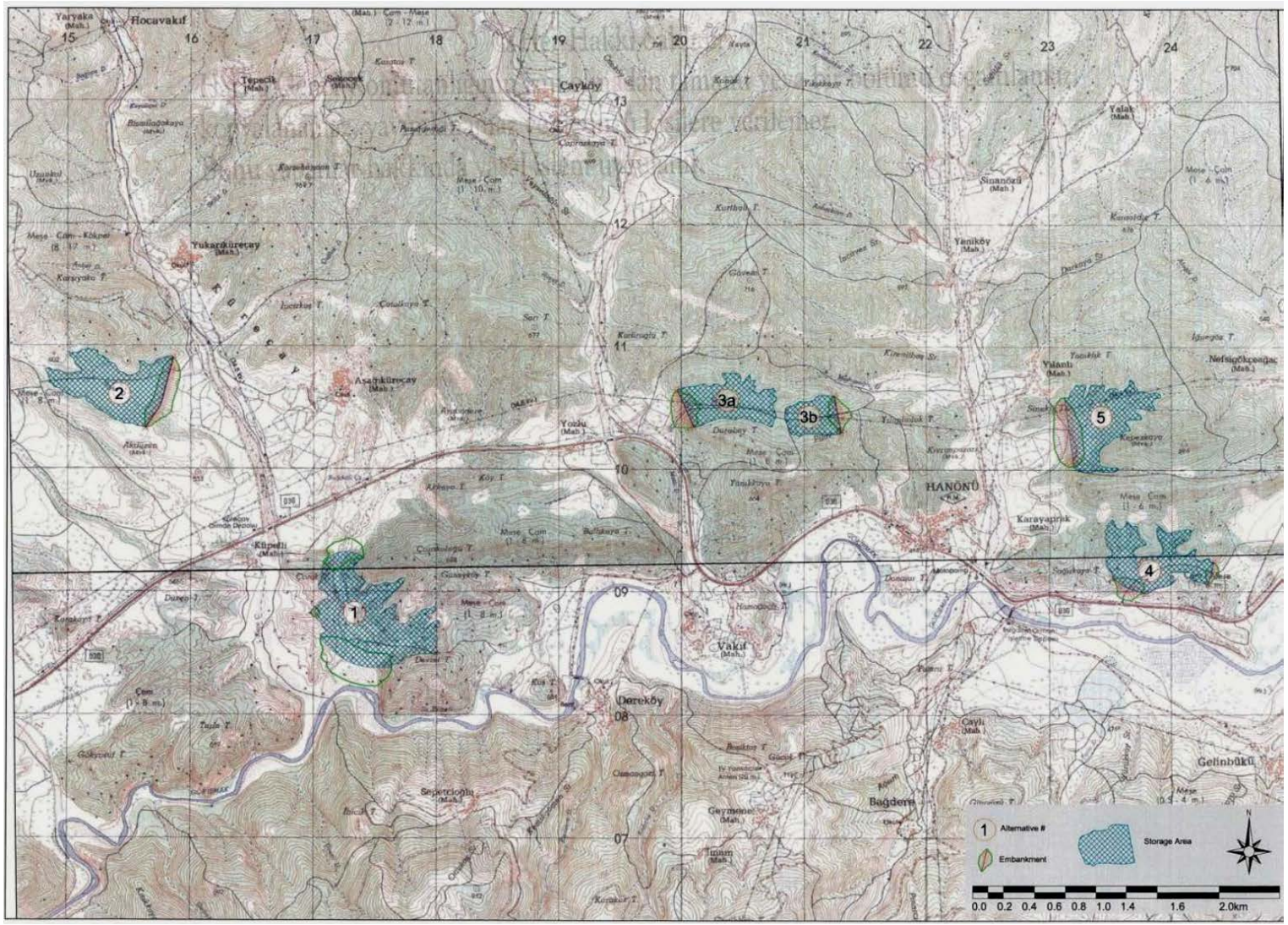


Figure 4-2 Assessed TSF Alternatives (Hidromark, 2013)

Table 4-3 Rank and Severity for TSF Alternatives

Code	Description	Rank					Severity
	Content	0	1	2	3	4	
A	Storage Capacity	<5 hm3	≥5 hm3 <6 hm3	≥6 hm3 <7 hm3	≥7 hm3 <8 hm3	≥8 hm3	4
B	Geological Conditions	inadequate	high cost to eliminate geological constrains	easy elimination	unimportant geological constrains	no geological constrains	3
C	Environmental Impact	Very high impact	High impact	Medium impact	Low impact	Negligible impact	4
D	Land Use	Existence of mining area, projects of other institution, settlement	Fertilized agricultural land	Agricultural land and dense forest area	Forest area	Unused state land, arid forest area, worthless area	4
E	Distance to settlement area	<100 m	≥100 m <500 m	≥500 m <1 km	≥1 km <2 km	≥2 km	2
F	Catchment Area	≥10 km2	<10 km2 ≥5 km2	<5 km2 ≥2 km2	<2 km2 ≥1 km2	<1 km2	1
G	Distance to mining area	≥20 km	<20 km ≥10 km	<10 km ≥5 km	<5 km ≥2 km	<2 km	1
H	Ease of operation	Not possible to excavate	Steep slopes, and very hard excavation	Medium slopes and hard excavation	Flat slopes and easy excavation	Very flat slopes and very easy excavation	2
I	Height of Embankment	≥100 m	<100 m ≥80 m	<80 m ≥60 m	<60 m ≥40 m	<40 m	2
J	The ratio of Bill of Quantity to storage volume	≥6 TL/m3	<6 TL/m3 ≥5 TL/m3	<5 TL/m3 ≥4 TL/m3	<4 TL/m3 ≥3 TL/m3	<3 TL/m3	3

Source: Hidromark, 2013

Table 4-4 TSF Alternatives Score Table

Code	Assessment	Alternative 1	Alternative 2	Alternative 3*	Alternative 4	Alternative 5
A	Storage Capacity (mill m3)	16	12	8	6	10
B	Geological Conditions	Deep alluvium. High cost for impermeability	Alluvium in base	No geological constrains	Alluvium not deep, no geological constrains	No geological constrains
C	Environmental Impact	No important environmental impact	Agricultural land. High groundwater table	Isolated area, low impact	Used for uncontrolled deposition of wastes, low impacts	Close to the settlement area
D	Land Use	Outside of the licensed area	Agricultural land	Full of forest area	Partly forest area, located in the licensed area	Forest area, located in the licensed area
E	Distance to settlement Area (m)	600	800	600	550	200
F	Catchment Area (km2)	4.6	2.4	0.51	0.72	1.01
G	Distance to mining area (km)	0.5	3.8	4.5	9.5	9.5
H	Ease of operation	Very flat slopes and very easy excavation	Very flat slopes and very easy excavation	Steep slopes, hard rock formation, very hard excavation	Flat slopes and easy excavation	Very flat slopes and very easy excavation
I	Height of Embankment (m)	40	45	65 + 50	45 + 30	55
J	The ratio of Bill of Quantity to storage volume	27.2 / 6 = 4.5	28.1 / 8 = 3.5	42.3 / 8 = 5.3	21.7 / 6 = 3.6	36.0 / 10 = 3.6
TOTAL		61	64	54	66	69

* Alternative 3 corresponds to Alternative 3a in Figure 4-2, Alternative 3b was not considered within the assessment.

Source: Hidromark, 2013

4.3 No Project Alternative

According to Macquarie Bank, global industrial output was over 2% in the second half of 2016 and that the main driver behind this improvement in industrial production is the improvement in mining, oil and utility output. Growing economies will certainly help metals that are heavily used in especially infrastructure projects and copper is one such metal that is being intensively used for these purposes. Positive effect of similar factors is expected to be increasingly felt in the next 3 years to 2021, at which point Wood Mackenzie forecasts above average copper demand growth close to 2% (Global Copper Long-term Outlook Q1 2017).

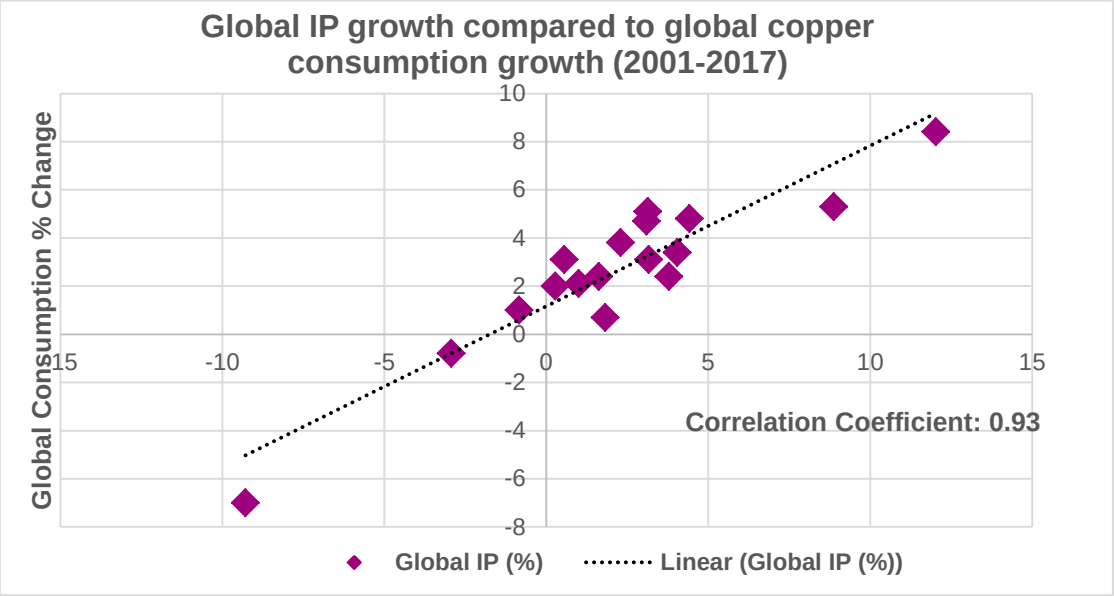


Figure 4-3 Relation Between Growth of Industrial Production and Copper Consumption

Base case mine production from existing mines, those currently under construction, and development projects with a high probability of completion, are expected to keep the market in balance until 2020 as reported by WoodMackenzie. At this point mine production capability will have reached 21.5 million tonnes per annum with about 1.5 million tonnes coming from probable projects. From 2020 onwards, base case mine production is expected to decline due to reserve depletion, and will fall to 18 million tonnes by 2025 and 14.5 million tonnes by 2030. This means that after the peak is reached in 2020, base case production capability will fall at an average rate of about 3.1% per annum until 2025. From 2020, demand will again exceed supply, and a demand gap is forecast to emerge. This gap will need to be filled with highly probable, probable, and possible projects. By 2025 this gap will have grown to 6 million tonnes, and by 2030 it is forecasted to reach 9 million tonnes (See Figure 4-4).

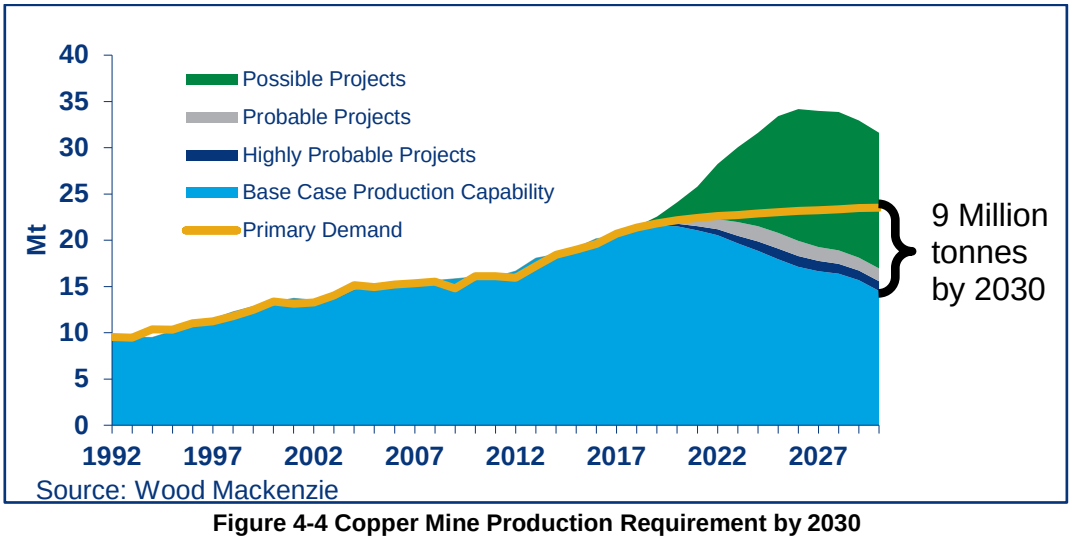


Figure 4-4 Copper Mine Production Requirement by 2030

The industry cost curve is expected to continue to rise in the long run due to declining copper ore grades and the end result of this is expected to be a higher copper floor price.

Between 2018 and 2029 global industrial production is forecast to grow by an average of approximately 2.6% per annum. Growth within the Organization for Economic Co-operation and Development (OECD) on the other hand is forecasted at approximately 2.0% per annum, while non-OECD growth is forecast to average about 4.0% per annum. Historically and as evident from Figure 4-3, global economic growth and growth in copper consumption have maintained a positive correlation. Copper demand is therefore forecast to rise by approximately 1.6% per annum for the period 2018 to 2029, while refined copper production is forecast by Wood Mackenzie (Global Copper Long-term Outlook Q2 2017) to rise by 0.5% per annum.

According to the last monthly Copper Sector Report of Tukey, the country's foreign dependency in terms of raw material is very high at 95%, which clearly indicates a significant need for additional copper ore production (Istanbul Ferrous and Non-Ferrous Metals Exporters Association, June 2017). On the other hand, it is stated in the Copper in World and Turkey Report that Turkey's copper ore production only corresponds to 0.4% of the total production in the world, despite its reserves' copper content reaching up to 3.79 million tons (MTA, 2016).

The Project Feasibility Report (June, 2017) states that; based on the metallurgical results provided, the market will classify the AMI concentrate as a clean and relatively good grade copper concentrate. Based on these results, AMI's discussions with a number of smelters including ones AMI is in advanced talks regarding long term agrements and the current state of the copper concentrate market, AMI does not expect any major problems in marketing the GCP copper concentrates.

In conjunction with the general copper sector information provided above, and in consideration of the fact that the market will classify the AMI concentrate as a clean and relatively good grade copper concentrate, opting for No Project Alternative will result in following:

- A total of 22Mt of ore at 1.50% Cu will not be produced. As stated above, the country's foreign dependency in terms of copper raw material is very high at 95% and in case "No Project Alternative" is selected, the copper to be produced by GCP will have to be either exported or supplied from other copper mines in the country, which may or may not have the same level of E&S assessments and safeguards in place, since GCP's E&S assessments and management are based primarily on international standards.
- An investment with a total capital cost estimated at US$250.0 million will not be made, which in turn will not provide benefits for multiple sectors and businesses in the supply chain.
- The US $36.9 million (US$0.06/lb) expected to be paid for royalties and US$79.2 million (US$0.13/lb) estimated to be paid as income tax in the entire mine life will not be paid to the state.
- Direct employment of 798 personnel (at peak) during the construction phase and 496 personnel (at peak) during the operation phase will not be provided. As stated in the SIA, employment opportunities are especially important for local communities and employment opportunities to be provided to local communities constitute the majority of total employment that will be provided.
- The total operating cost of GCP is estimated to be US $266.8 million. This number includes costs for services and products to be procured regionally and locally. Therefore, indirect national and local scale economic benefits and subsequent employment opportunities caused by procurement of services, equipment and materials will not be achieved.
- AMI has been providing Hanönü Municipality, the Family Health Center, Forestry Sub-directorate, District National Education Directorate and other governmental authorities in the area with resources and machinery for various infrastructure development projects such as road rehabilitation and construction of recreational areas and parks. In the case of No-Project Alternative, infrastructure development, emerging as another local scale indirect benefit that will be sourced through Project infrastructure development activities and provision of assistance to local authorities, will not be achieved.
- Similarly AMI has been providing resources and training to local communities, including specifically catered assistance for local women. In the case of No-Project Alternative, this type of indirect assistance will not be provided. Some of the planned social responsibility projects are; construction of an alternative water supply line for Sepetçi, construction of Yılanlı mosque, construction of Dereköy dining hall, construction of Bağdere townhouse and fencing the Dereköy cemetery,

- The Project will be developed in compliance with EBRD Environmental and Social Policy (2014) and PRs. In this sense, it will be a project that can form an example and benchmark for current and future businesses as well as environmental, social and health and safety for authorities. In the case of No Project Alternative, this opportunity will not be realized.

In the absence of the Project, the identified potential environmental and social impacts will not take place. However, above-mentioned benefits associated with the Project will also not be achieved. Considering that the Project's environmental and social impacts will be managed by the mitigation measures proposed by this ESIA study, the Environmental and Social Management System and related E&S management plans, the Project's environmental and social impacts are assessed to be manageable in a sustainable manner and therefore, due to the above mentioned benefits and considering the world general copper outlook and the need in Turkey for copper ore production as described above, the Project implementation alternative is preferable to the no Project alternative.

5. BASELINE CHARACTERISTICS

Detailed descriptions of the physical environment of the Project area, its vicinity and its general region are provided in this Chapter. The chapter consists of the following sections:

- Topography
- Land Use and Soil
- Geological Characteristics
- Climate and Meteorology
- Air Quality
- Noise and Vibration
- Water Resources
- Mining Waste Characteristics
- Biodiversity
- Cultural Heritage

It should be noted that some sections of the impact assessment (e.g. greenhouse gas emissions, wastewater and non-mining waste, health and safety), which is provided in the next chapter, includes baseline information as an integrated part of the assessment to provide a more compact and comprehensive assessment.

5.1 Topography

The Project site is located in Sepetçioğlu Quarter of Hanönü District of Kastamonu Province. Most of the open-pit area is located on a hilly/mountainous terrain. Following the completion of mining activities, the elevation difference will be around 600 m from toe to crest of the pit.

5.2 Land Use and Soil

Information provided in this section of the Report is based on the Geographical Information Systems (GIS) analyses done using the land use and soil database of the former Turkish General Directorate of Rural Affairs, Coordination of Information on the Environment (CORINE) Land Cover System (2012). Additionally, results of the sampling and analyses studies and site observations done by AECOM have been used for the soil quality assessments. It should be noted that the Project initially involved an explosive storage area as a Project component but this facility has then be taken out of the current feasibility design, as the explosives will be transported daily from Çankırı province according to current planning. However, the information on land use and soils and the relevant maps given below reflects the layout when the explosives storage area was included in the design (thus includes the 3.3 ha area allocated for explosive storage, which will not be constructed in the scope of the Project).

5.2.1 Land Use

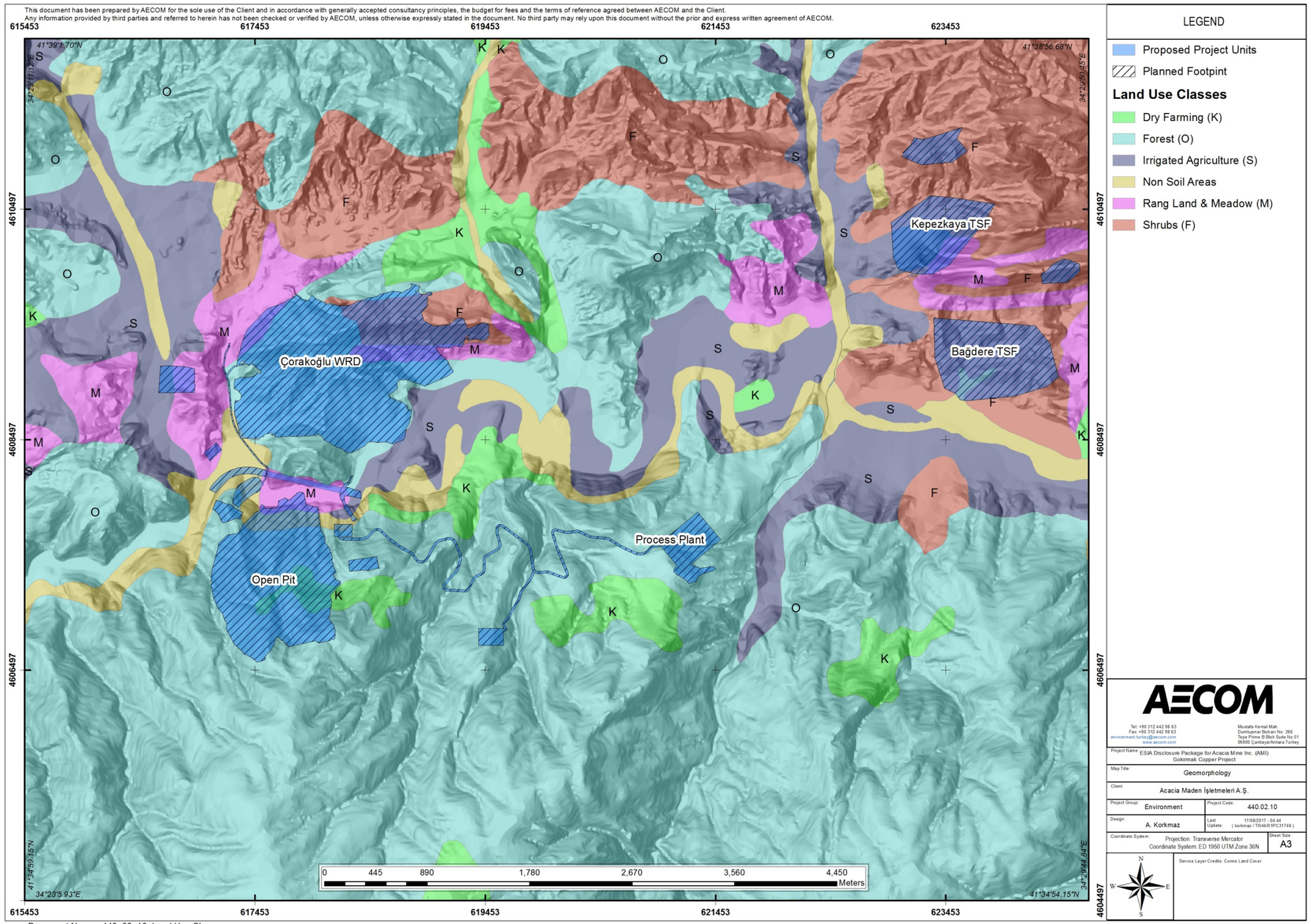
In the land use analyses, GDRS database (1993) has been used to represent the previous site conditions and CORINE (2012) database has been used to represent the current site conditions. For the analysis of previous conditions, a land use map of the Project Area (see Figure 5-1) has been developed using the “current land use” data acquired from the 1/100,000 scaled maps prepared by the former General Directorate for Rural Services (GDRS, 1993) that served under the Ministry of Food and Agriculture. According to this map, forests and shrubbery were the main land use types for the Project Area around 20 years ago. When the findings of the analyses done using CORINE (2012) database is compared to the findings of GDRS analyses (see Table 5-1), it is seen that the forests and shrubbery are still the main land use type in the current situation, while agricultural area and pasture lands have narrowed down and the area of forests has increased within the last 20 years period.

Table 5-1 Land Use Distribution of the Project Area

Land Use Type	GDRS (1993)		CORINE (2016)	
	(ha)	(%)	(ha)	(%)
Dry Farming	129.8	26.6	72.1	14.8
Irrigated Agriculture	13.5	2.8		
Forests and Shrubbery	306.3	62.9	415.2	85.2
Pasturelands	19.3	4.0	0	0.0
Others (e.g. non soil areas)	18.4	3.8	0	0.0
	487.3	100.0	487.3	100.0

Most of the open pit area corresponds to forest land (nearly 70%), while the remainder corresponds to mainly agricultural areas and limitedly shrubberies. Most of the Çorakoğlu WRD area is also located on forest land (around 80%), while some of the area correspond to agricultural lands and shrubberies as well. Kepezkaya TSF is located partly on forests and partly on agricultural lands. Bağdere TSF is predominantly located on shrubberies, which had been partially used as domestic waste dump site in previous years. Also, a limited portion of Bağdere TSF area has been allocated to a cemetery that has not been used in the recent years. According to expropriation data, ETL route passes predominantly through agricultural area, while the remainder passes through forests and shrubs and rarely through other types of land uses including pasturelands, water bodies, etc.

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



Document Name : 440_02_10_Land Use Classes

Figure 5-1 Land Use Map of the Project Area (GDRS, 2013)

5.2.2 Major Soil Groups, Land Use Capability Classes and Erosion Degrees

In this Section, major soil groups, soil capability classes and erosion degrees of the Project Area have been evaluated based on the GDRS database.

5.2.2.1 Major Soil Groups

Distribution of the soils within the Project Area according to their major soil groups is provided in Table 5-2 and shown in Figure 5-2.

Table 5-2 Distribution of Soils within the Project Area According to Major Soil Groups

Major Soil Group	Area (ha)	Percent (%)
Brown Forest Soils	324.9	66.7
Non-calcerous Brown Forest Soils	124.7	25.6
River Beds	18.4	3.8
Colluvial Soils	15.8	3.2
Alluvial Soils	3.4	0.7
	487.3	100.0

Characteristics of the major soil groups that have been identified within the Project Area are given below.

Brown Forest Soils

These soils have high calcareous content, their reactions can be either alkaline or neutral and they are either granular or blocked with round corners. They have an A, B, C soil profile; with a well-developed, porous A horizon and a poorly developed, brown or dark brown, granular or with a rounded angular block structured B horizon. Clay deposition does not exist or may occur in small amounts in B horizon. The borders of these horizons are transitional and gradual.

Non-Calcareous Brown Soils

These soils are also profiled as A, B, C soils. They are brown or light brown in colour, with dispersible topsoil and pale reddish brown B horizon. A wash-out is present and its topsoil character is more acidic than its subsoil, where free carbonates can be detected in trace amounts. The parent material is gravelly, sandy and clayey deposits as well as calcareous sandy clay and sandy clay stones. The general existing natural vegetation cover is weed with a mixture of weed and bush throughout some areas.

Colluvial Soils

This material is generally found at the foot of steep slopes and at the mouth of the valleys. They are profiled as young soils (horizon A), meaning that they are formed on materials that are transported and that have accumulated due to gravity, landslide and/or tributary streams. Additionally, although this soil is similar to the upper section soils in terms of characteristics, the gradation of main material is either lacking or insufficient. Their different layers have different particulate sizes, which can visually be identified in the profile, in accordance with intensity of precipitation or surface flow and inclination degree. As opposed to alluvial soils, these layers are not parallel and are not regular. The basic color of the colluvial soils depends entirely on the parent material. There is generally good drainage within these soils due to both inclination and texture and no sodicity and saltiness problems are experienced. The problems encountered in these soils stem from their coarse texture, stone size content, presence of inclination and exposure to floods. They are not specific to any climate or vegetation and therefore their vegetation cover can be diverse and they are distributed throughout the Earth.

River Beds

The rivers' flooding zones are covered with materials such as sand, gravel and debris. They do not contain soil materials as they are exposed to wash-out with flood water.

As can be seen in Figure 5-2 where the major soil groups of the Project Area are provided;

- Most of the open pit area lies on non-calcareous brown forest soil group, with a smaller portion on brown forest soil and some portion on river bed.
- Kepezkaya TSF is partially on brown soil group and on colluvial soil groups.
- Almost all of Bağdere TSF is on brown soil group, with a smaller portion of it on river bed.
- Çorakoğlu WRD sits on brown forest soil.

Alluvial Soils

These young and deep soils are made up of stream and lake originated deposits with both A and C horizons as well as various layers in its profile depending on the incoming sediment load. They are formed on fresh residue deposits and their heterogeneous mineral composition is contingent on lithological composition of the river basin, in addition to the overall erosion and accumulation phase which accumulates over time. There are no or very little distinct horizoning in the profiles.

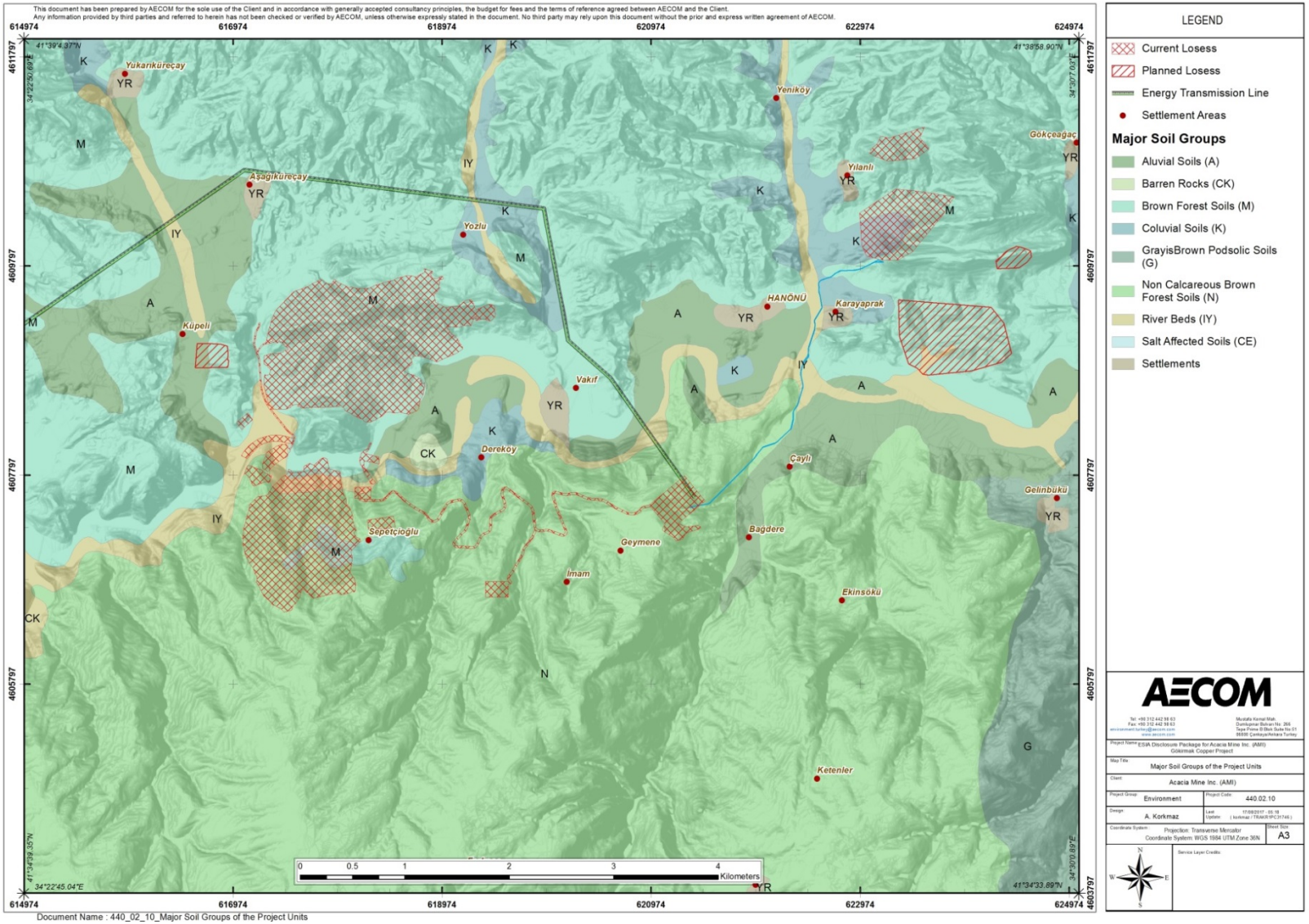


Figure 5-2 Major Soil Groups of the Project Units

5.2.2.2 Soil Capability Class

The general definitions of soil capability classes used by the Ministry of Food, Agriculture and Livestock are provided below in Table 5-3.

Table 5-3. Soil Capability Classes and Arability

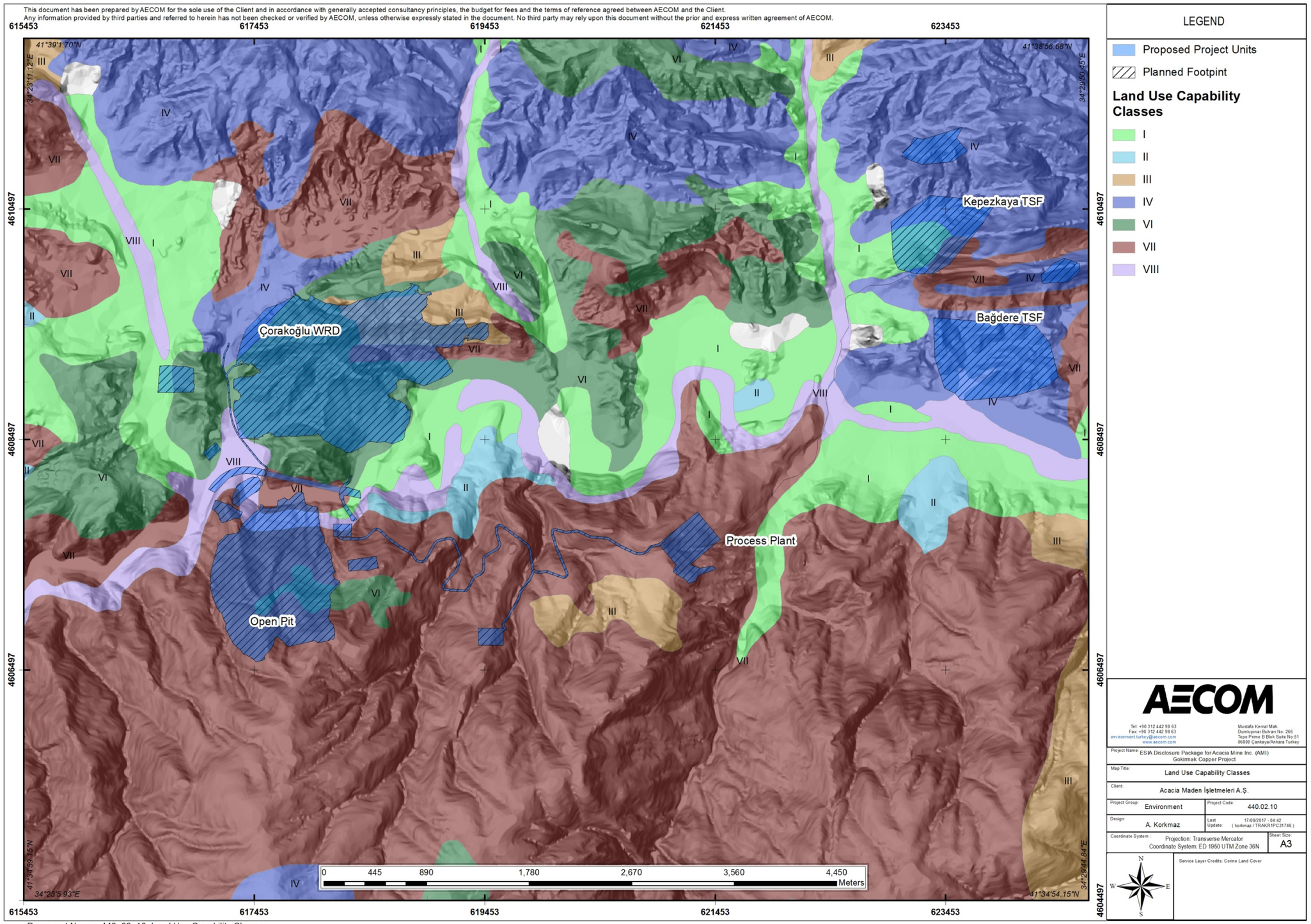
Capability Class	Arability	Factors Limiting Agriculture
I	It is arable for many crop types.	There is no or little limitation.
II	It is suitable for long term cultivation of several types of crops.	Special mitigation measures are required for soil and water loss.
III	It is suitable for the cultivation of specific crops that provide special mitigation measures. Generally, it needs special care during agricultural use.	It is prone to erosion and artificial drainage is required during cultivation.
IV	With suitable ploughing, some special agricultural crops can be cultivated. Generally, it needs special care during agricultural use.	There are serious limitations related with soil depth, stone content, humidity and inclination.
V	This class includes soils that are even or slightly inclined, stony or very moist. These are not suitable for ploughing and cultivation. Generally they are used for meadow or forestry area.	They have weak drainage and a structure not suitable for ploughing.
VI	This is not suitable for ploughing and cultivation. They are mostly used as pasture and forestry area.	Very serious limitations are present owing to inclination and shallow soil.
VII	It is not economic for agricultural activities; however it is suitable for weak pasture or afforestration areas.	There are limitations owing to shallow soil, stone content, inclination and erosion.
VIII	It is not suitable for vegetation. It can be used for recreational purposes or as wild life protection area.	It is lacking soil.

According to the analyses done based on GDRS database, the majority of Project units are located on soils corresponding to Classes IV, VI and VII. No soils having Class III capability is present in the Project Area. Soil having Class I and III capabilities cover only a limited area. As can be seen from Figure 5-3, Çorakoğlu WRD is mostly on Class VI, with some sections on Class III and Class VII. Most of the Kepezkaya TSF area correspond to soil capability Classes of I and IV, whereas Bağdere TSF area corresponds mostly to Class IV. Distribution of soil capability classes within the Project Area is provided in Table 5-4.

Table 5-4 Distribution of Soils within the Project Area According to their Land Use Capability Classes

Land Use Capability Class	Area (ha)	Percent (%)
I	24.2	5.0
II	0.0	0.0
III	34.6	7.1
IV	100.1	20.6
V	0.0	0.0
VI	164.6	33.8
VII	145.4	29.9
VIII	18.0	3.7
Total	**487.3**	**100.0**

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



Document Name : 440_02_10_Land Use Capability Classes

Figure 5-3 Land Use Capability Classes of Soils within the Project Area

5.2.2.3 Erosion Degree

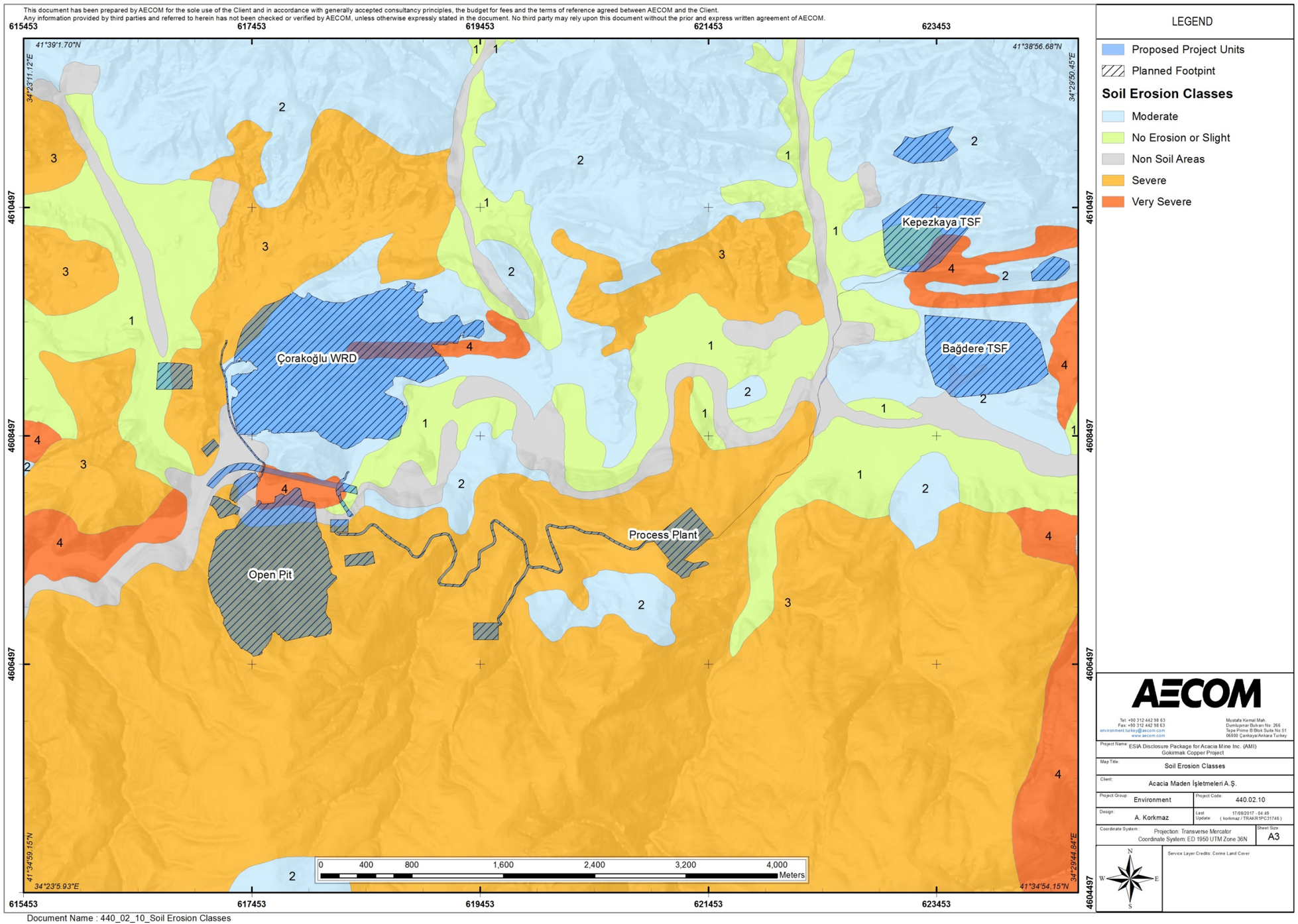
Erosion degrees of the soils have been identified based on the GDRS database, which classifies erosion degrees under four degrees as “Degree 1: None or very little”, “Degree 2: Moderate erosion”, “Degree 3: Severe erosion” and “Degree 4: Very severe erosion”. Distribution of soils within the Project Area according to their erosion degrees is presented in Table 5-5. Erosion degree map of the Project Area is provided in Figure 5-4 and the key findings of the analyses done are summarized below:

- Very severe baseline erosion conditions (Degree 4) are observed at the northern boundary of open pit; southeastern part of Kepezkaya TSF; and along a rectangular line starting from the center towards the eastern side of Çorakoğlu WRD.
- Significant portion of the Open Pit is classified under 3rd degree erosion class while its extension to the north along the Gökırmak River banks is classified under 2nd and 4th degree erosion classes.
- Çorakoğlu WRD is largely represented by 2nd degree erosion class whereas the western boundary is partially classified under 3rd degree erosion class. Part of the Çorakoğlu WRD to the eastern boundary is represented with 4th degree erosion class which its areal distribution was identified to be relatively low compared to the extent 2nd degree erosion zones.
- Kepezkaya TSF area was identified to show gradual change in erosion classes in direct relation with the topography. Relatively high portions located to the southeast boundary of the TSF are classified under 3rd degree erosion class while the remaining areas are represented by 1st, 2nd and 4th degree.
- Bağdere TSF area is classified under 2nd degree erosion class. Relatively small portion of the area is characterized by non-soil zone which corresponds to southern end of the TSF.
- Process Plant is classified under 3rd degree erosion zone.

Table 5-5 Distribution of Soils within the Project Area According to their Erosion Degrees

Erosion Degrees	Area (ha)	Percent (%)
No or Slight Erosion (1st Degree)	19.3	4.0
Moderate Erosion (2nd Degree)	278.5	57.1
Severe Erosion (3rd Degree)	138.4	28.4
Very Severe Erosion (4th Degree)	32.8	6.7
Non-soil Areas	18.4	3.8
Total	**487.3**	**100.0**

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



Document Name : 440_02_10_Soil Erosion Classes

Figure 5-4 Erosion Degree Map of the Project Area

5.2.3 Soil Quality

In order to determine the baseline soil quality (prior to commencement of construction activities) of the Project Area and its vicinity, soil sampling was conducted at 3 locations in the sampling study conducted for the national EIA and at 15 locations in the sampling study conducted by AECOM.

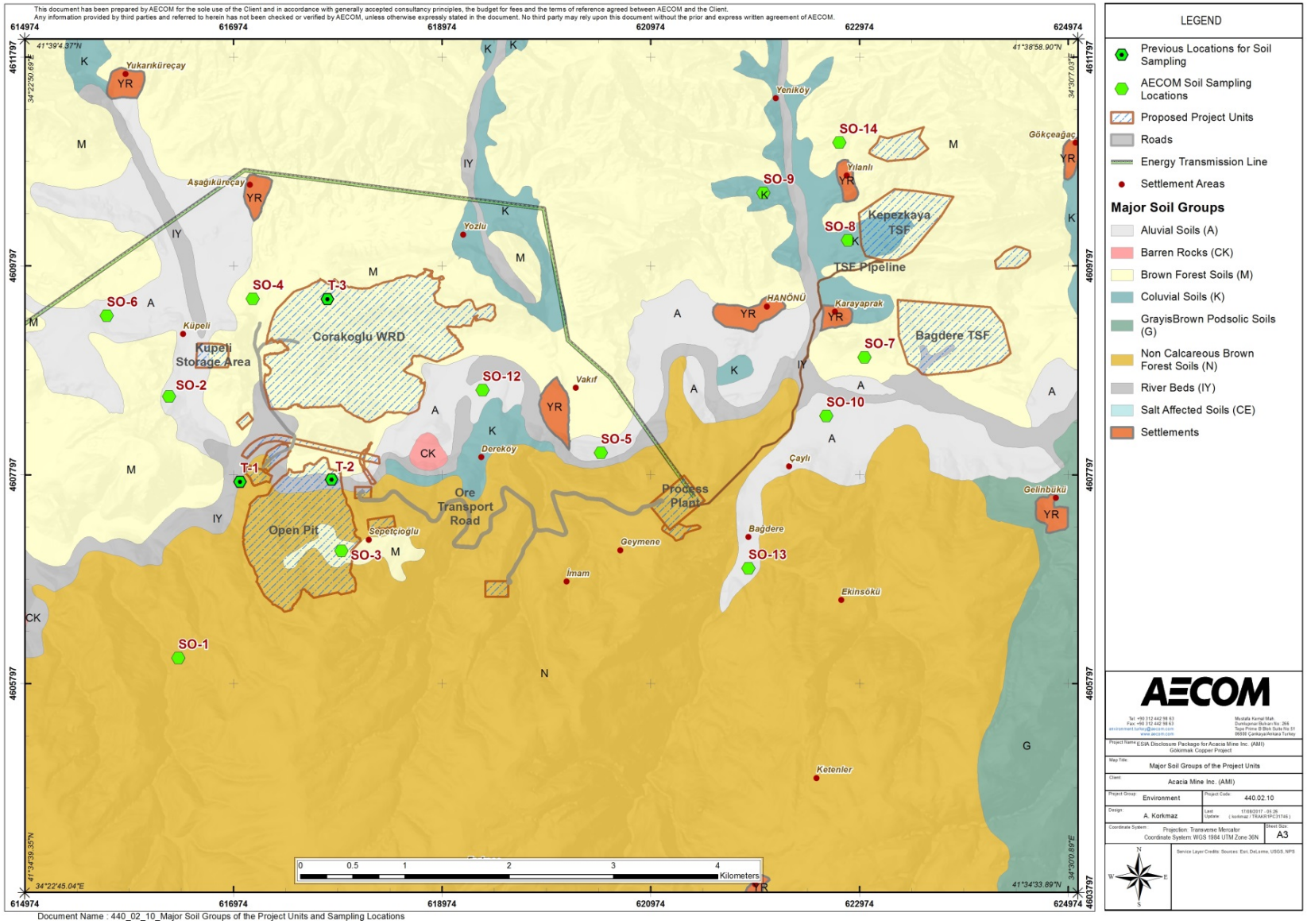
Soil sampling locations were selected to represent different soil groups as well as the existing land use classification. Therefore, sampling locations were distributed homogeneously over the Project Area to identify baseline soil conditions of the significantly important soil groups.

During the study completed by AECOM, construction works were ongoing at the Kepezkaya TSF and Process Plant areas. Taking into account the potential soil contamination/disturbance that might be originated from the construction activities, soil sampling was not carried out within the boundaries of these units. However, representative background information on soil quality of these units was obtained from the samples collected from the same soil types that are present in nearby areas. Soil sample for the Bağdere TSF area soil group was collected from a nearby location, since Bağdere TSF area was partially contaminated by domestic wastes that are being dumped in this area. Soil sampling locations were also evaluated on site in terms of topography, steepness, access to the location and site conditions. Taking into account all these particular aspects, the optimum representative locations for soil sampling were specified as shown in Figure 5-5.

The coordinates (UTM Projection, Datum ED50 Zone 36) of soil sampling points are given in Table 5-6.

Table 5-6 Coordinates of Soil Sampling Points

Soil Quality Sampling Points	Coordinates	
	X	Y
Sampling Conducted for the National EIA		
T-1	617043	4607810
T-2	617922	4607831
T-3	617882	4609560
Sampling Conducted by AECOM		
SO-1	616480.32	4606220.59
SO-2	616394.29	4608726.00
SO-3	618046.59	4607247.76
SO-4	617195.12	4609659.73
SO-5	620531.40	4608184.62
SO-6	615796.45	4609498.62
SO-7	623058.41	4609100.28
SO-8	622901.72	4610223.04
SO-9	622090.74	4610675.35
SO-10	622695.47	4608538.99
SO-11	614649.56	4608098.27
SO-12	619397.59	4608786.27
SO-13	621946.76	4607078.33
SO-14	622819.04	4611156.40
SO-15	614809.41	4605849.08



Document Name : 440_02_10_Major Soil Groups of the Project Units and Sampling Locations

Figure 5-5 Soil Sampling Points

The analysis results of soil samples and limit values defined in “Regulation on Control of Soil Contamination and Point Source Contaminated Lands” (Official Gazette dated 08.06.2010 and numbered 27605), are given in Table 5-7 and Table 5-8. Parameters exceeding either one of the respective limit values provided by the Regulation are summarized below. It should be noted that the Regulation defines these limits as screening values and exceedance of Regulation limit values does not entail a regulatory action, while it may indicate a potential for the impact on soil. In the case of GCP, chrome, arsenic and cobalt concentrations exceeding the screening values is believed to be a result of the background heavy metal concentrations (which is directly related with the local geology / geochemistry and the presence of heavy metals in the surrounding rocks):

- Chrome: Determined concentrations are above inhalation of fugitive dust in ambient air limit value for all samples (both the samples collected for National EIA and samples collected for AECOM study). Therefore, this parameter presents a consistent high value in the general area, in terms of given limit.
- Arsenic: Determined concentrations are above the soil ingestion and absorption through skin contact limit value for sampling points T1, T2 and T3 and SO-13.
- Cobalt: Determined concentrations are above the soil ingestion and absorption through skin contact limit value for sampling points T1, T2 and T3, SO-1, SO-3, SO-7, SO-9, SO-10, SO-11 and SO-15.

In addition to Turkish legislation, results have been compared with the Dutch Limits as provided in Table 5-9 and Table 5-10. The results indicate that the background concentrations for the Project Area soil groups are below the action limits except Cadmium for SO-10 soil sample.

Table 5-7 Soil Quality Comparison with Limit Values specified by Regulation on Control of Soil Contamination and Point Source Contaminated Lands (1/2)

Parameters		Analysis Results			Limit Values of Generic Pollutants[1]	
		T-1	T-2	T-3	Soil Ingestion and Absorption Through Skin Contact	Inhalation of Fugitive Dust in Ambient Air
Chrome (mg/kg)		***56.5***	***107***	***71.5***	235 [b.c]	***24*** [e]
Lead (mg/kg)		31.5	11	44.5	400 [n]	- [f]
Nickel (mg/kg)		108.5	92.5	73	1564 [b.c]	- [f]
Cadmium (mg/kg)		<0.75	<0.75	<0.75	70 [b.m]	***1124*** [e]
Copper (mg/kg)		119.5	115.5	34	3129 [b.c]	- [f]
Mercury (mg/kg)		0.85	<0.25	<0.75	23 [b.c]	-
Zinc (mg/kg)		73.5	68.5	66.5	23464 [b.c]	- [f]
Arsenic (mg/kg)		19.5	11.5	9	0.4 [e]	***471*** [e]
Barium (mg/kg)		275	285	575	15643 [b.c]	***433702*** [b]
Cobalt (mg/kg)		34.5	48.5	24.5	23 [b.c]	***225*** [e]
*1 Total Petroleum Hydrocarbons (TPH) (mg/kg)	Aliphatic (EC5-EC8)	0.011	0.01	0.008	4693 [b.c]	-
	Aliphatic (EC8>-EC16)				7821 [b.c]	-
	Aliphatic (EC16>- EC35)				156429 [b.c]	-
	Aromatic (EC5-EC8)				15643 [b.c]	-
	Aromatic (EC8>-EC16)				1564 [b.c]	-
	Aromatic (EC16>- EC35)				2346 [b.c]	-
*2 Vanadium (mg/kg)		148.69	127.61	135.76	548 [b.c]	- [f]

[1] *Parameters those exceed Soil Ingestion and Absorption through Skin Contact are shown underlined; whereas, parameters those exceed Inhalation of Fugitive Dust in Ambient Air are shown Bold Italic.*

(b) Danger index is accepted as "1" for calculation of these values. (c) No Absorption factor was found for that parameter, only swallowing the soil was considered. (d) Soil saturation concentration (e) Cancer risk is accepted as "10-6" for calculation of this value. (f) No toxicological value was found for that parameter. (g) It is used in the calculation of this value. (i) The limit values of potable water in TS-266 Water for Human Consumption are used to calculate this value. (m) For calculation of that limit value, value of swallowing of Cadmium through food consumption was used. (n) This value is taken from US EPA. 1994

Table 5-8 Soil Quality Comparison with Limit Values specified by Regulation on Control of Soil Contamination and Point Source Contaminated Lands (2/2)

Parameters		Analysis Results															Limit Values of Generic Pollutants[1]	
		SO-1	SO-2	SO-3	SO-4	SO-5	SO-6	SO-7	SO-8	SO-9	SO-10	SO-11	SO-12	SO-13	SO-14	SO-15	Soil Ingestion and Absorption Through Skin Contact	Inhalation of Fugitive Dust in Ambient Air
Chrome	(mg/kg)	***89.11***	***77.61***	***74.58***	***56.21***	***70.37***	***53.78***	***31.89***	***87.35***	***76.55***	***227.50***	***140.10***	***54.65***	***66.14***	***41.27***	***212.70***	235 [b.c]	***24*** [e]
Lead	(mg/kg)	70.88	56.92	73.03	53.77	57.56	56.43	41.85	49.44	48.60	59.03	44.85	40.62	60.89	52.97	47.27	400 [n]	- [f]
Nickel	(mg/kg)	67.80	27.05	83.86	26.59	38.66	29.69	14.45	37.38	27.83	79.09	87.37	34.97	39.02	23.41	90.16	1564 [b.c]	- [f]
Cadmium	(mg/kg)	6.71	5.93	5.57	6.22	5.94	6.48	5.65	5.82	6.73	6.37	6.43	5.95	7.09	6.26	5.61	70 [b.m]	***1124*** [e]
Copper	(mg/kg)	123.60	53.89	166.50	39.17	50.93	40.27	44.48	36.20	52.14	71.23	43.90	30.93	34.71	45.73	72.21	3129 [b.c]	- [f]
Mercury	(mg/kg)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	23 [b.c]	-
Zinc	(mg/kg)	100.50	2.66	37.33	51.92	15.83	25.28	46.77	46.11	8.84	198.70	67.14	37.41	24.60	<0.3	79.22	23464 [b.c]	- [f]
Arsenic	(mg/kg)	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	3.31	<0.4	<0.4	0.4 [e]	***471*** [e]
Barium	(mg/kg)	355.80	231.40	278.10	263.70	310.90	289.20	224.20	214.50	233.10	275.70	104.80	89.70	253.60	259.10	184.70	15643 [b.c]	***433702*** [b]
Cobalt	(mg/kg)	28.25	22.75	27.65	17.41	18.30	21.27	24.06	19.34	24.48	27.41	27.01	20.82	18.85	16.67	32.02	23 [b.c]	***225*** [e]
*1 Total Petroleum Hydrocarbons (TPH) (mg/kg)	Aliphatic (EC5-EC8)	<10	<10	<10	<10	<10	83.13	<10	<10	<10	<10	<10	<10	<10	<10	<10	4693 [b.c]	-
	Aliphatic (EC8>-EC16)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	7821 [b.c]	-
	Aliphatic (EC16>- EC35)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	156429 [b.c]	-
	Aromatic (EC5-EC8)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	15643 [b.c]	-
	Aromatic (EC8>-EC16)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	1564 [b.c]	-
	Aromatic (EC16>- EC35)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	2346 [b.c]	-
*2 Vanadium	(mg/kg)	92.91	204.43	187.70	87.48	84.09	106.00	237.30	181.10	197.70	70.63	129.60	89.34	81.11	67.61	111.20	548 [b.c]	- [f]

[1]Parameters those exceed Soil Ingestion and Absorption through Skin Contact are shown underlined; whereas, parameters those exceed Inhalation of Fugitive Dust in Ambient Air are shown Bold Italic.

(b) Danger index is accepted as "1" for calculation of these values. (c) No Absorption factor was found for that parameter. only swallowing the soil was considered. (d) Soil saturation concentration ( ). (e) Cancer risk is accepted as "10-6" for calculation of this value. (f) No toxicological value was found for that parameter. (g) It is used in the calculation of this value. (i) The limit values of potable water in TS-266 Water for Human Consumption are used to calculate this value. (m) For calculation of that limit value, value of swallowing of Cadmium through food consumption was used. (n) This value is taken from US EPA. 1994

Table 5-9 Soil Quality Comparison with Dutch Limits for Soil / Sediment Samples (1/2)

Parameters		Analysis Results			Dutch Limits	
		T-1	T-2	T-3	Soil Sediment	
					Optimum Value (mg/kg)	Action Limit (mg/kg)
Chrome (mg/kg)		56.5	107	71.5	100	***380***
Lead (mg/kg)		31.5	11	44.5	85	***530***
Nickel (mg/kg)		108.5	92.5	73	35	***210***
Cadmium (mg/kg)		<0.75	<0.75	<0.75	0.8	***12***
Copper (mg/kg)		119.5	115.5	34	36	***190***
Mercury (mg/kg)		0.85	<0.25	<0.75	0.3	***10***
Zinc (mg/kg)		73.5	68.5	66.5	140	***720***
Arsenic (mg/kg)		19.5	11.5	9	29	***55***
Barium (mg/kg)		275	285	575	200	***625***
Cobalt (mg/kg)		34.5	48.5	24.5	20	***240***
*1 Total Petroleum Hydrocarbons (TPH) (mg/kg)	Aliphatic (EC5-EC8)	0.011	0.01	0.008	50	***5000***
	Aliphatic (EC8>-EC16)					
	Aliphatic (EC16>- EC35)					
	Aromatic (EC5-EC8)					
	Aromatic (EC8>-EC16)					
	Aromatic (EC16>- EC35)					
*2 Vanadium (mg/kg)		148.69	127.61	135.76	42	***250***

Table 5-10 Soil Quality Comparison with Dutch Limits for Soil / Sediment Samples (2/2)

Parameters	Unit	Analysis Results															Dutch Limits Soil/Sediment	
		SO-1	SO-2	SO-3	SO-4	SO-5	SO-6	SO-7	SO-8	SO-9	SO-10	SO-11	SO-12	SO-13	SO-14	SO-15	Optimum Value (mg/kg)	Action Limit (mg/kg)
Chrome	(mg/kg)	89.11	77.61	74.58	56.21	70.37	53.78	31.89	87.35	76.55	227.5	140.1	54.65	66.14	41.27	212.7	100	***380***
Lead	(mg/kg)	70.88	56.92	73.03	53.77	57.56	56.43	41.85	49.44	48.6	59.03	44.85	40.62	60.89	52.97	47.27	85	***530***
Nickel	(mg/kg)	67.8	27.05	83.86	26.59	38.66	29.69	14.45	37.38	27.83	79.09	87.37	34.97	39.02	23.41	90.16	35	***210***
Cadmium	(mg/kg)	6.71	5.93	5.57	6.22	5.94	6.48	5.65	5.82	6.73	6.37	6.43	5.95	7.09	6.26	5.61	0.8	***12***
Copper	(mg/kg)	123.6	53.89	166.5	39.17	50.93	40.27	44.48	36.2	52.14	71.23	43.9	30.93	34.71	45.73	72.21	36	***190***
Mercury	(mg/kg)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	0.3	***10***
Zinc	(mg/kg)	100.5	2.66	37.33	51.92	15.83	25.28	46.77	46.11	8.84	198.7	67.14	37.41	24.6	<0.3	79.22	140	***720***
Arsenic	(mg/kg)	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	3.31	<0.4	<0.4	29	***55***
Barium	(mg/kg)	355.8	231.4	278.1	263.7	310.9	289.2	224.2	214.5	233.1	275.7	104.8	89.7	253.6	259.1	184.7	200	***625***
Cobalt	(mg/kg)	28.25	22.75	27.65	17.41	18.3	21.27	24.06	19.34	24.48	27.41	27.01	20.82	18.85	16.67	32.02	20	***240***
*1 Total Petroleum Hydrocarbons (TPH) (mg/kg)	Aliphatic (EC5-EC8)	<10	<10	<10	<10	<10	83.13	<10	<10	<10	<10	<10	<10	<10	<10	<10	50	***5000***
	Aliphatic (EC8>-EC16)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
	Aliphatic (EC16>- EC35)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
	Aromatic (EC5-EC8)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
	Aromatic (EC8>-EC16)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
	Aromatic (EC16>- EC35)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
*2 Vanadium	(mg/kg)	92.91	204.43	187.7	87.48	84.09	106	237.3	181.1	197.7	70.63	129.6	89.34	81.11	67.61	111.2	42	***250***

5.3 Geological Characteristics

5.3.1 Project Site Geology

The GCP area is located on the northern flank of the Çangaldağ-Complex (Figure 5-9) to the west of Hanönü. The Gökırmak valley approximately marks a significant structural contact, called the Ekinveren Fault Zone. Detailed lithological descriptions of the observed lithologies within the mapping area are provided by the recent drilling campaigns, but formation names have been avoided. Geological mapping was performed, which resulted in the construction of a geological map (Figure 5-7).

Table 5-11 shows the major rock units intersected in the drilling. The significant units are presented in the following sections.

Table 5-11 Major Rock Units

Rock Type Code	Rock Name
DEB	Alluvium/Debris
GSCH	Green Schist
MSCH	Mixed Schist
FB	Fault Breccia
MCU	Massive Cu Mineralization (>50%)
SMCU	Semi-massive Cu-mineralization (>10% - ≤50%)
LCU	Low Cu Mineralization (≤10%)
SR	Silica Rock

Identified lithologies in the area are listed below:

- **Debris (DEB):** All loose material derived either from surface weathering or through alluvial activities has been comprised under the term “Debris”. In a wide area along the Gökırmak stream, alluvial formations are observed. Outcrop widths of these formations reach up to 100 m–200 m. The alluvium comprises well-rounded sand, pebbles, and blocks of various sizes. The maximum thickness of the alluvial sediments in the Gökırmak valley around the GCP is approximately 40 m. On the hill slopes and mountain ranges, beyond the occurrence of alluvium, the term “Debris” has been used to describe the near surface, weathered, and loosened part of the solid underlying rock units. Soil cover and/or quaternary sediments are poorly developed or absent. Where they do occur they are also included into the term “Debris”.
- **Green Schist (GSCH):** Green Schist is mainly characterized by a massive, sometimes layered structure where the schistose texture is defined primarily by chlorite and possibly actinolite. The foliation is a result of mineral alignment of quartz, minor calcite, chlorite, and some mafic minerals. The grain size is mostly fine, very rarely coarse. The overall colour is green, light green with some dark green layers. Macroscopically distinguishable minerals are chlorite and calcite, sometimes small amounts of chalcopyrite and pyrite. The Green Schist precursor is potentially a mafic volcanic, either a lava and/or volcanoclastic.
- **Mixed Schist (MSCH):** The majority of the hosting stratigraphy is schistose rock consisting of quartz, lamellar micas, chlorite, talc, graphite, and minor feldspar. Quartz often occurs in elongated grains, forming irregular shaped layers. Mica-rich layers are sometimes intercalated with quartz-rich layers. Most minerals are drawn out in flakes. The schist shows multiple foliations. Inside the mica-rich layers, the individual mineral grains split-off easily into flakes or slabs. Mixed Schist also has alternating sequences of Green Schist and schist where each fraction can be present in bands below 1 mm size to more than 20 cm sizes. The colour is also a mixture of green and grey. Macroscopically distinguishable minerals are quartz, calcite, talc, graphite, chlorite, mica, and sometimes small amounts of chalcopyrite and pyrite. The non-Green Schist material of the Mixed Schist appears to have a more felsic component, and the precursor is likely to be an intermediate to mafic volcanic, possibly a volcanoclastic. It is suggested that the Mixed Schist unit is a shear zone related to the Ekinveren thrust zone, and that the occurrence of Green Schist are fragments of “country rock” caught up in the shear. The bedrock (green and mixed schist) in the open pit area is heavily fractured and faulted. One major approximately north-south oriented fault has been mapped, known as the Dividing Fault, but there are also numerous other significant fault zones in the pit area (RPS, 2015).



Figure 5-6 Core with MCU and SMCU Mineralization (SDD-44)

- **Fault Breccia (FB):** Tectonite formed by tectonic movement along a localized zone of brittle deformation in a rock formation. The surrounding rocks affected by FBs are grinded and milled. The result is unconsolidated material made of loose fragment. The grain sizes ranges from several cm to <0.01 mm. Sometimes large fragments with sharp edges appear to be “floating” in a finer grained matrix. Seamless transitions between more brittle rock on the one hand and fault gouge on the other are common. Some of the FBs have kept their internal cohesion, some are consolidated again by quartz and calcite, but most of them are unconsolidated without any cohesion. These are often areas of high core loss.
- **Massive Copper Mineralization (MCU):** Made up of more than 50% sulphides (Figure 5-6). The structure can be described as massive with only rare foliation visible. Macroscopically the mineral size appears to be fine-grained, but suggested recrystallization. The colour is grey-yellow with a metallic lustre. Macroscopically observable minerals are pyrite, chalcopyrite, rarely quartz and calcite on veins. Joints are wide-spaced.
- **Semi-Massive Cu Mineralization (SMCU):** Rock type made up of more than 10% but less than 50% of sulphides (Figure 5-6). The gangue associated with the sulphide mineralization is dominated by silica, and it is often interbedded with schist (MSCH or GSCH). The sulphide occurs as layers or patches of fine-grained pyrite and chalcopyrite. The colour is a grey-yellow. Observable minerals are pyrite, chalcopyrite, quartz, and calcite. Quartz and calcite also occur as veins. Jointing is medium to wide-spaced.
- **Low Cu Mineralization (LCU):** Rock type consists of silica containing up to 10% of sulphides as layers, laminae, lenses, or disseminations and interbedded with MSCH or GSCH. The colour is grey-white alternating with layers of schist. Macroscopically observable minerals are euhedral pyrite and chalcopyrite in quartz, and rarely quartz and calcite veins. Joint spacing is narrow and sometimes wide-spaced.
- **Silica Rock (SR):** Very porous white rock, made up of nearly 100% quartz. The overall texture is massive. Cavities are less than 1 mm thick with rounded or cubic shapes. Due to the porous and brittle nature of this rock, drill core is hardly recovered. The colour is white in core and white-brown/yellow in outcrop, and joints are generally wide-spaced. SR is the weathered representation of LCU, the voids being boxworks after sulphide. Thin and polished section analysis was used to distinguish sulphide minerals (pyrite, chalcopyrite and to a lesser extent sphalerite), and to understand their inter-granular relationships and grain size distribution. The thin section analysis also looked at determining the protolith of the metamorphosed country rock and assessing the metamorphic grade.

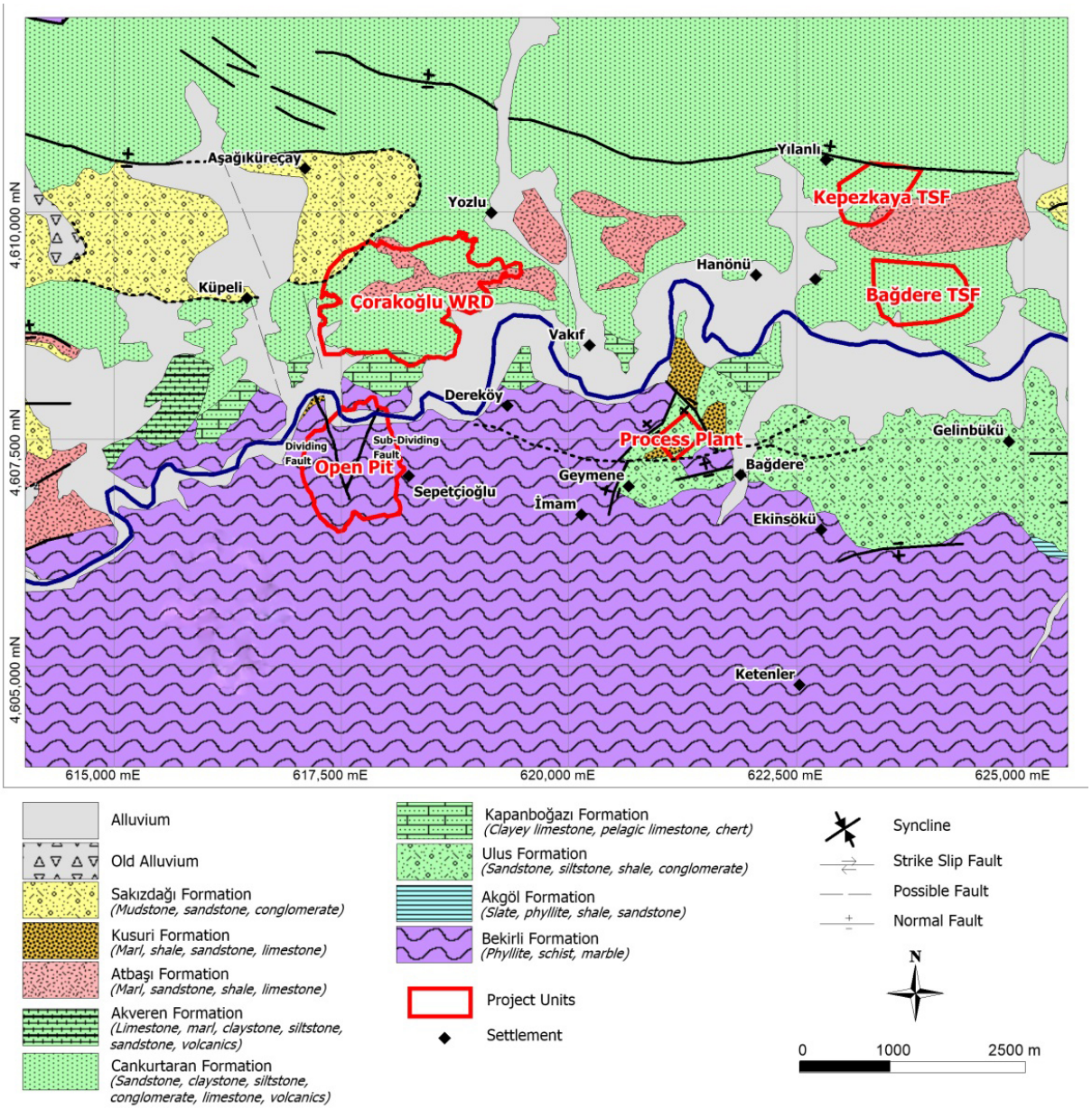


Figure 5-7 Geological Map and Major Structural Features of the Project Area

5.3.2 Structural Geology

According to Okay et al., (2006), the location of the license area is within the Çangaldağ-Complex. The intrusion by the Jurassic granites put a constraint to its age. Okay et al., (2006) describes the unit as a northward dipping tectonic slice with a true thickness of approximately 5 km. It is bounded to the south by a 50°–60° northward dipping shear zone (the Acisu Fault) as shown in Figure 5-9. The Acisu Fault is interpreted to be a normal fault which was reactivated during the Cretaceous Period as a thrust fault. North of the Gökırmak valley, the Çangaldağ-Complex is bordered by Maastrichtian to Eocene sediments which form the Gökırmak fold and thrust belt. The region has undergone extensional, as well as compressional forces since lower Jurassic times.

Taking lithological and structural considerations into account, the Çangaldağ-Complex is interpreted to be a late Permian-early Triassic, south-facing, intra-oceanic magmatic arc, accreted to the southern margin of Eurasia during the latest Triassic-early Jurassic Cimmerian orogeny (Okay et al., 2006).

After the closure of the Paleo-Tethys Ocean, the ophiolites that represent the Paleo-Tethian oceanic crust were exhumed as slices due to tectonic movements, most likely related to the Acisu detachment, (Okay et al., 2006). These rocks outcrop approximately 5 km south-east of the license area. Detailed descriptions of the Gökırmak fold and thrust belt (north of the Gökırmak valley), which is part of the Ekinveren thrust zone, are given in Okay et al., (2006). There is structural movement developed in east-west direction owing to compression from north-south direction. Syncline-anticline axis and bedding plane orientations are in west-east direction. “Ekinveren fault” is the most important fault in the studying area, and it limits the Kastamonu-Taşköprü-Boyabat basin from its north. Block, located in south part of the fault, expanded to generate Boyabat depression.

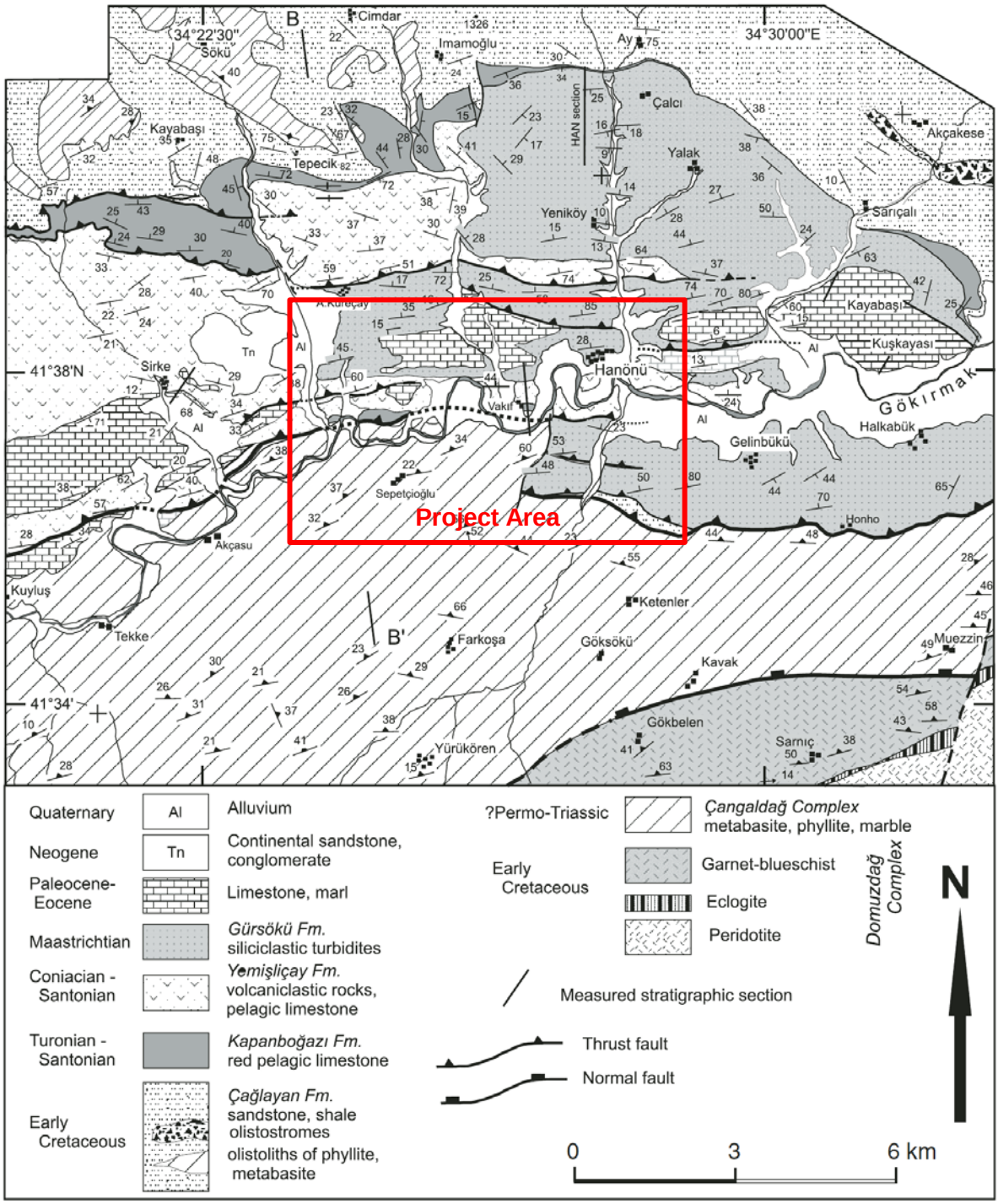


Figure 5-8 Geology of the Gökırmak Fold and Thrust Belt (Okay et al., 2006)

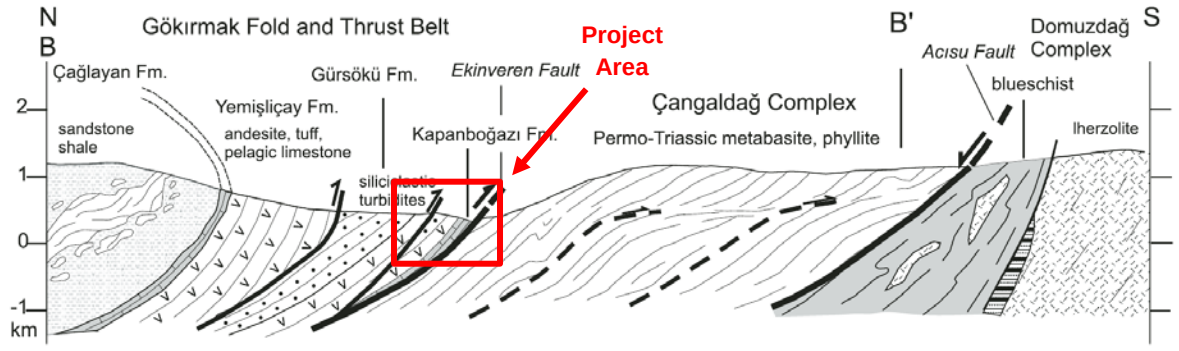


Figure 5-9: Cross-Section through the Gökirmak Fold and Thrust Belt (Okay et al., 2006)

When Paleotethys Ocean closed in Lower Mesozoic; ophiolite belonging to oceanic crust, raised as slices during tectonic activities (reverse fault, thrust, nappe etc.). As a result of these tectonic activities Mesozoic ophiolite (Mof) developed an anticline structure in NE- SW orientation.

Çangaldağ anticline extending in E-W orientation from north of Boyabat to Devrekani region, is a tectonic structure. This anticline southern part was cut by E-W oriented faults. These faults are generated the northern boundary of Taşköprü-Boyabat basin.

5.3.2.1 Tectonics and Seismicity

According to "Earthquake Zoning Map of Turkey" published by Earthquake Research Department of General Directorate of Disaster Affairs, the Project site lies on the 2nd Degree earthquake region (Özmen et. al., 1997) (see Figure 5-10).

From a local scale perspective, the most important fault in the Project Area is defined as "Ekinveren Fault", which limits Kastamonu-Taşköprü-Boyabat basin from its north (see Figure 5-11). The project is in an area of low seismic hazard, with potential for the area to be subjected to a peak ground acceleration of 0.1 g for a 10% probability of exceedance in 50 years. The open-pit slopes are therefore unlikely to be affected by regional earthquakes. A horizontal seismic loading has been applied during the slope stability analyses.

Earthquakes that cause damage in Kastamonu and its vicinity in the instrumental period (years between 1900 and 2000) are given chronologically as follows:

- 09th March 1902 Çankırı Earthquake (maximum intensity Io: IX),
- 25th June 1910 Tosya (Kastamonu) Earthquake (maximum intensity Io: VII, Ms:6,1),
- 09th June 1919 Almus (Tokat) Earthquake (Io: VIII, Ms:5;9),
- 21th November 1942 Osmancık Earthquake (Ms:5,5),
- 02nd December 1942 Çorum Earthquake (Io: VIII, Ms:5;9),
- 11th December 1942 Çorum Earthquake (Io: VI, Ms:5;9),
- 26th November 1943 Tosya – Ladik Earthquakes (Io:X, Ms:7,2). Kastamonu central district have been affected at VIII intensity from this earthquake. It has been recorded that, in the villages 75 % of houses was completely collapsed or severely damaged, in an area limited from Taşova in the east to Ilgaz in the west, covering approximately 45.000 km2. Inside this area, although the exact number has not been determined, 4.000 people died and 5.000 people injured. Moreover, it has been recorded that, among Destek Canyon in the east to Kurşunlu Region in the west, 250 km long surface fracture occurred (Eyidoğan et all., 1991).
- Last earthquake in the area was Kurşunlu Earthquake in 07th September 1953 (Io: VIII, Ms:6;4).

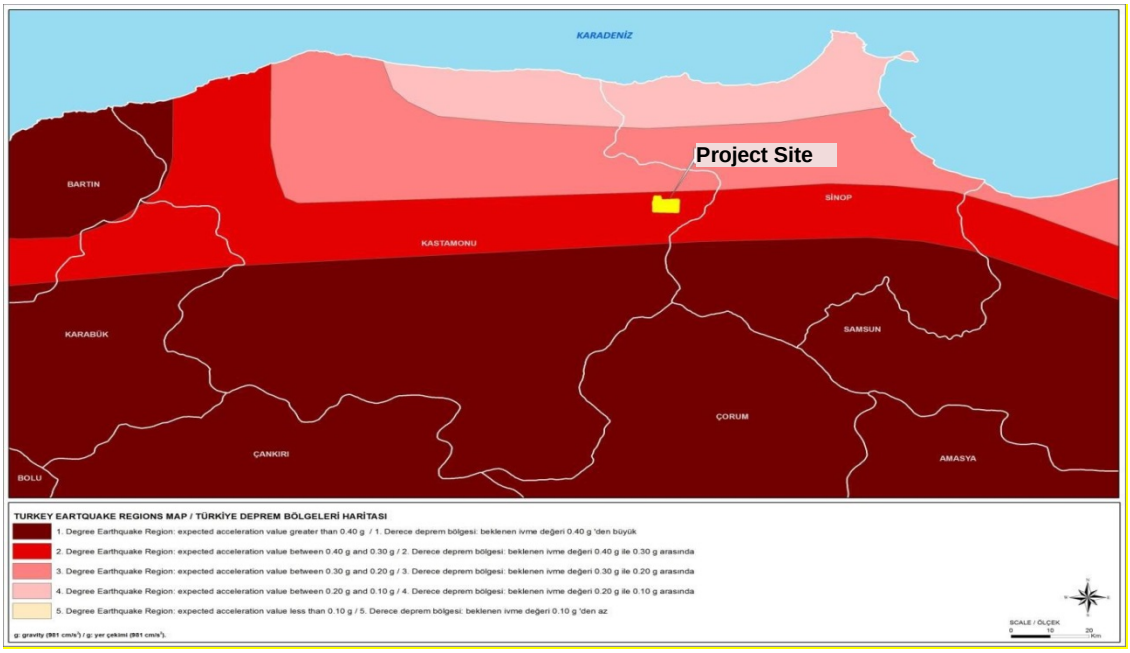


Figure 5-10 Earthquake Zones Map of Kastamonu Province

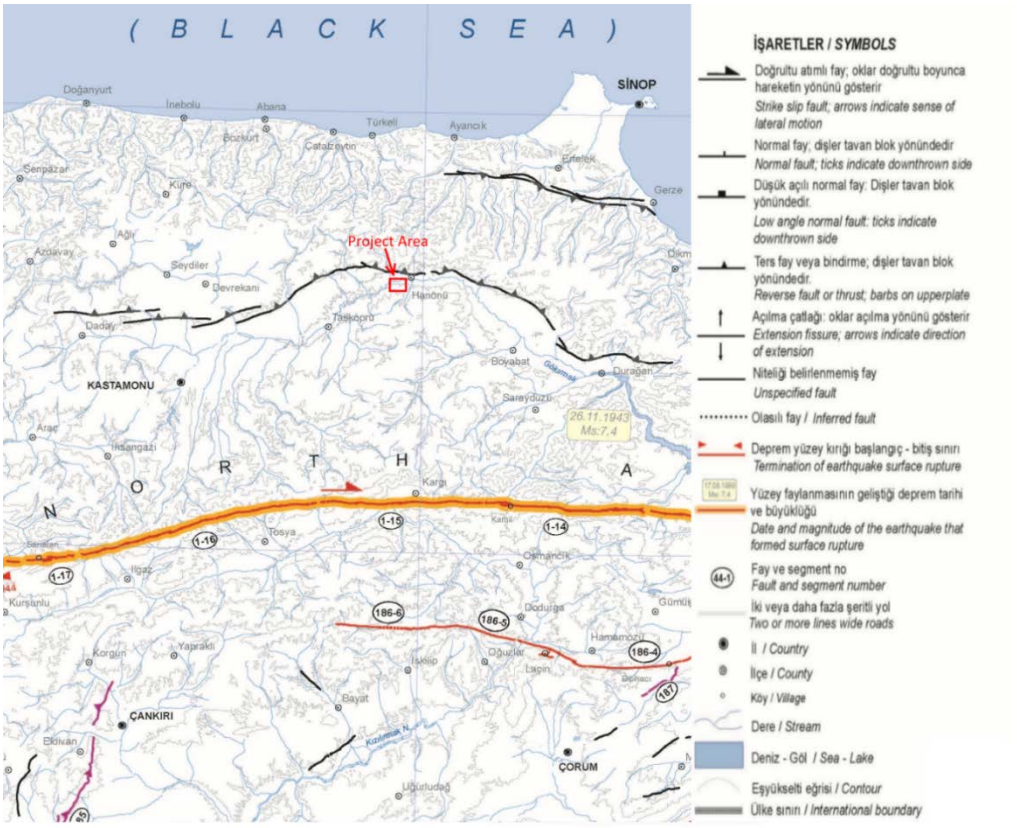


Figure 5-11 Active Fault Map of Region

From regional perspective, the major governing fault zone of the region is the North Anatolian Fault Zone (NAFZ) which is located within 60 km from the Project Area. Earthquakes that have magnitude Ms ≥ 4, in the region were observed to concentrate along the NAFZ and its near vicinity. The magnitude and the number of the earthquakes originated from the NAFZ were identified to decrease in the Project Area (Figure 5-12).

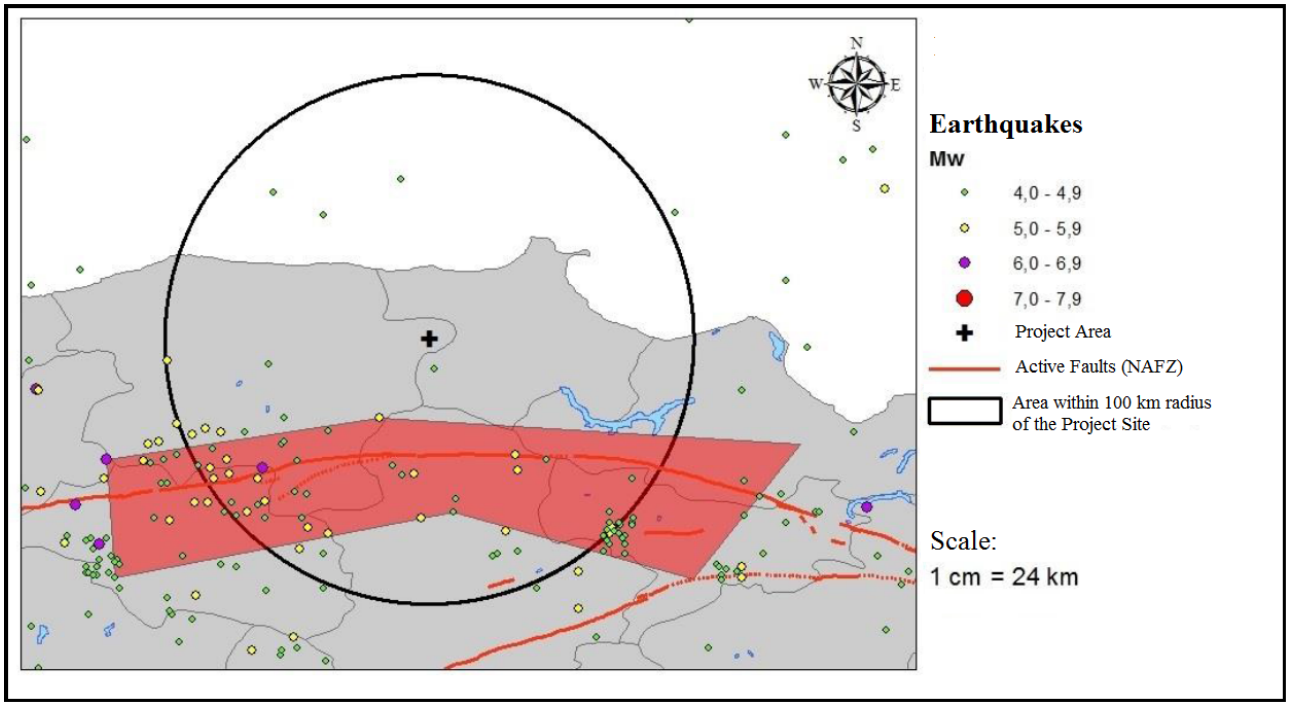


Figure 5-12 Earthquake Locations in Regional Scale with respect to the Project Area (Asya Maden, 2015)

5.3.2.2 Structural Features in the Project Units

The previous studies carried out for the Open Pit (RPS, 2015, Asya Maden, 2015) and recent pit characterization studies by Acacia indicate that two fault planes exist within the proposed pit area.

First fault, known as the Dividing Fault was reported to orient in northwest – southeast direction (Asya Maden, 2015) while the second one has an orientation in northeast – southwest direction. Since there is no specific name attributed to this second fault in previous reports, it is called as “Sub-Dividing Fault” through the following sections of this report.

The presence and location of these geological structures is largely inferred from drilling data. Dividing Fault and Sub-Dividing Fault were reported to intersect each other around the southern sections of the Open Pit creating a subsidence zone between each other (Asya Maden, 2015). Based on the drill log data and 3D wireframes obtained from Acacia, both faults are believed to show normal character with strike slip component and having fault surfaces dipping about 60° to Northeast (for the Dividing Fault) and Northwest (for the Sub-dividing Fault).

The Dividing Fault is observed to intersect the Gökırmak River to the north of the Open Pit (passing right under the spillway channel and upstream coffer dam) and west of the Çorakoğlu WRD. Geomorphology of the pit area and the area that extends to the North gives rise to a thought of likely continuation of the Dividing Fault to the North-Northwest direction along the Küreçay Stream (Figure 5-7 and Figure 5-13).

The Sub-Dividing Fault on the other hand, extends through the alluvium until the northern boundary of the Open Pit. However the geomorphology of this section suggests that the Sub-Dividing Fault is likely to continue until it reaches the eastern flank of the Çorakoğlu WRD. The extent of both fault zones to the South is not fully understood as the drill log data is limited within the open pit mineralization zone. Furthermore, the extent of these faults to the South cannot be clearly tracked from the geomorphology of the study area. Figure 5-7 and Figure 5-13 shows the locations of the two fault zones within the Open Pit and their potential extent to the North.

It has been reported in the previous studies that there will be localized, more-significant inflows as the mine intersects permeable fracture/fault or contact zones (RPS, 2015). A fracture zone inflow assessment has been completed and suggests that the initial interception of fully saturated discrete fractured zones could result in discrete groundwater inflows. However, these initial localized inflows might reduce in magnitude rapidly assuming that there is not a constant supply of water to these fracture zones. It is possible that large rainfall events or extended wet periods might re-saturate these fracture zones and that fracture flows could temporarily increase.

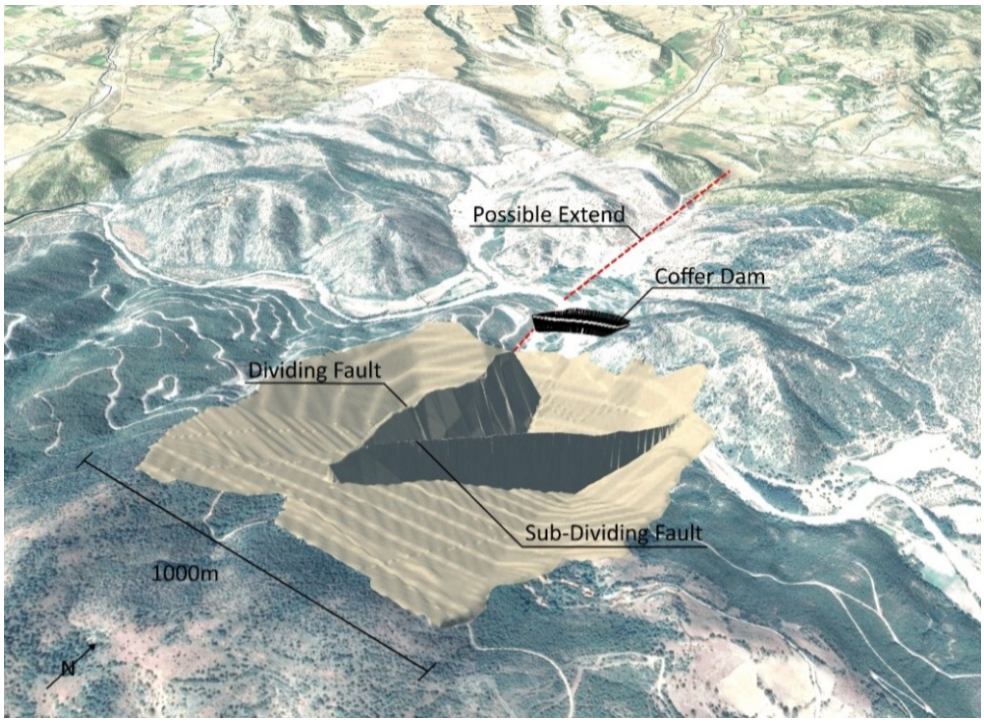


Figure 5-13 3D View of the Dividing and Sub-Dividing Faults in the Open Pit Area

During the site visits carried out by AECOM, minor landslides were observed to develop on areas where local faults are mapped. These ground movements were observed in the Open Pit and Process Plant areas where the top soil stripping or excavation strategy is specified accordingly. Relevant mitigation measures are already in place for the Process Plant area such as implementation of shot-crete on slopes and regrading of slopes that might potentially cause landslides. Process Plant area consists of some local faults that govern the topography in this area. The normal faults were observed to have southwest – northeast direction and their extents are limited within Process Plant and its near vicinity. Based on the existing geological maps and site observations, the faulting mechanism is mostly developed along the river valleys. This is apparent especially for the Dividing and Sub-dividing faults in the Open Pit area which their possible extent can reach further to the north, adjacent to the Çorakoğlu WRD. Existence of fault zones along the river valleys might potentially induce minor erosions along the river banks, depending on the existence of loose material. Erosion was partially observed along the river sections those are also shaped by the river water itself. Erosion was found to be negligible on zones primarily covered with natural vegetation. A normal fault has been identified to follow a West-East direction along the northern boundary of the Kepezkaya TSF (Figure 5-7). The design of the Kepezkaya TSF has been made taking the account of landslide and erosion risks to eliminate any potential impact that might originate from tectonic activities. No fault zone, erosion and/or landslide was observed within the Bağdere TSF area.

Detailed structural measurements of foliation and fractures within the GCP have been obtained through the interpretation of downhole geophysical logs. Generally, the results confirm the measurements of Okay et al., (2006) where the dip and dip-direction of the foliation is reported to be 40°/335° with an indistinct sub-horizontal mineral lineation trending ENE.

The mixed schists exhibits foliation parallel shearing and these shear zones may be present at all scales. Other faults are also present at GCP where two deposit-scale faults were interpreted by AMI. The shape of these structures is unlikely to be planar. They are likely to exhibit changes in dip and dip direction from the small- to large-scale (Asya Maden, 2015). Based on the available structural data, a systematic fracture orientation could not be defined.

5.4 Climate and Meteorology

Kastamonu lies in the Black Sea Region and due to topographical variance, two different climate types can be observed in the province. The coastal areas bordering the Black Sea have a temperate Oceanic climate with warm, wet summers and cool to cold, wet winters. The effects of the continental climate on the other hand, can be noted to the south. One of the most important factors forming the spatially shifting climate of Kastamonu is the morphology, as the Küre Mountains extending parallel to the shore, form an obstacle between the coastal parts and inner parts of the province. Subsequently, the effect of the Black Sea gradually decreases and the climate gets harsher towards south, gaining terrestrial characteristics similar to Central Anatolia climate. However, located south of Küre Mountains, province plateau areas that reach up to 1500 m are not completely away from the coastal effects.

Project Area is located at 415 m altitude in the north eastern part of the province. According to the Köppen classification system, the climate in the vicinity is classified as “oceanic” to “hot summer humid continental”, where annual mean temperature is about 10˚C and annual total precipitation is about 450 mm.

5.4.1 Meteorological Data Sources

The availability of the meteorological information is vital for the project, in respect of engineering design, drainage control, water balance, modeling studies, etc. Prior to start of mining system design works, such as design of ponds and channels, meteorological data should be evaluated and referred in all stages of the progress. It should also be noted that these data will be used in modeling studies.

The available state meteorological service stations in operation in the vicinity of the Project area are located in Devrekani and Kastamonu

- Devrekani Meteorological Station is located approximately 50 km west of the project area, at an elevation of 1050m. The available data for this station is for about 51 years, between 1964 and 2015.
- Kastamonu Meteorological Station is located 60 km south west of the project area, at an elevation of 800m. The station is in operation since 1960 and the data for 55 years (1960 – 2015) is available.

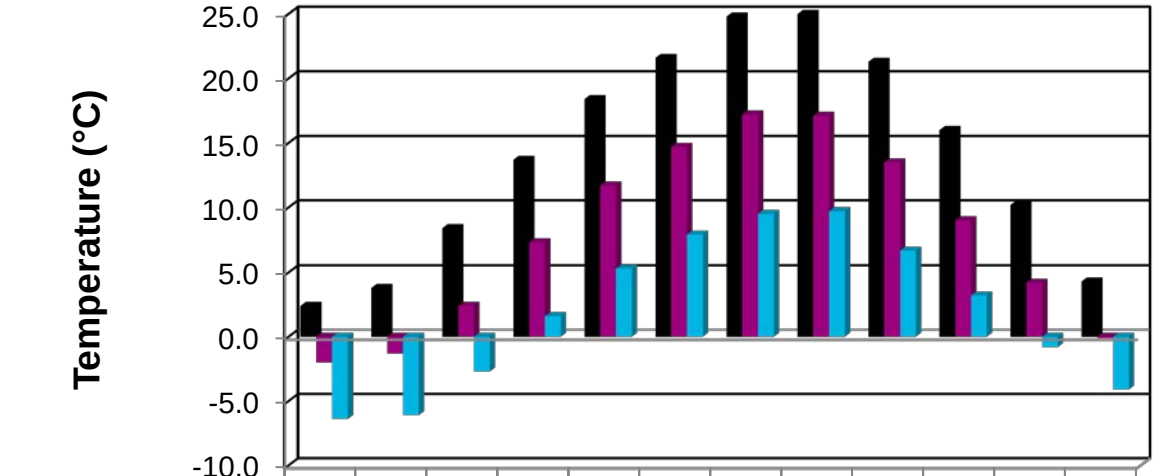
Interpretations regarding the long term data of Devrekani and Kastamonu Meteorological Stations are presented below.

5.4.1.1 Devrekani Meteorological Station

The long-term meteorological bulletin (1964-2015) regarding temperature, precipitation, evaporation, humidity and wind data for Devrekani Meteorological station is discussed in the following sections in detail.

Temperature

According to long-term meteorological data recorded by Devrekani Meteorological Station, the annual average temperature is 7.81°C. As shown in Figure 5-14, the warmest months are July and August whereas the coldest month is January. The maximum and minimum temperatures during the observation period are recorded a 40.6°C on July 30, 2000 and -28.1°C on December 27, 2002 respectively.



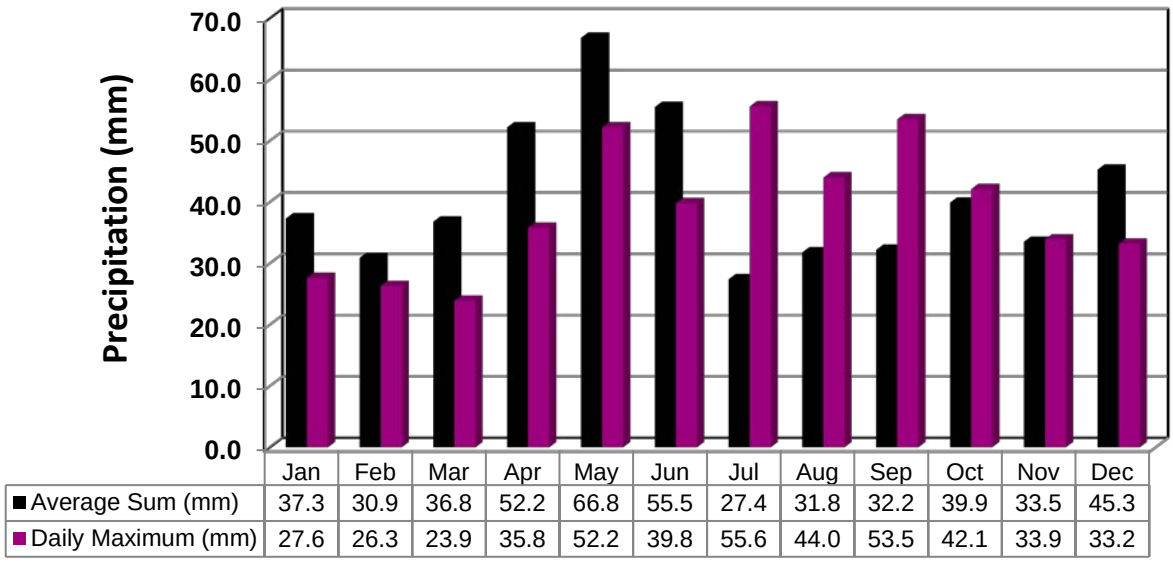
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Maximum (°C)	2.4	3.8	8.4	13.7	18.4	21.6	24.8	25.0	21.3	16.0	10.2	4.3
Average (°C)	-2.0	-1.3	2.4	7.3	11.7	14.7	17.2	17.1	13.5	9.0	4.2	-0.1
Average Minimum (°C)	-6.4	-6.1	-2.7	1.6	5.3	7.9	9.5	9.7	6.7	3.2	-0.8	-4.1

Figure 5-14 Long Term Temperature Data of Devrekani Meteorological Station

Precipitation

According to long-term meteorological data recorded by Devrekani Meteorological Station, the amount of precipitation differs seasonally. As seen from

Figure **5-15**, the maximum total precipitation occurs in May with a monthly average of 66.8 mm. On the other hand, the average total minimum precipitation falls in July as 27.4 mm. According to this data, average total annual precipitation amount is 489.6 mm in Devrekani.

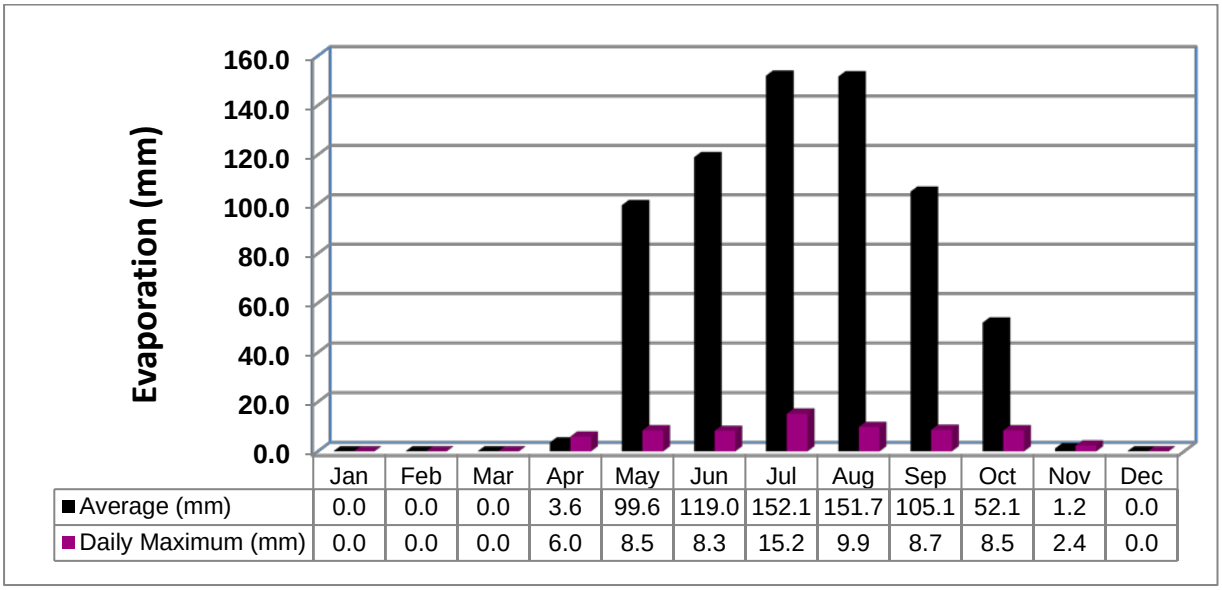


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Sum (mm)	37.3	30.9	36.8	52.2	66.8	55.5	27.4	31.8	32.2	39.9	33.5	45.3
Daily Maximum (mm)	27.6	26.3	23.9	35.8	52.2	39.8	55.6	44.0	53.5	42.1	33.9	33.2

Figure 5-15 Long Term Precipitation Data of Devrekani Meteorological Station

Evaporation

According to long-term data recorded by Devrekani Meteorological Station, annual average evaporation in Devrekani was identified to be 57.0 mm. As seen in Figure 5-16 Maximum average evaporation is observed in July as 152.1 mm on the other hand daily maximum evaporation is observed both in July as 15.2 mm.



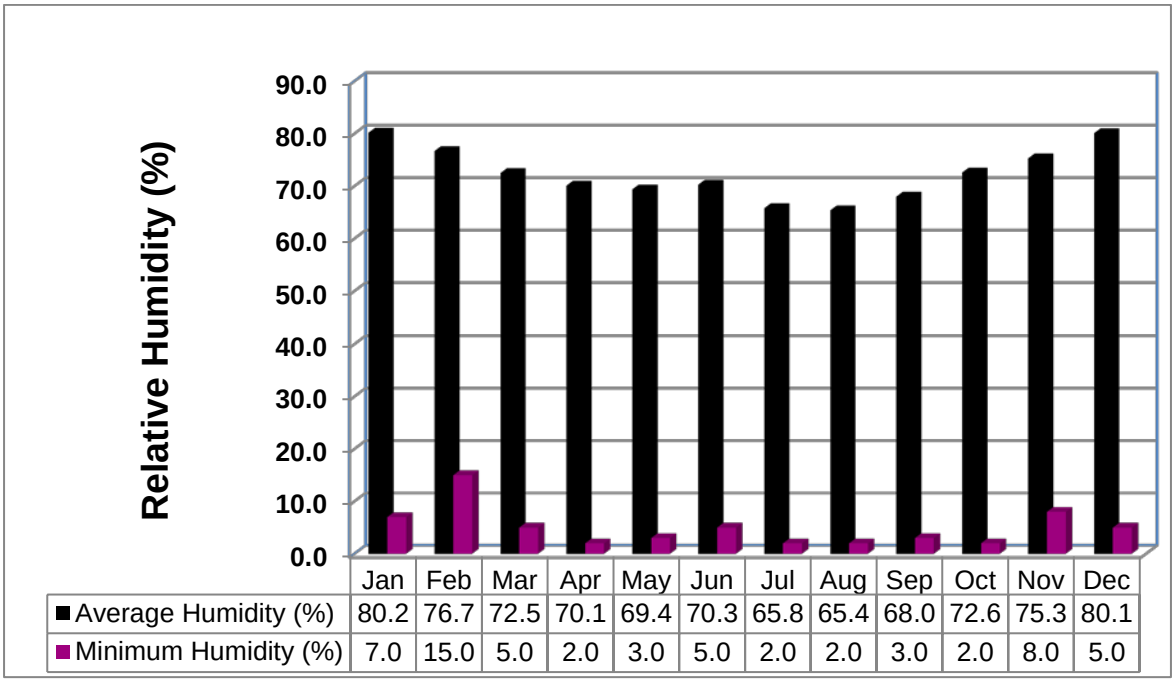
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average (mm)	0.0	0.0	0.0	3.6	99.6	119.0	152.1	151.7	105.1	52.1	1.2	0.0
Daily Maximum (mm)	0.0	0.0	0.0	6.0	8.5	8.3	15.2	9.9	8.7	8.5	2.4	0.0

Figure 5-16 Long Term Evaporation Data of Devrekani Meteorological Station

Humidity

According to the long-term meteorological data recorded by the Devrekani Meteorological Station, annual relative humidity in Devrekani was identified to be 72.2%. In addition, maximum average relative humidity is observed in January as 80.2% whereas least humid month is August when average relative humidity is 65.4% (see

Figure **5-17**).



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Humidity (%)	80.2	76.7	72.5	70.1	69.4	70.3	65.8	65.4	68.0	72.6	75.3	80.1
Minimum Humidity (%)	7.0	15.0	5.0	2.0	3.0	5.0	2.0	2.0	3.0	2.0	8.0	5.0

Figure 5-17 Long Term Humidity Data of Devrekani Meteorological Station

Wind

According to measurements conducted at the Devrekani Meteorological Station, annual average wind speeds are close to each other as velocity, for most of the direction changes between 1.2 m/sec, and 2.2 m/sec.

The wind diagram in Figure 5-18 depicts the annual and seasonal wind directions and intensity. It is shown in wind diagram that according to the measurements taken from Devrekani Meteorological Station, the highest intensity of wind is encountered in W and WNW directions.

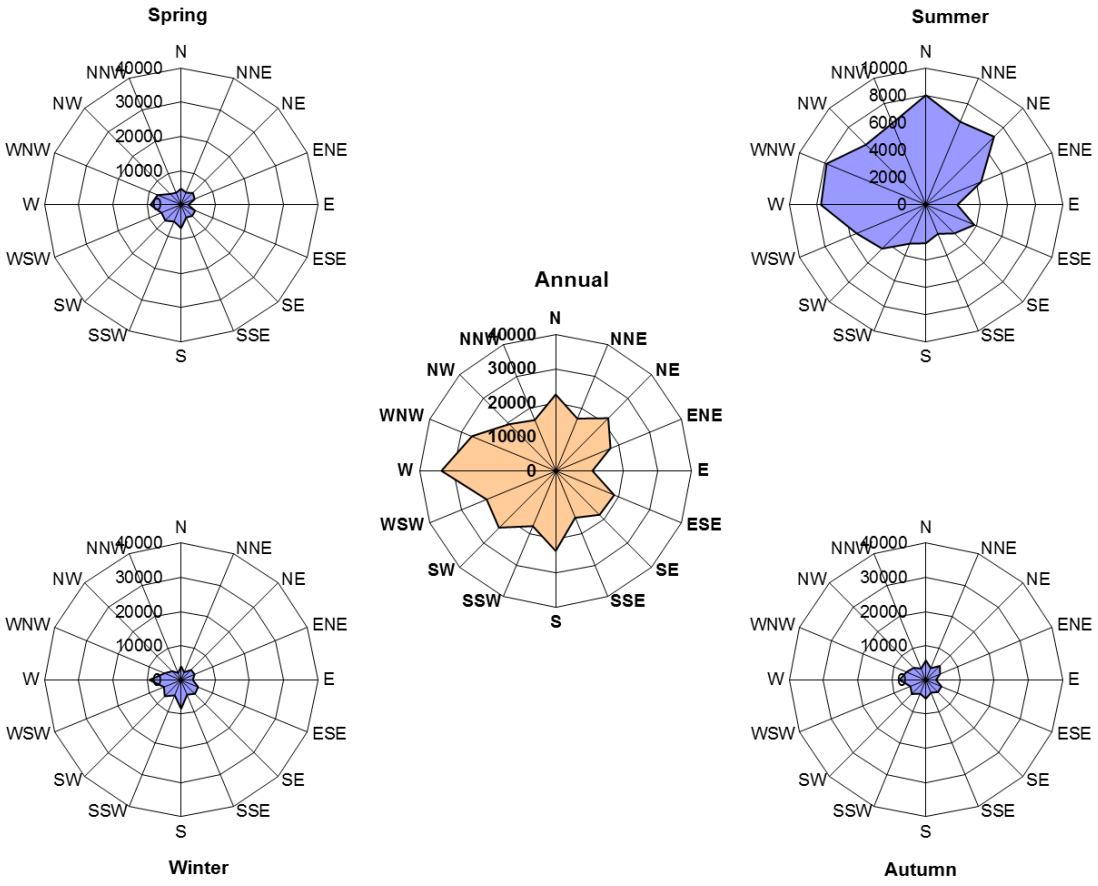


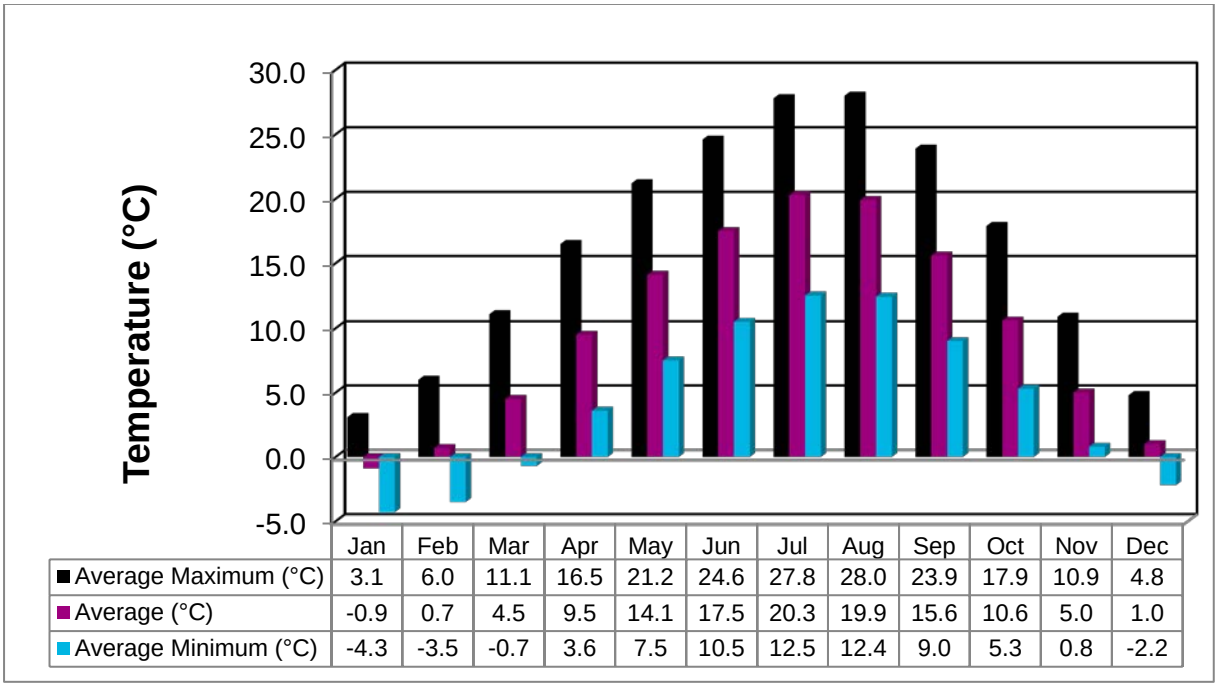
Figure 5-18 Annual and Seasonal Wind Roses Prepared for Devrekani Meteorological Station

5.4.1.2 Kastamonu Meteorological Station

The long-term meteorological bulletin (1960-2015) regarding temperature, precipitation, evaporation, humidity and wind data for Kasatamonu Meteorological station is discussed in the following sections in detail.

Temperature

According to long-term meteorological data recorded by Kastamonu Meteorological Station, the annual average temperature is 9.82°C. As shown in Figure 5-19, the warmest month is July, whereas the coldest month is January. The maximum and minimum temperatures during the observation period are recorded a 42.2°C on July 30, 2000 and -20.6°C on January 29, 1964 respectively.

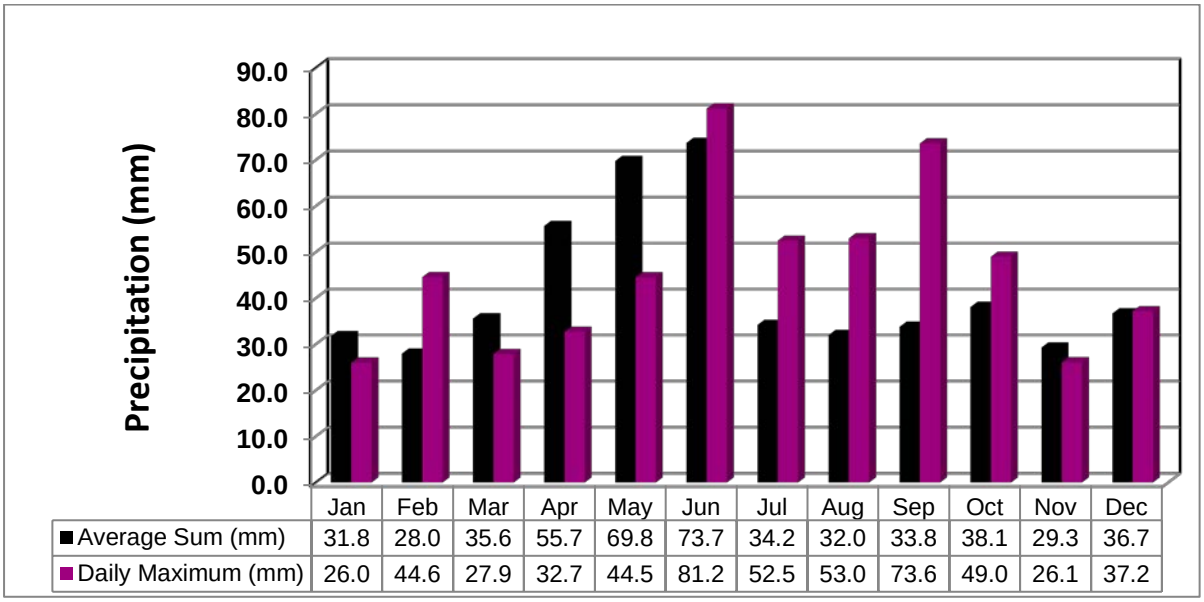


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Maximum (°C)	3.1	6.0	11.1	16.5	21.2	24.6	27.8	28.0	23.9	17.9	10.9	4.8
Average (°C)	-0.9	0.7	4.5	9.5	14.1	17.5	20.3	19.9	15.6	10.6	5.0	1.0
Average Minimum (°C)	-4.3	-3.5	-0.7	3.6	7.5	10.5	12.5	12.4	9.0	5.3	0.8	-2.2

Figure 5-19 TLong Term Temperature Data of Kastamonu Meteorological Station

Precipitation

According to long-term meteorological data recorded by Kastamonu Meteorological Station, the amount of precipitation differs seasonally. As seen from Figure 5-20, the maximum total precipitation occurs in June with a monthly average of 73.7 mm. On the other hand, the average total minimum precipitation falls in February as 28 mm. According to this data, average total annual precipitation amount is 498.7 mm in Kastamonu.

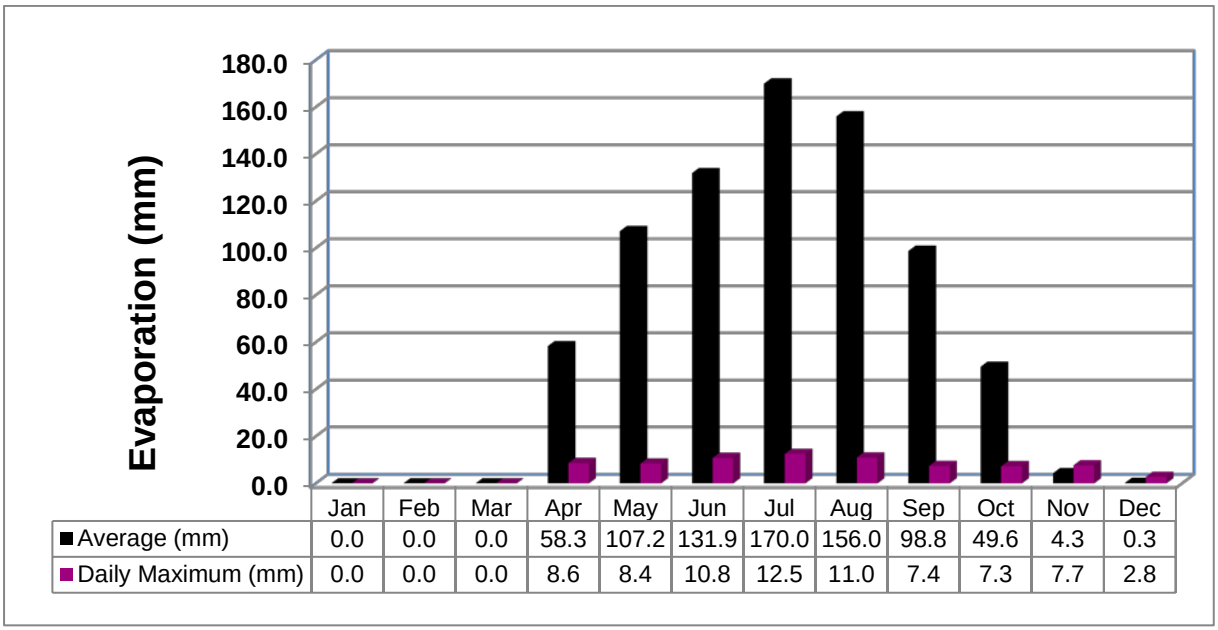


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Sum (mm)	31.8	28.0	35.6	55.7	69.8	73.7	34.2	32.0	33.8	38.1	29.3	36.7
Daily Maximum (mm)	26.0	44.6	27.9	32.7	44.5	81.2	52.5	53.0	73.6	49.0	26.1	37.2

Figure 5-20 TLong Term Precipitation Data of Kastamonu Meteorological Station

Evaporation

According to long-term data recorded by Kastamonu Meteorological Station, annual average evaporation in Kastamonu was identified to be 64.7 mm. As seen in Figure 5-21 Maximum average evaporation is observed in July as 170.0 mm on the other hand daily maximum evaporation is observed both in July as 12.5 mm.

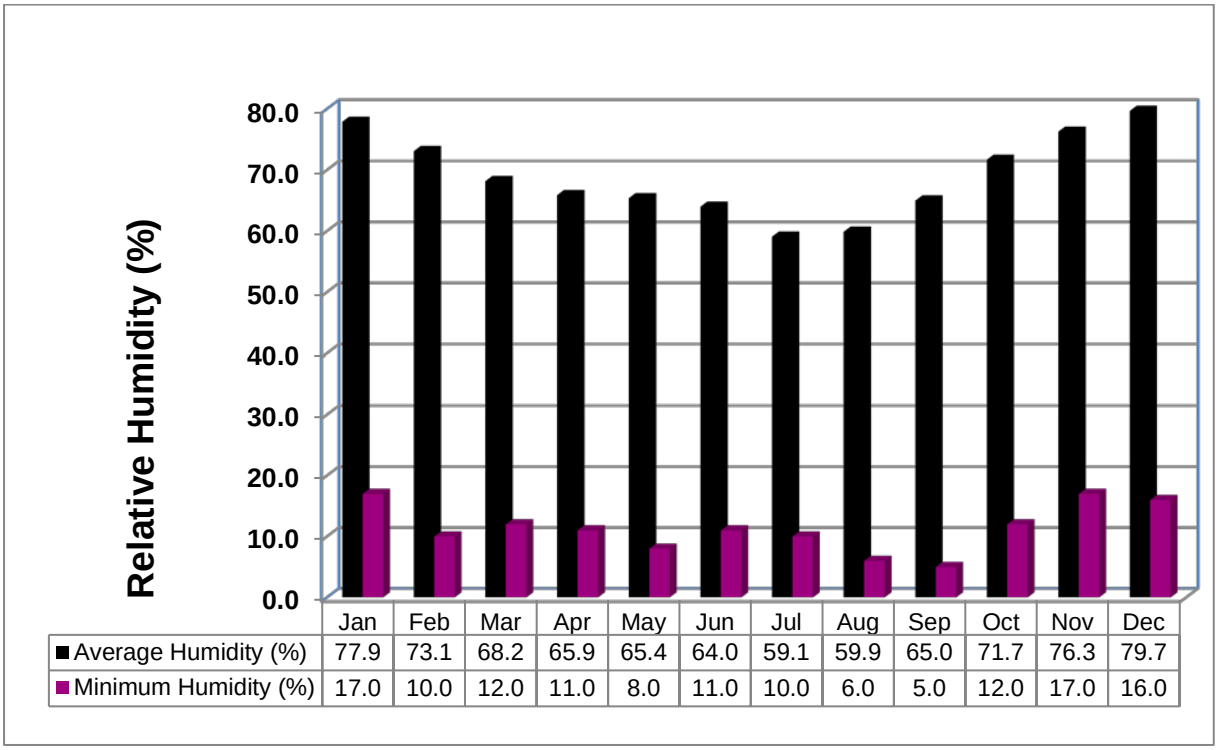


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average (mm)	0.0	0.0	0.0	58.3	107.2	131.9	170.0	156.0	98.8	49.6	4.3	0.3
Daily Maximum (mm)	0.0	0.0	0.0	8.6	8.4	10.8	12.5	11.0	7.4	7.3	7.7	2.8

Figure 5-21 Long Term Evaporation Data of Kastamonu Meteorological Station

Humidity

According to the long-term meteorological data recorded by the Kastamonu Meteorological Station, annual relative humidity in Kastamonu was identified to be 68.8%. In addition, maximum average relative humidity is observed in January as 77.9% whereas least humid month is July when average relative humidity is 59.1% (see Figure 5-22).



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Humidity (%)	77.9	73.1	68.2	65.9	65.4	64.0	59.1	59.9	65.0	71.7	76.3	79.7
Minimum Humidity (%)	17.0	10.0	12.0	11.0	8.0	11.0	10.0	6.0	5.0	12.0	17.0	16.0

Figure 5-22 Long Term Humidity Data of Kastamonu Meteorological Station

Wind

According to measurements conducted at the Kastamonu Meteorological Station, annual average wind speeds are close to each other as velocity, for most of the direction changes between 1.2 m/sec, and 1.5 m/sec.

The wind diagram in Figure 5-23 depicts the annual and seasonal wind directions and intensity. It is shown in wind diagram that according to the measurements taken from Kastamonu Meteorological Station, the highest intensity of wind is encountered in SSW direction.

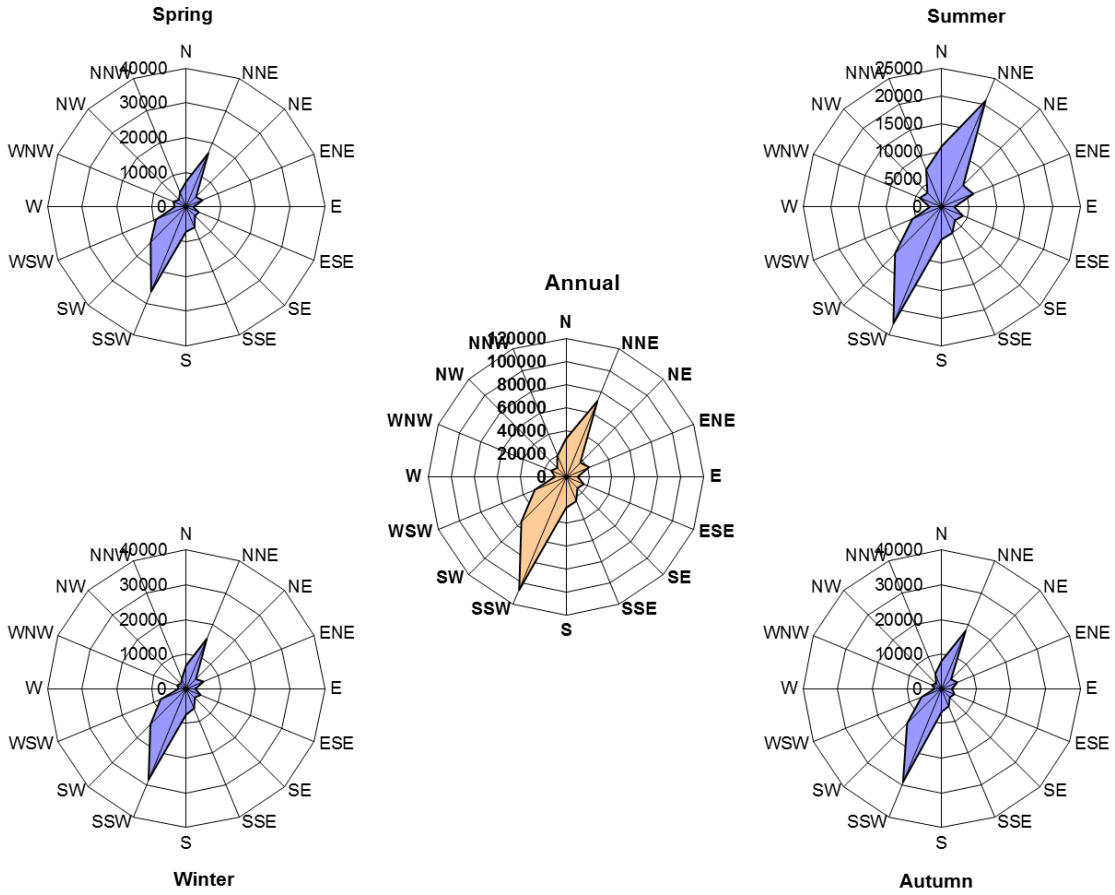


Figure 5-23 Annual and Seasonal Wind Roses Prepared for Kastamonu Meteorological Station

5.4.1.3 On-site Meteorological Model Data

Devrekani and Kastamonu stations collected over 50 years of meteorological data. However, for the purposes of related environmental assessments, they are located at a significant distance to the Project area and therefore, their data is not considered to be representative.

In order to complete a full assessment of climate related impacts, site specific climatic data was generated from the world wide accepted MM5 model. The MM5 is a regional mesoscale model developed by Penn State University and National Center for Atmospheric Research (USA). It is a limited-area, terrain-following sigma coordinate model that is used to replicate or forecast mesoscale and regional scale atmospheric circulation and is widely used for creating weather forecasts and climate projections, amongst other uses.

The model uses objective analysis of global weather reports. Objective analysis is a process of analysing the observed data and outputting them into a regular grid. The meteorological field is “balanced” to take account of the energy and momentum equations of the atmosphere. These objective analyses are products of global models, which are maintained by national weather centers or federal agencies such as UKMO (United Kingdom Meteorological Office) or NCEP (National Centre for Environmental Protection).

Lakes Environmental has run MM5 for GCP with the data obtained from NCEP (Global Reanalysis data). The model output provided by Lakes has a resolution of 12 km by 12 km, open pit being at the center. The output data was generated for 939 m elevation, on an hourly basis for five years for the following parameters:

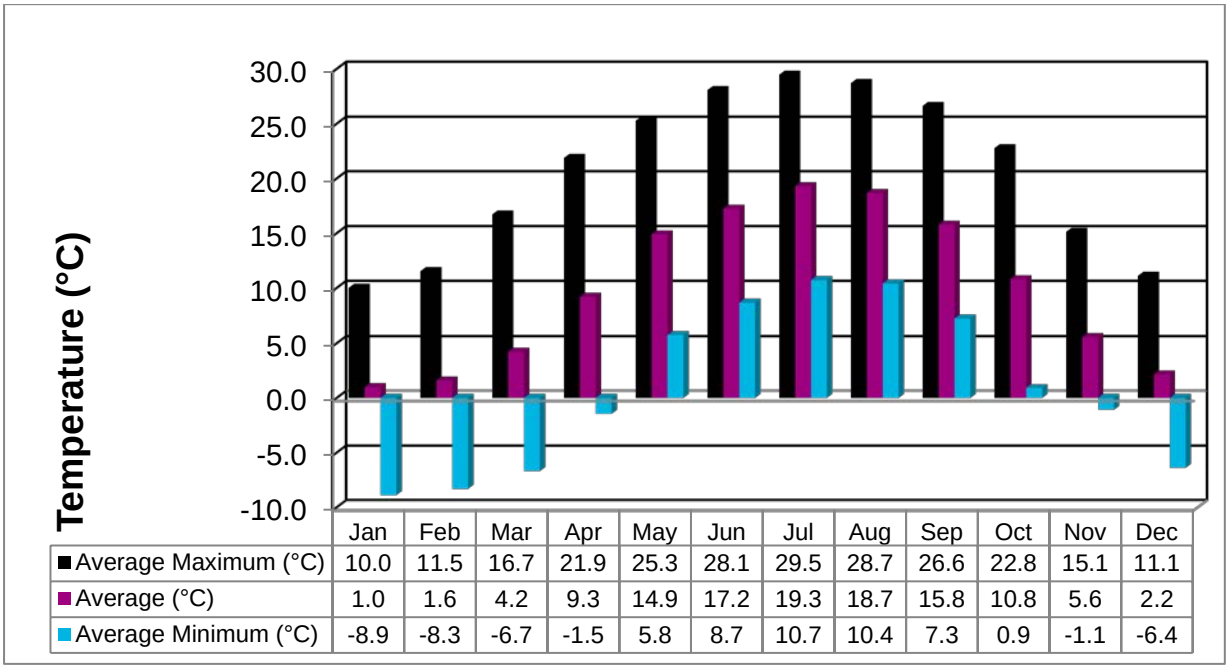
Table 5-12 Meteorological Parameters

Surface Level	Upper Air
Total cloud cover, opaque cloud cover (0-10) – derived by formula	Station ID, latitude, longitude
Ambient temperature (deg C)	Year (YYYY), month, day, hour (UTC)
Dew point temperature (deg C)	Number of vertical levels
Relative humidity (%)	Repeat number of vertical levels (currently, 18)
Station pressure (mb)	Pressure
Wind direction (0-360 deg)	Elevation
Wind speed (m/s)	Ambient temperature
Ceiling height (0-30450 m) - derived	Relative humidity
Present weather (09999, 99999:- unknown)	Wind direction
Hourly precipitation rate (inches and hundredths)	Wind speed
Global radiation (0-1415 Wh/m^2):- unknown	

The model output (2011-2015) regarding temperature, precipitation, evaporation, humidity and wind data for project area is discussed in the following sections in detail.

Temperature

According to 5 year on-site MM5 meteorological model data (2011 – 2015), the annual average temperature is 10.04°C. As shown in Figure 5-24, the warmest month is July, whereas the coldest month is January. The maximum and minimum temperatures during the observation period are recorded a 31.45°C on August 15, 2014 and -13.15°C on January 31, 2015, respectively.

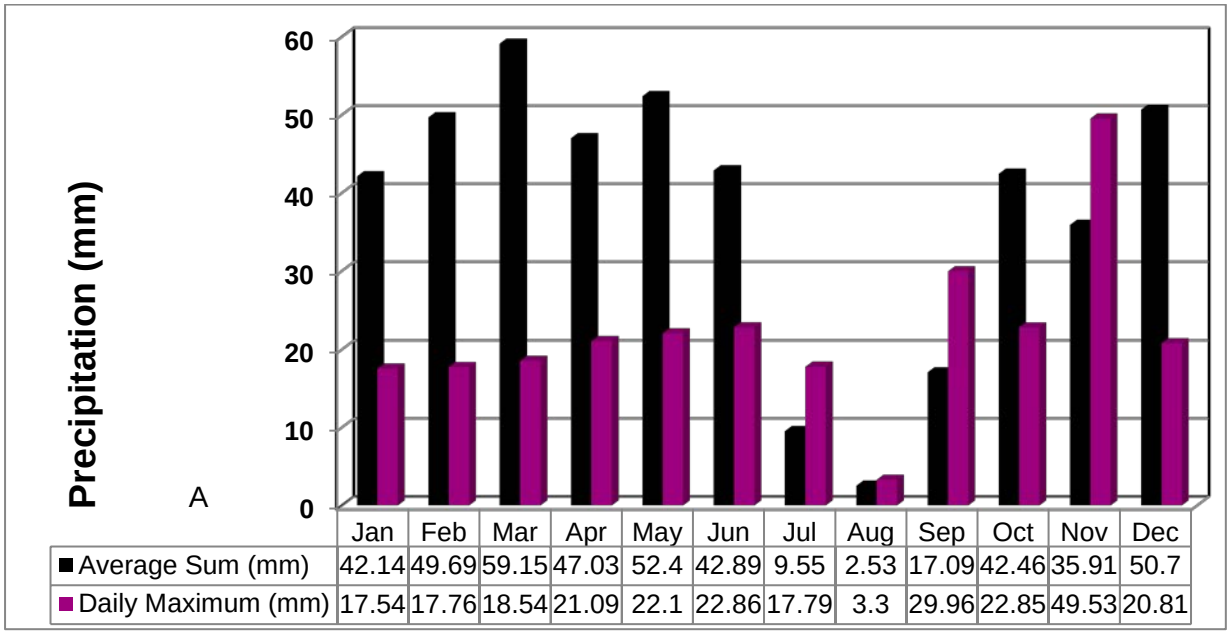


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Maximum (°C)	10.0	11.5	16.7	21.9	25.3	28.1	29.5	28.7	26.6	22.8	15.1	11.1
Average (°C)	1.0	1.6	4.2	9.3	14.9	17.2	19.3	18.7	15.8	10.8	5.6	2.2
Average Minimum (°C)	-8.9	-8.3	-6.7	-1.5	5.8	8.7	10.7	10.4	7.3	0.9	-1.1	-6.4

Figure 5-24 5-Year Temperature Data of on-site MM5 Meteorological Model

Precipitation

According to 5 year on-site MM5 meteorological model data, the amount of precipitation differs seasonally. As seen from Figure 5-25, the maximum total precipitation occurs in March with a monthly average of 59.15 mm. On the other hand, the average total minimum precipitation falls in August as 2.53 mm. According to this data, average total annual precipitation amount is 451.4 mm in the Project area.

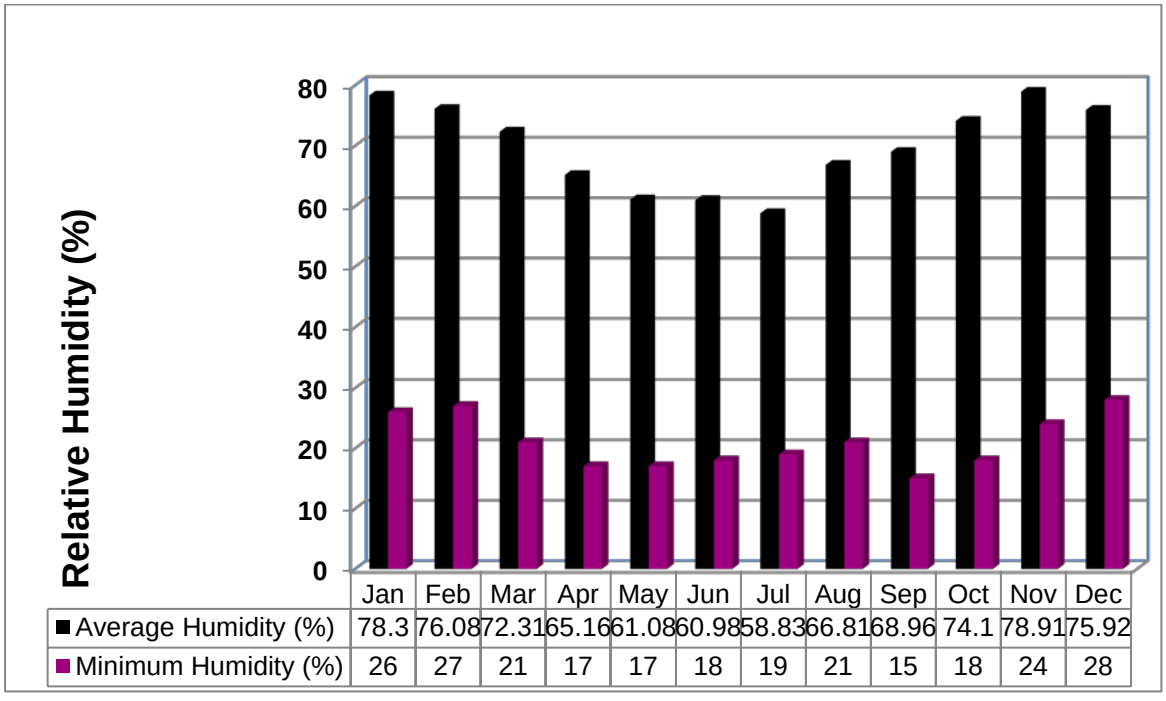


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Sum (mm)	42.14	49.69	59.15	47.03	52.4	42.89	9.55	2.53	17.09	42.46	35.91	50.7
Daily Maximum (mm)	17.54	17.76	18.54	21.09	22.1	22.86	17.79	3.3	29.96	22.85	49.53	20.81

Figure 5-25 5-Year Precipitation Data of on-site MM5 Meteorological Model

Humidity

According to the 5 year on-site MM5 meteorological model data, annual relative humidity was identified to be 69.23%. In addition, maximum average relative humidity is observed in November as 78.9% whereas least humid month is July when average relative humidity is 58.8% (see Figure 5-26).



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Humidity (%)	78.3	76.08	72.31	65.16	61.08	60.98	58.83	66.81	68.96	74.1	78.91	75.92
Minimum Humidity (%)	26	27	21	17	17	18	19	21	15	18	24	28

Figure 5-26 5-Year Humidity Data of on-site MM5 Meteorological Model

Wind

The wind diagram in Figure 5-27 depicts the annual and seasonal wind directions and intensity. It is shown in wind diagram that according to the measurements taken from the Meteorological Station, the highest intensity of wind is encountered in SW-WSW direction in spring and winter season and in summer the intensity is highest in NE-NNE.

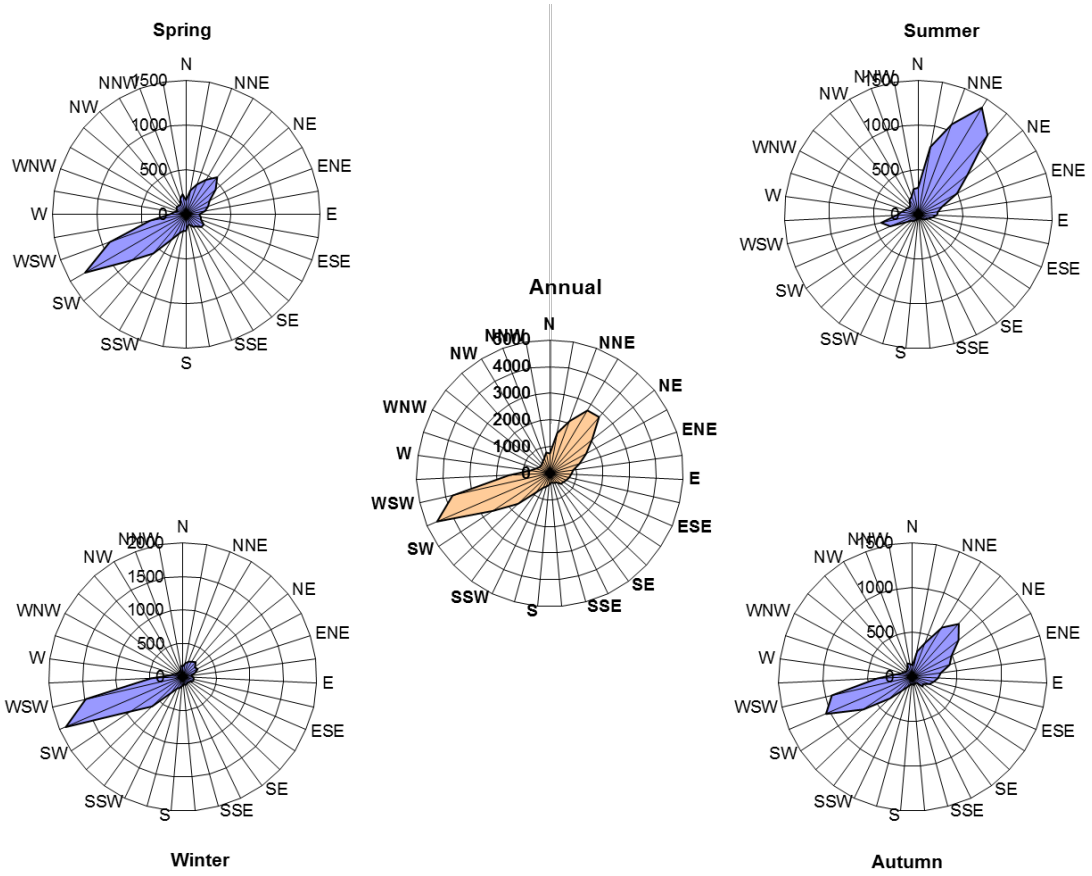


Figure 5-27 Annual and Seasonal Wind Roses of on-site MM5 Meteorological Model

5.5 Air Quality

The National Air Quality Monitoring Stations in Turkey record air pollutant statistics for each province. For Kastamonu, in 2016, the minimum and maximum levels for PM10 were recorded as 8 and 148 µg/m³ and for SO2 as 0 and 75 µg/m³, respectively.

In order to demonstrate the baseline air quality around the Project Area, PM10 and settled dust measurements were conducted during the national EIA process in 2014. Apart from that construction phase air quality monitoring is also in place including PM10 and settled dust measurements and as of August 2017 this has been extended to include measurements of PM10, PM2.5, settled dust, SO2, NO2, arsenic (As), cadmium (Cd), nickel (Ni), lead (Pb), CO, benzene and ozone to thoroughly assess the level of construction phase air emissions at the selected sensitive receptors (see Table 5-13 and Table 5-14 for monitoring results). The monitoring program results will be available 2017 Q4.

The existing PM10 and settled dust measurements are provided below with the measurement locations shown on the map as well.

The applicable national and international ambient air quality standards with limits are provided in Table 5-15.

- Turkish Air Quality Assessment and Management Regulation (AQAMR)
- Turkish Industrial Air Pollution Control Regulation (IAPCR)
- IFC General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality, April 30, 2007
- Directive 2008/50/EC on ambient air quality and cleaner air for Europe
- WHO Ambient Air Quality Guidelines (Table 1.1.1)

Table 5-13 PM10 Monitoring Results

Measurement Location	Baseline Measurement (µg/m3)		Construction Phase Monitoring (µg/m3)			
	11.07.2014	12.07.2014	04.05.2016 06.05.2016	01.08.2016 03.08.2016	02.11.2016 04.11.2016	01.02.2017 03.02.2017
Acacia Mine Guesthouse	28.54 (Hanönü)	28.02 (Hanönü)	27.57	18.64	16.77	42.14
Bağdere Neighborhood	-	-	17.7	36.79	32.24	12.5
Geymene Neighborhood	-	-	29.83	31.82	27.43	26.85
Sepetçioğlu Neighborhood	24.89	22.32	32.33	-	-	29.26
Dereköy Neighborhood	25.65	23.09	15.5	-	-	-
Yozlu Neighborhood	-	-	23.07	28.66	33.67	-
Küpeli Neighborhood	29.87	27.71	16.87	25.53	23.15	49.15
Yılanlı Neighborhood	-	-	12.77	24.2	28.31	22.45
Akçasu Neighborhood	-	-	14.43	-	-	-

Table 5-14 Settled Dust Monitoring Results during the Construction Phase

Measurement Location	Measurement Results (mg/m^2*day)												
	May 2016	**Jun 2016**	**Jul 2016**	**Aug 2016**	**Sep 2016**	**Oct 2016**	**Nov 2016**	**Dec 2016**	**Jan 2017**	**Feb 2017**	**Mar 2017**	**Apr 2017**	**Mean**
	04.05.2016 03.06.2016	03.06.2016 12.07.2016	12.07.2016 02.08.2016	02.08.2016 02.09.2016	02.09.2016 05.10.2016	05.10.2016 02.11.2016	02.11.2016 02.12.2016	02.12.2016 02.01.2017	02.01.2017 02.02.2017	02.02.2017 01.03.2017	01.03.2017 03.04.2017	03.04.2017 02.05.2017	
Acacia Mine Guesthouse	18.00	11.48	10.97	23.03	21.2	25.59	29.04	13.49	0.26	12.68	15.89	18.81	16.70
Çağlı Neighborhood	26.00	21.49	26.22	11.49	18.54	22.36	27.44	61.20	5.43	17.49	21.79	25.47	23.74
Bağdere Neighborhood	14.00	12.99	8.25	21.77	19.51	20.54	25.16	18.29	6.33	13.01	24.41	21.86	17.18
Geymene Neighborhood	19.00	18.94	18.29	24.72	29.41	28.36	30.61	32.57	1.00	20.76	21.64	23.95	22.44
Vakıf Neighborhood	31.00	22.83	26.14	53.61	28.78	29.3	34.58	61.51	2.48	17.73	31.94	24.51	30.37
Sepetçioğlu Neighborhood	22.00	10.94	5.68	15.92	22.29	26.67	33.66	21.56	2.69	21.60	22.93	24.51	19.20
Dereköy Neighborhood	25.00	59.87	35.4	54.61	31.13	48.49	44.28	55.92	0.63	24.63	34.41	28.12	36.87
Küpeli Neighborhood	13.00	65.61	33.85	30.73	26.79	26.73	34.42	32.84	1.32	24.33	22.43	26.71	28.23
Yozlu Neighborhood	23.00	15.38	21.86	29.99	28.04	25.21	32.08	40.74	0.32	16.04	14.26	16.11	21.92
Akçasu Neighborhood	15.00	13.82	29.14	107.95	56.61	62.03	70.75	56.72	3.85	21.24	23.22	25.00	40.44
Yılanlı Neighborhood	19.00	20.24	37.04	58.3	32.05	33.61	35.24	39.32	1.00	23.12	26.34	34.37	29.97

Table 5-15 Ambient Air Quality Standards and Project Standards

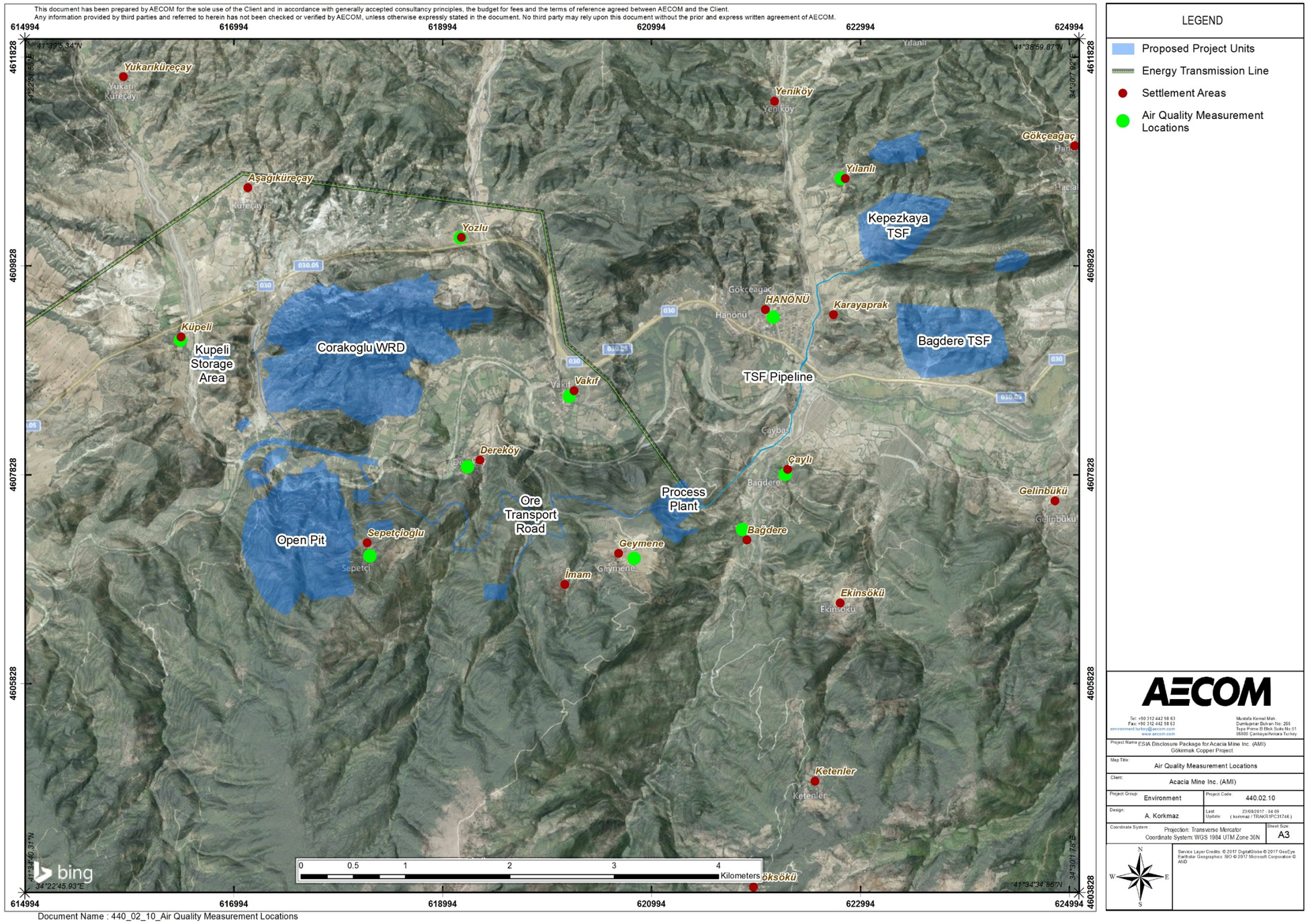
	AQAMR		IAPCR[4]	IFC/WB[1]		EU[2]		Project Limits[3]	
Parameter	**Averaging Period**	**Target Limits (1 Jan. 2019) (µg/m3)**	**Target Limits (1 Jan. 2019) (µg/m3)**	**Averaging Period**	**Guideline value µg/m3**	**Averaging Period**	**Limit Value**	**Averaging Period**	**Limit**
PM_{10}	24 hour (not to be exceeded more than 35 times a calendar year)	50 µg/m3	50 µg/m3	24 hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)	24 hours	50 µg/m3, not to be exceeded more than 35 times a year - limit values for the protection of human health	24 hour (not to be exceeded more than 35 times a calendar year)	50 µg/m3
	Yearly	40 µg/m3	40 µg/m3	Yearly	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)	Yearly	40 µg/m3 - limit values for the protection of human health	Yearly	20 µg/m3
$PM_{2.5}$	Limit Value not Available		Limit Value not Available	Limit Value not Available	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)	Yearly - Stage 1	25 µg/m3 Date by which limit value is to be met: 1 January 2015	Yearly	10 µg/m3
				50 µg/m3	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)	Yearly - Stage 2	20 µg/m3 Date by which limit value is to be met: 1 January 2020	24-hour	25 µg/m3
Sulphur dioxide (SO_2)	1 hour (not to be exceeded more than 24 times a calendar year)	350 µg/m3	350 µg/m3	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)	Hourly	350 µg/m3, not to be exceeded more than 24 times a calendar year	1 hour (not to be exceeded more than 24 times a calendar year)	350 µg/m3
	24 hour (not to be exceeded more than 3 times a calendar year)	125 µg/m3	125 µg/m3			24 hours	125 µg/m3	24 hour (not to be exceeded more than 3 times a calendar year)	20 µg/m3
	Yearly	60 µg/m3	60 µg/m3	10 minute	500 (guideline)	Yearly and winter (1 October to 31 March)	20 µg/m3 (critical level) - critical level for the protection of vegetation	Yearly	20 µg/m3
	Yearly and Winter season (1 October to 31 March) - ecosystem protection	20 µg/m3	20 µg/m3					Yearly and Winter season (1 October to 31 March) - ecosystem protection	20 µg/m3
NOx	Yearly – For the protection of vegetation	30 µg/m3	30 µg/m3	NA	NA	Yearly	30 µg/m3 NOx (critical level) - critical level for the protection of vegetation	1 Year - For the protection of vegetation	30 µg/m3
Nitrogen dioxide (NO_2)	1 hour (not to be exceeded more than 18 times a calendar year)	200 µg/m3 (1 Jan 2024)	200 µg/m3 (1 Jan 2024)	Hourly	200 (guideline)	Hourly	200 µg/m3, not to be exceeded more than 18 times a calendar year	1 hour (not to be exceeded more than 18 times a calendar year)	200 µg/m3 (1 Jan 2024)
	Yearly	40 µg/m3	40 µg/m3	Yearly	40 (guideline)	Yearly	40 µg/m3- limit values for the protection of human health	Yearly	40 µg/m3
CO	Maximum daily 8 hour mean	10 µg/m3	10 µg/m3	NA	NA	Maximum daily 8 hour mean	10 mg/m3- limit values for the protection of human health	Maximum daily 8 hour mean	10 µg/m3
Settled dust (mg/Nm3-day)	Monthly	390 (mg/Nm3-day)	390 (mg/Nm3-day)	NA	NA	NA	NA	Monthly	390 (mg/Nm3-day)
	Yearly	210 (mg/Nm3-day)	210 (mg/Nm3-day)	NA	NA	NA	NA	Yearly	210 (mg/Nm3-day)
Lead (Pb)	Yearly	0.5 µg/m3	0.5 µg/m3	NA	NA	Yearly	0.5 µg/m3	Yearly	0.5 µg/m3
Arsenic	Yearly	6 ng/m3	6 ng/m3	NA	NA	Yearly	6 µg/m3	Yearly	6 ng/m3
Cadmium	Yearly	5 ng/m3	5 ng/m3	NA	NA	Yearly	5 ng/m3	Yearly	5 ng/m3
Nickel	Yearly	20 ng/m3	20 ng/m3	NA	NA	Yearly	20 ng/m3	Yearly	20 ng/m3
Ozone	Maximum daily 8 hour mean	100 µg/m3	100 µg/m3	Maximum daily 8 hour mean	100 µg/m3	Maximum daily 8 hour mean	100 µg/m3	Maximum daily 8 hour mean	100 µg/m3

[1] *IFC General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality, April 30, 2007 & Table 1.1.1: WHO Ambient Air Quality Guidelines.*
[2] *Directive 2008/50/EC on ambient air quality and cleaner air for Europe.*
[3] *The project limit is determined by reference to the strictest limit.*
[4] *Limit values must be ensured within the impact area.*

The mean values of the PM10 sampling studies performed 2014, 2016 and 2017 are compared with the 24 hour limit values stated in Project Limits in Table 5-16 above. As can be seen from Table 5-16 values are in compliance with the short term limit values stated in the Project Limits.

Table 5-16 Mean Values of Baseline PM10 Measurement Results with Project Limits

Measurement Location	Baseline Measurement Results Average (µg/m3)	Construction Stage monitoring Results Average (µg/m3)	Project Limits (µg/m3)
Acacia Mine Guesthouse	-	26.28	**50** µg/m3 (24hr Averaging Period)
Bağdere Neighborhood	-	25.31	
Geymene Neighborhood	-	28.98	
Sepetçioğlu Neighborhood	23.60	30.80	
Dereköy Neighborhood	24.37	15.50	
Yozlu Neighborhood		28.47	
Küpeli Neighborhood	28.79	28.68	
Yılanlı Neighborhood		21.93	
Akçasu Neighborhood	28.28	14.43	



Document Name : 440_02_10_Air Quality Measurement Locations

Figure 5-28 Air Quality Measurement Locations

5.6 Noise and Vibration

5.6.1 Noise

Background noise measurements were conducted at 9 points at the Project Area and its surroundings for day, evening and night time periods The location of the noise measurement points were selected in accordance with Turkish RAMEN and the microphone was placed in a way to ensure it is protected from air currents, vibrations, electric or magnetic fields, as well as other influences that might affect the noise level recording. The measurements were conducted at 1.5 m height from the ground and 1.0 m away from the nearest receptor. As for the selection of the measurement locations, the nearest residential areas were considered.

The noise level measurement results are provided in Table 5-17 and measurement locations are presented in Figure 5-29.

The construction phase daytime noise monitoring results are below the limits set for construction phases of Projects within Turkish RAMEN. IFC does not distinguish between noise limits for construction and operation phases and thus it is assumed that the level given is applicable for the operation phase of the Project.

Table 5-17 Noise Level Measurement Results and Applicable Limits

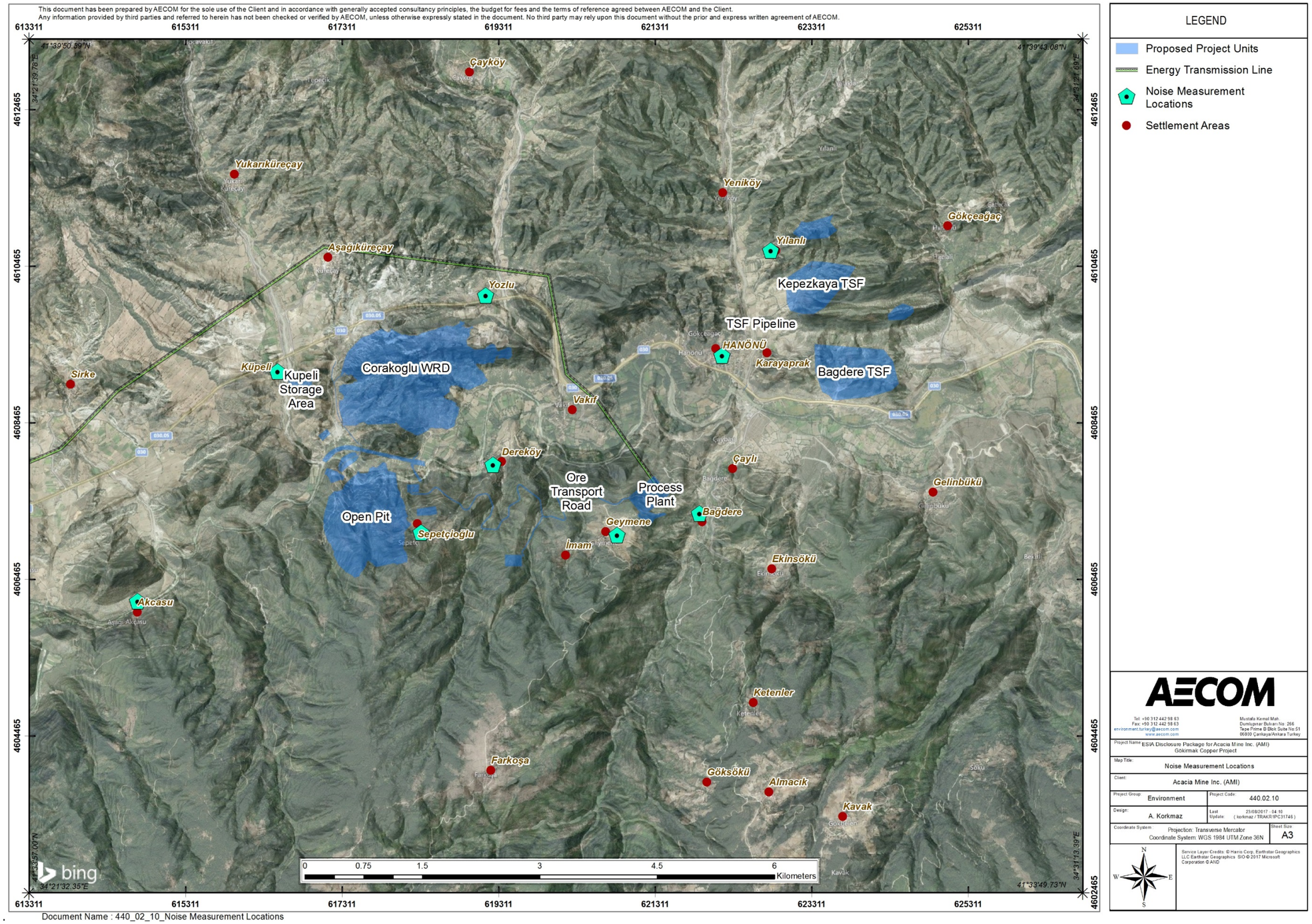
Measurement Location	Baseline Monitoring Results[1] Leq (DBA)			Construction Stage Monitoring Results[2] Leq (DBA)			Limits Leq (DBA)				Project Limits Leq (DBA)	
	Daytime	Evening time	Nighttime	04.05.2016 06.05.2016	01.08.2016 03.08.2016	02.11.2016 04.11.2016	EU	IFC	WHO	RAMEN	Construction Period	Operation Period
Hanönü (Acacia Mine Guesthouse)	-	-	-	57.9	56.5	53.7	N/A[3]	55 Daytime 45 Nighttime Background Level +3 dbA	45 Night (indoor with windows open)[4] 55 (interim Target)	55 Nighttime 60 Evening 65 Daytime 70 Construction Period Background Level +5 dbA	70 Daytime Construction Period 45 Nighttime	55 Daytime 45 Nighttime
Bağdere Neighborhood	-	-	-	61.5	61.8	61.8						
Geymene Neighborhood	39.7	33.5	34.2	61.4	61.7	61.7						
Sepetçioğlu Neighborhood	46.7	44.1	34.4	54.1	57.8	57.8						
Dereköy Neighborhood	46.9	36.5	33.2	48.2	51.2	49.4						
Küpeli Neighborhood.	45.3	46.1	33.8	56.3	55.2	51.7						
Yılanlı Neighborhood	37.3	35.9	33.9	49.7	51.4	48.7						
Vakıf (Akçasu) Neighborhood	-	-	-	60.3	-	-						

[1] Measured between 23.11.2012 to 24.11.2012 and 06.03.2013 to 07.03.2013 during national EIA studies.

[2] Daytime measurements.

[3] EU Legislation does not provide numerical limit value.

[4] This is an external noise level and assumes that internal noise levels are in the order of 15 dBA lower with open windows and 27 dBA lower with closed windows (which would be the expected normality in the Project's climate). In addition, WHO (1999) recommends that internal sound levels should not exceed approximately 45 dBA more than 10 to 15 times per night.



LEGEND

- Proposed Project Units
- Energy Transmission Line
- Noise Measurement Locations
- Settlement Areas

AECOM

Tel: +90 312 442 98 63
Fax: +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com

Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime D Blok Suite No:51
06810 Çankaya/Ankara Turkey

Project Name: ESIA Disclosure Package for Acacia Mine Inc. (AMI)
Gökırmak Copper Project

Map Title: Noise Measurement Locations

Client: Acacia Mine Inc. (AMI)

Project Group: Environment | Project Code: 440.02.10

Design: A. Korkmaz | Last Update: 23/08/2017 - 04:10 (korkmaz / TRAKRIPC31746)

Coordinate System: Projection: Transverse Mercator
Coordinate System: WGS 1984 UTM Zone 36N | Sheet Size: A3

N W E S

Service Layer Credits: © Harris Corp, Earthstar Geographics LLC Earthstar Geographics SIO © 2017 Microsoft Corporation © AND

Document Name : 440_02_10_Noise Measurement Locations

Figure 5-29 Noise Measurement Locations

5.6.2 Vibration

For open-pit operations, ANFO (ammonium nitrate/fuel oil), a widely used bulk industrial explosive, will be used for blasting and packaged emulsion explosives will be used for ignition. For blasting activities an Explosives Risk Analysis Report has been prepared by Okan University in 2014. According to the Report, a controlled blasting method will be applied by using delayed (millisecond) detonators and appropriate blast designs.

The Report states that the nearest settlement component to the open-pit is a hayloft located in Sepetcioglu Neighbourhood. The peak particle velocity at this location is calculated as 9,887 mm/sec. This value is compared with the peak particle velocity defined for vibration frequency between 4 Hz and 10 Hz. The peak particle velocity limit defined for this frequency interval is 19 mm/sec and the calculated value is lower than the limit value given in the Turkish Regulation on Assessment and Management of Environmental Noise (RAMEN) (see **Table 5-18** for Annex VII Table 6 of RAMEN, which includes Maximum Permissible Values of Ground Vibrations that can occur outside the nearest highly-sensitive zone for vibrations sourced from blasting in Mining Pits, Quarries and Similar Areas).

Table 5-18 Maximum Permissible Values of Ground Vibrations

Vibration frequency (Hz)	Maximum Permissible Vibration Rate (Peak Value-mm/s)
1	5
4-10	19
30-100	50

Ongoing Vibration Monitoring

AMI has been monitoring vibration levels at the open pit whilst blasting. The measured levels for June 2017 and July 2017 are given in Table 5-19 below.

As can be seen from the results, none of the vibration measurements recorded is above the limits as set in Turkish RAMEN.

Table 5-19 Ongoing Vibration Monitoring Results

Location	Date	Channel	Peak	Frequency	Location	Date	Channel	Peak	Frequency
Sepetçioğlu	02.06.2017	Vertical	1.61	12	Sepetçioğlu	08.07.2017	Vertical:	0.05	12
		Longitudinal	1.52	7			Longitudinal:	0.04	25
		Transverse	1.16	12			Transverse:	0.03	3
400m away from explosion point	03.06.2017	Vertical	<0.05	-		08.07.2017	Vertical:	0.03	23
		Longitudinal	<0.05	-			Longitudinal:	0.05	7
		Transverse	<0.05	-			Transverse:	0.04	6
Sepetçioğlu	06.06.2017	Vertical	0.75	9	350m away from explosion point	10.07.2017	Vertical:	0.05	7
		Longitudinal	1.71	6			Longitudinal:	0.08	3
		Transverse	0.05	8			Transverse:	0.05	12
400m away from explosion point	09.06.2017	Vertical	<0.05	-		10.07.2017	Vertical:	0.51	21
		Longitudinal	<0.05	-			Longitudinal:	0.92	13
		Transverse	<0.05	-			Transverse:	1.24	11
Sepetçioğlu	10.06.2017	Vertical	1.63	19	300m away from explosion point	12.07.2017	Vertical:	1.41	18
		Longitudinal	0.12	170			Longitudinal:	1.07	18
		Transverse	1.25	7			Transverse:	2	16
400m away from explosion point	13.06.2017	Vertical	1.48	12	Sepetçioğlu	14.07.2017	Vertical:	<0.05	-
		Longitudinal	1.32	6			Longitudinal:	<0.05	-
		Transverse	1.23	12			Transverse:	<0.05	-
	13.06.2017	Vertical	5.04	8	300m away from explosion point	17.07.2017	Vertical	1.23	14
		Longitudinal	8.42	12			Longitudinal	1.27	15
		Transverse	5.55	11			Transverse	1.1	13
Sepetçioğlu	15.06.2017	Vertical	<0.05	-		17.07.2017	Vertical:	0.57	7

Location	Date	Channel	Peak	Frequency	Location	Date	Channel	Peak	Frequency
		Longitudinal	<0.05	-			Longitudinal:	1.1	13
		Transverse	<0.05	-			Transverse:	0.5	16
		Vertical	0.25	10			Vertical:	1.65	12
Sepetçioğlu	17.06.2017	Longitudinal	0.5	7	300m away from explosion point	18.07.2017	Longitudinal:	1.53	14
		Transverse	0.69	15			Transverse:	1.57	15
		Vertical	0.3	27			Vertical:	0.31	4
	20.06.2017	Longitudinal	0.56	9		21.07.2017	Longitudinal:	0.73	12
		Transverse	0.42	5			Transverse:	0.58	15
Sepetçioğlu		Vertical	<0.05	-	300m away from explosion point		Vertical:	1.19	38
	20.06.2017	Longitudinal	<0.05	-		21.07.2017	Longitudinal:	1.72	15
		Transverse	<0.05	-			Transverse:	1.88	24
		Vertical	<0.05	-			Vertical:	0.36	7
Sepetçioğlu	22.06.2017	Longitudinal	<0.05	-		22.07.2017	Longitudinal:	0.62	6
		Transverse	<0.05	-			Transverse:	0.84	5
		Vertical	0.47	10	300m away from explosion point		Vertical:	0.53	23
Sepetçioğlu	28.06.2017	Longitudinal	0.56	6		22.07.2017	Longitudinal:	1.02	26
		Transverse	0.6	16			Transverse:	1.33	8
		Vertical:	0.52	5			Vertical:	1.15	26
Sepetçioğlu	01.07.2017	Longitudinal:	0.69	8	300m away from explosion point	24.07.2017	Longitudinal:	1.73	11
		Transverse:	0.56	8			Transverse:	1.19	11
		Vertical	<0.05	-			Vertical:	1.38	7
Sepetçioğlu	03.07.2017	Longitudinal	<0.05	-	300m away from explosion point	26.07.2017	Longitudinal:	1.81	4
		Transverse	<0.05	-			Transverse:	1.17	7

Location	Date	Channel	Peak	Frequency
Sepetçioğlu	04.07.2017	Vertical	<0.05	-
		Longitudinal	<0.05	-
		Transverse	<0.05	-
300m away from explosion point	06.07.2017	Vertical:	1.26	14
		Longitudinal:	1.51	14
		Transverse:	0.9	13
	06.07.2017	Vertical:	1.03	13
		Longitudinal:	1.6	13
		Transverse:	1.13	14
	26.07.2017	Vertical:	<0.05	-
		Longitudinal:	<0.05	-
		Transverse:	<0.05	-
300m away from explosion point	29.07.2017	Vertical:	3.75	13
		Longitudinal:	3.55	17
		Transverse:	1.93	7
300m away from explosion point	31.07.2017	Vertical:	0.92	33
		Longitudinal:	1.08	29
		Transverse:	1.16	10
	31.07.2017	Vertical:	0.47	28
		Longitudinal:	0.58	6
		Transverse:	0.48	10

5.7 Water Resources

5.7.1 Basin Characteristics

The Project Area is located within the Kızılırmak River catchment, which covers an area of approximately 82,000 km^2. The Gökırmak River, which is one of the biggest tributary of the Kızılırmak River, flows between the project units. The Gökırmak River passes Taşköprü and Hanönü districts and reaches Kızılırmak near Boyabat district, approximately 40 km away from the Project Area

Although the hydrogeological investigation and characterization of the Project Area is focused mainly on the project units, a study area is determined in order to limit the external boundary of the studies conducted in the area, such as geology and groundwater model. The northern and southern boundaries of the study area follow the watershed boundary. On the other hand, the western and eastern boundaries are located about 4 and 9 km away from the closest project units, respectively (Figure 5-30).

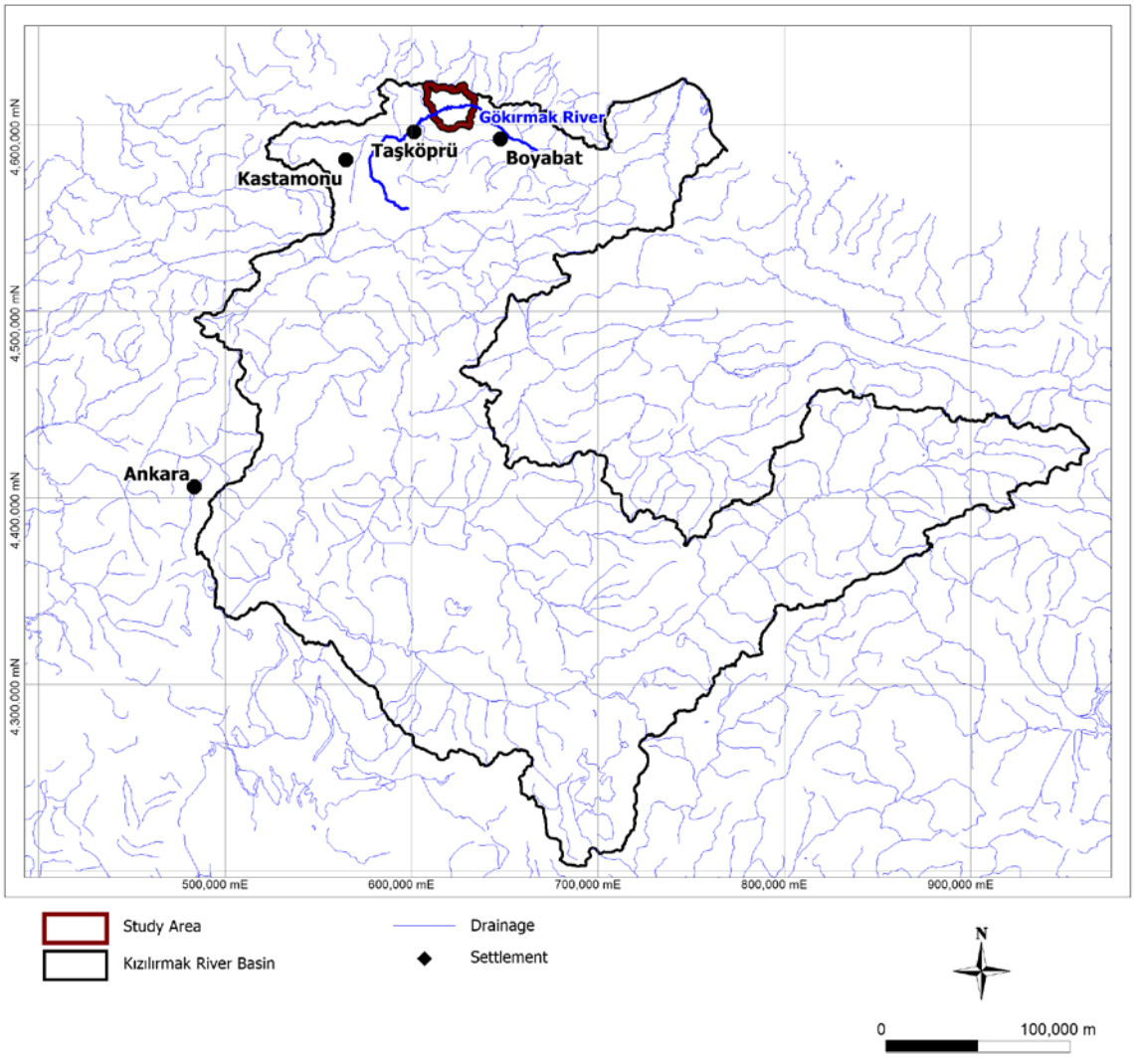


Figure 5-30 Drainage pattern of the Kızılırmak River

Steep and undulating topography is observed with altitudes ranging from 350 m at the eastern part around the Gökırmak River to 1799 m at the northern part of the study area. The altitude of the project units range from 880 m to 430 m in the Open Pit, 620 m to 436 m in the Çorakoğlu WRD, 602 m to 452 m in the Kepezkaya TSF, 530 m to 411 m in the Bağdere TSF, and 660 m to 528 m in the Process Plant area. The Project Area being located in the eastern part of the Kastamonu province is influenced by continental climate of Central Anatolia and mild and rainy climate of Black Sea region. The area is characterized by rainy seasons throughout the year, with cold and snowy winters and mild summers.

A series of meteorological stations collecting long term data have been established by the State Meteorological Organization (DMI) at Kastamonu, Devrekani, Taşköprü and Hanönü/Gökçeağaç. The closest meteorological station to the Project Area in operation is the Devrekani Meteorological Station, which is located approximately 50 km west of the area. In 2014, an automated meteorological station was established in Taşköprü region (station id: 18522) by DMI, but as representing the data of a relatively short operation period. Thereby, the measurements recorded at this station were not considered within the scope of this study. A site specific weather observation station was established in the Project Area on December 16, 2015. The station started data collection on December 18, 2015 and has so far been measuring meteorological data at 15-minute intervals.

The calculated mean annual precipitation values for Kastamonu, Gökçeağaç, Taşköprü and Devrekani stations are 484.95 mm, 448.4 mm, 450.44 mm and 539.30 mm, respectively. Measured precipitation values show seasonal variations, where maximum mean precipitation occurs in April to June, and minimum mean precipitation occurs in summer. The minimum monthly temperatures are below 0°C and observed in winter, while maximum monthly temperatures are approximately 15 - 20°C and observed in summer.

Surface Water Bodies and Structures

The nearest ponds to the Project Area were identified as the Asar Pond, having a distance of 30 km, and Kabalar Pond, having a distance of 31.1 km to Hanönü. Both ponds are primarily used for irrigation purposes with storage volumes of 4.56 hm3 and 0.56 hm3, respectively. There is also a natural lake, known as the Dipsiz Lake, located in Tosya region of the Kastamonu Province, however, no study has so far been carried out regarding its use as a water resource.

Seven dams are currently being operated within the Kastamonu Province. The dams were identified to be used for different purposes such as drinking and industrial water supply, irrigation, and power production. The nearest dam was identified to be the Karadere Dam having a distance of 31.1 km to the Project Area.

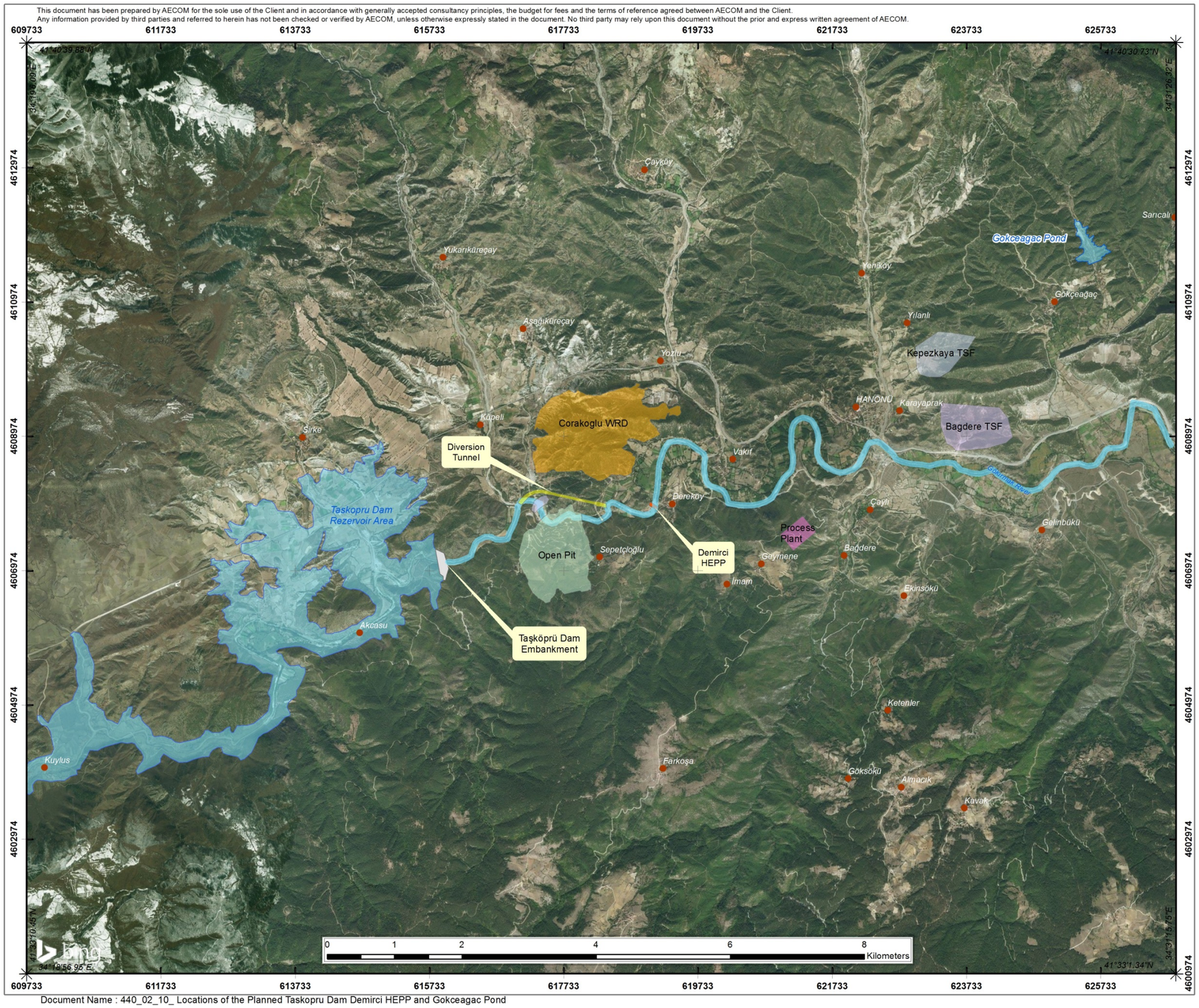
Privately-owned Demirci Regulator and Hydroelectric Power Plant (Demirci HEPP) is constructed on the Gökırmak River, next to the Dereköy Village in Hanönü. The facility consists of 18.500 m-long supply canal, forebay pool, 200 m-long penstock pipe, turbine and a power house. Thalweg and crest elevations of the Demirci HEPP are 420 m and 425m while maximum water elevation is 428 m, respectively. Installed capacity of the facility is 13.05 MW and it is planned to generate 59.1 GWh power per year. The nearest project units (water intake and spill way) to the Demirci HEPP are the Open Pit and the Çorakoğlu WRD which are situated in 1 km (Open Pit) and 600 m (Çorakoğlu WRD) distances.

Taşköprü Dam is planned to be constructed on the Gökırmak River approximately 1.5 km southwest of the upstream cofferdam of the Gökırmak River diversion. The dam is planned to provide water for both irrigation purposes and power generation. Following its construction, the Taşköprü Dam is expected to irrigate 6,062 ha gross agricultural land area (5,456 ha net area) with an annual energy production of 52.20 GWh. Dam site, reservoir and 1st unit of irrigation area (Hanönü Irrigation) are located within Kastamonu (Hanönü province) while the 2nd unit of Irrigation (Urluca Irrigation) site is located within Sinop, (Boyabat and Durağan provinces).

Gökçeağaç Pond is planned to be constructed approximately 7.5 km from the Open Pit area, to supply drinking water. The nearest project units to the planned Gökçeağaç Pond are the Kepezkaya and Bağdere TSFs that are located within 2 km and 2.6 km distances.

Locations of the planned Taşköprü Dam, Demirci HEPP and the planned Gökçeağaç Pond are shown in Figure 5-31 while the detailed information on Water Resources is provided in Hydrogeological Impact Assessment Report in Volume-III of this ESIA.

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



Document Name : 440_02_10_ Locations of the Planned Taskopru Dam Demirci HEPP and Gokceagac Pond

LEGEND

Legend

- Settlement Areas
- Gökırmak River
- Lakes and Ponds

AECOM

Tel: +90 312 442 98 63
Fax: +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com

Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime B Blok Suite No:51
06800 Çankaya/Ankara Turkey

Project Name:	ESIA Disclosure Package for Acacia Mine Inc. (AMI) Gökırmak Copper Project
Map Title:	Planned Taşköprü Dam, Demirci HEPP and Gökçeağaç Pond
Client:	Acacia Mine Inc. (AMI)
Project Group: Environment	Project Code: 440.02.10
Design: A. Korkmaz	Last Update: 05.09.2017 - 06:33 (ozbakirm / TRAKR1PC30441)
Coordinate System: Projection: Transverse Mercator Coordinate System: WGS 1984 UTM Zone 36N	Sheet Size: A3

Service Layer Credits: © Harris Corp, Earthstar Geographics LLC Earthstar Geographics SIO © 2017 Microsoft Corporation

Figure 5-31 Locations of the Planned Taşöprü Dam, Demirci HEPP and Gökçeağaç Pond

5.7.2 Study Area

Although the hydrogeological investigation and characterization of the Gökırmak Copper Project Area is focused mainly on the project units, a study area is determined in order to limit the external boundary of the studies conducted in the area, such as geology and groundwater model.

The northern and southern boundaries of the study area follow the watershed boundary. On the other hand, the western and eastern boundaries are located about 4 and 9 km away from the closest project units, respectively (Figure 5-32).

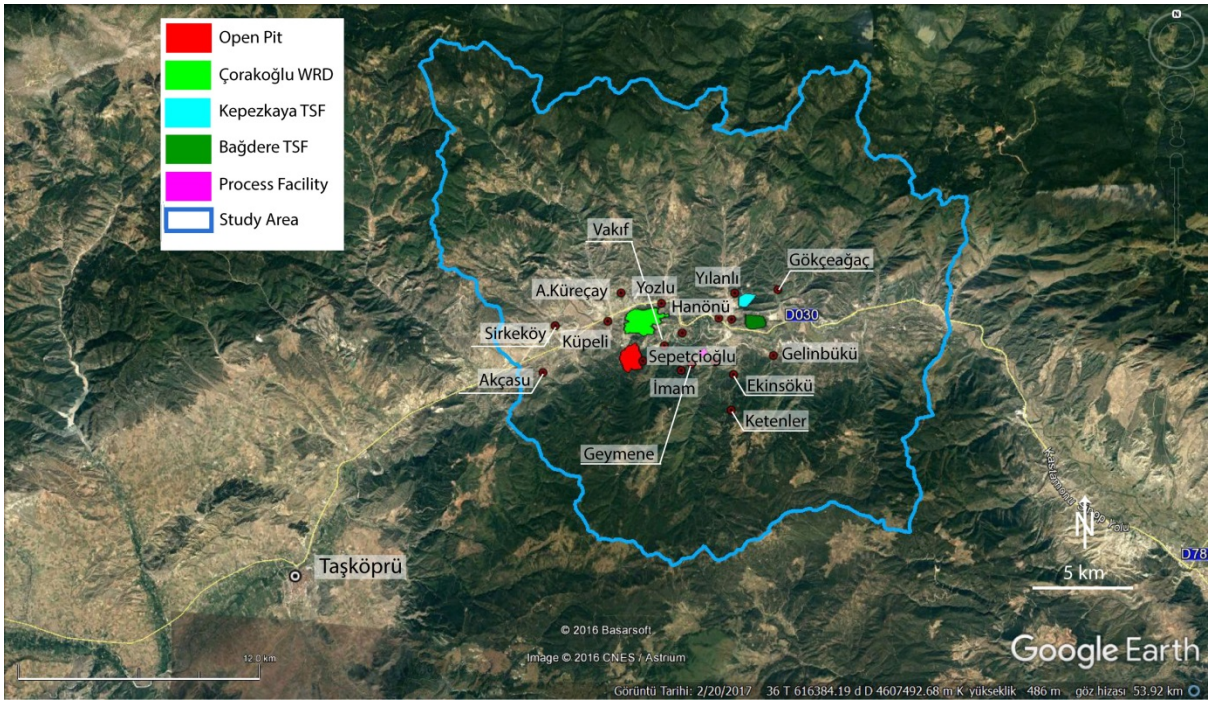


Figure 5-32 Location Map for the Study Area

5.7.3 Calculated Hydro-Meteorological Parameters for the Study Area

Since the study area is located in a steep and undulating topography, where the altitude ranges between 350 m and 1800 m, the distribution of precipitation and temperature expected to vary within the study area. In this regard, the precipitation and temperature data recorded at the meteorological stations are corrected based on the elevation that corresponds to 25th and 75th percentile of the area, which are 621.7 m and 1166.2 m, respectively.

Precipitation

In order to represent the precipitation regime of the lower elevations, precipitation values recorded at Taşköprü station was used. For the higher elevations, the representative precipitation regime is determined according to the precipitation values recorded at Devrekani station. The mean annual precipitation for the regime of the lower elevations (25th percentile) was calculated as 461.2 mm/year. The mean annual precipitation for the 75th percentile of the area was determined as 551.76 mm/year.

Temperature

The temperature distribution for the lower elevations (621.7 m) is estimated using the values recorded at the Kastamonu and Taşköprü stations, for the mutual operating period of 2014 – 2016. Based on the estimations, corrected values were determined to be 19.2°C for the month of July as maximum and -0.8°C for the month of January as the minimum during a year. The temperature distribution for the higher elevations (1166.2 m) was estimated using the temperature-elevation relationship. The long-term mean monthly temperature values recorded at the Devrekani station was used, since the Devrekani station is located as the station of highest altitude (1050 m) in the vicinity of the study area. Based on the estimation regarding the Devrakani station, corrected values for the month of July were evaluated to be 16°C as maximum and for the month of January was evaluated to be -3°C as minimum for the 75th percentile of the area during the year.

Evaporation

The evaporation values for the study area was determined by using the corrected temperature values for the median elevation of the study area and linear fit equation that was obtained from temperature-evaporation relationship of the Kastamonu station data. Approximately 200 mm of evaporation was determined around 22°C and 50 mm was determined around 7°C.

Estimation of Groundwater Recharge

Precipitation in an area is transformed into runoff, infiltration and/or evapotranspiration components. Water budget calculations estimate the ratio of these components to precipitation. During the estimation of the water budget for the study area, Thornthwaite method was used to calculate potential evapotranspiration while the estimated curve number was used for surface runoff determinations. The remaining portion of the precipitation was assumed to be equal to infiltration into groundwater.

According to the water budget calculations, average annual groundwater recharge from direct precipitation in the study area was calculated as 31.70 mm, which comprises 6% of the annual precipitation. The conceptual water budget calculations were repeated by using the corrected precipitation and temperature series for higher and lower elevations, which corresponds to 75th and 25th percentile of the area, respectively. Correspondingly, average annual groundwater recharge from direct precipitation at the higher elevations was calculated as 50.39 mm, which comprises 9% of the annual precipitation. On the other hand, at the lower elevations, average annual groundwater recharge from direct precipitation was determined as 14.03 mm, which comprises 3% of the annual precipitation. Details on calculated hydro-meteorological parameters for the study area are provided in Hydrogeological Impact Assessment Report in Volume-III of this ESIA.

5.7.4 Drinking Waters

A water quality sampling and monitoring program was initialized in September 2015 by AECOM, primarily to identify the quality of drinking waters. AECOM has collected samples from the water depots and springs at selected locations in the Project Area to understand the baseline conditions in more detail and more in line with the current mine layout. Project Area and its vicinity were also investigated to identify the major transmission lines that provide water for the nearby settlement areas. As of May 2016 AECOM has started an extensive sampling and monitoring program on drinking water quality that covers village water depots, fountains and springs located in the Project Area. Sampling and monitoring studies and water quality assessments are provided in Section 5.7.7.

Drinking water of the nearby villages is generally supplied from springs or from water collection structures constructed on upstream portion of the closest available surface water resources. Some of the villages located in close proximity to the relatively wide streambed of the Gökırmak River provide their water from the wells located in river bank alluviums of the Gökırmak River. Brief descriptions for notable village water supply systems are provided below while the locations of the water transmission lines are shown in Figure 5-33.

Sepetcioğlu Village: the closest village to the Open Pit area. Habitants of this village consume water directly from a nearby spring (K-1 in Figure 5-33). A depot does not exist in the village. K-1 coded water sample was collected and analyzed.

Dereköy Village: located in the southern bank of the Gökırmak River. This village uses a nearby spring located in the upstream portion of Kızılince stream. The K-4 coded water sample was collected from this spring and D-4 coded sample was collected from the water depot of the Dereköy village.

Vakıf Village: located at the northwest of the Process Plant near the Gökırmak River. Domestic water for this village is supplied from a well located in the village. Water is pumped to the depot of Vakıf village constructed in the northeast of the village and then distributed to the households.

Küpeli and Aşağıküreçay villages: located in the west of the Çorakoğlu WRD. Domestic water need of these two villages is met from a well (WSW-1), completed within the bank alluvium of the Gökırmak River. Water is pumped to Küpeli and Aşağıküreçay villages water depots via a buried pipeline system.

Hanönü Town: located in the west of the Kepezkaya and Bağdere TSFs. The spring used for drinking water supply is located north of the Yeniköy Village on the upstream of Yılanlı Stream. Hanönü has two water depots in the Karayaprak Village. The municipality of Hanönü utilizes a caisson well located at the intersection point of Gökırmak and Yılanlı streams to meet the additional water needs in the dry season.

Yılanlı Village: located near the Kepezkaya TSF. This village uses the same water supply system which is utilized for the Hanönü Town.

Imam Village: located toward the southwest of the Process Plant. The village has a relatively small water depot fed by a nearby spring located 50 m away from the depot.

Geymene Village: located at the south of Hanönü between Bağdere and İmam villages. Domestic water source location is not exactly known. However, based on the information verbally obtained from the locals, the source is close to the Farkoşa Village in the south. Water is stored in the depot of the village itself.

Yeniköy Village: located in the north of the Hanönü Town (upstream section of the Yılanlı Stream). Water is provided by the same source as the Hanönü Town.

Bağdere Village: located in the south of Hanönü Town. The village is supplying its water from a developed spring on the valley of Sarıkaya Creek, located in close proximity to a waterfall (called Şelale Spring). There are two water depots belonging to Bağdere in the South, one of them is known to be the old one while the other is the new. These depots belong to both Bağdere and Çaylı Villages.

Çaylı Village: Located between Bağdere and Hanönü. Tap water is transferred from the Bağdere Village water depot.

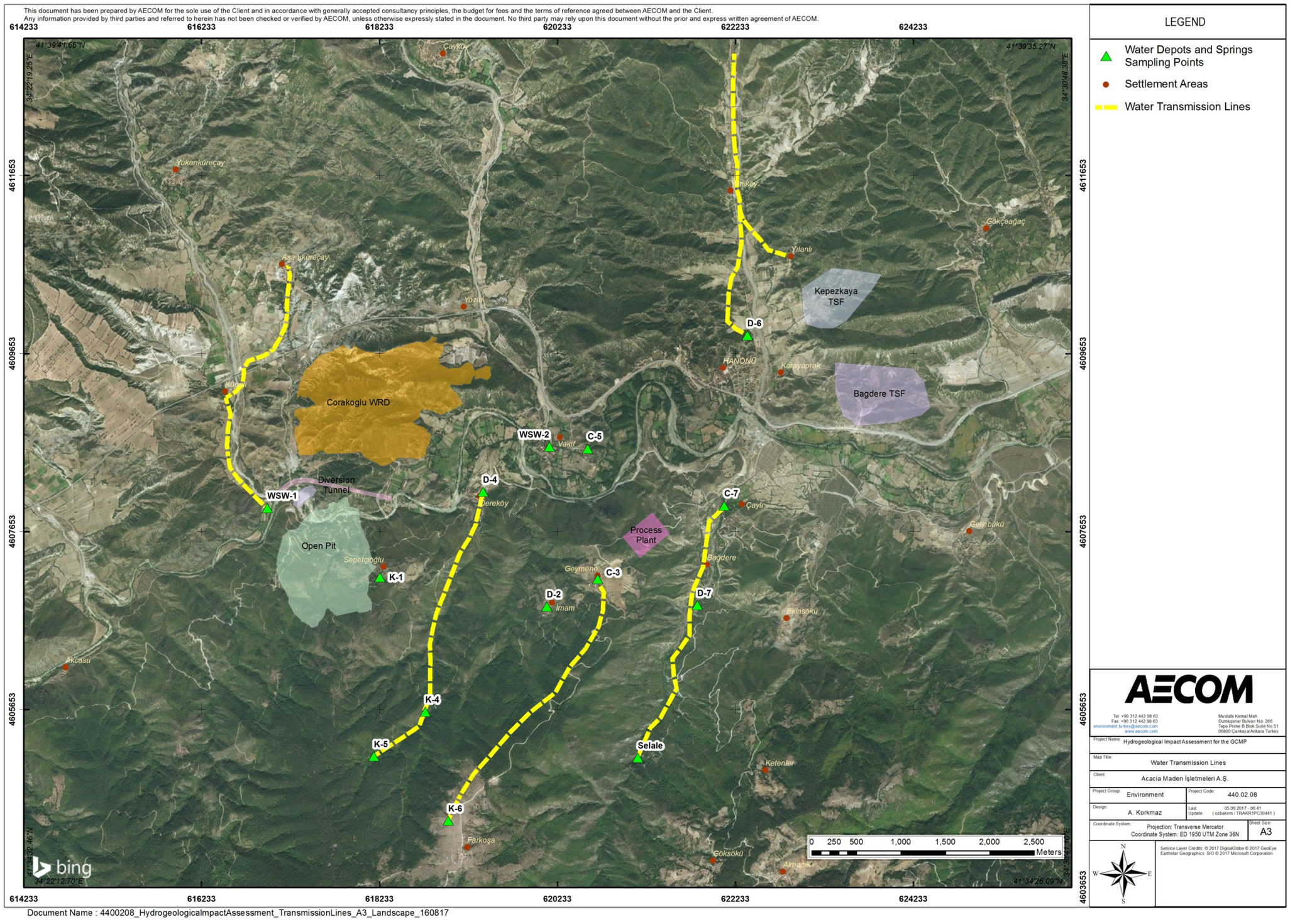


Figure 5-33 Water Depots and Springs Sampling/Monitoring Locations and Water Transmission Lines

5.7.5 Project's Water Supply

An initial water supply study was completed by Acacia in 2014 and three shallow caisson wells (KK-1, KK-2 and KK-3) were drilled on the river bank of Gökırmak, northwest of mobilization site. The tests completed on these wells were indicated that the yield of the wells is dependent to the river level.

Then, AECOM completed a water supply study in October 2016 to assess the sustainability of the water supply required for the mining activities. As a result of evaluating several water supply options, extracting groundwater from the alluvium aquifer (lying on the southeast of Hanönü) was considered to be the most efficient and sustainable approach for the Project's water supply.

There are 6 wells which were completed and tested for water supply purposes in the Project Area. The first water supply well (ST-1) has been drilled by Acacia within the mobilization site. Following the subsequent field work and desktop studies, additional 4 water supply wells (ST-1A, ST-2, ST-4 and ST-5) were drilled by AECOM in the mobilization site while one additional well (ST-3) was drilled within alluvium in the Küpeli Village. Among these wells, ST-2 was completed in February 2016 which was followed by the installation of ST-3 in May 2016. Based on the initial pumping test results obtained from these two initial wells, ST-2 (located at mobilization site) was found to produce relatively high well yield compared to ST-3 (located close to Küpeli Village). For this reason, subsequent water supply wells (ST-1A, ST-4 and ST-5) were completed within the alluvium in the mobilization site. Following the completion of drilling and well development, pumping tests in these wells were performed in October 2016. Remaining one well (ST-1), completed by Acacia prior to AECOM's involvement to the GCP, has been used as an observation well during the aquifer tests and included in the water level monitoring program.

All of ST coded wells (except for ST-3) were drilled and completed in the alluvial aquifer that lies as a corridor on the southern bank of Gökırmak River. This aquifer is composed of various sized poorly sorted alluvial material, lying in an area of 500m x 2,500m, mainly deposited by Sarıkaya Creek and Gökırmak River. It is bounded by the Gökırmak River on the north and low permeable metamorphic rocks on the south, east and west. The thickness of the alluvial aquifer was observed about 50m with an average saturated thickness of 40 m.

The recharge to this aquifer is controlled by three mechanisms;

1) Direct recharge from surface water (Sarıkaya Stream) to groundwater, having 50km^2 catchment area,
2) Gökırmak River - direct hydraulic interaction between surface and groundwater, and
3) Recharge from precipitation.

An extensive field survey was also carried out for this aquifer to identify any water users that might be affected by the groundwater pumping from water supply wells. This study indicated that no water user was identified within this area that depends on groundwater resources from the same aquifer system that may be adversely affected. Furthermore, the closest settlement to the water supply field, Çaylı Village, supply its water from Bağdere Depot, which it supplies its water from "waterfall" on the Sarıkaya Stream (3.7 km upstream of mobilization area, having more than 150m elevation difference with the water supply wells).

A set of aquifer tests has been completed on these wells. A simultaneous long term pumping test in three wells (ST-1A, ST-4 and ST-5) was also carried out for a total of 14 days in order to understand the long term response of the alluvium aquifer. Evaluation of the aquifer test results show that the water supply wells drilled within the alluvial fan of the Sarıkaya Creek (mobilization site) are capable of supplying the water demand of 35 L/s sustainability. It is important to note that the simultaneous long term test was performed during the driest period of the year that can be regarded as a worst case scenario.

Hydraulic conductivities for the alluvium aquifer in the mobilization site (ST-1, ST-1A, ST-2, ST-4 and ST-5) were found to range between 1.66E-03 m/s and 7.09E-04 m/s while the pumping test carried out in ST-3 in Küpeli Village indicates a hydraulic conductivity of 1.47E-05 m/s for this region. Details on Water Supply Study and estimated aquifer parameters for each drilled well are provided in Hydrogeological Impact Assessment Report in Volume-III of this ESIA.

A water quality sampling was carried out in alluvium aquifer (ST-1A) to understand the baseline chemistry of the groundwater that is planned to be extracted for water supply purposes. Results for the major ion analysis show that the groundwater to be used for water supply is enriched in Ca^{2+} as the dominant cation and HCO_3^- as the dominant anion. Hydrogeochemical facies type for this water was therefore identified to be Ca-HCO_3, indicating a fresh water reserve. Sample collected from water supply aquifer was also analyzed for metals, physical

parameters and inorganic parameters. Analysis results were compared with EU Drinking Water Criteria (EU Quality Criteria for Waters Intended for Human Consumption – Council Directive 98/83/EC of 3 November 1998), WHO Guidelines for Drinking Water Quality and Turkish Water Pollution and Control Regulation (WPCR) – Inland Water Quality Criteria. Based on the comparisons with EU and WHO drinking water quality criteria, parameters in water supply aquifer sample were found to have concentrations below the limit values. The sample is classified as Class I according to the quality classes specified in Turkish Water Pollution and Control Regulation. It is also important to note that groundwater extracted for water supply purposes will not be used as a drinking water, as drinking water will be supplied as bottled water. This water will be used in Process Plant for ore enrichment activities and for utility purposes after treatment. Quality comparisons for the water supply aquifer sample is given in Table 5-20 and Table 5-21 whereas the water supply well field and sampling location are shown in Figure 5-34.

Table 5-20 Water Supply Aquifer Sample (ST-1A) Quality Comparison with Turkish WPCR

Water Pollution And Control Regulation (WPCR) Inland Water Quality Criteria[1]	**Unit**	**Class I**	**Class II**	**Class III**	**Class IV**	**ST-1A**
Physical and inorganic-chemical parameters						
Temperature	°C	25	25	30	> 30	-
pH	-	6.5-8.5	6.5-8.5	6.0-9.0	out of 6.0-9.0	-
Dissolved Oxygen (O2)	mg/L	8	6	3	< 3	-
Chloride (Cl-)	mg/L	25	200	400b	> 400	4.35
Sulphate (SO4-2)	mg/L	200	200	400	> 400	28.9
Ammonium (NH4+-N)	mg/L	0.2c	1c	2c	> 2	<0.04
Nitrite Nitrogen (NO2--N)	mg/L	0.002	0.01	0.05	> 0.05	<0.002
Nitrate Nitrogen (NO3--N)	mg/L	5	10	20	> 20	0.784
Total Phosphorus (P)	mg/L	0.02	0.16	0.65	> 0.65	<0.01
Total Sodium (Na+)	mg/L	125	125	250	> 250	11
Chemical Oxygen Demand (COD)	mg/L	25	50	70	> 70	<5
Total Organic Carbon	mg/L	5	8	12	> 12	1.7
Total Kjeldahl-Nitrogen	mg/L	0.5	1.5	5	> 5	<0.5
Mercury (Hg)	mg Hg/L	0.0001	0.0005	0.002	> 0.002	<0.00001
Cadmium (Cd)	mg Cd/L	0.003	0.005	0.01	> 0.01	<0.0004
Lead (Pb)	mg Pb/L	0.01	0.02	0.05	> 0.05	<0.005
Arsenic (As)	mg As/L	0.02	0.05	0.1	> 0.1	<0.005
Copper (Cu)	mg Cu/L	0.02	0.05	0.2	> 0.2	<0.001
Chromium (total) (Cr)	mg Cr/L	0.02	0.05	0.2	> 0.2	0.0014
Cobalt (Co)	mg Co/L	0.01	0.02	0.2	> 0.2	<0.002
Nickel (Ni)	mg Ni/L	0.02	0.05	0.2	> 0.2	0.0043
Zinc (Zn)	mg Zn/L	0.2	0.5	2	> 2	0.0281
Cyanide (Total) (CN)	mg CN/L	0.01	0.05	0.1	> 0.1	<0.005
Flouride (F-)	mg F^-/L	1	1.5	2	> 2	<0.2
Iron (Fe)	mg Fe/L	0.3	1	5	> 5	0.0473
Manganese (Mn)	mg Mn/L	0.1	0.5	3	> 3	0.00055
Boron (B)	mg B/L	1	1	1	> 1	0.059
Selenium (Se)	mg Se/L	0.01	0.01	0.02	> 0.02	<0.01
Barium (Ba)	mg Ba/L	1	2	2	> 2	0.0233
Aluminum (Al)	mg Al/L	0.3	0.3	1	> 1	<0.01

[1] Water Pollution and Control Regulation (WPCR), Inland Water Quality Criteria – Turkish Ministry of Environment and Urbanization, 2004

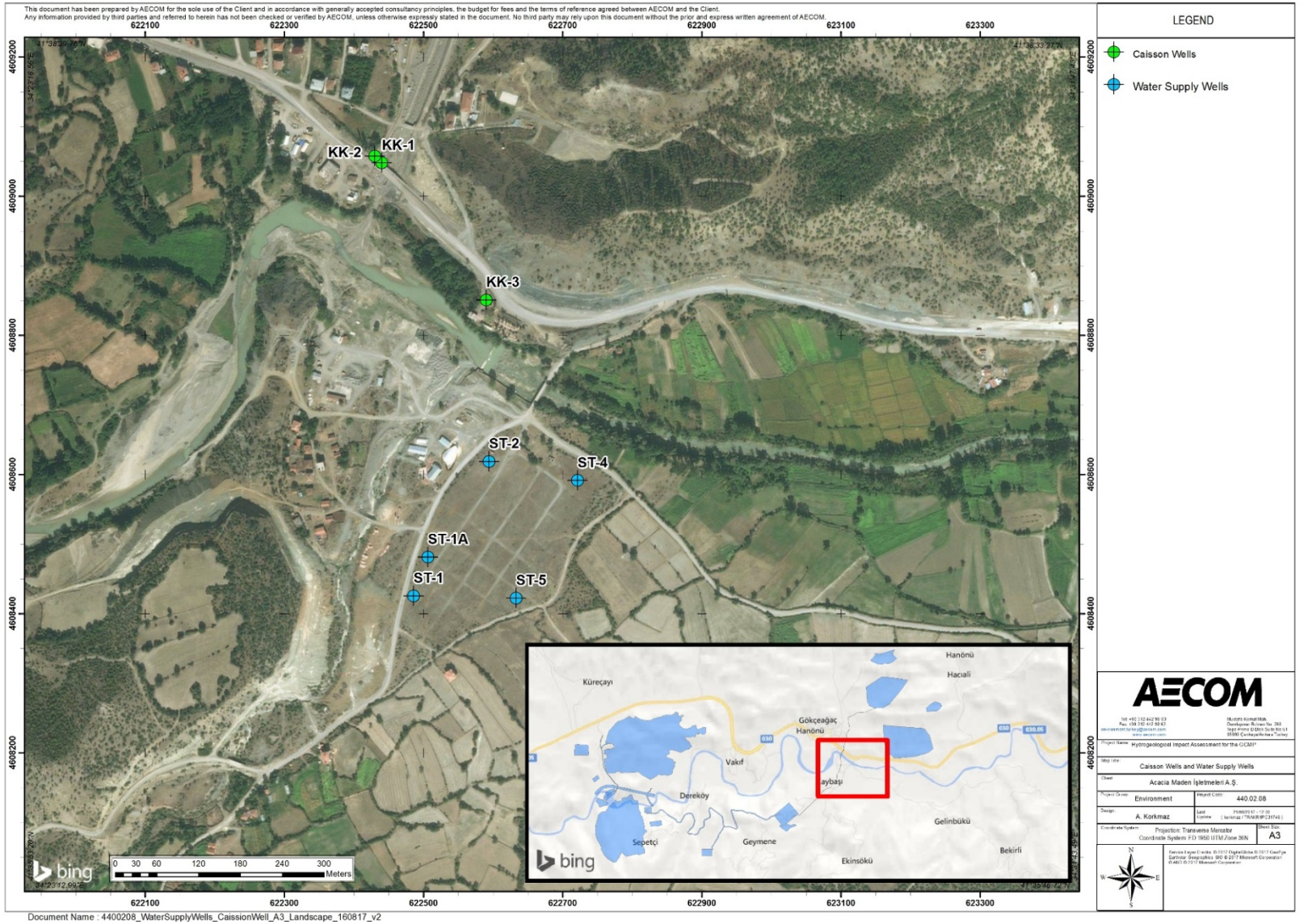


Figure 5-34 Water Supply Wells and Caisson Wells

Table 5-21 Water Supply Aquifer Sample (ST-1A) Quality

Parameters	Unit	ST-1A
Antimony	mg/L	Not measured
Arsenic	mg/L	<0.005
Barium	mg/L	0.0233
Benzene	mg/L	Not measured
Boron	mg/L	0.059
Cadmium	mg/L	<0.0004
Chromium	mg/L	0.0014
Copper	mg/L	<0.001
Cyanide	mg/L	<0.005
Fluoride	mg/L	<0.2
Lead	mg/L	<0.005
Mercury	mg/L	<0.00001
Nickel	mg/L	0.0043
Nitrate as NO3	mg/L	0.784
Nitrite as NO2	mg/L	<0.002
Selenium	mg/L	<0.01
Aluminum	mg/L	<0.01
Ammonium as NH4	mg/L	<0.04
Chloride	mg/L	28.9
Conductivity	µS/cm	Not measured
pH	-	Not measured
Iron	mg/L	0.0473
Manganese	mg/L	0.00055
Sulfate as SO4	mg/L	28.9
Sodium	mg/L	11
Uranium	mg/L	Not measured

5.7.6 Hydrogeological Characteristics

A series of hydrogeological field investigations were carried out both within the scope of the earlier EIA studies and during the subsequent investigations prior to AECOM's involvement to the GCP. A chronology and brief descriptions for the previous hydrogeological works carried out by third parties are provided below:

General Directorate of State Hydraulic Works (DSI) has completed a site investigation between 1994 and 1996 on boreholes called SK-3, SK-4 SK-5 SK-12 and SK-14 related with the construction of a hydroelectric dam on Gökırmak River (ERGIN 1998).

As part of the open pit hydrogeological and geotechnical site investigations, 5 monitoring wells (OW-1, OW-2, OW-3, OW-4 and OW-5) were drilled in the schists in the pit area in November 2012. Aquifer testing of these wells was performed by AMI in 2013 (AMI, 2013).

Four monitoring wells (DH-1, DH-2, DH-3 and DH-4) were completed in alluvium in 2013 by Nbaproje. Aquifer testing of these monitoring wells was performed by AMI in 2013 (AMI, 2013).

A total of 14 monitoring wells (DSK1 – 10) were completed, dominantly in the alluvium, in 2014. The drilling work is reported to be associated with geological and geotechnical investigations regarding the coffer dam and tunnel construction (Nbaproje 2014a and 2014b).

Kepezkaya TSF area was investigated with a total of 25 monitoring wells (KSK1 – KSK25) completed in 2014 and 2015 by AMI. AMI has completed aquifer tests on 14 of the monitoring wells in 2014.

Three caisson wells near the Gökırmak River were completed in 2014. Aquifer testing in these wells was performed by AECOM in 2015.

Field studies and installation of new boreholes were extended to cover Çorakoğlu WRD (WD series) along with additional monitoring wells that were installed in the Open Pit area (GT series) as of August 2015. Two of the Open Pit monitoring wells (GT-007 and GT-013) has been completed to characterize the hydraulic properties of a major fault, known as the Dividing Fault.

RPS has performed aquifer tests on GT-2, GT-3, GT-7, GT-9, GT-11, GT-13 and GT-15 in the Open Pit area. As for the Çorakoğlu WRD area, RPS has carried out aquifer tests in WD-001 and WD-002.

An investigation on the hydraulic properties of the discrete fault zones, and the potential interconnection between alluvium and the bedrock schists was discussed in previous reports (RPS, 2015). However, previous studies do not provide detailed assessment of the fault zones, especially for the Open Pit area

Beginning with AECOM's involvement, a total of 20 groundwater wells have been drilled by AECOM including 15 monitoring wells within the proposed project units and 5 water supply wells in the alluvium. Water supply wells were also tested to obtain aquifer parameters, being monitored in terms of static water level variations and quality parameters. A total drilling length of 1,760 m were completed either using air percussion and/or mud rotary drilling methods depending on the lithological properties of the drilling locations. Details on hydrogeological studies are provided in Hydrogeological Impact Assessment Report in Volume-III of this ESIA, while summary information is given below.

5.7.6.1 Water Bearing Units

Water bearing units in the Project Area can be classified into two main categories as highly permeable and semipermeable to impermeable units.

Highly Permeable Units

Unconsolidated alluvial deposits associated with the Gökırmak River and its tributaries are classified as highly permeable units. These deposits can exhibit a significant primary permeability where clean sand, gravel or pebble units are present. In the vicinity of the pit, the width of the alluvium is generally up to 200 meters and thicknesses of up to 40m have been recorded. Furthermore, where the tributaries meet with the Gökırmak River, alluvium fans can be noted. The width of these fans can reach up to 500m meters and thicknesses of up to 60m.

These coarse grained alluvial deposits have the potential to act as significant aquifers for the Project. A key feature is the storage properties of these aquifers and the degree of hydraulic continuity/connectivity of the deposits. Furthermore a study completed by AECOM in September 2015, indicated that these alluvial units are being recharged by the surface water. Especially on the upstream sections of the tributaries of Gökırmak River, up to 50 l/s of surface water flow was noted where the river bed was formed by the outcropping bedrock units. On the other hand, as soon as the flow reaches to a location where this alluvium unit overlies the bedrock; the water flow on the surface was fading away and continued at the subsurface.

Semipermeable to Impermeable Units

The schists, phyllites, metabasic rocks as well as the sedimentary and volcanoclastic rocks are classified as semipermeable to impermeable units. These units cover almost all of the Project Area except for the areas that the alluvial units are present (underlies the alluvial deposits as well).

Fresh and un-fractured sections of these units show low permeability behavior. On the other hand, the contact zones and significant fracturing and/or alteration zone of the rock mass shows relatively high hydraulic conductivities compared to bedrock schists. These zones partially behave as conduits that transport groundwater in terms of fracture flow.

5.7.6.2 Groundwater Levels

Groundwater contour maps were created using the combined data obtained from the previous studies and the additional fieldwork carried out by AECOM since September 2015. Groundwater levels were evaluated both in temporal and spatial scale. Groundwater contours were generated by taking the account of average values calculated from the groundwater level measurements, location of springs and topography data for the study area. Groundwater table is assumed to be located 3 m below stream level along valleys.

As a part of the hydrogeological characterization study;

- Historical groundwater level measurements were collected for the previously drilled wells,
- A bi-weekly groundwater level measurement program was initiated,
- All surface water features in the project area were identified with desktop and site studies
- Topography and the topographical measurements of the water features (wells, springs, streams) were analyzed, and Structural features (faults) were identified and their potential impacts on the groundwater levels were analyzed.

All this data was distilled to produce a groundwater elevation map of the study area (Figure 5-35). According to the findings of this study, groundwater levels generally follow the topography with a general flow pattern from northern and southern borders toward the Gökırmak River which forms the major drainage zone within the study area. Groundwater elevations (above mean sea level – amsl) decrease from a value of about 1600 - 1400 m in the northern and southern borders (respectively) to a value of about 350 - 400 m in the eastern part along the Gökırmak River. The hydraulic gradients are measured between 0.2 and 0.4 especially on the rough terrain and decrease to 0.01 in the lower elevations especially around the Gökırmak River bed.

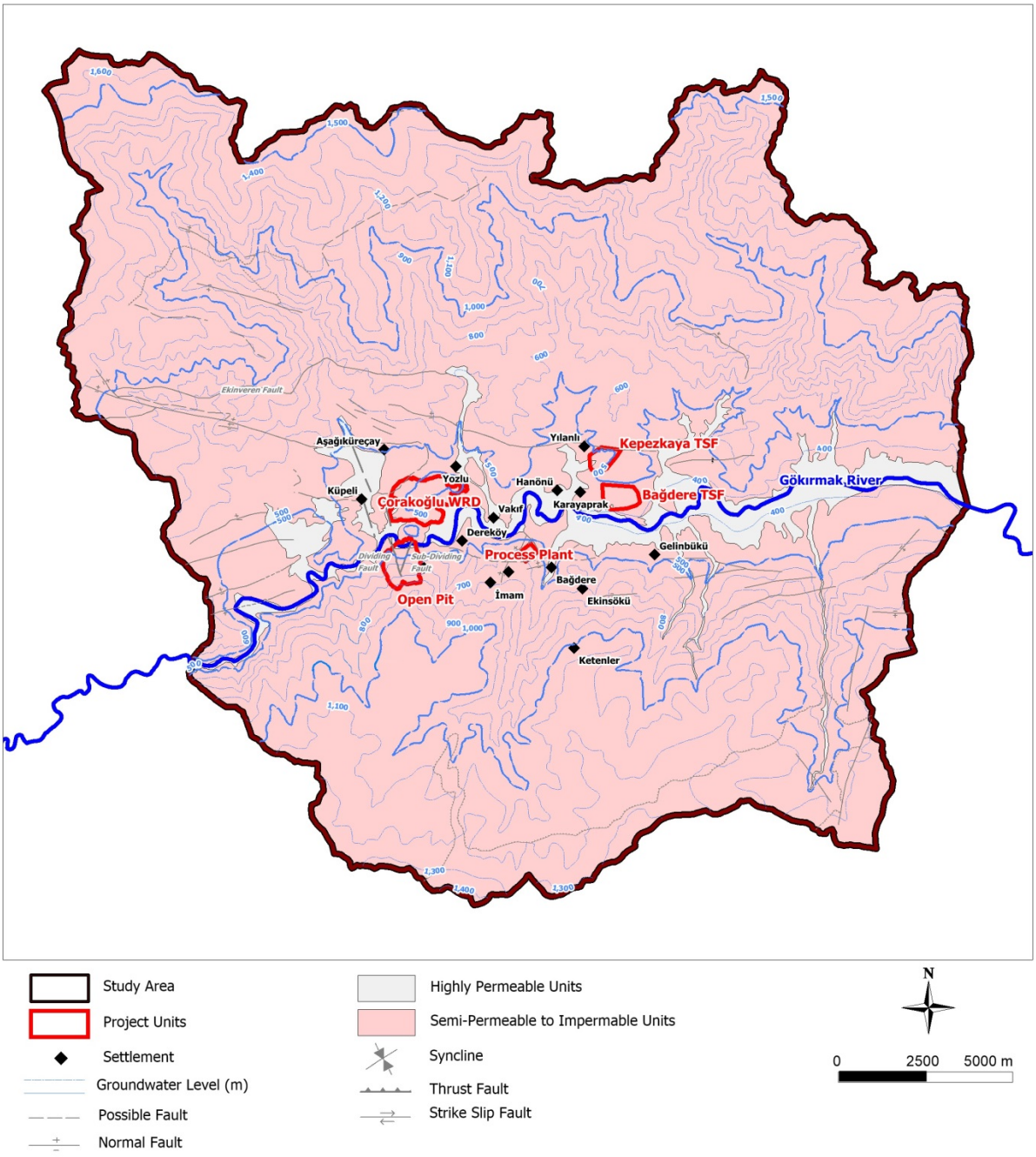


Figure 5-35 Regional Groundwater Level Map of the Study Area

5.7.6.3 Aquifer Parameters

A series of aquifer tests have so far been performed both by the third parties prior to AECOM's involvement to the GCP and by AECOM within the scope of the Hydrogeological Impact Assessment Study. In this context, pumping and slug tests were carried out on selected wells among those were previously-drilled by other parties and the wells completed by AECOM. The results obtained from the aquifer tests were used for the estimation of hydraulic properties such as transmissivity and hydraulic conductivity.

Several tests have been carried out in OW, GT, KSK and WD wells by Acacia under the supervision of third party consultants prior to AECOM's involvement to the GCP. The data collected from testing results were re-evaluated by AECOM and provided in detail in Hydrogeological Impact Assessment Report (in Volume-III of this ESIA).

As of October 2016, AECOM has completed individual pumping tests in the water supply wells (ST-1, ST-1A, ST-2, ST-3, ST-4 and ST-5) that were drilled within the scope of the water supply study. A simultaneous long term pumping test in three wells (ST-1A, ST-4 and ST-5) was also carried out in order to understand the long term response of the alluvium aquifer.

Within the scope of the Hydrogeological Impact Assessment Study, AECOM has performed pumping tests in the wells located in the project units including the Open Pit area, Çorakoğlu WRD area, Gelberi location, Kepezkaya TSF area and Bağdere TSF area (GK series wells). Additional pumping tests in the alluvium and schist monitoring wells (AOBH, ATBH, BOBH and BTBH) in the near vicinity of the Open Pit area and fault observation wells (FOBH, FTBH and SOBH) within the Open Pit area has also been carried out. In addition to the pumping tests, slug tests have been performed in selected AECOM wells (GK series) as well as in selected wells (OW-2, OW-3, OW-4, OW-5 and SOBH) among those which were previously-drilled. Hydrogeological testing locations prior to AECOM's involvement to GCP is shown in Figure 5-36 whereas monitoring wells completed by AECOM is given in Figure 5-37. Estimated hydraulic parameters for the Project Area are summarized in Table 5-22.

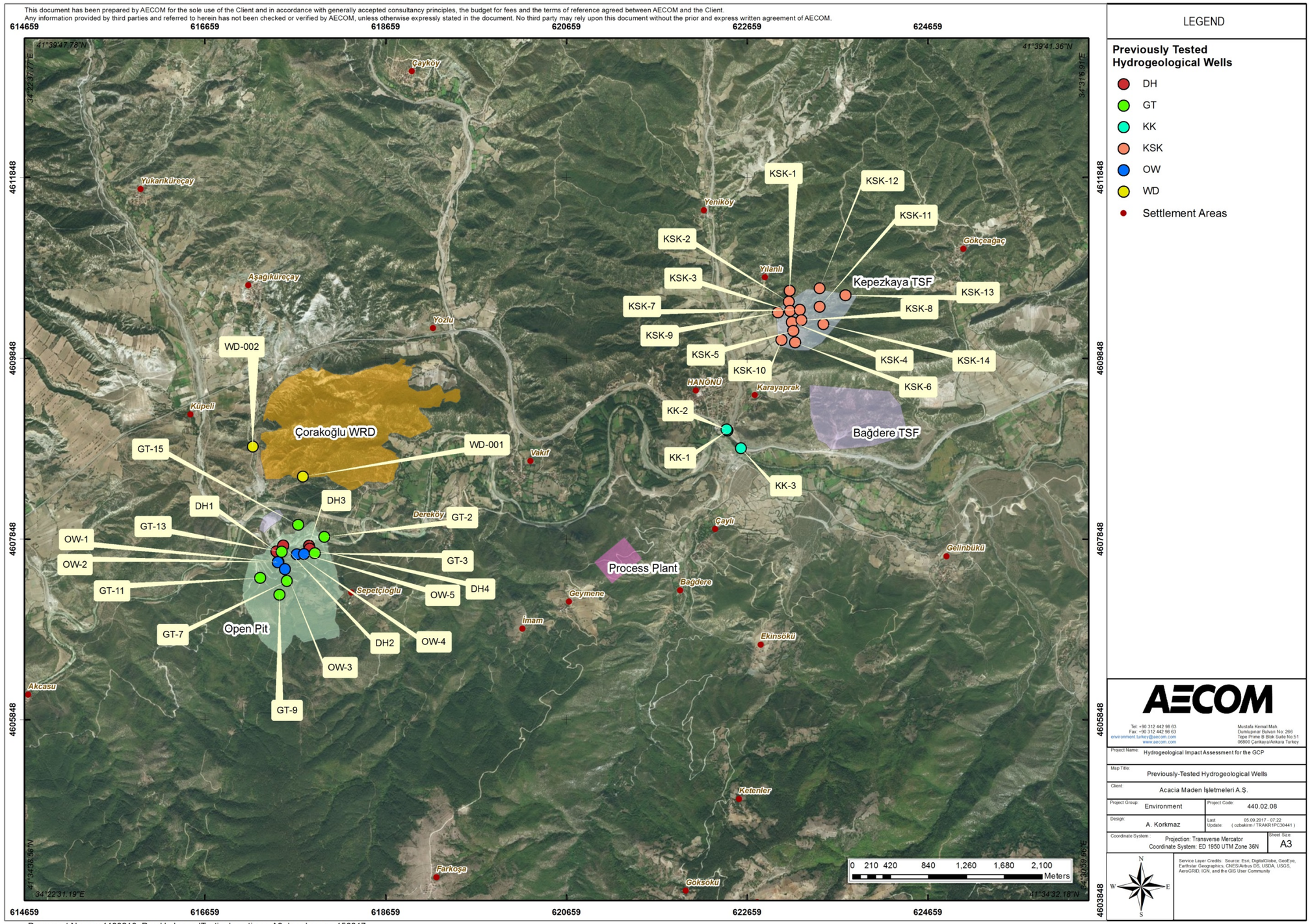
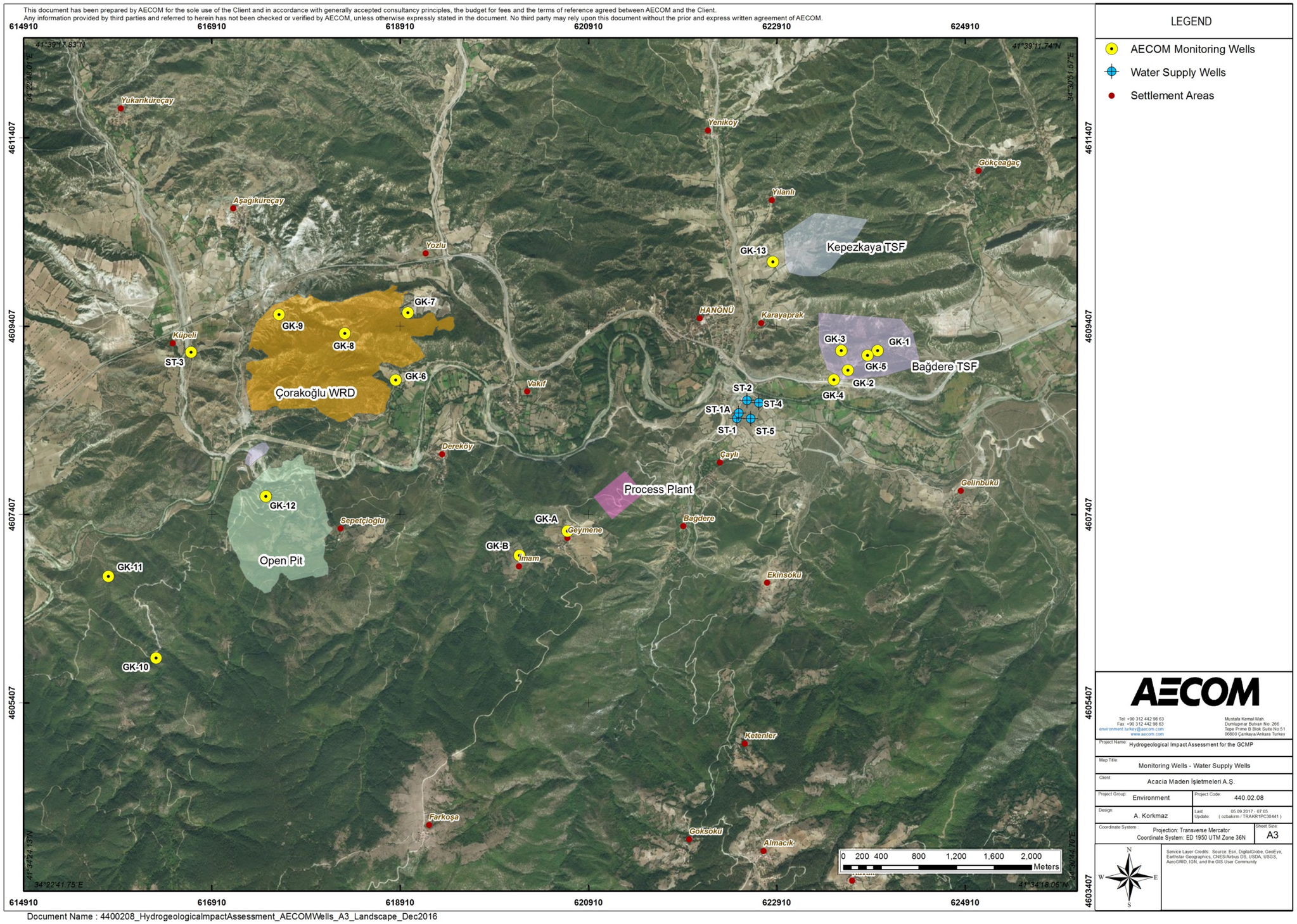


Figure 5-36 Previously-Tested Monitoring Wells Prior to AECOM's involvement to the GCP



Document Name : 4400208_HydrogeologicalImpactAssessment_AECOMWells_A3_Landscape_Dec2016

Figure 5-37 Locations for the Monitoring Wells Completed by AECOM

Table 5-22 Summary Table for the Estimated Aquifer Parameters

	Well ID	Supervision	Lithology	Project Unit	Aquifer Testing Type	Saturated Thickness (m)	Theis (1935)		Cooper-Jacob (1946)		Neuman (1974)		Moench (1997)		Tartakovsky-Neuman (2007)		Theis Recovery (1935)		Bouwer-Rice (1976)		Hvorslev(1951)		Geometric Mean of Hydraulic Conductivity (K-m/s)
							T(m2/s)	K(m/s)	T(m2/s)	K(m/s)	T(m2/s)	K(m/s)	T(m2/s)	K(m/s)	T(m2/s)	K(m/s)	T(m2/s)	K(m/s)	Falling Head (K-m/s)	Rising Head (K-m/s)	Falling Head Test (K-m/s)	Rising Head Test (K-m/s)	
PREVIOUSLY COMPLETED WELLS	OW-3	Drilled by AMI, 2013 Tested by AECOM, 2016	Schist	Open Pit	Unconfined	162.50	-	-	-	-	-	-	-	-	-	-	-	-	5.96E-08	8.91E-08	6.94E-08	1.08E-07	7.94E-08
	OW-4		Schist (partly Alluvium)	Open Pit	Unconfined	85.00	-	-	-	-	-	-	-	-	-	-	-	-	1.11E-06	1.76E-06	1.48E-06	2.08E-06	1.56E-06
	OW-5		Alluvium/Schist	Open Pit	Unconfined	108.00	-	-	-	-	-	-	-	-	-	-	-	-	3.70E-06	4.03E-06	5.22E-06	5.32E-06	4.51E-06
	AOBH		Alluvium	Northwest of Open Pit	Unconfined	33.00	2.94E-02	8.92E-04	3.96E-02	1.20E-03	-	-	2.11E-02	6.39E-04	2.11E-02	6.39E-04	2.50E-01	7.58E-03	-	-	-	-	1.27E-03
	ATBH1		Alluvium	Northwest of Open Pit	Unconfined	33.00	3.04E-02	9.22E-04	2.57E-02	7.79E-04	-	-	2.94E-02	8.91E-04	2.81E-02	8.51E-04	9.69E-02	2.94E-03	-	-	-	-	1.10E-03
	BOBH		Schist	Northwest of Open Pit	Confined	40.00	1.30E-06	3.25E-08	1.31E-06	3.27E-08	-	-	-	-	-	-	3.09E-06	7.72E-08	-	-	-	-	4.64E-08
	BTBH2		Schist	Northwest of Open Pit	Confined	40.00	6.77E-06	1.69E-07	7.68E-06	1.92E-07	-	-	-	-	-	-	4.53E-06	1.13E-07	-	-	-	-	1.54E-07
	SOBH		Schist (fault)	Open Pit	Unconfined	13.50	-	-	-	-	-	-	-	-	-	-	-	-	4.99E-06	8.36E-06	5.21E-06	8.53E-06	6.56E-06
	FOBH		Schist/Fault	Open Pit	Unconfined	52.00	8.36E-05	1.61E-06	1.07E-04	2.07E-06	8.21E-05	1.58E-06	-	-	7.87E-05	1.51E-06	1.00E-03	1.92E-05	-	-	-	-	2.73E-06
	FTBH3		Schist/Fault	Open Pit	Unconfined	52.00	9.61E-05	1.85E-06	1.01E-04	1.94E-06	8.10E-05	1.56E-06	-	-	7.44E-05	1.43E-06	9.50E-04	1.83E-05	-	-	-	-	2.71E-06
	KK-1		Alluvium	Alluvium	Unconfined	5.00	5.35E-03	1.07E-03															1.07E-03
	KK-2		Alluvium	Alluvium	Unconfined	5.00	2.17E-02	4.34E-03															4.34E-03
	KK-3		Alluvium	Alluvium	Unconfined	5.00	1.92E-02	3.84E-03															3.84E-03
AECOM WELLS	GK-1	AECOM, 2016	Sedimentary	Bağdere TSF	Unconfined	69.00	-	-	-	-	-	-	-	-	-	-	-	-	2.01E-07	1.37E-07	2.49E-07	1.83E-07	1.88E-07
	GK-2		Sedimentary	Bağdere TSF	Unconfined	50.00	-	-	-	-	-	-	-	-	-	-	-	-	1.24E-06	3.99E-07	1.29E-06	4.00E-07	7.11E-07
	GK-3		Sedimentary	Bağdere TSF	Unconfined	48.00	-	-	-	-	-	-	-	-	-	-	-	-	2.52E-07	1.41E-07	2.21E-07	1.41E-07	1.82E-07
	GK-4		Sedimentary	Bağdere TSF	Unconfined	41.00	1.32E-03	3.22E-05	1.36E-03	3.32E-05	1.30E-03	3.16E-05	1.34E-03	3.27E-05	1.39E-03	3.38E-05	1.45E-03	3.53E-05	-	-	-	-	3.31E-05
	GK-6		Sedimentary/Schist	Çorakoğlu WRD	Unconfined	34.00	2.62E-04	7.71E-06	2.30E-04	6.75E-06	8.26E-05	2.43E-06	8.61E-05	2.53E-06	1.48E-04	4.36E-06	1.60E-04	4.71E-06	-	-	-	-	4.42E-06
	GK-7		Sedimentary/Schist	Çorakoğlu WRD	Unconfined	33.00	-	-	-	-	-	-	-	-	-	-	-	-	2.22E-08	3.11E-08	2.28E-08	3.10E-08	2.64E-08
	GK-9		Sedimentary	Çorakoğlu WRD	Unconfined	39.00	-	-	-	-	-	-	-	-	-	-	-	-	-	6.20E-06	-	6.15E-06	6.18E-06
	GK-10		Schist	Gelberi Location	Unconfined	40.00	3.14E-05	7.84E-07	3.08E-05	7.71E-07	2.88E-05	7.19E-07	2.73E-05	6.83E-07	2.90E-05	7.25E-07	1.08E-05	2.70E-07	-	-	-	-	6.22E-07
	GK-11		Schist	Gelberi Location	Unconfined	53.00	-	-	-	-	-	-	-	-	-	-	-	-	1.34E-08	5.02E-08	1.74E-08	7.78E-08	3.09E-08
	GK-12 (Fracture Zone)		Schist	Open Pit	Unconfined	226.00	-	-	2.38E-06	1.89E-07	-	-	-	-	-	-	1.58E-06	1.25E-07	-	-	-	-	1.57E-07
	GK-12 (Rock Mass-Schist)				Unconfined		-	-	5.07E-07	1.31E-08	-	-	-	-	-	-	3.09E-07	9.95E-09	-	-	-	-	1.15E-08
	GK-13		Sedimentary	Kepezkaya TSF	Unconfined	34.00	-	-	-	-	-	-	-	-	-	-	-	-	4.98E-09		6.09E-09		5.51E-09
	GK-A		Schist	South of Process Plant	Unconfined	103.00	-	-	-	-	-	-	-	-	-	-	-	-	8.23E-08	4.33E-08	7.40E-08	3.61E-08	5.55E-08
	GK-B		Schist	South of Process Plant	Unconfined	65.00	-	-	-	-	-	-	-	-	-	-	-	-	2.11E-07	2.91E-07	1.79E-07	2.61E-07	2.31E-07
	ST-1		Alluvium/Sedimentary	Alluvium	Unconfined	54.00	5.47E-02	1.01E-03	3.81E-02	7.06E-04	-	-	-	-	4.88E-02	9.03E-04	2.12E-02	3.92E-04	-	-	-	-	7.09E-04
	ST-1A		Alluvium/Volcanics	Alluvium	Unconfined	54.00	4.88E-02	9.03E-04	4.87E-02	9.02E-04	-	-	-	-	2.11E-02	2.11E-02	2.90E-02	5.36E-04	-	-	-	-	1.74E-03
	ST-2		Alluvium/Volcanics	Alluvium	Unconfined	50.00	8.86E-02	1.77E-03	8.68E-02	1.74E-03	-	-	-	-	6.35E-02	1.27E-03	4.26E-02	8.52E-04	-	-	-	-	1.35E-03
	ST-3		Alluvium/Sedimentary	Alluvium	Unconfined	56.00	7.60E-04	1.36E-05	7.60E-04	1.36E-05	4.24E-04	7.57E-06	4.24E-04	7.57E-06	7.60E-04	1.36E-05	3.97E-03	7.09E-05	-	-	-	-	1.47E-05
	ST-4		Alluvium/Volcanics	Alluvium	Unconfined	54.00	4.40E-01	8.16E-03	4.56E-02	8.44E-04	-	-	-	-	1.48E-02	2.74E-04	3.78E-02	7.00E-04	-	-	-	-	1.07E-03
	ST-5		Alluvium/Volcanics	Alluvium	Unconfined	40.00	8.14E-02	2.03E-03	8.22E-02	2.05E-03	-	-	-	-	7.53E-02	1.88E-03	3.83E-02	9.58E-04	-	-	-	-	1.66E-03

Notes:
1: Storativity (S) values of ATBH: 0.54 (Cooper&Jacop), 0.02 (Theis), 0.096 (Tartakovsky-Neuman) and 0.096 (Moench)
2: Storativity (S) values of BTBH: 0,00039 (Cooper&Jacop), 0.00048 (Theis)

3: Storativity (S) values of FTBH: 0.40 (Cooper&Jacop), 0.51 (Theis), 0.66 (Tartakovsky-Neuman) and 0.66 (Neuman)

5.7.7 Water Quality

Several water quality sampling/monitoring surveys have so far been carried out within the scope of the GCP. Initial studies on water quality comprise field works performed as part of the local EIA studies conducted by ENVY, 2014. An additional water quality sampling and monitoring survey was performed in September 2015 by AECOM, primarily to assess the quality of drinking waters and identify the gaps in baseline water quality of the Project Area and its vicinity. Within the scope of the September 2015 survey, the number of sampling and monitoring locations was increased to characterize the upstream and downstream sections of the individual project units. Project Area and its vicinity were also investigated to identify the major transmission lines that provide water for the nearby settlement areas.

As of May 2016, a more comprehensive sampling and monitoring program has been established within the scope of the Hydrogeological Impact Assessment Study for the GCP. Baseline studies on water quality has been extended to involve groundwater, village water depots, fountains, springs and surface water locations as to represent each project unit such as WRD, TSFs, Process Plant and the Open Pit. Field parameter measurements (including pH, electrical conductivity, dissolved oxygen and temperature) have been started to be performed on a monthly basis while water sampling surveys have been started to be carried out on a quarterly basis to improve the understanding on the quality of the water resources.

Following sections provide the details on general methodology of the water quality program, field parameter measurements, chemical characteristics of the water resources and quality assessments with respect to relevant international and local regulatory criteria. Samples collected from drinking water resources such as village water depots, fountains and springs used by the communities were compared with national and international drinking water criteria which are described in Section 5.7.7.1. It is also important to note that the streams and groundwater from the monitoring/production wells (including the water supply wells) will not be used as a drinking water resource. Groundwater to be extracted from the water supply wells will be used in process water demand. Even so, the analysis results of the groundwater sample collected from the water supply aquifer was compared both with drinking water criteria and other relevant water quality criteria (See Section 5.7.5 and 5.7.7.3).

Each sampling/monitoring survey has been evaluated separately and chronologically to reflect the progressive development on the overall status on Project's water quality. Summary for the overall water quality monitoring surveys is shown as a timeline in Figure 5-38.

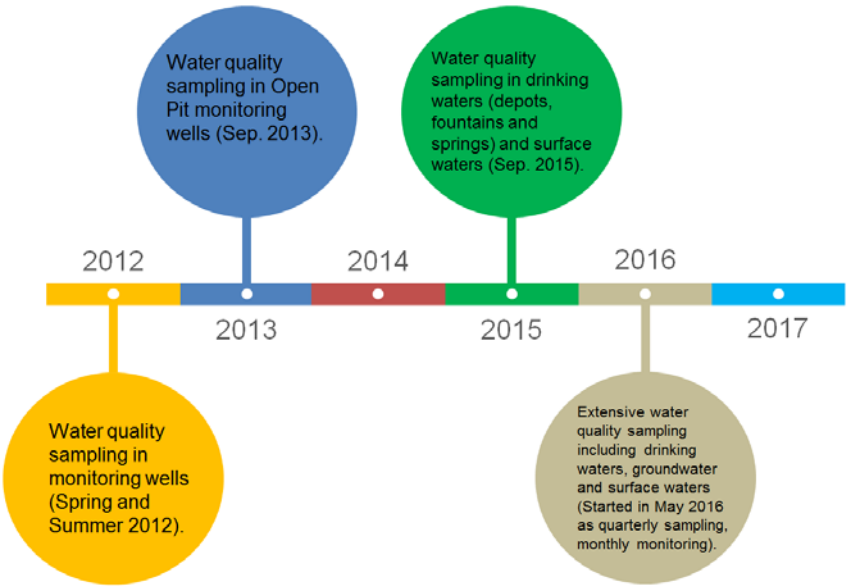


Figure 5-38 Summary of the GCP Water Quality Surveys

5.7.7.1 Sampling and Monitoring Methodology

Methodology of the water quality studies includes two major tasks. These are;

- Measurement of Field Parameters (incl. pH, temperature, electrical conductivity (EC) and dissolved oxygen (DO)) to evaluate temporal and spatial trends for water resources.
- Sampling and chemical analysis of the water samples representative of each project unit, to identify hydrogeochemical characteristics and quality classes for each water type (See Table 5-23 for full set of parameters).

Monitoring locations were categorized under three different water types as Drinking Waters (village water depots and village fountains/springs), Groundwater (monitoring wells and natural springs), Surface Waters (intermittent and permenant streams and ponds). Although the assessments for previous sampling/monitoring studies are also provided in this report, AECOM has extended the number of the analysis parameters to bridge the gaps in baseline water quality of the Project Area. The list of the parameters analyzed within the scope of the water quality monitoring is given in Table 5-23 while the laboratory analysis results are provided in Hydrogeological Impact Assessment Report in Volume III of the ESIA Disclosure Package.

Table 5-23 Parameters analyzed within the scope of the Hydrogeological Impact Assessment Study

Aggregate Parameters	**Nonmetallic Inorganic Parameters**
Calcium Hardness	Acid neutralizing capacity (alkalinity) as CaCO3pH 4.5
Hardness	Ammonia (free)
Hardness as CaCO3	Ammonia (free) as N
Magnesium Hardness	Ammonia and ammonium ions as N
Total Organic Carbon	Ammonia and ammonium ions as NH4
	Bicarbonate Alkalinity as CaCO3
Dissolved and Total Metals / Major Cations	Bromide
Aluminum	Carbonate Alkalinity as CaCO3
Antimony	Chemical Oxygen Demand (COD-Cr)
Arsenic	Chloride
Barium	Dissolved Oxygen
Beryllium	Dissolved solids dried at 105 °C
Boron	Easily released cyanides
Cadmium	Fluoride
Calcium	Free Cyanide
Chromium	Hydroxide Alkalinity as CaCO3
Cobalt	Inorganic Nitrogen as N
Copper	Nitrate as N
Hexavalent Chromium - Soluble	Nitrates
Iron	Nitrite + Nitrate as N
Lead	Nitrite as N
Lithium	Nitrites
Magnesium	Organic Nitrogen as N
Manganese	Oxygen Saturation
Mercury*	Phosphorus (as P2O5)
Molybdenum	Sulphate as SO42-
Nickel	Suspended solids dried at 105 °C
Phosphorus	Total Cyanide
Potassium	Total Kjeldahl Nitrogen as N
Selenium	Total Nitrogen as N
Silver	Total Phosphorus as P
Sodium	Total Phosphorus as PO43-
Thallium	
Vanadium	**Physical Parameters**
Zinc	Electrical Conductivity @ 25°C
	pH Value

Water quality studies and evaluations were performed in consideration of the following national legislation, EU directives, guidelines and criteria which are described below.

Turkish Legislation and Standards

- Groundwater Law No: 167,
- Water Pollution and Control Regulation (WPCR), Inland Water Quality Criteria – Turkish Ministry of Environment and Urbanization, 2004;
- Regulation on the Protection of Groundwater Due to Pollution and Degradation (RPGDPD) – Turkish Ministry of Forestry and Water Works, 2015;
- Surface Water Quality Regulation (SWQR), Inland Surface Waters Quality Criteria – Turkish Ministry of Forestry and Water Works, 2012;
- Regulation on Waters Intended for Human Consumption (RWIHC), Chemical Parameters and Indicator Parameters – Turkish Ministry of Health, 2005;
- TS-266 Drinking Water Quality Standards – Turkish Standards Institution.

European Union Directives and International Guidelines

- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 Establishing a Framework for Community Action in the Field of Water Policy;
- Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the Protection of Groundwater Against Pollution and Deterioration;
- Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on Environmental Quality Standards (amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council);
- Decision 2455/2001/EC on a First list of priority substances
- European Union Quality Criteria for Waters Intended for Human Consumption – Council Directive 98/83/EC of 3 November 1998;
- Guidelines for Drinking Water Quality – World Health Organization (WHO), 2011.

Water Pollution and Control Regulation (WPCR) – Inland Water Quality Criteria

The analytical results were compared with the quality limits referred in current Turkish Water Pollution Control Regulation (WPCR) published in Official Gazette No. 25687, dated December 31, 2004, and amended on February 13, 2008, March 30, 2010, April 24, 2011 and November 2012. The aim of the WPCR is to determine the necessary legal and technical principles in order to protect surface and groundwater resources and prevent water pollution in harmony with sustainable development objectives.

The WPCR covers water quality classes and utilization principles, planning principles and prohibitions concerning water quality, wastewater discharge principles and discharge permits, applications in wastewater infrastructure facilities and monitoring and auditing principles in order to prevent water pollution. Industries are categorized according to their sectors in the WPCR. The WPCR presents “sector-specific” discharge limits for numerous types of wastewater discharges. It also sets the discharge limits for domestic wastewaters and protection zones for drinking water dam reservoirs.

The WPCR for groundwater (spring and groundwater well sources), include three quality classes, as defined below.

- Class I: High quality groundwater: Groundwater that attains the quality parameters of Class I surface water shall be regarded as Class I groundwater, provided that the required oxygen can be supplied by aeration alone.
  - Drinking water and food industry

- Class II: Medium quality groundwater: Groundwater that attains the quality parameters of Class II surface water (excluding ammonia, iron, manganese, and dissolved oxygen) shall be regarded as Class II groundwater.
  - Drinking water supply after treatment
  - Agricultural and livestock water
  - Cooling water
- Class III: Low quality groundwater.

Regulation on the Protection of Groundwater Due to Pollution and Degradation and Surface Water Quality Regulation

Analytical results were reviewed in accordance with the parameter limits defined in 7, 8, 11, 12, 13 and 22 clauses of WPCR limits issued by the Ministry of Environment and Urbanization in 2004 and amended finally in 2012. However, these clauses were cancelled with the issuance of the following regulations:

- Regulation on the Protection of Groundwater Due to Pollution and Degradation (RPGDPD), dated April 7, 2012 and numbered 28257 in the official gazette; and,
- Surface Water Quality Regulation (SWQR) dated November 30, 2012 and numbered 28483.

Those cancelled clauses define groundwater and surface water classification, classes and enacts prohibitions of groundwater pollution and related regulations. The objectives of the new regulations are protection of good conditions of available groundwater and surface water, prevention of pollution and degradation of groundwater and surface water, and improvement of these waters.

The 9th clause of the RPGDPD defines that the monitoring of a groundwater body and chemical condition are realized in accordance with the Annex 5 of the regulation, after the groundwater characterization is completed. According to the Annex 5 of the regulation, the parameters of ammonium, nitrate, conductivity, pH values, and oxygen content will be monitored for general monitoring purposes. According to the 9th Clause of this regulation, groundwater characterization tables will be completed in five years after the regulation is published.

The newly published SWQR includes classification limits for inland water resources. The surface water resources are classified into four classes by these defined limits. Guidelines of the surface water classes according to SWQR are as follows:

- Class I High quality water: These waters are regarded as a potential water supply for drinking after disinfection, recreational use (including body contact), trout propagation, animal production, and farming needs.
- Class II Slightly contaminated water: These waters are also considered a potential water supply for drinking after proper treatment, recreational use, propagation of fish other than trout, irrigation water, provided they meet the irrigation water quality criteria.
- Class III Contaminated water: These waters could be used as industrial water needs after appropriate treatment, except for those industries that require high quality water, such as the food and textile industries.
- Class IV Highly Contaminated Water.

Drinking Water Criteria

In addition to WPCR and SWQR, analytical results are compared with the chemical and indicative parameter limits defined in Regulation on Water Intended for Human Consumption (RWIHC – by Turkish Ministry of Health (MoH)), which was published in Official Gazette No: 25730 in 2005 and amended in 2009. The RWIHC separates the water resources for consumption into two different groups which are natural springs and bottled drinking water resources, and provides different limits for each. However, this differentiation is only valid for “Microbiological Parameters”, and therefore, there is only one set of limits for the remaining parameters. The RWIHC provides limits for the below mentioned parameter groups:

In addition to classification of water sources according to WPCR and RWIHC, there exists a similar standard on "Water Intended for Human Consumption, TS266" published by the Turkish Standard Institution (TSE), which provides limits for the below mentioned groups of different water sources:

a. Class 1: Natural Springs,

b. Class 2: Water sources other than springs in which two types are differentiated;

- Type 1: Processed spring water
- Type 2: Drinking and usage water

Drinking water resources which were sampled within the scope of the Hydrogeological Impact Assessment Study were also compared with the drinking water quality criteria specified in the European Union Council Directive (98/93/EC of November 1998). According to the council directive, water intended for human consumption is defined as

a. all water either in its original state or after treatment, intended for drinking, cooking, food preparation or other domestic purposes, regardless of its origin and whether it is supplied from a distribution network, from a tanker, or in bottles or containers,

b. all water used in any food-production undertaking for the manufacture, processing, preservation or marketing of products or substances intended for human consumption unless the competent national authorities are satisfied that the quality of the water cannot affect the wholesomeness of the foodstuff in its finished form.

Drinking water resources which were sampled within the scope of the Hydrogeological Impact Assessment Study were lastly compared with the drinking water guideline values specified by the World Health Organization (WHO). The Guidelines provide the recommendations of the WHO for managing the risk from hazards that may compromise the safety of drinking-water. The recommendations should be considered in the context of managing the risk from other sources of exposure to these hazards, such as waste, air, food and consumer products (WHO, 2011).

5.7.7.2 Drinking Waters

Water quality sampling and monitoring survey for drinking waters was first performed in September 2015 by AECOM, primarily to identify the location and quality of drinking water resources. Within the scope of the September 2015 survey, 3 village fountains, 2 spring and 6 village water depots were visited for sample collection and field parameter measurements.

An extended baseline water quality program has been initiated in May 2016 to collect drinking water samples and to measure physical site parameters. Within the scope of this updated water quality program, 10 water depots, 1 village fountain and 1 spring were visited. The locations were visited both for quarterly sampling (with respect to parameters given in Table 5-23) and monthly field parameter monitoring. Field parameters including pH, electrical conductivity (EC), temperature (T) and dissolved oxygen (DO) were monitored for each selected water point. Sampling and monitoring points were selected to represent downstream and upstream locations of the project units.

Coordinates, descriptions and sampling periods for the drinking water sampling and monitoring points are provided in Table 5-24; whilst their locations are shown in Figure 5-39.

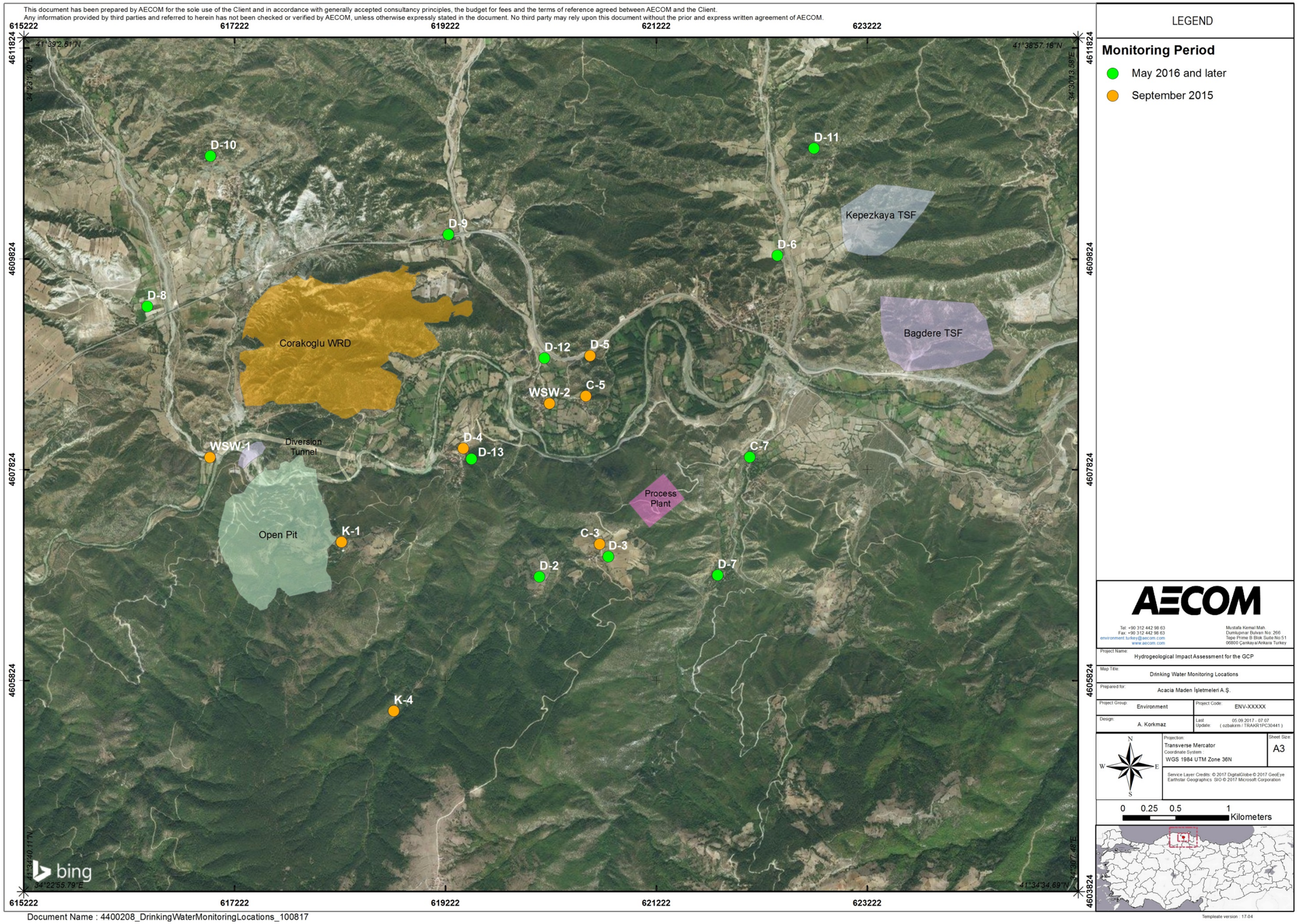
Well head housing for the water supply wells that provide water for Küpeli – Aşağıküreçay villages (WSW-1) and Vakıf Village (WSW-2) were found to be closed at the time of the monitoring period. Since there is no direct sampling point available at the well location, water samples were collected from the village water depots (D-8 for Küpeli Village, D-10 for Aşağıküreçay Village, D-5 for Vakıf Village) connected to these water supply wells.

Table 5-24 Coordinates and Descriptions for Drinking Water Samples

Source	Station ID	Coordinates (WGS84 UTM Zone 36N)		Type[1]	Description	Sampling Period(s)[2]	Monitoring Period(s)[3]	Project Unit(s)
		X	Y					
Springs	K-1	618246	4607061	SP	Sepetçioğlu Village natural spring.	Sep. 2015 / May-Aug.-Nov.16	Monthly (from May 2016 to present)	Open Pit
	K-4	618732	4605535	SP	Dereköy Village natural spring, water provider for D-4.	Sep. 2015	Sep. 2015	Open Pit
Village Water Depots	D-2	620114	4606808	DE	Imam Village water depot, southwest of the Processing Plant.	Sep. 2015 / May-Aug.-Nov.16	Monthly (from May 2016 to present)	Process Plant
	D-3	620769	4607000	DE	Geymene Village water depot, southwest of the Processing Plant.	Sep. 2015 / May-Aug.-Nov.16	Monthly (from May 2016 to present)	Process Plant
	D-4	619392	4608026	DE	Dereköy Village water depot, east of the Open Pit.	Sep. 2015	Sep. 2015	Çorakoğlu WRD
	D-5	620595	4608905	DE	Vakıf Village water depot, east of the Open Pit and Çorakoğlu WRD.	Sep. 2015	Sep. 2015	Çorakoğlu WRD
	D-6	622371	4609856	DE	Hanönü Village water depot, southwest of TSFs.	Sep. 2015 / May-Aug.-Nov.16	Monthly (from May 2016 to present)	Kepezkaya TSF
	D-7	621805	4606823	DE	Bağdere Village water depot, downstream of the Processing Plant.	Sep. 2015 / May-Aug.-Nov.16	Monthly (from May 2016 to present)	Process Plant
	D-8	616394	4609372	DE	Küpeli Village water depot, west of Çorakoğlu WRD.	Sep. 2015 / May-Aug.-Nov.16	Monthly (from May 2016 to present)	Çorakoğlu WRD
	D-9	619244	4609981	DE	Yozlu Vil. water depot, northeast of Çorakoğlu WRD.	Sep. 2015 / May-Aug.-Nov.16	Monthly (from May 2016 to present)	Çorakoğlu WRD
	D-10	616985	4610714	DE	Aşağıküreçay Village water depot, northwest of Çorakoğlu WRD.	Sep. 2015 / May-Aug.-Nov.16	Monthly (from May 2016 to present)	Çorakoğlu WRD
	D-11	622718	4610872	DE	Yılanlı Vil. water depot, northwest of Kepezkaya TSF.	Sep. 2015 / May-Aug.-Nov.16	Monthly (from May 2016 to present)	Kepezkaya TSF
	D-12	620161	4608882	DE	Vakıf Village water depot, east of the Open Pit and Çorakoğlu WRD.	Sep. 2015 / May-Aug.-Nov.16	Monthly (from May 2016 to present)	Çorakoğlu WRD
	D-13	619469	4607924	DE	Dereköy Village water depot, east of the Open Pit.	Sep. 2015 / May-Aug.-Nov.16	Monthly (from May 2016 to present)	Open Pit
Village Fountains	C-3	620686	4607117	FO	Geymene Vil. fountain, southwest of the Proces. Plant.	Sep. 2015	Sep. 2015	Process Plant
	C-5	620555	4608521	FO	Vakıf Village fountain, east of the Open Pit and Çorakoğlu WRD.	Sep. 2015	Sep. 2015	Çorakoğlu WRD
	C-7	622106	4607865	FO	Çaylı Village water depot, downstream of the Processing Plant.	Sep. 2015 / May-Aug.-Nov.16	Monthly (from May 2016 to present)	Process Plant

Notes:
[1]: SP: Spring, DE: Village Water Depot, FO: Village Fountain
[2]: indicates water quality sampling periods,
[3]: indicates field parameters measurement periods.

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



LEGEND

Monitoring Period

- May 2016 and later
- September 2015

AECOM

Tel: +90 312 442 98 63
Fax: +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com

Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime B Blok Suite No:51
06800 Çankaya/Ankara Turkey

Project Name:	Hydrogeological Impact Assessment for the GCP
Map Title:	Drinking Water Monitoring Locations
Prepared for:	Acacia Maden İşletmeleri A.Ş.
Project Group: Environment	Project Code: ENV-XXXXX
Design: A. Korkmaz	Last Update: 05.09.2017 - 07:07 (ozbakirm / TRAKR1PC30441)
Projection: Transverse Mercator Coordinate System : WGS 1984 UTM Zone 36N	Sheet Size: A3

Service Layer Credits: © 2017 DigitalGlobe © 2017 GeoEye Earthstar Geographics SIO © 2017 Microsoft Corporation

N W E S

0 0.25 0.5 1 Kilometers

Document Name : 4400208_DrinkingWaterMonitoringLocations_100817

Templeate version : 17-04

Figure 5-39 Drinking Water Monitoring Locations

Drinking Water Field Parameters

Aiming to identify the existing status of groundwater in the near vicinity of the project units, village fountains and water depots of the nearby settlement areas and their corresponding upstream springs were monitored in September 2015. In situ measurements were carried out in water depots/springs of the settlements located in downstream of the open pit (D-4 and K-1), process plant (C-7) and tailings storage facilities (D-6). Fountains, water depots and springs located in the villages of Vakıf and Geymene (C-5, D-5, K-4, D-2, C-3 and D-3) were also included in field parameters measurements because of their proximity to the open pit, Çorakoğlu WRD and processing facility areas.

Monitoring points visited in September 2015 display near neutral to slightly alkaline conditions with an average pH value of 7.8. Electrical conductivity values range between 453 and 654 µS/cm with average EC of 573 µS/cm. Based on the measurements starting from May 2016 slightly alkaline conditions were obtained for the pH values having an overall mean of 7.78. Electrical conductivity values show a relatively stable trend throughout the course of the monitoring period, with an overall mean of 543 µS/cm. Temperature values obtained from water depots, fountains and springs were observed to reflect a similar trend with the atmospheric conditions varying between 31.10-10.0 ºC and 6.30-2.10 ºC for summer and winter seasons, respectively. Mean of dissolved Oxygen measured for the water depots, fountains and springs were found to be 9.04 mg/L.

Drinking Waters Hydrochemistry

Ionic characteristics of the groundwater samples and their hydrochemical facies types were evaluated using relevant water quality diagrams. In this regard, Piper and Schoeller diagrams were generated based on the major ion concentrations. In order to assess the groundwater samples regarding their potential use for irrigation purposes, analysis results were evaluated through Wilcox Diagram.

The majority of the September 2015 drinking water samples were identified to be enriched in Ca^{2+} ion among the major cations. Village fountain of Çaylı (C-7) and water depot of Bağdere (D-7) were found to display a mixture of Ca^{2+} and Mg^{2+} due to their relatively high Mg^{2+} concentrations. Groundwater samples were identified to be enriched in HCO_3^- with respect to their anion concentrations. Water depots and fountains located in the villages of Çaylı and Geymene were observed to have higher concentrations of HCO_3^- compared to the rest of the samples. Water depots/fountains located in north of the Gökırmak River (C-5, D-5 and D-6) were found to have relatively low HCO_3^- values compared to the points those are located in the villages of Çaylı and Geymene. This difference however, does not have a major influence on waters to be dominated by SO_4^{2-} and/or Cl^-. Major ion concentrations indicate that the groundwater samples have Ca-HCO_3 and Ca-Mg-HCO_3 facies types, suggesting that the samples are representative of shallow groundwater that was freshly recharged.

Starting from May 2016, based on the major ion distribution of the samples collected from the village water depots, fountains and springs, the majority of the samples were found to be enriched in Ca^{2+} and HCO_3^- for all sampling periods. Two village water depots located at downstream of the Çorakoğlu WRD (Yozlu: D-9 and Küpeli: D-8) were identified to have relatively high concentrations of Na^+ compared to the rest of the water depots, fountains and springs. Hanönü water depot (D-6) was observed to have relatively high $SO4^{2-}$ and Cl^- concentrations for the August 2016 sampling period. Piper and Schoeller diagrams for the village water depots, fountains and springs are provided through Figure 5-40and Figure 5-45.

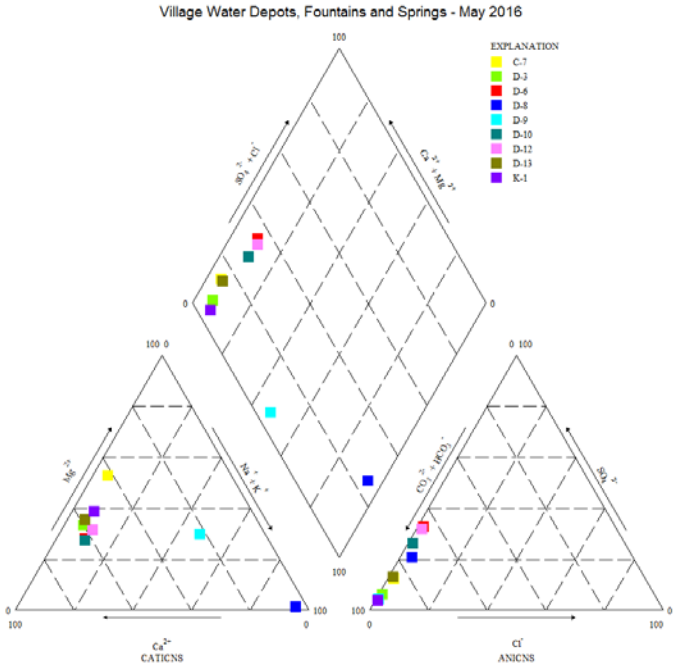


Figure 5-40 Piper Diagram for the May 2016 Drinking Water Samples

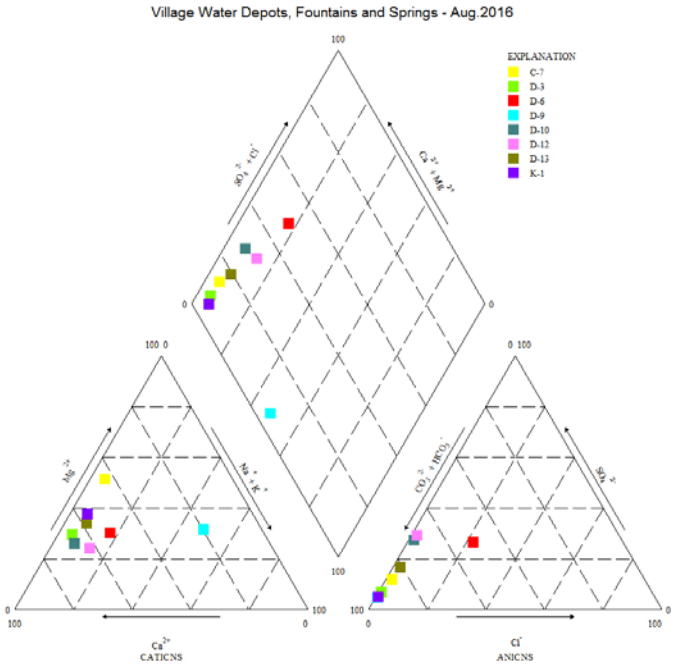


Figure 5-41 Piper Diagram for the August 2016 Drinking Water Samples

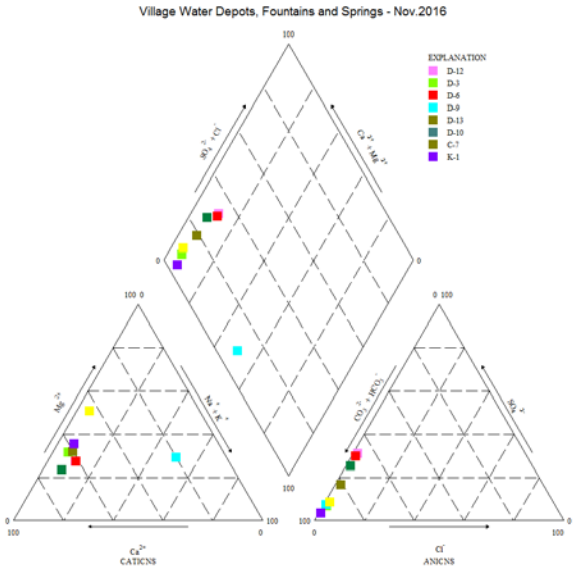


Figure 5-42 Piper Diagram for the November 2016 Drinking Water Samples

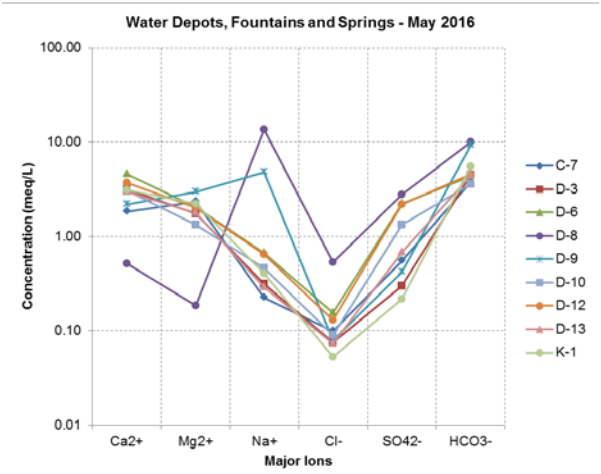


Figure 5-43 Schoeller Diagram for the May 2016 Drinking Water Samples

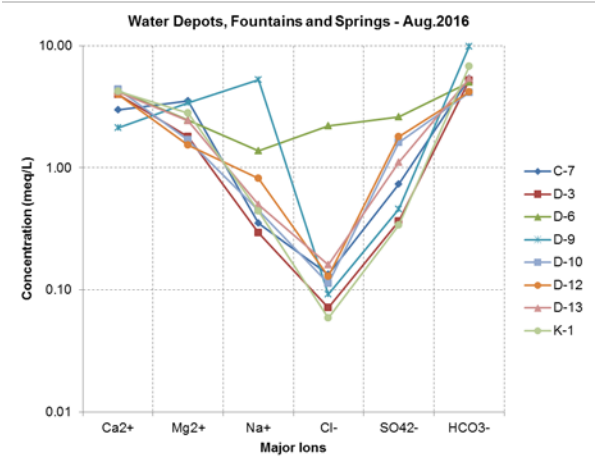


Figure 5-44 Schoeller Diagram for the August 2016 Drinking Water Samples

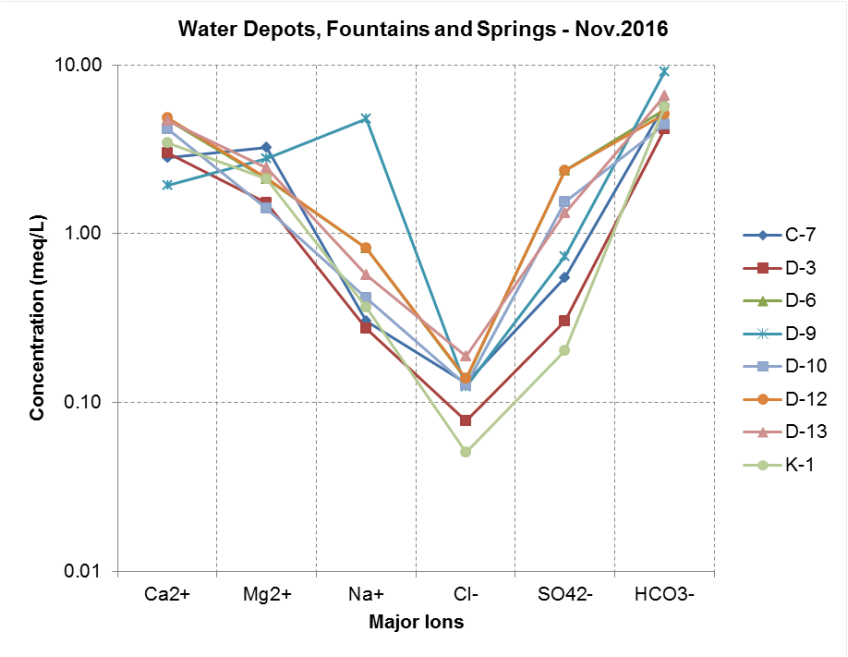


Figure 5-45 Schoeller Diagram for the November 2016 Drinking Water Samples

According to the Wilcox Diagram, the majority of the village water depots, fountains and springs were found to have moderate salinity hazard - low sodium hazard (C2/S1). Küpeli Village water depot (D-8) were found to have high salinity hazard – very high sodium hazard (C3/S4) for the May 2016 sampling period. Water depots for the Hanönü and Yozlu villages (D-6 and D-9) were observed to show variances as they reflect moderate or high salinity hazards (C2 or C3) for different sampling periods (August and November 2016). Both of these samples were identified to show low sodium hazard (S1). Wilcox diagrams for the monitoring wells are provided in Figure 5-46.

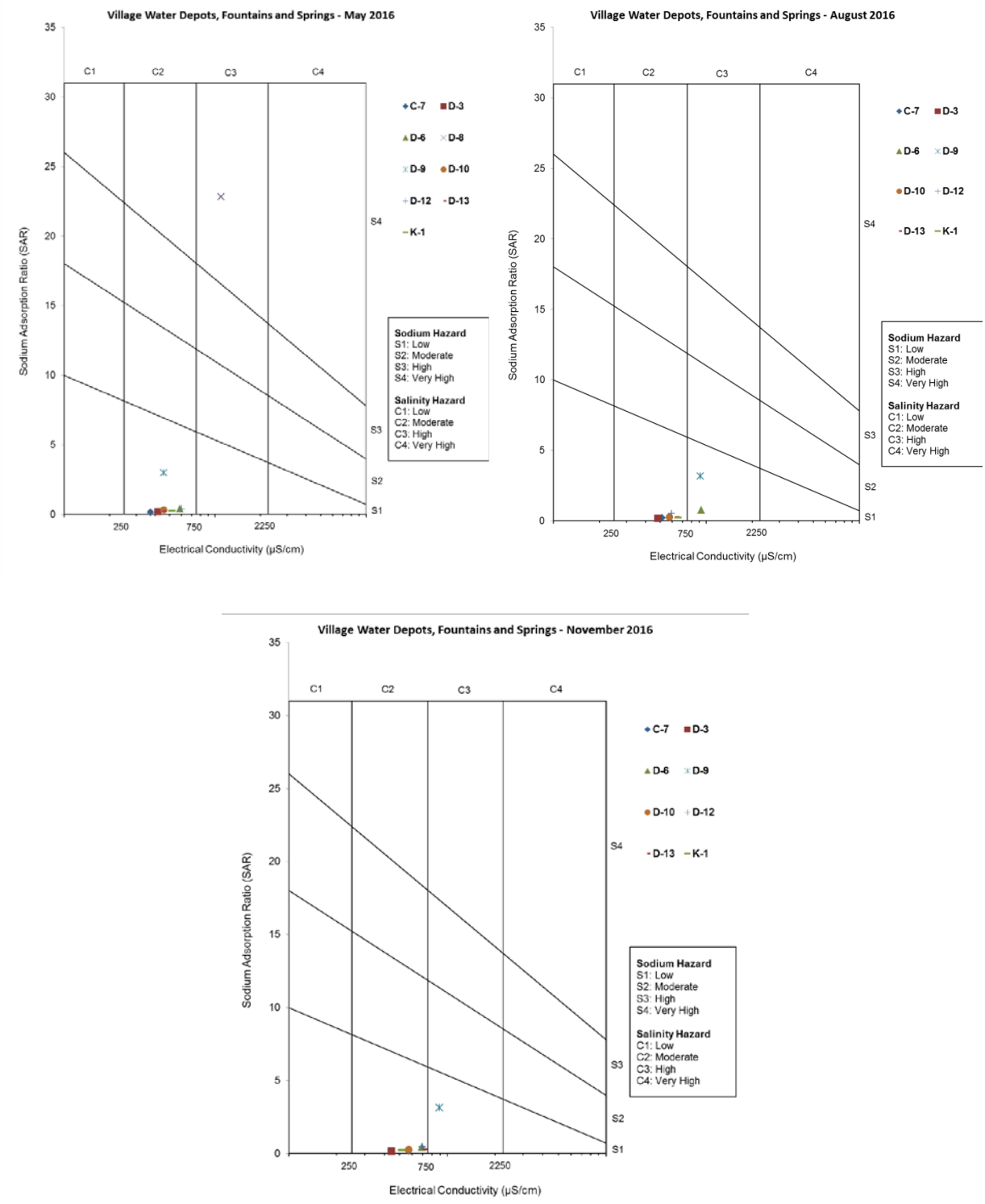


Figure 5-46 Wilcox Diagrams for the Drinking Water Samples

Drinking Waters Quality Classifications

Samples collected from village water depots, fountains and springs were compared with the drinking water standards/guidelines specified by the Turkish Ministry of Health, Turkish Standards Institution, EU Drinking Water Directive and WHO. Comparisons with drinking water criteria are given in Table 5-25 and Table 5-26 while the details are provided below.

- The majority of the village water depots, fountains and springs (except D-3: Geymene Village and K-1: Sepetçioğlu Village spring) were found to be classified as Class II-Type II with respect to TS-266 drinking water standards, mainly due to SO_4 concentrations.
- Al, Fe, SO_4, Na and EC values in D-8 (Küpeli Village water depot) were identified to be within Class II-Type II limits, unlike the majority of the drinking water resources. EC values in D-9, Cl concentrations in D-6 and Fe concentrations in D-12 were seasonally found to be within Class II-Type II levels with respect to TS-266 drinking water standards. All samples collected from village water depots, fountains and springs except D-8 were found to be in compliance with Turkish Ministry of Health drinking water criteria (RWIFHC). Al, Fe and Na concentrations in D-8 were observed to exceed the limit values specified in RWIFHC.
- All samples collected from village water depots, fountains and springs except D-8 were found to be in compliance with the drinking water criteria specified within the EU Council Directive (98/83/EC, 1998). D-8 was found to have exceeding concentrations of Na with respect to EU drinking water criteria.

All samples collected from village water depots, fountains and springs were found to be in compliance with the drinking water guidelines specified by World Health Organization (WHO, 2011).

Table 5-25 Comparison of Drinking Water Samples with EU Drinking Water Quality Criteria and WHO Drinking Water Guidelines

Drinking Water Guidelines	Unit	EU Drinking Water Quality Criteria, 1998[1]	WHO Drinking Water Guidelines, 2011[2]	C-7			D-3			D-6			D-8	D-9			D-10			D-12			D-13			K-1		K-1
Parameters				May.16	Aug.16	Nov.16	May.16	Aug.16	Nov.16	May.16	Aug.16	Nov.16	May.16	May.16	Aug.16	Nov.16	May.16	Aug.16	Nov.16	May.16	Aug.16	Nov.16	May.16	Aug.16	Nov.16	May.16	Aug.16	Nov.16
Antimony	mg/L	0.005	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	mg/L	0.01	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium	mg/L	-	0.7	0.00239	0.00258	0.00296	0.00121	0.00055	0.00074	0.0508	0.0498	0.0483	0.0527	0.182	0.15	0.114	0.0223	0.0271	0.0258	0.0499	0.0418	0.0486	0.00232	0.00356	0.00398	0.00393	0.00144	<0.0005
Benzene	mg/L	0.001	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron	mg/L	1	2.4	0.033	0.06	0.053	0.01	0.015	0.01	0.077	0.086	0.092	0.396	0.213	0.232	0.268	0.08	0.094	0.107	0.078	0.109	0.094	0.014	0.052	0.052	0.044	0.051	0.012
Cadmium	mg/L	0.005	0.003	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Chromium	mg/L	0.05	0.05	0.0012	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	2	2	0.006	0.0061	0.0025	<0.002	<0.002	<0.002	0.0022	<0.002	<0.002	0.0067	0.007	0.0025	<0.002	0.0025	0.0023	<0.002	<0.002	<0.002	<0.002	0.0061	0.0047	0.0159	<0.002	<0.002	<0.002
Cyanide	mg/L	0.05	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluoride	mg/L	1.5	1.5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.32	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Lead	mg/L	0.01	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Mercury	mg/L	0.001	0.006	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Nickel	mg/L	0.02	0.07	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Nitrate as NO3	mg/L	50	50	<0.27	<0.27	<0.27	14.1	14.8	17.1	3.26	3.36	4.85	5.3	<0.27	0.94	1.1	3.09	4.35	2.14	3.32	2.54	4.44	<0.27	2.65	2.86	1.2	0.89	1.15
Nitrite as NO2	mg/L	0.5	3	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0823	<0.005	<0.005	<0.005	0.0103	0.013	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Selenium	mg/L	0.01	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	mg/L	0.2	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ammonium as NH4	mg/L	0.5	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chloride	mg/L	250	-	3.49	4.78	4.64	2.67	2.55	2.78	5.46	78.3	4.89	18.8	2.8	3.26	4.4	3.21	4.03	4.5	4.64	4.6	4.93	2.58	5.67	6.71	1.88	2.09	1.81
Conductivity	µS/cm	2500	-	338	332.2	409	374	289.8	310	489	-	536	1043	737	919	597	395	549	458	519	547	564	373	327.5	540	433	282.5	402
pH	-	6.5≤pH≤9.5	-	8.17	7.92	7.62	8.14	7.79	8.44	7.8	-	7.62	8.24	7.46	7.61	8.45	8.34	7.77	7.34	7.9	7.79	8.03	7.89	7.55	7.71	7.87	7.43	7.75
Iron	mg/L	0.2	-	0.0023	0.0031	<0.002	<0.002	<0.002	<0.002	<0.002	0.0101	<0.002	0.0033	0.0042	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0087	0.0086	<0.002
Manganese	mg/L	0.05	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00059	<0.0005	<0.0005
Sulfate as SO4	mg/L	250	-	26.4	35.1	26.4	14.3	17.4	14.6	106	124	113	133	19.9	21.8	34.9	63.2	76.6	73.5	105	85.2	113	32.2	52.9	63.1	10.4	16.3	9.75
Sodium	mg/L	200	-	5.15	8.05	6.92	7.18	6.71	6.29	15.4	31.4	18.7	310	109	120	110	10.6	10.2	9.55	14.8	18.8	18.7	6.66	11.4	13	9.36	10.1	8.4
Uranium	mg/L	-	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

[1]: European Union Quality Criteria for Waters Intended for Human Consumption – Council Directive 98/83/EC of 3 November 1998,

[2]: Guidelines for Drinking Water Quality – World Health Organization (WHO), 2011.

Laboratory detection limits for some parameters were found to be greater than the regulatory limit values. Concentrations for those parameters were assumed as the same values with the laboratory detection limits

Table 5-26 Comparison of Drinking Water Samples with Drinking Water Standards specified in Turkish Ministry of Health (RWIFHC) and Turkish Standards Institution (TSE-266)

Parameters	Unit	TSE-266		RWIFHC	C-7			D-3			D-6			D-8	D-9			D-10			D-12			D-13			K-1		
		Class 1 or Class 2 -Type 1 Limits	Class 2 - Type 2 Limits	Limit Values	May.16	Aug.16	Nov.16	May.16	Aug.16	Nov.16	May.16	Aug.16	Nov.16	May.16	May.16	Aug.16	Nov.16	May.16	Aug.16	Nov.16	May.16	Aug.16	Nov.16	May.16	Aug.16	Nov.16	May.16	Aug.16	Nov.16
Antimony (Sb)	mg/L	0.005	0.005	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic (As)	mg/L	0.01	0.01	0.01	<0.005	<0.005	<0.005	<0.005	0.0064	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0068	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Boron (B)	mg/L	1	1	1	0.034	0.07	0.057	0.01	0.021	0.014	0.083	0.09	0.096	0.394	0.225	0.239	0.268	0.087	0.1	0.107	0.082	0.115	0.094	0.016	0.057	0.051	0.046	0.053	0.016
Cadmium (Cd)	mg/L	0.005	0.005	0.005	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.002	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Chromium (Cr)	mg/L	0.05	0.05	0.05	0.0012	<0.001	0.0014	<0.001	<0.001	<0.001	0.0027	<0.001	<0.001	<0.002	0.0018	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper (Cu)	mg/L	0.1	2	2	0.0131	0.0087	0.0032	0.0024	0.0027	<0.001	0.0038	0.0038	<0.001	0.0093	0.0072	0.0032	<0.001	0.0025	0.0028	0.0017	0.0012	0.0028	<0.001	0.0067	0.0168	0.0201	<0.001	<0.001	<0.001
Cyanide (CN)	mg/L	0.05	0.05	0.05	-	<0.005	<0.005	-	<0.005	<0.005	-	<0.005	<0.005	-	-	<0.005	<0.005	-	<0.005	<0.005	-	<0.005	<0.005	-	<0.005	<0.005	-	<0.005	<0.005
Fluoride (F-)	mg/L	1	1.5	1.5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.32	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Lead (Pb)	mg/L	0.01	0.01	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Mercury (Hg)	mg/L	0.001	0.001	0.001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Nickel (Ni)	mg/L	0.02	0.02	0.02	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	<0.002
Nitrate (NO_3)	mg/L	25	50	50	<0.27	<0.27	<0.27	14.1	14.8	17.1	3.26	3.36	4.85	5.3	<0.27	0.94	1.1	3.09	4.35	2.14	3.32	2.54	4.44	<0.27	2.65	2.86	1.2	0.89	1.15
Nitrite (NO_2)	mg/L	0.1	0.5	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0823	<0.005	<0.005	<0.005	0.0103	0.013	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Selenium	mg/L	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminium (Al)	mg/L	0.2	0.2	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	0.013	0.011	<0.01	0.014	2.75	0.012	0.02	<0.01	0.011	0.01	<0.01	0.016	0.054	0.035	<0.01	<0.01	<0.01	0.01	0.015	<0.01
Ammonium (NH_4)	mg/L	0.05	0.5	0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chloride (Cl)	mg/L	30	250	250	3.49	4.78	4.64	2.67	2.55	2.78	5.46	78.3	4.89	18.8	2.8	3.26	4.4	3.21	4.03	4.5	4.64	4.6	4.93	2.58	5.67	6.71	1.88	2.09	1.81
Conductivity 20°C	µS/cm	650	2500	2500	338	332.2	409	374	289.8	310	489	-	536	1043	737	919	597	395	549	458	519	547	564	373	327.5	540	433	282.5	402
pH	-	6.5≤pH≤9.5	6.5≤pH≤9.5	6.5≤pH≤9.5	8.17	7.92	7.62	8.14	7.79	8.44	7.8	-	7.62	8.24	7.46	7.61	8.45	8.34	7.77	7.34	7.9	7.79	8.03	7.89	7.55	7.71	7.87	7.43	7.75
Iron (Fe)	mg/L	0.05	0.2	0.2	0.0059	0.0076	0.0142	0.0042	0.0034	0.0124	0.007	0.0076	0.0128	2.21	0.0121	0.0048	0.0022	0.0097	0.011	0.0107	0.0067	0.197	0.147	0.0109	0.0092	0.0102	0.0122	<0.002	0.0039
Manganase (Mn)	mg/L	0.02	0.05	0.05	<0.0005	0.00128	0.0014	<0.0005	<0.0005	0.0016	<0.0005	<0.0005	0.00057	0.0196	<0.0005	0.00082	<0.0005	0.00083	0.00161	0.00159	<0.0005	0.00585	0.00227	0.0005	0.00268	0.00374	0.00164	0.00155	<0.0005
Sulphate (SO_4)	mg/L	25	250	250	26.4	35.1	26.4	14.3	17.4	14.6	106	124	113	133	19.9	21.8	34.9	63.2	76.6	73.5	105	85.2	113	32.2	52.9	63.1	10.4	16.3	9.75
Sodium (Na)	mg/L	100	200	200	5.4	8.18	7.1	7.36	6.89	6.34	17.5	33.8	18	300	112	124	102	11.2	10.2	9.53	15.8	19.1	18.2	6.86	11.5	13.5	9.48	10.6	8.71
Total Organic Carbon (TOC)	mg/L	No unusual changes			2.89	2.67	1.55	<0.5	0.85	0.6	0.7	1.19	0.68	2.9	0.72	1.57	0.98	0.56	1.49	0.66	<0.5	0.87	0.66	2.34	1.8	1.3	<0.5	0.92	<0.5

Notes:

Laboratory detection limits for some parameters were found to be greater than the regulatory limit values. Concentrations for those parameters were assumed as the same values with the laboratory detection limits

5.7.7.3 Groundwater

Groundwater quality sampling and monitoring surveys were started in Spring and Summer 2012 by ENVY to identify initial baseline conditions for the Project Area groundwater resources. In order to represent wet and dry periods of the year, consecutive field surveys were conducted in May and August 2012. Four groundwater points were visited for sampling and in-situ field parameter measurements. The locations of the monitoring wells were selected to identify the groundwater quality for both upstream and downstream portions of the Project Area with respect to the Gökırmak River. One monitoring well (DG-101) located in the proposed open pit area was also sampled to obtain quality information of groundwater pertaining to the pit area.

A water quality sampling and monitoring program was performed in September 2015 by AECOM, primarily to identify the quality of drinking waters. AECOM has also collected samples of groundwater from the selected locations in the project area to understand the baseline conditions in more detail and more in line with the up-to-date mine layout. Within the scope of this new program, the number of the sampling locations was increased to characterize the upstream and downstream portions of the individual project units. In this regard, 5 monitoring wells were also visited for water quality sampling.

An extended baseline water quality program has been initiated in May 2016 to collect groundwater samples and to measure physical site parameters. Within the scope of this program, a total of 29 monitoring wells were visited including the existing and recently completed wells by AECOM. Fifteen of the 29 monitoring wells were visited for quarterly sampling while field parameter measurements were carried out in all 29 monitoring wells. Field parameters including pH, electrical conductivity (EC), temperature (T) and dissolved oxygen (DO) were monitored for each selected water point. Sampling and monitoring points were selected to represent downstream and upstream locations of the project units. Monitoring wells (GK series) completed by AECOM within the scope of the Hydrogeological Impact Assessment Study were included in the water quality sampling and monitoring program upon their completion and well development by early December 2016.

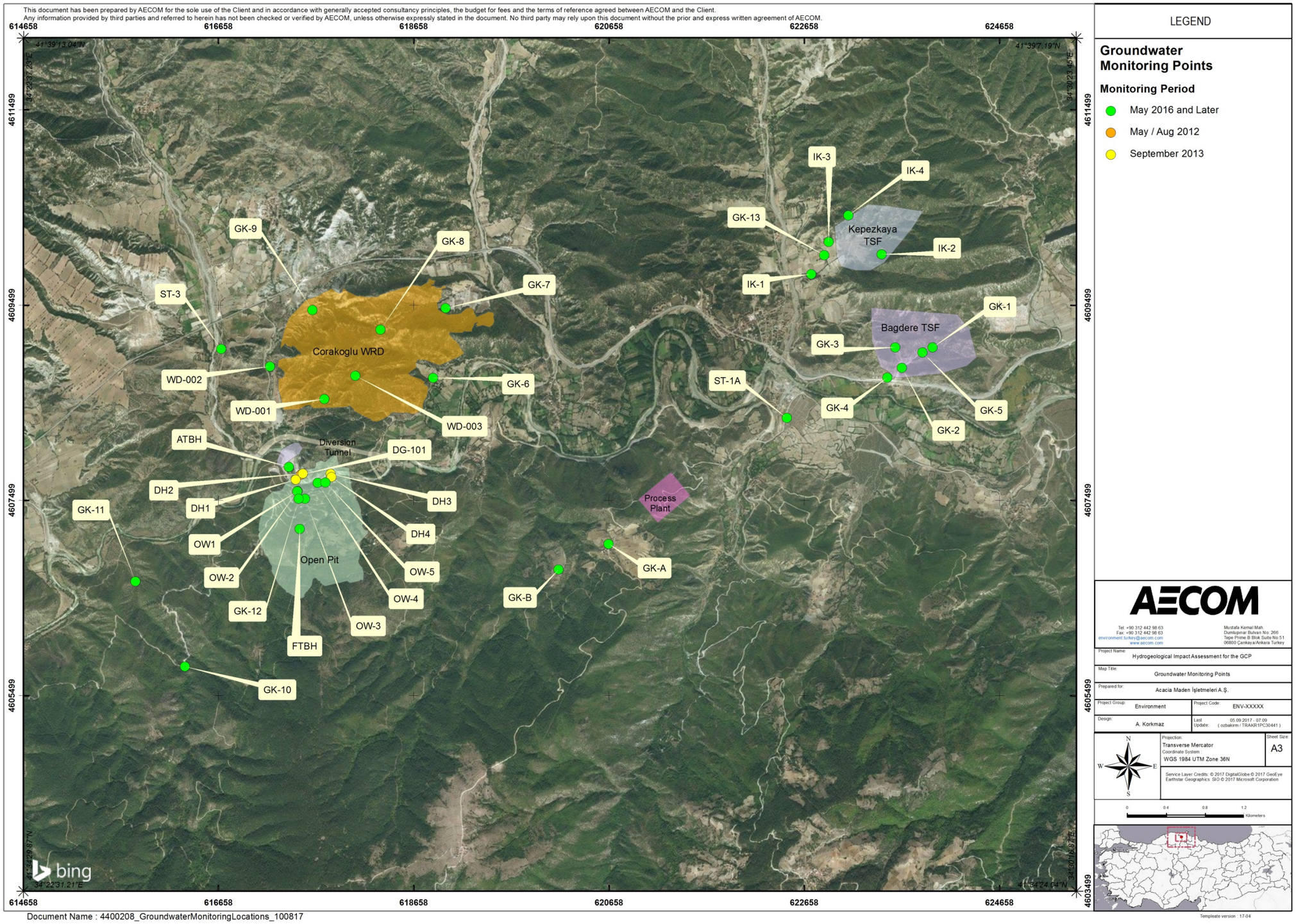
Coordinates, descriptions and sampling periods for the groundwater sampling and monitoring points visited since 2012 are provided in Table 5-27 while groundwater sampling and monitoring locations are shown in Figure 5-47.

Table 5-27 Coordinates and Descriptions for Groundwater Samples

	Station ID	Coordinates (WGS84 UTM Zone 36N)		Type[1]	Description	Sampling Period(s)[2]	Monitoring Period(s)[3]	Project Unit(s)
		X	Y					
Monitoring Wells	KS-1	605408	4602649	MW	Upstream Gökırmak River, Southwest of the Project Area.	May / Aug. 2012	May / Aug. 2012	Project Area Upstream
	KS-2	613010	4607397	MW	Upstream of Akcasuköy, West of the Project Area.	May / Aug. 2012	May / Aug. 2012	Project Area Upstream
	KS-3	627390	4608585	MW	Downstream Gökırmak River, East of the Project Area.	May / Aug. 2012	May / Aug. 2012	Project Area Downstream
	DG-101	617504	4607762	MW	South bank of the Gökırmak River, within the Open Pit boundaries.	May / Aug. 2012	Aug. 2012	Open Pit
	DH-1	617449	4607711	MW	Open pit area monitoring well.	Sep. 2013	Sep. 2013	Open Pit
	DH-2	617522	4607775	MW	Open pit area monitoring well.	Sep. 2013	Sep. 2013	Open Pit
	DH-3	617808	4607772	MW	Open pit area monitoring well.	Sep. 2013	Sep. 2013	Open Pit
	DH-4	617814	4607740	MW	Open pit area monitoring well.	Sep. 2013	Sep. 2013	Open Pit
	OW-1	617468	4607596	MW	Open pit area monitoring well.	Sep. 2013 / July 2015	Sep. 2013	Open Pit
	OW-2	617464	4607592	MW	Open pit area monitoring well.	Sep. 2013	Monthly (from July 2016 to present)	Open Pit
	OW-3	617544	4607515	MW	Open pit area monitoring well.	Sep. 2013 / Jul. 2015 / May-Aug.-Nov.16	Monthly (from May 2016 to present)	Open Pit
	OW-4	617673	4607678	MW	Open pit area monitoring well.	Sep. 2013	Monthly (from July 2016 to present)	Open Pit
	OW-5	617753	4607682	MW	Open pit area monitoring well.	Sep. 2013 / Jul. 2015	Monthly (from July 2016 to present)	Open Pit
	IK-1	622730	4609815	MW	Southwest of the Kepezkaya TSF and northeast of Hanönü	May-Aug.16	Monthly (from May 2016 to present)	Kepezkaya TSF
	IK-2	623452	4610019	MW	Monitoring well within the Kepezkaya TSF, northeast of Hanönü.	May-Aug.-Nov.16	Monthly (from May 2016 to present)	Kepezkaya TSF
	IK-3	622909	4610147	MW	Monitoring well within the Kepezkaya TSF, northeast of Hanönü.	May-Aug.-Nov.16	Monthly (from May 2016 to present)	Kepezkaya TSF
	IK-4	623112	4610417	MW	Monitoring well within the Kepezkaya TSF, northeast of Hanönü.	May-Aug.-Nov.16	Monthly (from May 2016 to present)	Kepezkaya TSF
	ATBH	617378	4607841	MW	Open pit area monitoring well.	-	Monthly (from Sept. 2016 to present)	Open Pit
	FTBH	617490	4607206	MW	Open pit area monitoring well.	May-Aug.-Nov.16	Monthly (from July 2016 to present)	Open Pit
	WD-001	617742	4608536	MW	Monitoring well, southwest of Çorakoğlu WRD.	May-Aug.16	Monthly (from May 2016 to present)	Çorakoğlu WRD
	WD-002	617186	4608870	MW	Monitoring well, southwest of Çorakoğlu WRD.	May-Aug.16	Monthly (from May 2016 to present)	Çorakoğlu WRD
	WD-003	618060	4608775	MW	Monitoring well, south of Çorakoğlu WRD.	May-Aug.16	Monthly (from May 2016 to present)	Çorakoğlu WRD
	ST-1	622501	4608400	MW	Water supply well, mobilization area.	Aug.16-Nov.16	Monthly (from December 2016 to present)	Mobilization Area
	ST-1A	622480	4608345	MW	Water supply well, mobilization area.	-	Monthly (from December 2016 to present)	Mobilization Area
	ST-2	622588	4608538	MW	Water supply well, mobilization area.	-	Monthly (from December 2016 to present)	Mobilization Area
	ST-3	616685	4609049	MW	Water supply well, mobilization area.	-	Monthly (from December 2016 to present)	Mobilization Area
	ST-4	622716	4608510	MW	Water supply well, mobilization area.	-	Monthly (from December 2016 to present)	Mobilization Area
	ST-5	622627	4608342	MW	Water supply well, mobilization area.	-	Monthly (from December 2016 to present)	Mobilization Area
	GK-1	623975	4609065	MW	Bağdere TSF area monitoring well.	-	Monthly (from December 2016 to present)	Bağdere TSF
	GK-2	623660	4608858	MW	Bağdere TSF area monitoring well.	-	Monthly (from December 2016 to present)	Bağdere TSF
	GK-3	623591	4609067	MW	Bağdere TSF area monitoring well.	-	Monthly (from December 2016 to present)	Bağdere TSF
	GK-4	623510	4608757	MW	Bağdere TSF area monitoring well.	Dec.16	Monthly (from December 2016 to present)	Bağdere TSF
	GK-5	623870	4609015	MW	Bağdere TSF area monitoring well.	-	Monthly (from December 2016 to present)	Bağdere TSF
	GK-6	618858	4608755	MW	Çorakoğlu WRD area monitoring well.	Dec.16	Monthly (from December 2016 to present)	Çorakoğlu WRD
	GK-7	618986	4609469	MW	Çorakoğlu WRD area monitoring well.	-	Monthly (from December 2016 to present)	Çorakoğlu WRD
	GK-8	618318	4609249	MW	Çorakoğlu WRD area monitoring well.	-	Monthly (from December 2016 to present)	Çorakoğlu WRD
	GK-9	617620	4609450	MW	Çorakoğlu WRD area monitoring well.	-	Monthly (from December 2016 to present)	Çorakoğlu WRD
	GK-10	616313	4605799	MW	Gelberi location monitoring well.	Dec.16	Monthly (from December 2016 to present)	Gelberi Location
	GK-11	615806	4606668	MW	Gelberi location monitoring well.	-	Monthly (from December 2016 to present)	Gelberi Location
	GK-12	617478	4607517	MW	Open Pit area monitoring well.	Dec.16	Monthly (from December 2016 to present)	Open Pit
	GK-13	622863	4610010	MW	Kepezkaya TSF area monitoring well.	Dec.16	Monthly (from December 2016 to present)	Kepezkaya TSF
	GK-A	620654	4607053	MW	Process Plant area monitoring well.	-	Monthly (from December 2016 to present)	Process Plant
	GK-B	620141	4606792	MW	Process Plant area monitoring well.	-	Monthly (from December 2016 to present)	Process Plant
Groundwater Wells	KK-1	622440	4609048	GW	Hanönü groundwater well, southwest of TSFs.	Sep. 2015	Sep. 2015	Bağdere & Kepezkaya TSFs
	KK-2	622430	4609058	GW	Hanönü groundwater well, southwest of TSFs.	Sep. 2015	Sep. 2015	Bağdere & Kepezkaya TSFs
	KK-3	622590	4608851	GW	Hanönü groundwater well, southwest of TSFs.	Sep. 2015	Sep. 2015	Bağdere & Kepezkaya TSFs
	BK-1	622426	4609225	GW	Hanönü groundwater well, southwest of TSFs.	Sep. 2015	Sep. 2015	Bağdere & Kepezkaya TSFs

Notes:
1.: MW: Monitoring Well, GW: Groundwater Well, SP: Spring, DE: Village Water Depot, FO: Village Fountain
2.: indicates water quality sampling periods,
3.: indicates field parameters measurement periods.

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



LEGEND

Groundwater Monitoring Points

Monitoring Period

- May 2016 and Later
- May / Aug 2012
- September 2013

AECOM
Tel: +90 312 442 98 63
Fax: +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com

Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime B Blok Suite No:51
06800 Çankaya/Ankara Turkey

Project Name:	Hydrogeological Impact Assessment for the GCP
Map Title:	Groundwater Monitoring Points
Prepared for:	Acacia Maden İşletmeleri A.Ş.
Project Group: Environment	Project Code: ENV-XXXXX
Design: A. Korkmaz	Last Update: 05.09.2017 - 07:09 (ozbakirm / TRAKR1PC30441)
Projection: Transverse Mercator Coordinate System: WGS 1984 UTM Zone 36N	Sheet Size: A3

Service Layer Credits: © 2017 DigitalGlobe © 2017 GeoEye Earthstar Geographics SIO © 2017 Microsoft Corporation

0 0.4 0.8 1.2 Kilometers

Document Name : 4400208_GroundwaterMonitoringLocations_100817

Templeate version : 17-04

Figure 5-47 Groundwater Monitoring Locations

Groundwater Field Parameters

Field parameter measurements conducted in 2012 field surveys show that the electrical conductivity (EC) values are relatively high in KS-2 and DG-101 monitoring wells as were measured to be over 1000 µS/cm. Remaining groundwater wells (KS-1 and KS-3) which were also monitored in May and August 2012 show EC values between 600 and 1000 µS/cm. pH values were generally observed to vary between 6.5 to 8 reflecting a near neutral to slightly alkaline character. pH value for the open pit monitoring well, DG-101, was measured as 6.15 in the showing near neutral to slightly acidic conditions.

Groundwater quality in the open pit area was monitored in September 2013 by collecting samples from 9 monitoring wells (DH1 – DH4 and OW1 – OW5). The majority of the EC values for these wells were identified to be below 1000 µS/cm except OW-2 which reflects an EC value of 4670 µS/cm. pH values were observed to vary between 6.5 to 8 reflecting a near neutral to slightly alkaline character. Additional sampling was carried out in three of these monitoring wells (OW-1, OW-3 and OW-5) in July 2015. EC value in OW-1 was observed to increase in July 2015 sample compared to September 2013 while EC values in OW-3 and OW-5 were measured to be between 700 and 1000 µS/cm. pH values between 7 and 7.5 for July 2015 period shows that the groundwater samples collected from OW-1, OW-2 and OW-3 are near neutral in character.

Monitoring points display near neutral to slightly alkaline conditions with an average pH value of 7.8. The minimum pH was recorded as 6.9 in KK-1 groundwater well while the maximum as 9.4 in BK-1. Relatively high pH value observed in BK-1 suggests a potential influence of domestic activities that are likely to originate in the town of Hanönü. The remaining water samples were found to have pH values between 7 and 8, having neutral to slightly alkaline character.

Based on the monthly field parameter measurements performed since May 2016, temperature values were observed to have coinciding trend with the atmospheric conditions, varying between 20.10-13.83 ºC and 16.10-8.20 ºC for summer and winter seasons, respectively. Dissolved Oxygen measurements present two different increasing trends for the months of July and October. This trend gives a peak in the same months for the wells OW-3, OW-5 and FTBH which are located in the Open Pit. Mean value for all dissolved oxygen measurements was determined as 4.72 mg/L. IK-1, IK-2 and IK-3 which are located in Kepezkaya TSF gave relatively high electrical conductivity readings with a mean value of 4093 µS/cm while the rest of the measurements have a mean of 1643 µS/cm. Slightly alkaline conditions were observed in this period of monitoring as well with an average pH value of 7.63. pH measurements through May 2016 to present gave relatively stable values.

Temperature values obtained from water depots, fountains and springs were observed to reflect a similar trend with the atmospheric conditions varying between 31.10-10.0 ºC and 6.30-2.10 ºC for summer and winter seasons, respectively. Electrical conductivity values show a relatively stable trend throughout the course of the monitoring period, with an overall mean of 543 µS/cm. Slightly alkaline conditions were obtained for the pH values having an overall mean of 7.78.

Groundwater Hydrogeochemistry

Ionic characteristics of the groundwater samples and their hydrogeochemical facies types were evaluated using water quality diagrams. In this regard, Piper and Schoeller diagrams were generated based on the major ion concentrations. In order to assess the groundwater samples regarding their potential use for irrigation purposes, analysis results were evaluated through Wilcox Diagram. Following the completion of monitoring wells drilled within the scope of the Hydrogeological Impact Assessment Study, selected 5 monitoring wells were also added to the sampling/monitoring program by December 2016.

Based on the analysis results for the September 2013 groundwater samples, monitoring wells located in the open pit area were identified to be enriched in Ca^{2+} except the groundwater sample collected from OW-2. OW-2 was found to have relatively high concentrations of Mg^{2+} compared to the other major cations. The majority of the groundwater samples collected from the open pit area was observed to display a mixture of HCO_3^- and SO_4^{2-} with respect to major anion concentrations. DH-1, OW-1, OW-2 and OW-5 were found to have relatively high SO_4^{2-} concentrations compared to HCO_3^- and Cl^-. SO_4^{2-} enrichment in DH-1, OW-1 OW-2 and OW-5 suggests a probable indication of the open pit mineralization on groundwater.

Relatively high SO_4^{2-} concentration in OW-2 is accompanied by higher conductivity values compared to the remaining monitoring wells in the open pit. Major ion distribution indicates that the open pit monitoring wells in September 2013 are mostly characterized by Ca–HCO_3–SO_4 facies type. Relatively increased SO_4^{2-} concentrations in DH-1 and OW-5 show that these monitoring wells reflect a facies type of Ca – SO_4. OW-2 on the other hand is characterized by relatively high Mg and SO_4^{2-} concentrations resulting in Mg-SO_4 type of groundwater.

All groundwater samples were observed to have low sodium hazard potential (S1). With regard to their conductivity values most of the groundwater samples collected from the open pit area was observed to have moderate risk for salinity hazard (C2). Among the open pit monitoring wells (sampled in September 2013), OW-3 and OW-5 were identified to have high salinity hazard (C3) while OW-2 shows very high salinity hazard (C4).

September 2015 groundwater samples indicate that, the majority of the groundwater samples were identified to be enriched in Ca^{2+} ion among the major cations and enriched in HCO_3^- with respect to their anion concentrations. Groundwater wells located in downstream of the town of Hanönü (except KK-3) were found to have relatively low HCO_3^- values. This difference however, does not have a major influence on waters to be dominated by SO_4^{2-} and/or Cl^-. All groundwater samples collected in September 2015 were observed to have low sodium hazard potential (S1). All groundwater samples collected in September 2015 were classified to have moderate risk for salinity hazard (C2).

As of May 2016, the number of the groundwater samples was increased to represent all Project units. Major ion distribution of the samples collected from monitoring wells indicates that the dominant cation and anion types differ among the Project Area groundwater resources. Three monitoring wells (IK-1, IK-2, IK-4) located in the Kepezkaya TSF area were found to be enriched in Na^+ while IK-3 was found to show a mixed type of cations for all sampling periods. Groundwater sample collected from the Çorakoğlu WRD area shows similar characteristics in terms of major cations as it was observed to be enriched in Na^+. Two Open Pit groundwater samples (OW-3 and FTBH) were identified to be enriched in Ca^{2+}; however, FTBH was found to a have considerable amount of Mg^{2+} in addition to its Ca^{2+} content. Major anion distribution for the monitoring wells indicates 3 dominant anion groups as CO_3^{2-}-HCO_3^-, SO_4^{2-} and Cl enrichments. Open Pit monitoring well, FTBH, was identified to have a dominant anion type of CO_3^{2-}-HCO_3^- along with OW-3 and IK-4. The latter (OW-3 and IK-4) were identified to reflect slightly higher SO_4^{2-} concentrations compared to FTBH. Two of the samples (IK-1 and IK-3) collected from the Kepezkaya TSF area, were observed to be enriched in SO_4^{2-} along with WD-1 representing the Çorakoğlu WRD area. IK-2 on the other hand, was found to have a dominant anion type of Cl^-. In addition to the above-mentioned monitoring wells, one of the water supply wells (ST-1A) was also sampled to chemically characterize groundwater in the alluvium. This sample was found to be enriched in Ca^{2+} as the dominant cation and CO_3^{2-}-HCO_3^- as the dominant anion. Hydrogeochemical facies types for the groundwater monitoring wells were identified as:

- IK-1 (Kepezkaya TSF): Na-SO_4
- IK-2 (Kepezkaya TSF): Na-Cl
- IK-3 (Kepezkaya TSF): mixed-SO_4
- IK-4 (Kepezkaya TSF): Na-HCO_3
- ST-1A (Mobilization Area) – Ca-HCO_3
- WD-1 (Çorakoğlu WRD): Na-SO_4
- OW-3 and FTBH (Open Pit): Ca-HCO_3

As the installation and well development of the GK-series wells were completed by late November 2016, 5 of them were included in the sampling program. Therefore, chemical characteristics of groundwater within each project unit were also evaluated from the results of the 5 wells (GK-4, GK-6, GK-10, GK-12 and GK-13) representing each project unit. The results show that the groundwater samples representative for the Kepezkaya TSF downstream (GK-13) and the Çorakoğlu WRD area (GK-6) are enriched in Na^+ in terms of major cations. Sample collected from the Gelberi location (GK-10) indicates that the groundwater in this area is enriched in Ca^{2+} as the dominant cation. Similarly, groundwater samples representing the Open Pit (GK-12) and the Bağdere TSF area (GK-4) were found to be enriched in Ca^{2+}. However they were also found to show relatively high concentrations of Mg^{2+} compared to GK-10.

Major anion distribution of the GK-series on the other hand, shows anion types varying from CO_3^{2-}-HCO_3^- and SO_4^{2-}. Groundwater sample representing the Gelberi location (GK-10) was observed to have a dominant anion type of CO_3^{2-}-HCO_3^- while the samples representative for Kepezkaya TSF (GK-13) and Çorakoğlu WRD (GK-6) areas were found to be enriched in SO_4^{2-} as the dominant anion. Open Pit (GK-12) and Bağdere TSF (GK-4) groundwater samples were identified to be characterized by CO_3^{2-}-HCO_3^- showing slight increases in their Mg^{2+} concentrations. Hydrogeochemical facies types for the GK series groundwater monitoring wells were identified as:

- GK-4 (Bağdere TSF): Ca-HCO_3
- GK-6 (Çorakoğlu WRD): Na-SO_4
- GK-10 (Gelberi location): Ca-HCO_3
- GK-12 (Open Pit): Ca-HCO_3
- GK-13 (Kepezkaya TSF): Na-SO_4

Piper and Schoeller diagrams for the monitoring wells are shown through Figure 5-48 and Figure 5-55.

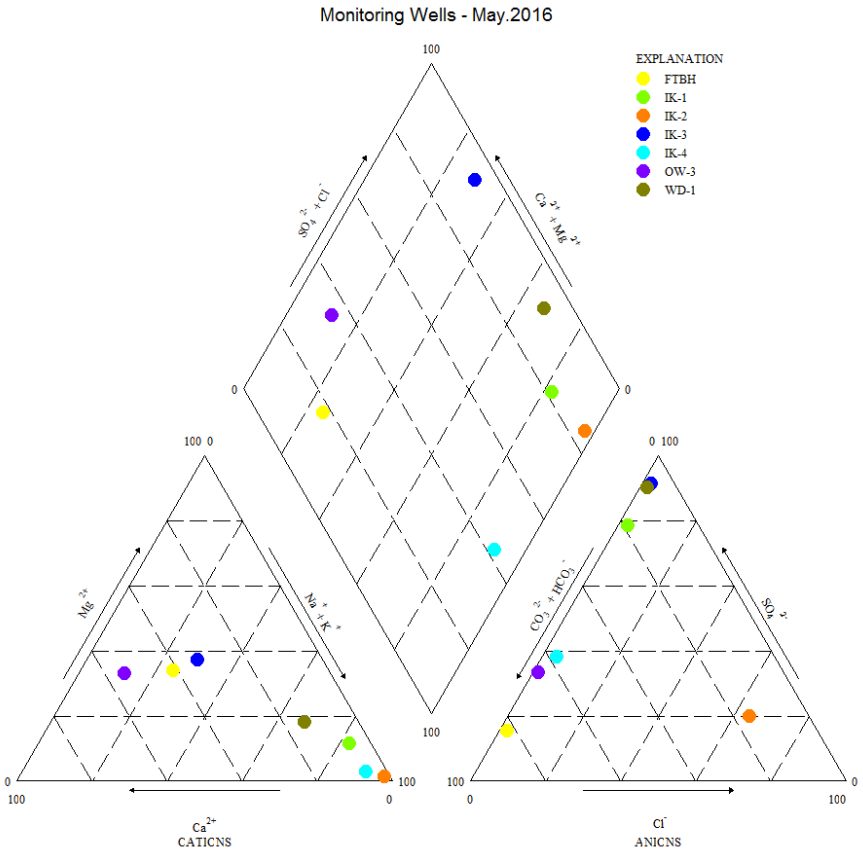


Figure 5-48 Piper Diagram for the May 2016 Monitoring Wells

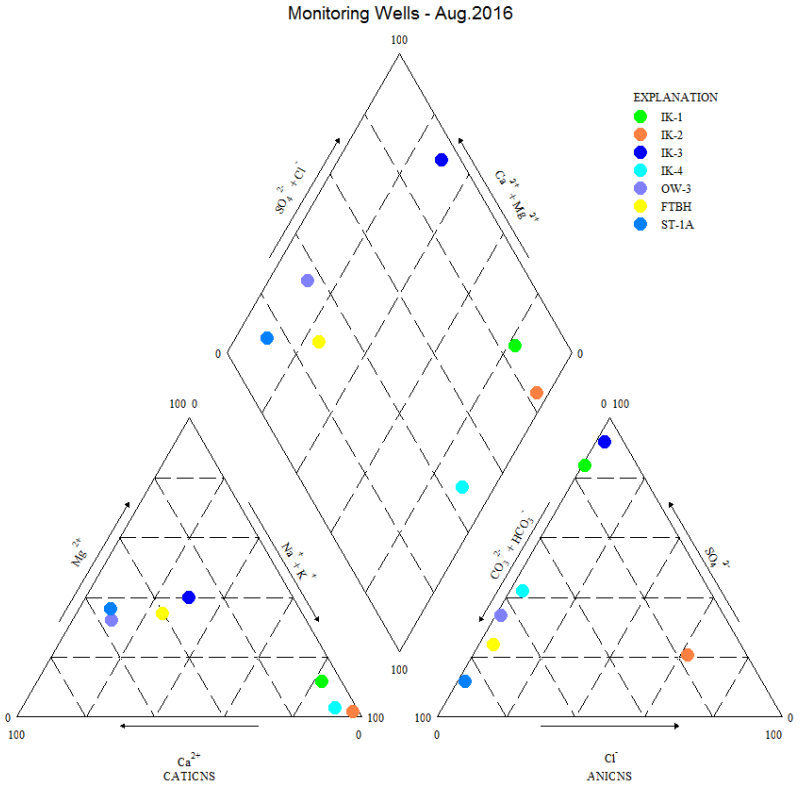


Figure 5-49 Piper Diagram for the August 2016 Monitoring Wells

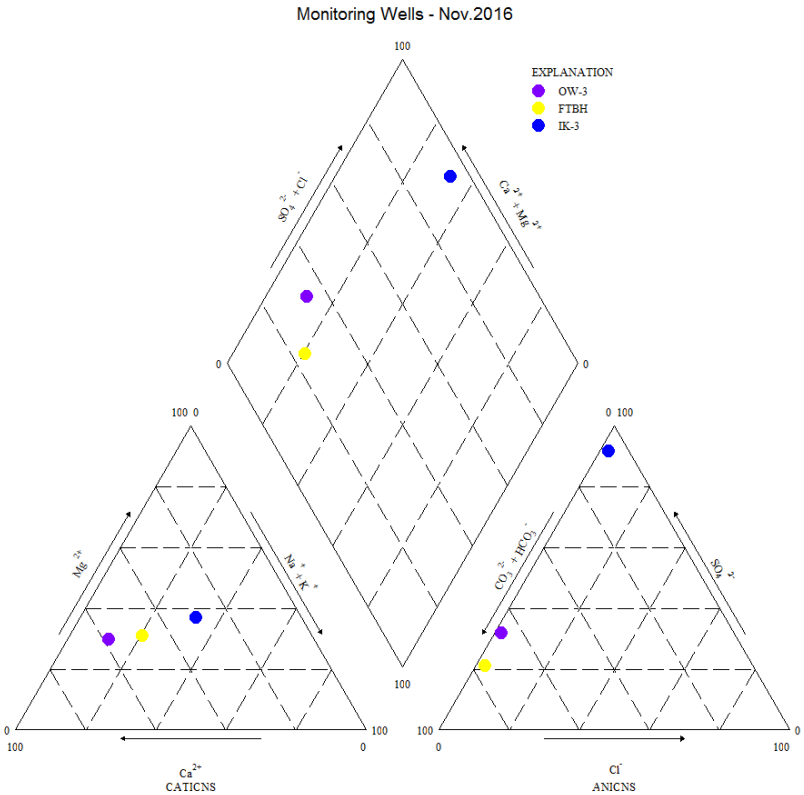


Figure 5-50 Piper Diagram for the November 2016 Monitoring Wells

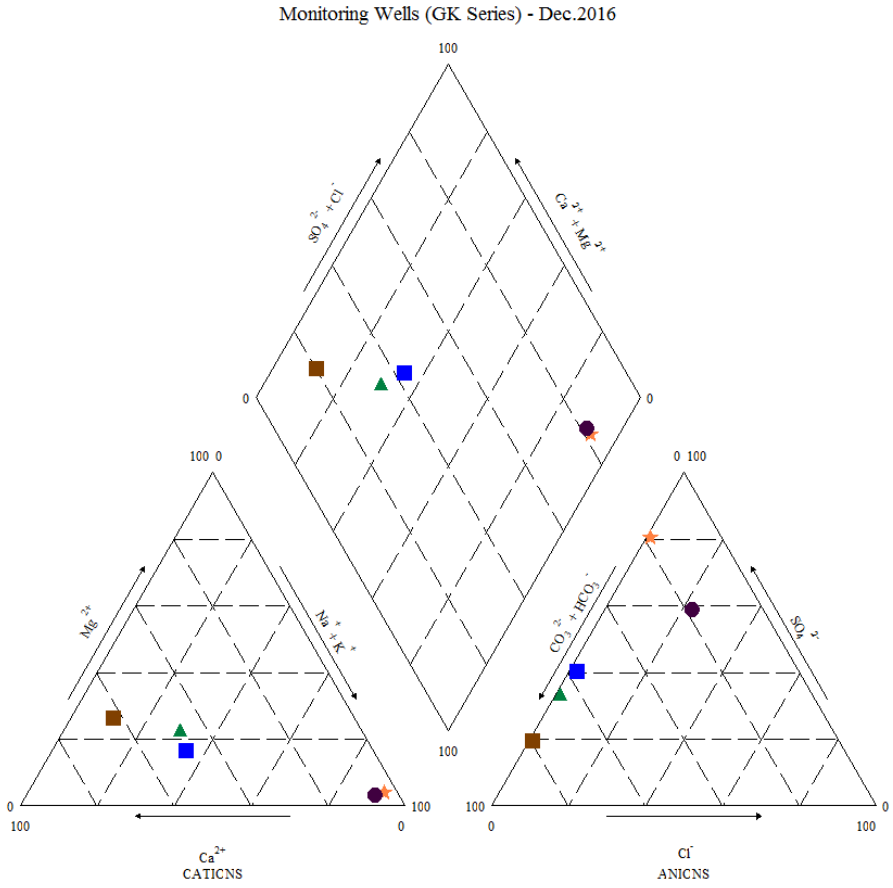


Figure 5-51 Piper Diagram for the GK-Series Wells (December 2016)

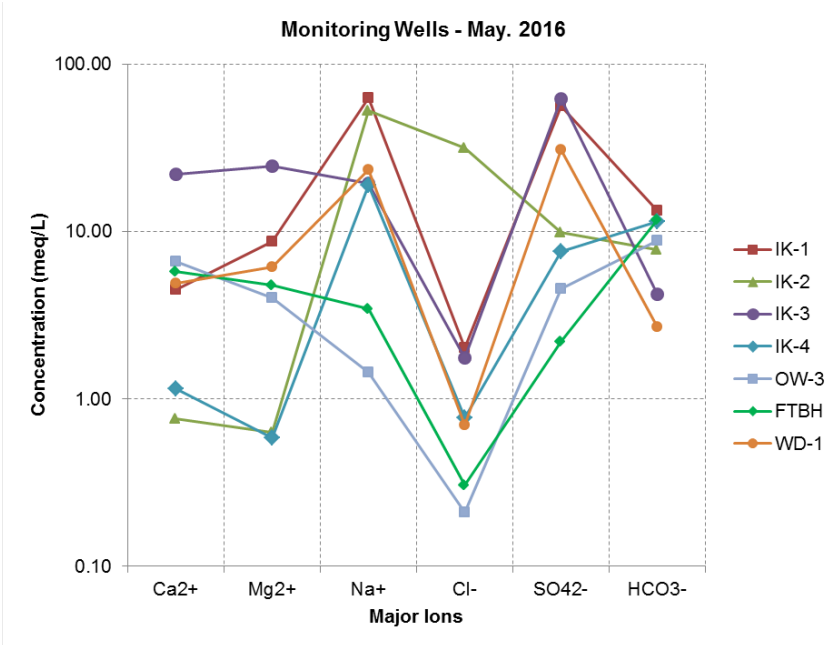


Figure 5-52 Schoeller Diagram for the May 2016 Monitoring Wells

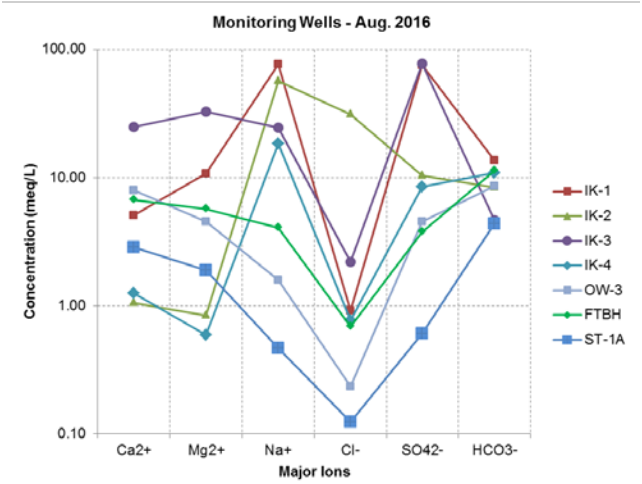


Figure 5-53 Schoeller Diagram for the August 2016 Monitoring Wells

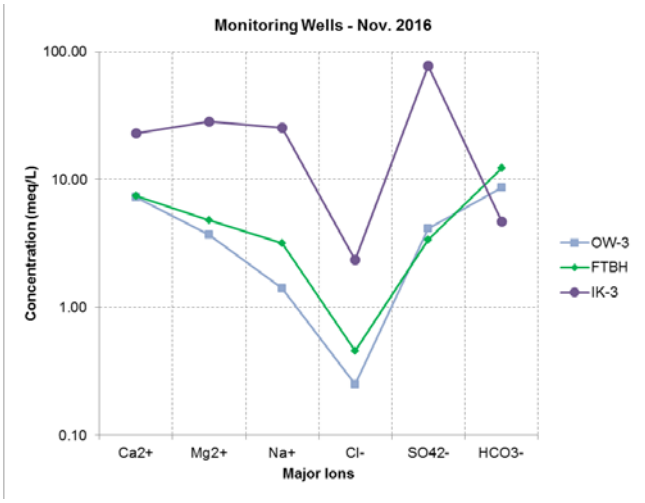


Figure 5-54 Schoeller Diagram for the November 2016 Monitoring Wells

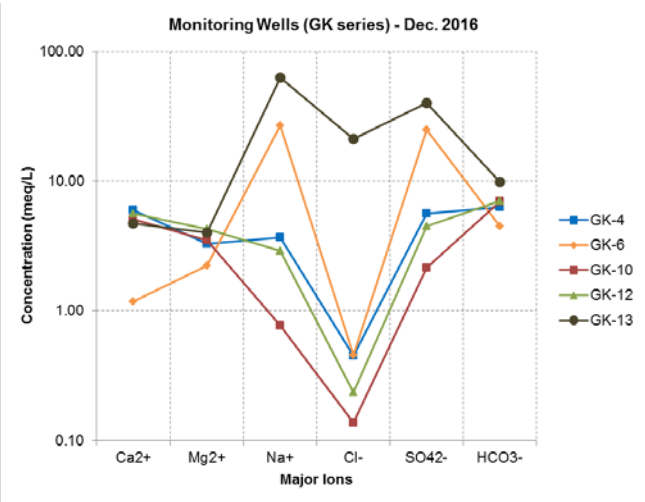


Figure 5-55 Schoeller Diagram for the GK-Series Wells (December 2016)

According to the Wilcox Diagram, three of the groundwater samples collected from the Kepezkaya TSF monitoring wells (IK-1, IK-2 and IK-4), were found to have relatively high sodium adsorption ratios (SAR) compared to the remaining groundwater samples. IK-1 and IK-2 are classified within very high salinity hazard and very high sodium hazard (C4/S4) while IK-4 is classified within high salinity hazard and very high sodium hazard (C3/S4). The other sample from the Kepezkaya TSF area (IK-3) and the sample collected from the Çorakoğlu WRD area (WD-1) were found to have very high salinity hazard. Among these two monitoring wells, WD-1 shows high sodium hazard (C4/S3) while IK-3 shows medium salinity hazard (C4/S2). Groundwater samples collected from the Open Pit area (OW-3 and FTBH) were found to have high salinity hazard with low sodium hazard (C3/S1). As for the GK-series, monitoring wells located in the Open Pit area (GK-12), Bağdere TSF area (GK-4) and Gelberi location (GK-10) were identified to show high salinity hazard with low sodium hazard (C3/S1). Wilcox diagrams for the monitoring wells are provided in Figure 5-56.

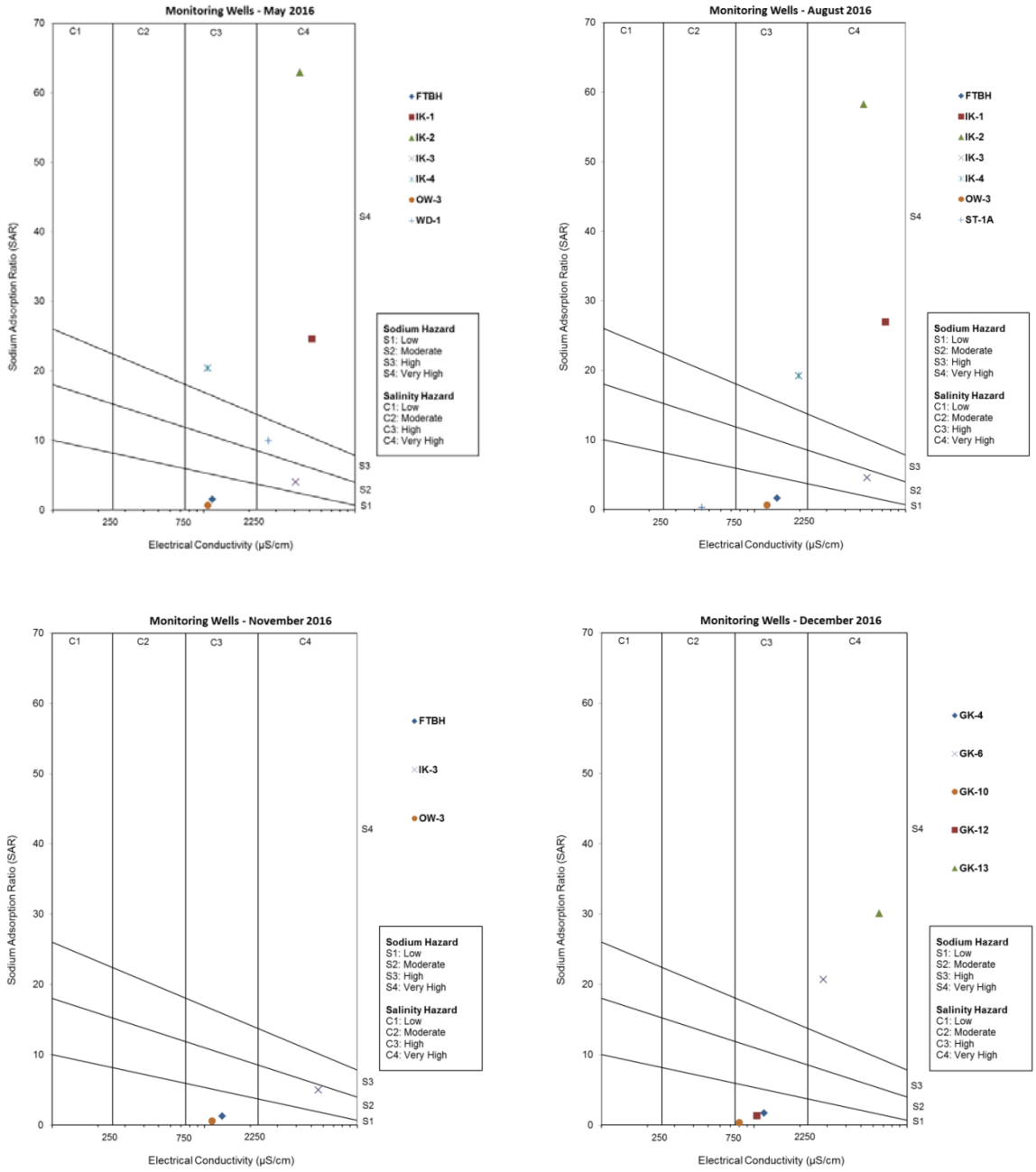


Figure 5-56 Wilcox Diagrams for the Groundwater Monitoring Wells

Groundwater Quality Classifications

Analysis results for the groundwater samples have been compared with the Water Pollution Control Regulation (WPCR) which was published on Official Gazette (# 25687) dated 31st December, 2004. The comparison is based upon the Quality Criteria of the Inland Water Resources which is provided in Table 1 of the WPCR. Groundwater samples were also compared with the drinking water standards of those specified by the Ministry of Health and Turkish Standards Institution.

Laboratory detection limits for some parameters were found to be greater than the limit values specified in WPCR and drinking water standards. Concentrations for those parameters were assumed as the same values with the laboratory detection limits and are shown in bold in results below (See Hydrogeological Impact Assessment Report in Volume III of the ESIA Disclosure Package or water quality comparison tables).

- May and August 2012 analysis results show that the collected groundwater samples from the monitoring wells (KS-1, KS-2, KS-3, DG-1) are classified as Class III with respect to the WPCR. SO_4, Na, TKN, **Pb** and Zn concentrations were observed to be within Class III levels for KS-2 and DG-1. Parameters measured in DG-1 were observed to have elevated concentrations within Class III limits which suggest the effect of mineralization in the Open Pit area. Accordingly, pH value in DG-1 was measured below 6.5 which indicate slightly acidic conditions while TDS, Fe, Mn show relatively high values. KS-1 was observed to show Class III level SO_4 as a seasonal increase in May 2012 while KS-3 was found to show Class III levels of TKN in May 2012 and Class III levels of TOC and **Pb** in August 2012.
- Dissolved oxygen and oxygen saturation values for the May and August 2012 groundwater samples were found to be within Class II limits with the exceptions of KS-2 and DG-1 August 2012 samples, which indicate concentrations within Class III limits. Remaining parameters for the groundwater samples for May and August 2012 were found to have concentrations within Class I and Class II limits.
- Comparison with the drinking water criteria show that groundwater samples collected from monitoring wells are classified as Class II-Type II with respect to TS-266 drinking water standards, due to relatively elevated concentrations of **Pb**, Al, NH_4 and SO_4. Ni and Mn were found to be within Class II-Type II levels as seasonal increases in the monitoring wells.

A water quality comparison was also made for the analysis results available for the September 2013 and July 2015 sampling periods. Since the number of the analyzed parameters is less than those of May/August 2012 and September 2015, the comparisons for September 2013 and July 2015 are shown in separate tables (See Hydrogeological Impact Assessment Report in Volume III of the ESIA Disclosure Package).

- 6 of the 9 groundwater samples (DH-2, DH-3, OW-1, OW-2, OW-3 and OW-5) collected from the Open Pit monitoring wells in September 2013 are classified as Class III with respect to WPCR. The remaining 3 wells are classified as Class I. OW-2 was observed to be distinct from the other monitoring wells as it has relatively elevated concentrations of SO_4. Zn, Fe and Mn concentrations in this well were found to be within Class III limits while Cd was identified to be within Class II limit. SO_4 concentrations were also identified to be within Class III limit for OW-5
- Zn concentrations were observed to be within Class III limit in September 2013 groundwater samples collected from DH-3, OW-1, OW-2 and OW-3. Mn concentrations were found to be within Class III limits in OW-2 and OW-3 and within Class II limits in DH-3. Pb and Cd concentrations were found to be within Class III limits respectively for DH-2 and DH-3

All three samples collected in July 2015 (OW-1, OW-3 and OW-5) are classified as Class III due to their dissolved oxygen values with respect to WPCR while SO_4 and Zn concentrations in OW-1 and OW-3 were observed to be within Class III limits. Cu and Mn concentrations in OW-3 and OW-5; Fe concentrations in OW-1 and OW-5 were found to be within Class II limits. Fe concentration for the OW-3 July 2015 sample was found to be within Class III.

According to the comparison with WPCR, most of the September 2015 groundwater samples were identified to be classified as Class I while some of them are classified as Class II and Class III.

- Groundwater wells (KK-1 and KK-3) located in the downstream of Hanönü, are classified as Class III due to their Fe and Al concentrations. Dissolved oxygen and oxygen saturation values for these two wells were found to be within Class II levels. Total dissolved solids (TDS) and Mn concentrations were observed to be within Class II levels particularly for KK-1. Total Phosphorus concentration for KK-3 was detected to be within Class II levels.

A total of four water quality sampling surveys (May 2016, August 2016, November 2016 and December 2016) have so far been carried out within the scope of the Hydrogeological Impact Assessment Study. Analysis results for the all groundwater samples were compared with the Water Pollution Control Regulation (WPCR) which was published on Official Gazette (# 25687) dated 31st December, 2004. The comparison is based upon the Quality Criteria of the Inland Water Resources which is provided in Table 1 of the WPCR.

Laboratory detection limits for some parameters were found to be greater than the regulatory limit values. Concentrations for those parameters were assumed as the same values with the laboratory detection limits and are shown in bold in results below.

- Majority of the groundwater samples were determined to be Class II while the remaining were seasonally found to be Class III, showing changes in different periods of sampling with respect to the WPCR.
- Groundwater samples collected from the Kepezkaya TSF area (IK-1, IK-2, IK-3, IK-4 and GK-13) were found to be classified as Class III due to -but on a seasonal scale not limited to – DO, SO_4, Na, Zn, B and Al concentrations. Some of the parameters for the Kepezkaya TSF area (inc. NH4-N, TKN, Fe and Mn) were found to be within Class II and Class III limits indicating seasonal variations in groundwater quality. **Se** concentrations in Kepezkaya TSF wells were seasonally found to be within Class II and Class III limits.
- Groundwater samples collected from the Open Pit area (FTBH, OW-3 and GK-12) are classified as Class III due to their DO and Zn concentrations. Fe and Cu concentrations were seasonally observed to have concentrations within Class III limits for FTBH and OW-3, however, they were found to be within Class I limits in GK-12. Seasonal existence of Co within Class II limits were observed in the Open Pit area in FTBH and GK-12 while TKN concentrations were seasonally observed to have Class II limits in FTBH, OW-3 and GK-12. **Se** concentrations were found to be within Class II limits for the groundwater samples collected from the Open Pit area.
- Groundwater samples collected from the Çorakoğlu WRD area (WD-1 and GK-6) are classified as Class III due to relatively high SO_4 and Na concentrations. NO_2-N, TKN and Mn concentrations for WD-1 were found to be within Class II limits while Pb and Al concentrations are within Class III limits. On the other hand, GK-6 was found to have Class III limits of DO values. **Se** concentrations were found to be within Class III limits for the groundwater samples collected from the Çorakoğlu WRD area.
- Groundwater samples collected from Bağdere TSF (GK-4) and Gelberi location (GK-10) were found to be classified as Class III due to relatively high concentrations of SO_4 in GK-4 and DO in GK-10. DO and NO_3-N concentrations were found to be within Class II limits for GK-4. **Se** concentrations were found to be within Class II limits for GK-4 while GK-13 were observed to have Class III levels of **Se**.

5.7.7.4 Surface Waters

Surface water quality monitoring was first started in 2012 to identify initial baseline conditions for the project area surface water resources. In order to represent wet and dry periods of the year, consecutive field surveys were conducted in May and August 2012. Three surface water stations were visited in each field survey for sampling and in-situ field parameter measurements. It is understood from the previous reports (ENVY, 2014 and ENVY, 2015) that surface water stations visited in 2012 were selected to be along the Gökırmak River which is the primary surface water body in the Project Area. Surface water stations were selected to cover both upstream and downstream sections of the Project Area.

A water quality sampling and monitoring program was initialized in September 2015 by AECOM, primarily to identify the quality of drinking waters. AECOM has also collected samples from the surface waters and groundwater from the selected locations in the project area to understand the baseline conditions in more detail and more in line with the current mine layout. In addition to sampling, field parameters including pH, electrical conductivity (EC), temperature (T) and redox potential (ORP) were monitored for each selected water point. Three of the sampling locations were found to be dry at the time of the September 2015 field survey.

As of May 2016, an extended water quality sampling and monitoring program has been commenced by AECOM to improve the understanding on the quality of the surface waters located in the Project Area. A total of 11 surface water locations have been visited including the Gökırmak River upstream and downstream sections and its sidelong branches. Quarterly sampling has been performed among these locations simultaneously with monthly field parameter measurements. Field parameters including pH, electrical conductivity (EC), temperature (T) and dissolved oxygen (DO) were monitored for each surface water point. A significant number of the surface waters were found to be dry during the summer and autumn seasons. Gökırmak River were observed to have continuous flow throughout the year with decreasing and increasing flow rates during the summer and spring seasons, respectively.

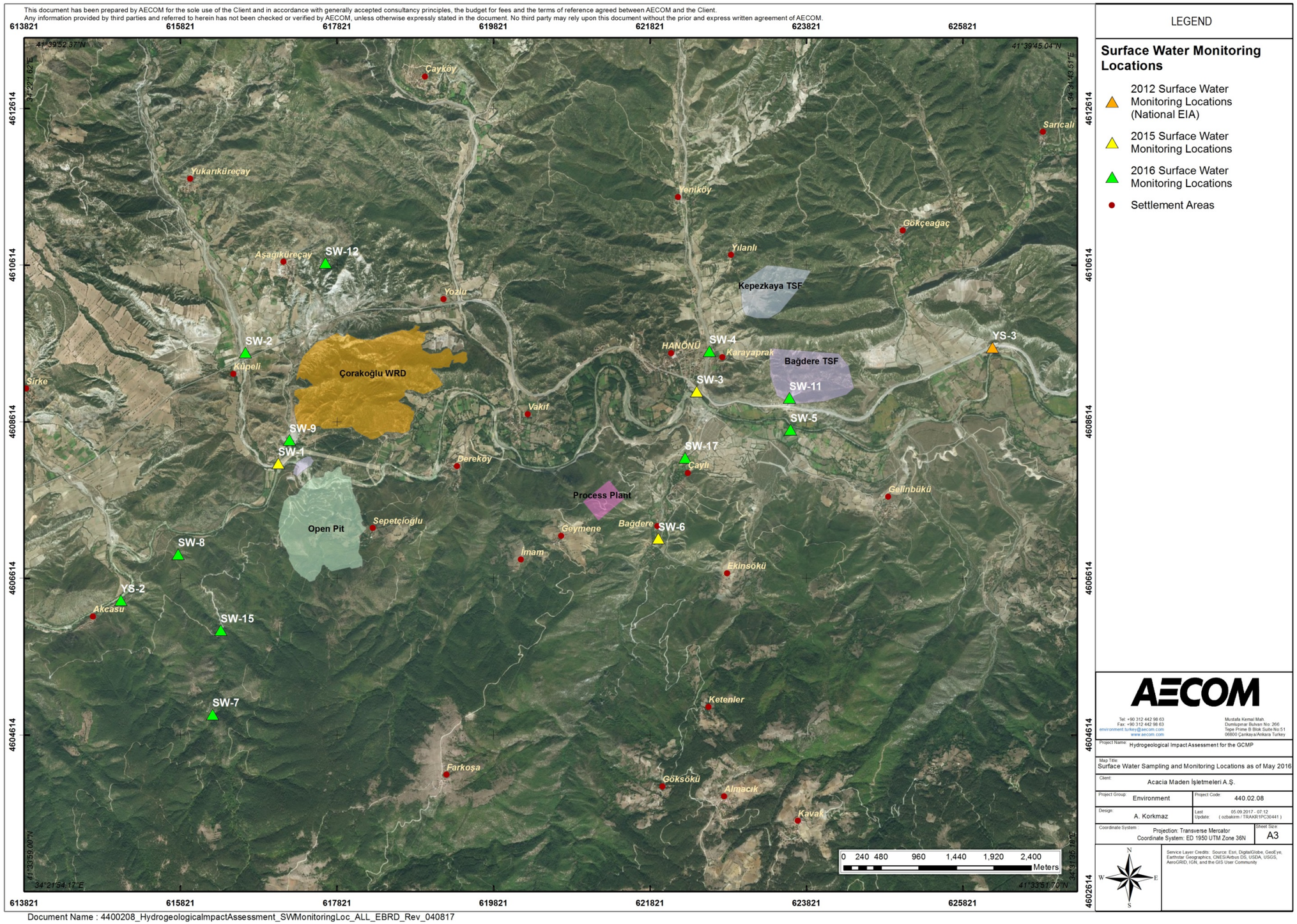
Coordinates, descriptions and sampling periods for the surface water sampling and monitoring points are provided in Table 5-28 while their locations are shown in Figure 5-57.

Table 5-28 Coordinates and Descriptions for Surface Water Samples

Station ID	Coordinates (WGS84 UTM Zone 36N)		Description	Sampling Period(s)[1]	Monitoring Period(s)[2]	Corresponding Project Unit(s)
	X	Y				
SW-1	617084	4608138	Gökırmak River, upstream of the Open Pit.	Sep. 15	Sep. 15	Open Pit
SW-2	616650	4609497	Downstream and west of the Çorakoğlu WRD.	Sep.15 / May-Aug.-Nov.16	Monthly (from May 16 to present)	Çorakoğlu WRD
SW-3	622430	4609058	Gökırmak River, south of Hanönü settlement area.	Sep. 15	Sep. 15	Bağdere TSF
SW-4	622580	4609513	Downstream and west of the Kepezkaya TSF.	Sep.15 / May-Aug.-Nov.16	Monthly (from May 16 to present)	Kepezkaya TSF
SW-5	623584	4608525	Gökırmak River, downstream of the Project Area and the Bağdere TSF.	Sep.15 / May-Aug.-Nov.16	Monthly (from May 16 to present)	Bağdere TSF
SW-6	621928	4607121	Bağdere Stream, downstream of the Process Plant.	Sep. 15	Sep. 15	Process Plant
SW-7	616230	4604875	Upstream of the Gelberi location.	May-Aug.-Nov.16	Monthly (from May 16 to present)	Gelberi location
SW-8	615788	4606921	Downstream of the Gelberi location.	May-Aug.-Nov.16	Monthly (from May 16 to present)	Gelberi location
SW-9	617212	4608378	Downstream and southwest of the Çorakoğlu WRD.	May-Aug.-Nov.16	Monthly (from May 16 to present)	Çorakoğlu WRD
SW-11	623604	4608918	Downstream of the Bağdere TSF.	May-Aug.-Nov.16	Monthly (from May 16 to present)	Bağdere TSF
SW-12	617672	4610643	Upstream and north of the Çorakoğlu WRD.	May-Aug.-Nov.16	Monthly (from May 16 to present)	Çorakoğlu WRD
SW-15	616333	4605951	Upstream of the Gelberi location.	May-Aug.-Nov.16	Monthly (from May 16 to present)	Gelberi location
SW-17	622269	4608154	Downstream of the Process Plant area.	May-Aug.-Nov.16	Monthly (from May 16 to present)	Process Plant
YS-1	605097	4602674	Gökırmak River upstream, southwest of the Project Area.	May / Aug 2012	May / Aug 2012	Project Area Upstream
YS-2	615019	4606283	Gökırmak River, downstream of the Gelberi location.	May / Aug 2012 / May-Aug.-Nov.16	Monthly (from May 16 to present)	Project Area Upstream
YS-3	615075	4607146	Gökırmak River downstream, east of the Project Area.	May / Aug 2012	May / Aug 2012	Project Area Downstream

Notes:
[1]: indicates water quality sampling periods.
[2]: indicates field parameters measurement periods.

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



LEGEND

Surface Water Monitoring Locations

- 2012 Surface Water Monitoring Locations (National EIA)
- 2015 Surface Water Monitoring Locations
- 2016 Surface Water Monitoring Locations
- Settlement Areas

AECOM
Tel: +90 312 442 98 63
Fax: +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com
Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime B Blok Suite No:51
06800 Çankaya/Ankara Turkey

Project Name: Hydrogeological Impact Assessment for the GCMP

Map Title: Surface Water Sampling and Monitoring Locations as of May 2016

Client: Acacia Maden İşletmeleri A.Ş.

Project Group: Environment | Project Code: 440.02.08

Design: A. Korkmaz | Last Update: 05.09.2017 - 07:12 (ozbakirm / TRAKR1PC30441)

Coordinate System: Projection: Transverse Mercator
Coordinate System: ED 1950 UTM Zone 36N

Sheet Size: A3

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Document Name : 4400208_HydrogeologicalImpactAssessment_SWMonitoringLoc_ALL_EBRD_Rev_040817

Figure 5-57 Surface Waters Monitoring Locations

Surface Waters Field Parameters

Based on the field measurements conducted in May and August 2012, surface water locations were found to reflect atmospheric temperatures. Monitored surface waters display near-neutral to slightly alkaline pH conditions having values around 7.5. Electrical conductivity values along the Gökırmak River were observed to vary between 530 and 700 µS/cm.

September 2015 field survey shows that the visited surface waters were found to reflect atmospheric temperatures for the monitoring periods. Monitored surface waters display slightly alkaline pH conditions having values between 7.67 and 8.02. Electrical conductivity values among the monitored surface waters were observed to vary between 630 and 680 µS/cm.

Field parameter measurements which have been conducted since May 2016 show that surface water temperatures typically reflect atmospheric temperatures for all seasons. In terms of pH parameter, June 2016 monitoring period show with a mean of 8.73, although the rest of the months give an average of 8.06 having slightly alkaline character. Electrical conductivity values were observed to have a mean value of 569 µS/cm, yet SW-12 that is located in the east of Aşağıküreçay Village gives an average value of 1233 µS/cm for its ephemeral period of May/July 2016. YS-2 shows a decrease in electrical conductivity value from 700 µS/cm to 246 µS/cm for the months of August and September 2016, respectively. Increasing trend for the dissolved oxygen was observed through the period of May/October and relatively higher values (14-15 mg/L) were measured in project upstream and project downstream areas of the Gökırmak River. Mean of dissolved oxygen measurements for all other surface water points is 9 mg/L.

Surface Waters Hydrochemistry

As of May 2016, a more comprehensive baseline water quality sampling/monitoring program has been established for the GCP. In this respect, the number and spatial distribution of surface sampling/monitoring points have been improved to represent each project unit. Based on this improved program, analysis results for three successive periods of water quality sampling have been assessed to identify ionic characteristics and hydrochemical facies types for Project's surface water resources.

Some of the surface waters were found to be dry as they display intermittent stream characteristics during the large part of the year. Therefore, the number of surface water samples varies depending on the sampling/monitoring season.

September 2015 surface waters were observed to be enriched in HCO_3^- among the major anions while major cation concentrations indicate Ca^{2+} dominancy in surface water samples. It was identified that there is no significant difference in chemistry along the Gökırmak River as the surface water samples show consistent facies types. Hydrochemical facies type for surface water samples was found to be Ca-HCO_3. All surface water samples were observed to have low sodium hazard potential (S1). With regard to their conductivity values all surface water samples were classified to have moderate risk for salinity hazard (C2).

As for the water quality sampling carried out from May 2016 and further periods, majority of the surface water samples were observed to be enriched in Ca^{2+} as the dominant cation, whereas HCO_3^- was identified to be the dominant anion. SW-12, located north of the Çorakoğlu WRD was found to have relatively enriched concentrations of Na^+ and $SO4^{2-}$ indicating a Na-SO_4 facies type for this water. Remaining surface water samples were characterized to have Ca-HCO_3^- facies type. Piper and Schoeller diagrams for the surface waters are provided through Figure 5-58 and Figure 5-63.

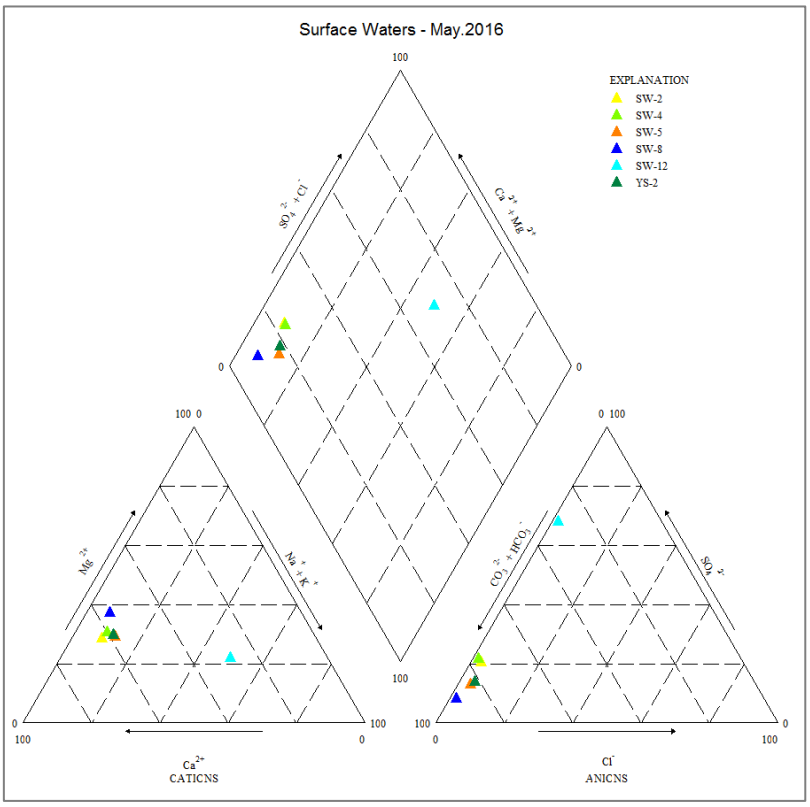


Figure 5-58 Piper Diagram for the May 2016 Surface Water Samples

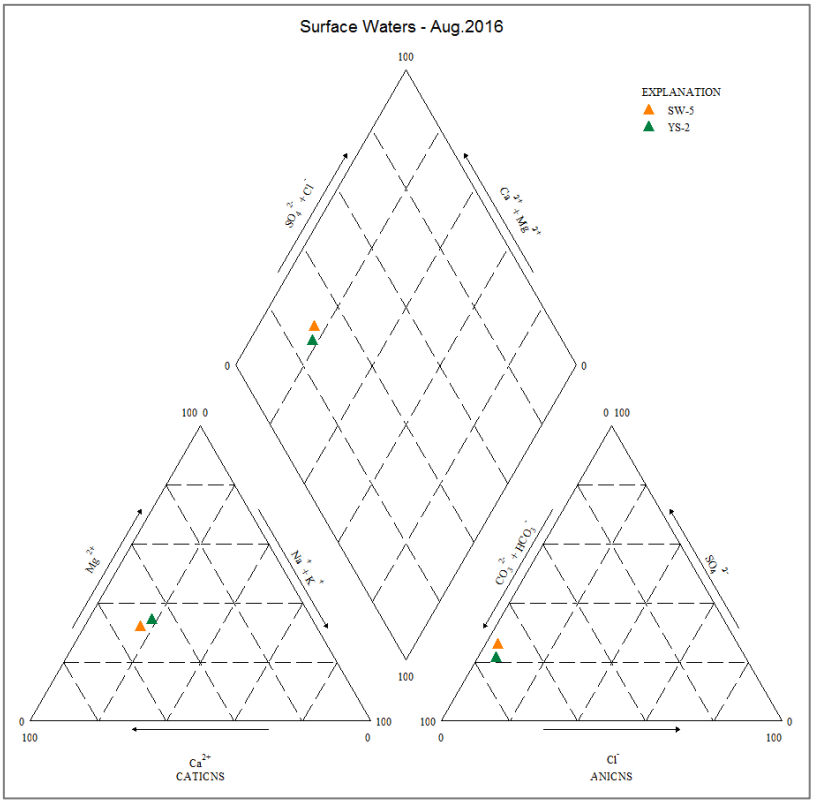


Figure 5-59 Piper Diagram for the August 2016 Surface Water Samples

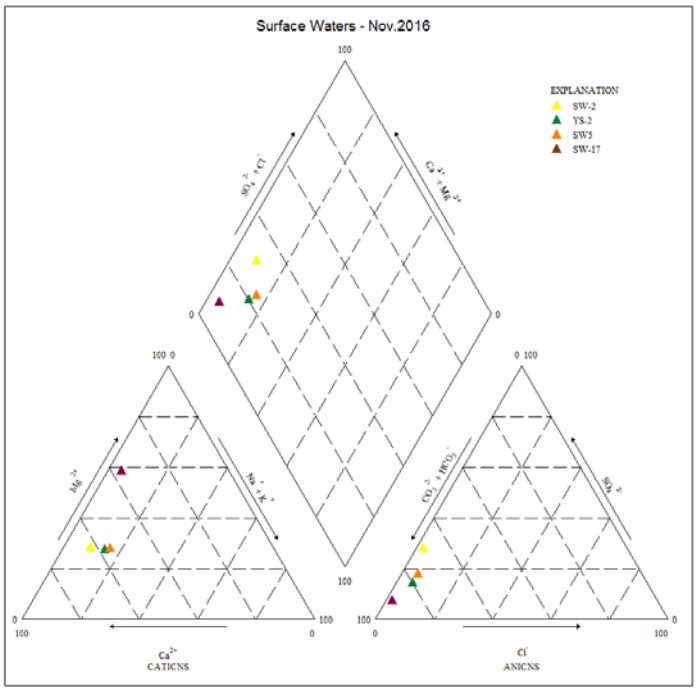


Figure 5-60 Piper Diagram for the November 2016 Surface Water Samples

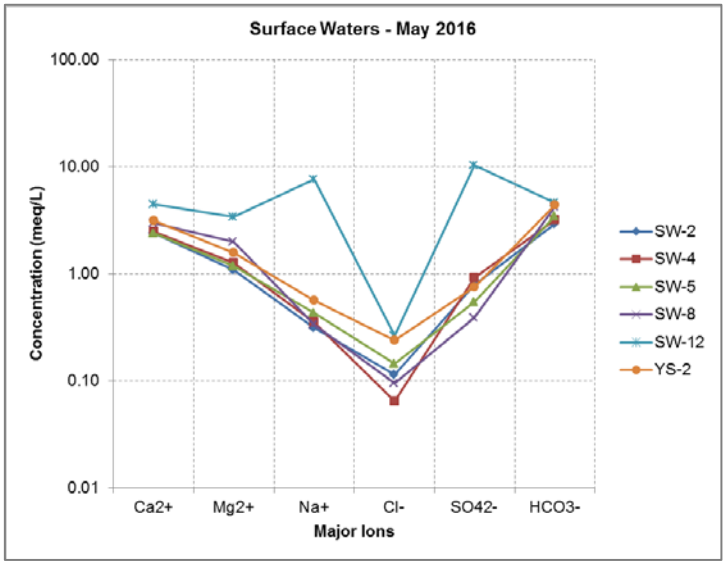


Figure 5-61 Schoeller Diagram for the May 2016 Surface Water Samples

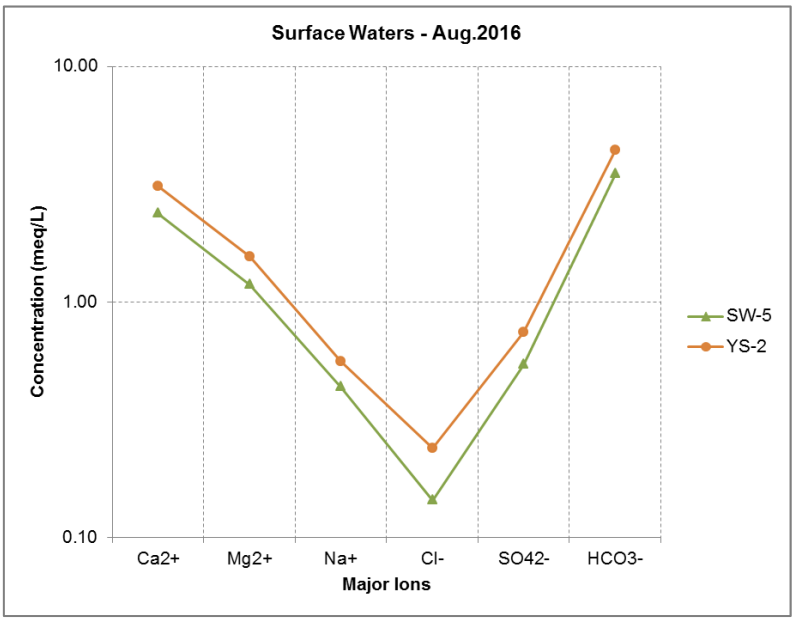


Figure 5-62 Schoeller Diagram for the August 2016 Surface Water Samples

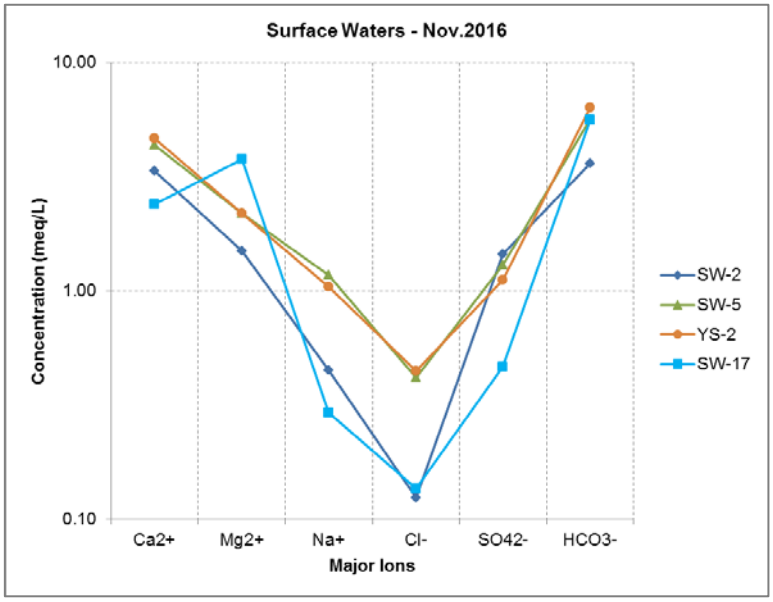


Figure 5-63 Schoeller Diagram for the November 2016 Surface Water Samples

According to the Wilcox Diagrams, surface water samples for all sampling periods were classified as having moderate salinity hazard – low sodium hazard (C2/S1). Wilcox diagrams for the surface waters are provided in Figure 5-64.

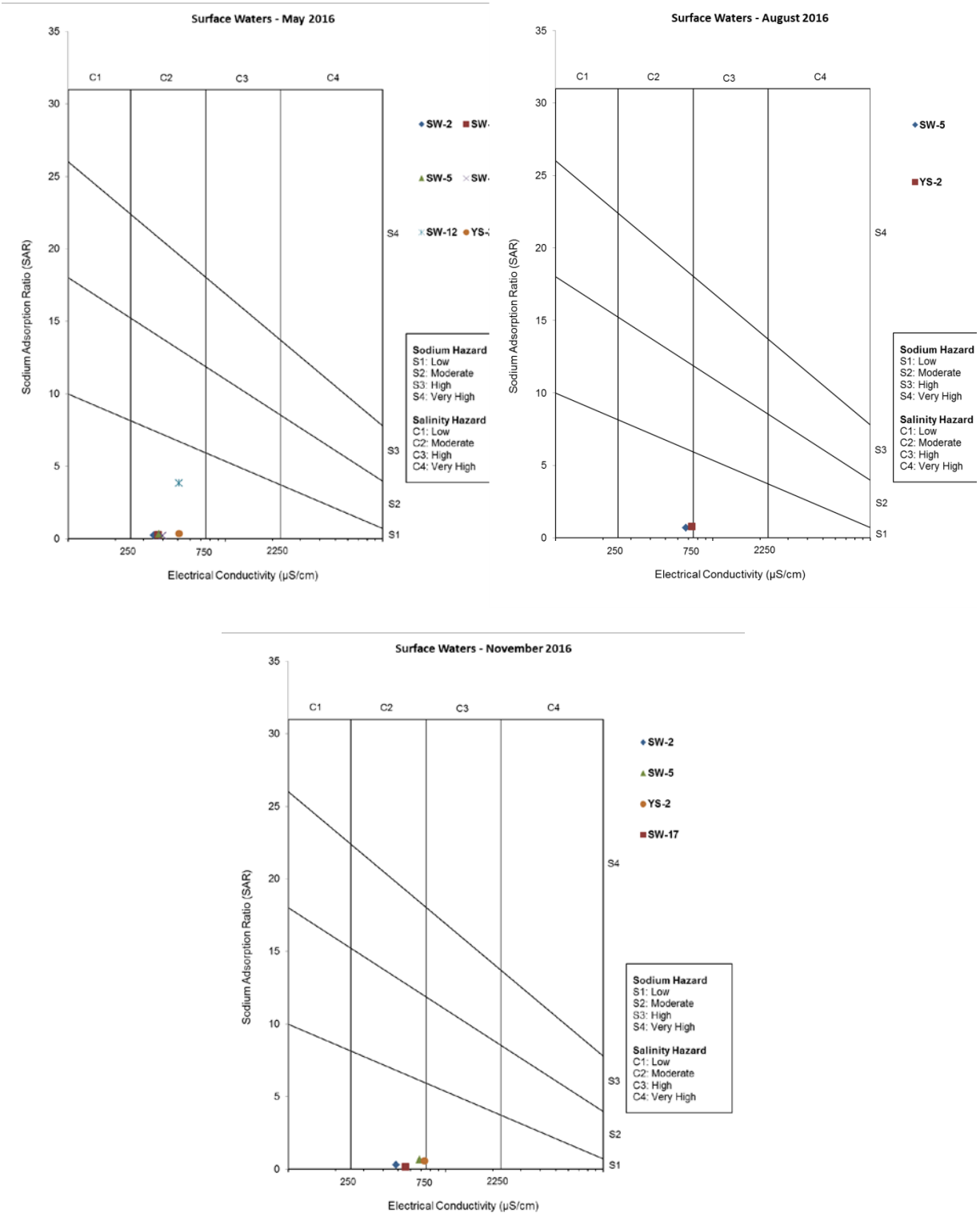


Figure 5-64 Wilcox Diagrams for the Surface Waters (2016)

Surface Water Quality Classifications

Analysis results for the surface water samples have been compared with the Surface Water Quality Regulation (SWQR) which was published on Official Gazette (# 28483) dated 30th November, 2012. The comparison is based on the Quality Criteria of the Inland Surface Water Resources which is provided in Table 5 of the SWQR.

Laboratory detection limits for some parameters were found to be greater than the limit values specified in SWQR. Concentrations for those parameters were assumed as the same values with the laboratory detection limits and are shown in bold in below results (see Hydrogeological Impact Assessment Report in Volume III of the ESIA Disclosure Package or water quality comparison tables).

May/August 2012 Surface Water Quality Classifications

- Initial surface water samples (YS-01, YS-02 and YS-03) collected in May and August 2012 are classified as Class II due to TKN (Total Kjeldahl Nitrogen as N) concentrations. Total P and Mn concentrations for May 2012 samples for these three locations were found to be within Class II limits.
- Total P concentration was observed to be relatively high (within Class II limit) in YS-01 August 2012 sample compared to the remaining two samples (YS-02 and YS-03) collected in this period.

September 2015 Surface Water Quality Classifications

- September 2015 analysis results show that SW-3 and SW-5 surface water samples (collected from the east of the Project Area) are classified as Class III due to relatively high Total P concentrations while SW-1 is classified as Class II due to Total P and electrical conductivity.
- Parameters were mostly observed to be slightly increased along the Gökırmak River as SW-3 and SW-5 reflects relatively high concentrations of TKN-N, Total P, and Mn, compared to SW-1. Dissolved oxygen concentrations in SW-3 and SW-5 were observed to decrease to Class II limits compared to SW-1 which has dissolved oxygen value within Class I limit.

Surface water quality classifications starting from May 2016

- May 2016 samples collected from SW-2 (Çorakoğlu WRD), YS-2 (Project Area Upstream), SW-5 (Bağdere TSF) and SW4 are classified as Class IV due to **Se** concentrations. In terms of Total P, Cr and Ni concentration, SW-5 were found to be in the same class for the same sampling period.
- As for the November 2016 sampling period, NO2-N concentrations were determined to be within Class IV limits for YS-2 and SW-5. Yet, August 2016 samplings for the YS-2 revealed that NO2-N concentration was observed to be within Class II limits.
- Dissolved Oxygen concentration for SW-8 (Gelberi location) and both Dissolved Oxygen concentration and EC value for SW-12 (Çorakoğlu WRD) showed that surface waters in these locations were regarded as Class III for May 2016 sampling period. Because of its pH value, SW-17 was determined to be a Class III quality type of surface water in November 16 sampling period.

5.7.7.5 Gökırmak River Water Quality

AECOM has carried out different surface water sampling surveys along the Gökırmak River in order to identify the temporal change in water quality, if any. Sampling locations were selected to represent the downstream and upstream of the Project Area to document the overall baseline water quality and assess the overall potential impacts of the Project's existing activities.

Surface water sampling locations along the Gökırmak River is shown in Figure 5-65 while basic water quality parameter results are given in Table 5-29.

Hydrochemistry and Physical Parameters

Based on the major ion concentrations of these samples (See Section 5.7.7.4 for further details), the facies type was identified to be Ca-HCO_3 indicating typical hydrochemical characteristics of fresh waters. The facies type was observed to be similar in upstream and downstream sections of the Gökırmak River, which indicates the so far Project activities have negligible impact on major ion concentrations that has not created any change in water facies type.

Similarly, the pH and electrical conductivity values show stable trend for the Gökırmak River along its course through the Project Area. The pH values indicate neutral to slightly alkaline character having values between 8 and 8.5. The EC values were observed to slightly decrease having values between 740 and 380 µS/cm.

Total Suspended Solids

Collected samples were also analyzed for Total Suspended Solids (TSS) in order to monitor the year-long trend in suspended solid load in surface waters. Analysis results show relatively high suspended solid concentrations were observed in surface waters particularly during the spring season while tend to decrease during the August, September and November samples. Locations for TSS measurements are provided in Figure 5-65 while TSS analysis results are given in Table 5-29.

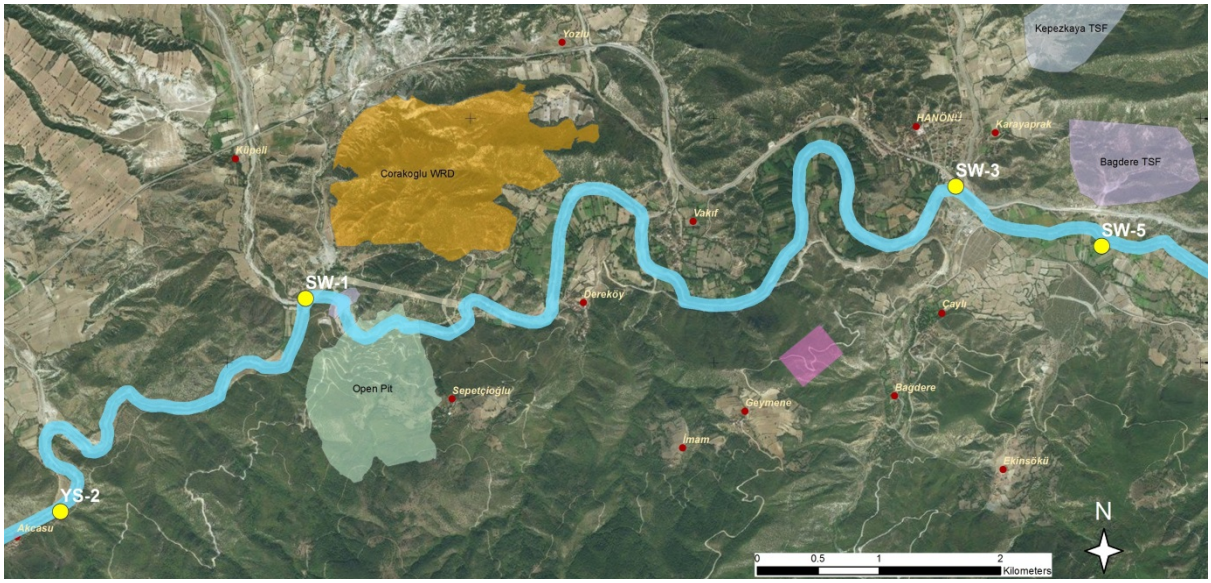


Figure 5-65: Water Quality Sampling Locations along the Gökırmak River

Table 5-29 Total Suspended Solids along Gökırmak River*

Parameter	Gökırmak River Upstream				Gökırmak River Downstream				
	YS-2			SW-1	SW-3	SW-5			
	May.16	Aug.16	Nov.16	Sep.15	Sep.15	Sep.15	May.16	Aug.16	Nov.16
Total Suspended Solids TSS (mg/L)	120	7.5	32.6	60.3	203	348	2350	5.9	27.6
* Gökırmak River Diversion tunnel construction started in 2015 and finalized in December 2016.									

Metals

With respect to the quality classes specified in Turkish Surface Water Quality Regulation and based on the metal analysis results collected from the Gökırmak River, the river is seasonally classified as Class III and Class IV due to Nitrite-Nitrogen (NO_2-N) concentrations. NO_2-N was observed to be relatively increased in November 2016 samples both in upstream (YS-2) and downstream sections of the Gökırmak River (SW-5). Phosphorus and Total Kjeldahl Nitrogen concentrations were found to be relatively increased in downstream, indicating probable effect of agricultural activities on the river water.

5.7.8 Overall Summary on Surface Waters and Groundwater

Surface Waters

The Project Area is drained by the Gökırmak River and its tributaries. Overall assessment on water quality shows that the current hydrochemical characteristics of Project Area surface waters and groundwater are related to rainfall composition and water-rock interactions that further influence the downstream waters. Project Area surface waters are mainly characterized by Ca-HCO_3 water type that is representative for recently recharged fresh waters.

The main surface water in the Project Area is the Gökırmak River having several intermittent tributaries, where some of them are located within the downstream of the Project units. Key risks for the surface waters and hence Gökırmak river are potential seepages from the toe of the Çorakoğlu WRD, potential seepages from the bottom of the Kepezkaya TSF, potentially impacted surface waters that are in contact with Process Plant and pit lake walls. No surface water will be used as a drinking water resource during the construction, operation and closure phases of the Project.

Tailings from the Process Plant will be stored in two Tailing Storage Facilities (TSFs), which are located on the north of the Gökırmak River. The Kepezkaya TSF will be located approximately 1 km northeast of the Hanönü town center while the Bağdere TSF is located about 2 km southeast of the town center. Both TSFs will be lined with clay and a geomembrane, and equipped with decant and leachate collection systems. The closest receptors to Kepezkaya and Bağdere TSFs are determined to be the Yılanlı Stream and the Gökırmak River, respectively. Potential failure of TSF embankment and/or potential damages/ruptures on the impervious bottom liner might cause degradation in downstream water quality.

The closest receptor to Çorakoğlu WRD on the other hand, was determined to be the Gökırmak River. The key risk within this Project Unit is potential seepages of WRD contact waters which may further alter the receiving surface water body.

Groundwater

In relation with different lithology types in different Project units, water chemistry differs amongst the water samples collected from different Project units. Accordingly, groundwater beneath the Kepezkaya TSF and Çorakoğlu WRD is characterized by sodium and sulfate rich waters whereas the groundwater beneath the Open Pit, Gelberi location and Bağdere TSF indicates calcium and bicarbonate rich waters. Groundwater beneath the Open Pit reflects relatively high salinity due potentially to mineralization.

There are several key risk zones for the groundwater that becomes significant in terms of community water resources. Taking the account that the open pit will be dewatered during the operation phase, nearby communities comprise the primary risk zones in terms of groundwater reduction. As for the groundwater quality in the open pit area, the baseline groundwater chemistry results indicate Class III waters with respect to the Qualiy Criteria for the Inland Water Resources of the Turkish Water Pollution and Control Regulation. Water that will be derived from pit dewatering may therefore pose quality related risks that will be important for the downstream surface waters. Therefore, water derived from pit dewatering will to be collected in downstream sedimentation ponds for further treatment, prior to discharge to downstream surface waters. Collected water in sedimentation pond should to satisfy relevant regulatory limits for discharge.

Other key risk zones for the Project Area groundwater comprise Kepezkaya and Bağdere TSF areas, Çorakoğlu WRD area and Gelberi location. Potential seepages beneath these Project units might create risks to downstream groundwater sources. Although the hydraulic tests in the water supply aquifer indicates promising quantities of water for process water demand, overpumping in these wells poses risks to the groundwater quantity within the well field. It is important to note that the water extracted from the water supply wells will not be used as a drinking water resource during the construction, operation and closure phases of the Project. This water will be pumped to Process Plant to be used in ore processing.

Baseline information on water resources (both quality and quantity) not only documents the existing status of Project Area waters but also provides fundamental data to build up a long term water monitoring plan. The key risk zones identified in baseline studies are further assessed in terms of potential impacts on environment and community water resources (See Section 6)

5.8 Mining Waste Characteristics

This section presents the baseline conditions for geochemistry of the mining wastes which have been studied and reported by Geochemico Consulting Inc. The information and data sources were taken from the following documents:

- ARD/ML Characterization of Rock Samples by Static Testing, Gökırmak Copper Project, Kastamonu (December, 2016).
- Final Report on Geochemical Characterization by Kinetic Testing of Lithologies at the Gökırmak Copper Project, Kastamonu, Turkey (December, 2016).

Baseline geochemistry of the mining lithologies and mining wastes (incl. waste rock, tailings, waste rock and low grade ore remained on pit walls) were identified a series of static and kinetic testing methods which are provided in below sections. Potential impacts of the mining wastes were assessed in Section 6.8.

5.8.1 Geochemical Characterization of the Mining Lithologies

A geochemical characterization study has been carried out in order to identify the potential impacts of acid rock drainage and metal leaching (ARD/ML) that might originate from the mining activities. Representative samples from the waste rock, tailings and ore material were selected to be analyzed in terms of static and kinetic testing methods. The static testing and subsequent interpretation were carried out following acknowledged best practices for characterization of acid rock drainage and metal leaching (MEND, 2009). Abbreviations used in the following sections are provided below in Table 5-30.

Table 5-30 The List of Abbreviations Used in Geochemical Characterization

Abbreviation	Description
ABA	Acid base accounting
APP	Acid producing potential
ARD/ML	Acid rock drainage/Metal leaching
COMP	Composite
CS	Calcareous Schist
FB	Fault Breccia
GS	Green schist
GCP	Gökırmak Copper Project
ICP-MS	Inductively coupled argon plasma mass spectroscopy
LCU	Low Grade Cu Ore
M	Metabasic Green Schist
MS	Mixed Schist
NP	Neutralization Potential
NNP	Net neutralization potential
PAF	Potentially Acid Forming
PCOC	Principle contaminants of concern
RDL	Reported detection limit
S	Schist
SFE	Shake flask extraction
Seq-SFE	Sequential shake flask extraction
5XCA	5 times crustal abundance
TCPL	Toxic characteristic leaching procedure
TSF	Tailings Storage Facility

5.8.1.1 Geochemical Testing Program

A phased geochemical characterization program was implemented in accordance with the internationally accepted standards for Acid Rock Drainage and Metal Leaching (ARD-ML) assessments. Geochemical testing was carried out in two stages to identify any potential ARD-ML issues prior to mining operations. Representative drill core samples from the waste rock lithologies were collected to be analyzed with relevant analysis methods to enable initial characterization of the main rock types that will be deposited in the waste rock dump (WRD). Selected samples also include low grade copper ore samples to represent lithologies that are likely to remain on the exposed pit walls at the end of the operational phase.

Geochemical testing program was carried out in two stages. Stage 1 - Static Tests were performed for each selected sample to identify bulk geochemical properties and potential to mobilize constituents that may create a negative impact on the surrounding environment. Stage 2 – Kinetic Tests were performed to identify reaction rates and solute loads over long term, through a simulation of natural processes in laboratory environment.

A total of 255 samples were collected and together with the 17 older samples (excluding 2 composite samples), a total of 272 samples were analyzed within the scope of this study. The samples were tested in two stages;

- 17 old rock (drill core) samples were collected in 2012 by Jeoband Danışmanlık AŞ (Jeoband) and submitted for static testing by the fully accredited AGAT laboratories, Burnaby, BC, Canada.
- 139 rock (infill) samples, 11 sedimentary samples, 10 soil samples and 95 pulp and coarse reject samples were collected in 2015 by Geochemico Consulting Inc. (Geochemico) and submitted for static testing to Global ARD's laboratory. The samples were selected carefully to ensure that all major lithologies were sampled for the static testing.

Table 5-31 shows the number of samples based on sample type and Table 5-32 indicates the number of samples based on lithology.

Table 5-31 Number of samples based on the sample type

Sample Type	Number of Samples
Old Samples	17*
Rock (infill) Samples	139
Sedimentary Samples	11
Soil Samples	10
Pulp and Coarse Reject Samples	95
Total*	272

*: Two composite samples were not included.

Table 5-32 Number of samples based on lithology

Lithology	Rock Code	Number of Samples
Greenschist	GS	125
Mixed Schist	MS	115
Sedimentary	Sandstone	11
Overburden	Soil	10
Low Copper Ore	LCU	11
	Total	272

Analysis results were compared with common parameters of Turkish and Canadian standard values which are given in Table 5-33 and Table 5-34, respectively. For the Turkish standards the values set forth in the Turkish Ministry of Health Drinking Water Guidelines (MoHDWG), 2005) were used. For the Canadian standards, a combination of Ontario Ministry of the Environment, 1994, Water management: policies, guidelines, provincial water quality objectives of the Ministry of the Environment and Canadian Council of Ministers of the Environment, 2002, Canadian water quality guidelines for the protection of aquatic life was used to construct a complete list of Canadian Water Quality Objectives (PWQO).

Table 5-33 Turkish Regulatory Parameters (Regulation on Waters Intended for Human Consumption (RWIHC), Chemical Parameters and Indicator Parameters – Turkish Ministry of Health, 2005)

Parameter	Parametric Value	Unit
Aluminum	0.2	mg/L
Antimony	0.005	mg/L
Arsenic	0.01	mg/L
Copper	2	mg/L
Boron	1	mg/L
Mercury	0.001	mg/L
Iron	0.2	mg/L
Fluoride	1.5	mg/L
Conductivity	2.5	mS/cm^{-1} at 20 °C
Cadmium	0.005	mg/L
Chromium	0.05	mg/L
Lead	0.01	mg/L
Chloride	250	mg/L
Manganese	0.05	mg/L
Nickel	0.02	mg/L
pH	≤ 9.5-6.5≤	pH units
Selenium	0.01	mg/L
Sodium	200	mg/L
Sulphate	250	mg/L

Table 5-34 Canadian Regulatory Parameters

Parameter	Parametric Value	Unit
Aluminum	0.75	mg/L
Beryllium	1.1	mg/L
Copper	0.005	mg/L
Iron	1	mg/L
Cadmium	0.0005	mg/L
Lead	0.007	mg/L
Chloride	0.86	mg/L
Molybdenum	0.073	mg/L
Nickel	0.15	mg/L
pH	6.5 < x < 9	pH units
Phosphorous	0.03	mg/L
Vanadium	0.006	mg/L
Zinc	0.03	mg/L

Sampling locations along with the detailed information on geochemical characterization study are provided in ARD/ML Characterization of Rock Samples by Static Testing Report in Volume-III of this report.

5.8.1.2 Static Testing

274 samples (including 2 composite samples) of rocks, sediments and overburden from the GCP were submitted for geochemical characterization by static testing. The testing request included a four acid digestion followed by cation determination by ICP-MS to determine major and trace elements in particular as well as shake flask extraction (SFE) testing and ABA testing. Below are the key findings of the GCP static testing samples.

- Greenschist rocks are generally not capable of generating ARD/ML and therefore do not require special treatment and may be used for general construction and foundations, except where visible sulphides are present (only found in one sample close to the ore);
- Approximately thirty percent of mixed schist rocks were found to potentially be capable of generating ARD/ML. Mixed schist was further tested to understand its real potential on ARD/ML.
- Overburden is very unlikely to generate acidity and may be stockpiled and used for remediation purposes;
- One sample of sandstone (intended for TSF impoundment construction) was found to be potentially capable of generating acidity, although the remainder of the samples are benign. Sandstone from the area of the PAF sample should not be used for construction and,
- A number of PCOC were identified for all lithologies at the 95th percentile of sample population concentrations including Al, Cu, Fe, Mo, Zn, P, V, pH, Cd, Ni, V, Se, sulphate, Sb, Na, and Mn. Therefore, regular monitoring of waste rock leachate during operations and post-closure is strongly advised.

5.8.1.3 Kinetic Testing

Two rock types were found to require kinetic testing; tailings derived from copper ore and mixed schist. Results from two types of kinetic testing are described herein;

- Sequential shake flask testing (or SSFE kinetic testing), and;
- Humidity cell testing.

Sequential shake flask testing is in use world-wide and allows rapid (although only approximate) prediction of the time of lag to the beginning of ARD as well as the likely extent of ARD generation. The advantage of the SSFE technique is that data are received within a month instead of the usual 6 to 8 months required for humidity cell testing. It is important to note that kinetic testing is still required, but SSFE does provide a measure of confidence regarding ARD generation over the short term (two to five years) that allows some mine development and planning to occur while the humidity cell data is acquired.

Sequential Shake Flask Testing (SSFE)

SSFE Testing Data for Rock Samples

Geochemical data was acquired for six samples collected at the GCP. Two of the samples are composited from a number of different samples of drill core, SS-ASYA (composite of schist) and SC-ASYA (composite of calc-silicate). The samples analyzed for SSFE are listed below in Table 5-35.

Table 5-35 Sample Characteristics for SSFE Testing

Sample ID	DDH #	Meters	Rock Type	Sulphide in Rock	Inorganic C
				weight %	weight %
DG106-134-S	106	133 - 134	MS	1.09	0.25
DG510-184-S	510	183-184	MS	6.671	0.31
DG506-130-M	506	129 - 130	MS	1.173	0.6
DG102/70- 160-S	102/70	159 - 160	GS	0.154	0.44
SS-ASYA (composite)	Composite	Composite	MS	3.996	0.46
SC-ASYA (composite)	Composite	Composite	MS	1.982	0.62

Three of the six samples analyzed by SSFE proved to be capable of generating ARD (DG106-134-S, DG510-184-S and SS-ASYA; all are mixed schist samples). Two samples are deemed not capable of generating ARD according to static testing (DG506-130-M and DG102/70-160-S). The sixth sample, SC-ASYA, shows a balance of NP and APP over time, indicating a possibility for local ARD production depending on grain size, mineralogy etc.

The important aspect of the ARD characteristics of the samples is that the SSFE testing shows that for all samples the onset of ARD is between 190 and over 2000 years into the future. This prediction will hold provided that the pH of the leachate does not fall below 5.0. Below this pH a much more rapid reaction rate will apply and the samples may generate ARD much faster. This analysis was further checked using humidity cell testing. It should be noted that SSFE predictions are based on a short period of testing and are therefore only applicable for the first two years of weathering/oxidation at the mine site. SSFE summary statistics are shown in Table 5-36 while detailed information on the kinetic tests is provided in Volume-III of this ESIA (Final Report on Geochemical Characterization by Kinetic Testing of Lithologies at the GCP).

Table 5-36 SSFE Summary Statistics

Sample ID		DG106-134-	DG510-184-	DG506-130-M	DG102/70-	SS-ASYA	SC-ASYA
Rock Type	UNITS	Schist	Schist	Metabasic	Schist	Schist	Calc Silicate Schist
Sulphide in Rock	weight %	1.09	6.671	1.173	0.154	3.996	1.982
Sulphide in Rock	moles	0.124	0.759	0.133	0.0175	0.454	0.225
Sulphate Loading rate	m/l/kg/wk	3.52E-06	6.31E-06	1.19E-06	2.44E-06	6.92E-06	4.07E-06
Inorganic C	weight %	0.25	0.31	0.6	0.44	0.46	0.62
CaCO3 in rock	moles	0.178	0.221	0.429	0.314	0.328	0.442
CO3 Loading rate	m/l/kg/wk	1.44E-05	1.57E-05	1.01E-05	7.63E-06	3.44E-05	3.61E-05
Min. Field Sulphide Loading	m/l/kg/wk	0.0000017	0.000003	0.0000005	0.0000012	0.000007	0.000004
Max. Field Sulphide Loading	m/l/kg/wk	0.0000072	0.000008	0	0.0000038	0.000017	0.000018
Min. start to ARD	Field years	240	270	820	800	190	240
Max start to ARD	Field years	980	680	6900	2500	910	2100
Min end to ARD	Field years	330	300	510	90	510	240
Max. end to ARD	Field years	1360	760	4300	280	2500	2100
Acid Generation Potential	Logical	Not in the Short Term	Not in the Short Term	No	No	Yes	Not in the Short Term

SSFE Testing Data for Rougher Tails Sample

A one kilogram sample of rougher tails, prepared by bench testing of bulked ore was shipped to AGAT laboratories in Canada for static, pre-kinetic and kinetic testing. The results from the pre-kinetic (SSFE) testing indicate that the neutralization potential provided by calcium carbonate in the rougher tails will very likely start to fall below the level required to maintain neutral pH quickly after a year at the mine site.

Humidity Cell Testing

Four humidity cell tests were initiated on the GCP rock samples.

- One test consisted of composited (bulked) samples of schist waste rock as well as some fault breccia from within the mixed schist lithologies. The first test was named SS-ASYA; static testing, including ABA, was also carried out on this composite of five 1 kg samples.
- The second humidity cell was composed of four 1 kg composited samples of calc-silicate schist as well as some fault breccia from within the calc silicate schists (a sub-group of mixed schist). The second humidity cell test was named SC-ASYA and static testing was also carried out on it.
- The third humidity cell test was carried out on rougher tails produced from bench testing of the ore.
- The final humidity cell test was carried out on bench test tails generated from updated (2015) processing.

The static and pre-kinetic testing indicated that; composite sample SS-ASYA would probably generate ARD and that composite sample SC-ASYA probably would not. The static testing showed that it is likely that both tailings samples will generate ARD.

Humidity cell testing is normally carried out in a laboratory where the temperature is maintained at a constant 25°C and the relative humidity at close to 90%. The 1 kg samples are partially pulverized and are held in a large funnel using a fine mesh support. Once a week the sample is irrigated with approximately 0.5 liters of deionized water and allowed to percolate into a covered beaker. The leachate is subsequently analyzed for cation content by ICP-MS and for anion content as well as Hg by a number of techniques including CVAA (cold vapour atomic absorption spectrophotometry) and IC (ion chromatography). The first five to six weeks of humidity cell testing flushes out soluble compounds from the sample.

Distribution of the principal parameters (Sulphate, Ca and pH) through testing time in the laboratory is provided in Figure 5-66 for the humidity cell tests. Detailed reports with regard to the Geochemical Characterization for the GCP are given in Volume-III of this ESIA.

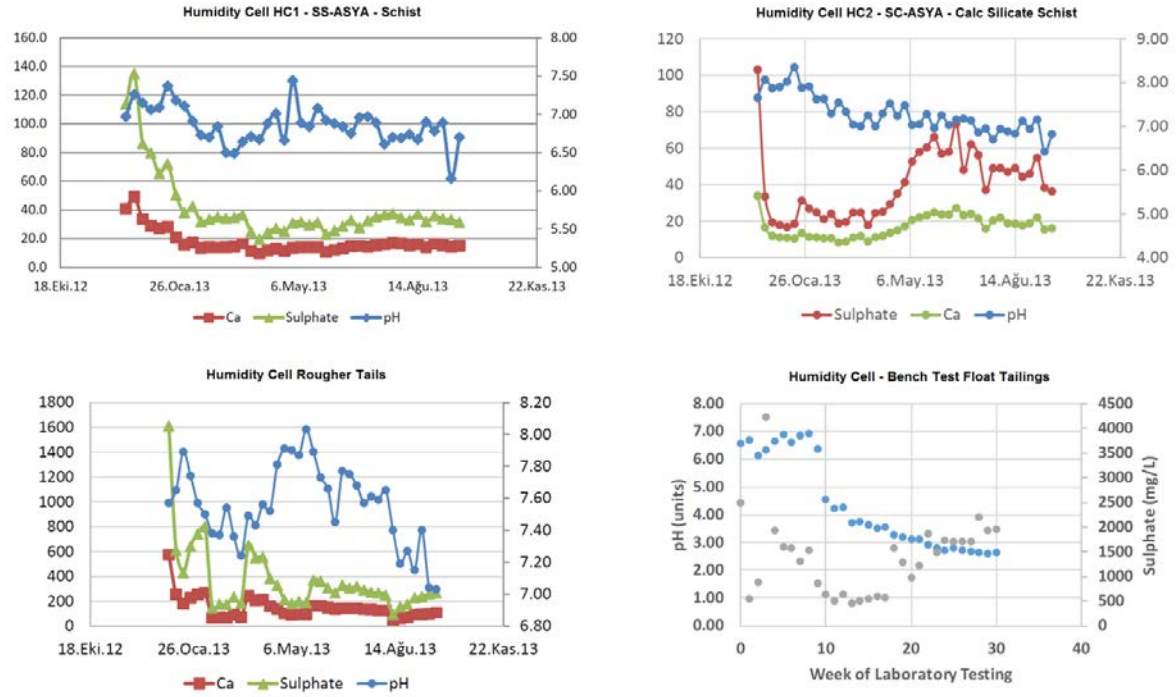


Figure 5-66 Distribution of the principal parameters (SO4, Ca and pH) for the humidity cell tests

Following findings have been obtained from the humidity cell tests:

Humidity Cell HC1 – SS-ASYA – Schist

- Both sulphate and Ca2+ show gradually falling concentrations although changes in the sulphate concentration are more marked.
- The time required to dissolve all of the carbonate neutralization potential in the sample can be calculated from the inorganic carbon content of the composite sample (determined by ABA static testing) and the observed rate of Ca dissolution in response to the production of acidity by oxidizing sulphide. Approximately 1242 weeks in the laboratory would be required to exhaust the acid producing potential of the sample leaving most of the neutralization potential in the sample unreacted.

Humidity Cell HC2 – SC-ASYA – Schist

- Both sulphate and Ca2+ show some significant changes in concentration after week 5 of testing indicating that sulphide oxidation is underway. Cu is also high in these weekly analyses, indicating that copper sulphides are probably responsible for the elevated sulphate concentrations.
- The loading rates are very similar for sulphate and Ca again indicating equilibrium has been reached for this sample. The carbonate content of this sample is much higher than for composite sample SS-ASYA and the statistics reflect this; indicating that the calc-silicate schist is unlikely to generate ARD at the proposed mine site. No carbonate needs to be added to the calc-silicate schist when it is piled on the waste rock dump as there is sufficient carbonate to allow a significant safety factor.

Humidity Cell – Rougher Tails

- Ion concentrations begin at a very high value (over 1500 mg/l) but this quickly drops to approximately 500 mg/l. There is increased production of sulphate at 5 and 11 weeks, which is matched by increased aqueous Ca species. At first glance the humidity cell does not seem to have reached equilibrium.
- The sulphide content of the rougher tails is extremely high (14.62 weight %) and with only 4.3 weight percent inorganic carbon in the tails, ARD production is inevitable. The lag to ARD production is estimated at about 2 laboratory years after which point the tails will very likely generate acidity for a further 167 years in the tailings storage facility. Appropriate regulatory procedures must be adhered to in order to ensure safe containment of the oxidizing tailings in a tailings storage facility.

Humidity Cell for Bench Test Float Tailings

- The pH fluctuates between 6.0 and 7.0 for the first ten weeks of testing and then abruptly drops to approximately 4.5 in the 11th weeks and continues to decrease through the remainder of the test. The float tails therefore are expected to generate ARD after approximately two years at the mine site, yielding very acidic leachate. Appropriate regulatory procedures must be adhered to in order to ensure safe containment of the oxidizing tailings in a tailings storage facility.

Metal Leaching

Humidity cell testing is able to provide long term equilibration estimates of metal leaching when allowed to equilibrate. Therefore it is a preferred method for identifying potential contaminants of concern (PCOC), especially when samples have potential for acid forming.

Each of the four humidity cell tests are assessed separately below by comparing median and 95th percentile parameter concentrations with both Turkish and Canadian water quality objectives, in order to identify the potential for long term metal leaching and the PCOC. Comparisons with Turkish and Canadian water quality standards (ESIA Volume-III) were made to provide an assessment of the PCOC.

For the Turkish standards the values set forth in the Turkish Ministry of Health Drinking Water Guidelines (MoH, 2005) were used. For the Canadian standards, a combination of Ontario Ministry of the Environment, 1994, water management policies, guidelines, provincial water quality objectives of the Ministry of the Environment and the Canadian Council of Ministers of the Environment, 2002 together with the current Canadian water quality guidelines for the protection of aquatic life were used to construct a complete list of Canadian Water Quality Objectives (PWQO) were combined. Below are the findings achieved through comparisons.

Humidity Cell HC1 – SS-ASYA

- Manganese in HC1 is the only parameter that was found to exceed Turkish water quality standards for the median and 95th percentile leachate concentrations of the last five weeks of the humidity cell test.
- None of the median or 95th percentile statistics for the last five weeks of humidity cell test data for SS-ASYA were found to exceed the Canadian water quality guidelines.

Humidity Cell HC2 – SS-ASYA

- None of the median or 95th percentile summary statistics exceed either the Turkish or Canadian water quality standards.

Humidity Cell HC3 – Rougher Tails

- The only parameter that exceeds the Turkish water quality standards, at both the median and 95th percentile levels is manganese.
- None of the humidity cell leachate summary statistics from the rougher tails exceed Canadian water quality guidelines.

Humidity Cell for Bench Float Tailings

- Exceedances were observed, compared to Turkish water quality standards, for aluminum, arsenic (95th percentile only), copper, iron, cadmium, chromium, lead, manganese, nickel, pH, and sulphate for both median and 95th percentile summary statistics.
- Exceedances, compared to Canadian water quality guidelines were observed for aluminum, copper, iron, cadmium, lead, nickel, pH, vanadium and zinc at both the median and 95th percentile levels.
- Clearly, the float tails leachate is much higher in a number of regulated parameters than the rougher tails, and once the leachate remains acidic for longer periods it is likely that the metal concentrations will become higher. The tails will, however, be isolated in a tailings storage facility with regulatory lining according to Turkish standards and therefore seepage of metal(loid) laden water into ground or surface water is unlikely to occur. The possibility of long term leakage from the tailings storage facility will be numerically modelled and reported in the Tailings Water Quality modelling report.

5.8.1.4 Conceptual Design of Waste Rock Lithology Storage

Static testing of the mixed schist lithology indicated that up to 30% of the waste rocks of this type may be potentially acid forming. Thus a kinetic testing program was run on two composite samples of mixed schist. The results indicate that ARD would not be generated by these samples. Kinetic testing also showed that manganese is the most likely PCOC arising from storage of the mixed schist. Waste rock dump design should take into account that although sulphide oxidation will occur, laboratory testing indicates that acidic leachate will not in general, be produced, however, isolated pockets of ARD may occur in portions of the dump. The conceptual model for the proposed waste rock dump takes these factors into consideration.

5.8.1.5 Summary of the test results

Characterization of Acid Rock Drainage and Metal Leaching (ARD/ML) requires the use of two types of tests: Static tests, and; Kinetic tests. The two types of tests have different purposes and commonly produce different results for this reason.

Static tests are intended as a relatively low-cost screening tool to facilitate the identification of lithologies or tailings or other waste products such as pulped tails that may potentially cause ARD/ML. Static testing investigates the bulk properties of samples that are typically pulverized to a fine grain size before testing. Static testing therefore does not take account of many important factors in the generation of ARD/ML such as grain size, mineralogy, petrology, mineral stoichiometry, humidity, solubility, temperature etc. For this reason, static tests may be seen as an indication of worst-case conditions.

Kinetic tests, on the other hand, are designed to take into account factors such as: grain size, mineralogy, petrology, mineral stoichiometry, humidity, solubility, temperature etc. Kinetic tests (such as humidity cell testing) are designed to measure the rate of development of ARD/ML and are, generally speaking, more indicative of conditions at the mine-site.

An example of the possible differences between static and kinetic testing results for an actual lithology from Turkey, in which sulphide grains are present, may serve as an example. The lithology contains abundant sulphide minerals, but they are encased in a quartz groundmass. The results of static testing on the pulverized sample indicate that the rock will generate ARD/ML, since the encasing quartz covering on the sulphide minerals is fractured by the sample pulverization. Kinetic testing on the disaggregated sample, however, shows that ARD/ML will not be generated at the mine-site because of the sulphide grains are protected by a silica covering.

Static and kinetic testing results, therefore, must be interpreted with caution and in tandem to understand the processes that the lithology will undergo at the mine-site.

Following results have been achieved from the geochemical testing program:

- Greenschist rocks are generally not capable of generating ARD/ML and therefore do not require special treatment and may be used for general construction and foundations, except where visible sulphides are present (only found in one sample close to the ore);
- Approximately thirty percent of mixed schist rocks were found to potentially be capable of generating ARD/ML. Mixed schist was further tested to understand its real potential on ARD/ML.
- Overburden is very unlikely to generate acidity and may be stockpiled and used for remediation purposes;
- One sample of sandstone (intended for TSF impoundment construction) was found to be potentially capable of generating acidity, although the remainder of the samples are benign. Sandstone from the area of the PAF sample should not be used for construction and,
- A number of PCOC were identified for all lithologies at the 95th percentile of sample population concentrations including Al, Cu, Fe, Mo, Zn, P, V, pH, Cd, Ni, V, Se, sulphate, Sb, Na, and Mn. Therefore, regular monitoring of waste rock leachate during operations and post-closure is strongly advised.
- Kinetic testing shows that only the rougher and float tails at the Gökırmak Copper Project can be expected to generate ARD/ML;
- Metal leaching is unlikely to be a significant problem for the rougher tails, however, the float tails will very probably generate leachate exceeding most of both Turkish and Canadian water quality standards. Tails must be contained within a lined storage facility as dictated by Turkish environmental legislation;

- Kinetic testing of the representative sample of rougher tails showed that the lag time to ARD generation is about 24 years although the float tails are likely to generate ARD/ML within two years of deposition;
- All mixed schist (including calc-silicate schist and fault breccia) lithologies are unlikely to generate ARD/ML, despite the static testing data suggesting otherwise as the neutralization potential of the rocks is generally adequate to prevent the formation of acidic leachate from the oxidizing sulphides.
- The mixed schist has sufficient neutralizing potential to prevent ARD/ML. Furthermore, the placement of the inert green shchist to the bottom of WRD will provide a buffer zone and a safe guard to prevent ARD/ML. Nevertheless Acacia will implement the monitoring program provided in Section 6.7.3.1 in line with the monitoring frequencies and monitoring parameters in Table 6.70.
- The quality of WRD seepage waters were modeled taking the account of current WRD design and mining lithologies to be deposited in the Çorakoğlu WRD area. In the case of a capacity increase which may require a necessity of an additional WRD area, additional modeling studies will be performed to assess future potential impacts.

5.9 Biodiversity

The assessment considers habitat loss, degradation and fragmentation, invasive alien species, overexploitation, migratory corridors, hydrological changes, nutrient loading and pollution.

The field surveys for biodiversity and habitat related subjects conducted for the Project until the time that this ESIA has been published are given in Table 5-37.

Table 5-37 Biodiversity Field Surveys

Timing	Subject of Survey	Scope of Survey and Assessment Areas	Methodology
May 2012	Terrestrial Flora and Fauna and Aquatic Biodiversity (ESIA Report, Envy)	Open pit, Bağdere and Kepezkaya TSFs and WRDs, Process Plant, social and administrative buildings and the vicinity including Gökırmak river.	Collection of plants, visual inspections, analysis of observed nests, fur, traces, faeces, bones, teeth, skin samples, voices and taken photos for terrestrial fauna Sample taking and capture and release for aquatic flora and fauna, Literature surveys
August 2012	Terrestrial Flora and Fauna and Aquatic Biodiversity (ESIA Report, Envy)	Open pit, Bağdere and Kepezkaya TSFs and WRDs, Process Plant, Concrete Plant, social and administrative buildings and the vicinity including Gökırmak river.	Collection of plants, visual inspections, analysis of observed nests, fur, traces, faeces, bones, teeth, skin samples, voices and taken photos for terrestrial fauna Sample taking and capture and release for aquatic flora and fauna, Literature surveys
October 2015	Flora (AECOM)	Open pit, Bağdere and Kepezkaya TSFs, Çorakoğlu WRD, process plant, auxiliary units (diversion channel for Gökırmak River, haul roads, pipelines and piping structures for make-up water, tailings pumping, access roads, pipelines and social and admisintrative buildings and the vicinity.	Collection of plants, visual inspections and literature surveys.
April 2016	Terrestrial Flora and Fauna and Aquatic Biodiversity (AECOM)	Open pit, Bağdere and Kepezkaya TSFs, Çorakoğlu WRD, process plant, auxiliary units (diversion channel for Gökırmak River, derivation channel, haul roads, pipelines and piping structures for make-up water, tailings pumping, access roads, pipelines and social and admisintrative buildings, ETL route and the vicinity.	Collection of plants, visual inspections, analysis of observed nests, fur, traces, faeces, bones, teeth, skin samples, voices and taken photos for terrestrial fauna Sample taking and capture and release for aquatic flora and fauna, Literature surveys

The evaluation criteria of the biodiversity elements used in this report (ERL, CITES, BERN, EU Habitat and Bird Directives) are given in detail below.

European Red List (ERL) (IUCN Red List)

The ERL categories of conservation status according to IUCN Red List are given in Table 5-38:

Table 5-38 IUCN Red List Categories

Category of Conservation Status	Definition of the Category
EX (Extinct)	A taxon is categorized as EX when there is no reasonable doubt that the last individual is no longer exist.
EW (Extinct in the Wild)	A taxon is categorized in this group when exhaustive surveys conducted in known habitat and at different times throughout the year have failed to record an individual and when it is known only to survive in cultivation, in captivity or as a naturalized population well outside the past range.
CR (Critically Endangered)	A taxon is categorized in this group when the best available evidence indicates that it is facing an extremely high risk of extinction in the wild.
EN (Endangered)	A taxon is categorized in the group EN only when it is considered to be facing a very high risk of extinction in the near future, but not classified within the CR group.
VU (Vulnerable)	The taxa are categorized in this group when they are not classified in CR and EN groups, but considered to be facing a medium-term high risk of extinction in the wild.
LR (Lower Risk)	The plants are categorized in these groups when they cannot be classified in any of the groups listed above and when they have better populations.
CD (Conservation Dependent)	The taxa that can quality for one of the categories above within a period of 5 years.
NT (Near Threatened)	The candidates not categorized in the previous group, but are close to qualifying for the category VU.
LC (Least Concern)	Those not that are threatened and not requiring any conservation.
DD (Data Deficient)	The taxon is classified in this group when there is inadequate information about its distribution and population status.
NE (Not Evaluated)	Those that cannot be evaluated in any of the groups above.

Red Data Book for Birds of Turkey

There are two main categories as Category A and Category B.

Species in Category “A” are either native ones that stay in Turkey all year around, or summer migrants (migrant birds that leave Turkey after breeding).

Species in Category “B” either choose to spend winter in Turkey or use Turkey as a passage on their migration routes. As these species face relatively high levels of risk of extinction, they are treated as are those in Category “A”.

The description of sub-categories under “A” and “B” are given below (see Table 5-39).

Table 5-39 Red Data Book for Birds of Turkey Categories

Category	Definition
A.1.0	These are species that went extinct without doubt and that cannot be observed in natural habitats anymore. It is falling under the **EX** category of IUCN.
A.1.1	These are domesticated species whose natural population no longer exists or has not been observed within the fifteen or twenty years, yet which exist in the aviaries, cages or and other artificial mediums. It is falling under the category of **EW** of IUCN.
A.1.2	Population sizes of these bird species has fallen dramatically all around Turkey. Within regions they are observed, these species are represented by 1 individual – 10 pairs (= 1-20 individuals). Because they are under a very great risk of extinction, these species require protection all over Turkey. It is falling under the category of **CR** of IUCN.
A.2	The number of the species ranges between 11 and 25 pairs (22-50 individuals) in the regions where they are observed. They face a very important risk of extinction. If the threat of extinction continuous as it does today, these species are bound to face extinction. It is falling under the category of **EN** of IUCN.

Category	Definition
A.3	Population sizes of these species in Turkey ranges between 26 and 250 pairs (52-500 individuals) in regions observed. These are extremely vulnerable to extinction and face a high risk of extinction in the wild. It is falling under the category of **VU** of IUCN.
A.3.1	Populations of these species display a decline in the regions observed. Their population sizes change between 251 and 500 pairs (502-1000 individuals). Compared to older records, recent observations reveal that there is a decrease in the number of individuals.
A.4	Population density of these species does not as yet show any tendency toward the risk of extinction; yet, there is a trend toward a decrease in local population and they are likely to face the risk of extinction in time. Their populations in regions observed ranges between 501 and 5000 pairs (1002-10000 individuals). It is falling under the category of **NT** of IUCN.
A.5	There is neither a decline in population size nor a risk of extinction for these species. It is falling under the category of **LC** of IUCN.
A.6	These species have not been studies sufficiently and there is no authoritative data about them. Since the data available rest on a few sporadic observations, there is no way of evaluating these according to reliable observations. It is falling under the category of **DD** of IUCN.
A.7	These are the species about which a certain assessment has not been made against any of the categories mentioned above. It is falling under the category of **NE** of IUCN.
B.1	There are no samples for the group of species which are reported to spend winter in Turkey but which have gone extinct.
B.1.1	These species either spend winter in Turkey or use Turkey as a passage on their migration routes, but their population is under a great risk of extinction. Natural populations of birds in this group have already disappeared and they are today domesticated species kept in aviaries, cages, or other artificial conditions. It is falling under the **EX** category of IUCN.
B.1.2	The number of these species has fallen down dramatically and they are represented by 1 individual-10 pairs (1-20 individuals) in regions observed. Since these species face a very high risk of extinction, they must be protected all around Turkey. It is falling under the category of **CR** of IUCN.
B.2	The number of these species ranges between 11 and 25 pairs (22-50 individuals) in regions observed. They face a very big risk of extinction continue, they are bound to go extinct. It is falling under the category of **EN** of IUCN.
B.3	Population sizes of these species in Turkey ranges between 26 and 250 pairs (52-500 individuals) in regions observed. These are extremely vulnerable to extinction and face a high risk of extinction in the wild. It is falling under the category of **VU** of IUCN.
B.3.1	Populations of these species display a decline in the regions observed. Their population sizes change between 251 and 500 pairs (502-1000 individuals). Compared to older records, recent observations reveal that there is a decrease in the number of individuals.
B.4	Despite the fact that these species do not face a risk of extinction in regions observed in populations. These are species that are likely to face the risk of extinction in time. Their populations in regions observed ranges between 501 and 5000 pairs (1002-10000 individuals). It is falling under the category of **NT** of IUCN.
B.5	There is no observed decline in the population of these species, nor do they face a risk of extinction. It is falling under the category of **LC** of IUCN.
B.6	These are insufficiently analyzed species, about which very few records exist. Since the data available rest on a few sporadic observations, there is no way of evaluating these according to reliable observations. It is falling under the category of **DD** of IUCN.
B.7	It is not possible to make any assessment about these species because records available are both small in number and far from being reliable. It is falling under the category of **NE** of IUCN.

CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora)

The species covered by CITES are listed in three Appendices, according to the degree of protection they need.

Appendix I lists species that are the most endangered among CITES-listed flora and fauna. They are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial for instance for scientific research. In these exceptional cases, trade may take place provided it is authorized by the granting of both an import permit and an export permit (or re-export certificate) (Convention on International Trade in Endangered Species of Wild Fauna and Flora, Appendices I, II & III).

Appendix I includes species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances.

Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. It also includes so-called "look-alike species", i.e. species of which the specimens in trade look like those of species listed for conservation reasons. International trades in specimens of Appendix-II species may be authorized by the granting of an export permit or re-export certificate. No import permit is necessary for these species under CITES (although a permit is needed in some countries that have taken stricter measures than CITES requires). Permits or certificates should only be granted if the relevant authorities are satisfied that certain conditions are met, above all that trade will not be detrimental to the survival of the species in the wild. (Convention on International Trades in Endangered Species of Wild Fauna and Flora, Appendices I, II & III).

Appendix III contains species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade. Changes to Appendix III follow a distinct procedure from changes to Appendices I and II, as each Party's is entitled to make unilateral amendments to it.

BERN Convention

The aim of the Convention is "to conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co-operation of several States, and to promote such co-operation. Particular emphasis is given to endangered and vulnerable species, including endangered and vulnerable migratory species."

The Convention lists protected species in four appendices:

Appendix I lists strictly protected flora species,

Appendix II lists strictly protected fauna species,

Appendix III lists protected fauna species, and

Appendix IV lists prohibited means and methods of killing, capture and other forms of exploitation.

Each contracting Party is obliged to take appropriate and necessary legislative and administrative measures to ensure the special protection of the wild fauna species specified in Appendices II and III of the convention.

Annex I – Strictly Protected Flora Species

The approximately 700 plant species listed in Appendix – I may not be taken from the wild or harmed. The habitats of these species are subject to strict protection, with the choice of habitat protection measures left to signatory states.

Annex II- Strictly Protected Fauna Species

The Contracting Parties undertake to give special attention to the protection of areas that are of importance for the migratory species specified in Appendices II and III and which are appropriately situated in relation to migration routes, as wintering, staging, feeding, breeding or moulting areas.

The following activities are strictly prohibited:

- Any kind of deliberate capturing- keeping and illegal methods of killing;
- Deliberate damage and destruction of the breeding or sheltering areas;
- Deliberately disturbing the wild fauna especially during their breeding, development and winter sleep seasons in a manner contrary to the intended purpose of this convention;
- Collecting eggs from the wild or deliberately destructing such eggs or keeping such eggs even if they are empty;
- Being in possession of or domestic trading of the fauna species either alive or dead.

Annex III- Protected Fauna Species

There is temporary or regional prohibition under appropriate conditions in order to ensure that the related wild fauna reach to the satisfactory population levels. There are closed hunting seasons and the other national principles according to the decisions of the CHC.

The related works and activities will not certainly lead to any negative impacts on the species specified in the fauna lists above and the other wildlife species such as hunting of such species, deliberate killing or keeping of such species, or damaging- destruction of their eggs, etc. protected duly by the Bern Convention.

Each Contracting Party shall take appropriate and necessary legislative and administrative measures to ensure the protection of the wild fauna species specified in Appendix III.

Any exploitation of wild fauna specified in Appendix III shall be regulated in order to keep the populations out of danger, taking into account the requirements of Article 2. (Article 2: The Contracting Parties shall take requisite measures to maintain the population of wild flora and fauna at, or adapt it to, a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements and the needs of sub-species, varieties or forms at risk locally.)

Measures to be taken shall include:

a) closed seasons and/or other procedures regulating the exploitation;

b) the temporary or local prohibition of exploitation, as appropriate, in order to restore satisfactory population levels;

c) the regulation as appropriate of sale, keeping for sale, transport for sale or offering for sale of live and dead wild animals.

EU Habitats Directive (92/43/EEC)

The Habitats Directive, adopted in 1992, ensures the conservation of a wide range of rare, threatened or endemic animal and plant species. Its main aim is to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. Some 200 rare and characteristic habitat types are also targeted for conservation in their own right.

All in all, over 1,000 animal and plant species, as well as 200 habitat types, listed in the directive's annexes are protected in various ways:

- Annex-I: natural habitat types of community interest whose conservation requires the designation of special areas of conservation.
- Annex-II: animal and plant species of community interest whose conservation requires the designation of special areas of conservation.
- Annex-III: animal and plant species of community interest in need of strict protection.
- Annex-IV (over 400 species, including many annex II species): animal and plant species of community interest who's taking in the wild and exploitation may be subject to management measures. A strict protection regime must be applied across their entire natural range within the EU, both within and outside Natura 2000 sites.
- Annex V species (over 90 species) Member States must ensure that their exploitation and taking in the wild is compatible with maintaining them in a favorable conservation status.

EU Birds Directive (2009/147/EC)

This Directive ensures far-reaching protection for all of Europe's wild birds, identifying 194 species and sub-species among them as particularly threatened and in need of special conservation measures. There are a number of components to this scheme (EC, 2014a):

Member States are required to designate Special Protection Areas (SPAs) for 194 particularly threatened species and all migratory bird species listed in Annex I of the Birds Directive. SPAs are scientifically identified areas critical for the survival of the targeted species, such as wetlands. They are part of the ecological network set up under the Habitats Directive 92/43/EEC.

A second component bans activities that directly threaten birds, such as the deliberate killing or capture of birds, the destruction of their nests and taking of their eggs, and associated activities such as trading in live or dead birds (with a few exceptions).

A third component establishes rules that limit the number of bird species listed in Annex III, which can be hunted (82 species and sub-species) and the periods during which they can be hunted. It also defines hunting methods which are permitted (e.g. non-selective hunting is banned).

Annex I: Species subject to special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution.

Annex II: Species may be hunted under national legislation. Member States shall ensure that the hunting of these species does not jeopardize conservation efforts within their distribution area.

Annex III: Species whose sale, transport for sale, keeping for sale and the offering for sale of live or dead birds and of any readily recognizable part or derivatives of such birds is not prohibited provided that the birds have been legally killed or captured or otherwise legally acquired.

5.9.1 Terrestrial Flora

As a result of the observations during the site visits (see Table 5-37) and literature studies, an inventory of flora species which were identified on Project Area was prepared and presented in Appendix B.

The flora table presents the family, scientific name, common Turkish name, habitat preference, phytogeographical region, endemism category and conservation status of the species. In order to determine conservation status of the identified flora species "Red Data Book of Turkish Plants" (Ekim et al., 2000) that is published by Turkish Association for the Conservation of Nature (Türkiye Tabiatını Koruma Derneği) was used. The conservation statuses of the plants are also classified according to International Union for Conservation of Nature (IUCN) Red List of Threatened Species and European Red List of Vascular Plants (Bilz et al., 2011).

Turkish Plant Names Dictionary (Türkçe Bitki Adları Sözlüğü) (Baytop, 1997) was used in the nomenclature. In addition, Turkish Plant Information Service (TÜBİVES), which is prepared by the Scientific and Technological Research Council of Turkey (TUBITAK), was used for the local name, habitat and endemism categories

The Project Area is located within the A5 square according to Grid Square System (see Figure 5-67). Flora of Turkey and East Aegean Islands (Davis, P. 1985 and Güner et al., 1985) was used as the main guide in the identification procedure of the species that form the flora of the region. The flora table presents the family, scientific name, habitat, endemism, phytogeographical region, common name and conservation status according to International Union for Conservation of Nature's (IUCN) Red List of Threatened Species for each species.

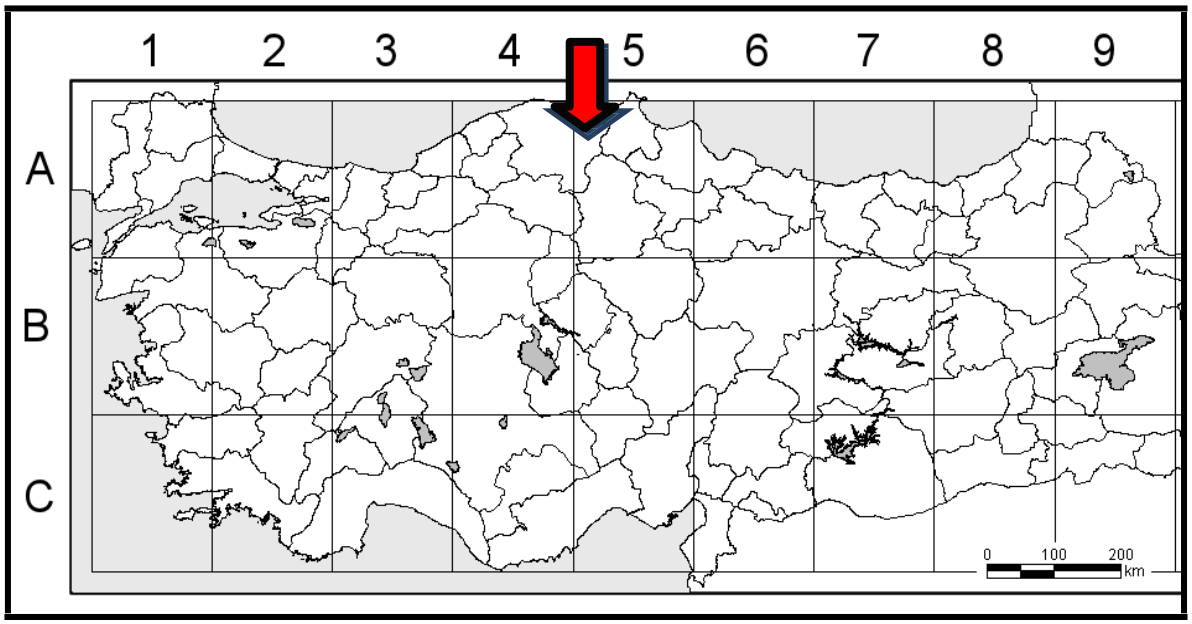


Figure 5-67 Location of the Project Area According to Grid Square System

Anatolia has been divided into three main phytogeographical regions: The European-Siberian (Black Sea), Iran-Turan (Central, Eastern and Southeastern Anatolia Regions) and Mediterranean (Aegean and Mediterranean Regions) Phytogeography Region (Atalay, 1994).

The Project Area is located in the Euro-Siberian Phytogeographical Region. This territory extends along most of North Anatolia and in a narrower strip along the Black Sea coast of Turkey -in-Europe (Istranca Mountains to the Belgrad forest near the Bosporus). The relatively humid climate puts little strain on the plant and is reflected in the predominantly mesophytic vegetation, deciduous forest being the usual climax in the middle and lower regions; phanerophytes and hemicryptophytes are abundant in the region.

The dominant plant species and communities in the Project Area and its vicinity are the ones that characterize the Euro-Siberian phytogeographic region on the moderate elevation. The glades especially of "Land sparsely wooded with mixed broadleaved and coniferous trees" are also very interesting. These glades shelter many xerophyte (plants that have adapted to survive in an environment with little liquid water) plant species that belong to Iranian-Turanian phytogeographic region. In other words, there is dry vegetation on the valley bottom and the southern hillsides of Gökırmak valley while there is humid vegetation on the northern hillsides of the valley.

The general vegetation types of the area determined during the field surveys in the Project Area and its vicinity are grouped in 3 main vegetation types are identified in the Project Area:

- Riparian Vegetation
- Forest Vegetation
- Anthropogenic Areas

Riparian Vegetation

A riparian area is the interface between land and a river or a stream. Riparian vegetation identified within and the vicinity of the Project Area is in places that are formed by impact of Gökırmak River.

Forest Vegetation

Kastamonu Province has 750,423 ha forest area in total (see Table 5-40 for the general distribution of the main tree species and forest types).

Table 5-40 Distribution Areas of Tree/Forest Types of Kastamonu Province

Tree/Forest Types	Area (Ha) (Percentage of the tree/forest type comparing the total ha of the forest area in Kastamonu)
European Black Pine	182,760 (24%)
Yellow Pine	49,490 (7%)
Turkish Pine	5,617 (0.7%)
Fir	30,220 (4%)
Common Beech	38,682 (5%)
Oak	88,921 (12%)
Other Leafed Trees	980 (0.1%)
European Chestnut	2,736 (0.4%)
Between Coniferious mixed forest	93,304 (12%)
Between Leafed mixed forest	98,484 (13%)
Coniferious+Leafed Mixed Forest	159,229 (21%)
Total	**750,423 ha**

Source: Kastamonu Provincial Directorate of Environment and Forestry.2004. Environment Condition Report, page 59

Three different sub habitat types are determined within the forest vegetation for the Project Area and its close vicinity regarding the EUNIS classification. “Degraded Pinus brutia forests”, “Carpinus orientalis - Quercus pubescens forests” and “Pinus nigra - Quercus petraea forests” are the dominant types in the area. Various forest clearings both natural and anthropogenic exist within these habitat types. Especially the natural glades within the “Degraded Pinus brutia forests” habitat type are ideal habitats for xerophytes. The species determined in the glades are assigned to the dominant habitat type that they occur. For example, Krascheninnikovia ceratoides (Pamirian Winterfat) growing in Pinus brutia (Turkish Pine) assembles is indicated in “Degraded Pinus brutia forests” habitat type. The forest vegetation described for this Project Area covers also shrub and herbeceaous plant species.

The total habitat loss of both on-going construction/excavation activity and the planned future construction/excavation activity is given below in Table 5-41.

Approximately 91,200 trees are planned to be cut in total with forestry permits obtained and to be obtained in the Project Area.

The amount of forest land to be cleared from each Project unit is calculated using Corine Land Cover maps and the exact status of permits are given in Table 5-42.

Table 5-41 Land Cover Assessment due to Terrestrial Habitat Loss

Category of the Habitat Loss due to the Project	Corine Land Cover Code	CORINE Land Cover Class	Code (2016)	Habitat Loss / Alteration (ha)
The Habitats with Existing/ On-going Construction / Excavation Activity (Administrative buildings, Closed Ore Storage, Çorakoğlu WRD, Gökırmak Diversion System, Downstream Coffer Dam, Upstream Coffer Dam, Spillway, Kepezkaya TSF and Kepezkaya TSF Surface Soil Storage Area, TSF Pipeline, Küpeli Storage Area, Open Pit and Related, Ore Road, Process Plant, Process Plant – Surface Soil Storage Area)*	Agricultural areas	Arable Land	211, 212, 213	0.1
		Pastures	231	0
		Heterogeneous agricultural areas	241, 242, 243, 244	72
	Forests and semi natural areas	Forests	311, 312, 313	313.6
		Shrub and/or herbaceous vegetation associations	321, 322, 323, 324	25
The Habitats of Planned Future Construction / Excavation Activity (Bagdere TSF, Topsoil Storage Areas)**	Agricultural areas	Arable Land	211, 212, 213	0.04
		Pastures	231	0
		Heterogeneous agricultural areas	241, 242, 243, 244	0
	Forests and semi natural areas	Forests	311, 312, 313	4.3
		Shrub and/or herbaceous vegetation associations	321, 322, 323, 324	69
				484

* activities dated due to September 2017
** activities to be conducted September 2017 onforward

The habitat loss of forested areas per Project unit is given below. The habitat loss of forest and semi natural areas considering both the on-going and planned activities, the total area is 411.9 ha. As 317.3 ha of it consists of broad-leaved forests, coniferous forests and mixed forests while 94.6.of it consists of natural grasslands and transitional woodland-shrubs.

Table 5-42 Forest Land to be Cleared per Project Unit and the Status of the Forestry Permits

Project Unit	Forested Land Type according to Corine Land Cover Map Classification	Calculated Forest Land to be Cleared (hectares)	Status of Forestry Permit
Administrative buildings	Transitional woodland-shrub	1.17	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4120200070, dated 16.07.2014)
Closed Ore Storage	Broad-leaved forest	1.25	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4210200109-110, dated 30.06.2015)
Çorakoğlu WRD	Transitional woodland shrub Mixed forest	13.07 161.03	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4120200119, dated 12.01.2016)
Gökırmak Diversion System	Transitional woodland-shrub Mixed forest	3.17 4.03	Forestry Permit obtained for DSİ 23rd Regional Directorate (No. 5220200095, dated 17.02.2015)

Project Unit	Forested Land Type according to Corine Land Cover Map Classification	Calculated Forest Land to be Cleared (hectares)	Status of Forestry Permit
Downstream Coffer Dam	Mixed forest	0.76	Forestry Permit obtained for DSİ 23rd Regional Directorate (No. 5220200095, dated 17.02.2015)
Upstream Coffer Dam	Broad-leaved forest Mixed forest Transitional woodland shrub	0.04 0.14 3.46	Forestry Permit obtained for DSİ 23rd Regional Directorate (No. 5220200095, dated 17.02.2015)
Spillway	Broad-leaved forest Transitional woodland shrub	2.63 0.24	Forestry Permit obtained for DSİ 23rd Regional Directorate (No. 5220200111, dated 10.06.2015)
Kepezkaya TSF and Kepezkaya TSF Surface Soil Storage Area	Coniferous forest	40.17	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4210200064, 4120200118, 4120200125, dated 16.07.2014, 19.11.2015, 28.10.2016)
TSF Pipeline	Broad-leaved forest Coniferous forest Transitional woodland shrub	0.02 0.11 0.12	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4120200077, dated 17.11.2014.
Küpeli Storage Area	Transitional woodland-shrub	6.83	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4210200109-110, dated 30.06.2015)
Open Pit and Related	Broad-leaved forest Mixed forest Transitional woodland-shrub	71.81 5.85 2.17	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4210200109-110, dated 30.06.2015)
Ore Storage Area	Broad-leaved forest Transitional woodland shrub	9.70 0.51	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4120200123, dated 18.10.2016)
Process Plant	Broad-leaved forest	13.67	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4120200070, dated 18.07.2014)
Process Plant – Surface Soil Storage Area	Broad-leaved forest	2.81	Not required – Topsoil stripped from process plant was transported and stored in open pit surface soil storage area.
Bağdere TSF	Transitional woodland-shrub	62.05	Not obtained - Unit will be needed until year 4.75 of production. This requires that the construction of the Bağdere TSF commences approximately in Q3 of year 3 of production.
Bağdere TSF – Surface Soil Storage Area	Coniferous forest	5.01	Not obtained - Unit will be needed in year 4.75 of production. This requires that the construction of the Bağdere TSF commences approximately in Q3 of year 3 of production.
ETL	Since the ETL route is very long (28.8), the pylons are located on various forest land types that are given in this table.	has been considered to be almost negligible due to their small sizes	Forestry permit issued by Kastamonu Provincial Directorate of Forestry (No. 4120200070, 4120200074, 4120200088, 4120200115; dated 18.07.2014, 18.07.2014, 31.07.2014, 30.09.2015)
Total		411.9	

Anthropogenic Areas

Gökçeağaç, Bağdere, Vakıfgeymene, Sepetçioğlu, Küreçayı, Sirkeköy and center of the district are some of the anthropogenic areas (settlements) that are within the Project Area located in Hanönü district. Almost the whole valley bottom of Gökırmak River is covered by these settlements and their agricultural lands. Besides, there are many junction roads from districts and villages in addition to Kastamonu-Sinop state highway (D030) in the Project Area. The plants that are favoring nitrogen grow along these anthropogenic habitats and their vicinity. These areas have a heterogeneous floristic structure. Residues of the species belonging to the primary vegetation are often seen in this floristic structure of the anthropogenic areas.

As none of the habitat types in the Project Area and its vicinity have been determined to have a protection status outlined in the EU Habitats Directive, they also don't have a protection status on the national level.

5.9.1.1 Floristic Analysis

640 species and lower taxa belonging to 386 genus in 92 families are determined within the Project Area and its vicinity along the site visits and literature as 5 included in Pteridophyta and 83 included in Spermatophyta (Davis, 1965-1985; Davis et al., 1988; Avcı, 1998; Korkmaz & Engin, 2001; Baysal, 2008; Hamzaoğlu, 2014).

The heterogeneity of the habitat types can be seen also in the distribution of the plant taxa according to their phytogeographic regions. 143 of these taxa belong to Euro-Siberian, 45 taxa belong to Mediterranean and 29 taxa belong to Iranian-Turanian phytogeographical region. The remaining 423 taxa are widespread.

Among the 640 determined plant taxa in the Project Area, 1 is listed in EN category according to Red Data Book of Turkish Plants (*Crocus speciousus subs. zantholaimos*), 1 is considered to be EN according to the expert judgement of Prof. Hamzaoğlu who identified the species (however it should be evaluated further considering the IUCN RedList criteria) and 228 are listed in LC category according to IUCN Red List criteria as the remaining are not evaluated.

26 plant taxa identified within the Project Area are identified to be endemic. These are given in the table below together with their IUCN categories (Table 5-43).

The full list of flora of the 640 identified plant taxa of the Project Area and its vicinity is given in Appendix B.

Table 5-43 Endemic Plant Species within and the Vicinity of the Project Area

No	Scientific Name of the Taxa	English Name of the Taxa	Turkish Name of the Taxa	IUCN
1	*Dianthus aculeatus* Hamzaoğlu	Tuff Carnation	Tüf karanfili	EN
2	*Crocus speciosus* M.Bieb. subsp. *xantholaimos* Mathews	Bieberstein's Crocus	Boğaç çiğdemi	EN
3	*Allium kastambulense* Kollmann	Küre Onion	Küre soğanı	LC
4	*Arum euxinum* R.R.Mill	Arum Lilies	Yılanyastığı	LC
5	*Asperula pestalozzae* Boiss.	Woodruff	Has belumotu	LC
6	*Astragalus micropterus* Fisch.	Milk Vetch	Serçe geveni	LC
7	*Centaurea consanguinea* DC.	Centaury	Tezdüğme	LC
8	*Delphinium venulosum* Boiss.	Larkspur	Hezaren	LC
9	*Dianthus carmelitarum* Reut. ex Boiss.	Black Sea Carnation	Karadeniz karanfili	LC
10	*Dianthus kastembeluensis* Freyn & Sint.	Kastamonu Carnation	Kastamonu karanfili	LC
11	*Digitalis lamarckii* Ivanina	Lamarck's Foxglove	Yüsükotu	LC
12	*Epipactis pontica* Taubenheim	Helleborine	İnce bindallı	LC
13	*Euphorbia cardiophylla* Boiss.& Heldr.	Spurge	Sütleğen	LC
14	*Ferulago thirkeana* Boiss.	Ferulago	Sarıçakşır	LC
15	*Hieracium bornmuelleri* Freyn	Hawkweed	Pala şahinotu	LC
16	*Iris kerneriana* Asch. & Sint. ex Baker	Kerner's Iris	Çalı süseni	LC
17	*Linaria corifolia* Desf.	Field Toadflax	Tarla nevruzotu	LC

No	Scientific Name of the Taxa	English Name of the Taxa	Turkish Name of the Taxa	IUCN
18	*Lonicera caucasica* Pall. subsp. *orientalis* (Lam.) Chamb. & Long.	Honeysuckle	Çakkana	LC
19	*Phlomis armeniaca* Willd.	Sage	Boz şavlak	LC
20	*Phlomis russeliana* (Sims) Lag. ex Benth.	Russel's Sage	Akbaşlı çalba	LC
21	*Salvia cyanescens* Boiss. & Balansa	Blue Turkish Sage	Mor galabor	LC
22	*Sideritis germanicopolitana* Bornm. subsp. *germanicopolitana*	Ironwort	Karakurbağa çayı	LC
23	*Trifolium pannonicum* Jacq. subsp. *elongatum* (Willd.) Zohary	Hungarian Clover	Uzun yapraklı üçgül	LC
24	*Verbascum cheiranthifolium* Boiss. var. *asperulum* (Boiss.) Murb.	Mullein	Bozkulak	LC
25	*Astragalus sigmoideus* Bunge	Include Milkvetch	Güdük geven	LC
26	*Hieracium paphlagonicum* Freyn & Sint.	Hawkweed	Havlı şahinotu	LC

5.9.2 Terrestrial Fauna

199 terrestrial vertebrate species (10 amphibian, 20 reptile, 120 bird and 49 mammalian species) are identified to exist within and the vicinity of the Project Area. The diversity of the identified species indicates that the Project Area and its close vicinity have suitable habitats for the vertebrate species. The identified vertebrate species are mainly elements of Central Black Sea region. The Project implementation area is used by these vertebrates for various purposes while some use the area the whole year, some use in some seasons throughout a year.

No endemic terrestrial vertebrate animal is identified within and the vicinity of the Project Area.

20 reptile species are identified in the Project Area as 3 belong to Testudinata, 9 belong to Sauria and 8 belong to Serpentes. Spur-thighed Tortoise (*Testudo graeca*) is the only vertebrate species that is included in VU category of IUCN RedList.

It is determined that 120 bird species use the Project Area and its close vicinity.

49 mammal species are identified in the Project Area and its close vicinity as 7 belong to Insectivora, 14 belong to Rodentia, 13 belong to Chiroptera, 1 belong to Leporidae, 11 belong to Carnivora and 3 belong to Artiodactyla.

The full list of these animal groups of the Project Area and its vicinity are given in Appendix B.

5.9.2.1 Amphibians (Amphibia)

10 amphibian species determined to exist within the Project Area and in the close vicinity living in and sides of the streams, humid maquies shrublands and forest areas of deciduous trees, in the crevices and under stones. The ones living more on the terrestrial areas prefer being in humid areas such as under stones, under leaves, in the crevices during the day and become active during night for feeding and breeding purposes. The site surveys in order to determine the amphibian species were conducted especially along Gökırmak River and its vicinity. Although there are many tributary streams of Gökırmak River, they are intermittent streams and do not stand as priority habitats for the amphibian species.

Among 10 amphibian species identified within the Project Area and its close vicinity, 2 belong to Urodela (salamanders and newts) and 8 belong to Anura (frogs and toads). The populations of these species in the Project Area are relatively low.

Considering the IUCN Red List, 1 amphibian species in the Project Area, *Ommatotriton ophryticus* (Northern Banded Newt) is evaluated as NT and the remaining 9 species are evaluated as LC.

Considering the lists of Bern Convention, 5 amphibian species in the Project Area are listed in Annex-II, 4 of them are listed in Annex-III and Northern Banded Newt is not included in any lists.

Considering the lists of Habitat Directive dated 2006, 1 amphibian species is listed in Annex-II and 4 are listed in Annex-IV.

5.9.2.2 Reptiles (Reptilia)

20 reptile species are determined to exist within the Project Area and its vicinity. These species prefer mainly the areas of glades, sides of agricultural lands, forest areas and riversides.

Considering the IUCN Red List, 1 reptilian species - *Testudo graeca* (Spur-thighed Tortoise) - is listed as VU - A1cd, 1 reptilian species - *Emys orbicularis* (European Pond Turtle) - is listed as NT, 10 are listed as LC and the remaining 8 are not evaluated. Although the European Pond Turtle and Spur-thighed Tortoise have these conservation status for European countries in general, these are widespread species throughout Turkey.

Considering the lists of Bern Convention, 13 reptilian species in the Project Area are listed in Annex – II, 7 of them are listed in Annex – III.

Considering the lists of Habitat Directive dated 2006, 2 reptilian species are listed in Annex-II and 12 of them are listed in Annex-IV.

5.9.2.3 Birds (Aves)

In addition to the site surveys with the suitable equipment such as cameras with 400 mm lens and binoculars, interviews with the local people and the literature survey was conducted in order to determine the bird species within the Project Area and its vicinity. Since there is a wide variety of habitats, there is a wide variety of bird species in the Project Area and its vicinity. 119 bird species are determined to exist in the Project Area and its vicinity. The species are assessed according to the time of the year when the species is most likely to occur in the area.

Considering the IUCN Red List, 1 bird species in the Project Area, Egyptian Vulture (*Neophron percnopterus*), is evaluated as EN, 2 species, Kruper's Nuthatch (*Sitta krüperi*) and Corncrake (*Coturnix coturnix*), are evaluated as NT and the remaining 116 species are evaluated as LC.

Considering the lists of Bern Convention, 73 bird species in the Project Area are listed in Annex – II, 40 of them are listed in Annex – III and 6 of them are not included in any lists.

Considering the categories in Red Data Book for Birds of Turkey, the bird species in the Project Area are listed as following;

8 bird species are in A.1.2 category, 28 bird species are in A.2 category, 43 bird species are in A.3 category, 14 bird species are in A.3.1 category, 4 bird species are in A.4 category, 17 bird species are in A.5 category, 1 bird species are in A.6 category, 1 bird species are in B.2 category, 1 bird species are in B.3 category and 2 bird species are in B.5 category.

Finally, considering the lists of Birds Directive, 30 bird species are listed in Appendix-I, 10 bird species are listed in Appendix-II/1, 16 bird species are listed in Appendix-II-2, 2 bird species are listed in Appendix-III/1 and 6 bird species are listed in Appendix-III/2.

The status of occurrence of the bird species in the Project Area and its vicinity have been evaluated as a mixture of the definitions from Red Data Book for Birds of Turkey and RSPB. These are as following;

- Y (Yearly-resident (native) bird species): These species breed and spend winter in the same area. Also some members of these species may spend winter in another area of Turkey.
- YZ (Summer Visitor): Summer visitors are birds that arrive in spring from the south to breed. Many are insect eaters. They spend summer here, then they – and their new young – return south in autumn.
- KZ (Winter Visitor): These species are mainly of northern and western origin; they arrive in Turkey to spend winter
- T (Transit Migrant): These species migrate via Anatolia in spring and fall.

The Project Area is not located on one of the main migratory routes over Turkey. However, the Project has a location that can support some of the bird populations using the flight routes over Blacksea coast during their stop-overs.

As most of the bird species (86 species) found in the Project Area and its vicinity have been determined to be residents (Y) for the area, the second largest group (26 species) has been determined to be summer visitors (YZ) for the area (5 of them are both residents and summer visitors).

5.9.2.4 Mammals (Mammalia)

49 mammal species are determined to exist in the Project Area and its vicinity.

Considering the IUCN Red List; 3 mammal species - *Rhinolopus mehelyi* (Mehely's Horseshoe Bat), *Vormela peregusna* (Marbled Polecat) and *Ursus arctos* (Brown Bear) - are listed in VU category, 2 are listed in NT category - *Miniopterus schreibersii* (Common Bent-wing Bat) and *Lutra lutra* (Eurasian Otter) -, 1 is listed in DD category - *Nannospalax nehringi* (Nehring's Mole Rat) - and the remaining 43 mammal species are listed in LC category.

Although the NT species Eurasian Otter has not been observed during the site visits or addressed along the interviews, the habitat of the Project Area and its vicinity is suitable for the species as also the known distribution map is overlapping.

Considering the lists of Bern Convention; 18 mammal species in the Project Area are listed in Annex – II, 15 of them are listed in Annex – III and 16 of them are not included in any lists.

Considering CITES; 1 mammal species (*Lutra lutra*) in the Project Area is listed in Annex-I, 4 are listed in Annex – II and remaining 35 of them are not included in any lists.

Considering Habitat Directive; 12 mammal species are listed in Annex-II, 5 are listed in Annex-IV and 1 is listed in Annex-V.

The full list is given in Appendix B.

Table 5-44 Conservation Status of the Vertebrate Species in the Project Area

	Total Number of Species	**IUCN**						**BERN**		**CITES**			**HAB. DIRECTIVE / BIRD DIRECTIVE**							
		LC	VU	NT	NE	EN	DD	Annex-II	Annex-III	Appendix-I	Appendix-II	Appendix-III	Annex-I	Annex-II	Annex-II/1	Annex-II/2	Annex-III/1	Annex-III/2	Annex-IV	Annex-V
AMPHIBIANS (AMPHIBIA)	10	9	-	1	-	-	-	5	4	-	-	-	-	1	-	-	-	-	4	-
REPTILES (REPTILIA)	20	10	1	1	8	-	-	13	7	-	1	-		2					12	
BIRDS (AVES)	119	116	-	2	-	1	-	73	40	-	-	-	30	-	10	16	2	6	-	-
MAMMALS (MAMMALIA)	49	43	3	2	-	-	1	18	15	1	4	-		12					5	1
Total		178	4	6	8	1	1	109		1	5		30	15	10	16	2	6	21	1

5.9.3 Aquatic Flora and Fauna

Gökırmak River which is one of the most important tributary of Kızılırmak River passes through the Project Area. The river flows in west-east direction. Gökırmak River rises in northern shoulders of Ilgaz Mountain which is in borders of Kastamonu. It passes through centre of Kastamonu, Taşköprü, Hanönü, Boyabat, Durağan and reaches to Kızılırmak River. Akkaya, Karadere, Uludere, Daday, Kastamonu, Karasu, Alpagut, Ağçıkavak, Çit, Çakmak, Çana, Hamzaoğlu, Küre and Kavakpazarı brooks that rise in mentioned places flows into Gökırmak River and this river system flows to Boyabat. It flows into Kızılırmak River after Durağan.

The only river habitat in terms of aquatic ecosystems within the scope of the Project is Gökırmak. Wetlands are defined by two major ecosystem types which are stagnant and flowing ecosystems. Besides, it is possible to define sub-system types according to physical and chemical structure of waters and Gökırmak is a flowing (lotic) and freshwater habitat.

The flowing environments are divided into sub-habitat types that are smaller and can change and repeat successively. As, flowing habitats in high velocity can be seen depending on the slope along the upper elevations of the basin, stagnant habitats or habitats with lower velocity can be seen in the basin along the other parts of the basin. As habitats change, species that live depending on these habitats also change. The aquatic species living in flowing water are completely different from species in stagnant areas.

The aquatic habitat within the Project Area has been observed to have these sub-habitat types depending on the physical differences along the riverbed. The bottom structure of Gökırmak within and the vicinity of the Project Area consists of small and big stones as big rock blocks are observed especially at the middle parts, small and large stones towards the shore and there are small gravels and sand deposits in the shoreline. These variations at the bottom structure also provide diversity in terms of adaptation of different species to these environments.

5.9.3.1 Freshwater Algae

Algea are primary producers in wetlands. This chemical energy is stored in carbohydrate molecules, such as sugars, which are synthesized from carbon dioxide and water. In most cases, oxygen is released as a waste product. In this way, they increase the amount of nutrition and oxygen in water. Therefore, they play a crucial role as contributing to production and with their relationship with the other groups of aquatic biodiversity.

A total of 89 taxa belonging to 5 different algae classes are identified in the Project Area and its close vicinity where the samples were collected during the field surveys. When considering the distribution of species on the classis base, Bacillariophyceae is represented by 57 taxa, Chlorophyceae is represented by 15 taxa, Cyanophyceae is represented by 11 species, Euglenophycea is represented by 3 species and Pyrrophyceae is represented by 2 species.

The members of Bacillariophyceae classis are dominant among attached algae. Free forms of phythoplanctonic organisms are found rare because of the high flow rate.

Generally, all freshwater algae identified in the Project Area are cosmopolitan and none are endemic, rare or endangered species.

The list of the freshwater algae can be seen in Appendix B.

5.9.3.2 Zooplankton

Among the zooplanktonic organisms, 19 species from Rotifera and 1 species from Copepoda and 3 species from Cladocera are identified along the survey stations. Zooplanktons can change their locations depending on water movement and they live in stagnant water habitats. Their presence is limited in rivers with high flow rate. However, some groups can live in the sandy areas in rivers with high flow rate as attached to the sand and gravel at the bottom structure (i.e. species can also live under rocks). Especially, Rotifera species live under the rocks, in order that they eliminate the negative effects of the flow rate.

Diversity of zooplanktonic organisms is determined to be low due to the limiting factor of flow speed. Identified species are cosmopolitan and widespread.

The zooplanktonic organisms identified in the Project Area and its vicinity within Gökırmak river are given in Appendix B.

5.9.3.3 Benthic Organisms

As a result of sampling works during the site surveys in the Project Area, 34 benthic invertebrate species are identified belonging to three major phylum; Mollusca, Annelida and Arthropoda. As 1 species belongs to subphylum Crustacea, order Diptera is represented by 15 species, order Ephemeroptera is represented by 6 species, Coleoptera is represented by 1 species, Plecoptera is represented by 2 species, Trichoptera is represented by 3 species and order Odonata is represented by 3 species among the orders of classis Insecta.

There are no benthic species that should be protected according to results of sampling. In addition, species that can be found in high mountain waters and species of clean water indicator are widespread and abundant in the area.

Identified benthic organisms are given in Appendix B.

5.9.3.4 Fish

A total of 9 species which are members of two families are identified in Gökırmak River in this study. Among the species detected in Project Area, *Alburnoides fasciatus* (Caucasian Sprilin) and *Alburnus fasciatus* (Danube Bleak) are in Annex-III list of BERN Convention. *Barbus tauricus* (Crimean barbell) is listed in Vulnerable (VU) category; *Aburnoides fasciatus* (Transcaucasian Spirlin), *Squalis cephalus* (Chub) and *Alburnus chalcoides* (Caucasian Sprilin) are listed in Least Concern (LC) category while *Capoeta tinca* (Anatolian khramulya) is listed in Not Evaluated (NE) category and *Nemachelius angorae* is in Data Deficient (DD) category according to IUCN.

Family Cyprinidae is represented by the highest number of fish species with 7 species most importantly as Squalius and Capoeta are the most important fish genus of the Project Area. These species are widespread and abundant in Anatolia. Chondrostoma angorense and Capoeta tinca are dominant and widespread along the shore of Black Sea although they are endemic species.

Identified fish species are given in Appendix B.

5.9.4 Naturally Protected Areas

The statutory and non-statutory designated protection areas in the Project Area and its vicinity are described below.

Statutory Designated Protection Areas

The Project Area is not located in any statutory designated protected area according to Kastamonu Provincial Directorate of Environmental and Urbanization.

There are 2 natural monuments, 2 nature parks and 5 wildlife improvement areas within a range of 50 km of the Project Area.

The Project Area is under the control of Kastamonu Regional Directory of Forestry and Nature Conservation and National Parks in terms of nature and species protection.

The general restrictions for the areas regulated under the National Parks Law No. 2873 dated 1983 are given below:

a) degradation of natural and ecological balance and natural ecosystem value,

b) destruction of wildlife,

c) any intervention that may lead to the loss or change of the features of these areas or processes that may lead to environmental problems such as pollution of soil, water and air,

d) production of any kind of forest product, hunting and grazing,

e) construction and operation of any structure and facility unless required by the Presidency of the Republic of Turkey or Turkish Armed Forces General Staff or found to be necessary for the public interest.

Natural Monuments, Natural Site Areas, Wildlife Improvement Areas and Nature Parks mentioned in the report are places designated by Nature Conservation and National Parks General Directorate of Ministry of Forestry and Water Affairs according to National Parks Law No. 2873. Defining their statuses and borders, monitoring the conditions of natural resources and the activities within the areas and deciding to do changes related to the areas are conducted by the same directorate of the Ministry.

Natural Site Areas

“Natural Site Areas are incidental to geological period and they have extraordinary characteristics due to their rareness. Natural Site Areas can be located at surface underground or under water. For these reasons, they must receive protection” (Ministry of Environment and Urbanisation, Directorate General for Preservation of Natural Heritage, Guideline No 28635, Clause 4-c).

According to Environment Status Report of Kastamonu Province for 2015 prepared by Kastamonu Provincial Directorate of Environment and Urbanization (2016), no natural sites exist within the 50 km radius of the Project Area.

Wildlife Improvement Areas

Areas where game and wildlife animals and wildlife are protected, developed, game animals are placed, measures are taken to improve the living environment, and hunting can be carried out within the framework of a special hunting plan if necessary.

Any kind of activities that can affect the flora and fauna in the area are forbidden such as; grazing, plant collection, highland, forestry activities, beekeeping activities, hunting activities, road and path construction, infrastructure, construction, building and plant construction, mining exploration and operation, material and water intake from the area, changing the river bed, fish production and except for ecotourism and studies and researches for scientific purposes.

The closest nationally protected area is Elekdağ Wildlife Improvement Area (WIA) which is at approximately 4 km distance to the Project Area.

Ilgaz Wildlife Improvement Area: at approximately 42 km distance to the ETL

Gavurdağı WIA : at approximately 48 km distance to the Project Area.

Nature Parks

Nature Park is a category of Naturally Protected Areas that is identified by General Directorate of Nature Conservation and National Parks of MoFWA according to National Parks Law No 2873.

Nature Parks are defined as “nature areas with rich vegetation and wildlife with a nice view ensuring the public to rest and enjoy.” (National Parks Law No 2873).

The closest nature park is Topalçam Nature Park where is at approximately 33 km distance to the Project Area. Tatlıca Nature Park where is at approximately 36 km distance to the Project Area.

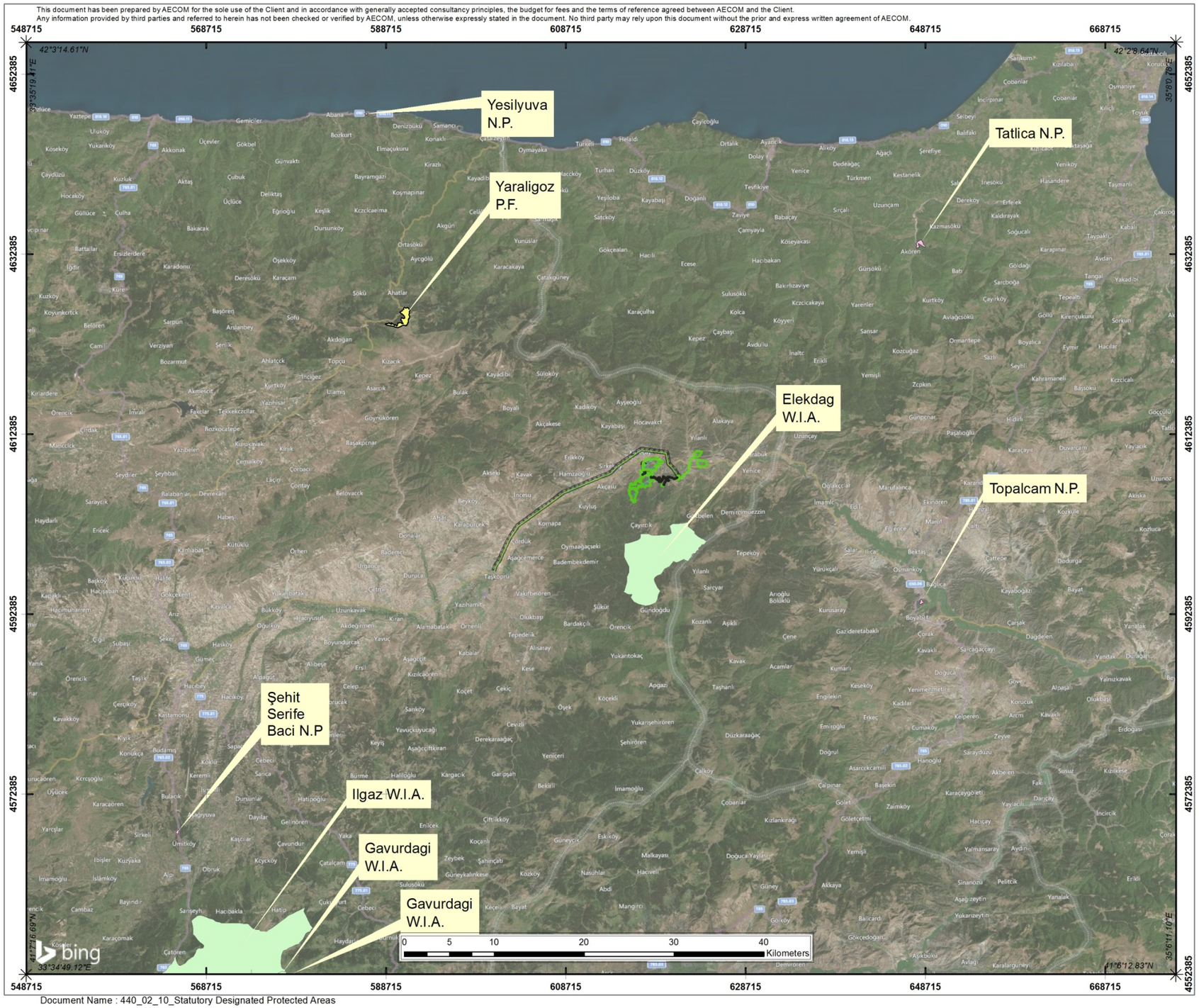
Şehit Şerife Bacı Nature Park: at approximately 45 km distance to the Project Area.

Yeşilyuva Nature Park: at approximately 46 km distance to the Project Area.

As the Project Area is not located in a protected area and all the listed statutory designated protected areas above are at more than 20 km distance to the Project Area. Therefore, it is considered that there will not be a direct negative impact on these areas due to Project related activities.

The statutory designated areas in the vicinity of the Project Area are given in Figure 5-68.

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



LEGEND

- Proposed Project Units
- Roads
- Energy Transmission Line

Protected Areas

- Protection Forest (P.F.)
- Wildlife Improvement Areas (W.I.A)
- Natural Parks (N.P.)

AECOM

Tel: +90 312 442 98 63
Fax: +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com
Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime B Blok Suite No:51
06800 Cankaya/Ankara Turkey

Project Name:	ESIA Disclosure Package for Acacia Mine Inc. (AMI) Gökırmak Copper Project
Map Title:	Statutory Designated Protected Areas
Client:	Acacia Mine Inc. (AMI)
Project Group: Environment	Project Code: 440.02.10
Design: A. Korkmaz	Last Update: 30/08/2017 - 09:17 (korkmaz / TRAKR1PC31746)
Coordinate System: Projection: Transverse Mercator Coordinate System: WGS 1984 UTM Zone 36N	Sheet Size: A3

Service Layer Credits: © Harris Corp, Earthstar Geographics LLC Earthstar Geographics SIO © 2017 Microsoft Corporation © AND

Document Name : 440_02_10_Statutory Designated Protected Areas

Figure 5-68 Statutory Designated Protected Areas

Non-statutory Designated Protected Areas

In addition to the statutory protected areas, the Project Area is evaluated in terms of non-statutory protection areas such as Key Biodiversity Areas (KBA) which also corresponds to Important Bird Areas (IBA), and Important Plant Areas (IPA).

There are three non-statutory designated areas in the vicinity of the Project Area. These three areas are both IBAs and IPAs and following it designated as KBAs. As the IBA, IPA and KBAs have subtle differences in terms of their borders, the KBA borders are given in the map (see: Figure 5-69) as it is more inclusive.

Key Biodiversity Areas

Key Biodiversity Areas (KBAs) are places of international importance for the conservation of biodiversity at the global level. The concept of KBAs has been developed by conservation organizations including BirdLife International, Conservation International, and PlantLife International. The scientific studies in order to determine the KBAs in Turkey have been carried out by Doğa Derneği with the support of the RSPB (Royal Society for Protection of Birds) and BirdLife International. In 2006, Doğa Derneği published the book “Key Biodiversity Areas of Turkey” which is also available in the Official Website of Doğa Derneği.

These KBAs also constitute the basis of scientific studies that are carried out within the scope of Natura 2000 network for Turkey’s EU accession process. Natura 2000 is an ecological network of protected areas in the territory of the European Union (EU). There are two directives of EU that form the Natura 2000 network. These are the Birds Directive (Council Directive 79/409/EEC on the conservation of wild birds) and the Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora). In order to meet the requirements of these directives, Doğa Derneği and the MoFWA have carried out various studies.

Since the idea of Key Biodiversity Areas (KBA) is to help to identify and designate areas of international importance in terms of biodiversity conservation using globally standardized criteria, the determination of KBAs often brings sites onto the conservation agenda that hadn't previously been identified as needing protection due to the nature of the two non-exclusive criteria used to determine them; vulnerability; and irreplaceability.

The closest KBA is Küre Mountains that is at 43 km distance to the Project Area. The other relatively close KBA is Sinop Peninsula where is at approximately 54 km distance to the Project Area. Sinop Peninsula is important for lots of endemic and rare plant species.

Important Bird Areas

The European Important Bird Area (IBA) Program is implemented through national IBA Program in 29 countries with the support and co-ordination of the European Division of the BirdLife Secretariat. The IBAs in Turkey have been identified by the Society for the Protection of Nature (Doğal Hayatı Koruma Derneği) and BirdLife International and this study was published as a book called “Important Bird Areas in Turkey” in 1997. The book was revised in 2004 by the Doğa Derneği (Nature Society) and BirdLife International with additional support from RSPB.

The Project Area does not lie within any important bird area.

The 3 Important Bird Areas in the vicinity of the Project Area are Sinop Peninsula (at approximately 50 km distance), Ilgaz Mountains (at approximately 55 km distance) and Küre Mountains (at approximately 70 km distance).

Important Plant Areas

Important Plant Areas (IPA), are defined as "areas with very rich in plant diversity, rare and / or endemic (grows naturally nowhere else in the world) species rich communities and natural habitats”.

The concept of the IPA was developed under the leadership of three-organizations co-operating in order to protect the natural flora in Turkey: DHKD (Nature Conservation Society), FFI (Fauna & Flora International) and ISTE (Istanbul University, Faculty of Pharmacy, Department of Botany) in the early 1990s.

The same period, gained an international dimension with PlantLife International's coordination in England and the criteria are established.

IPAs provide a very important infrastructure that will contribute to the implementation of international conventions, strategies and programs that Turkey is a party.

IPAs include botanical and scientific data about protecting nature which will be used for compliance and implementation of international environmental protection conventions, network of protected areas, biodiversity conservation strategies and policies.

There are 3 Important Plant Areas around the Project Area; Küre Mountains, Ilgaz Mountains and Sinop Peninsula. The distances to the Project Area are given in above (approximately the same distances as the KBAs).

In Küre Mountains, there are 27 plant taxa with one of them is endemic species which is Ornithogalum kuereanum grow only here in the world.

Ilgaz Mountain has 37 plant taxa with some endemic species included within the IPA borders. *Festuca ilgazensis, Hieracium macrogonum* and *Hieracium tuberculatum* grow only here in the world. Although it is not endemic, relict *Salix myrsinifolia* is only recorded in this area in Turkey.

Sinop Peninsula is a very important area for rare and endemic plant species. There are 3 species that are Endangered in the area; *Isatis arenaria*, *Verbascum degenii* and *Crocus speciosus* ssp. *xantholaimos*.

Wetlands

Regarding the definition of Ramsar international wetland conservation treaty, the wetlands are defined as following;

Article 1.1: "...wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters."

Article 2.1: "[Wetlands] may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands."

The Convention on Wetlands of International Importance, Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

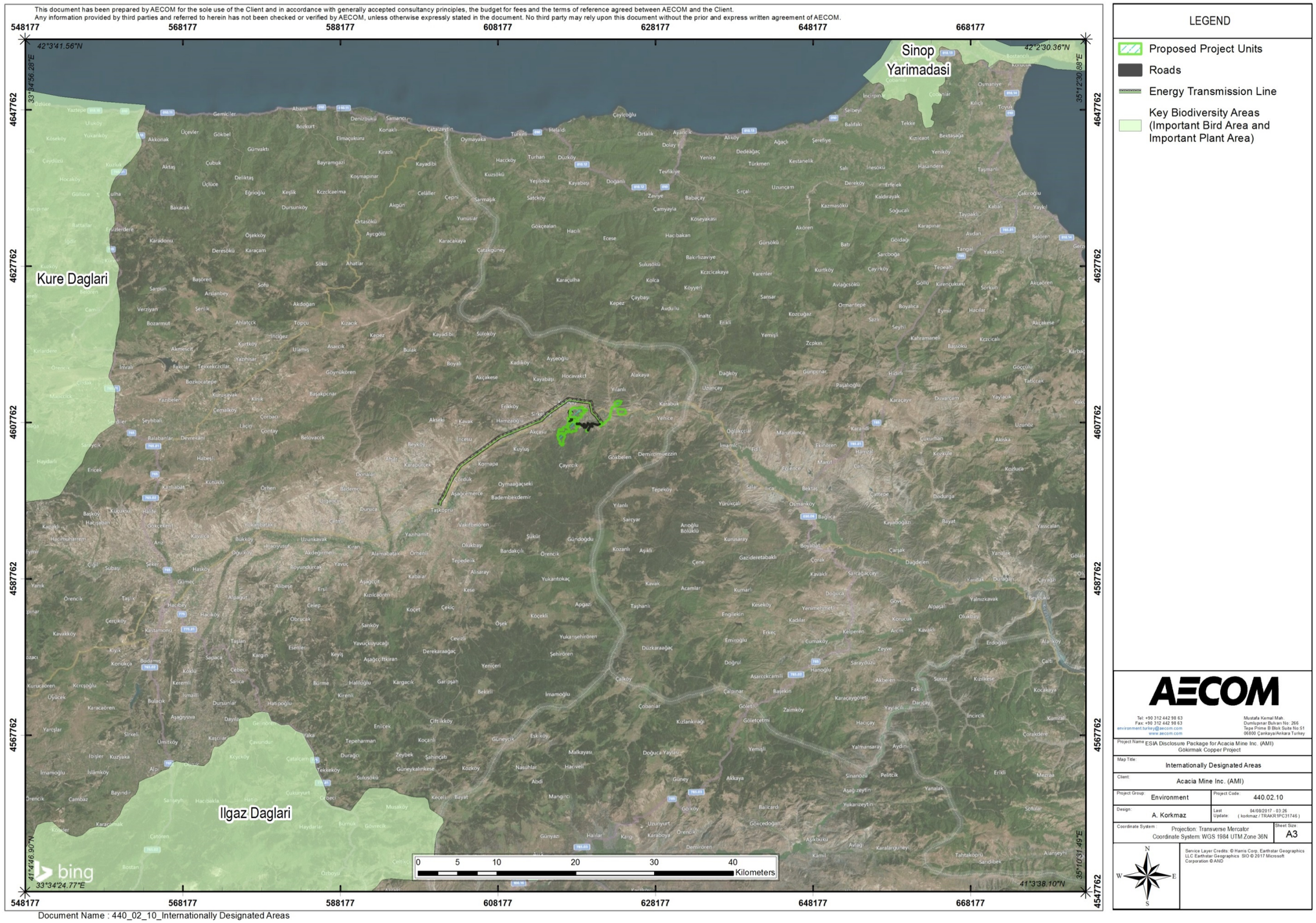
Wetlands have an incomparable function and value among other ecosystems.

According to the list of wetlands presented in the Official Website of Ministry of Forestry and Water Affairs, General Directorate of Nature Conservation and National Parks, the project site does not lie within any wetland.

There are no Key Biodiversity Areas, Important Bird Areas, Important Plant Areas or RAMSAR Sites within the Project Area. And all the mentioned non-statutory designated protected areas above are at more than 20 km distance to the Project Area. Therefore, it is considered that there will not be a direct negative impact on these areas due to Project related activities.

Although there are various prohibited activities for these areas especially for the nationally protected areas, none of the Project activities will occur close to one of these areas. Therefore, these areas will not be directly impacted by any of the Project activities.

.



Document Name : 440_02_10_Internationally Designated Areas

Figure 5-69 Internationally Designated Areas

5.9.5 Habitat Assessment

Habitat is defined as a terrestrial, freshwater or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment.

The EUNIS habitat classification is a comprehensive pan-European system to facilitate the harmonised description and collection of data across Europe through the use of criteria for habitat identification. It is hierarchical and covers all types of habitat types from natural to artificial, from terrestrial to freshwater and marine.

Seven different EUNIS habitat types have been identified at the Project Area (including both the mine area and the ETL route) and its vicinity as follows:

1) Aegean pine forests -EUNIS code G3.75- (seen in the Project Area as *Pinus brutia* forests)

2) Inner Illyrian oriental hornbeam woods -EUNIS code G1.7C2- (seen in the Project Area as *Carpinus orientalis* woods)

3) Mixed Black pine (*Pinus nigra*) - evergreen oak woodland -EUNIS code G4.D- (seen in the Project Area as *Pinus nigra – Quercus petraea* forests)

4) Land sparsely wooded with mixed broadleaved and coniferous trees -EUNIS code X16- (seen in the Project Area as land sparsely wooded with mixed broadleaved and coniferous trees)

5) Riparian and gallery woodland, with dominant alder, birch, poplar or willow -EUNIS code G1.1- Riparian and gallery woodland, (seen in the Project Area as dominant species belonging to genuses Alnus, Betula, Populus or Salix.

6) Native pine plantations -EUNIS code G3.F12

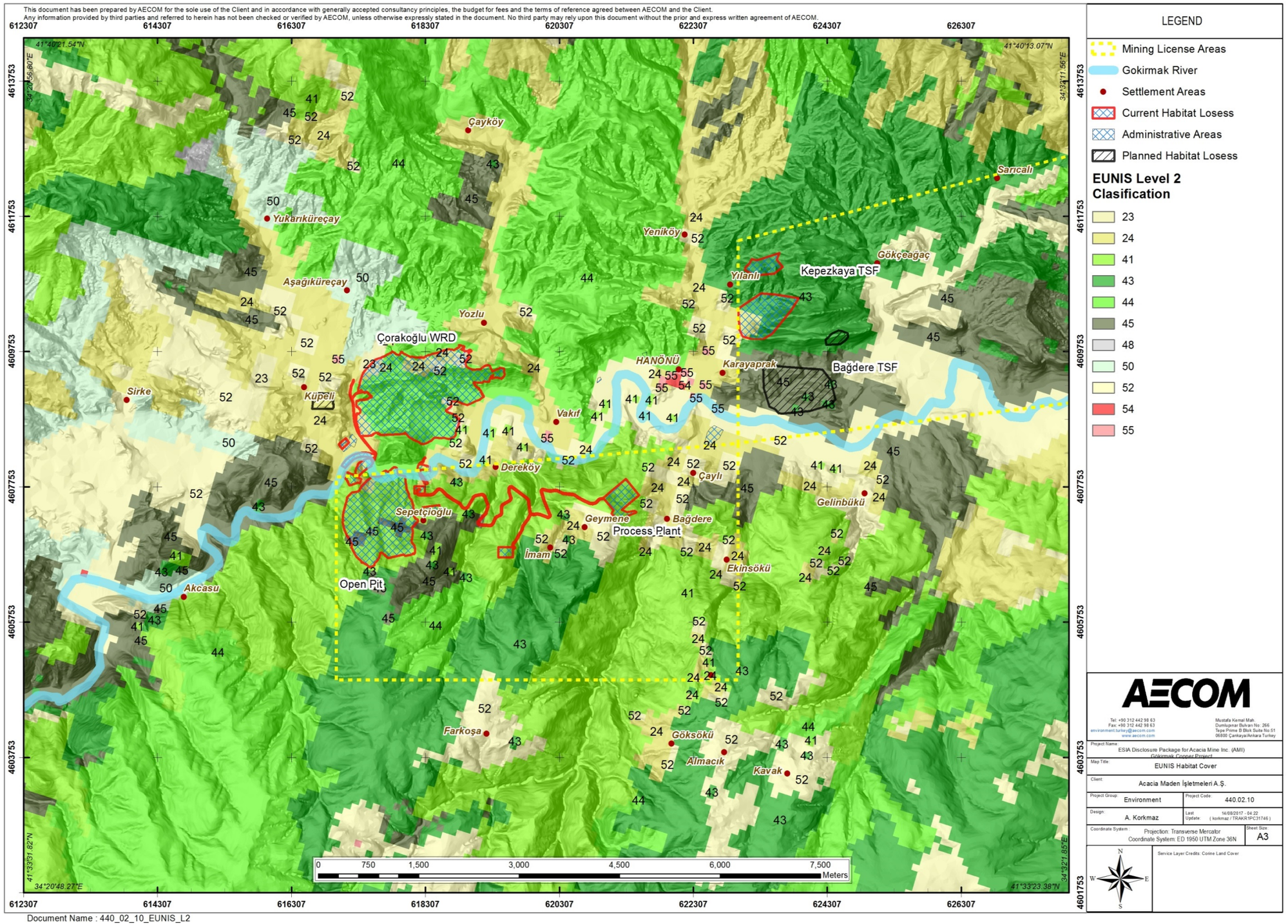
7) Regularly or recently cultivated agricultural, horticultural and domestic habitats -EUNIS code I

The dominant habitat types at the Project Area and its vicinity are (i) Pinus brutia forests, (ii) *Carpinus orientalis* woods and (iii) Land sparsely wooded with mixed broadleaved and coniferous trees. Within these habitats, forest clearings due to natural or anthropogenic effects are frequently encountered.

The Habitat Map (Level 2) regarding EUNIS habitat types is given in Figure 5-70 and the habitat map using the CORINE land cover European seamless vector database (RELEASE v18_5) showing the land cover of the Project Area and its vicinity is prepared as given in Figure 5-71.

The definitions of the habitat types regarding the CORINE land cover map and EUNIS habitat types map is given in with an analogy in between these two habitat classification.

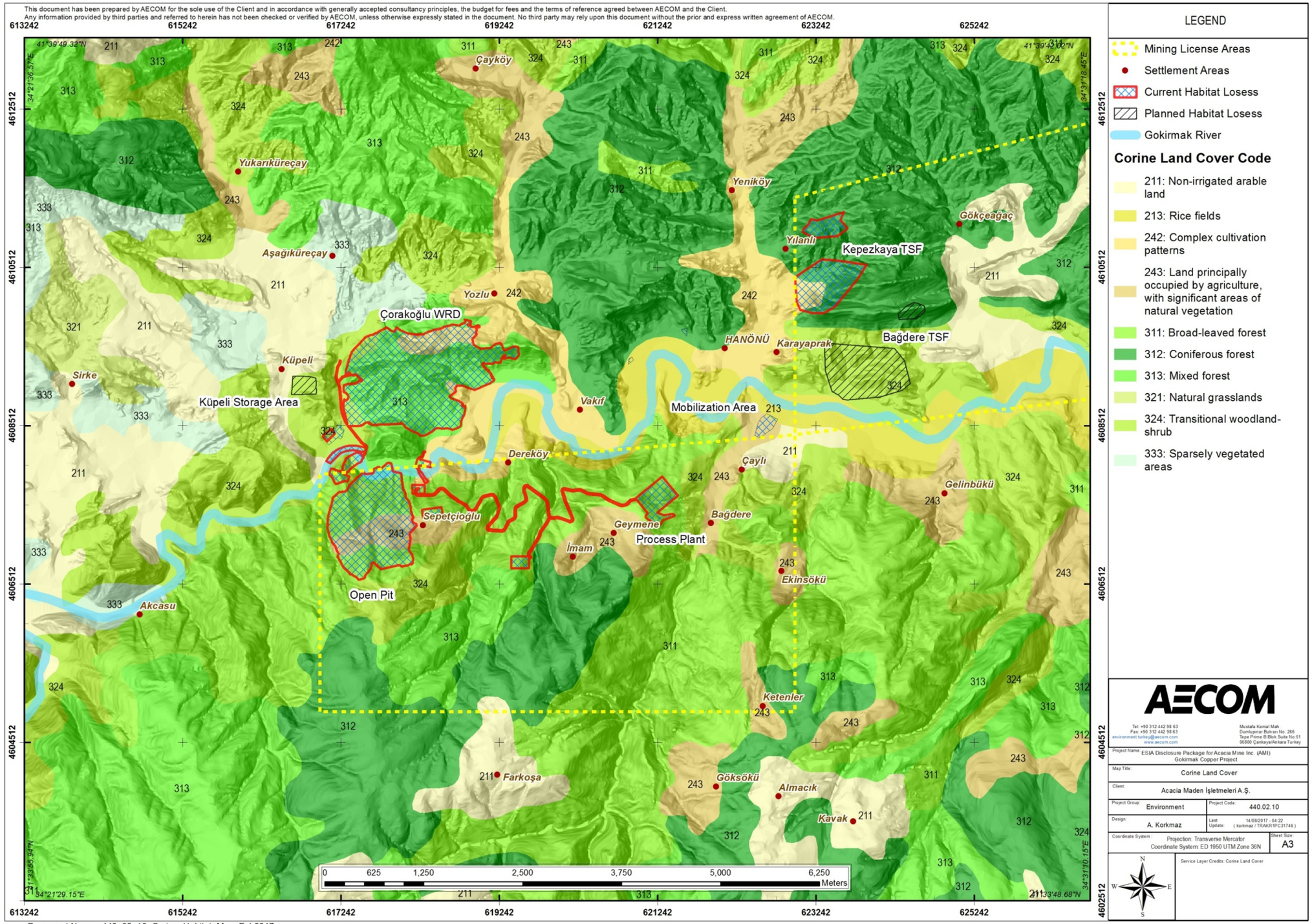
This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



Document Name : 440_02_10_EUNIS_L2

Figure 5-70 EUNIS Habitat Map (Level 2) of the Project Area and its Vicinity

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



Document Name : 440_02_10_Corine_Habitat_Map_Feb2017

Figure 5-71 Habitat Map of the Project Area and its Vicinity

Table 5-45 CORINE Land Cover Code Classification

CORINE Land Cover Code	Type of Land Cover	EUNIS Code	EUNIS Habitat Classification	Field Survey Findings (the Project Area and its Vicinity)
211	Non-irrigated arable land	I1	Arable land and market gardens	Croplands planted for annually or regularly harvested crops other than those that carry trees or shrubs.
213	Rice fields	I1.4	Inundated or inundatable croplands, including rice fields	Regularly or recently cultivated agricultural, horticultural and domestic habitats
242	Complex cultivation patterns	I2	Cultivated areas of gardens and parks	Regularly or recently cultivated agricultural, horticultural and domestic habitats
243	Land principally occupied by agriculture, with significant areas of natural vegetation	I1	Arable land and market gardens	Regularly or recently cultivated agricultural, horticultural and domestic habitats
311	Broad-leaved forest	G1.7 – 41 / G1.1	Broadleaved deciduous woodland / Riparian and gallery woodland, with dominant alder, birch, poplar or willow	G1.7C2 - Carpinus orientalis woods / Dominant species belonging togenuses Alnus, Betula, Populus or Salix
312	Coniferous forest	G3.7 – 43	Coniferous woodland	*Pinus brutia* forests / G3.F12 - Regularly or recently cultivated agricultural, horticultural and domestic habitats
313	Mixed forest	G4.D	Mixed Black pine (*Pinus nigra*) - evergreen oak woodland	*Pinus nigra – Quercus petraea* forests
321	Natural grasslands	E1-23 / E2-24	Dry grasslands / Mesic grasslands	Natural grasslands
324	Transitional woodland-shrub	X16	Land sparsely wooded with mixed broadleaved and coniferous trees	X16 - land sparsely wooded with mixed broadleaved and coniferous trees
333	Sparsely vegetated areas	E1-23 / E2-24	Dry grasslands / Mesic grasslands	Dry grasslands / Mesic grasslands

5.9.5.1 Critical Habitat Assessment

The concept of biodiversity is defined by Article 2 of the Convention on Biological Diversity (CBD) and adopted by EBRD PR 6 “Biodiversity Conservation and Sustainable Management of Living Natural Resources”, as “the variety living organisms inhabiting all terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, this includes biodiversity within species, between species and of ecosystems”.

To meet EBRD PR 6 requirements an additional assessment was carried out based on characteristics of the Project and biodiversity features it might be impacting in order to identify potential Project-related risks and define a mitigation hierarchy to establish an approach ensuring no-net-loss of biodiversity. It is required to consider not only biodiversity features but also integrity of ecosystems in question, independent of their conservation status.

If biodiversity screening and related assessments reveal that there will be potential Project-related impacts on biodiversity, it is required that all of the associated impacts and risks are managed through the mitigation hierarchy and good international practice. In order to put forward effective mitigation and management strategies, areas and species affected by the Project should be well-identified based on their natural characteristics, as well as nationally and internationally recognized conservation status. Those are identified as “priority biodiversity features” by EBRD PR 6:

(i) threatened habitats

(ii) vulnerable species

(iii) significant biodiversity features identified by a broad set of stakeholders or governments

(iv) ecological structure and functions needed to maintain the viability of priority biodiversity features.

Based on biodiversity assessments, if “significant, adverse and irreversible impacts” to priority biodiversity features are identified, then project activities should not be implemented unless

- There are no technically and economically feasible alternatives
- The overall benefits outweigh the project impacts on biodiversity
- Stakeholders are consulted in accordance with PR 10
- The project is permitted under applicable environmental laws, recognizing priority biodiversity features
- Appropriate mitigation measures are put in place, in accordance with the mitigation hierarchy to ensure no net loss and preferably a net gain of priority biodiversity features over the long term to achieve measurable conversion outcomes.

Of the priority biodiversity features, critical habitats are the most sensitive biodiversity features, which comprise one of the following according to EBRD PR 6:

(i) : Highly threatened and/or unique ecosystems

(ii) : Critically Endangered (CR) and/or Endangered (EN) species

(iii) : Endemic and/or restricted-range species

(iv) : Migratory and/or congregatory species

(v) : Key evolutionary processes

(vi) : Ecological functions.

EBRD PR 6 requires the clients not to implement any project activities in areas of critical habitat unless all of the following are met:

- No other viable alternatives within the region exist for development of the project in habitats of lesser biodiversity value;
- Stakeholders are consulted in accordance with PR 10 (Information Disclosure and Stakeholder Engagement);
- The project is permitted under applicable environmental laws, recognizing the priority biodiversity features;
- The project does not lead to measurable adverse impacts on those biodiversity features for, which the critical habitat was designated;
- The project is designed to deliver net gains for critical habitat impacted by the project;
- The project is not anticipated to lead to a net reduction in the population of any endangered or critically endangered species, over a reasonable time period; and
- A robust and appropriately designed, long-term biodiversity monitoring and evaluation program aimed at assessing the status of critical habitat is integrated into the client’s adaptive management program.

Potential Biodiversity Features that Trigger Critical Habitat

Based on the Project's Biodiversity field studies and available data from previous surveys and literature review, the priority biodiversity features that trigger critical habitat criteria are summarized in Table 5-46below, followed by each section in this chapter evaluating these identified components in terms of their characteristics and significance.

Table 5-46 Potential Critical Habitat Trigger Features

Biodiversity Feature	Status	CH as per EBRD PR 6
Pinus brutia forests / Turkish pine	Habitats Directive Annex I (Natura2000 Code tbd.)	CH(i)
Riparian and gallery woodland	Habitats Directive Annex I (Natura2000 Code: 92A0)	CH(i)
Dianthus aculeatus **/** Tuff carnation	Red Data Book of Turkish Plants EN / Regional endemic	CH(ii)
Crocus speciosus / Bieberstein's crocus	Red Data Book of Turkish Plants EN/ Regional endemic	CH(ii)
Neophron percnopterus / Egyptian Vulture	IUCN Red List EN	CH(ii)
Vormela peregusna / Marbled polecat	Distinct evolutionary history	CH(v)

It should be noted that although not listed under any of the threat categories of the IUCN Red List, a number of bird species identified within the biodiversity study area are listed as Endangered or Critically Endangered according to the categories defined by Kiziroglu (2009). However, based on expert opinion, these species are not listed as critical habitat trigger components due to the following reasons:

- Kiziroglu (2009) does not provide an official list of threatened bird species. As a matter of fact, unlike flora species, there is no official or widely recognized national list for fauna species to assess their threat statuses. Being one of the limitations to this study, and to any of its kind, Turkey lacks a nationwide population based assessment of its fauna species.
- Evaluations made by Kiziroglu (2009) on threat statuses of bird species are conservation-oriented and do not include range of distribution for each of the individual species.
- Although stands as a reference to national threat categories for bird species, evaluations made by Kiziroglu (2009) are not sufficient enough to make a thorough CHA.

Yet, national threat statuses of bird species presented as part of the Project biodiversity baseline studies were further considered in determining species of conservation importance together with Annex I to the Birds Directive providing complementary criteria.

Highly Threatened or Unique Ecosystems

- ***Pinus brutia* forests**

Different than *Pinus brutia* forests of the Aegean and Mediterranean, Turkish pine forests at the Project Area are rather rare in terms of their presence in this part of Anatolia. Therefore, the understory is also different than that of *Pinus brutia* forests in other parts of Turkey.

As part of the Project Biodiversity Studies, an EUNIS code has been assigned to habitats formed by this type of vegetation as G3.75, which has a Habitats Directive Annex I correspondence (natural habitat types of community interest whose conservation requires the designation of special areas of conservation) as "Mediterranean pine forests with endemic Mesogean pines", with the Natura2000 Code of 9540. *Pinus brutia* forests in this region of Turkey, however, do not meet the description provided by EUNIS. Rather, it is suggested that these more Central Anatolian forests are considered separately.

Although these habitats at the Project Area do not have an exact correspondence due to lack of categorization and coding of some of the habitats in Turkey, they are still considered to be potentially triggering critical habitat. The fact that forests in the area are already degraded and no direct further Project-related impact is expected on *Pinus brutia* habitats, no habitat specific measures are proposed at this point in time. However, as the Project proceeds forests will be closely monitored to ensure that not only *Pinus brutia* species, but also overall health of the ecosystem is not impacted adversely, and if required specific to this species measures will be incorporated into the Biodiversity Action Plan (BAP) based on additional site-specific data collection and monitoring to ensure no-net-loss of the habitat.

- ***Riparian woodlands***

This habitat type is observed along Gökırmak River and its tributaries. A number of small streams flow into Gökırmak from hills in the north-east direction, which constitute natural boundaries to the valley. The most significant of these small streams, most of which dry out during summer are Küre, Bağ ve Yılanlı streams. Riparian woodlands bear a number of hydrophytes, as listed part of the Project biodiversity studies.

The EUNIS code assigned for this habitat is G1.1, which covers riparian and gallery woodland with dominant *Alnus, Batula, Populus* or *Salix*. Riparian woodlands of the Project Area correspond to a Habitats Directive Annex I habitat (natural habitat types of community interest whose conservation requires the designation of special areas of conservation), namely; *Salix alba* and *Populus alba* galleries, with a Natura2000 code of 92A0. It triggers critical habitat in line with EBRD PR 6 requirements.

As part of the Gökırmak River Diversion System, a 1.5-km section of Gökırmak, which lies within the open pit has been diverted. Consequently, part of the riparian woodland habitat at the Project Area has been lost. In order to achieve no-net-loss, habitat loss in this section of the river will be compensated through an effective offset strategy to be developed during BAP development and update based on additional site-specific data collection and monitoring, after careful consideration of how habitat structure and species composition can be established and so there is no net loss of neither the riparian habitat nor its species' populations.

Critically Endangered (CR) and/or Endangered (EN) species

- ***Dianthus aculeatus* (Tuff carnation)**

Dianthus aculeatus (Tuff carnation) is a regional endemic wild carnation species, which was fairly newly discovered (see Hamzaoglu 2014 for more detail on the species). Previously known from a total of five other locations in provinces of Afyonkarahisar and Kutahya in Turkey, *Dianthus aculeatus* was observed at openings of the *Pinus brutia* forest around Küreçay Village within the wider Project Area, as well as near Hanönü. The species is known to have a rather narrow distribution along its range and at the locations it has been observed so far it is represented by a relatively low number of individuals, which has also lead to a conclusion on its presence in the Project Area to be rare.

As a recently discovered species, *Dianthus aculeatus* is yet to be included in the IUCN Red List, both at national and international levels. On the other hand, Prof. Hamzaoğlu, author of the species, has assessed the species to be listed as "Endangered: EN" based on IUCN Red Lists Categories and Criteria. His assessment is based on his preview records of the species in other provinces as mentioned above. More studies are required on its population to confirm this category. However, for conservation purposes, in accordance with IUCN and in line with the underlying principles of this Critical Habitat Assessment, based on expert opinion *Dianthus aculeatus* is considered to be an "Endangered species", which makes it a potential critical habitat trigger species.

Where *Dianthus aculeatus* was mostly observed at the wider Project Area around Küreçay Village in large clusters, there are no foreseen project-related activities to be conducted. Yet, it is highly probably that there are other populations within the area, possible again at *Pinus brutia* openings. Exact locations of the species at the Project Area, where it can be directly or indirectly impacted are yet to be confirmed.

Considering the status of this species, during the Project Biodiversity Action Plan (BAP) development, more thorough GIS work will be conducted on-site to determine the locations of the clusters that *Dianthus aculeatus* forms within the Project Area. Based on further data collection, these locations will be transferred to habitat maps prepared for the Project, upon which a species-specific Biodiversity action plan will be developed targeting no-net-loss of species' populations.

- ***Crocus speciosus subp. xantholaimos (Bieberstein's crocus)***

Crocus speciosus subp*. xantholaimos* (Bieberstein's crocus) is a regional endemic species mostly known from Northern parts of Turkey, including Western to Central Black Sea regions. It is listed as "Endangered: EN" by the Red Data Book of Turkish Plants. Although there have been more recent studies on its population at locations that have been identified following the publication of the Turkish Red List, its national status is to be further examined to suggest a change in its category. Therefore, it is a potential critical habitat trigger species.

At the Project Area, Bierberstein's crocus is observed in Çangal and Elek Mountain, where no Project-related activities are planned. Potential locations of the species' populations in the Project Area will be established and mapped during BAP development. Accordingly, BAP will be updated if required to ensure there is no-net-loss of species populations in the area.

- ***Neophron percnopterus (Egyptian vulture)***

Neophron percnopterus (Egyptian Vulture) is a 'presumed present' species, whose inclusion in the Project biodiversity species' lists is based on previous studies conducted by the Project ornithologist at locations outside the Project Area.

There are a number of studies conducted by Turkish researchers in collaboration with their European colleagues, pointing out a number of other locations and Important Bird Areas (IBAs), where the species is known to have breeding populations (although there is a lack of monitoring at a majority of these sites; see Inigo et al. 2008). An extensive study was undertaken by Doğa Derneği on Egyptian Vulture in cooperation with Bulgarian Society for the Protection of Birds (BSPB) in 2010, which identified Beypazarı District of Ankara as the most intensive breeding ground (up to 100 pairs) for this species in entire Europe (Doğa Derneği, n.d. Şen, 2012, Şen et al. 2011, Şen & Tavares, 2010). There is also an ongoing GPS-tagged monitoring study conducted by KuzeyDoğa Derneği, in collaboration with the General Directorate of Nature Conservation and National Parks of the Ministry of Forestry and Water Affairs, as well as Utah University. This study, however, also covers locations in eastern Turkey.

Inigo et al. (2008) lists the following IBAs as of the most important sites for breeding populations of the Egyptian Vulture in Turkey (for more information on IBAs see Kılıç & Eken, 2004):

- Doğu Karadeniz Dağları IBA
- Göreme Tepeleri IBA
- Kirmir Vadisi IBA
- Kızılcahamam Ormanları IBA
- Munzur Dağları IBA
- Sarıyar Barajı IBA
- Tortum Havzası IBA
- Yalnızçam Dağları IBA
- Sertavul Pass IBA
- Allahuekber Dağları IBA

Neophron percnopterus is a potential critical habitat triggering species due to its IUCN listing of EN. It is, however, a 'presumed present' species for the Project Area since there is no available data at this point in time to confirm its presence. Considering Turkey has the largest breeding population of this "Endangered" species after Spain, it is worth conducting a more thorough analysis of the mine study area, specifically researching for presence of any breeding population. Its status will be confirmed during BAP development and the site will be monitored throughout the Project life-cycle.

Key Evolutionary Processes

***Vormela peregusna* (Marbled polecat)**

The Turkish population of *Vormela peregusna* (Marbled polecat), which is widely distributed from Southeast Europe through Southwest Asia and Central Asia to Mongolia and Northern China, is known to show genetic divergence from other Marbled Polecat populations. There have not been enough studies to outline an infra-specific taxonomy of the species. Nor have been to outline the genetic divergence and phylogenetic relations of the Turkish Marbled Polecat to populations in other parts of its range. İbiş and Tez (2014) in their most recent study on the subject also suggest that more samples are required to reveal conclusive results. Yet, due to its distinct evolutionary history, it is assessed as a potential critical habitat trigger species.

Marbled Polecat is a specialized predator, feeding mainly on rodents of deserts and steppes that it inhabits, loss of which is the major threat that the species is facing today[2]. The record from the Project biodiversity studies is based on habitat suitability, mainly due to the fact that forest openings at the Project Area show steppe characteristics, which may be inhabited by the species known to occur in Anatolian steppes. These are also areas where there will be no direct Project activities.

For this species to trigger critical habitat, its presence at the area is required to be confirmed and if required a species related BAP will be developed in order to confirm no-net-loss of *Vormela peregusna* population at the area.

Priority Biodiversity Features (PBF)

Priority Biodiversity Features as defined by EBRD in its PR 6 Guidance Note have a high, but not the highest degree of irreplaceability and/or vulnerability", conservation and management of which might require special actions to be taken.

In order to confirm no-net-loss, additional data collection and monitoring will be conducted and focus on these PBF species and habitats. Different segments of assessments made within the scope of Biodiversity studies presented a number of criteria in terms of evaluation of habitats and species for their threat and conservation status. Consequently, all biodiversity assessments were based on one or more of these sets of criteria, in their areas of application.

As a result of all the assessments made so far within the scope of Project biodiversity studies, below is the list of selection criteria for PBF to be considered for biodiversity conservation in line with the provisions of EBRD PR 6, and which would require preparation of biodiversity action plans (BAP) to ensure no-net-loss of biodiversity at the Project Area.

It should be noted that there is another category of PBF as per EBRD PR 6; "significant biodiversity features identified by a broad set of stakeholders or governments", which is not further evaluated as there are not such areas identified to be impacted by Project activities.

- Threatened habitats that are of global, national and/or regional conservation importance (Habitats Directive Annex I habitats)
- Vulnerable species as listed by the IUCN Red List, and those included in Annex II of the EU Habitats Directive
- Ecological structure and functions needed to maintain the viability of priority biodiversity features
- Potential critical habitat trigger species identified as a result of CHA

Biodiversity features of higher priority and conservation importance will be identified during additional field surveys and monitoring to confirm presence in situ of those species that are listed here due to habitat suitability or previous literature mention. Conservation of these PBF would require special actions to be taken during project implementation, more specifically through biodiversity action planning, in case their habitats location at the project site is confirmed.

Conclusion:

Based on biodiversity studies carried out for the Project and covering biodiversity screening, impact assessment and mitigation measures analysis, as well as literature review and consultations with external experts and stakeholders, a critical habitat assessment was conducted to define the most sensitive biodiversity features, which comprise one of the following according to EBRD PR 6; (i) highly threatened and/or unique ecosystems, (ii) critically endangered and/or enddangered species, (iii) endemic and/or restricted range species, (iv) migratory and/or congregatory species, (v) key evolutionary processes and (vi) ecological functions.

The Project can potentially affect priority biodiversity features and critical habitats as and therefore per EBRD PR 6 Biodiversity Management Plan (BMP) is developed and a site-specific habitat and species Biodiversity Action Plan (BAP) will be prepared to ensure no-net-loss of critical habitats. The critical habitat assessments was carried out within the scope of this ESIA based on the project baseline biodiversity studies and will be further updated based on additional surveys and site-specific monitoring.

5.9.6 Invasive Alien Species

Invasive alien species are defined as non-native species that pose a risk of spreading quickly can create significant environmental and socioeconomic impacts (for example, crop pests, disease vectors, new predators).

19 plant species are identified to be invasive alien species in the Project Area and its close vicinity which are *Aegilops triuncialis* L. subsp. *triuncialis* (Barb Goat Grass), *Agrostis capillaris* L. var. *capillaris* (Common Bent), *Alnus glutinosa* (L.) Gaertn. subsp. *glutinosa* (Black Alder), *Asparagus officinalis* L. (Asparagus), *Bellis perennis* L. (Daisy), *Centaurea solstitialis* L. subsp. *solstitialis* (Barnaby's Thistle), *Cirsium arvense* (L.) Scop. subsp. *vestitum* (Wimmer & Grab.) Petrak (Canada Thistle), *Clematis vitalba* L (Old Man's Beard), *Coronilla varia* L. susbp*. varia* (Crownvetch), *Cotinus coggygria* Scop. (Smoketree), *Erodium cicutarium* (L.) L'Hér. subsp. *cicutarium* (Redstem Filaree*), Frangula alnus* Mill. subsp. *alnus* (Alder Buckthorn), *Hedera helix* L. (Common Ivy), *Iris pseudacorus* L. (Yellow Iris), *Lotus corniculatus* L. var. *tenuifolius* L. (Bird's Foot-Trefoil), *Lythrum salicaria* L. (Purple Loosestrife) , *Melilotus alba* Desr. (White Melilot), *Rumex acetosella* L. (Sheep's Sorrel) and *Tussilago farfara* L. (Cough-Wort).

Three bird species are identified to be invasive alien species in the Project Area and its close vicinity which are *Columba livia* (Rock Dove), *Streptopelia decaocto* (Eurasian Collared-dove) and *Anas platyrhynchos* (Mallard).

Three mammal species are identified to be invasive alien species in the Project Area and its close vicinity which are *Mustela nivalis* (Least Weasel), *Lepus europaeus* (European Hare) and *Crocidura suaveolens* (Lesser Shrew).

5.9.7 Ecosystem Services

Ecosystem services are the benefits that people, including businesses, derive from ecosystems. Ecosystem services can be clustered into four groups:

a. provisioning services, which are the products people obtain from ecosystems (may include food, freshwater, timber, fibers, medicinal plants);

b. regulating services, which are the benefits people obtain from the regulation of ecosystem processes (may include surface water purification, carbon storage and sequestration, climate regulation, protection from natural hazards);

c. cultural services, which are the nonmaterial benefits people obtain from ecosystems (may include natural areas that are sacred sites and areas of importance for recreation and aesthetic enjoyment); and

d. supporting services, which are the natural processes that maintain the other services (may include soil formation, nutrient cycling, primary production).

Ecosystem services valued by humans are often underpinned by biodiversity. Impacts on biodiversity can therefore often adversely affect the delivery of ecosystem services.

A part of Gökırmak River, which is one of the important branches of Kızılırmak River, stays within the Project Area. There are existing and future dam and HEPP projects on Gökırmak River for energy generation and irrigation purposes. The Demirci Regulator and HEPP project located downstream of the Project Area uses the river water for energy purposes. This plant produces energy after a kilometer long channel taking the river water as its working principle. In the section between the regulator and the plant, the necessary baseflow has been left in the creek bed. At the upstream of the Project Area, Taşköprü Dam and HEPP Project will become operational in the future as well (this Project received its EIA Positive Certificate at the beginning of 2017).

Although fishing activities are also being carried out by local people along most of the areas where Gökırmak passes, these activities are not seen as a source of people's livelihood but rather as hobby fishing.

The most commonly used ecosystem services value of Gökırmak is agricultural irrigation in the vicinity of the Project Area. The region uses river water for the purpose of cultivating crops such as rice.

Local people are mostly engaged with small scale gardening, small scale animal husbandry and foresting. Daily life in rural areas of the Project Area is mainly work activities in garden, agriculture, animal herding and care and small scale logging and forestry.

One of the most important ecosystem services provider within and the vicinity of the Project Area is the forests as they cover a wide area in the region. The forest wealth in the district is at a level that is sufficient to resort forestry activities as a regular source of income.

Forestry is an important source of income in the district. The members of the 13 forestry cooperatives in total in the district play a crucial part in cleaning and rejuvenation of forests. Settlements in the Project Area that have forestry cooperatives are Bağdere, Gökçeağaç and Küreçayı. According to the interview with the Regional Director of Forestry, 55,000 m^3 of lumbering was informed to be carried out in 2014, which provided 3,212,000 TL of income for each of these forestry cooperatives in total.

The range of goods and services provided by forest in general is large and can be seen through a non-exhaustive list below:

- Wood and non-wood products: e.g. biomass based energy
- Climate regulation: e.g. C-sequestration
- Pollution control
- Soil protection and formation: e.g. erosion control
- Nutrients cycling
- Biodiversity protection
- Water regulation and supply
- Recreation
- Disturbance regulation

However, no other major ecosystem services use of the forest areas have been recorded apart from the lumbering as it is hard to assess the individual uses of the forests such as recreation and food collection or large extent of services such as climate regulation and nutrient cycling.

5.10 Cultural Heritage

Turkey has very rich and varied tangible and intangible cultural resources and the preservation and development of these have been stipulated by law. Many organizations have been set up in connection with this subject and preservation has now become a subject that concerns these organizations, institutions and people. Turkey has approximately 2,700 historical ruins some dating back to prehistoric times and 41,000 works of culture. The United Nations Educational, Scientific and Cultural Organization (UNESCO) encourages the identification, protection and preservation of cultural and natural heritage around the world considered to be of outstanding and universal value to humanity. World Heritage sites belong to all the peoples of the world, irrespective of the territory on which they are located. In the UNESCO "World Cultural Heritage List" there are 17 heritage sites from Turkey, out of 1073 properties (as of July 2017) around the world. Two of these sites are "mixed" (Goreme and Pamukkale) and 15 of them are "cultural" heritage sites.

Information presented in this section regarding the archeological and historic background conditions of the Project area and its vicinity is taken from the “Gökırmak Copper Project Archaeological and Immovable Cultural Heritage Current State Impact Assessment Report (2017)” and “Gökirmak Copper Mine Project Intangible Cultural Heritage Report (2017)” prepared by Regio Cultural Heritage Managament Consultancy (“Regio”) (2017). The Report itself is presented in Volume-III of this ESIA.

Objectives of the baseline studies were to;

- Identify the current status and geographical distribution of potential archaeological or tangible and intangible cultural assets in the project impact area;
- Assess possible negative impacts of the project on the archaeological and tangible and intangible cultural assets;
- Develop attainable mitigation measures to enhance positive impacts and avoid or manage negative impacts;
- Identify and document archaeological and tangible and intangible cultural heritage in Turkey and the social study area;
- Develop management and monitoring measures to be implemented throughout the life of the project.

5.10.1 Immovable Cultural Heritage

5.10.1.1 Baseline Survey Methodology

As described below, three different phases were followed to identify and assess the current status of the archaeological and immovable cultural heritagein the scope of the Gökırmak Copper Project.

Desktop Studies and Consultations

The archaeological publications were reviewed to assess the archaeological potential of the region. In addition, by contacting Ankara Regional Board No:1 for Conservation of Cultural Assets, information on previously registered archaeological or cultural assets in the Project Area and its vicinity was collected. The information resources used during literature review are as following:

- Academic publications
- Historic maps
- Reports on the previous Cultural Heritage Studies and Results of Field Surveys
- Inventory records of Kastamonu Museum and Ankara Regional Board No:1 for Conservation of Cultural Assets

Field Survey

In order to locate the archaeological and immovable cultural heritage, the field survey was conducted at the facilities of the copper mine project except for places covered with forest.

The field survey was conducted between January 5th and 7th 2017. In case any archaeological finding was encountered during the field survey, the method of “Intensive Field Survey” was followed. In addition to this method, rest of the construction site and impact area was searched by following the “Extensive Field Survey” methodology. Field and assessment works were conducted by a team of experts consisting of a Senior Sociologist (Intangible Cultural Heritage), a Senior Archaeologist and two Senior Archaeologist/Ancient History Experts.

Reporting

In the course of all studies, the data gathered about the archaeological or immovable cultural assets located within the project construction site and impact area were conveyed to GIS medium and current geographical positions of these sites, their site classifications, impact of the construction sites and possible mitigation methods to be followed in the construction phase were determined and reporting is finalized.

5.10.1.2 Archaeological and Historic Background

Kastamonu region is covered with two steep mountain chains which lie parallel to the Black Sea in the south and north and connect Black Sea Region with the Central Anatolia through few passages and wide plateaus at the average altitude of 900-1000 m above sea level between these mountains. These plateaus are divided by Gökırmak, the longest western tributary of Kızılırmak River in the east-west axis and numerous streams, which join to Gökırmak, in the north-south axis. The riverbed of Gökırmak Valley, which becomes wider at the city centre of Kastamonu and between Taşköprü and Hanönü Districts, is covered with a thick layer of alluvial fill carried by the streams. The mountainous regions are covered with thick forests which allow lumber production, while plateaus are covered with shrubs and rich variety of herbaceous plants. The region also has rich mineral deposits (Özdoğan, 1996: 304).

The mountains which run parallel to the Black Sea constituted a barrier between the sea and the central Anatolia in the prehistoric ages. On the other hand, the natural roads formed by long rivers flowing in the east-west axis enabled the cultural relationship between the Marmara Region and Inner Black Sea Region.

Agriculture is done in the narrow fertile alluvial plains in the region where vast plains are rare. As a precaution against floods, the villages are often located in pleateus and in some regions on the rocky ground. Although timber is predominantly used in the vernacular architecture of the region, it is known that mudbrick and stone are also important building materials in some places (Özdoğan, 1996: 305).

In the period following the Early Bronze Age, in the 2nd Millenium of the historic geography of Anatolia, Kastamonu was inhabited by tribes named Pala and Tummana. The language of these tribes is called Pala and their cuneiform writing was encountered in very few clay tablets in the Hittite archives. These tribes, which were most possibly of Transcaucasian origin, were migrated to Anatolia together with their close relatives Hittites and Luwians and settled in the region (Kıymet, 2004: 58)

Following the collapse of the Hittite state, the region was captured by Phrygians for a short period and then occupied by Lydians, Persians, Hellenistic and then Pontic states respectively. In the region, which was annexed to the Roman Republic by Gnaeus Pompeus Magnus in 73-72 BCE, the most important settlement is “Pompeiopolis” located in modern Taşkopru province. The city, which was founded by Roman commander “Pompey”, who was assigned to the region, in 64 BCE and was named after this commander (Çakır, 1994: 41).

Pompeipolis was captured by Seljuk ruler Alaaddin Keykubat in 1213 CE. The city was completely abandoned after the Citadel of Kastamonu was conquered by Turks. After this, Taşkopru, which was founded by Turks was started to be inhabited.

Taşköprü and Hanönü were located in the region which was named Paphlagonia in the ancient period. The borders of this region covered modern Sinop, Zonguldak, Bolu, Samsun (Alaçam and Bafra districts) Çorum (Kargı and Osmancık districts), Çankırı and Kastamonu (Yaman, 1990: 64).

Archaeological field surveys and excavations conducted in Taşköprü and Hanönü districts and their vicinities revealed that the traces of human kind went back to the Palaeolithic Period in the region (Çakır, 1994:41). In the researches, in addition to the Palaeolithic Period, archaeological materials belonging to the Neolithic, Chalcolithic and Early Bronze Ages were also encountered (Özdoğan, 1996: 305-313, 1998: 63-104, 1998:219-244).

Majority of the settlements, which were identified in the field surveys, are located in the south and north of Taşkopru and Hanonü districts, on top of hills at the altitude of 950-1800 m above sea level, in mountainous areas (Özdoğan, 1996: 305-313, 1998: 63-104).

As a result of the researches, it was identified that the first examples of mining in the region took place in the Chalcolithic period. Slags and galleries belonging to prehistoric mines were identified in Koçaç Tepe near Garipşah Village and Bakırboku locality near Bozarmut Village (Özdoğan, 1998:66-70).

The locations of the sites mentioned in the literature are given in the Table 5-47 and Figure 5-72. As can be noted on the table, no archaeological sites were indicated in Hanönü district. All sites listed are located in Taşköprü district and the closest one to the project area is at a distance of 11 km.

Table 5-47 Archaeological Sites in Taşköprü District

No	Name of the Site	City	District	Village	Distance to Project License Area (km)	Reference
1	Pompeiopolis/ Zımbıllı Hill Mound	Kastamonu	Taşköprü	Zımbıllı	19	Çakır, N.(1995).
2	Sokukayası	Kastamonu	Taşköprü	Kızılcaören	28	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
3	Çetmi	Kastamonu	Taşköprü	Çetmi	30	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
4	Deliklitepe/Zelatintepe	Kastamonu	Taşköprü	Aşağıurgancı	30	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
5	Yüklütepe	Kastamonu	Taşköprü	Samanlıören	31	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
6	Kayaaltı	Kastamonu	Taşköprü	Bademci	27	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
7	Direkkaya	Kastamonu	Taşköprü	Afşar	21	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
8	Ören	Kastamonu	Taşköprü	Bey	18	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
9	Kargalarini	Kastamonu	Taşköprü	Bey	18	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
10	Akseki X	Kastamonu	Taşköprü	Akseki	15	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
11	Türbe	Kastamonu	Taşköprü	İncesu	12	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
12	Katrak Creek	Kastamonu	Taşköprü	İncesu	12	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
13	Örentepe	Kastamonu	Taşköprü	Abay	37	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
14	Tokatlıköy	Kastamonu	Taşköprü	Abay	37	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
15	İkitepe T1	Kastamonu	Taşköprü	Alamaşişli	25	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
16	İkitepe	Kastamonu	Taşköprü	Alamaşişli	25	Özdoğan,A.,Marro,C., Tibet,A.,(1997).
17	Çal	Kastamonu	Taşköprü	İncesu	12	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
18	Küçükçat	Kastamonu	Taşköprü	Akçakese	11	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).

No	Name of the Site	City	District	Village	Distance to Project License Area (km)	Reference
19	Bakırboku	Kastamonu	Taşköprü	Bozarmut	21	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
20	Kabakçısırtı	Kastamonu	Taşköprü	Bozarmut	21	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
21	Değirmenderesi	Kastamonu	Taşköprü	Bulak	21	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
22	Garipoğlukayası	Kastamonu	Taşköprü	Akçakese	11	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
23	Mercimeklisırtı	Kastamonu	Taşköprü	Ömerli (Eğlecek)	27	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
24	Örenderesi	Kastamonu	Taşköprü	Hasanlı	25	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
25	Isırganlık Ridge	Kastamonu	Taşköprü	Çiftlik	38	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
26	Atmeydanı	Kastamonu	Taşköprü	Armutlu(Cevizli)	26	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
27	Şebekebaşı	Kastamonu	Taşköprü	Armutlu(Cevizli)	26	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
28	Hızarderesi	Kastamonu	Taşköprü	Armutlu(Cevizli)	26	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
29	Sülüklütepe	Kastamonu	Taşköprü	Ömerli (Eğlecek)	28	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
30	Namaztepe T1-T2	Kastamonu	Taşköprü	Armutlu(Cevizli)	26	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
31	Koçaçtepe	Kastamonu	Taşköprü	Garipşah	32	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
32	Tellotepe	Kastamonu	Taşköprü	Dağbelören	34	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
33	İslamtepe	Kastamonu	Taşköprü	Dağbelören	34	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
34	Kirenklitepe T	Kastamonu	Taşköprü	Uzunkavak	33	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
35	Üyüktepe T	Kastamonu	Taşköprü	Uzunkavak	33	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
36	Akarcatepe T	Kastamonu	Taşköprü	Uzunkavak	33	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
37	Emennitepesi	Kastamonu	Taşköprü	Çiftlik	38	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
38	Türbetepe	Kastamonu	Taşköprü	Bekirli	33	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
39	Patdağsırtı	Kastamonu	Taşköprü	Kapaklı (Avdullar)	22	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
40	Mandaçukuru	Kastamonu	Taşköprü	Kapaklı (Avdullar)	22	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
41	Patdağ nekro	Kastamonu	Taşköprü	Kapaklı (Avdullar)	22	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
42	Ulupınar	Kastamonu	Taşköprü	Kapaklı (Avdullar)	22	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).

No	Name of the Site	City	District	Village	Distance to Project License Area (km)	Reference
43	Cığarlıktepe/Kadıun	Kastamonu	Taşköprü	Alisaray	19	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
44	Tepekaya	Kastamonu	Taşköprü	Köçekli	22	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
45	Büyükçayır	Kastamonu	Taşköprü	Kapaklı	22	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
46	Nameless	Kastamonu	Taşköprü	Kapaklı	22	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
47	Mahmatlı	Kastamonu	Taşköprü	Yoğunoluk	23	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
48	Eylik Pöyresi	Kastamonu	Taşköprü	Köçekli	22	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
49	Yusuftepesi	Kastamonu	Taşköprü	Kılıçlı	20	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(1998).
50	Öşektürbe Tepe	Kastamonu	Taşköprü	Abdalhasan	24,5	Özdoğan,A.,Marro,C., Tibet,A.,Kuzucuoğlu,C.(2000).

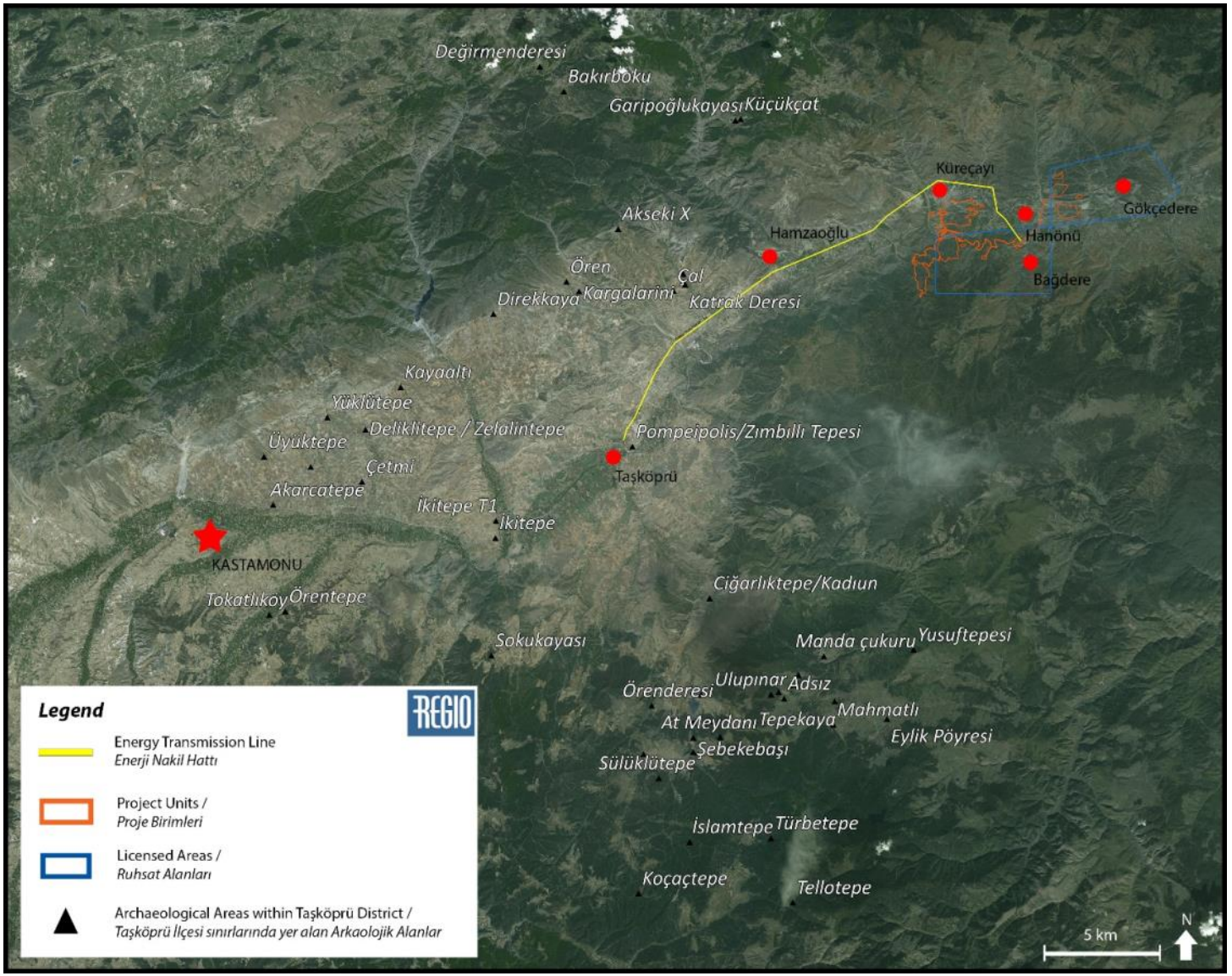


Figure 5-72 Archaeological and Immovable Cultural Heritage Sites Located in Gokırmak Copper Project Area and its Vicinity

An important site, Pompeiopolis is 1.1 km away from the planned Electrical Transmission Line, which is far enough for keeping the area safe from the operational activities (see below photos)



Figure 5-73 General Views of Project ETL and Pompeipolis

The field survey for identifying the archaeological and immovable cultural assets located in the area of Gokirmak Copper Project and assessing the impact of the project was held 5-7 January 2017.

Within the scope of the preparation works of EIA report in line with the local regulations in 2012, it was reported that no cultural assets were discovered as a result of the field visits conducted by Ankara Regional Board no: 1 for Conservation of Cultural Assets and inventory review (Annex 3 of the report in Volume-III of the ESIA).

However, some examples of civil architecture which reflect the cultural identity of the region were encountered in the project area. These examples of civic architecture exhibit a wide variety in terms of building technique and design in compliance with the geography of the region they are located.

Three civil architecture examples of these buildings are located in Küpeli Neighbourhood on the left side of the road between Hanönü and Taşköprü (for details please see Field Works Results Status Table given in Annex 1 of the Regio Report). None of these structures are registered by the Regional Conservation Board. Küpeli Neighbourhood is located 100 m northwest of “Küpeli Stock Area” (see Figure 5-74).

There are many abandoned houses in the region representing traditional architecture. Three of those are located in Küpeli Neighbourhood. Every house has a door number (Door No: 1, Door No: 5 and Door No: 9).

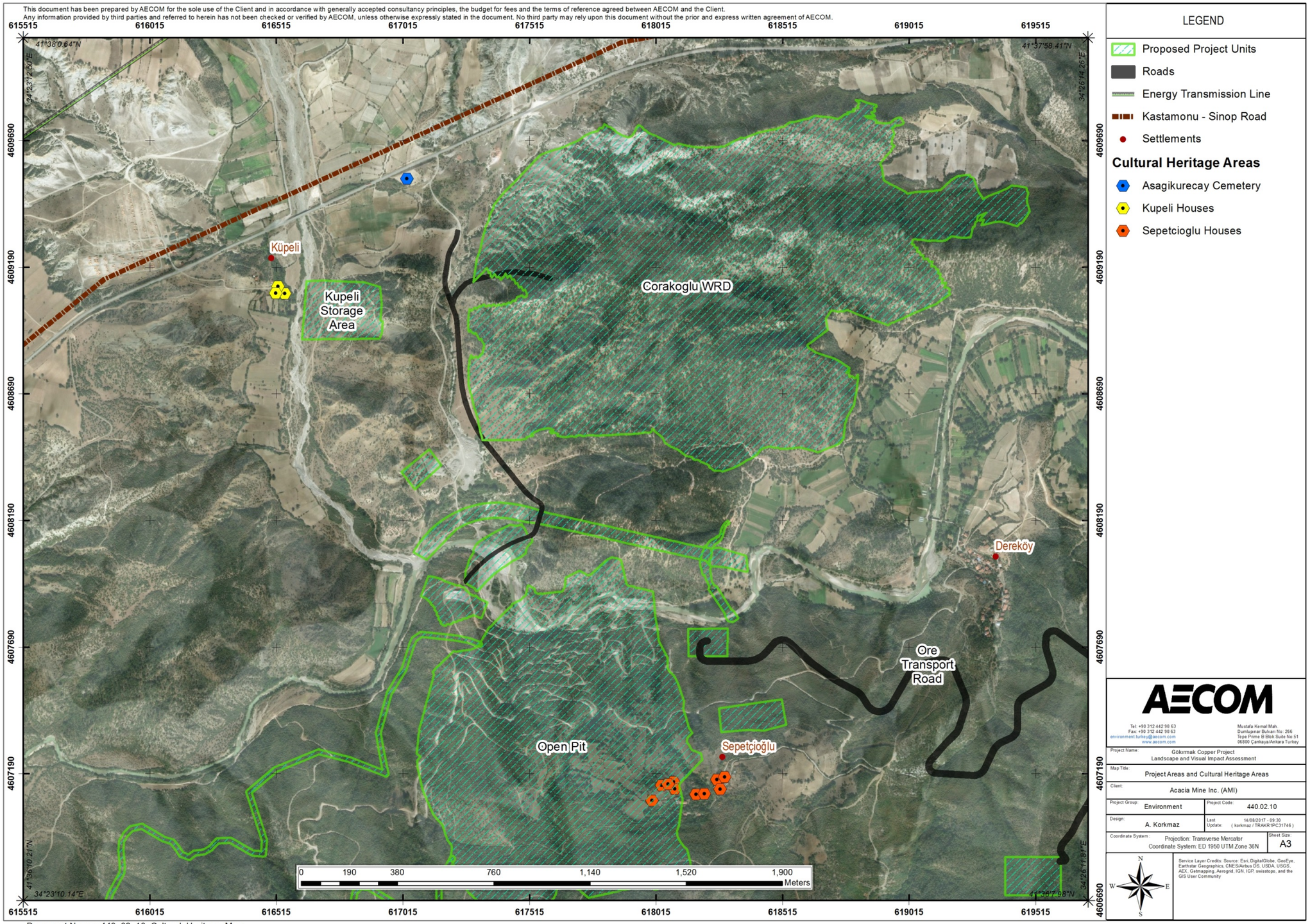
Küpeli House No: 1 is built entirely with timber with interlocking technique (see Figure 5-75). The house is elevated on eight timber piers which are approximately 1.5 m high and supported by surrounding stones. The building which is elevated above the ground is accessed through a timber stairway.

Different from House No: 1, Küpeli House No: 5 is a two-floored structure in which timber, stone and brick were used together. The entrance of the building is on the eastern facade and the timber annex located right side of the entrance was entirely demolished. The first floor was built above a basement, which was constructed with stone, via bricks laid in form of fishbone between timber beams. Above this, the second floor is located where timber and mudbrick were used together (see Figure 5-76).

Küpeli House No: 9 is the most intact and best maintained example. The entrance of the building is on the eastern facade. In the backyard, there is an annex made of timber for hay storage. The door, roof, timber structure and intact plaster of the house point to the fact that the building has been in use until very recently. On the upper floor, the gaps between timber piers were filled with brick (see Figure 5-77).

The distance of the closest Küpeli house to Küpeli Storage Area, i.e. the closest Project unit, is 85 m.

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



Document Name : 440_02_10_Cultural_Haritage_Map

Figure 5-74 Cultural Assets in the Vicinity of the Project Area



Figure 5-75 Kupeli House No: 1



Figure 5-76 Küpeli House No: 5



Figure 5-77 Küpeli House No: 9

There are similar houses in Sepetçioğlu Neighborhood, which is located between the Open Pit and Surface Soil Storage Area. None of these houses are classified as cultural heritage by Ankara Regional Board No:1 for Conservation of Cultural Assets (see Figure 5-72).

The structures in Sepetçioğlu Neighborhood, which are called as Timber Cluster Houses are one or two floored buildings (Figure 5-78). Among these buildings there are those built entirely with timber and those built in combination of materials (stone, brick and timber together). Among the timber cluster houses, which are considered one of the examples of civic architecture, some situated in the western edge of the Sepetçioğlu Neighborhood are located within the boundaries of the Project Open Pit.



Figure 5-78 Küme Houses in Sepetçioğlu Quarter

Another immovable cultural heritage site that remains within the vicinity of Project area is “Aşağı Küreçay Cemetery”, which is located at the leftside of the entrance of the road that reaches to “Çorakoğlu WRD” Area on the left side of the highway between Hanonu and Taşkopru before Kupeli Neighborhood. The cemetery is located at a distance of 1.7 km from open pit area where blasting activities will take place and thus it is not likely to be affected by the project during the construction and operational phases.

The Cemetery was most probably used until the 19th century and is not registered by the Regional Conservation Board. It was observed that the stylised patterns of the “tree of life” were carved on the grave stones which possibly belong to the 19th century. As a living cultural tradition, these trees of life have been carved on various stone artefacts since the prehistoric periods. On some of the gravestones, Ottoman inscriptions were noticed (see Figure 5-79).



Figure 5-79 Graves and Gravestones dated to the 19th century

5.10.2 Intangible Cultural Heritage

Intangible cultural heritage research is based on study carried out in 1 urban and 9 rural settlements in the vicinity of the Project area. Participant observations and 16 in-depth interviews covering most of the settlements were made with local residents.

Table 5-48 The Settlements Covered in the Study

Province	District	Village	Number of Houses/Inhabitants
Kastamonu	Hanönü	Hanönü (Urban Center)	1900 inhabitant
Kastamonu	Hanönü	Küpeli	2 House
Kastamonu	Hanönü	Yılanlı	13 House
Kastamonu	Hanönü	Karayaprak	9 House
Kastamonu	Hanönü	Çaylı	30 House
Kastamonu	Hanönü	Bağdere	12 House
Kastamonu	Hanönü	Geymene	11 House
Kastamonu	Hanönü	İmamköy	4 House
Kastamonu	Hanönü	Dereköy	22 House
Kastamonu	Hanönü	Sepetçioğlu	16 House
Kastamonu	Hanönü	Vakıf	24 House

The interviews were systematic to find out local Intangible Cultural Heritage, not limited to but concentrating on following topics:

- Oral cultural heritage: Common orally transmitted legends, beliefs, myths, fairy tales, epics, by local people from generation to generation over an unknown time as well as People's faith, joy, sadness, expectation, distress, longing, value judgments, a folk song, folk tales, jokes and even idioms and proverbs.
- Life's milestones: Birth, childhood, circumcision, marriage, military service, being apart from her/his community (‘’Gurbetlik’’) and death customs.
- Daily life: Any tradition or pattern related to daily meetings, hospitality, entertainment, household chores or chat sessions of community.
- Traditional institutions: Any form of local traditional organization; trades organizations, yaren organizations, youth organizations.
- Traditional medicine and healing: Traditional medications used in local community, healers, magical and traditional folk medicine processes and practices.
- People’s meteorology: Weather forecast traditions based on experience acquired in the light of local weather events, assessment and interpretation of the results accordingly.
- People’s calendar: Traditional knowledge to determine repetitiveness of community’s social, economic, cultural, religious and magical events.
- Traditional law enforcement: any mechanism to solve disputes within community member or families; traditional orders, the laws, rewards and punishments.
- People's economy: any mode of production created by local community for subsistence including production and consumption patterns, habits, behaviors, traditional way in this process, methods, tools and supplies.
- People’s mathematics; measuring and weighing traditions: local techniques, related equipment and the knowledge of measuring and weighing.
- Holidays, special days, celebrations: Seasonal holidays such as Nevruz, Hıdırellez.
- Beliefs: Hoodoo magic, evil eye, good luck, amulets and votive offerings places.
- Sports games: Children's games, games for adults, sports games.

- Folk dances (dances): Folk dances accompanied by traditional music, played on special days and nights, passed down from generation to generation.
- Folk music: Folk music, from within the community, which transferred from person to person, in continuity, passed down from generation to generation by people. Folk Instruments, Folk Songs.
- Traditional handicrafts: Knowledge of making dresses, decorations and crafts passed from father to son, from mother to daughter or from artisans to assistants which can be earth works, metal works, glass works, wood work, stone work, leather work, wool works etc.
- Traditional architecture: Knowledge of making living spaces with locally available materials, adapted to local climate.
- Traditional food and food processing: Food and drinks providing nutrition of the people; their preparation, cooking, preservation as well as the practices and beliefs, around kitchen and eating.

Intangible cultural heritage assessment of GCP area tried to identify the abovementioned assetsof the communities in order to find out which one of them are likely to be impacted by construction and operation activities.

It is extremely important to respect people's right to privacy and to recognize that cultural knowledge is the intellectual property of those who hold it. To find out intangible cultural heritage of people, in-depth interviews and participant observations were conducted with local residents. The interviews were systematically done on each intangible cultural heritage topic and participant observations were used as guidance in analyses. Analyses show that;

- The majority of the population "Gökırmak Copper Mine Project" area is of Turkish ethnicity.
- Local people are mostly engaged with small scale gardening, small scale animal husbandry and forestry.
- Although it is vaguely believed today, oral cultural heritage still survives and is mostly about stories of the past, tails, jokes and anecdotes.
- Traditional celebrations of Life's Milestones are still known and nostalgia about them is present.
- Daily life (socialization) in villages of project area is concentrated around common village house (köy odası), Tea Houses in Hanönü for man and neighbor visits for woman.
- Unique local traditional institutions are not present but there are more than 15 local unions in Hanönü district mostly about agriculture such as irrigation unions or production unions owned by local producers.
- Cultural practice of traditional medicine and healing does not exist and is not believed.
- Weather forecast traditions still survive as remains of their rural past.
- Traditional knowledge to determine repetitiveness of community's social, economic, cultural, religious and magical events is absent.
- There is not any traditional mechanism to solve disputes within community members. Modern way of seeking justice is present through court and judiciary system of the state.
- Measuring and weighing traditions do not exist, modern methods are used.
- Religious holidays such as Ramadan and festival of sacrifices are the only festivals widely celebrated.
- There are no region-specific child games, games for adults or sports games.
- There are folk dances and traditional music of the area. Some are unique to Hanönü.
- Spread hemp weaving and rug making tradition is widely conducted in the region, as handicrafts that kept surviving through an income generation project.
- Knowledge of making living spaces with locally available materials is still available but not practiced anymore.
- Husbandry, self-subsistence poultry and gardening has a distinct influence over local cuisine.

Settlers of Gökırmak Copper Mine area were found to be well informed about the Project and all the interviewers knew what will be constructed and what areas are going to be used. That gave a unique opportunity in analysis to link between significance of intangible cultural heritage related sites and ongoing / planned Project area, while conducting interviews. There is a Public Relations Office in Hanönü which is open two days a week for local people to get information. There is also a public relations department of the project. During the site visits, anouncements regarding the Project were also encountered on announcement boards of the Project Administration at the entrance of the villages.

6. ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION MEASURES

The identified potential environmental impacts of the GCP and its associated facilities are described and prevention, mitigation and compensation measures for these impacts are proposed in the extent of this Chapter. The impact assessment covers the impacts and risks associated with all phases of the Project, including earthworks activities.

Subjects regarding the social environment, including identification of positive and negative impacts stemming from social issues associated with the Project are the subject of the Social Impact Assessment (SIA) study, which is presented in Volume-II of this ESIA. It should be noted that, although the social impacts of the Project are included in the SIA, occupational health and safety and community health and safety issues are evaluated in terms of risks and mitigation in the scope of this Chapter, since the requirements and guidance for the two issues are provided together in Performance Requirement 4 of EBRD.

The assessment provided in this Chapter consists of the following main subjects:

- Visual Impact Assessment
- Land Use and Soils
- Air Quality
- Greenhouse Gas Emissions
- Noise and Vibration
- Water Resources
- Mining Waste
- Wastewater
- Non-Mining Waste
- Biodiversity
- Health and Safety
- Cultural Heritage
- Closure and Rehabilitation Impacts

In addition; the identified impacts, measures proposed and to be taken for these impacts, related Management Plans (MPs), monitoring components and Key Performance Indicatiors (KPIs) for monitoring are also presented together in an integrated format, in the Environmental and Social Management and Monitoring Framework Plan (ESMMFP), which is developed seperately for the Project as a part of ESIA Disclosure Package.

6.1 Impact Assessment Methodology

The methodology used for characterization of potential environmental impacts has been developed based on the methodologies described in the UK's applicable government publications on Environmental Impact Assessment (Institute of Environmental management and Assessment-IEMA, 2011: The State of Environmental Impact Assessment Practice in the UK; Highways Agency 205/08: Volume 11, Section 2 Environmental Impact Assessment and Handbook for Scoping Projects: Environmental Impact Assessment), Scottish Natural Heritage's (SNH) Handbook on Environmental Impact Assessment and other available guidance documents on impact assessment (Canter, 1993, Standards Association of Australia, 1999, etc.). In line with good EIA practice, this methodology employs the prediction of impacts by using quantitative or where not applicable qualitative methods and assigning significance of impacts based mainly on professional jugdement especially when quantitative thresholds are not present for the specific assessment subject.

Significance of environmental and social impacts is formulated as a function of the sensitivity/value/importance of the receptor/resource and the overall magnitude of the Project's impact on that receptor/resource. Sensitivity/value/importance of the receptor/resources is determined based on the baseline information characterized for the Project in consideration of public interest, designations, legal requirements, acceptability, sustainability, etc. Overall magnitude of impact, on the other hand, represents the degree of change and is influenced by a number of different factors as listed below:

- Geographical extent (wide, local or restricted)
- Magnitude (high, medium or low; e.g. how much area, how many trees, level of emission or noise, etc.)
- Reversibility (long term reversible, short term reversible or irreversible)
- Duration (long term, middle term or short term)
- Frequency (continuous, intermittent or one-off)

The sensitivity/value/importance of the receptor/resource and the overall magnitude of the Project's impact on that receptor/resource are specific to the each assessment topic. The typical/generic criteria to be taken into consideration when determining sensitivity/value/importance of the receptor/resource and the overall magnitude are provided in Table 6-1and Table 6-2 while specific assesments will be done for each environmental and/or social component in the relevant sections of this report.

Table 6-1 Typical Descriptors for Sensitivity/Value/Importance of Receptors/Resources

Level of Sensitivity/Value/ Importance	Typical Descriptors
High	High importance and rarity, national or international scale of importance, very limited potential for substitution
Medium	Medium importance and rarity, regional scale of importance, limited potential for substitution
Low	Low or medium importance and rarity, local scale of importance
Negligible	No or very low importance and rarity

Source: UK HA 205/08 Volume 11, Section 2.

Table 6-2 Typical Descriptors for Magnitude of Impacts

Level of Magnitude	Typical Descriptors
High	Loss of resource and/or quality and integrity of resources; severe damage to key characteristics, features or elements (e.g. Irreversible, Long-term duration, Restricted in Geographical Extent, High Magnitude, One-off impact)
Medium	Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features and elements (e.g. Long term reversible, Short term duration, Wide in Geographical Extent, Low Magnitude, One-off impact)
Low	Some measurable change in attricbutes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements (e.g. Short-term reversible, Medium term duration, Restricted in Geographical Extent, Low Magnitude, One-off impact)
Neigligible	No or very minor loss or detrimental alteration to one or more characteriscs, features or elements

Source: UK HA 205/08 Volume 11, Section 2.

Once the sensitivity/value/importance of the receptor/resource and the overall magnitude of impact are determined, the significance of impact is determined by using a standard matrix style approach. The matrix (4 x 4) to be used in the assessment of GCP impacts is provided in Table 6-3 with a general description of each significance level from major to negligible (not significant) provided in Table 6-4.

Table 6-3. Significance Assessment Matrix

		Senstivity/Value/Importance of Receptor/Resource			
		High	Medium	Low	Negligible
Overall Magnitude	High				
	Medium				
	Low				
	Negligibe				

Source: Adapted from IEMA, 2011; UK HA 205/08 Volume 11, Section 2 and other impact assessment methodology guidances/handbooks.

Table 6-4 Significance Levels

Significance Levels	Major	Impacts are considered to be very important and are likely to be material in decision-making, which would be associated with sites or features of international, national or regional importance as well as local importance if the site or feature is subject to a major change. Mitigation measures are imperative to reduce the significance to lower levels before proceeding with the Project.
	Moderate	Impacts are not likely to be key decision-making factors. The cumulative impacts of such factors may influence decision-making, if they lead to an increase in the overall adverse effect on a particular resource/receptor.If possible, impact significance are to be reduced to lower levels by taking mitigation measures; otherwise acceptance of associated risks is required for proceeding with the Project.
	Minor	Impacts may be raised as local factors, which are unlikely to be critical in the decision making process, but important in enhancing the subsequent design of the Project. Assurance of compliance with standards and safety criteria is sufficient to proceed.
	Negligible (Not Significant)	No impact or impacts are beneath the level of perception so that they are acceptable with normal operating procedures.

Source: Adapted mainly from UK HA 205/08 Volume 11, Section 2 and Canter, L., 1993.

In the assessment of impacts of the GCP, the methodology described above will be used. Both the adverse and beneficial, direct and indirect impacts will be assessed. The methodology to be followed for the Cumulative Impact Assessment is separately described in “Chapter 7”.

6.2 Visual Impact Assessment

Visual impact assessment is not directly referenced in EBRD's Environmental and Social Policy and related PRs (2014). However, PR1 states that the assessment process will cover in an integrated way, all relevant direct and indirect environmental and social impacts and issues of the project. The construction and operation of the Project will result in changes of elements and the physical structure of the landscape and therefore, a visual impact assessment (VIA) is required.

6.2.1 Study Area

The study area for the VIA has been determined in consideration of the baseline visual and topographical features, the potentially visible major Project units and the potential visual receptors.

Amongst the Project units, Open Pit, Çorakoğlu WRD, Kupeli Storage Area, Kepezkaya TSF, Bagdere TSF, Process Plant Site, Haul (Access, Ore Transport, Rock Transport) Roads and Soil Storage Areas and the a 28.8 km Energy Transmission Line (ETL) were considered for the purposes of visual assessment. Tailings pipeline will be buried at outside of the fenced project units, thus it is not included in the VIA.

To identify the key visual features, a preliminary desktop analysis of existing visual amenity, within the Project area, was undertaken to inform this VIA. This included analysis of the underlying topography and land cover. Key information sources reviewed as a component of the desktop analysis include the following:

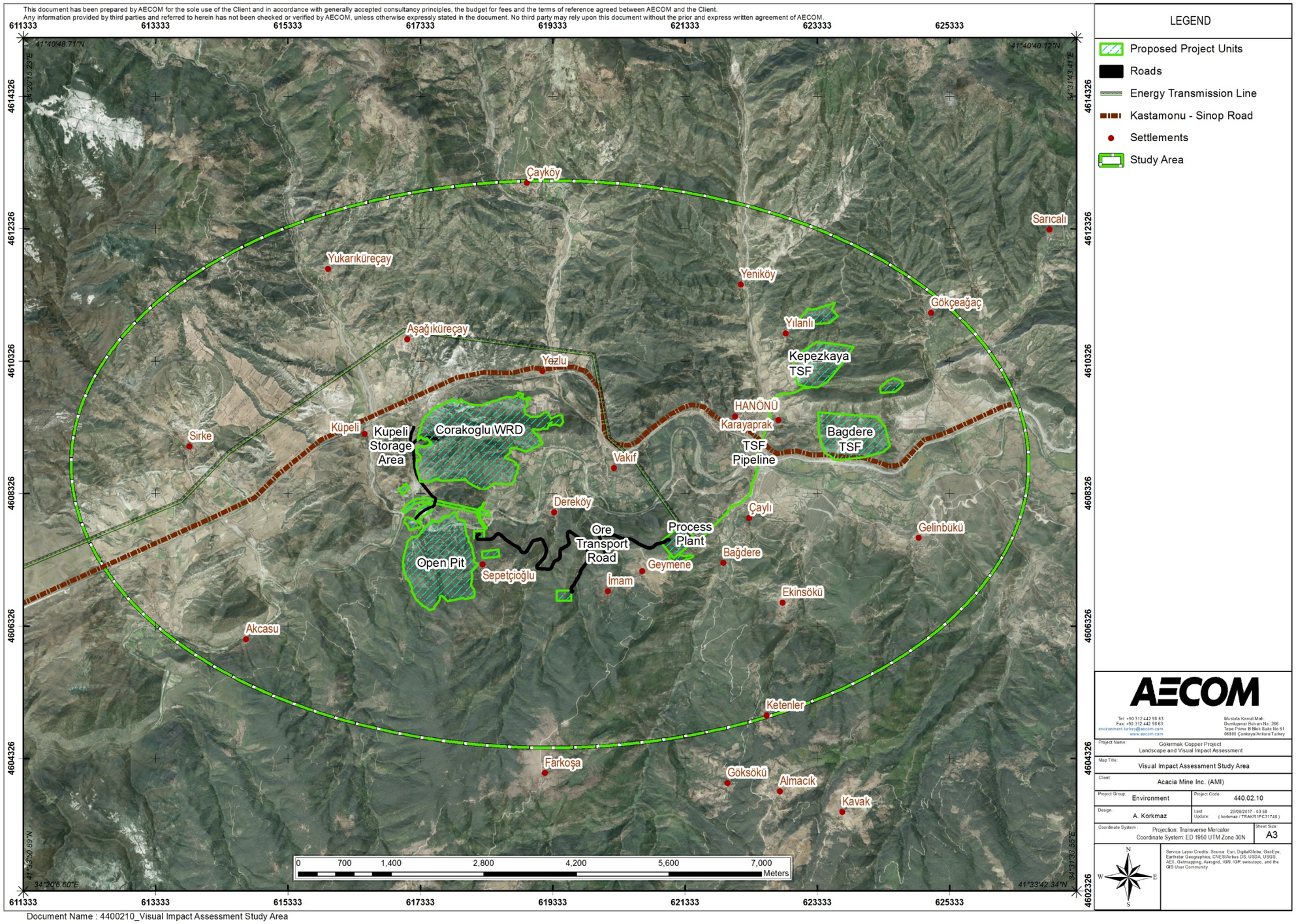
- Publically available information on recreation spaces and public visitor areas;
- Digital aerial photography (imagery dated 2015 from Google Earth);
- Cadastral data (showing roads, property boundaries and built areas);
- Existing infrastructure.

To support the desktop analysis, a field visit was carried out on 28 October 2015 for all main project units and the field survey for the associated facilities (the ETL) was carried out in February 2016. The field survey was used to ground truth the findings of the desktop assessment and to undertake an on-site assessment of visual amenity. During the field surveys, photographs were taken in order to:

- Portray the visual character;
- Inform the viewpoint assessment done at representative viewpoints; and
- Provide base images for the production of photographic simulations and visualizations.

Visual receptor audiences are assessed and described in terms of the views which can be obtained from selected representative viewpoints within the Project area. Representative viewpoints were identified and described as part of the VIA. A VIA elliptical study area (Horizontal axis: 7 km; Vertical axis: 4 km) around the Project units was established in consideration of the locations of Project units, potential visual receptors and topographical conditions. The study area for the VIA is shown in Figure 6-1. It should be noted that it is unlikely that any visual receptors located approx. 5 km beyond the boundary of the Project area will be able to obtain clear/significant views of the Project due to highlands, topography and high trees with strong vegetation.

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



LEGEND

- Proposed Project Units
- Roads
- Energy Transmission Line
- Kastamonu - Sinop Road
- Settlements
- Study Area

AECOM

Tel: +90 312 442 98 63
Fax: +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com

Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime B Blok Suite No:51
06800 Çankaya/Ankara Turkey

Project Name:	Gökırmak Copper Project Landscape and Visual Impact Assessment
Map Title:	Visual Impact Assessment Study Area
Client:	Acacia Mine Inc. (AMI)
Project Group: Environment	Project Code: 440.02.10
Design: A. Korkmaz	Last Update: 23/08/2017 - 03:58 (korkmaz / TRAKR1PC31746)
Coordinate System: Projection: Transverse Mercator Coordinate System: ED 1950 UTM Zone 36N	Sheet Size: A3

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Name : 4400210_Visual Impact Assessment Study Area

Figure 6-1 Study Area

6.2.2 Methodology

The international best practice guidelines and references used to conduct the VIA for the Project are listed below:

- The Landscape Institute and the Institute of Environmental Management and Assessment, UK (2013) Guidelines for Landscape and Visual Impact Assessment, Second Edition.
- Scottish Natural Haritage, A handbook on environmental impact assessment.

Evaluation of significance of potential impacts on visual amenity is based on the sensitivity of receptors to change and the magnitude of change that is likely to occur. No prescribed methods for assessment of significance of impacts exist; therefore, professional judgement and experience are applied in order to identify the level of significance.

The impact significance will be determined based on the matrix provided in Table 6-5. The general criteria for the determination of magnitude of impact and sensitivity of are further described below.

Table 6-5 Significance Rating Matrix with Significance Color Scale for Negative Ratings

		Sensitivity of Receptor		
		High	Medium	Low
Magnitude of Change	High	Major	Major	Moderate
	Medium	Major	Moderate	Minor
	Low	Moderate	Minor	Minor

Source: Adapted from Scottish National Heritage, 2005. A Handbook on Environmental Impact Assessment.

Sensitivity Criteria

Low: People engaged in work activities indoors, with limited opportunity for views of the Development, road users on minor access roads travelling for other purposes than just the view.

Medium: Users of primary transport road network, orientated towards the Development, likely to be travelling for other purposes than just the view, dwellings with oblique views of the proposed development or with no or very little number of residents.

High: Users of outdoor recreational facilities, on recognized national cycling or walking routes or in nationally designated landscapes, dwellings with views oriented towards the proposed development.

Magnitude Criteria

Negligible: No real change to perception of the view. Weak, not legible, hardly discernible.

Low: The development would cause very minor changes to the existing view over a wide area or minor changes over a limited area.

Medium: The development would cause minor changes to the existing view over a wide area or noticeable change over a limited area.

High: The development would cause a considerable change to the existing view over a wide area or an intensive change over a limited area.

6.2.3 Impact Assessment

The existing visual setting is described in terms of views from the 6 selected representative viewpoints around the Project area. These viewpoints have largely been selected due to the fact that they respond to the location of existing residents, frequently used roads or highways and recreational areas. Of the Project units shown in Figure 6-1, the key components which may be visually prominent within or near the study area are the open pit, the WRD, the TSFs and the process plant. These elements and features have been considered in defining likely sensitive receptors.

The key route through the area is the Hanönü Road, which is the main route to Sinop from Kastamonu. When observing the existing landscape from Hanönü Road, receptor audiences are likely to have minimal or no awareness that there is an existing mine within reasonable proximity to the highway.

6.2.3.1.1 Distance and Horizontal Analysis

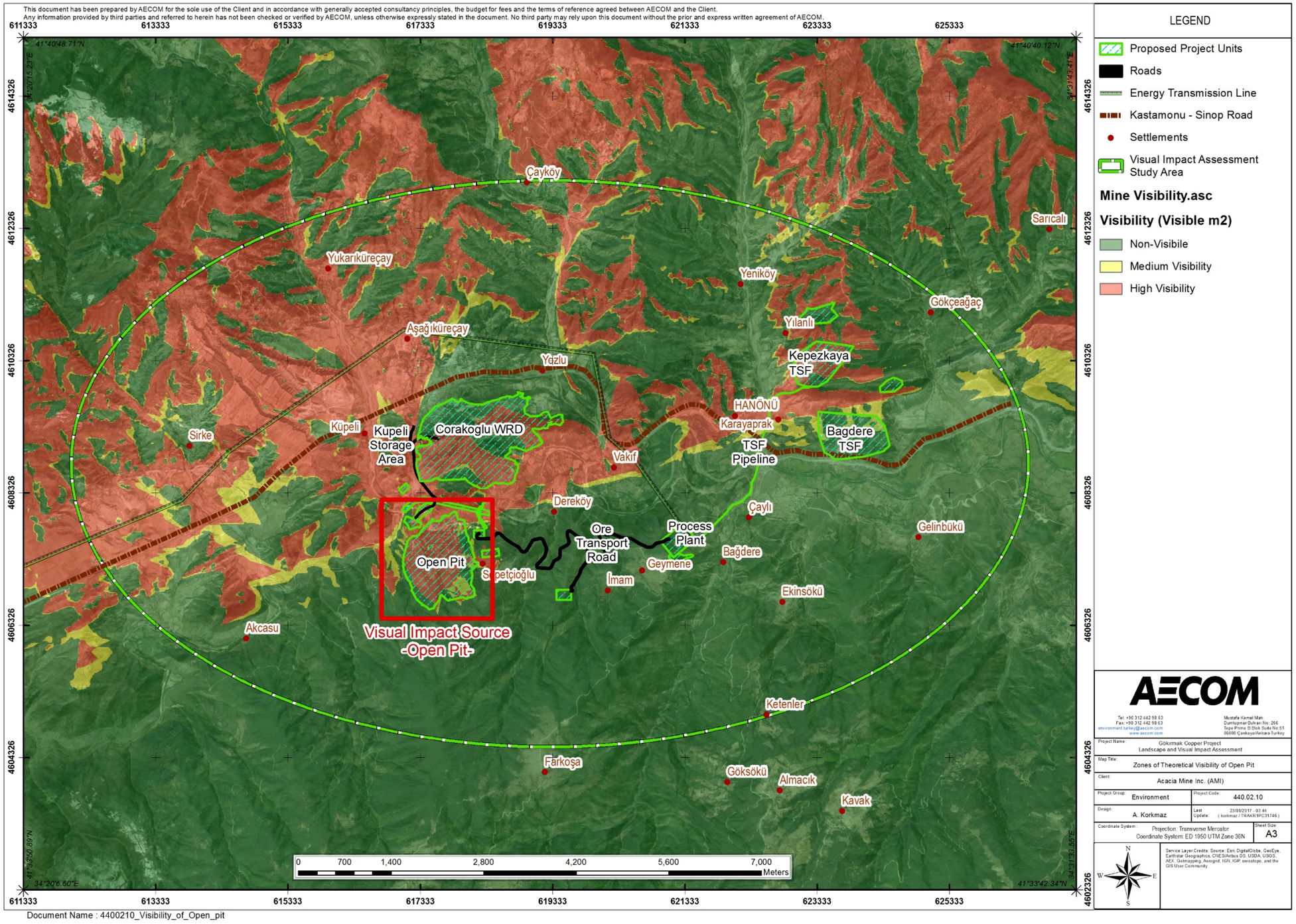
Autodesk Products was used to create the Distance and Horizontal Analysis used in the visualisation process. Existing and proposed topography data was imported into Infraworks, from which a wireframe surface was created. An alignment was then placed into the model, which was used to generate the cross sections by analysing the two surfaces. Colours were then added manually for clarity and to identify the proposed (worst case) mined area, pit slopes/bench, topsoil stock piles and rehabilitated areas. A model of a person (1.6 m tall) was then placed at the viewpoint location to evaluate the line of sight towards the mine. These cross sections do not include any existing vegetation, and are therefore based purely on topographical data.

Distance and Horizontal Analysis Figures for each viewpoint are given in Appendix C.

6.2.3.1.2 Viewpoints for Visual Assessment

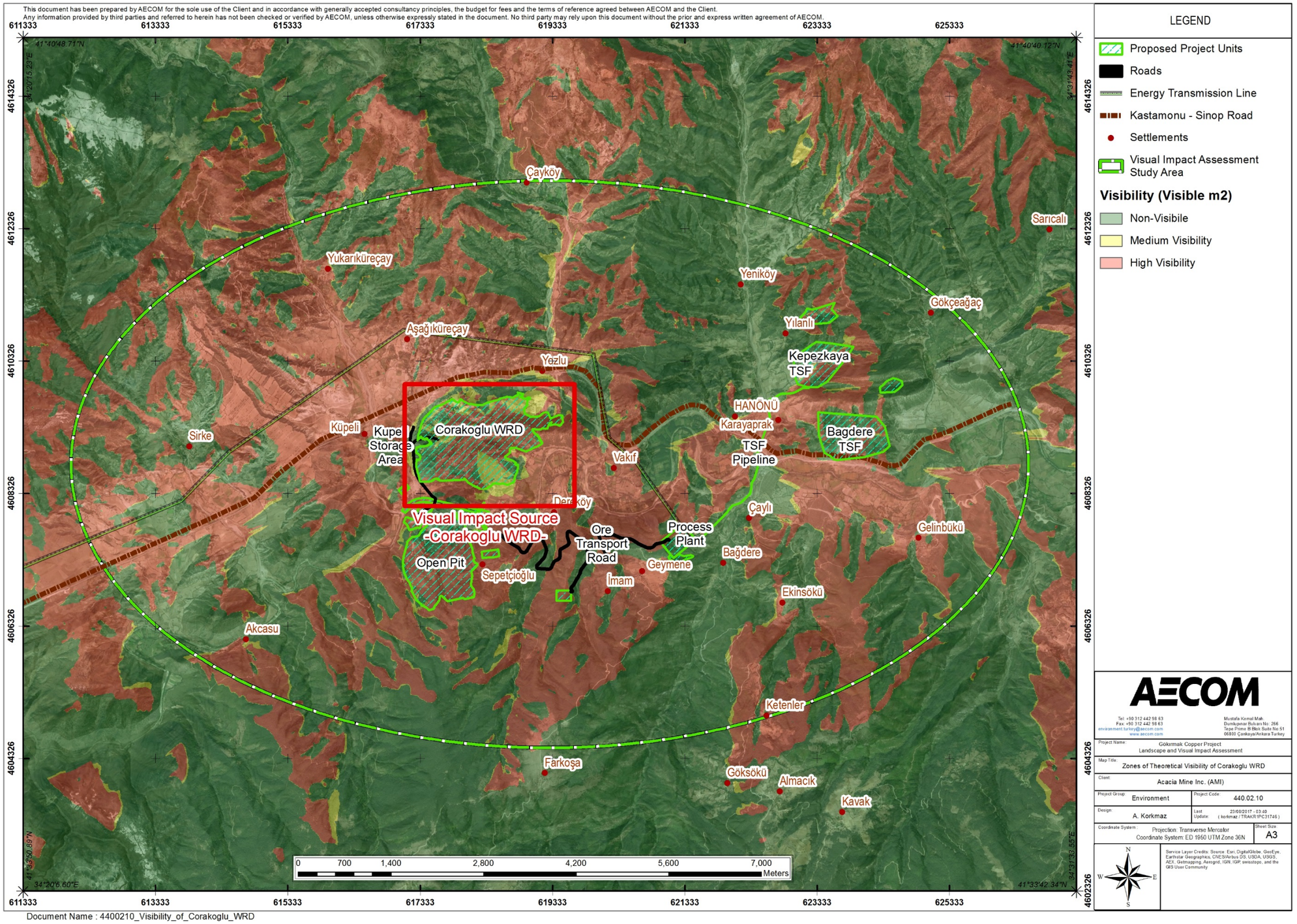
Zone of Theoretical Visibility (ZTV) mapping per project, as shown below, undertaken to assist in the identification of any potential receptor audiences in the surrounding area. ZTV represents the area over which a development can theoretically be seen, based on a Digital Elevation Model (DEM). The ZTV usually presents a ‘bare ground’ scenario; that is, a landscape without screening structures or vegetation and comprises a mapped representation of the area within which a proposed development may have an influence or effect upon views and visual amenity; it is often used as a tool to select representative viewpoints for more detailed assessment. ESRI Arcgis 10.4 software was used to model the ZTV.

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



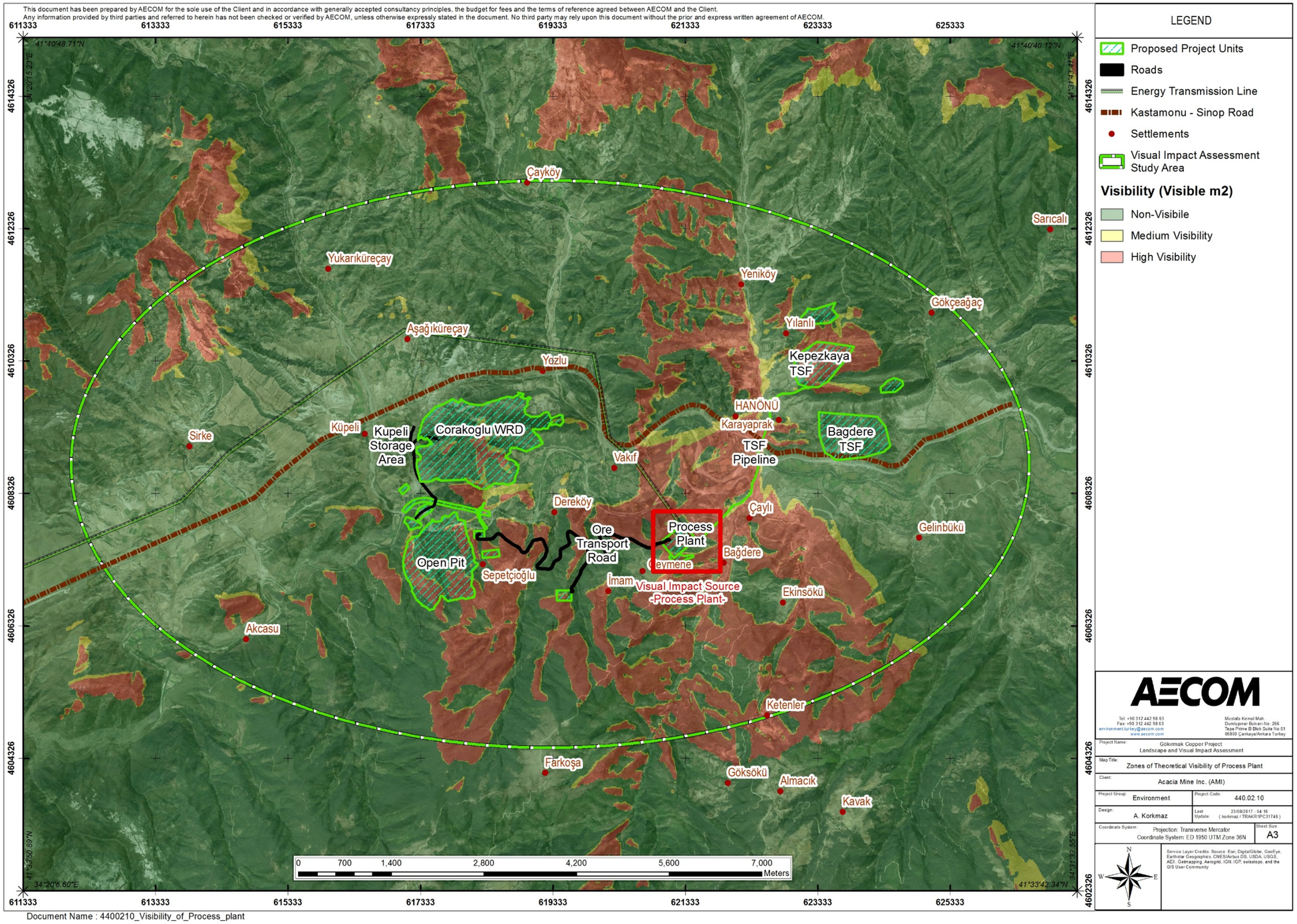
Document Name : 4400210_Visibility_of_Open_pit

Figure 6-2 Zones of Theoretical Visibility of Open Pit



Document Name : 4400210_Visibility_of_Corakoglu_WRD

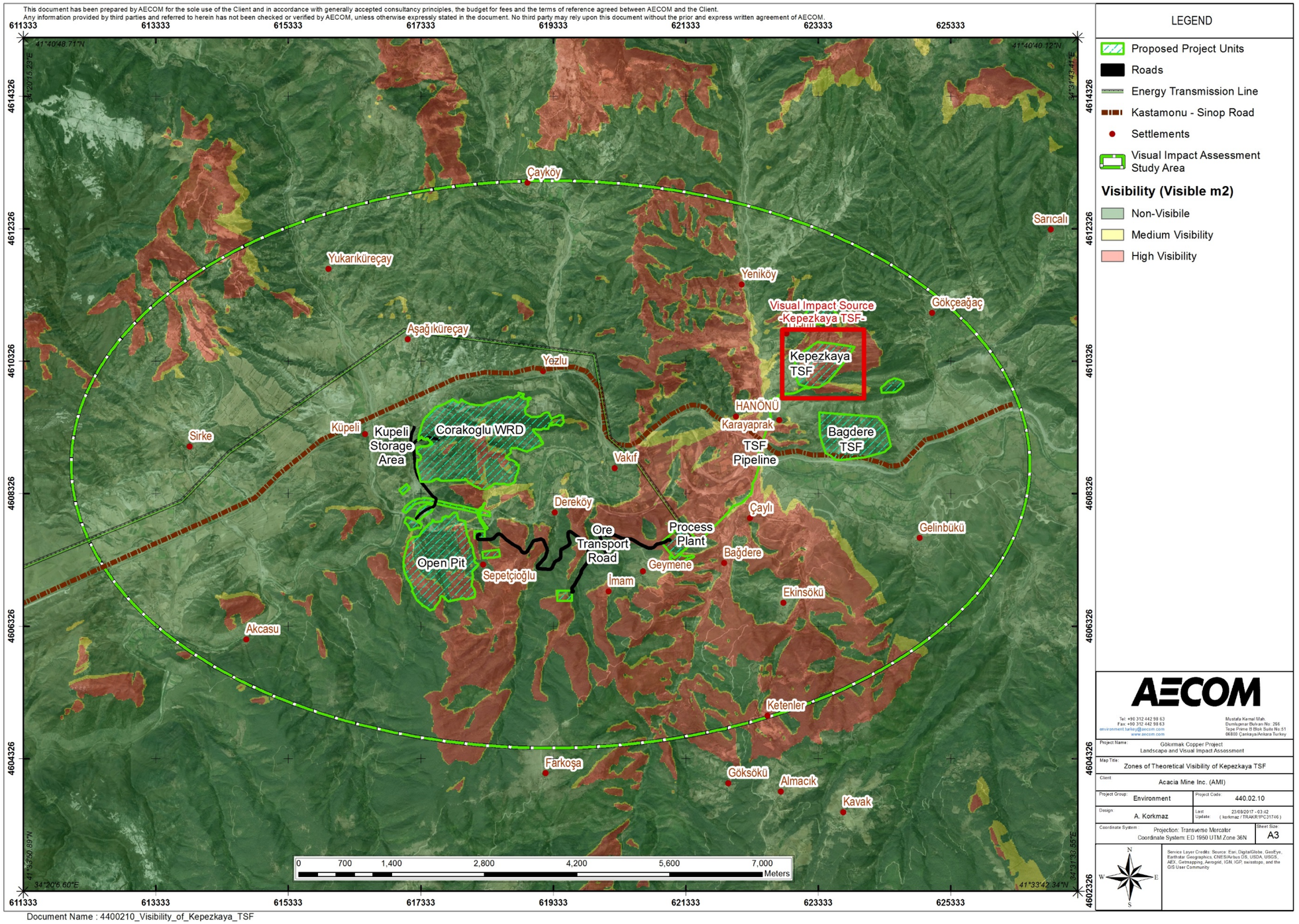
Figure 6-3 Zones of Theoretical Visibility of Corakoglu WRD



Document Name : 4400210_Visibility_of_Process_plant

Figure 6-4 Zones of Theoretical Visibility of Process Plant

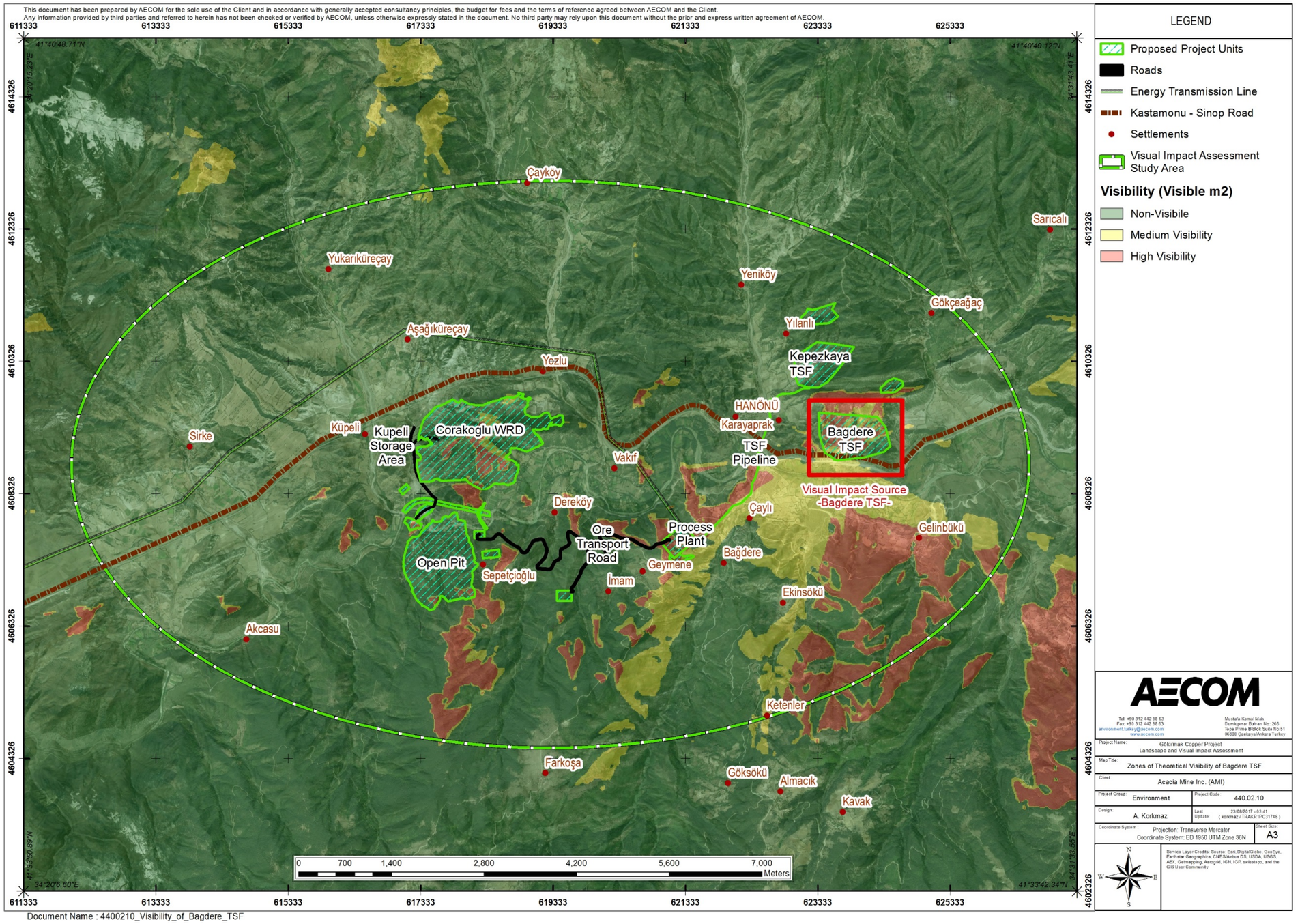
This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



Document Name : 4400210_Visibility_of_Kepezkaya_TSF

Figure 6-5 Zones of Theoretical Visibility of Kepezkaya TSF

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



LEGEND

- Proposed Project Units
- Roads
- Energy Transmission Line
- Kastamonu - Sinop Road
- Settlements
- Visual Impact Assessment Study Area

Visibility (Visible m2)

- Non-Visibile
- Medium Visibility
- High Visibility

AECOM

Tel: +90 312 442 98 63
Fax: +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com

Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime B Blok Suite No:51
06800 Çankaya/Ankara Turkey

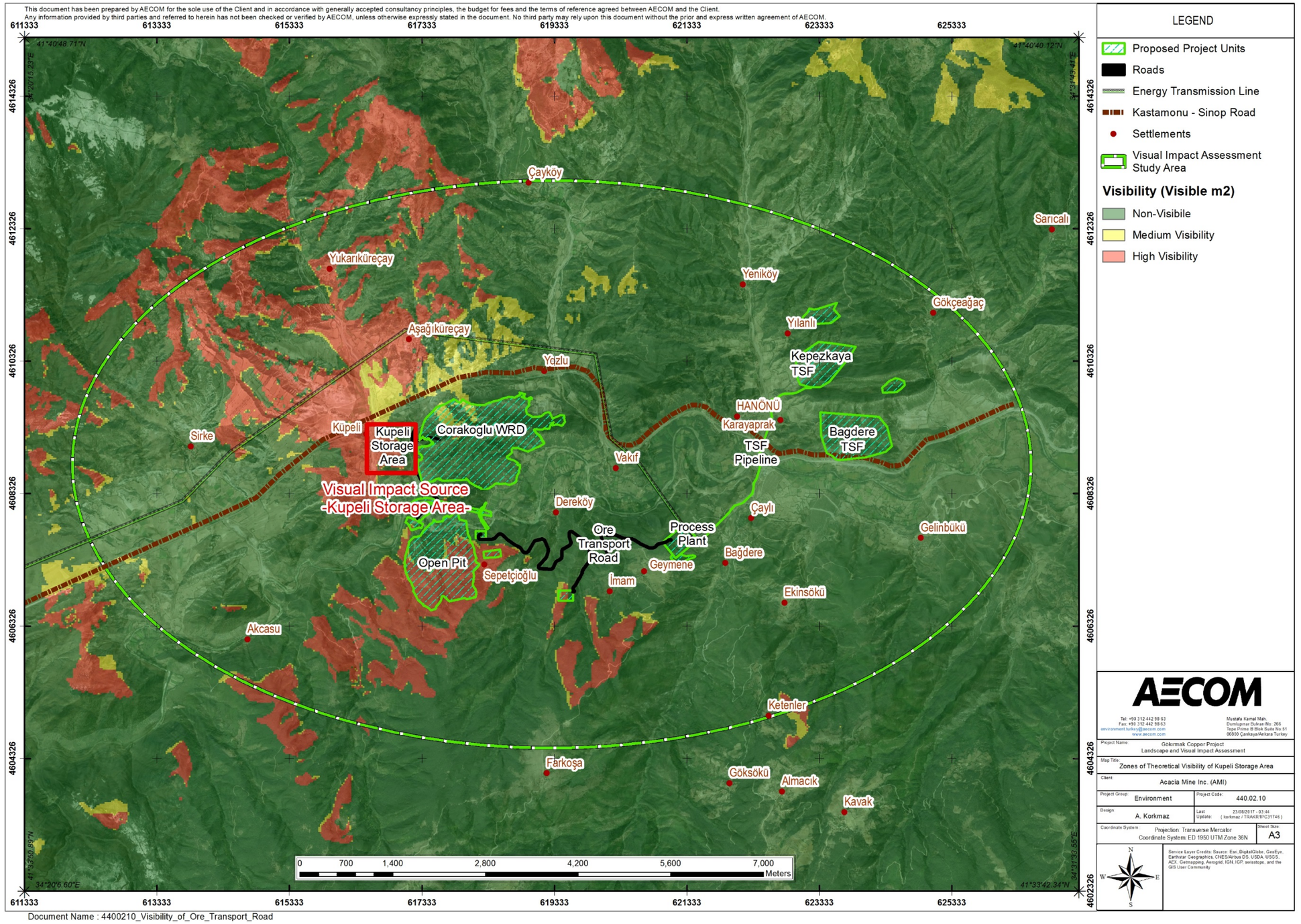
Project Name:	Gökırmak Copper Project Landscape and Visual Impact Assessment
Map Title:	Zones of Theoretical Visibility of Bagdere TSF
Client:	Acacia Mine Inc. (AMI)
Project Group: Environment	Project Code: 440.02.10
Design: A. Korkmaz	Last Update: 23/08/2017 - 03:41 (korkmaz / TRAKBIPC31748)
Coordinate System: Projection: Transverse Mercator Coordinate System: ED 1950 UTM Zone 36N	Sheet Size: A3

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Name : 4400210_Visibility_of_Bagdere_TSF

Figure 6-6 Zones of Theoretical Visibility of Bagdere TSF

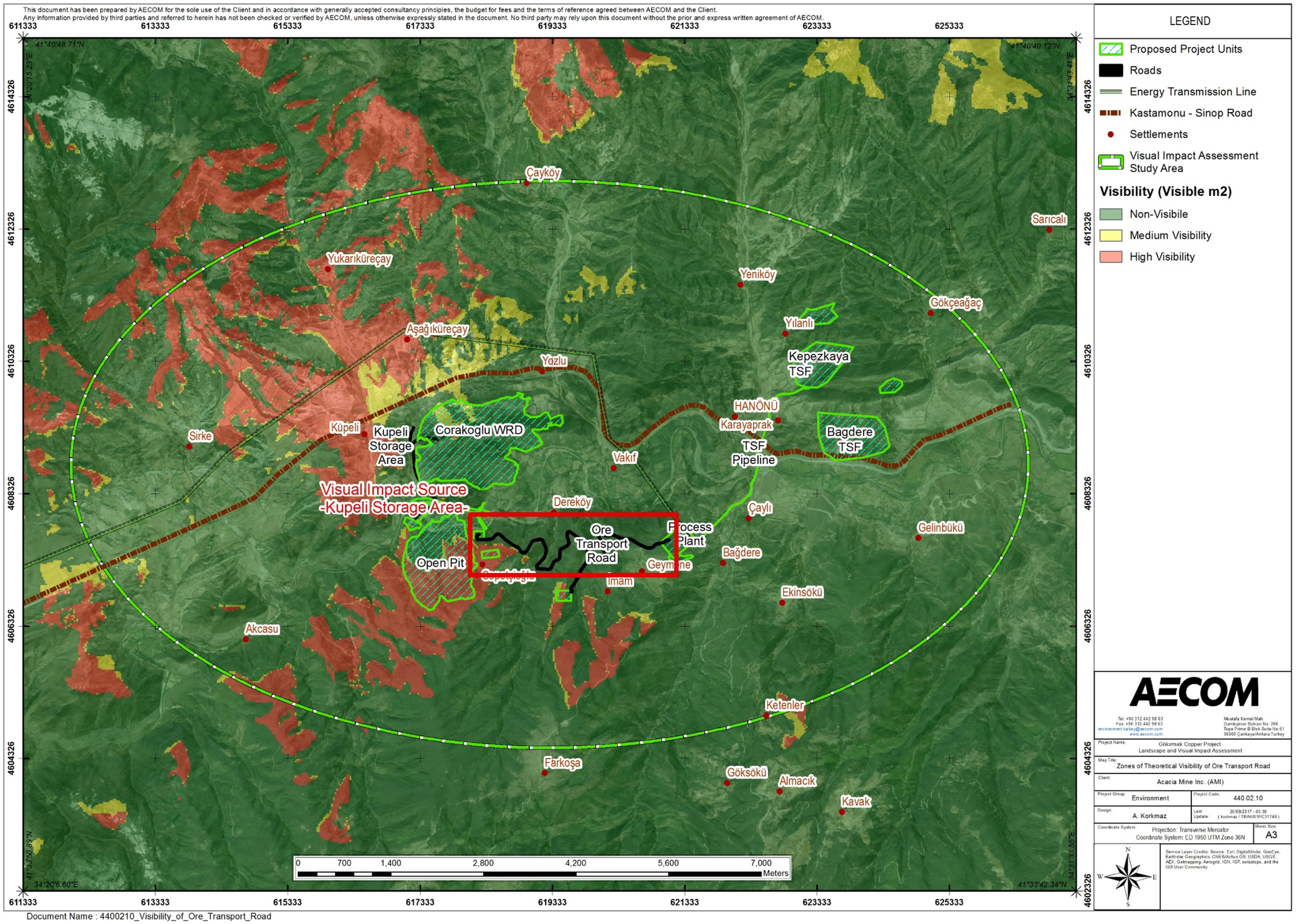
This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



Document Name : 4400210_Visibility_of_Ore_Transport_Road

Figure 6-7 Zones of Theoretical Visibility of Kupeli Storage Area

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



LEGEND

- Proposed Project Units
- Roads
- Energy Transmission Line
- Kastamonu - Sinop Road
- Settlements
- Visual Impact Assessment Study Area

Visibility (Visible m2)

- Non-Visibile
- Medium Visibility
- High Visibility

AECOM

Tel: +90 312 442 98 63
Fax: +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com

Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime B Blok Suite No:51
06800 Çankaya/Ankara Turkey

Project Name:	Gökırmak Copper Project Landscape and Visual Impact Assessment
Map Title:	Zones of Theoretical Visibility of Ore Transport Road
Client:	Acacia Mine Inc. (AMI)
Project Group: Environment	Project Code: 440.02.10
Design: A. Korkmaz	Last Update: 26/09/2017 - 05:30 (korkmaz / TRAKR1PC31746)
Coordinate System: Projection: Transverse Mercator Coordinate System: ED 1950 UTM Zone 36N	Sheet Size: A3

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Name : 4400210_Visibility_of_Ore_Transport_Road

Figure 6-8 Zones of Theoretical Visibility of Ore Transport Road

A receptor audience is a group of people that have the potential to view the Project from outside the Project boundaries. The wide variety of views that can be obtained by individual receptors are intended to be represented by the six viewpoints that are included in this assessment. Each of these viewpoints was carefully selected to represent areas where either the most sensitive receptors are permanently located or where the highest number of receptors are likely to pass by. The representative viewpoint locations are therefore based on the identification of both public and private visual receptor audiences that are located in the visual amenity surrounding the Project and also those locations in the wider landscape that may also have views towards the Project. The audiences can be defined as;

- A public receptor is any member of the general public who may be using public roads, highways, parks, open spaces, state forests or other publically accessible spaces and,
- A private receptor is any person living, renting, working or spending prolonged periods of time on private land that does not allow general public access.

Generally, there are often higher numbers of individuals in the public receptor audiences than those occurring on private land. This can vary in urban environments, although the visual amenity surrounding the Project Site appears to be consistent with the former statement.

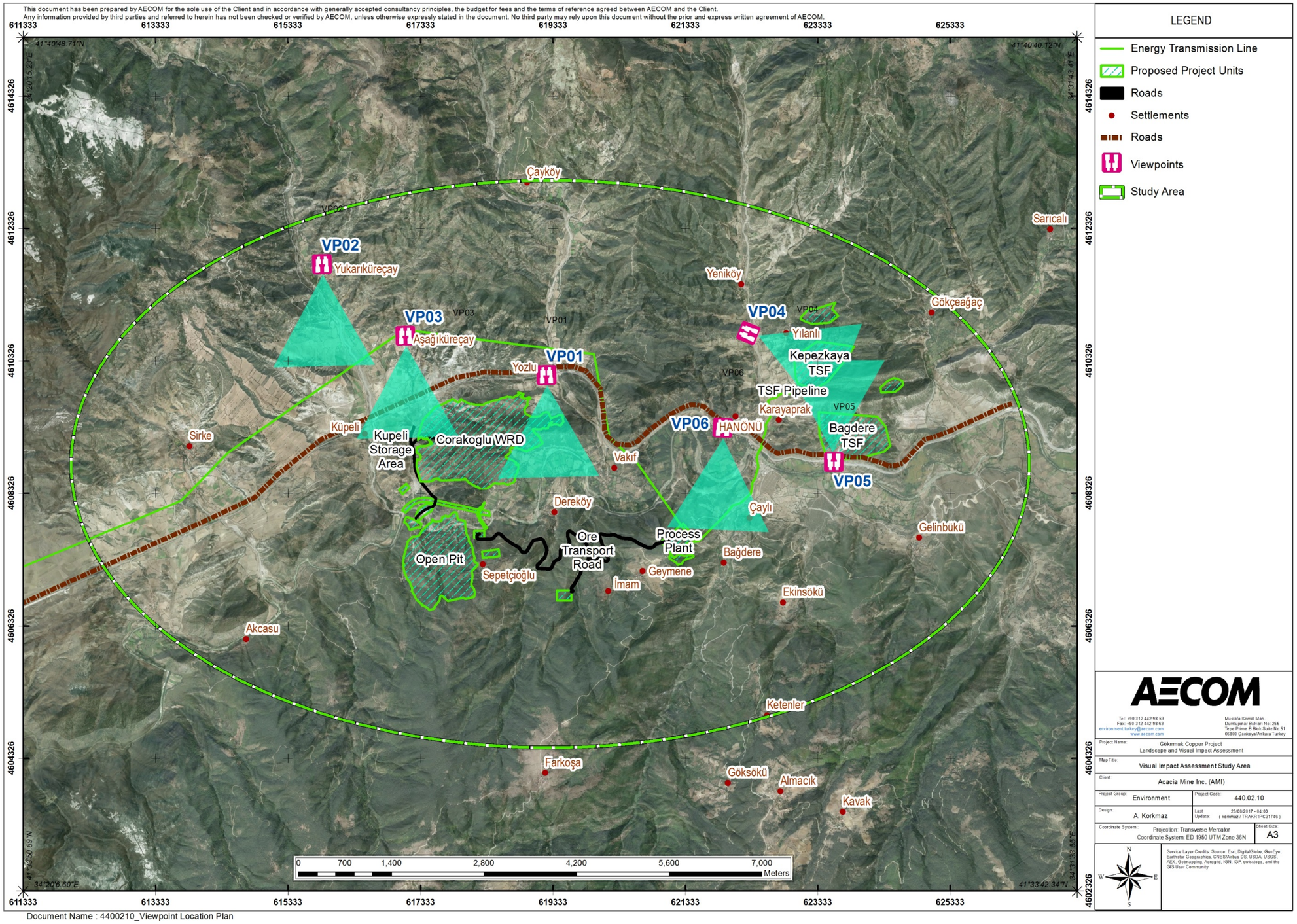
Key public and private receptor audiences that may see changes to existing views and visual amenity as a result of the Project are shown in Table 6-6.

Table 6-6. Public and private receptor audiences

Public Receptors	Private Receptors	Represented by Viewpoints
Motorists, cyclists or other recreation travelers using Kastamonu Sinop Road	-	VP01, VP05,
Guests, staffs, Motorists, cyclists or other recreation travelers using Hanönü District	Residents of Hanönü District	VP06, VP4
Guests of Yukarıküreçayı Village	Residents of Yukarıküreçayı Village	VP02
Guests of Asagikurecayi Village	Residents of Asagikurecayi Village	VP03
Pilots and passengers in planes or other aircrafts	-	Not represented

All viewpoints were described and assessed to inform the visual impact assessment as given in Table 6-7. Each of the six viewpoints is illustrated in Figure 6-9.

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



Document Name : 4400210_Viewpoint Location Plan

Figure 6-9. Viewpoint Locations

Table 6-7 Representative Viewpoint Assessment

Viewpoint 1: Kastamonu Sinop Road



Existing view from Kastamonu Sinop Road – looking west from roadside lay-by to Corakoglu Waste Rock Area

Viewpoint Information

VP01 is located on the roadside of Kastamonu Sinop State Road, looking west in the direction of the Corakoglu WRD area. VP01 represents the outlook of drivers and passengers travelling Corakoglu west along Kastamonu Sinop Road. No mining activities were visible from this location at the time of the assessment. The Project boundary is approximately 1 km from this viewpoint. The right corner of the image shows the planned Corakoglu waste rock area, which is located to the western side of Kastamonu Sinop Road; however no private dwellings are located in close proximity to the property boundary.

Visual Location

Latitude=41.633084
Longitude=34.431407
View Direction=178º
Taken Date=2015-10-28
Time=13.47

Viewpoint 2: Yukarıküreçayı Village



Existing view from Yukarıküreçayı Village – looking west from village road to Mine and Corakoglu WRD

Viewpoint Information

VP02 is located on the top of Yukarıküreçayı Village, looking west in the direction of both the Planned Mine Area and the Waste Rock Area. Mining activities a Waste Rock will be visible albeit from long distance. No mining activities were visible from this location at the time of the assessment. The Project boundary is approximately 4 km from this viewpoint.

Visual Location

Latitude=41.648699
Longitude=34.391051
View Direction=178º
Taken Date=2015-10-28
Time=12.14

Viewpoint 3: Aşağıüreçayı Village



Existing view from Aşağıküreçayı Village – looking west from village road to Mine and Corakoglu WRD

Viewpoint Information

VP03 is located at the north of open pit and waste rock area. 2.5 km from the Project and looks planned Corakoglu waste rock and mine area. Large out of mine area and waste rock area dominate a considerable amount of the viewpoint from this location. Mining activities (Spillway andexploratory drillings roads) were visible at the time of the viewpoint photograph being taken.

Visual Location

Latitude=41.638772
Longitude=34.405933
View Direction=178º
Taken Date=2015-10-28
Time=12.58

Viewpoint 4: Yeniköy village Road from Hanönü District (Yılanlı) - looking east from roadside to Kepezkaya TSF



Existing view from Yeniköy village Road from Hanönü District (Yılanlı) - looking east from roadside to Kepezkaya TSF

Viewpoint Information

Located at a roadside and represented planned Kepezkaya TSF areas actual situation. This road has not been active but topographic view will be changed and will be active in construction stage.

Visual Location

Latitude=41.638395
Longitude=34.468135
View Direction=111 º
Taken Date=2015-10-28
Time=15.09

Viewpoint 5: Kastamonu Sinop Road



Existing view from Kastamonu Sinop Road – looking west from roadside lay-by to Bagdere TSF

Viewpoint Information

VP05 is located on the roadside lay-by of Kastamonu Sinop Road, looking north in the direction of the Bagdere TSF. 500m from the planned Kepezkaya.

Visual Location

Latitude=41.620633
Longitude=34.483240
View Direction=0 º
Taken Date=2015-10-28
Time=15.35

Viewpoint 6: Hanönü District Center



Existing view from Hanönü District Center - looking west from Hanönü Center junction to Process Plant

Viewpoint Information

VP06 is located along Kastamonu Sinop Road, in center of the Hanönü Homestead property. This viewpoint is looking west towards just the Process Plant.
Construction activity (crane and topographic changes) is still visible (not in surface level/bottom side) on the right-up corner of the image.

Visual Location

Latitude=41.625555
Longitude=34.463223
View Direction=182 º
Taken Date=2015-10-28
Time=16.51

6.2.3.1.3 Assessment of Key Project Activities

Key components of the Project that have the potential to impact visual character and visual amenity are described in Table 6-8 below.

Table 6-8. Key Sources of Potential Visual Impact

Facility/Component Description	Indicative Imagery
Haul roads (mainly Ore Road) Construction and operation of haul roads (light and heavy vehicle): The construction of unpaved haul roads within the Project Site will entail the presence of construction traffic to and within the Project Area resulting in shorter term impacts on visual amenity. Once operating, the roads will generate longer term adverse impacts on visual amenity, particularly associated with the presence of intermittent vehicular traffic. The visual changes that the units creates the residential locations are will be visible are; Hanonu, Asagikurecay, Yukarikurecay, Vakıf, Bagdere, Geymene, Yılanlı.	 Taken Date: 03 March 2017 (Haul Roads)

Facility/Component Description	Indicative Imagery
ETL New power infrastructure will entail the construction and operation of new power lines from the nearest Energy network connection point. Other likely sources of impact include the presence of construction traffic to and within the mining lease areas. The ETL Route of 28.8 km, between Taşköprü to the project site near Hanönü lays parallel to the existing highway. The construction of the ETL has already been finished. The residential locations that the ETL route will be visible are; Vakıfgeymene, Küreçayı, Sirkeköy, Hamzaoğlu, Kornapa, Çördük, Eskiatça, Musalla, Ağcıkişi and the outer territory of Taşköprü district.	 Taken Date: 03 March 2017 (ETL)

Facility/Component Description	Indicative Imagery
Administrative Buildings The Project will result in an increase to the number of buildings. This will include upgrades to the accommodation village, offices and workshops as well as the crib hut facilities and car parking areas within the mine services area (MSA). This construction will bring additional traffic, staff and machinery to the Project Area. The introduction of the new built form can be seen as uncharacteristic elements in a predominantly hilly landscape.	 Taken Date: 14 August 2017 (Administrative buildings area)

Facility/Component Description	Indicative Imagery
Open Pit Open Pit site preparation activities, which will be undertaken to provide access to the cooper resource, are commonly conducted during daylight working hours. This removal of vegetation will generate traffic on surrounding rural roads and within the Project Site. It is also likely that there will be a presence of construction staff and large scale machinery to assist in vegetation clearance or trimming activities.	 Taken Date: 14 August 2017 (Open Pit)

Facility/Component Description	Indicative Imagery
Open Pit (Removal and storage of topsoil) To assist in the creation of the mining pits, topsoil will be collected and stored in topsoil stockpiles which will later be used in the rehabilitation phase of the Project. Due to the naturally high nutrient levels which may be found in the topsoil, there is potential for these stockpiles to appear as grassed bunds rather than piles of gravel or dirt.	 Taken Date: 22 February 2017 (Mine Site)

Facility/Component Description	Indicative Imagery
Çorakoğlu Waste Rock Dump: Overburden removal activities will be carried out by using truck/excavator and dozer push. Dozer push will used to develop the first blast pad prior to the drilling and loading of explosives which will then blast the overburden to a pre-strip horizon. The blast itself may create minor temporary visual impacts associated with dust if not appropriately managed. Open pit excavation along with the presence of waste rock dumps and associated machinery, are likely to cause some of the most prominent sources of impacts within the Project Site. From a landscape character perspective, this is due to the contrast between the Project's footprint and the surrounding landscape. However, visual impacts are likely to be associated with size and height of the out of pit spoil dumps and the dragline excavators that are used to create them and transfer overburden materials.	 Taken Date: 14 August 2017 (Corakoglu WRD)

Facility/Component Description	Indicative Imagery
Process Plant: The process plant will constantly undergo visual change during the construction period. In the operating period, there will be static and unchanging buildings except vehicle traffic.	 Taken Date: 14 August 2017 (Process Plant)

Facility/Component Description	Indicative Imagery
Tailing Storage Facility TSF has intense mobilization during the construction period. No visual activity is expected after the construction period.	 Taken Date: 14 August 2017 (TSF)

6.2.4 Mitigation

Visual impacts of the Project components on the receptors are assessed in Table 6-9 together with proposed mitigation measures and the residual impacts. Impacts have been assessed for the operation phase as the construction phase will be temporary and the receptors to be affected will be the same. During the operation phase, impacts for permanent Project units will be wide in geographic extent, long-term in duration, irreversible and continuous, even though they would be mitigated to some extent by the application of effective rehabilitation. Visibility of the Project components will vary from receptor to receptor, meaning that, some of the receptor may have a complete view of the components while others may have partial or slight views. As can be seen from the table, some of the receptor will experience cumulative visual impact due to visibility of multiple Project components.

Given the scale and the nature of the Project, there are a limited number of mitigation measures that can be realistically introduced. Progressive rehabilitation is proposed throughout the life of the Project. The final land use objectives will be stable and self-sustainable native grass and woodlands consistent with the surrounding undisturbed areas. The process will concentrate on the collection of topsoil resources prior to disturbance for future rehabilitation activities, and the detailed design and construction of mined landforms that promote spoil stabilization.

Rehabilitated landscapes are unlikely to look the same as they did prior to the existence of the mine. However, they will potentially blend more consistently into their wider surroundings than they would if left un- rehabilitated. The colors visible in these rehabilitated landscapes are also likely to be noticeably different to that which currently exists. This is due to the new growth of grass seed and juvenile trees, which may stand out as being somewhat greener than surrounding areas. It should be also noted that the residual impacts would only be mitigated to acceptable levels once afforestation and rehabilitation works show their effectiveness within years after implementation.

Table 6-9. Summary of Impacts, Mitigation and Residual Impacts for Visual Impacts

Receptor	Magnitude of Impact for the Impact Causing project Component							Sensitivity/ Value of Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
	Open Pit	WRD	Kepezkaya TSF	Bağdere TSF	Process Plant	Haul Road	ETL				
Yukarıküreçayı (VP02)	Low							High	Moderate	• Following a review of the existing Preliminary Mine Closure and Rehabilitation Plan a site-specific Mine Closure and Rehabilitation Plan will be developed before decommissioning of Project components (considering progressive closure provisions of certain components such as WRD) taking the visual impacts into account. This plan will be implemented in the decommissioning of Project components. • Site-specific Mine Closure and Rehabilitation Plan will ensure that restoration processes will commence as soon as possible following completion of mining or storage activities within particular areas. Rehabilitated landform profile will emulate pre-operation landforms to the greatest extent possible using naturally flowing contours that integrate smoothly into undisturbed areas. Where pre-operation landforms cannot be achieved, character of landforms observed in the wider landscape will be aimed to be emulated. • A Reforestation Plan will be developed and implemented. • Erosion and Sediment Control Plan will be implemented. • Top soil management measures will	Minor
Aşağıküreçayı (VP03)	Medium	High					Medium	High	High		Moderate
Yozlu		High						Medium	High		Moderate
Küpeli	Medium	High						Medium	High		Moderate
Sepetçioğlu	High	High				Medium		High	High		Moderate
Dereköy						High		High	High		Moderate
Vakıf					Medium	High	Medium	High	High		Moderate
Geymene						Medium	Medium	High	High		Moderate
Hanönü district center (VP06)			High		High	High	Medium	High	High		Moderate
Yılanlı			Low					High	Moderate		Minor
Bağdere				Medium	High			High	High		Moderate
Gelinbükü				Medium				High	High		Moderate
Ekinsökü					High			Medium	High		Moderate
Sirkeköy	Low						Medium	High	High		Moderate
Çaylı					High			Medium	High		Moderate
Karapürçek							Medium	Medium	Moderate		Minor
İncesu							Medium	Medium	Moderate		Minor
Kornapa							Medium	Medium	Moderate		Minor

Receptor	Magnitude of Impact for the Impact Causing project Component							Sensitivity/ Value of Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
	Open Pit	WRD	Kepezkaya TSF	Bağdere TSF	Process Plant	Haul Road	ETL				
Hamzaoğlu							Medium	Medium	Moderate	be implemented as described in Section 6.3. • Fences adjacent to the neighboring properties will be kept in good condition throughout the Project life. • The number of lights during nighttime works will be kept to a minimum, insofar as is consistent with maintaining operations and health and safety requirements. Light spill will be contained to the greatest extent possible e.g. by using directional lighting wherever possible. If required based on feedback of affected people an additional shielding might need to be installed. • Regular monitoring of the affected people's feedback with regards to visual impacts will be provided.	Minor
Eskiatça							Medium	Medium	Moderate		Minor
Çördük							Medium	Medium	Moderate		Minor
Kastamonu-Sinop Road (VP01, VP05)	High	Medium	Low	High	High			Medium	High		Moderate
Yılanlı-Yenikoy Village Road (VP04)			High					Low	Moderate		Minor
Hanönü-Bağdere Village Road					High			Low	Moderate		Minor
Hanönü-Vakıfgeymene Village Road					Medium			Low	Minor		Neglible
Yukarıküreçay Village Road	Low	Medium						Low	Minor		Minor

6.3 Land Use and Soil

EBRD PR3-Resource Efficiency and Pollution Prevention and Control states that “The client’s environmental and social assessment process will determine the appropriate pollution prevention and control methods, technologies and practices (“techniques”) to be applied to the project”. Soil and land use impact assessment presented here used the national Law on Soil Protection and Land Use and its related regulation (the Regulation on Control of Soil Pollution and Point Source Polluted Sites) as well as relevant EU legislation, IFC EHS Guidelines and GIIP on soil and land use management as listed below:

- Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the Management of Waste from Extractive Industries and Amending Directive 2004/35/EC,
- EBRD’s Sub-sectoral Guideline for Mining, Extractive Industries and Mineral Processing: Mining Open Cast
- IFC’s Environmental, Health and Safety Guidelines for Mining
- Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities.

For the analyses of impacts on land use and soils, Coordination of Information on the Environment (CORINE) Land Cover” (2016; Seamless Vector Database Version 18.5) and theg database of the former Turkish General Directorate of the Rural Affairs (for Kastamonu province) have been used.

6.3.1 Impacts

Potential impacts of the Project on existing land use and soils will occur during the land preparation, construction, operation and closure phases. During the land preparation and construction phase, the footprint areas of the Project units and infrastructure (other than the open pit) to be developed will be subject to impacts, while during the operation phase, open pit mining and transportation activities and the progressive development of WRD will be the main areas where impacts on land use and soils will take place. During closure phase, the rehabilitation activities to be conducted will aim to restore the changes in the land use and soils to the extent possible. In the following sections impacts on land use and soils during the different phases of the Project will be assessed.

6.3.1.1 Impacts on Land Use

Lands to be required in the scope of the Project have been/will be acquired in accordance with the relevant legislation prior to the start of land preparation at sites and the corresponding land uses will permanently change at the footprint of the Project units including main mine facilities as well as access roads and ETL. Due to the nature of the Project, changes in land use will continue throughout the operation of the Project as the open pit mining and waste rock management activities progress. The major Project impacts on land use are summarized below:

- Loss of forests and shrubs;
- Loss of agricultural lands (non-arable lands and lands suitable for soil cultivation);
- Loss of pasturelands currently available for public use;
- Diversion of Gökırmak River (completed during construction phase);

Social impacts associated with the land acquisition, changes in land use and access restrictions are assessed in the scope of the SIA Report prepared as a separate document (Volume II of the ESIA). Area of land to be lost at the footprint of the Project units is provided in Table 6-10.

It should be noted that the Project initially involved an explosive storage area as a Project component but this facility has then be taken out of the current feasibility design, as the explosives will be transported daily from Çankırı province according to current planning. However, the impact assessment on land use given below reflects the layout when the explosives storage area was included in the design (thus includes the 3.3 ha area allocated for explosive storage, which will not be affected by the Project any more).

Table 6-10 Area of Affected Lands According to Land Use Type (CORINE, 2016)

Level 1	Level 2	Code (2016)	Area (ha)						Area	
			Open Pit	Çorakoğlu WRD	Kepezkaya TSF	Bağdere TSF	Access Roads	Others*	Total (ha)	Percent (%)
Agricultural areas	Arable Land	211, 212, 213	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0.
	Pastures	231	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Heterogeneous agricultural areas	241, 242, 243, 244	33.5	24.9	11.8	0.0	0.0	1.8	72.0	14.8
Forests and semi natural areas	Forests	311, 312, 313	77.7	161.0	29.0	0.0	9.4	43.5	320.6	65.8
	Shrub and/or herbaceous vegetation associations	321, 322, 323, 324	2.2	13.1	0.0	62.1	2.2	15.0	94.6	19.4
Total			**113.4**	**199.0**	**40.8**	**62.1**	**11.6**	**60.4**	**487.3**	**100.0**

* Others include process plant, top soil storage areas, diversion system inlet and outlet, spillway, Küpeli storage area, mobilization site, ore storage area, administrative buildings. Since the total area to be covered by ETL pylons (3,900 m^2) is negligible and they are distributed along the 28 km route, they have not been included in this analysis for practical reasons.

Major findings of the assessment done according to CORINE database are summarized below:

- A total of 487.3 ha of land will be affected by corresponding Project units. This land is mainly composed of forestlands, shrubs and/or herbaceous vegetation associations and heterogenous agricultural areas.
- Among different land use types, major land use impact of the Project will be on forests. Total area of the forestlands to be affected from the Project is 320.6 ha (65.8% of the total affected area). When the shrubs and/or herbaceous vegetation associations are included (94.6 ha corresponding to 19.4% of the total affected area), total forest and semi natural areas to be affected reaches up to 415.2 ha (85.2% of the total affected area) (Please note that the originally planned explosive storage area of 3.3 ha, which is included in 415.2 ha, will not be affected anymore) .
- Heterogenous agricultural areas are the third dominant type of land use types to be affected by the Project with a total area of 72 ha (14.8% of the total affected area).
- CORINE database does not indicate any impact on pasturelands; however, the SIA Report (ESIA Vol II) identifies that 8,900 m^2 (significantly less than 1% of the total affected area) of pastureland has been affected by the Project in Vakıfgeymene neighborhood, for which regulatory process (change of land use allocation) has been completed by Acacia and pasture agreement has been signed between Acacia and Vakıfgeymene Muhtarship to compensate the impact by means of allocation of a new pasture area (off-set).
- CORINE database does not indicate any impact on water bodies but the Gökırmak River section corresponding to the open pit (around 1.5 km) has been diverted through a diversion system. This system has an approximate length of 650 m (consisting of tunnels connecting the upstream and downstream sides of the river) and ensure the continuity of flow of Gökırmak River during the operation.

According to the CORINE database, the ETL route passes predominantly through agricultural areas (around 70% of the route), while the remainder passes through forests and shrubs. The expropriation data shows that the total area expropriated for the construction of ETL pylons (in total 122 pylons) is around 3,900 m^2 (significantly less than 1% of the total affected area). This area will be permanently lost but is negligible when compared to the total area to be affected by the Project (487.3 ha). In addition to the expropriated area, easement rights have been obtained along the ETL route, which is around 28 km, for a total area of around 50 ha; nevertheless, the land use will not change in this right of way.

6.3.1.2 Impacts on Soil

The major Project impacts and/or risks on soils that are to be managed in the scope of the Project are summarized below:

- Loss of top soil (in terms of quantity and/or vegetative quality) during the land preparation, construction and operation;
- Loss of soils suitable for agricultural cultivation (Class I to IV) during land preparation, construction and operation;
- Erosion of soils due to earthworks and excavation and fill operations during land preparation, construction and operation;
- Risk of soil contamination due to unplanned accidents improper management of hazardous materials and wastes during land preparation, construction and operation;
- Contamination of soils due to improper management of waste rock and tailings during operation and post-operations phases.

Besides the direct impacts on soils, elevated concentrations of suspended solids and turbidity can be observed in Gökırmak River due to disturbance of river banks during the diversion tunnel construction works and in the downstream surface and groundwater receptors due to disturbance of top soil (construction activities including diversion tunnel works, WRDs, TSFs and other project units). Impacts on water resources are assessed separately in this ESIA Report.

As suggested by the EBRD in the Sub-sectoral Environmental and Social Guidelines on Mining Open Cast, all structures such as open pits, waste dumps, tailing dams and containment facilities should be planned, designed and operated to minimise the risk of landslides, rockfalls, face slumping or land collapse. During the construction and operation phase, landslides due to existence/development of multiple cracks where there are top soils, clays and silts which might potentially become liquefiable will be a risk that would require effective management. Impact assessment and measures to be taken against geotechnical risks during the construction, operation and post-operation phases have been described in relevant section of this ESIA.

Top Soil Stripping and Management

Top soil available at the Project sites (i.e. open pit, WRD, TSF, process plants, access roads, etc.) will be stripped before the start of construction activities. If not stored under suitable conditions, there would be a risk of losing vegetative structure of the soils. According to the results of the soil investigations and baseline studies, top soil thickness has been estimated as 50 cm for the agricultural lands and 10 cm for the forestlands found in the Project Area. In consideration of the footprint areas of the Project units total volume of the top soil to be stripped from the Project Area has been calculated as 435,768 m^3.

Loss of Soils Suitable for Agricultural Cultivation

The former General Directorate for Rural Services defines land use capabilities of soils in eight different classes that indicate the agricultural potential of the soils. In this classification system, Class I to IV soils represent agricultural lands suitable for agricultural soil cultivation; Class V to VII soils represent agricultural lands not suitable for soil cultivation and Class VIII soils represent the non-arable lands. On Class I soils, agricultural activities can be conducted in the most efficient, economic and simplest way without causing erosion, and Class VIII soils cannot even be used as grassland or forest areas but support only wildlife development or can be used as resting area or national park by humans (Former Ministry of Agricultural and Rural Services, July 2008, Technical Procedure on Soil and Land Classification Standards and Relevant Legislation).

Accordingly, loss of soils having Class I to IV capabilities will be important in terms of agricultural activities. Land use capabilities of the soils corresponding to the Project units are presented in Table 6-11. As can be seen, Class I soils that are to be lost due to Project is 24.2 ha, which is 5% of the total area to be affected as a result of the Project. There are no Class II soils corresponding to the Project units. Class III soils covers an additional area of 34.6 ha (71% of the total affected area). Class IV soils are present at 100.1 ha (20.6%) of the affected area; however, it is not likely that all of Class IV soils are used for soil cultivation as total area of agricultural lands to be affected is 72 ha. The remainder of the total affected area is formed of Class VI, VII and VII soils, which are classified as not suitable for soil cultivation.

If the work sites and access roads are not clearly described during the construction and operation phases, adjacent soils may also become disturbed.

Table 6-11 Land Use Capability Classes of the Affected Soils

Land Use Capability Class	Open Pit		Çorakoğlu WRD		Kepezkaya TSF		Bağdere TSF		Access Roads		Others*		Area	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Total (ha)	Percent (%)
I	0.0	0.0	0.3	0.2	15.7	38.4	0.0	0.0	0.0	0.0	8.2	13.6	24.2	5.0
II	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III	0.0	0.0	34.6	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.6	7.1
IV	0.0	0.0	5.9	2.9	19.5	47.8	58.3	93.9	0.3	2.4	16.1	26.7	100.1	20.6
V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VI	13.4	11.8	146.1	73.4	0.0	0.0	0.0	0.0	0.6	5.6	4.5	7.5	164.6	33.8
VII	90.7	80.0	11.6	5.8	5.6	13.8	0.0	0.0	9.9	85.5	27.7	45.9	145.4	29.9
VIII	9.4	8.2	0.6	0.2	0.0	0.0	3.8	6.0	0.7	6.5	3.8	6.2	18.0	3.7
Total	**113.4**	**100**	**199.0**	**100**	**40.8**	**100**	**62.1**	**100**	**11.6**	**100**	**60.4**	**100**	**487.3**	**100.0**

* Others include process plant, top soil storage areas, diversion system inlet and outlet, spillway, Küpeli storage area, mobilization site, ore storage area, administrative buildings. Since the total area to be covered by ETL pylons (3,900 m^2) is negligible and they are distributed along the 28 km route, they have not been included in this analysis for practical reasons.

Erosion of Soils

Soil erosion is process of soil material transportation resulting in extensive degradation, which can occur either naturally within its own balance or be expedited by human activities. Improper agricultural practices (e.g. such as cultivation on relatively high slope lands, plowing of the fields in the direction of the slope and excessive grazing on pasturelands or deforestation) can increase the rate of erosion. The agents of soil erosion are water and wind, whereas water is known to be more prominent. Water erosion is observed on lands with sparse or no vegetative cover allowing runoff to flow with sufficient energy transporting loosened soil particles down the slope. This results in the loss of fertile top layer from the agricultural lands causing reduced agricultural productivity and deteriorated quality of the surface water resources as a result of sedimentation and eutrophication (Former Ministry of Agricultural and Rural Services, July 2008).

Land preparation, construction and operation activities to be conducted in the scope of the Project will increase the risk of soil erosion with the effect of wind and rain. Additionally, the ground surfaces that will become exposed as result of Project activities (land clearing, open pit mining, etc.) will have increased risk of erosion. Erosion of littoral areas during the wet season of the year as a result of elevated flow rates of the Gökırmak River and its tributaries will also be a concern in the scope of the Project. It should be noted that an Erosion and Sedimentation Control Plan has already been developed for the Project (see Volume IV of the ESIA).

Soils having severe and very severe baseline erosion conditions will be more sensitive to erosion impacts. Based on the erosion degree map provided in Section 6.2, the northern bank of the Gökırmak River is generally classified as having no/slight erosion risk and moderate erosion risk except the area corresponding to south of the Çorakoğlu WRD and west of the Open Pit. Erosion risk within these zones is partially mitigated as a result of existence of dense natural vegetation that favors the capturing of river sediments and resisting erosion of the river banks. Considerable soil depth and vegetative cover were also observed at some locations in the Project Area, especially in gently sloping colluvial areas and flat alluvial areas (river terraces) found at the river banks. These littoral zones of the Gökırmak River are classified within very severe erosion class due to the river bank slopes and geometry of the river along the diversion tunnel construction area. These severe risk zones might be affected from littoral erosion as a result of disturbance due to diversion tunnel construction. It is necessary to stabilize the downslope side of the cuts in order to contain the fall-downs of the larger materials like debris and rock fragments and to check slopes sliding down given construction cuts will be implemented on the slopes, which are nearby the river.

Soil Contamination

Hazardous materials leakage/spill, wastewater leakage/spill/uncontrolled discharge and improper waste management practices during the construction and operation phases may result in contamination of soils. During the operation and post-operation phases, potential ARD/ML leachates from the bottom of WRDs and TSFs due to poor segregation of WRD and potential damage on TSF liner will be other risk sources for soil contamination.

6.3.2 Mitigation

Mitigation measures to be taken to manage impacts on land use and soils are listed in Table 6-12 for the potential impacts identified in the previous sections. Significance of impacts before and after mitigation (residual impacts) is also identified in the table.

Table 6-12 Summary of Impacts, Mitigation and Residual Impacts for Land Use and Soils

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Loss of forests and shrubs (415.2 ha)	Ecosystem components Local communities	High -Restricted -Long-term -Long-term reversible -High in magnitude -One-off	High (National importance)	Major	• A reforestation plan will be developed and implemented • Erosion and Sediment Control Plan will be implemented	Moderate
Loss of agricultural land (72 ha)	Local communities	Medium -Restricted -Long-term -Irreversible or long-term reversible -Low in magnitude -One-off	Medium (Regional importance)	Major	• Measures to be taken to mitigate social and economic impacts of agricultural land loss are described in the SIA Report (ESIA Volume II) • Vehicle movements will be restricted to designated roads to avoid disturbance of soils adjacent to the roads. • Erosion and Sediment Control Plan will be implemented	Minor
Loss of pasturelands (8,900 m^2)	Local communities (Vakıfgeymene)	High -Restricted -Long-term -Long-term reversible -Negligible in magnitude -One-off	Low (Local importance)	Major	• Measures to be taken to mitigate social and economic impacts of pasture land loss are described in the SIA Report (ESIA Volume II) (e.g. signing pasture agreements between the Project Owner and the affected settlements administration) • Implement the Erosion and Sediment Control Plan	Negligible
Diversion of Gökırmak River section corresponding to the open pit (along 1.5 km river section that is diverted via two 650 m long tunnels and river diversion system)	Gökırmak River and aquatic life	Medium -Restricted -Long-term -Irreversible -Low in magnitude -Continuous	Low (Local importance)	Major	• A River Diversion System has been constructed to allow continuity of Gökırmak River's flow in the stretch that crossed the open pit area (see Section 3.3.7 for details) • Erosion and Sediment Control Plan will be implemented • Aquatic biodiversity impacts addressed via implementation of the Biodiversity Management Plan • Reinstatement of the river flow through the pit lake after the mine closure in line with the site-specific Mine Closure and Rehabilitation Plan	Minor
Top soil stripping and management (565,613 m^3)	Ecosystem components Local communities	Low -Restricted -Short-term -Short-term reversible -Medium in	Low (Local importance)	Moderate	• Top soil stripping and excavation activities will be performed in compliance with the Regulation on Control of Excavated Soil, Construction and Demolition Wastes, EBRD performance Requirement 3 and other good international practice. • Unnecessary soil stripping will not be carried out during	Negligible

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
		magnitude -Intermittent			construction activities to minimize disturbance to vegetation, grpund species and soils. • Soil loss will be minimized with suitable equipment, procedure, and work schedule (windy and rainy periods should be avoided for activities that cause soil disturbance such as soil stripping, etc.). • The topsoil will be carefully stripped up to its full depth and stored at topsoil storage areas to be used for the rehabilitation activities. The stockpiles will have a maximum height of 2 m to avoid the occurrence of anaerobic conditions and will be drained with open channels. To avoid wind and rain erosion of the stockpiles, measures such as light compacting of the stockpile surfaces to reduce rain penetration, moisturizing the stockpile surfaces, covering the surfaces with a plastic cover, or grain-sized gravel will be taken, where applicable. • Soil conservation measures such placement, location, design, duration, coverage and reuse will be considered in top soil storage. Storage areas will be protected to prevent erosion. • Vegetative soil will not be used as fill material under any circumstances (prohibition of backfilling practice).. • Topsoil will be placed back after the closure of the Project units such as WRDs and TSFs. • Erosion and Sediment Control Plan will be implemented • Mine Closure and Rehabilitation Plan will be implemented.	
Erosion of soils	Ecosystem components	Medium -Restricted -Long-term -Long-term reversible -Medium in magnitude -Intermittent	Medium (Regional importance)	Major	• Erosion and Sedimentation Control Plan will be implemented and updated as necessary to prevent/minimize the landslide and erosion impacts that might potentially arise as a result of Project activities. • Natural vegetation will be preserved in non-exposed ground areas for effective sediment and erosion control. • Disturbance to existing areas of site vegetation will be limited, especially along the Gökırmak River and its tributaries to minimize littoral erosion and landslides. • All required and effective drainage and construction procedures will be applied in order to minimize the impacts on soil hydrology and to benefit soil infiltration. Interception channels around the Open Pit, WRDs and TSFs will be built to divert runoff waters and to prevent/minimize erosion	Minor

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
					caused by water. • Limiting activities (particularly for Open Pit and WRDs) during adverse weather conditions to reduce potential wind and water erosion will be considered. • Erosion and Sediment Control Plan will be implemented. • Walls stability in the open pit will be monitored.	
Soil contamination	Ecosystem components Project personnel Local communities	Low -Restricted -Short-term -Reversible -Low to high magnitude -One-off	Low (Local importance)	Moderate	• Waste rock material potentially generating Acid Rock Drainage and Metal Leachate will be encapsulated within the WRDs to minimize any impact on underlying soil and groundwater. Mineralized vein waste will be placed randomly within the WRD to allow access to neutralization potential. Closure capping will be implemented with a capillary break layer of 0.15m of gravel, an impermeable clay layer of 0.5m and an upper erosion/desiccation protection layer of 0.1 m of gravel. Contouring and closure capping of the WRD to be completed as rapidly as possible after the end of WRD construction. • TSFs bed will be lined with high density polyethylene (HDPE) liner to prevent any leakage to soil and groundwater • The non-mining waste storage areas will be constructed on hard surface and with other relevant measures that prevent soil as well as surface and groundwater pollution. Non-mining waste management at the Project Area will be done in line with Turkish legislation, international legislation/guidance documents (listed at the beginning of this section), the Waste Management and Pollution Prevention Plan, and good international industry practices. Hazardous waste will be temporarily stored on-site in an area designated just for this purpose, appropriately enclosed and with concrete paved surface and managed in line with the Hazardous Materials and Chemical Usage Management Plan. • The water accumulated at the open-pit due to groundwater leakage and precipitation will be pumped out to sedimentation ponds to prevent soil and groundwater contamination. Run-off waters from undisturbed areas around disturbed areas will be diverted including areas that have been graded, seeded or planted. Such drainages will be diverted to sedimentation ponds to be treated for sediment removal.	Negligible

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
					• Waste storage out of the designated storage areas will be prohibited. • Oil changes, refueling, or lubrication of vehicles will be conducted in a dedicated area with hard surface. Storage tanks and refueling stations will be equipped with drip trays and spill control equipment. • All measures will be taken into consideration for possible leakage in line with the Emergency Action Plan. • When spills or leakages of any type of hazardous materials occur, the contamination will be controlled by using absorbents. The contaminated soil (if any) will be stripped to the adequate depth and disposed as hazardous waste in compliance with the provisions of “Regulation on Hazardous Waste Control” and the Oil and Chemicals Spill Response Plan and Hazardous Materials and Chemical Usage Management Plan. • No wastewater discharges of any type to land will be allowed. • Hazardous Materials and Chemical Usage Management Plan will be implemented. • Waste Management and Pollution Prevention Plan will be implemented • Oil and Chemicals Spill Response Plan will be implemented • Emergency Preparedness Plan for Kepezkaya Tailings Storage Facility will be implemented. • In case of a spill/leakage incident on-site, contamination levels will be identified by means of sampling and analyses studies to be conducted by accredited laboratories and the results will be compared with baseline concentrations of the related parameters to plan corrective actions where necessary.	

6.4 Air Quality

This section of the EIA Report presents the findings of the assessment of impacts of the GCP on air quality as a result of the construction and operation activities.

The Project related impacts are assessed taking into account both national legislation and international standards, namely relevant EU Directives, IFC EHS Guidelines for Mining Sector, EU BAT Reference Document for Management of Tailings and Waste Rock in Mining Activities.

6.4.1 Emission Sources

The Project has the potential to affect local air quality due to emissions from earthmoving activities and stationary sources, exhaust and blasting emissions. Potential emission sources of mining activities are:

- Overburden removal (excavation)
- Boring/Blast hole drilling
- Blasting
- Blasting explosives
- Material handling (excavation, earthmoving, loading, handling)
- Wind erosion of stockpile surfaces
- Exhaust emissions from vehicles and construction/operation machinery
- Vehicles and equipment moving on unpaved surfaces
- Combustion of coal for heating purposes

The principal air pollutants from mining operations are given in Table 6-13 below.

Table 6-13 Air Emissions from Mining Operations

Earthmoving Emissions	**Emissions of Exhaust, Stationary Sources and Blasting**
Particulate Matter (PM_{10})	Oxides of nitrogen, or NOX composed of nitrogen dioxide (NO2) and nitric oxide (NO)
Particulate Matter ($PM_{2.5}$)	Carbon monoxide (CO), Carbon dioxide (CO_2)
Dust (comprising both suspended and deposited dust, i.e. Settled dust)	Sulfur dioxide (SO_2)
	Ozone (O_3)
	Metals (Lead, Arsenic, Cadmium, Nickel)
	Hydrocarbons (HCs)
	Benzene (C_6H_6)

The assessment of impacts on local air quality from the Project focuses on dust ($PM_{10,}$ $PM_{2.5,}$ and settled dust) and exhaust emissions.

6.4.1.1 Dust Emissions

Dust is defined as all particulate matter up to 75 µm in diameter and comprising both suspended and deposited dust; whereas, PM_{10} is a mass fraction of airborne particles of diameter 10 µm or less. Fine particles (PM2.5) are 2.5 micrometers in diameter or smaller, and can only be seen with an electron microscope. Fine particles are produced from all types of combustion, including motor vehicles.

According to Watson and Chow (2000), samples taken from excavation sites have about 35% of particulate matter in the PM_{10} fraction. The health impacts associated with dust include eye, nose and throat irritation in addition to the nuisance caused by deposition on cars, windows and property. Dust, PM_{10} and $PM_{2.5}$ emissions arise from a number of sources, so both construction activities and emissions from vehicles associated with the construction site need to be considered. Particulate matter contains microscopic solids or liquid droplets that are so small that they can be inhaled and cause serious health problems. Particles less than 10 micrometers in diameter pose the greatest problems, because they can get deep into lungs, and some may even get into bloodstream (US EPA, Health and Environmental Effects of Particulate Matter (PM).

Table 6-14 presents the Project Standards applicable for construction and operation phase of the Project (see Baseline Air Quality Section for details) in relation to ambient air quality for PM_{10}, PM2.5 and settled dust. .

Table 6-14 Project Standards for PM10, PM 2.5 and Settled Dust

Parameter	Averaging Period	Limit	Reference
PM_{10}	24 hour (not to be exceeded more than 35 times a calendar year)	50 µg/m3	AQMRD, IAPCR, IFC/WB and EU Limits are compatible
	1 year	20 µg/m3	IFC/WB[1]
$PM_{2.5}$	1 year	10 µg/m3	IFC/WB[1]
	24-hour	25 µg/m3	IFC/WB[1]
Settled dust[2] (mg/Nm3-day)	Monthly	390 (mg/Nm3-day)	AQMRD, IAPCR
	1 Year	210 (mg/Nm3-day)	AQMRD, IAPCR

[1] *The strictest limit is taken as a reference*
[2] *IFC/WB and EU does not provide settled dust limit.*

6.4.1.2 Emissions of Exhaust, Stationary Sources and Blasting

The main products of the combustion of motor fuels are carbon dioxide and water, but inefficiencies and high temperatures inherent in engine operation encourage the production of many other pollutants of varying effects. Carbon monoxide (CO), nitrogen oxides (NOx), and particulate matter the one of major pollutants of vehicle emissions.

Table 6-15 presents the Project Standards applicable for construction and operation phase of the Project (see Baseline Air Quality Section for details) for emissions from exhaust, stationary sources and blasting in relation to ambient air quality limits.

Table 6-15. Project Standards for Emissions from Exhaust, Stationary Sources and Blasting

Parameter	Averaging Period	Limit	Reference
Sulphur dioxide (SO_2)	1 hour (not to be exceeded more than 24 times a calendar year)	350 µg/m3	AQMRD, IAPCR and EU Limits are compatible[1]
	24 hour (not to be exceeded more than 3 times a calendar year)	125 µg/m3	IFC/WB
	Yearly	20 µg/m3	EU
	1 Year and Winter seasion (1 October to 31 March) - ecosystem protection	20 µg/m3	AQMRD, IAPCR and EU Limits are compatible[1]
NOx	1 Year - For the protection of vegetation	30 µg/m3	AQMRD, IAPCR and EU Limits are compatible[1]
Nitrogen dioxide (NO_2)	1 hour (not to be exceeded more than 18 times a calendar year)	200 µg/m3 (1 Jan 2024)	AQMRD, IAPCR IFC/WB and EU Limits are compatible
	Yearly	40 µg/m3	AQMRD, IAPCR IFC/WB and EU Limits are compatible
CO	Maximum daily 8 hour mean	10 µg/m3	AQMRD, IAPCR and EU Limits are compatible[1]
Lead (Pb)	Yearly	0.5 µg/m3	
Arsenic	Yearly	6 ng/m3	
Cadmium	Yearly	5 ng/m3	
Nickel	Yearly	20 ng/m3	
Ozone	Maximum daily 8 hour mean	100 µg/m3	AQMRD, IAPCR IFC/WB and EU Limits are compatible

[1] IFC does not provide limit for this averaging period.

The potential impact of the Project was assessed considering the scenario corresponding to the highest material movement (ore and waste rock) according to the Project feasibility study. Accordingly, the following case is modelled:

- Second year of Operation Phase (Y2) (with Çorakoğlu WRD in operation) – Controlled 43,600,000 tonnes of material movement (41,600,000 tonnes waste rock and 2,000,000 tonnes ore)

The construction is currently underway and air quality measurements are being conducted for the abovementioned parameters at the Project Area as given in the baseline section.

6.4.2 Emission Calculations (dust, PM_{10} and gaseous emissions)

The main sources of air emissions from the Project will be:

- Dust emissions from excavation, earthmoving, loading, handling, waste rock storage, vehicles moving over dusty surfaces
- Emissions from blasting
- Dust emissions from haul (unpaved) roads
- Exhaust emissions from construction machinery and vehicles
- Other emission sources (e.g. coal usage for heating).

According to the Turkish IAPCR (2009), if the mass flow rate of PM10 emissions from area sources is below the limit value of 1 kg/hr, there is no need to perform a modelling study.

6.4.2.1 Dust Emissions

Dust emissions will be caused mainly by excavation, loading, transportation, unloading, waste rock storage works. To identify the real-case scenario, controlled dust emissions were calculated. Controlled dust emission factors from the Turkish IAPCR Annex-1 were used in determining dust emissions as given below.

Table 6-16.Controlled Dust Emission Factors

Sources	Dust Emission Factors (kg/ton)
	Controlled
Excavation	0.0125
Loading	0.005
Transportation	*
Unloading	0.005
Storage	2.9 (kg dust/hectare day)

Source: Industrial Air Pollution Control Regulation (IAPCR), Official Gazette No. 27277 dated July 3, 2009

*The Transportation Emissions factors used from EPA AP42, Section 13.2.2 Unpaved Roads Document

Dust emission calculations for the years Y2 (second year of operation) for the controlled case for different activities are tabulated below.

Table 6-17.Controlled Dust Emissions from Waste Rock Movement for Y2

Amount of material: 41,600,000 tonnes (out of 43,600,000 tonnes)

EXCAVATION					
All material will be torn by blasting.					
LOADING FROM OPEN PIT					
Explanation	**Total amount of material**	**Full operating time**	**The amount of material from loading**	**The emission factor for loading**	**Total emission amount**
Formula	The amount of material tons/m3	Total work hours per day	(The amount of material - daily) / [the number of shift * 338 day) * (1 day / 19,5 hrs)]	0.005 kg/ton	(The amount of material) * (Emission Factor)
Results	41,600,000 tonne	19.5 hr	6,311.63tons/hr		31.6 kg/hr
UNLOADING TO ÇORAKOĞLU WRD					
Explanation	**Total amount of material**	**Full operating time**	**The amount of material from unloading**	**The emission factor for unloading**	**Total emission amount**
Formula	The amount of material tons/m3	Total work hours per day	(The amount of material - daily) / [the number of shift * 338 day) * (1 day / 19,5 hrs)]	0.005 kg/ton	(The amount of material) * (Emission Factor)
Results	41,600,000 tonne	19.5 hr	6,311.63 tons/hr		31.6 kg/hr
TOTAL EMISSION					63.2 kg/hr

Table 6-18.Controlled Dust Emissions from Ore Movement for Y2

Amount of material: 2,000,000 tonnes (out of 43,600,000 tonnes)

EXCAVATION					
All material will be torn by blasting.					
LOADING					
Explanation	**Total amount of material**	**Full operating time**	**The amount of material from loading**	**The emission factor for loading**	**Total emission amount**
Formula	The amount of material tons/m3	Total work hours per day	(The amount of material - daily) / [the number of shift * 338 day) * (1 day / 19,5 hrs)]	0.005 kg/ton	(The amount of material) * (Emission Factor)
Results	2,000,000 tonne	19.5 hr	303.44 tons/hr		1.51 kg/hr
UNLOADING					
Unloading to a Closed (confined) Facility					
TOTAL EMISSION					1.51 kg/hr

Table 6-19.Controlled Dust Emissions from Wind Erosion of Corakoglu WRD for Y2

Çorakoğlu WRD					
Explanation	**Storage surface area**	**Full operating time**	**The emission factor for Storage**	**Total emission amount**	
Formula	Total storage surface area hectare at Y2	Emissions Activity Average	2.9 (kg dust/hectare day)	(Total storage surface area hectare) * (Emission Factor) / 24	
Results	120 ha	24 hr		14.9 kg/hr	
TOTAL EMISSION					14.9 kg/hr
Ore Storage Area – No dust emissions as it is a closed (confined) facility.					

6.4.2.2 Emissions from Blasting

The main emissions from blasting are PM10, *NOx, H_2S and SO_2. These emissions for GCP are calculated as below.*

PM10 Emissions from Blasting

The following formula is used to estimate PM10 emissions from the displacement of solid rock through the use of explosives (*Source : * Source: U.S. EPA Fifth Edition, Volume I Chapter 11, Mineral Products Industry, section 11.9: Western Surface Coal Mining, table 11.9-2"*).

PM_{10} Emissin Factor (kg/blast) = $EF_{(PM10)}$ = $(0.00022\ (A)^{1.5})$ x 0.52

A: horizontal area* (m2), with blasting ≤ depth 21 m.
EF : Emission factor for corresponding PM (kg/blast)
0.52 : PM10 Scaling Factor
* *The blasting area on the open pit was assumed to be 6000 m^2*

PM10 Emission Factor (kg/blast) = $(0.00022 \times 6000^{1.5})$ x 0.52
PM10 Emission Factor (kg/blast)= 53.17

Dust emission duration during blasting is assumed to be 15 minutes.
PM10 Emission (gr/sec) = 53.17/15 min /60 sec * 1000
PM10 Emission (gr/sec) = 59.08 gr/sec

Other emissions from blasting

The emission factors for *NOx, H_2S and SO_2 from blasting are given below.*

Table 6-20.Emission Factors for Detonation of ANFO

Type	Composition	CO (kg/tonne)	NOx (kg/tonne)	H2S (kg/tonne)	SO2 (kg/tonne)
ANFO	Ammonium nitrate with 5.8-8% fuel oil	34	8	-	1

Source: Source: U.S. EPA Fifth Edition, Volume I Chapter 13, section 13.3: 'Explosive detonations, Table 11.3-1

Accordingly, the Project emissions are calculated as follows:

Table 6-21.Emission from Detonation of ANFO

Type	Annual Usage (for Y2)	CO (kg/tonne)	NOx (kg/tonne)	H2S (kg/tonne)	SO2 (kg/tonne)
Blasting – ANFO [(1)]	3,666 tonnes	124.6	29.3	-	3.7

[1] *Emission factor of dynamite and ANFO are obtained from EPA Emission Factors for Detonation of Explosives*

6.4.2.3 Dust Emissions from Haul (Unpaved) Roads (Transportation)

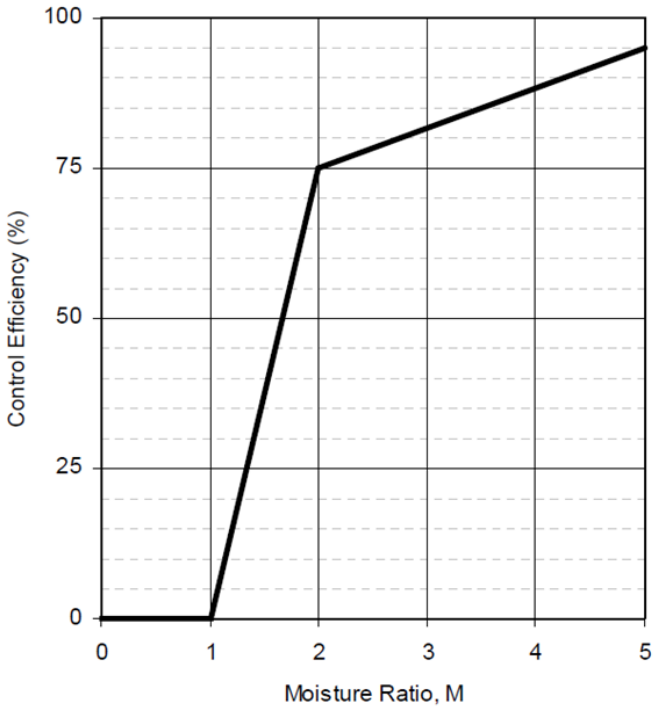
When a vehicle travels on an unpaved surface such as an unpaved road or unpaved parking lot, the force of the wheels on the road surface causes pulverization of surface material.

The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic. Dust emissions from unpaved roads have been found to vary directly with the fraction of silt (particles smaller than 75 micrometers in physical diameter) in the road surface materials.

The haul roads are subject to some natural mitigation because of rainfall and other precipitation. The annual average emissions are inversely proportional to the number of days with measurable (more than 0.254 mm) precipitation.

Control Efficiency

As shown in Figure 6-10 below, the control effect can be increased up to 95% with 5 times of wetting per day (USEPA, Control of Open Fugitive Dust Sources, 1988). At the GCP, the haul roads will be watered sufficiently to achieve 90% control efficiency.



Source: EPA AP42- 13.2.2 Unpaved Roads Document

Figure 6-10 Watering Control Effectiveness for Unpaved Roads

Haul Roads Emission Calculation

The following flowchart is used for Emission Calculation of the Project haul roads;

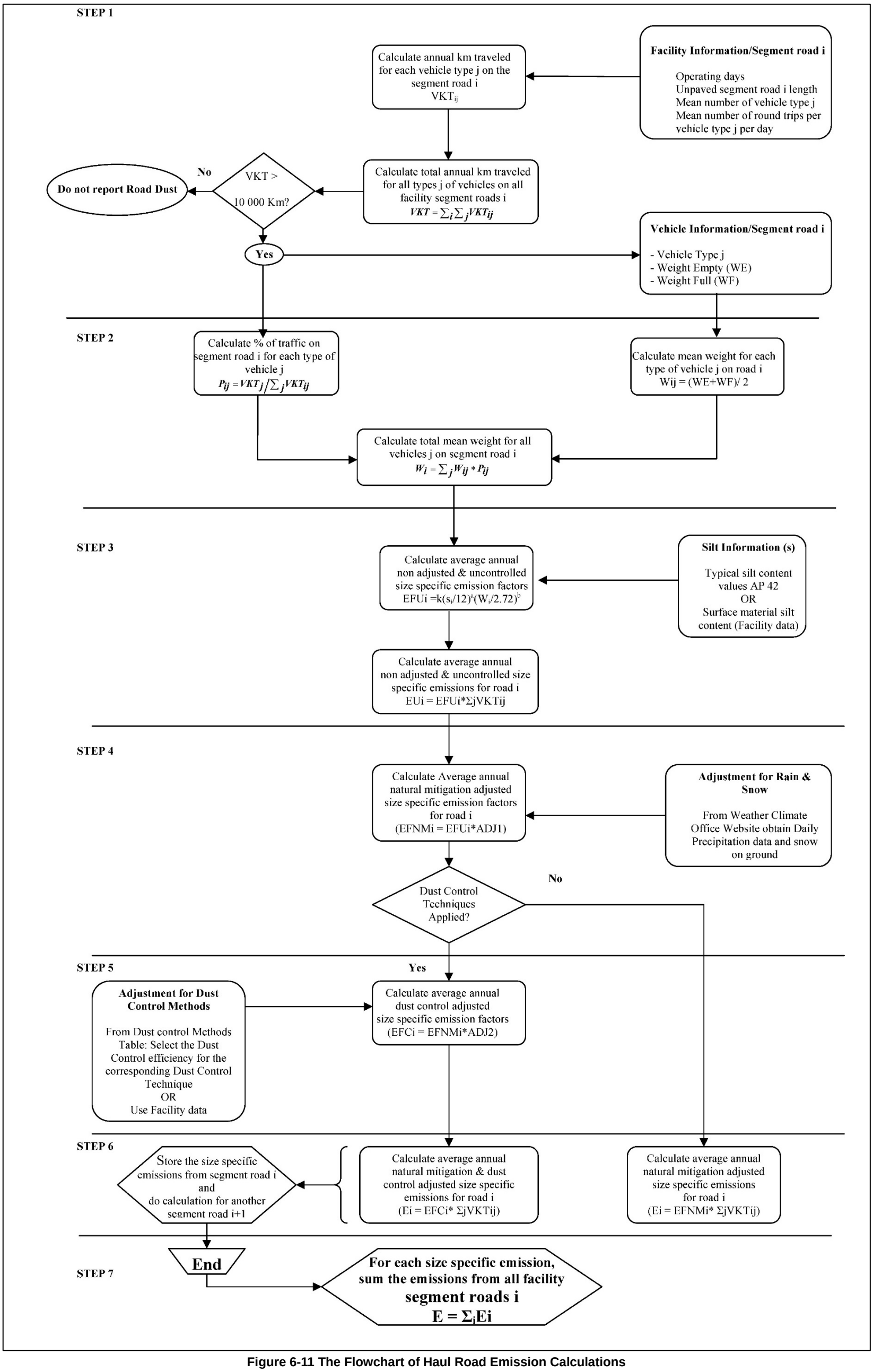


Figure 6-11 The Flowchart of Haul Road Emission Calculations

Source: Environment and Climate Change Canada and EPA

The emission calculations and result for GCP are given in below

Table 6-22. Emission Calculations of Haul Roads

Parameter	Ore Transportation Road (Y2)	Çorakoğlu WRD Road (Y2)	Unit
Unpaved Segment Road Length	5	1.84	km
Number of operating days per year	338	338	Days/Year
Number of operating hours per a work day	10	19,5	Hours/Day
Silt Content	8.4		%
Estimated working days when roads were frozen or snow covered and wet for Winter + Estimated working days with precipitation exceeding 0.2 mm	120		Days[1]
Average daily traffic	54	3005	#/day
Mean Vehicle Weight	38	38	metric tonnes
Calculated VKT [2]	91260	1868869	km
Annual uncontrolled emissions	91.8	1878	tonnes per year (PM10)
Dust Control Technique	Watering more than five a day		
Dust Control Technique Efficiency	90%		%
Adjustment factor for natural mitigations	64		%
Annual adjusted emissions for natural mitigation	59.1	1211.2	tonnes per year (PM10)
Total Release[3]	5.91	121.12	tonnes per year (PM10)
Total Release	1.75	18.38	kg/hour (PM10)

[1] *Calculated from Meteorological Data*
[2] *Vehicle Kilometers Travelled (VKT)* - Based on the road length, number of vehicles, the days of operation, the kilometres travelled by each class of vehicle. This calculation is used when the actual VKT is unknown.
[3] *The total release take in account the natural mitigations and any other applied dust control methods.*

6.4.2.4 Exhaust Emissions

Construction machinery and vehicles use mainly diesel engines that can lead to emissions of NOx and particulate matter. Most site equipment (excavator, dozer, trucks, loaders, bulldozers, diggers, etc.) can be considered as similar to medium or heavy duty trucks. Vehicles are used mainly for the transport of materials and equipment on and off site.

Emission factors for the exhausts of construction and operation equipment were taken from the US EPA WebFIRE Database. Calculated total hourly emissions from the construction equipment at different phases of the construction activities are given in Table 6-23. According to the Turkish IAPCR (2009), if the mass flow rate of emissions from area sources is below the parameter-specific limit value, there is no need to perform a modelling study for the pollutant. However, as the emissions amount caused by equipments and vehicles do exceed the limit value given in Table 6-24 and NOX and SO_2 was modelled for operation phase of the Project.

Type and number of estimated equipment and machinery that will be used during the construction and operation period are listed in Table 6-23.

Table 6-23. Estimated Equipment List for Construction and Operation Period[1]

Equipment	Construction Period	Equipment	Operation Period
	Number of Items		Number of Items
Backhoe Loader	4	Backhoe Loader	1
Bus	1	Backhoe/loader	1
Crane	2	Backhoe-excavator (35 t)	2
Cylinder	1	Backhoe-excavator (50 t)	1
Cylinder	30	Backhoe-excavator (85 t)	5
Drill Rig	3	Backhoe-excavator (85 t)	5
Dump Truck	15	Boom Truck 20T	1
Excavator	8	Compactor	1
Forklift	1	Concentrate FEL	1
Grader	1	Forklift	1
Grader	1	Front-end loader	2
Jumbo	3	Grader	2
Loader	6	Haul truck	89
Mobile Crane	1	Loader F/E	1
Rock Drill	1	Mobile Crane 60T	1
Shot Crete	4	Motor grader	4
Snow Removal/Dump Truck	1	Rockbreaker attachment	1
Tractor	2	ROM FEL	1
Truck	53	Rotary/DTH drill	2
Truck 1/2 tonne	4	Rotary/DTH drill	3
Truck Mixer	8	Snow Removal/Dump Truck	1
Water Truck	1	Track dozer	1
		Track dozer	2
		Truck 1/2 tonne	6
		Vibrating roller	2
		Water truck	4
		Welding Truck	1

[1] *Information provided by Acacia*

Table 6-24 Exhaust Emission Calculations of Fuel Usage

Substance Name	Emission Factors				Earthwork Activities on Open Pit (Fuel Usage at Y2 = 7,902,685 Liters)[2]		Material Movement to Corakoglu WRD (Fuel Usage at Y2= 6,778.74)[2]		Ore Movement to Process Plant (Fuel Usage at Y2=7902685 Liters)[2]		Process Plant Activies (Fuel Usage at Y2=196666 Liters)[2]		Total Release	Limit	Air Quality Modeling requirement? (according to IAPCR)
	CAS Number	Emission Factor	EF*** Units	EF Rating	Total Release to 3 decimals	kg/hr	Total Annual Release to 3 decimals	kg/hr	Total Release to 3 decimals	kg/hr	Total Release to 3 decimals	kg/hr	kg/hr	kg/hr	
1,3-Butadiene	106-99-0	3,209E-04	kg/m3	E	0,003 tonnes	0,0004	0,002 tonnes	0,0003	0,000 tonnes	0,0000	0,000 tonnes	0,0000	0,0008	-	N/A[1]
1,3-Butadiene	106-99-0	3,209E-04	kg/m3	E	0,003 tonnes	0,0004	0,002 tonnes	0,0003	0,000 tonnes	0,0000	0,000 tonnes	0,0000	0,0008	-	N/A
Acenaphthene	83-32-9	1,166E-05	kg/m3	E	0,092 kg	0,0000	0,079 kg	0,0000	0,008 kg	0,0000	0,002 kg	0,0000	<0.000	-	N/A
Acenaphthylene	208-96-8	4,153E-05	kg/m3	E	0,328 kg	0,0000	0,282 kg	0,0000	0,028 kg	0,0000	0,008 kg	0,0000	<0.000	-	N/A
Acetaldehyde	75-07-0	1,259E-02	kg/m3	E	0,100 tonnes	0,0151	0,085 tonnes	0,0129	0,009 tonnes	0,0013	0,002 tonnes	0,0004	0,0297	-	N/A
Acrolein	107-08-8	7,593E-04	kg/m3	E	0,006 tonnes	0,0009	0,005 tonnes	0,0008	0,001 tonnes	0,0001	0,000 tonnes	0,0000	0,0018	-	N/A
Anthracene	120-12-7	3,070E-05	kg/m3	E	0,000 tonnes	0,0000	0,000 tonnes	0,0000	0,000 tonnes	0,0000	0,000 tonnes	0,0000	<0.000	-	N/A
Benzene	71-43-2	1,532E-02	kg/m3	E	0,121 tonnes	0,0184	0,104 tonnes	0,0158	0,010 tonnes	0,0016	0,003 tonnes	0,0005	0,0362	-	N/A
Benzene	71-43-2	1,532E-02	kg/m3	E	0,121 tonnes	0,0184	0,104 tonnes	0,0158	0,010 tonnes	0,0016	0,003 tonnes	0,0005	0,0362	-	N/A
Carbon Monoxide (CO)	**630-08-0**	**1,560E+01**	**kg/m3**	**D**	**123,246 tonnes**	**18,6991**	**105,717 tonnes**	**16,0396**	**10,650 tonnes**	**1,6158**	**3,067 tonnes**	**0,4653**	**36,8198**	**50**	**Not Required (but modelled within this Report)**
Dibenzo (a,h) anthracene	53-70-3	4,785E-06	kg/m3	E	0,038 kg	0,0000	0,032 kg	0,0000	0,003 kg	0,0000	0,001 kg	0,0000	<0.000	-	N/A
Fluoranthene	206-44-0	1,249E-04	kg/m3	E	0,987 kg	0,0001	0,847 kg	0,0001	0,085 kg	0,0000	0,025 kg	0,0000	0,0003	-	N/A
Fluorene	86-73-7	4,794E-04	kg/m3	E	3,788 kg	0,0006	3,249 kg	0,0005	0,327 kg	0,0000	0,094 kg	0,0000	0,0011	-	N/A
Formaldehyde	50-00-0	1,937E-02	kg/m3	E	0,153 tonnes	0,0232	0,131 tonnes	0,0199	0,013 tonnes	0,0020	0,004 tonnes	0,0006	0,0457	-	N/A
Formaldehyde	50-00-0	1,937E-02	kg/m3	E	0,153 tonnes	0,0232	0,131 tonnes	0,0199	0,013 tonnes	0,0020	0,004 tonnes	0,0006	0,0457	-	N/A
Indeno(1,2,3-c,d) pyrene	193-39-5	3,078E-06	kg/m3	E	0,024 kg	0,0000	0,021 kg	0,0000	0,002 kg	0,0000	0,001 kg	0,0000	<0.000	-	N/A
Isomers of Xylene	1330-20-7	4,679E-03	kg/m3	E	0,037 tonnes	0,0056	0,032 tonnes	0,0048	0,003 tonnes	0,0005	0,001 tonnes	0,0001	0,0110	-	N/A
Isomers of Xylene	1330-20-7	4,679E-03	kg/m3	E	0,037 tonnes	0,0056	0,032 tonnes	0,0048	0,003 tonnes	0,0005	0,001 tonnes	0,0001	0,0110	-	N/A
Mercury	7439-97-6	4,948E-06	kg/m3	U	0,039 kg	0,0000	0,034 kg	0,0000	0,003 kg	0,0000	0,001 kg	0,0000	<0.000	-	N/A
Naphthalene	91-20-3	1,392E-03	kg/m3	E	0,011 tonnes	0,0017	0,009 tonnes	0,0014	0,001 tonnes	0,0001	0,000 tonnes	0,0000	0,0033	-	N/A
Oxides of Nitrogen, expressed as NO2 (NOx)	**11104-93-1**	**7,240E+01**	**kg/m3**	**D**	**572,119 tonnes**	**86,8031**	**490,751 tonnes**	**74,4577**	**49,437 tonnes**	**7,5006**	**14,238 tonnes**	**2,1602**	**170,9216**	**4**	**Required (Modelled)**
Phenanthrene	85-01-8	4,826E-04	kg/m3	E	3,814 kg	0,0006	3,272 kg	0,0005	0,330 kg	0,0001	0,095 kg	0,0000	0,0011	-	N/A
Propylene	115-07-1	4,235E-02	kg/m3	E	0,335 tonnes	0,0508	0,287 tonnes	0,0436	0,029 tonnes	0,0044	0,008 tonnes	0,0013	0,1000	-	N/A
Propylene	115-07-1	4,235E-02	kg/m3	E	0,335 tonnes	0,0508	0,287 tonnes	0,0436	0,029 tonnes	0,0044	0,008 tonnes	0,0013	0,1000	-	N/A
Pyrene	129-00-0	7,847E-05	kg/m3	E	0,620 kg	0,0001	0,532 kg	0,0001	0,054 kg	0,0000	0,015 kg	0,0000	0,0002	-	N/A
Sulphur Dioxide (SO2)	**7446-09-5**	**4,761E+00**	**kg/m3**	**D**	**37,622 tonnes**	**5,7081**	**32,272 tonnes**	**4,8963**	**3,251 tonnes**	**0,4932**	**0,936 tonnes**	**0,1421**	**11,2397**	**6**	**Required (Modelled)**
Toluene	108-88-3	6,714E-03	kg/m3	E	0,053 tonnes	0,0081	0,046 tonnes	0,0069	0,005 tonnes	0,0007	0,001 tonnes	0,0002	0,0159	-	N/A
Toluene	108-88-3	6,714E-03	kg/m3	E	0,053 tonnes	0,0081	0,046 tonnes	0,0069	0,005 tonnes	0,0007	0,001 tonnes	0,0002	0,0159	-	N/A
Volatile Organic Compounds (VOCs)	*	5,910E+00	kg/m3	D	46,704 tonnes	7,0860	40,061 tonnes	6,0782	4,036 tonnes	0,6123	1,162 tonnes	0,1763	13,9528	-	N/A

[1] *Not Applicable : Industrial Air Pollution Control Regulation not providing Model Requirement limit value for specified parameters*
[2] *Fuel usage estimation received from Acacia*

6.4.2.5 Other Emission Sources

The other main emission sources are coal usage for heating purposes and emergency diesel generators. As the emergency generators are only used when required they have not been included in the model run. Emission factors for coal usage are given below.

Table 6-25 Emission Factors of Coal Usage for Heating

Source		**Emission Factors (Energy Base)**				**Emission Factors (Mass Base)**			
Type	Fuel Type	Unit	NO_x	SO_2	PM_{10}	Unit	NO_x	SO_2	PM_{10}
Heating	Stone coal / Imported coal	g/GJ	110	900	200	t/kt	2,8	5,8	5,07

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016)

The following formula is used for the calculations:

$$E_{Source,Fuel,Pollutant,Year} = A_{RSource,Fuel,Year} \times E_{FSource,Fuel,Pollutant}$$

E emissions (kg)
AR activity rate =fuel consumption (TJ)
EF emission factor (kg/TJ)

Only coal will be used as a heating source for the Project. The consumption of coal is estimated to be 326 tons for Y2 (when material movement is highest at the mine and which is taken as the basis for modelling). The results are given in below.

Table 6-26 Emission Calculation Results of Coal Usage for Heating

Annual Fuel Usage	Emissions (kg/hr)		
	NOx	SO2	PM10
Y2 (326 tones)	0.103	0.215	0.188

6.4.3 Emission Calculations ($PM_{2.5}$ Emission Estimation)

In 1996, Midwest Research Institute (MRI) recommended to the $PM_{2.5}$ to PM_{10} multipliers for various fugitive dust categories. The values vary from 0.15 to 0.25 depending on the source category as shown in Table 6-27.

Table 6-27 Multipliers to estimate $PM_{2.5}$ from PM_{10} in the EPA National Emissions Inventory I (Cowherdand Kuykendal 1996)

Category	**Multiplier**
Wind Erosion	0.15 to 0.25
Construction	0.15
Paved Roads	0.25
Unpaved Roads	0.15

The 0.15 multiplier is selected for the Project as the main dust source is unpaved roads and construction works. Thus, $PM_{10\ (kg/hr)}$ emissions are multiplied by 0.15 to calculate $PM_{2.5}$ emission rate and used in $PM_{2.5}$ air quality models.

6.4.4 Air Quality Modelling Study

According to the Turkish IAPCR (2009), if the mass flow rate of PM10 emissions from area sources is below the limit value of 1 kg/hr, there is no need to perform a modelling study. The GCP exceeds this value and an air quality modelling study has been conducted for the following parameters:

- PM10
- PM2.5
- Settled Dust
- CO
- SO_2
- NO_x

An atmospheric dispersion model was used to predict pollutant concentrations at nearest sensitive receptors to be affected by the Project activities. The version of the EPA-promulgated AERMOD dispersion model (version 16216R which is the most recent version at July 2017) was used for the modelling study.

AERMOD was run in regulatory default mode and deposition was only considered for assessing the final PM10 modelled ambient air impacts. Deposition was not considered for any other pollutants. The Lakes Aermod View (Lakes Environmental, Version 9.4) graphical modelling interface was used to set up the near-field modelling runs.

The AERMOD model is based on the Gaussian plume, its concentration estimates are based on a steady-state plume approach with significant improvements over commonly applied regulatory dispersion models. Complex terrain influences are provided by combining a horizontal plume state and a terrain-following state. Dispersion algorithms are specified for convective and stable conditions, urban and rural areas, and in the influence of buildings and other structures. In convective conditions (typically experienced during calm, hot summer periods), the effects of random vertical updraft and downdraft velocities are simulated with a bi-Gaussian probability density function. In both convective and stable conditions, the mean vertical wind speed is assumed equal to zero.

The receptor resolution approaches used for the Project are:

- Nested Grid Receptor (Receptor ID: NESTED) for detailed impact assessment : 250 m receptor space for the first 5.5 km X 7.0 km from centre of the Project, 500 m receptor space for 25.5 km X 27.0 km after first box

The receptor point's map is given in Figure 6-12.

Meteorological Parameters Used for Modelling

Meteorological stations are available at Hanönü (5 km) and Taşköprü villages (20 km); however, Hanönü and Taşköprü Meteorological Stations do not observe hourly meteorological data and Taşköprü Meteorological Station is too far from the Project Area. Therefore, hourly MM5 model data was used for this modelling study. The MM5 is a regional mesoscale model developed by Penn State University and National Center for Atmospheric Research (USA) and used for creating weather forecasts and climate projections.

Lakes Environmental has run MM5 for GCP with the data obtained from NCEP (Global Reanalysis data). The model ouput provided by Lakes has a resolution of 12km by 12 km, locating the open pit in the center. The output data was generated for 939 m elevation, on an hourly basis for five years for the Hourly Meteorological Parameters given in Table 6-28 below;

Table 6-28 Hourly Meteorological Parameters

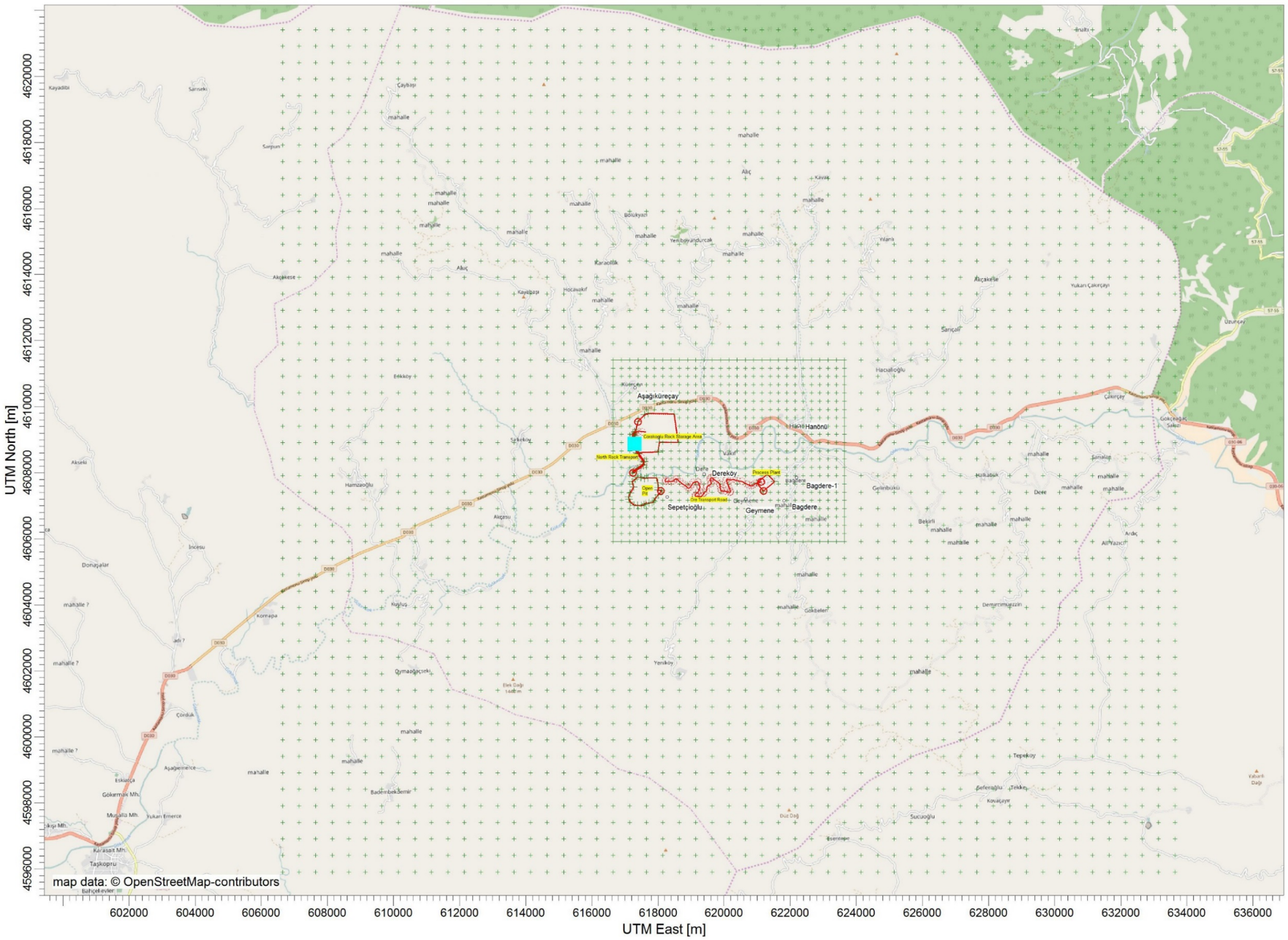
Surface Level	Upper Air
Total cloud cover, opaque cloud cover (0-10) – derived by formula	Station ID, latitude, longitude
Ambient temperature (deg C)	Year (YYYY), month, day, hour (UTC)
Dew point temperature (deg C)	Number of vertical levels
Relative humidity (%)	Repeat number of vertical levels (currently, 18)
Station pressure (mb)	Pressure
Wind direction (0-360 deg)	Elevation
Wind speed (m/s)	Ambient temperature
Ceiling height (0-30450 m) - derived	Relative humidity
Present weather (09999, 99999:- unknown)	Wind direction
Hourly precipitation rate (inches and hundredths)	Wind speed
Global radiation (0-1415 Wh/m^2):- unknown	

The model output (2011-2015) regarding temperature, precipitation, evaporation, humidity and wind data for Project Area is discussed in the following sections in detail.

Meteorological Data

5 year hourly meteorological data generated by MM5 model and also data for three years (2013-2015) was used for the assessment and 3 year data was used to compare the annual max PM10 concentrations for each year. The 5-year wind rose and year 2013-2015 wind rose from MM5 model data is given in Figure 6-13 and Figure 6-14, respectively.

PROJECT TITLE:
Gokirmak Copper Project
Receptor Grid



COMMENTS:

SOURCES:
5

RECEPTORS:
3413

COMPANY NAME:
AECOM TURKEY

MODELER:
A. Korkmaz

DATE:
24/04/2017

SCALE: 1:120,000
0 4 km

AECOM

PROJECT NO.:
440.02.10

AERMOD View - Lakes Environmental Software

D:\Modelleme\Model\AE002 Asya Maden\1_Model\Acacia_Copper_Mine_Y2_S\Acacia_Copper_Mine_Y2_S.isc

Figure 6-12 Receptor Points Map

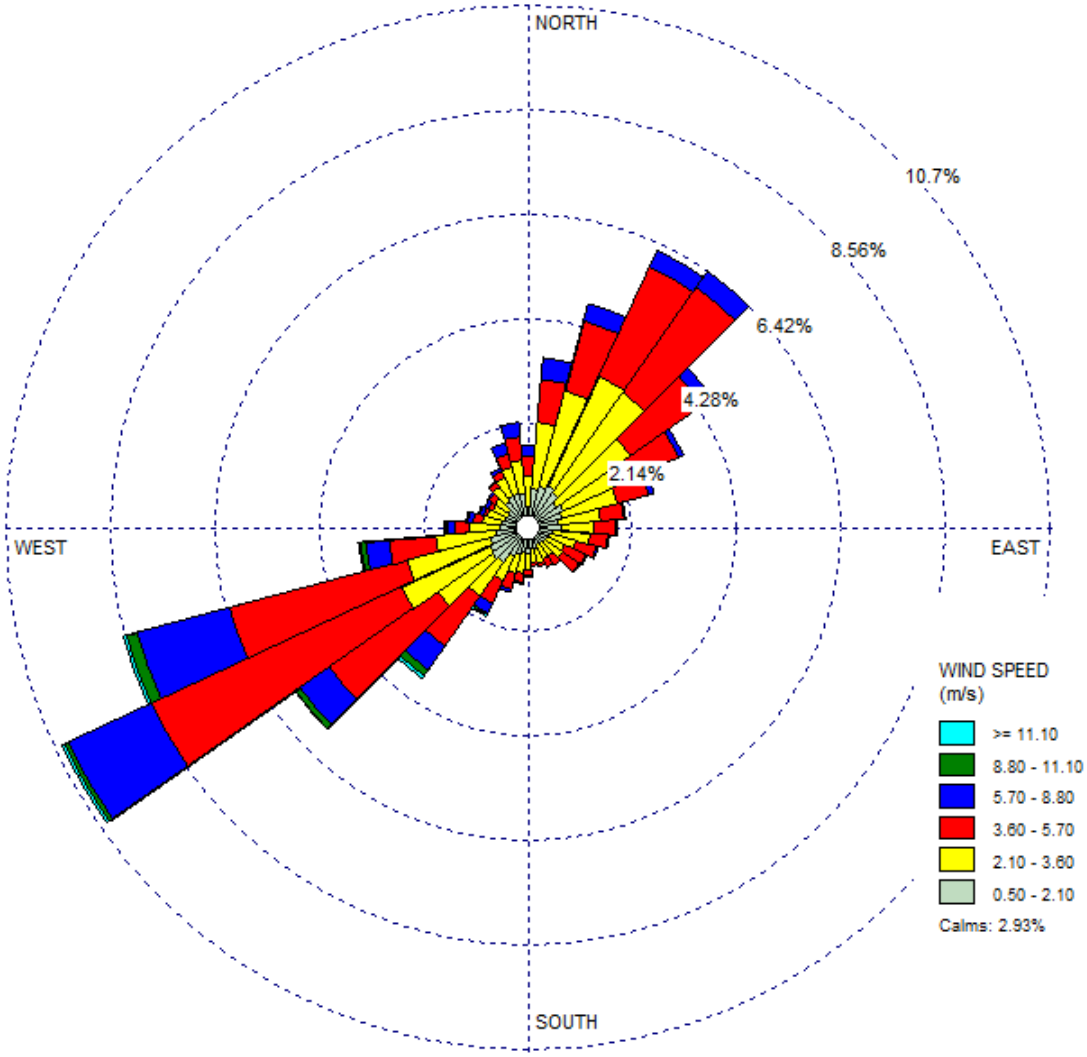


Figure 6-13 Wind Rose of MM5 Based Data Station for the Period 01/01/2010-/31/12/2015

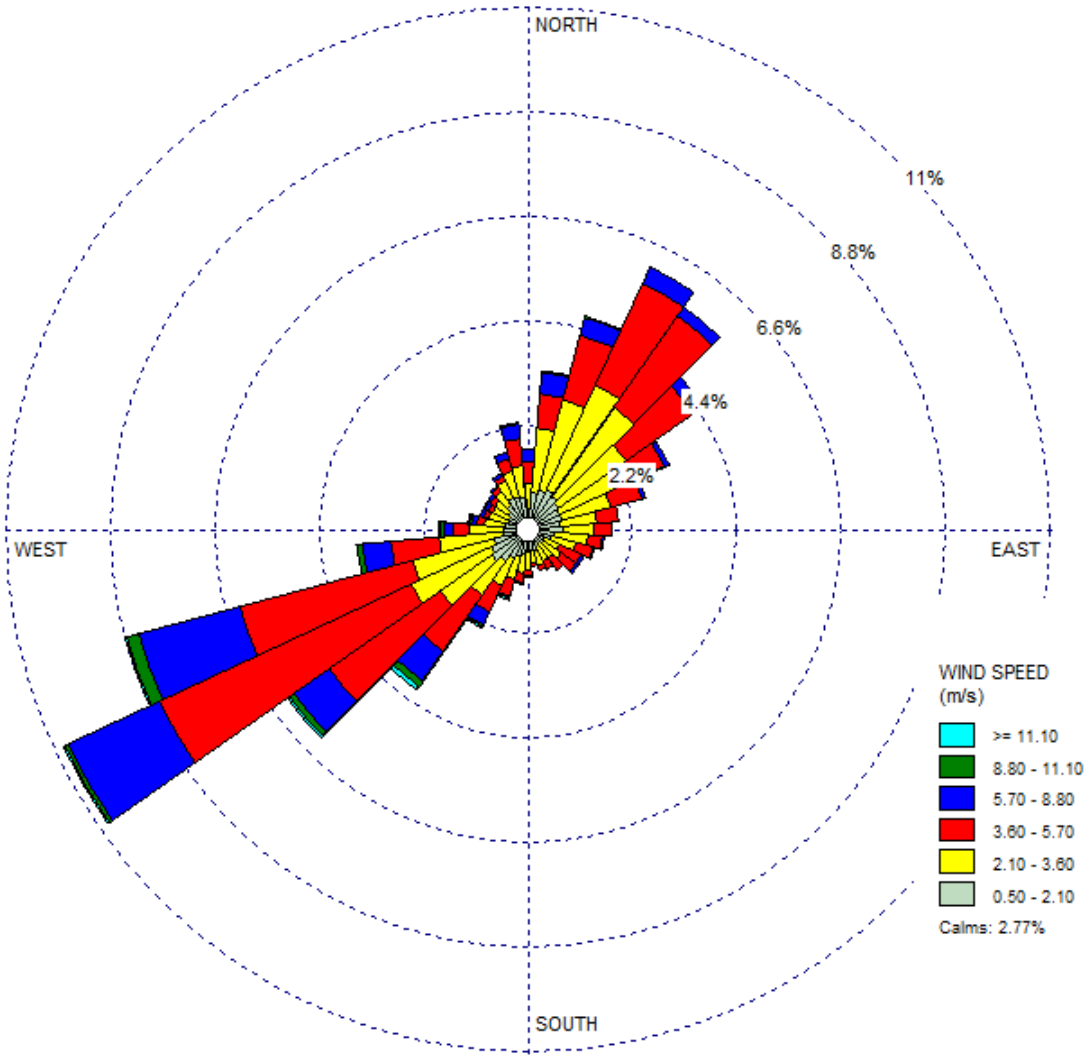


Figure 6-14 Wind Rose of MM5 Based Data Station for the Period 01/01/2013-31/12/2015 (Modelled Period)

Air Quality Sensitive Receptors

The sensitivity of receptors to air pollution has been determined based on the criteria provided in the table below.

Table 6-29 Sensitivity Criteria

Sensitivity	Description	Examples of Receptors
High	Receptors where people or operations are particularly susceptible to air pollution	Educational, cultural, health institutes or summer residential, recreational and camping areas
Medium	Receptors moderately sensitive to air pollution, where it may cause some distraction or disturbance	Commercial area, Agricultural areas, Forest, Offices, Restaurants
Low	Receptors where distraction or disturbance from air pollution is minimal	Industrial areas with existing high air pollution. Mining/old areas, project area

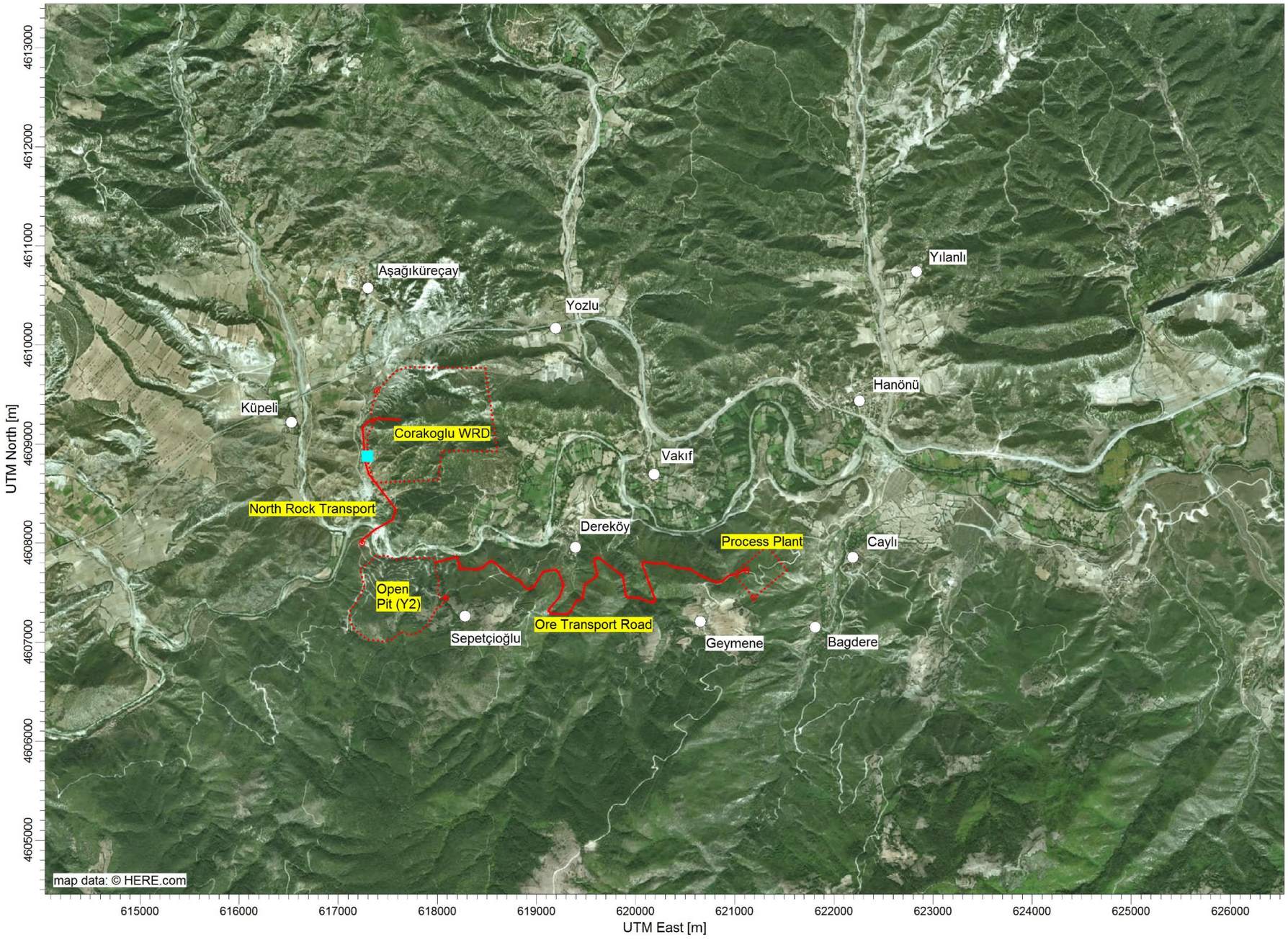
The sensitivity reasons of receptors and coordinates are given in Table 6-30.

Table 6-30 Selected Sensitive Receptors

Name of Location*	Sensitivity Reason	Coordinates (UTM ED50 ZONE:36)	
		X	Y
HANONU	Residential and School	622257.59	4609436.94
YOZLU	Residential	619194.92	4610167.10
VAKIF	Residential	620186.58	4608694.11
CAYLI	Residential	622192.03	4607855.71
SEPETCIOGLU	Residential	618281.02	4607263.38
DEREKOY	Residential	619393.42	4607958.12
GEYMENE	Residential	620653.38	4607210.12
AKURECAY	Residential	617301.06	4610574.87
BAGDERE	Residential	621810.50	4607151.35
KUPELI	Residential	616529.32	4609220.65
YILANLI	Residential	622833.47	4610739.47

* All receptors have the code “RCA: Commercial area where residential buildings are predominant”

PROJECT TITLE:
Gokirmak Copper Project
Air Quality Sensitive Receptors



COMMENTS:

SOURCES:
5

RECEPTORS:
3417

COMPANY NAME:
AECOM TURKEY

MODELER:
A. Korkmaz

DATE:
29/08/2017

SCALE: 1:40,000
0 1 km

PROJECT NO.:
440.02.10

AERMOD View - Lakes Environmental Software

D:\Modelleme\Model\AE002 Asya Maden\2017_Model_EBRD\Acacia_2017_PM10\Acacia_2017_PM10.isc

Figure 6-15 Selected Air Quality Sensitive Receptors

6.4.5 Impact Assessment

AERMOD was used to predict Project related emission concentrations at a network of receptor locations within the study area over a 3-year meteorological data period (01 Jun 2013 to 31 Dec 2015). Air quality effects from the processing activities were estimated based on both a short-term (maximum 1, 8 and 24 hour) and long-term (average annual) emissions for the Y2 scenario (year with max material movement).

The emission estimates of the Project are given below and emission dispersion maps are given in Appendix D. It should be noted that there are no available long-term monitoring data to use as background emission at each selected receptor. Considering that the Project is located in a rural area with no major existing projects as detailed under Cumulative Impact Assessment section, it is assumed that the background concentrations will not be high. Besides, all the modelled parameters have been included in the proposed air quality monitoring programme.

6.4.6 Air Quality Monitoring Program

Continuous air quality monitoring at Sepetçioğlu village through installation of a fixed air quality measurement station (exact location to be determined during the site surveys) is required. Additionally, it is required to conduct air quality measurements at the settlements proposed in Table 6-32.

Table 6-31 Emission Estimates from Dispersion Modeling

Receptor	PM10 (µg/m3)			PM10 (from Blasting) (µg/m3)			PM2.5 (µg/m3)			Settled Dust (mg/Nm3-day)			NO2 (µg/m3)			SO2 (µg/m3)			CO (µg/m3)		
	Ave. Period	Limit	Modelled*	Ave. Period	Limit	Modelled*	Ave. Period	Limit	Modelled*	Ave. Period	Limit	Modelled*	Ave. Period	Limit	Modelled*	Ave. Period	Limit	Modelled*	Ave. Period	Limit	Modelled*
Hanonu	-	-	-	-	-	-	-	-	-	-	-	-	1hr	200	57.1	1hr	350	4.2	8hr	10	3.5
	24hr	50	6.2	24hr	50	2.2	24hr	25	1.3	Monthly	390	4.8	-	-	-	24hr	20	0.4	-	-	-
	Yearly	20	0.7	Yearly	20	<0.1	Yearly	10	0.1	Yearly	210	0.7	Yearly	40	0.2	Yearly	20	0.0	-	-	-
Yozlu	-	-	-	-	-	-	-	-	-	-	-	-	1hr	200	51.4	1hr	350	3.9	8hr	10	4.2
	24hr	50	15.2	24hr	50	2.2	24hr	25	2.7	Monthly	390	17.5	-	-	-	24hr	20	0.5	-	-	-
	Yearly	20	1.9	Yearly	20	<0.1	Yearly	10	0.3	Yearly	210	2.3	Yearly	40	0.4	Yearly	20	0.0	-	-	-
Vakif	-	-	-	-	-	-	-	-	-	-	-	-	1hr	200	95.2	1hr	350	6.8	8hr	10	7.2
	24hr	50	13.4	24hr	50	3.8	24hr	25	2.6	Monthly	390	10.4	-	-	-	24hr	20	0.9	-	-	-
	Yearly	20	1.4	Yearly	20	<0.1	Yearly	10	0.2	Yearly	210	1.5	Yearly	40	0.5	Yearly	20	0.0	-	-	-
Cayli	-	-	-	-	-	-	-	-	-	-	-	-	1hr	200	28.2	1hr	350	2.3	8hr	10	2.1
	24hr	50	8.3	24hr	50	1.2	24hr	25	1.5	Monthly	390	5.5	-	-	-	24hr	20	0.3	-	-	-
	Yearly	20	0.5	Yearly	20	<0.1	Yearly	10	0.1	Yearly	210	0.3	Yearly	40	0.1	Yearly	20	0.0	-	-	-
Sepetcioglu	-	-	-	-	-	-	-	-	-	-	-	-	1hr	200	33.9	1hr	350	2.6	8hr	10	1.6
	24hr	50	20.2	24hr	50	6.7	24hr	25	3.1	Monthly	390	27.5	-	-	-	24hr	20	0.2	-	-	-
	Yearly	20	1.3	Yearly	20	0.3	Yearly	10	0.2	Yearly	210	2.2	Yearly	40	0.2	Yearly	20	0.0	-	-	-
Dereköy	-	-	-	-	-	-	-	-	-	-	-	-	1hr	200	44.4	1hr	350	2.8	8hr	10	3.5
	24hr	50	19.7	24hr	50	3.4	24hr	25	3.1	Monthly	390	19.7	-	-	-	24hr	20	0.4	-	-	-
	Yearly	20	1.8	Yearly	20	<0.1	Yearly	10	0.3	Yearly	210	2.2	Yearly	40	0.4	Yearly	20	0.0	-	-	-
Geymene	-	-	-	-	-	-	-	-	-	-	-	-	1hr	200	24.6	1hr	350	2.9	8hr	10	3.5
	24hr	50	9.4	24hr	50	2.2	24hr	25	1.5	Monthly	390	6.0	-	-	-	24hr	20	0.2	-	-	-
	Yearly	20	0.3	Yearly	20	<0.1	Yearly	10	0.1	Yearly	210	0.3	Yearly	40	0.1	Yearly	20	0.0	-	-	-
Asagikurecay	-	-	-	-	-	-	-	-	-	-	-	-	1hr	200	57.2	1hr	350	3.6	8hr	10	3.0

Receptor	PM10 (µg/m3)			PM10 (from Blasting) (µg/m3)			PM2.5 (µg/m3)			Settled Dust (mg/Nm3-day)			NO2 (µg/m3)			SO2 (µg/m3)			CO (µg/m3)		
	Ave. Period	Limit	Modelled*	Ave. Period	Limit	Modelled*	Ave. Period	Limit	Modelled*	Ave. Period	Limit	Modelled*	Ave. Period	Limit	Modelled*	Ave. Period	Limit	Modelled*	Ave. Period	Limit	Modelled*
	24hr	50	16.7	24hr	50	3.7	24hr	25	2.8	Monthly	390	6.5	-	-	-	24hr	20	0.3	-	-	-
	Yearly	20	0.6	Yearly	20	<0.1	Yearly	10	0.1	Yearly	210	0.4	Yearly	40	0.6	Yearly	20	0.0	-	-	-
Bagdere	-	-	-	-	-	-	-	-	-	-	-	-	1hr	200	32.9	1hr	350	2.1	8hr	10	1.8
	24hr	50	6.3	24hr	50	1.5	24hr	25	1.0	Monthly	390	4.1	-	-	-	24hr	20	0.2	-	-	-
	Yearly	20	0.4	Yearly	20	<0.1	Yearly	10	0.1	Yearly	210	0.2	Yearly	40	0.1	Yearly	20	0.0	-	-	-
Kupeli	-	-	-	-	-	-	-	-	-	-	-	-	1hr	200	129.2	1hr	350	7.6	8hr	10	6.6
	24hr	50	25.4	24hr	50	3.8	24hr	25	4.2	Monthly	390	13.4	-	-	-	24hr	20	0.7	-	-	-
	Yearly	20	1.8	Yearly	20	<0.1	Yearly	10	0.3	Yearly	210	1.2	Yearly	40	0.7	Yearly	20	0.0	-	-	-
Yilanli	-	-	-	-	-	-	-	-	-	-	-	-	1hr	200	19.5	1hr	350	1.4	8hr	10	1.3
	24hr	50	6.9	24hr	50	2.5	24hr	25	1.2	Monthly	390	4.6	-	-	-	24hr	20	0.2	-	-	-
	Yearly	20	0.7	Yearly	20	<0.1	Yearly	10	0.1	Yearly	210	0.7	Yearly	40	0.15	Yearly	20	0.0	-	-	-

* “Modelled” value includes only the Project related emissions at the receptors (does not include the background value at each receptor).

Table 6-32. Proposed Air Quality Monitoring Locations

Monitoring Location	Emission Parameters and Frequencies							
	PM_{10}	$PM_{2.5}$	Settled Dust	TSP / Heavy Metals	NO_2	SO_2	CO	Meteorology
Hanonu	Monthly[2]	Quarterly	Monthly[2]	Monthly[2]	Monthly[2]	Monthly[2]	Routinely	-
Yozlu	Monthly[2]	Quarterly	Monthly[2]	Monthly[2]	-	-	-	-
Vakif	Monthly[2]	Quarterly	Monthly[2]	Monthly[2]	-	-	-	-
Cayli	Monthly[2]	Quarterly	Monthly[2]	Monthly[2]	-	-	-	-
Sepetcioglu	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Routinely	Continuous
Derekoy	Monthly[2]	Quarterly	Monthly[2]	Monthly[2]	Monthly	Monthly	Routinely	-
Geymene	Monthly[2]	Quarterly	Monthly[2]	Monthly[2]	-	-	-	-
Asagikurecay	Monthly[2]	Quarterly	Monthly[2]	Monthly[2]	-	-	-	-
Bagdere	Monthly[2]	Quarterly	Monthly[2]	Monthly[2]	-	-	Routinely	-
Kupeli	Monthly[2]	Quarterly	Monthly[2]	Monthly[2]	-	-	Routinely	-
Yilanli	Routinely[1]	Routinely[1]	Routinely[1]	Routinely[1]	-	-	-	-
Various Location (inside of fence)	-	-	-	-	-	-	-	Meteorology

[1] Monthly basis during the construction of TSF
[2] Every one month on dry sessions, Every 2 month on winter session.

6.4.7 Mitigation

AMI will fully comply with dust reduction mitigation measures as committed within the national EIA report. The following list of mitigation measures will be in place for dust and exhaust emissions during construction and operation phase of the Project to ensure compliance with EBRD PR3 and relevant EU legislation and GIIP.

Mitigation Measures for Dust Emissions:

- Use of water sprinkling on unpaved roads
- Wetting and covering vehicle loads with sheeting before transport from the site
- Application of speed limits
- Dedicated parking areas for employees' vehicles
- Periodic wetting of the unpaved areas
- Loading, transfer, and discharge of materials should take place with a minimum height of fall
- Implement restrictions to off-site travel of heavy vehicles used at the open pit (except for maintenance purposes)
- Fitting crushing and screening machinery with filter systems
- Use and maintenance of effective filters in vehicle cabs to keep air free of dusts and fumes;
- Visual inspection of high level dust emissions will be conducted and water sprinkling will be applied in these areas
- Rehabilitating cleared areas as soon as possible after completion of construction

- Undertaking progressive rehabilitation of land during operations so that land is revegetated as soon as possible after mining and waste disposal operations are completed.
- Minimizing the haulage distances in movement of material with road planning at the open pit
- If required, based on monitoring results
- All vehicles should be washed down before exiting the site
- Use of dust suppression spray systems during material loading and unloading

Mitigation Measures for Exhaust Emissions and Stationary Sources:

- Application of speed limits
- Dedicated parking areas for employees' vehicles
- Restriction of off-road travel
- Periodic maintenance of both heavy and light vehicle fleets
- Periodic maintenance of machinery and equipment
- Vehicles will not be permitted to keep engines running while waiting to enter the sites or waiting on-sites.
- Machinery and equipment will not be left running in periods between work, or will be throttled down to a minimum.
- Minimizing the haulage distances in movement of material
- Uphill movements will be avoided as far as possible with low-angle road planning in open pit
- Vehicle and equipment movements will be scheduled to minimize idle time and distances travelled

Successful implementation of these measures will be supported by provision of training for the operators of equipment and truck drivers. A summary of Project impacts on air quality and proposed mitigations are given in Table 6-33 below.

Table 6-33. Summary of Impacts, Mitigation and Residual Impacts for Air Quality

Impact Description	Receptors	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Dust emissions from Construction	Hanonu, Yozlu Vakif Cayli Sepetcioglu Derekoy Geymene Asagikurecay Bagdere Kupeli Yilanli	Medium - Short term duration (Two year) - Wide in Geographical Extent - Long term reversible	High (Residential)	Moderate	• Apply Dust Emissions Mitigation Measures given above, • Implement Air Quality Management Plan, • Conduct water sprinkling for dust suppression for at least 5 times a day during dry season on unpaved roads, • Surfaces in inactive/decommissioned Project areas should be re-vegetated or otherwise rendered non-dust forming, • Monitor emission according to air quality monitoring program,	Minor
Dust Emissions from Operation Period	Hanonu, Yozlu Vakif Cayli Sepetcioglu Derekoy Geymene Asagikurecay Bagdere Kupeli Yilanli	High - Long Term - Wide in Geographical Extent - Irreversible or long-term reversible - High Magnitude	High (Residential)	Major	• Apply Dust Emissions Mitigation Measures given above, • Implement Air Quality Management Plan, • Monitor emission according to air quality monitoring program, • Based on the air quality model results, water sprinkling will initially be conducted for at least 5 times a day during dry season. Frequency will be increased in the case monitoring results require so, • Re-vegetation or otherwise rendering non-dust forming of surfaces in inactive/decommissioned Project areas • Construction of wind fences and/or vegetative barriers on one side or both sides of ore transport road (if required, depending on the assessment of monitoring results), • Cover material transported by trucks, • Fitting stockpiles with sprinkler systems or dust caps (if required depending on monitoring results),	Moderate

Impact Description	Receptors	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Emissions from Blasting	Sepetcioglu, Kupeli, Vakıf, Bagdere,	Low - Short term duration - Restricted - One-off impact (per day) - Narrow in Geographical Extent	High (Residential)	Moderate	• Wetting down the entire blasting area prior to initiating the blast, • Use of an air-water fogger spray prior to, during, and after initiating the blast, • Ensure compliance with the requirements of SEVESO III Directive, • Monitor emissions according to air quality monitoring program.	Minor
Dust emissions from Stockpiles And Open Areas (Wind Erosion)	Hanonu, Yozlu Vakif Cayli Sepetcioglu Derekoy Geymene Asagikurecay Bagdere Kupeli Yilanli	Medium -Long Term - Wide in Geographical Extent - ireversible	High (Residential)	Moderate	• Apply Dust Emissions Mitigation Measures given above, • Implement Air Quality Management Plan, • Fitting stockpiles with sprinkler systems or dust caps (if required depending on monitoring results).	Minor
Exhaust and Stationary Emissions		High -- Long Term - Wide in Geographical Extent - Irreversible or long-term reversible - High Magnitude	High (Residential)	Major	• Apply Exhaust Emissions and Stationary Sources Mitigation Measures given above • Implement Air Quality Management Plan, • Monitor emission according to air quality monitoring program, • Burning of waste materials, foliage etc, must be avoided, • Use of heavy oil and diesel fuel for the mine activities should be minimized whenever possible; • Vehicles and equipment should not emit black smoke from exhaust systems except during ignition at start-up	Moderate

6.5 Greenhouse Gas Emissions

According to EBRD Performance Requirement 3 - Resource Efficiency and Pollution Prevention Control, the environmental and social assessment will consist of the options to minimize the project-related greenhouse gas (GHG) emissions during the design and operation of GCP. So it is important to determine the amount of GHG emissions that the facility currently produces and is expected to produce during operation and closure phases. This section presents a calculation and assessment of the potential GHG emissions associated with the construction, operation and closure phases of GCP.

EBRD's Methodology for Assessment of GHG Emissions (Version 7, 6 July 2010) was used as a guidance in the assessments carried out in this section of the report.

GHG emissions are categorized into three different scopes – Scope 1, Scope 2 and Scope 3 – according to the GHG Protocol, developed by World Resources Institute (WRI) and World Business Council on Sustainable Development (WBCSD). Figure 6-16 provides the relationship between Scope 1, Scope 2 and Scope 3 emissions and the activities that generate direct and indirect emissions along a company's value chain.

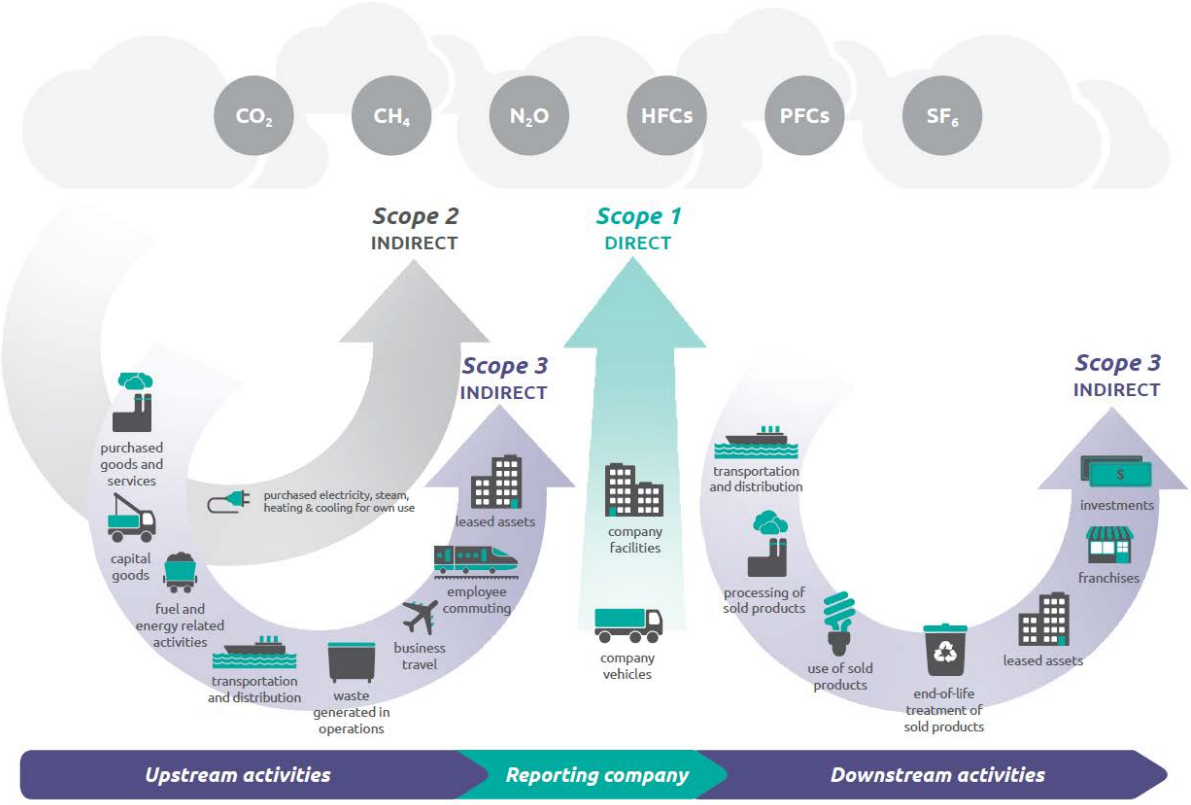


Figure 6-16 GHG Sources

Source: Corporate Value Chain (Scope 3) Accounting and Reporting Standard, Greenhouse Gas Protocol)

Scope 1, 2 and 3 are explained below.

- Scope 1 describes 'direct' greenhouse gas emissions from sources that are owned by or under the direct control of the company. The quantification of Scope 1 emissions is considered mandatory by the GHG Protocol.

Scope 1 emissions are included within the scope of this study.

- Scope 2 describes 'indirect' greenhouse gas emissions associated with the project that are a consequence of the activities of the company, but occur at sources owned or controlled by another company. Emissions associated with the generation of purchased electricity that is consumed by the reporting company are reported in scope 2. The quantification of Scope 2 emissions is also considered mandatory by the GHG Protocol.

Since the facility purchases electricity, Scope 2 emissions are included in this study.

- Scope 3 describes wider greenhouse gas emissions that occur along the value chain. The quantification of Scope 3 emissions considered optional by the GHG Protocol.

Scope 3 emissions consisting of the upstream emissions associated with the provision of materials used by the project and the downstream emissions from the use of the goods and services generated by the project are not included within the scope of this study.

GHGs include not only carbon dioxide emissions, but five of the six gases addressed in the Kyoto Protocol. These gases are:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Sulphur hexafluoride (SF_6);
- Hydro fluorocarbons (HFC); and
- Per fluorocarbons (PFC).

It is noted that HFC and PFCs are not emitted by any process associated with the Project; thus, are not considered any further within the assessment.

Non-CO_2 GHGs are calculated as "CO_2-equivalence" (CO_2-e) based on their contribution to the enhancement of the greenhouse effect. The CO_2-equivalence of a gas is calculated using an index called the Global Warming Potential (GWP). The GWPs for a variety of non-CO_2 GHGs are contained within IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006). The GWPs of relevance to this assessment are presented below in Table 6-34.

Table 6-34 Global Warming Potentials

Gas	Chemical Formula	IPCC 2014 Global Warming Potential
Carbon dioxide	CO_2	1
Methane	CH_4	28
Nitrous oxide	N_2O	265
Sulfur hexafluoride	SF_6	23,500

Source: IPCC Fifth Assessment Report, 2014 (AR5)

6.5.1 Construction Phase

Scope 1: Direct GHG Emissions

During the construction phase of the GCP, Scope 1 GHG emissions will be emitted from the following activities:

- Combustion of diesel in construction vehicles and equipment for construction of mine facilities,
- Combustion of coal for heating purposes,
- Blasting (ANFO),
- Clearing of vegetation,and
- SF_6 emissions from switchgear and circuit breakers

The mine facilities will be constructed over a two year construction phase where on-road vehicles and non-road vehicles will be used. It is estimated that the construction period will consume 20.2 million liters of diesel.

AECOM was informed that only coal will be used as a heating source within the Project area. The consumption amount of coal is approximately 238 tonnes during construction.

Contribution amount of emissions from ammonium nitrate/fuel oil (ANFO) blasting agent used during construction phase to direct GHG emissions is too low to be considered.

Vegetation clearance for the Project would result in the release of greenhouse gas emissions. The vegetation area that would be cleared is approximately 490 ha (including the areas both the construction activities are currently ongoing and the future construction activity that is planned to be carried out). The breakdown of the Project vegetation area to be cleared is shown Table 6-35 below.

Table 6-35 Vegetation Area of the Project to be cleared

	CORINE Land Cover Code	CORINE Land Cover Class	The areas with Currently On-going Construction Activity	The areas of Planned Future Construction Activity	Area (m^2)	Total Area (ha)
Agricultural Areas	211	Non-irrigated arable land	17	114	131	72
	213	Rice Fields	0	76	76	
	242	Complex cultivation patterns	381,668	0	381,668	
	243	Land principally occupied by agriculture, with significant areas of natural vegetation	334,951	0	334,951	
Forest and Semi natural Areas	311	Broad-leaved forest	1,085,244	0	1,085,244	418
	312	Coniferous forest	401,561	50,047	451,608	
	313	Mixed forest	1,686,610	0	1,686,610	
	324	Transitional woodland-shrub	252,447	705,404	957,851	
					TOTAL	490

The total vegetation area to be cleared within the Project is comprised of 418 ha forest and semi natural areas and 72 ha of agricultural areas. Carbon stock change in agricultural land and forest and seminatural areas during construction and operation periods of the Project was calculated using 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4: Agriculture, Forestry and Other Land Use. The amount of CO2 emissions sourced from carbon stock change in vegetation during construction and operation of the Project is given in Table 6-36.

AECOM was informed that the 3 types of medium voltage switchgears will be used in construction and operation periods and the total quantity of SF_6 in the switchgears using SF_6 as the circuit insulating and interrupting medium is 6.7 kg. Hence, the total amount of SF_6 emissions during construction period is calculated considering 1% of existing SF_6 charge lost each year (as IPCC suggested) and found as 4.3 tons CO2-e which is too small to be considered in total GHG amount calculation (i.e. approximately only 0.0003% of the calculated total).

Scope 2: GHG emissions from purchased electricity

The CO_2 grid emission factor in Turkey is around 0.5 tons CO_2/MWh (Development of the electricity carbon emission factors for Turkey, EBRD, 2015). AECOM was informed that the use of purchased electricity from the grid would be 3,990 MWh during construction.

Based on the above GHG emissions assumptions, the projected total emissions by emissions type (Scope 1 and Scope 2) for construction phase are presented below in Table 6-36.

Table 6-36 Greenhouse Gas Emissions in Construction Phase

Emission Types	Quantity	Net Calorific Values (NCV)	TJ	GHG	Emission Factor (EF)	EF Unit	tons of GHG	IPCC 2014 Global Warming Potential	GHG (tons CO2-e)	Total GHG (tons CO2-e) during construction period
Scope 1 Emissions										
Carbon Stock Change in Vegetation (1)	490 ha									49,922
Combustion of Diesel Oil (2)	20.2 million liters (16.9 Gg)	43 TJ/Gg	728.6	CO_2	74,100	kg of GHG/TJ	71,652	1	53,987	54,164
				CH_4	3	kg of GHG/TJ	2.2	28	61.2	
				N_2O	0.6	kg of GHG/TJ	0.4	265	115.8	
Combustion of Coal (2)	238 tons (0.238 Gg)	11.9 TJ/Gg	2.8322	CO_2	101,000	kg of GHG/TJ	286	1	286	287
				CH_4	1	kg of GHG/TJ	0.003	28	0.1	
				N_2O	1.5	kg of GHG/TJ	0.004	265	1.1	
Scope 2 Emissions										
Purchased Electricity (3)	3,990 MWh	-	-	CO_2	0.5	tons CO2/MWh	1995	1	1995	1,995
									TOTAL	106,368

(1) Calculated from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4: Agriculture, Forestry and Other Land Use Chapter 2

(2) Net calorific values and emission factors are obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2: Energy

(3) Emission factor is obtained from Development of the electricity carbon emission factors for Turkey, EBRD, 2015

6.5.2 Operation Phase

Scope 1: Direct GHG Emissions

During the operation phase of the GCP, Scope 1 emissions will be emitted from the following activities:

- Explosives for blasting
- Combustion of diesel in vehicles and equipment
- Combustion of coal for heating purposes
- SF_6 emissions from switchgear and circuit breakers

Emissions from ANFO and dynamite blasting agents will contribute to the GHG emissions in operation phase. According to Turkish EIA (2014) the amount of ANFO and dynamite used in blasting operations within the life of the Project are 181,247 tons and 3,212 tons, respectively.

In the operation period diesel is consumed in non-road mining equipment and on-road vehicles used to transport of ore to processing plant, of waste rock to WRDs and of concentrated ore to Samsun Port. AECOM was informed that total amount diesel oil consumed in operation period is 130.4 million liters.

Only coal will be used as a heating source within the Project area. The consumption amount of coal is approximately 4,000 tons during operation phase.

The total amount of SF_6 emissions during operation period is calculated as 17.8 tons of CO2e which is too small to be considered in total GHG amount calculations.

Scope 2: GHG emissions from purchased electricity

AECOM was informed that the use of purchased electricity from the grid would be 830,6 GWh during operation.

Based on the above GHG emissions assumptions, the total emissions (Scope 1 and Scope 2) for operation phase are presented in Table 6-37 below.

Table 6-37 Greenhouse Gas Emissions in Operation Phase

Emission Types	Quantity	Net Calorific Values (NCV)	TJ	GHG	Emission Factor (EF)	EF Unit	tons of GHG	IPCC 2014 Global Warming Potential	GHG (tons CO2-e)	Total GHG (tons CO2-e) during operation period
Scope 1 Emissions										
Blasting – Dynamite (1)	3,212 tons	-	-	N_2O	26	kg/Mg	83.5	265	22,131	22,158
				CH_4	0.3	kg/Mg	1	28	27	
Blasting – ANFO (1)	181,247 tons	-	-	N_2O	8.0	kg/Mg	1,450	265	384,244	384,244
Combustion of Diesel(2)	130.4 million liters (109.5 Gg)	43.0 TJ/Gg	4,709	CO_2	74,100	kg of GHG/TJ	349,007	1	349,007	350,152
				CH_4	3.0	kg of GHG/TJ	14.1	28	395.6	
				N_2O	0.6	kg of GHG/TJ	2.8	265	748.9	
Combustion of Coal	4,000 tons (4 Gg)	11.9 TJ/Gg	47.6	CO_2	101,000	kg of GHG/TJ	4,808	1	4,808	4,828
				CH_4	1.0	kg of GHG/TJ	0.0	28	1	
				N_2O	1.5	kg of GHG/TJ	0.1	265	19	
Scope 2 Emissions										
Purchased Electricity (3)	830,571 MWh	-	-	CO_2	0.5	tons CO2/MWh	415,286	1	415,286	415,286
									TOTAL	1,176,666

(1) Emission factor of dynamite and ANFO are obtained from EPA Emission Factors for Detonation of Explosives

(2) Net calorific values and emission factors are obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2: Energy

(3) Emission factor is obtained from Development of the electricity carbon emission factors for Turkey, EBRD, 2015

6.5.3 Closure Phase of GCMP

During the closure phase of the GCP, GHG emissions will be emitted from the use of on-road and non-road vehicles for the removal and dismantling of mine facilities, and reclamation of the open pits and waste facilities. The total emissions for rehabilitation phase are presented in Table 6-38 below

Table 6-38 Greenhouse Gas Emissions in Rehabilitation Phase

Emission Types	Quantity	Net Calorific Values (NCV)	TJ	GHG	Emission Factor (EF)	EF Unit	tons of GHG	GHG (tons CO_2-e)	Total GHG (tons CO_2-e) during closure
Scope 1 Emissions									
Combustion of Diesel Oil (1)	4,3 million liters	43.0 TJ/Gg	156.8	CO_2	74,100	kg of GHG/TJ	11,616.4	11,616.4	11,654
				CH_4	3.0	kg of GHG/TJ	470.3	13.2	
				N_2O	0.6	kg of GHG/TJ	94.1	24.9	

(1) Net calorific value and emission factor are obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2: Energy

6.5.4 Results and Assessment

A detailed breakdown of greenhouse gas emissions over the lifetime of the mine (i.e. 16 years Project life, consisting of 11.3 years operation activities, 2 years closure activities and a remaining approximate of 2.7 years active construction activities) is provided in Table 6-39 below.

Table 6-39 Total GHG Emissions

Phase	Tones CO_2
Construction	106,368
Carbon Stock Change in Vegetation (due to land-use change)	49,922
Combustion of Diesel	54,164
Combustion of Coal	287
Purchased Electricity	1,995
Operation	1,176,666
Blasting - Dynamite	22,158
Blasting - ANFO	384,244
Combustion of Diesel	350,152
Combustion of Coal	4,828
Purchased Electricity	415,286
Closure	11,654
Combustion of Diesel	11,654
TOTAL	1,294,688

Additionally, AECOM was informed that Project area will be revegetated as soon as after mining and waste disposal operations are completed.

6.5.5 Mitigation

As seen from Table 6-39, GHG emissions are predominantly from blasting operations, combustion of diesel and purchased electricity in the operation phase. Reduction in diesel consumption, use of blasting agents and electricity use will therefore be the key focus for mitigation measures at the mine.

Identified mitigation measures are listed below:

- Minimizing the haulage distances in movement of material;
- Uphill movements to be avoided as far as possible;
- Optimizing ore and waste handling processes to minimize the need for multiple handling;
- Vehicle and equipment movements to be scheduled to minimize idle time and distances travelled;
- Keeping land clearance during construction to the minimum necessary for the works;
- Rehabilitating cleared areas as soon as possible after completion of construction and
- Perform regular maintenance
- Undertaking progressive rehabilitation of land during operations so that land is revegetated as soon as possible after mining and waste disposal operations are completed.

According to the “EBRD Methodology for Assessment of Greenhouse Gas Emissions (Version 7, 6 July 2010)”, projects are categorized in terms of annual GHG emissions as:

- Negligible (no GHG assessment necessary)
- Low (< 20 kt/y CO2-equivalent per year)
- Medium-Low (20 – 100 kt CO2/yr)
- Medium-High (100 kt – 1 Mt CO2/yr)
- High (>1 Mt CO2/yr)

So, the Project is in Medium-Low Category since the yearly greenhouse gas emission amount is 80,918 tons CO2-e/year. According to EBRD PR 3, for projects that currently produce, or are expected to produce post-investment, more than 25,000 tons of CO_2-equivalent annually, these emissions shall be quantified in accordance with EBRD Methodology for Assessment of Greenhouse Gas Emissions and reported to EBRD. The scope of GHG assessment shall include all direct emissions from the facilities, activities and operations that are part of the Project or system, as well as indirect emissions associated with the production of energy used by the Project.

A summary for GHG emissions impact and mitigation is presented below in Table 6-40.

Table 6-40 Summary of Impact, Mitigation and Residual Impact for GHG Emissions/ All Phases

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Lifetime GHG emissions due to carbon stock change, combustion of diesel oil, combustion of coal, purchased electricity and blasting operations	Living organisms and ecosystems	Low -Long term -Long term reversible or irreversible -Wide in geographical extent (global) -Low in magnitude -Continous	High (National or international scale of importance)	Moderate	• Minimizing the haulage distances in movement of material • Uphill movements will be avoided as far as possible • Vehicle and equipment movements will be scheduled to minimize idle time and distances travelled • Keeping land clearance during construction to the minimum necessary for the works • Rehabilitating cleared areas as soon as possible after completion of construction • Perform regular maintenance of the transport fleet • Optimizing ore and waste handling processes to minimize the need for multiple handling • Undertaking progressive rehabilitation of land during operations so that land is revegetated as soon as possible after mining and waste disposal operations are completed • Keeping records of regular GHG calculations and publishing annual data. • If required, additional training of the staff on carbon saving plans.	Minor

6.6 Noise and Vibration

The Project will involve various noise and vibration generating activities such as blasting and ore haulage operations, and thus there is the potential of both noise and vibration impacts on local environment and communities.

6.6.1 Project Standards

6.6.1.1 Noise

The noise limits given in the Turkish Regulation on the Assessment and Management of Environmental Noise (RAMEN), relevant EU Directives and international GIIP documents have been assessed to set the Project noise limits for the construction and operation phases of the Project. It should be noted that amongst the available legislation, standards and GIIP documents, only RAMEN includes specific noise limits for the construction phase; whereas, others have limits applicable for the operation phase of the Project.

The noise limits set by the above-mentioned standards are given in Table 6-41 below, together with Project Limits.

Table 6-41 Noise Limits of Project at Sensitive Receptors

Noise Limits				Project Limits at Residential Areas[3]	
EU	**IFC**	**WHO**	**RAMEN**	**Construction Period**	**Operation Period**
Leq (dBA)	Leq (dBA)	Leq (dBA)	Leq (dBA)	Leq (dBA)	Leq (dBA)
N/A[1]	- 55 Daytime - 45 Nighttime - Background Level +3 dbA	- 45 Night (indoor with windows open)[2] -55 (interim Target)	- 55 Nighttime -60 Evening -65 Daytime -70 Construction Period -Background Level +5 dbA	- 70 Daytime Construction Period - 45 Nighttime	- 55 Daytime - 45 Nighttime

[1] EU Legislation does not provide numerical limit value
[2] This is an external noise level and assumes that internal noise levels are in the order of 15 dBA lower with open windows and 27 dBA lower with closed windows (which would be the expected normality in the Project's climate). In addition, WHO (1999) recommends that internal sound levels should not exceed approximately 45 dBA more than 10 to 15 times per night.
[3] Project limits must be ensured at the residential areas

6.6.1.2 Vibration

RAMEN, Annex VII, Table 6 provides Maximum Permissible Values of Ground Vibrations outside the nearest highly-sensitive zone due to vibrations that may be sourced from blasting activities in Mining Pits, Quarries and Similar Areas (See Table 6-42). No limits are provided by EU and IFC Environmental, Health, and Safety Guidelines for ground vibration.

Table 6-42 Maximum Permissible Values of Ground Vibrations for Project

Vibration frequency (Hz)	Maximum Permissible Vibration Rate (Peak Value-mm/s)
1	5
4-10	19
30-100	50

6.6.1.3 Sensitivity of Noise Receptors

RAMEN defines different types of industrial noise receptors as below:

- Industrial Area
- Commercial area with noise-sensitive area where workplaces are predominant
- Commercial area with noise-sensitive area where residential buildings are predominant
- Noise-sensitive areas where educational, cultural, health institutes, or summer residential and camping areas are predominant

The sensitivity of receptors to noise and vibration has been determined based on the criteria provided in Table 6-43.

Table 6-43 Sensitivity Criteria

Sensitivity	Description	Examples of Receptors
High	Receptors where people or operations are particularly susceptible to noise	Residential Schools in daytime Hospitals/residential care homes
Medium	Receptors moderately sensitive to noise, where it may cause some distraction or disturbance	Offices Restaurants
Low	Receptors where distraction or disturbance from noise is minimal	Residences and other buildings not occupied during working hours. Factories and working environments with existing high noise levels.

Noise sensitive receptors are determined to have High sensitivity since they are settlements.

6.6.2 Noise Assessment

The noise assessments are provided below, separately for construction and operation phases. Acacia is monitoring construction phase noise levels at sensitive receptors as given in Noise Baseline section. This section compares the construction monitoring results with Project Limits and focuses on operation phase noise modelling and results for daytime and nighttime periods. In order to predict the noise levels generated during the operation period, modeling of the dispersion of noise sourced from operation activities (that will be additive to the background) was performed. ISO 9613-2 noise prediction method was used in the SoundPLAN noise modeling software.

The SoundPLAN noise modeling software uses the following information to predict noise levels at noise sensitive receptors:

- Three-dimensional digital terrain map of site and surrounding area;
- Sound power level noise data for equipment operating at the site;
- Intervening ground cover;
- Shielding by barriers, intervening buildings or topography; and
- Atmospheric conditions.

During the course of construction, many of the activities will occur simultaneously and at varying levels of intensity. It is difficult, therefore, to predict construction noise emissions throughout the entire construction period. In order to facilitate the noise assessment, a ‘worst case’ scenario has been developed. In this regard, it is assumed that all equipment will operate simultaneously and at full load.

Type and number of equipment and machinery that will be used during the construction phase and their equivalent sound power levels are listed in Table 6-44.

The following assumptions and limitations were taken into consideration during the noise modelling;

- Blasting operations will be carried out only at daytime (08:00-18:00),
- Ore transfer road will be used only during daytime by heavy vehicles,
- The machinery and equipment list, sound levels and hourly truck traffic provided by Acacia are accurate and up-to-date.

6.6.2.1 Construction Phase

Construction activities create some degree of noise emissions at locations in close vicinity of the construction sites. The noise levels generated by construction works may have potential impacts on noise sensitive receptors (NSRs). Construction phase noise measurements were conducted at 8 points at sensitive receptors given in Table 6-44 below.

Table 6-44 Noise Monitoring Results for Construction Phase

Measurement Location	Construction Stage Monitoring Results[1] Leq (DBA)			Project Limits Leq (DBA)
	04.05.2016 06.05.2016	01.08.2016 03.08.2016	02.11.2016 04.11.2016	Construction Period
Hanönü (Acacia Mine Guesthouse)	57.9	56.5	53.7	- 70 Daytime Construction Period
Bağdere Neighborhood	61.5	61.8	61.8	
Geymene Neighborhood	61.4	61.7	61.7	
Sepetçioğlu Neighborhood	54.1	57.8	57.8	
Dereköy Neighborhood	48.2	51.2	49.4	
Küpeli Neighborhood.	56.3	55.2	51.7	
Yılanlı Neighborhood	49.7	51.4	48.7	
Vakıf (Akçasu) Neighborhood	60.3	-	-	

[1] *Measurements conducted only during daytime and are therefore compared with daytime Project Limit for construction phase.*

The results of the construction phase noise level measurements are compared with Project Limits. None of the Construction Stage Monitoring Results are above the daytime limits. See “Section 6.6.4 Mitigation” below for construction phase monitoring requirements, including nighttime monitoring.

6.6.2.2 Operation Phase

Mining operations comprise a large number of processes, activities and equipment that create noise emissions. The Project operation activities will generate varying degrees of noise for 19.5 hours per day and 338 days per year. In order to predict the noise levels generated during the operation phase, a noise modeling study is carried out as discussed above for the operation phase.

Type and number of equipment and machines that will be used during the operation phase and their equivalent sound power levels are listed in Table 6-45.

Table 6-45 Equipment List for Operation Phase

Equipment	Number of Items	$L_{A\text{-weighted}}$ (dBA)
Grader	1	85
Backhoe Loader	1	80
Snow Removal/Dump Truck	1	84
Forklift	1	87
Truck 1/2 tonne	3	75
Mobile Crane 60T	1	85
Boom Truck 20T	1	81
Welding Truck	1	75
Loader F/E	1	85
Compactor	1	80
Grader	1	85
Truck 1/2 tonne	3	75
ROM FEL	1	80
Concentrate FEL	1	80
Backhoe-excavator (85 t)	10	85
Backhoe-excavator (50 t)	1	85
Backhoe-excavator (35 t)	2	85
Rockbreaker attachment	1	80
Rotary/DTH drill	3	80
Rotary/DTH drill	2	75
Haul truck[1]	59	80
Track dozer	1	85
Truck dozer	2	85
Motor grader	4	81
Front-end loader	4	84
Vibrating roller	2	80
Water truck	4	82
Backhoe/loader	1	78
Expected Blasting Noise Level at Source (instantaneous)	-	130 dbA (L_{max})

[1] *Haul road noise emissions calculated by hourly truck traffic.*

Predicted truck traffic is 154.1 truck per hour for Corakoglu WRD road and 5.4 truck per hour for Ore Transfer Road. Ore transfer road will not be used at nighttime.

Compared to the construction phase, the number of NSRs during the operation phase is less. This is due to the fact that there will be no noise generating activity at the TSFs during the operation phase.

Operation Phase Modelling Results

The predicted L_{eq} noise levels at each NSR are calculated assuming maximum activity with all equipment working simultaneously. The predicted noise levels and the relevant Project Limits are given in Table 6-46. The noise levels predicted at the selected NSRs during the operation phase of the Project are given in Figure 6-17 for daytime and Figure 6-18 for nighttime.

Table 6-46 Calculated Operation Phase Noise Levels

No.	NSR Name	Coordinates		Storey of the building*	Level dB(A)**	
		X	Y		Day	Night
1	Aşağıküreçay	617256.23	4610495.06	GF	22.2	22.1
				1.Fl	25.4	25.4
				2.Fl	28.3	28.3
2	Bağdere	621817.61	4607161.75	GF	5.4	1.7
				1.Fl	5.2	1.0
				2.Fl	6.4	2.1
3	Caylı (Bağdere-2)	622092.35	4607736.87	GF	7.6	2.0
				1.Fl	7.9	2.0
				2.Fl	8.2	2.1
4	Dereköy	619360.87	4607897.72	GF	41.7	19.9
				1.Fl	42.0	20.0
				2.Fl	42.2	20.1
5	Geymene	620600.17	4607227.58	GF	17.3	12.3
				1.Fl	17.5	12.5
				2.Fl	17.6	12.8
6	Hanönü	621738.23	4609745.3	GF	20.8	4.8
				1.Fl	20.8	4.8
				2.Fl	20.9	4.8
7	Küpeli	616520.18	4609235.92	GF	36.3	36.3
				1.Fl	36.7	36.7
				2.Fl	37.3	37.3
8	Sepetçioğlu	618119.13	4607229.26	GF	41.0	41.0
				1.Fl	41.1	41.1
				2.Fl	41.2	41.1
9	Vakıf	620177.62	4608507.8	GF	34.6	11.8
				1.Fl	34.7	12.4
				2.Fl	34.7	13.0

* GF: Ground Floor, 1. Fl: First Floor, 2.Fl: Second Floor

**Does not include background noise levels.

The Project Limits for operation phase, determined by the relevant IFC guideline, are 55 and 45 dB(A) for daytime and nighttime respectively. As can be seen from the noise modeling results for the operation phase, the predicted noise levels for daytime and nighttime are below the Project Limits.

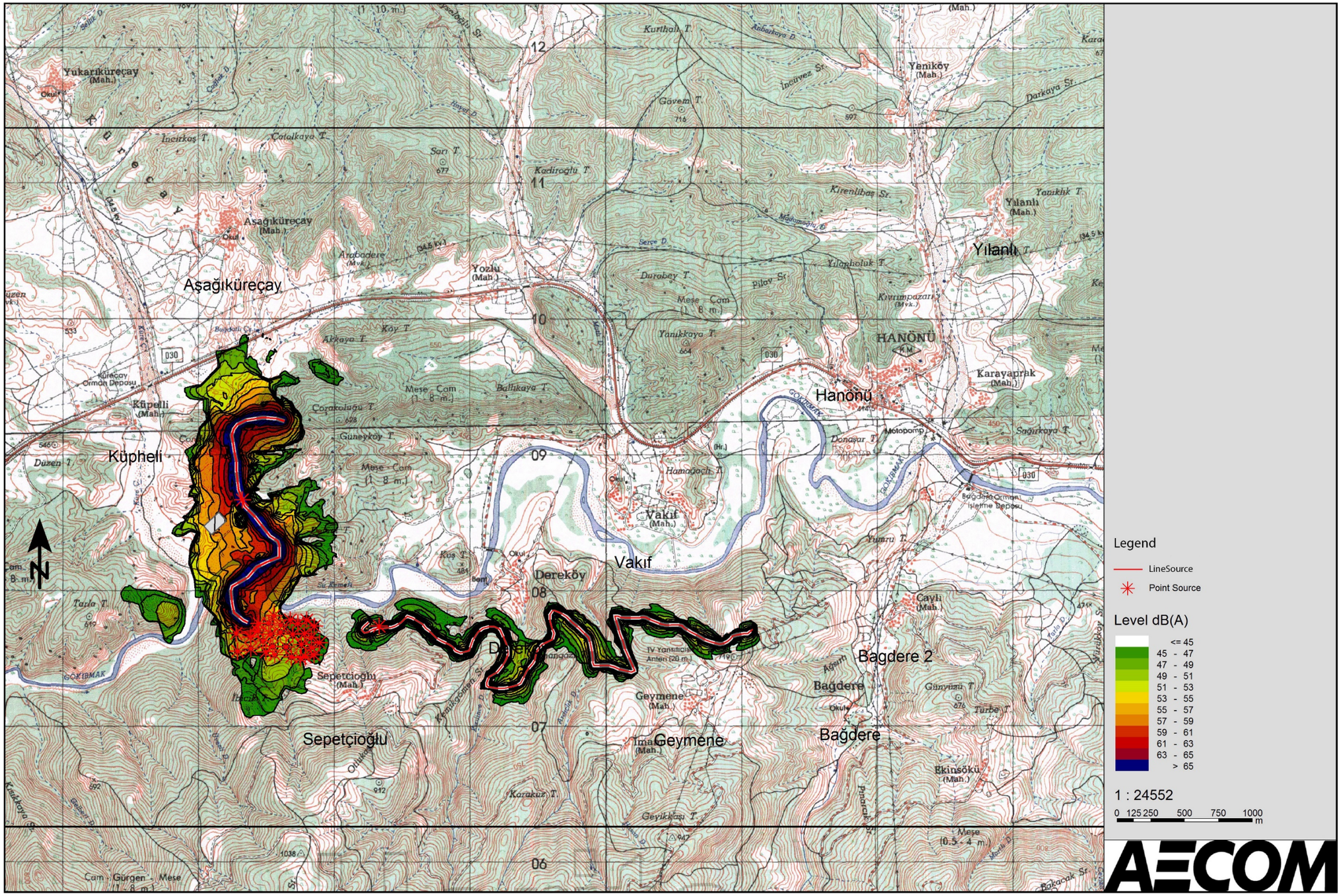


Figure 6-17 Predicted Daytime Noise Levels of Operation Phase

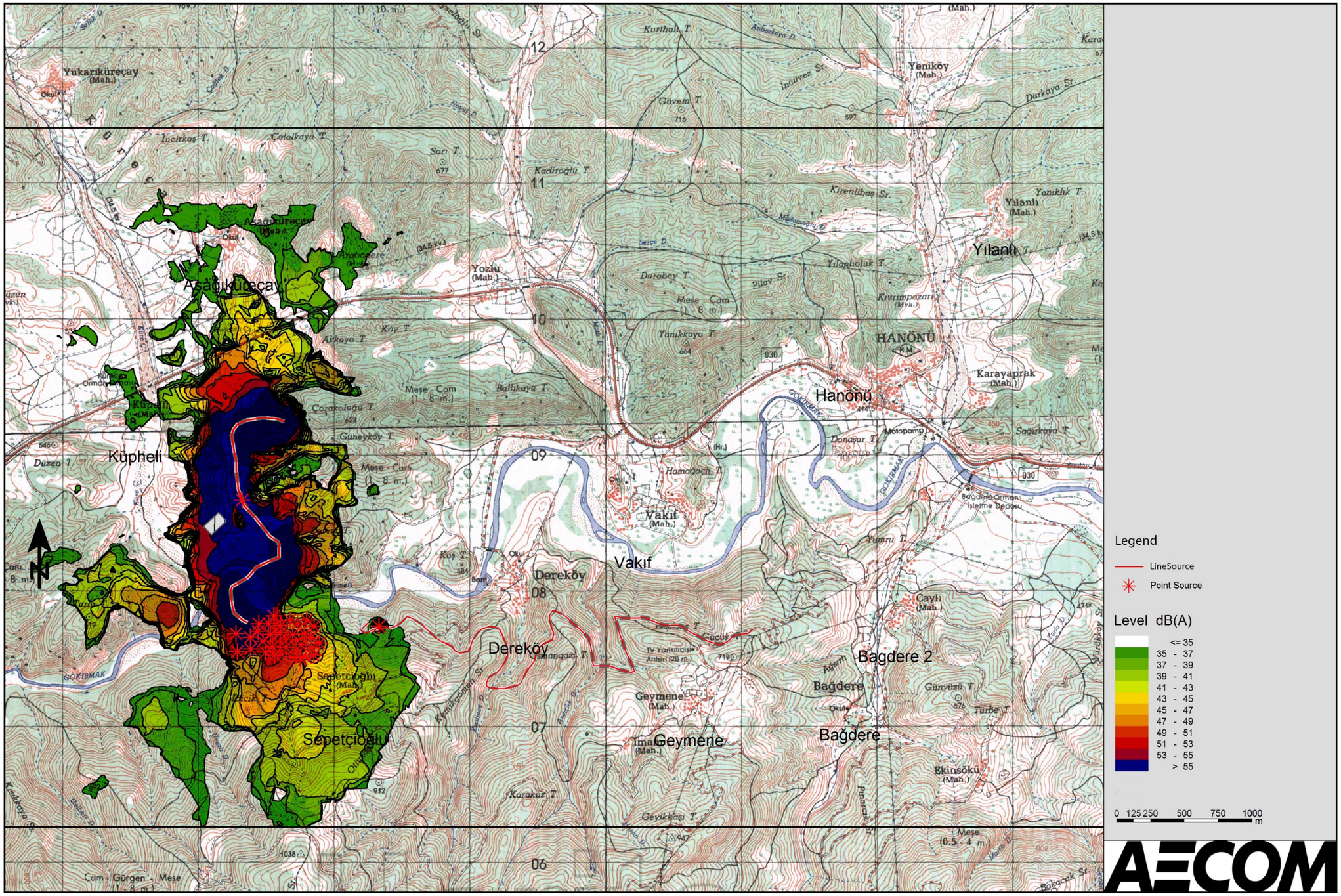


Figure 6-18 Predicted Nighttime Noise Levels of Operation Phase

6.6.2.3 Blasting

Explosives will be used for open-pit operations. ANFO (ammonium nitrate/fuel oil), a widely used bulk industrial explosive, will be used for blasting, and packaged emulsion explosives will be used for ignition. For blasting activities an Explosives Risk Analysis Report has been prepared by Okan University in 2014. According to the Report, a controlled blasting method will be applied by using delayed (millisecond) detonators and appropriate blast designs.

Blasting has potential to cause noise and vibration impacts on human receptors and biodiversity features in terms of either nuisance or discomfort. Blasting from mining activities can have impacts on surrounding residential areas with regard to ground-borne vibration and air-blast overpressure events. Air-blast is the pressure wave (sound) produced by the blast and transmitted through the air. Unlike ground vibration there is only one air-blast phase but it too is a complex wave-train consisting of various peaks and with a range of frequencies.

Ground-borne blast vibration is assessed in the following “Vibration Assessment” section.

Blasting operations are currently ongoing for earthworks at the open pit and will continue for the remainder of construction and operation phases. The measured noise levels during blasting are given in Table 6-47.

Table 6-47. Measured Noise Levels during Blasting

Measured Location	Blasting Date	Measured Noise Level (dB)	Measured Location	Blasting Date	Measured Noise Level (dB)
Sepetçioğlu	28.06.2017	122.8	300m (approx.) away from explosion point	18.07.2017	120.0
	01.07.2017	120.0		21.07.2017	113.3
300m away from explosion point	06.07.2017	122.4		21.07.2017	114.6
	06.07.2017	144.2		22.07.2017	113.3
Sepetçioğlu	08.07.2017	123.1		22.07.2017	118.1
	08.07.2017	107.2		24.07.2017	121.4
300m (approx.) away from explosion point	10.07.2017	104.9		26.07.2017	123.0
	10.07.2017	107.2		29.07.2017	126.1
	12.07.2017	120.2	375m (approx.) away from explosion point	31.07.2017	113.9
	17.07.2017	124.0		31.07.2017	117.1
	17.07.2017	112.7			

Noise measurements were used to determine the potential effects of blasting noise at nearest sensitive receptor (Sepectcioglu). Expected blasting noise level is 130 dbA at source. Noise sourced from blasting activities is not expected to be a significant impact, since blasting is performed once a day and the impact occurs instantaneously.

6.6.3 Vibration Assessment

AMI has been monitoring vibration levels sourced from blasting activities conducted at the Open pit. The measured vibration levels for the last two months (June 2017 and July 2017) are given in Table 5-19 and a map showing the location of Sepetcioglu Vibration Sensitive receptor is given Figure 6-19.

The Maximum Permissible Vibration Rate limit is 5 mm/s for <1 hertz (Hz) vibration frequency, 19 mm/s between 4 Hz to 10 Hz and 19 mm/s between 30 Hz to 100 Hz, as given Vibration Baseline section. The results of the vibration level measurements are compared with respect to Turkish RAMEN, none of the measurement results are above the limits of RAMEN.

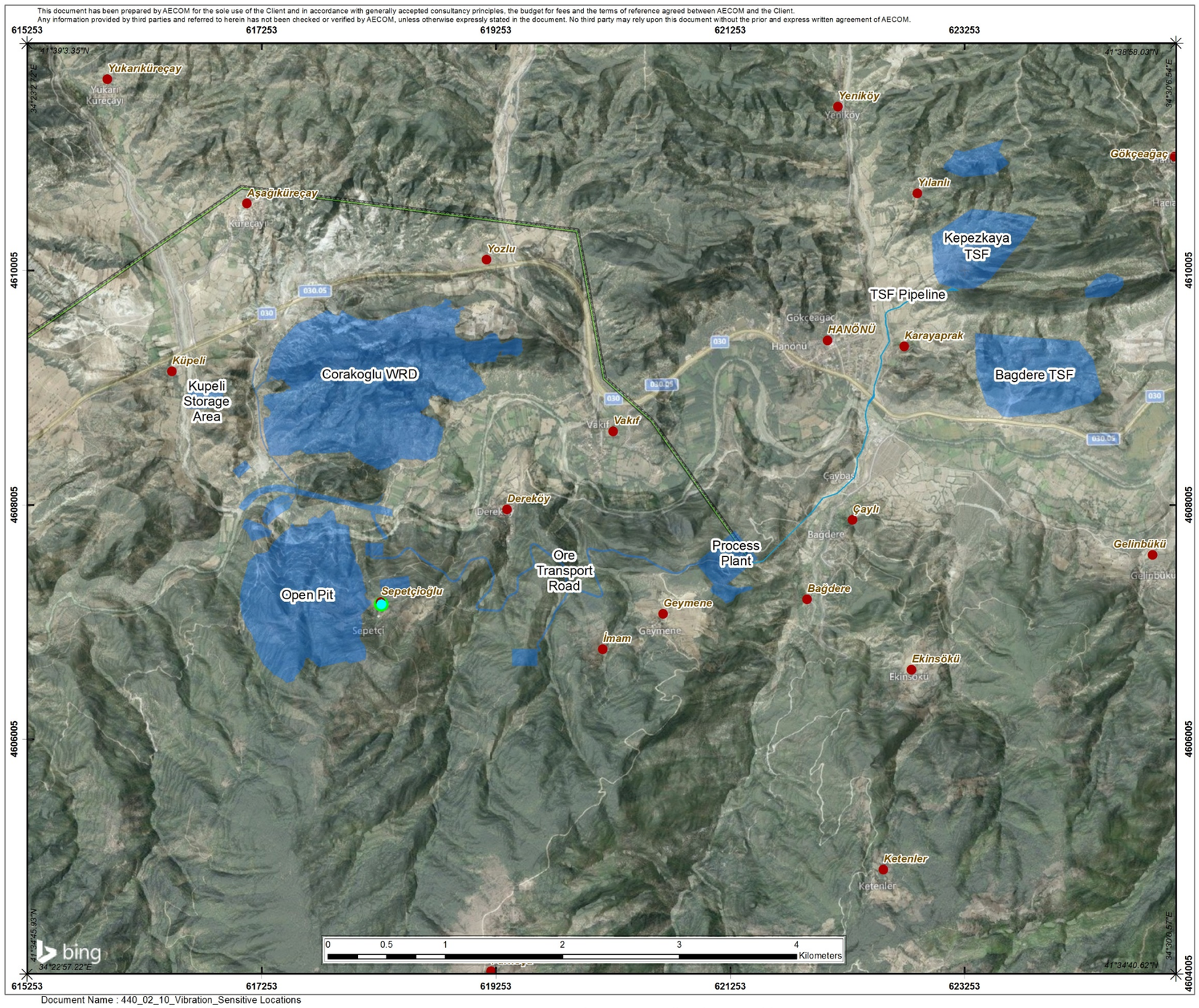
Table 6-48 Measured Vibration Monitoring Results

Location	Date	Channel	Peak Vibration Value (mm/s)	Frequency(Hertz)	Location	Date	Channel	Peak Vibration Value (mm/s)	Frequency (Hertz)
Sepetçioğlu	02.06.2017	Vertical	1.61	12	Sepetçioğlu	08.07.2017	Vertical:	0.05	12
		Longitudinal	1.52	7			Longitudinal:	0.04	25
		Transverse	1.16	12			Transverse:	0.03	3
400m away from explosion point	03.06.2017	Vertical	<0.05	-		08.07.2017	Vertical:	0.03	23
		Longitudinal	<0.05	-			Longitudinal:	0.05	7
		Transverse	<0.05	-			Transverse:	0.04	6
Sepetçioğlu	06.06.2017	Vertical	0.75	9	350m away from explosion point	10.07.2017	Vertical:	0.05	7
		Longitudinal	1.71	6			Longitudinal:	0.08	3
		Transverse	0.05	8			Transverse:	0.05	12
400m away from explosion point	09.06.2017	Vertical	<0.05	-		10.07.2017	Vertical:	0.51	21
		Longitudinal	<0.05	-			Longitudinal:	0.92	13
		Transverse	<0.05	-			Transverse:	1.24	11
Sepetçioğlu	10.06.2017	Vertical	1.63	19	300m away from explosion point	12.07.2017	Vertical:	1.41	18
		Longitudinal	0.12	170			Longitudinal:	1.07	18
		Transverse	1.25	7			Transverse:	2	16
400m away from explosion point	13.06.2017	Vertical	1.48	12	Sepetçioğlu	14.07.2017	Vertical:	<0.05	-
		Longitudinal	1.32	6			Longitudinal:	<0.05	-
		Transverse	1.23	12			Transverse:	<0.05	-
	13.06.2017	Vertical	5.04	8	300m away from explosion point	17.07.2017	Vertical	1.23	14
		Longitudinal	8.42	12			Longitudinal	1.27	15
		Transverse	5.55	11			Transverse	1.1	13

Location	Date	Channel	Peak Vibration Value (mm/s)	Frequency(Hertz)	Location	Date	Channel	Peak Vibration Value (mm/s)	Frequency (Hertz)
Sepetçioğlu	15.06.2017	Vertical	<0.05	-		17.07.2017	Vertical:	0.57	7
		Longitudinal	<0.05	-			Longitudinal:	1.1	13
		Transverse	<0.05	-			Transverse:	0.5	16
Sepetçioğlu	17.06.2017	Vertical	0.25	10	300m away from explosion point	18.07.2017	Vertical:	1.65	12
		Longitudinal	0.5	7			Longitudinal:	1.53	14
		Transverse	0.69	15			Transverse:	1.57	15
Sepetçioğlu	20.06.2017	Vertical	0.3	27	300m away from explosion point	21.07.2017	Vertical:	0.31	4
		Longitudinal	0.56	9			Longitudinal:	0.73	12
		Transverse	0.42	5			Transverse:	0.58	15
	20.06.2017	Vertical	<0.05	-		21.07.2017	Vertical:	1.19	38
		Longitudinal	<0.05	-			Longitudinal:	1.72	15
		Transverse	<0.05	-			Transverse:	1.88	24
Sepetçioğlu	22.06.2017	Vertical	<0.05	-	300m away from explosion point	22.07.2017	Vertical:	0.36	7
		Longitudinal	<0.05	-			Longitudinal:	0.62	6
		Transverse	<0.05	-			Transverse:	0.84	5
Sepetçioğlu	28.06.2017	Vertical	0.47	10		22.07.2017	Vertical:	0.53	23
		Longitudinal	0.56	6			Longitudinal:	1.02	26
		Transverse	0.6	16			Transverse:	1.33	8
Sepetçioğlu	01.07.2017	Vertical:	0.52	5	300m away from explosion point	24.07.2017	Vertical:	1.15	26
		Longitudinal:	0.69	8			Longitudinal:	1.73	11
		Transverse:	0.56	8			Transverse:	1.19	11
Sepetçioğlu	03.07.2017	Vertical	<0.05	-	300m away from	26.07.2017	Vertical:	1.38	7
		Longitudinal	<0.05	-			Longitudinal:	1.81	4

Location	Date	Channel	Peak Vibration Value (mm/s)	Frequency(Hertz)	Location	Date	Channel	Peak Vibration Value (mm/s)	Frequency (Hertz)
		Transverse	<0.05	-	explosion point		Transverse:	1.17	7
Sepetçioğlu	04.07.2017	Vertical	<0.05	-		26.07.2017	Vertical:	<0.05	-
		Longitudinal	<0.05	-			Longitudinal:	<0.05	-
		Transverse	<0.05	-			Transverse:	<0.05	-
300m away from explosion point	06.07.2017	Vertical:	1.26	14	300m away from explosion point	29.07.2017	Vertical:	3.75	13
		Longitudinal:	1.51	14			Longitudinal:	3.55	17
		Transverse:	0.9	13			Transverse:	1.93	7
	06.07.2017	Vertical:	1.03	13	300m away from explosion point	31.07.2017	Vertical:	0.92	33
		Longitudinal:	1.6	13			Longitudinal:	1.08	29
		Transverse:	1.13	14			Transverse:	1.16	10
						31.07.2017	Vertical:	0.47	28
							Longitudinal:	0.58	6
							Transverse:	0.48	10

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



LEGEND

- Proposed Project Units
- Energy Transmission Line
- Settlement Areas
- Vibration Sensitive Receptors

AECOM

Tel: +90 312 442 98 63
Fax: +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com

Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime B Blok Suite No:51
06800 Çankaya/Ankara Turkey

Project Name: ESIA Disclosure Package for Acacia Mine Inc. (AMI) Gökırmak Copper Project

Map Title: Vibration Sensitive Receptors

Client: Acacia Mine Inc. (AMI)

Project Group: Environment

Project Code: 440.02.10

Design: A. Korkmaz

Last Update: 03/09/2017 - 08:24 (korkmaz / TRAKR1PC31746)

Coordinate System: Projection: Transverse Mercator
Coordinate System: WGS 1984 UTM Zone 36N

Sheet Size: A3

Service Layer Credits: © 2017 DigitalGlobe © 2017 GeoEye Earthstar Geographics SIO © 2017 Microsoft Corporation © AND

N W E S

Document Name : 440_02_10_Vibration_Sensitive Locations

Figure 6-19. Vibration Sensitive Receptors

6.6.4 Mitigation

AMI will fully comply with noise control mitigation measures as committed within the national EIA report. The following list of general mitigation measures will be in place for noise management during construction and operation phases of the Project to ensure compliance with EBRD PR3 and relevant EU legislation and GIIP.

Noise Control Measures;

- Apply noise mitigation technologies on individual equipment where necessary,
- Implement measures outlined in the Tansport/Traffic Management Plan and Community Health and Safety Plan,
- Optimize the internal-traffic routing, particularly to minimize vehicle reversing needs (reducing noise from reversing alarm) and to maximize distances to the closest sensitive receptors,
- Select equipment with lower sound power levels,
- Ensure that equipment is regularly maintained,
- Limit noisier operations to normal work day hours to reduce or eliminate complaints,
- Manage any complaint in relation to noise emissions in accordance with Project's Grievance Mechanism;
- Investigate complaints to determine the source of the nuisance noise and take corrective actions where necessary,
- Implement a noise monitoring program as given below.

Noise and vibration measurements will be conducted at selected receptors during the construction and operation period of the Project. Proposed monitoring locations and frequencies are given in Table 6-49.

Table 6-49. Proposed Noise and Vibration Monitoring Locations

Monitoring Location	Parameters and Frequencies	
	Noise[1]	Vibration
Hanonu	Monthly	-
Yozlu	Monthly	-
Sepetcioglu	Monthly (minimum 48hr)[2]	at the time of blasting
Derekoy	Monthly (minimum 48hr)[2]	-
Geymene	Monthly	-
Asagikurecay	Monthly	-
Bagdere	Monthly	-
Kupeli	Monthly (minimum 48hr)[2]	-
Yilanli	Monthly[3] (minimum 48hr)	-

[1] *Leq dB(A) LAeq, LA10, LA90*

[2] *Continuously for at least 48 hours*

[3] *Only construction Period of TSF.*

The summary for noise and vibration impacts on human receptors and specific mitigation is given below in Table 6-50. Impacts on ecological receptors due to Project induced noise and vibration are separately discussed in Biodiversity Impact Assessment Section (Section 7.11).

Table 6-50. Summary of Impacts, Mitigation Measures and Residual Impacts for Noise and Vibration

Impact Description	Receptors	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Noise from Construction	Sepetcioglu Hanonu, Vakif Cayli Derekoy Geymene Asagikurecay Bagdere Kupeli Yilanli	Medium - Middle term duration - Local in Geographical Extent - High Magnitude - Continuous - Medium term to long term reversible (health impacts)	High (Residential)	High	• Apply general Noise Control Mitigations given above • Implement Noise and Vibration Management Plan • Reschedule construction activities based on monitoring results to ensure compliance with set limits for daytime and nighttime works (e.g. avoid night time activities near sensitive receptors if recorded noise levels are above 50 dB) • • •	Minor
Noise from Operation	Sepetcioglu Kupeli Derekoy Vakif Geymene Bagdere	High - Long Term duration - Local in Geographical Extent - Medium Magnitude (due to model results) - Continuous - Medium term to long term reversible (health impacts)	High (Residential)	High	• Apply general Noise Control Mitigations given above • Implement Noise and Vibration Management Plan • Reschedule operation activities based on monitoring results to ensure compliance with the set limits for daytime and night-time works (e.g. avoid night time activities near sensitive receptors if recorded noise levels are above 50 dB) •	Minor
Noise from ore haulage, unpaved roads and/or trucks	Sepetcioglu Kupeli Bagdere Vakif Derekoy Geymene	Medium - Long Term duration - Local in Geographical Extent - Medium Magnitude (due to model results) - Continuous Impact	High (Residential)	High	• Apply general Noise Control Mitigations given above • Implement Noise and Vibration Management Plan • Use the ore transfer road only during the daytime • Maintain the surface of haul roads in good condition and impose a speed limit for vehicle traffic • Implement maintenance and operation procedures to minimise nuisance noise emissions from equipment, including servicing and maintenance of exhaust systems on mine equipment. •	Moderate

Impact Description	Receptors	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Noise from Blasting	Sepetcioglu Hanonu, Vakif Cayli Derekoy Geymene Asagikurecay Bagdere Kupeli	Low - Short term duration - Local in Geographical Extent - Low Magnitude - Intermittent impact (per day) - Only Daytime	High (Residential)	Moderate	• Apply general Noise Control Mitigations given above • Implement Noise and Vibration Management Plan • Take applicable safety measures prior to blasting, such as warning signs and siren alarm • Careful control of blasting to reduce noise and vibration, e.g. timing and proximity to receptors • Provide personnel training on explosives handling and safety management. Only certified blasters or explosives experts will conduct blasting activities • Conduct blasting only during the daytime period (between 08:00 and 18:00) (as is the current case) • Plan to blast during the middle of the day when background noise levels are higher than at other times of day	Minor
Vibration	Sepetcioglu	Medium - Short term duration - Extent Highly Restricted - Medium Magnitude - Only Daytime - One-off impact (per day)	High (Residential)	High	• Implement Noise and Vibration Management Plan • Use specific blasting plans, correct charging procedures and blasting ratios, delayed / microdelayed or electronic detonators, and specific in-situ blasting tests (the use of downhole initiation with short-delay detonators improves fragmentation and reduces ground vibrations) • Develop a blast design, including a blasting-surfaces survey, to avoid overconfined charges, and a drill-hole survey to check for deviation and consequent blasting recalculations • Monitor vibration level at Sepetcioglu while blasting. • Baseline conditions of the houses located in the blasting impact area (approximately 150 m radius area around the explosion point in open pit; Sepetcioglu village is located in the blasting impact area) will be established before the start of operation phase.	Minor

6.7 Water Resources

Impacts on the quantity and quality of the water resources including surface and groundwater resources in and around the Project Area are discussed in this section. In this scope, the mine water balance established for the Project and the findings of the three dimensional (3D) numerical groundwater flow and transport model constructed for the Project Area are provided. To simulate groundwater flow and advective transport processes. AECOM has used VISUAL MODFLOW 2011.1 Premium software package which uses MODFLOW 2000 –three dimensional finite difference code. Objectives of the modeling study included an assessment of pit dewatering potential impacts on nearby groundwater and surface water resources (incl. community water resources), assessment of potential impacts on groundwater as the potential seepages from TSFs and WRD infiltrate through the unsaturated zone further to the saturated zone, assessment of pit lake water levels and closure strategy as the operations cease and groundwater rebounds back to its original state. In addition, geochemical impacts of mining wastes on water quality are also assessed under this section while the full report on geochemical aspects of the Project is provided in Volume-III of the ESIA Disclosure Package.

6.7.1 Modeling

6.7.1.1 Conceptual Model of the Study Area

A conceptual model for the study area has been developed prior to construction of the numerical model to distinguish and summarize the components that play role in overall hydrogeology. Conceptual model of the study area is presented in Figure 6-20 and explained below.

The study area consists of igneous, metamorphic and sedimentary rock units whose ages range between Mesozoic and Quaternary. Among these, pre-Upper Jurassic igneous and metamorphic lithologies form the basement rocks of the study area, whereas the post-Upper Jurassic sedimentary and volcanic rocks constitute the cover units overlying the basement rocks. Water bearing units can be classified into two main categories as “highly permeable” and “semi-permeable to impermeable” units. Unconsolidated alluvial deposits associated with the Gökırmak River and its tributaries represent highly permeable units whereas the schists in the open pit area, and sedimentary / volcanoclastic rocks distributed over the study area represent the semi-permeable to impermeable units.

The flow regime within the Project Area typically follows the topography as the groundwater flow occurs towards the Gökırmak River which is the main surface water body. The project units will be situated to the north and south of the Gökırmak River. Groundwater elevations (above mean sea level, masl) decrease from a value of about 1,600 – 1,400 m in the northern and southern borders (respectively) to a value of about 350 - 400 m in the eastern part along the Gökırmak River. The hydraulic gradients are measured between 0.2 and 0.4 especially on the rough terrain and decrease to 0.01 in the lower elevations especially around the Gökırmak River bed.

Due to relatively steep and undulating topography, the distribution of groundwater recharge varies within the study area. Based on the water budget calculations (See Hydrogeological Impact Assessment Report in Volume III of the ESIA Disclosure Package), average annual groundwater recharge from direct precipitation at the higher elevations (corresponding to northern and southern boundaries of the study area) was calculated to be 50.39 mm, which comprises 9% of the annual precipitation. As for the lower elevations on the other hand (corresponding to areas close to the Gökırmak River), groundwater recharge from direct precipitation was estimated to be 14.03 mm which comprises 3% of the annual precipitation.

Open Pit

Open pit will be developed within the low permeability schists showing an unconfined behavior within the pit area. Secondary porosity and permeability were developed in the schists due to fracturing and faulting zones. In addition to schists, a relatively thin (about 40 m) alluvium layer is present within the open pit boundaries. However, the alluvial material within the open pit boundaries has been hydraulically disconnected from the rest of the alluvial aquifer along the Gökırmak River with the slurry walls of the coffer dams. Furthermore, during the operation phase, the alluvium within the open pit area will be removed and will not be a component of the groundwater flow.

The groundwater levels changes from 800 m at the southern part to 425-450 m near the Gökırmak River. Depth to groundwater levels measured in this area is varying between 5 and 50 meters. Groundwater table generally follows the topography and the groundwater flow direction is from south to north with hydraulic gradient ranging between 0.25 and 0.4. The effect of dividing and subdividing faults can be clearly seen on the groundwater levels, indicating a relatively high conductivity zone in between the faults. The area lying in between the dividing and subdividing faults is also assumed to have a relatively high conductivity zone due to the activity of the both faults.

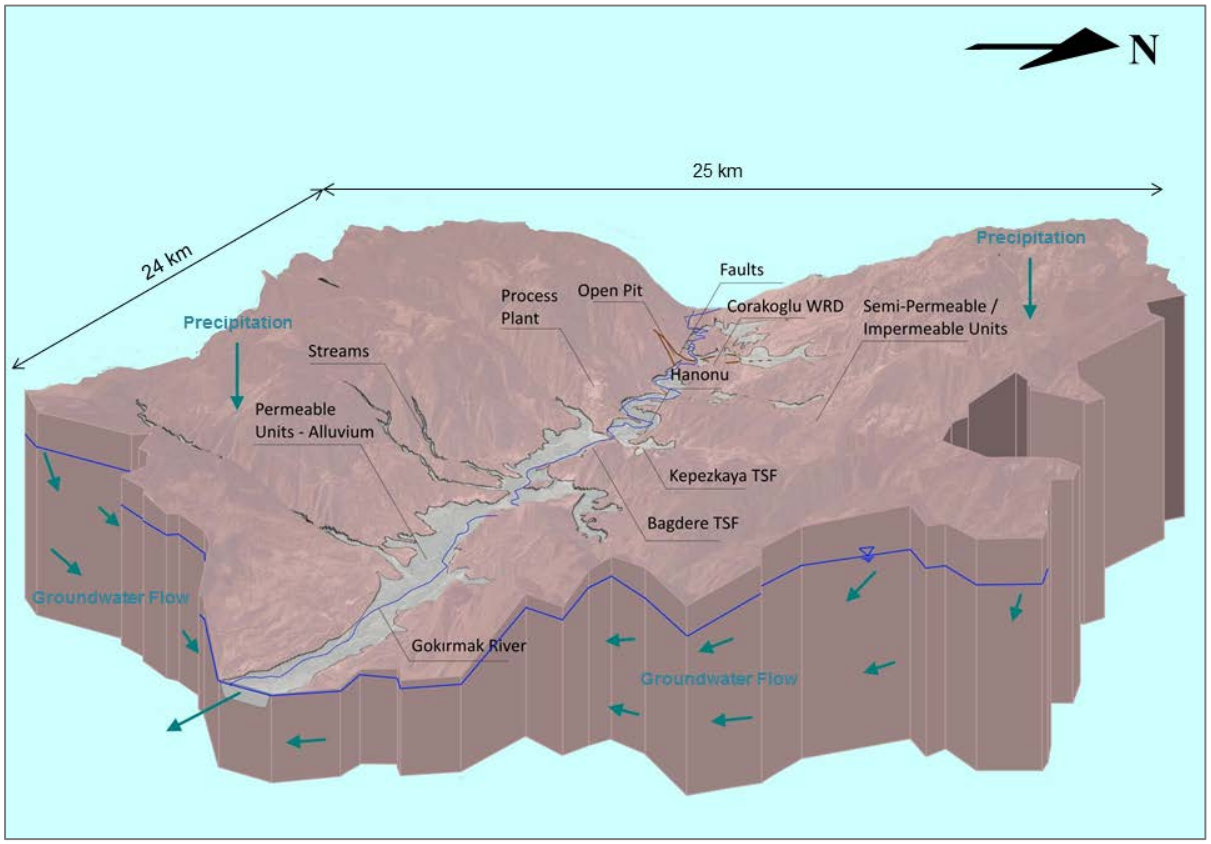


Figure 6-20 Conceptual Model of the Study Area

6.7.1.2 Numerical Model

A numerical groundwater flow model was constructed for the study area using the Visual MODFOW 2011.1 Premium software package developed by Schlumberger Water Services. Using this software, groundwater flow equations were solved by the MODFLOW-2000 code known as “3D Modular Finite-Difference Groundwater Flow Model” developed by the United States Geological Survey (USGS) (Harbaugh et al., 2000).

The model domain covers an area of 446 km^2 and is discretized into cells of variable size (see Figure 6-21). The grid is coarsest (100 x 100 m) along the model boundaries; at the open pit area where higher accuracy is required, grid size was refined to 25 x 25 m. The topographical surface was introduced in the model with elevations ranging between 350 m and 1850 m. At the bottom, the model is confined with a no flow boundary at 0 m, corresponding to an elevation that is 270 m below the ultimate pit bottom. The thickness between these surfaces was divided into 5 layers in vertical direction to enable a better simulation of the dewatering process during the operational phase of the mine. Details on boundary conditions, model parameters and numerical model calibration are provided in Hydrogeological Impact Assessment Report in Volume-III of the ESIA Disclosure Package.

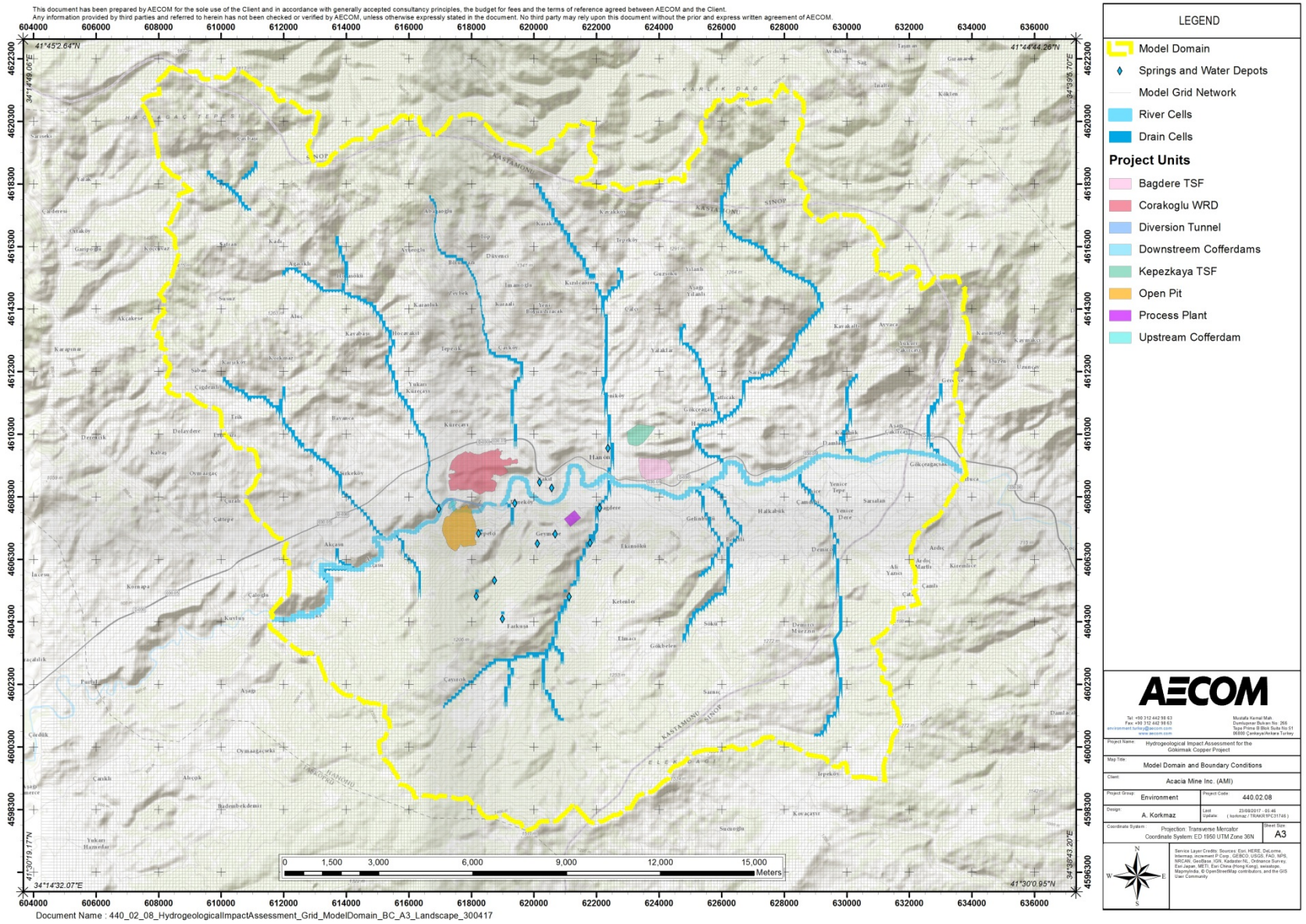


Figure 6-21 Model Domain and Boundary Conditions

6.7.2 Impacts on Water Resources

6.7.2.1 Impacts on Groundwater Quantity

Open pit mining, which requires deep excavations that reach below static groundwater level might impose potential environmental impacts on groundwater resources. In order to maintain safe and stable conditions for mining during the operational phase of the Project, the open pit area needs to be dewatered. The dewatering process can potentially modify the water balance which might further create potential impacts on nearby water sources.

Following the operational phase, as the pit dewatering ceases, the groundwater table tends to recover to its original position. Due to the hydraulic gradient towards the pit, an open pit lake will form until the hydrogeological regime in the pit reaches steady-state conditions.

In addition to the mining activities in the open pit, there will be two tailings storage facilities and a waste rock dump that are planned to be operated in the Project Area. The Çorakoğlu WRD is planned towards North of the open pit, in close proximity as the primary waste rock storage area.

In order to assess the hydrogeological impacts of the mining activities, following processes and/or project units were studied. Details for each topic are provided in the following sections.

- Open pit dewatering
- Pit lake formation
- Seepage transport (Tailings storage facilities and waste rock dump)
- Groundwater extraction for water supply

Finally, in consideration of the Project design and the relevant assessments, Mine Water Balance has been established for the Project.

6.7.2.1.1 Open Pit Dewatering

The elevation of the pit bottom of the Gökırmak Copper Mine will reach to its ultimate level at 270 m by the end of the operation phase of the Project. This implies that by the end of the operation phase, the groundwater levels will have to be lowered to this elevation via proper dewatering system. In order to design such a system, the groundwater inflow rate has to be quantified. At this stage, the calibrated numerical groundwater flow model was used to predict the amount of groundwater that will flow into the open pit as the pit deepens during the operation phase.

Although the duration of the open pit excavation will last 12 years and 4 months, numerical groundwater flow model was constructed to assume 13 full years to simulate a conservative pit dewatering scenario. The numerical groundwater flow model was utilized to simulate the time-dependent processes and was run in monthly stress periods to simulate the 13 years. In addition to boundary conditions, specific yield values had also to be defined before the model could be run under transient conditions. The model was run with a specific yield of 0.05. In order to evaluate the model's sensitivity to specific yield, an additional run with S_y=0.075 was also performed to obtain an upper bound for the pit inflow rates.

Figure 6-22 demonstrates the time-wise progression of the pit bottom (solid black line) together with the corresponding groundwater inflow rates (bars) calculated by the numerical model for specific yield values of 0.05 and 0.075. Annual groundwater inflow rates to the pit, calculated by the numerical model for both specific yield values during the 13-year dewatering period are illustrated in Figure 6-22. The results show that the annual groundwater flow rates into the pit varies between 5.8 L/s and 26.9 L/s for S_y=0.05 and 6.2 L/s and 34.1 L/s for S_y=0.075.

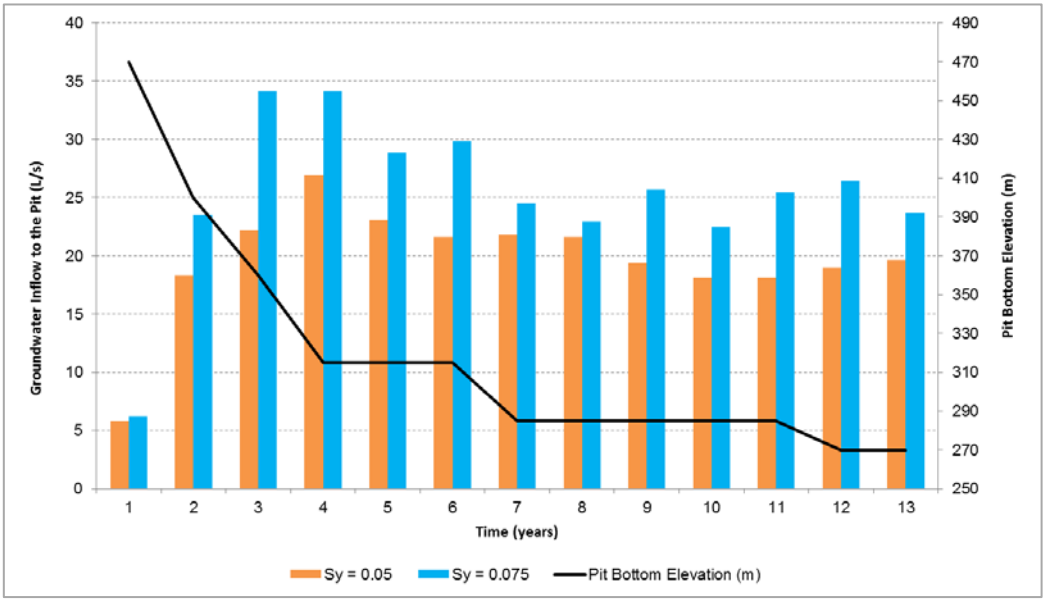


Figure 6-22 Groundwater Flow Rates into the Pit and Elevation of the Pit Bottom versus Time

The expansion of the cone of depression due to pit dewatering was also checked. Figure 6-23 shows the estimated lateral extents of final cone of depressions expressed by 20 m, 10 m, 5 m and 1 m drawdown cones at the end of 13 years of mining operation. Model outputs show that these depression cones will reach to the Sepetçioğlu Village spring. In order to assess the radius of influence, model budgets were checked and changes in the interactions between the modeled units and nearby community water sources were quantified. Accordingly, it was concluded that there are two water sources to be potentially affected providing water for three communities. The two water sources are the Sepetçioğlu Village spring (K-1) and water supply well (WSW-1) that supply water for the Küpeli and Aşağıküreçay villages. Numerical modeling results indicate that the Sepetçioğlu Village spring is vulnerable to open pit dewatering process and under current operational plan, it is expected that the water level in the Sepetçioğlu Village spring would drop more than 5 m at the end of second year of the operation and the water resource would become unavailable for the current users. Cone of depression for the open pit area is shown in Figure 6-23.

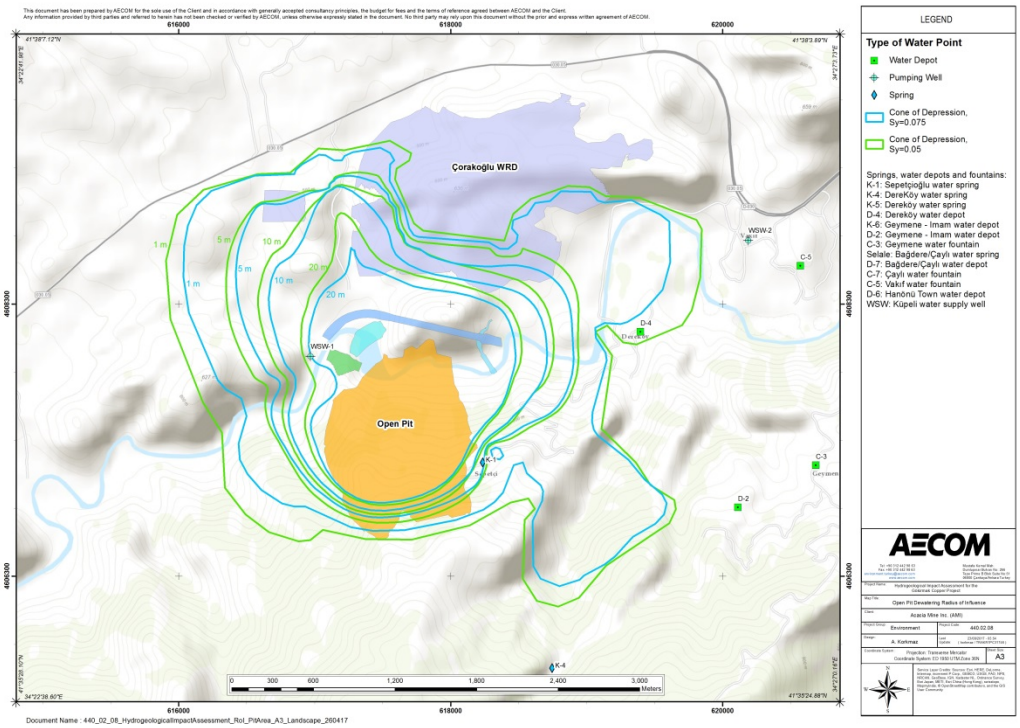


Figure 6-23 Open Pit Area Cone of Depressions for Specific Yields of 0.05 and 0.075 (End of Operation)

Water supply well for the Küpeli and Aşağıküreçay villages on the other hand, is located on the Gökırmak riverbank. The well is known to be screened both in alluvium and underlying schists. Numerical modeling results indicate more than 20 m drawdown for the underlying schists. On the other hand high hydraulic conductivity of alluvium could compensate the reduced drawdown in the schists.

Dewatering impact on other community water resources including Dereköy and Geymene villages, Selale Spring and Hanönü Town were observed to be negligible as those settlement areas remain out of the cone of depression that will be formed by the end of 13 years.

Recommendations and measures to prevent/minimize potential impacts of pit dewatering are provided below:

6.7.2.1.2 Pit Lake Formation

As the operation of the open pit ceases and the dewatering pumps are shut down, groundwater levels will start to rise back to static water level. Two components of pit lake formation are included in the pit lake assessments. These are:

- The inflow components of the pit lake can be classified as (1) direct precipitation falling onto the lake surface; (2) runoff from the pit walls following a precipitation event and (3) groundwater inflow.
- The outflow components are (1) evaporation from the lake surface and (2) groundwater outflow.

All relevant characteristics specific to the Study Area and to the ultimate pit design were considered in selecting the appropriate methodology to simulate the pit lake formation process. A volumetric balance approach was adopted to allow simulations for progressive pit lake levels until the water level of the pit lake stabilizes. The rate of groundwater inflow and/or groundwater outflow will be controlled by the lake level and groundwater level surrounding the pit. These two components were calculated numerically, by running the groundwater flow model under steady-state conditions for each 20 m increments in lake level from the bottom of the pit. Output of the numerical model was then incorporated into the pit lake budget to calculate the volumetric changes of all components on daily basis. Further, it was used to predict the time-wise change in lake levels, final pit lake and the time required to reach this level.

In evaluation of the sensitivity of the pit lake budget to climatic conditions, two additional runs were performed with ± 5% of the precipitation and ±10% of the evaporation data. Intervals for the sensitivity runs were specified based on the generalized projected changes in precipitation and temperature outlined by Turkey's National Climate Change Adaptation Strategy and Action Plan (Ministry of Environment and Urbanization, 2012). Based on this document, the precipitation is projected to decrease while the evaporation rates increase for the future climatic conditions of the zone that the Project Area is located. Accordingly, dry conditions are likely to occur in the future, however wet conditions were also simulated to evaluate opposite climatic conditions.

Within the scope of the numerical modeling study, following three scenarios of pit lake formation were evaluated. Sensitivity runs were evaluated for Scenario 1 and Scenario 2. Taking into account that pit lake formation in Scenario 3 takes relatively short period of time, sensitivity runs for this scenario were not conducted. The optimal closure of the pit will be decided during the operational phase as the long term data from the on-site meteorological is collected.

Scenario 1

The first scenario is leaving the open pit as it is with the diversion tunnels and cofferdams in place and allowing formation of a pit lake. This process will eventually create a hydraulic gradient towards the open pit to form a pit lake over a period of time as a result of a combination of groundwater inflow to the pit, direct precipitation and pit wall runoff. In this case, the Gökırmak River will be kept diverted out of the pit preventing the river flowing into the open pit. Conceptual closure conditions for Scenario 1 are illustrated in Figure 6-24.

According to this scenario, the open pit area will be bounded by the upstream and downstream cofferdams, in the west and in the east. Assuming that the cofferdams will act as barriers, the crest elevation of the downstream cofferdam (431 m) was assigned to the model as the maximum elevation of the pit lake reservoir. Beyond this elevation, the pit lake overflows the cofferdam into the Gökırmak River.

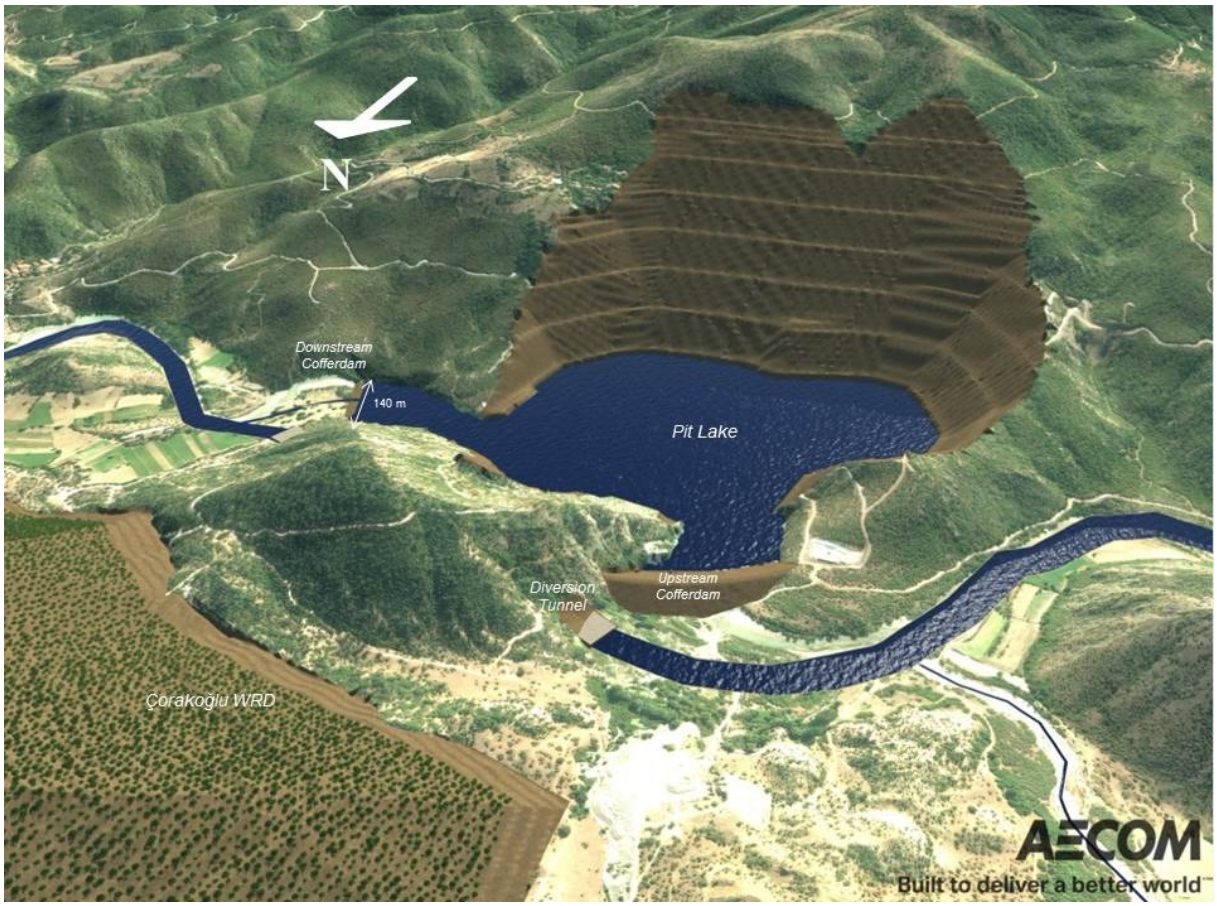


Figure 6-24 Conceptual Closure Conditions for Scenario 1

Figure 6-25 shows the pit lake level change with different data sets for a period of 100 years as the dewatering pumps are shut down. According to this run, the maximum water level in the pit lake is assumed to be 431 m as explained above. Two initial runs were completed with the climate data of Kastamonu and Devrekani Meteorological Stations. The simulations indicated that the pit lake will reach to 431 m elevation;

- Within 46 years after the mining operations cease with the Devrekani Climate Data.
- Within 51 years after the mining operations cease with the Kastamonu Climate Data.

In addition to these runs, a second set of simulations were completed by modifying the climate data – for the wet and dry future conditions.

- *Scenario 1 – Simulation 1:* Evaporation data obtained from the Kastamonu meteorological station was decreased by 10% while precipitation data was increased by 5% to simulate relatively wet conditions. The simulation result indicated that the pit lake will reach to 431 masl within 42 years.
- *Scenario 1 – Simulation 2:* Evaporation data obtained from the Devrekani meteorological station was increased by 10% while precipitation data was decreased by 5% to simulate relatively dry conditions. The simulation result indicated that the pit lake will reach to 431 masl within 57 years.

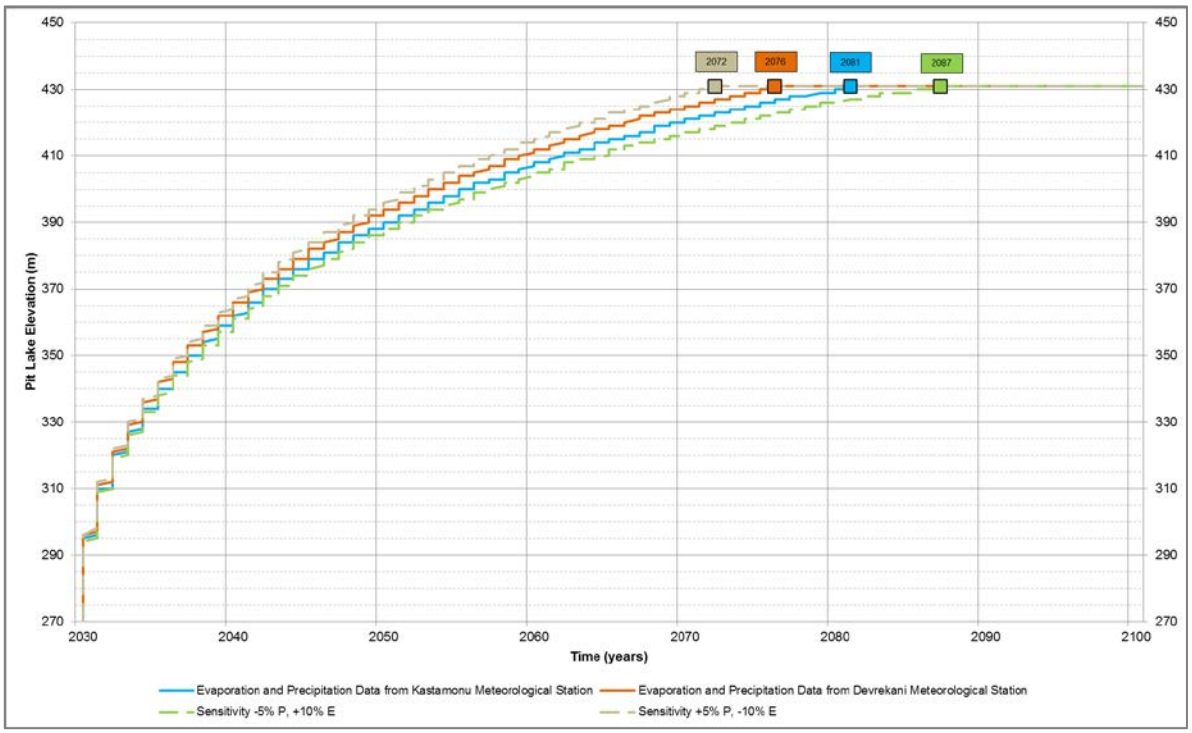


Figure 6-25 Pit Lake Level Change within Time for Scenario 1

All runs indicate that a pit lake will be formed and will rise to 431 m level. After this level the pit lake will start to flow out of its enclosed area over the downstream cofferdam into the Gökırmak River Bed and will act as a source to the Gökırmak River. Table 6-51 shows the estimated monthly discharge rates from the pit lake as a result of each simulation. Taking the account that the information on pit lake water quality is currently limited, this scenario has to be reevaluated again during the operation phase of the Project.

Table 6-51 Estimated Monthly Discharge Rates from the Pit Lake According to Scenario 1

Months	Kastamonu Meteorological Station (L/s)	Devrekani Meteorological Station (L/s)	Scenario 1 Simulation 1 (L/s)	Scenario 1 Simulation 2 (L/s)
January	17.0	20.8	21.6	16.4
February	16.8	20.0	20.8	16.2
March	17.4	18.9	19.9	16.4
April	13.2	9.1	12.3	10.9
May	14.1	17.0	20.3	11.0
June	10.5	9.3	12.8	6.8
July	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0
September	0.3	0.1	2.6	0.0
October	9.9	11.2	13.2	8.3
November	13.2	14.1	15.3	12.3
December	18.3	24.4	25.4	17.6

Scenario 2

Second scenario assumes that during the closure phase, the river will still be diverted out of the pit via the diversion tunnel but the cofferdams will be removed as the mine closure starts. Pit wall runoff will be diverted out of the pit to Gökırmak River downstream by in-pit interception channels. Hence, pit wall runoff is eliminated in this scenario which reduces the amount of water input to the pit lake, resulting in longer period for the pit lake to form. The final post-closure pit water elevation is estimated to be approximately 426 masl which corresponds to the Gökırmak river stage. The resulting lake reservoir will cover an area of 378,268 m^2 with a maximum depth of 156 m. Conceptual closure conditions for Scenario 2 is given in Figure 6-26.

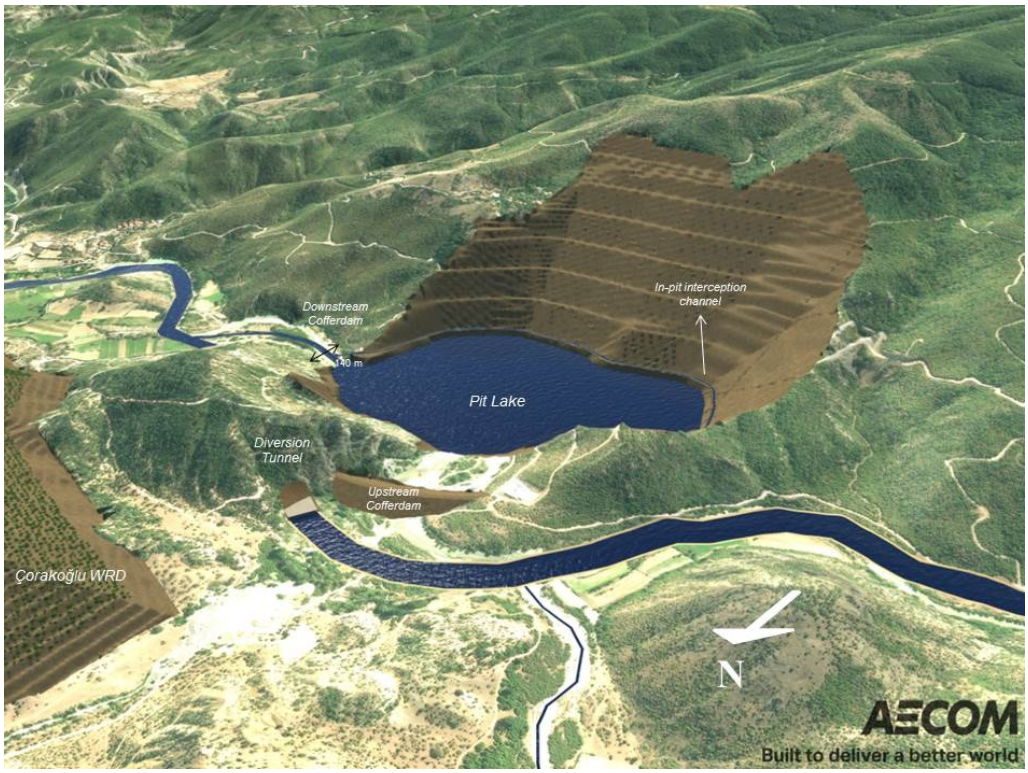


Figure 6-26 Conceptual Closure Conditions for Scenario 2

Figure 6-27 shows the pit lake level changes with different data sets for this scenario over a period of 100 years as the dewatering pumps are shut down. Initially two runs were completed with the climate data of Kastamonu and Devrekani Meteorological Stations. The simulations indicated that the pit lake will reach to 426 m elevation;

- Within 103 years after the mining operations cease with Devrekani Climate Data.
- Within 109 years after the mining operations cease with Kastamonu Climate Data.

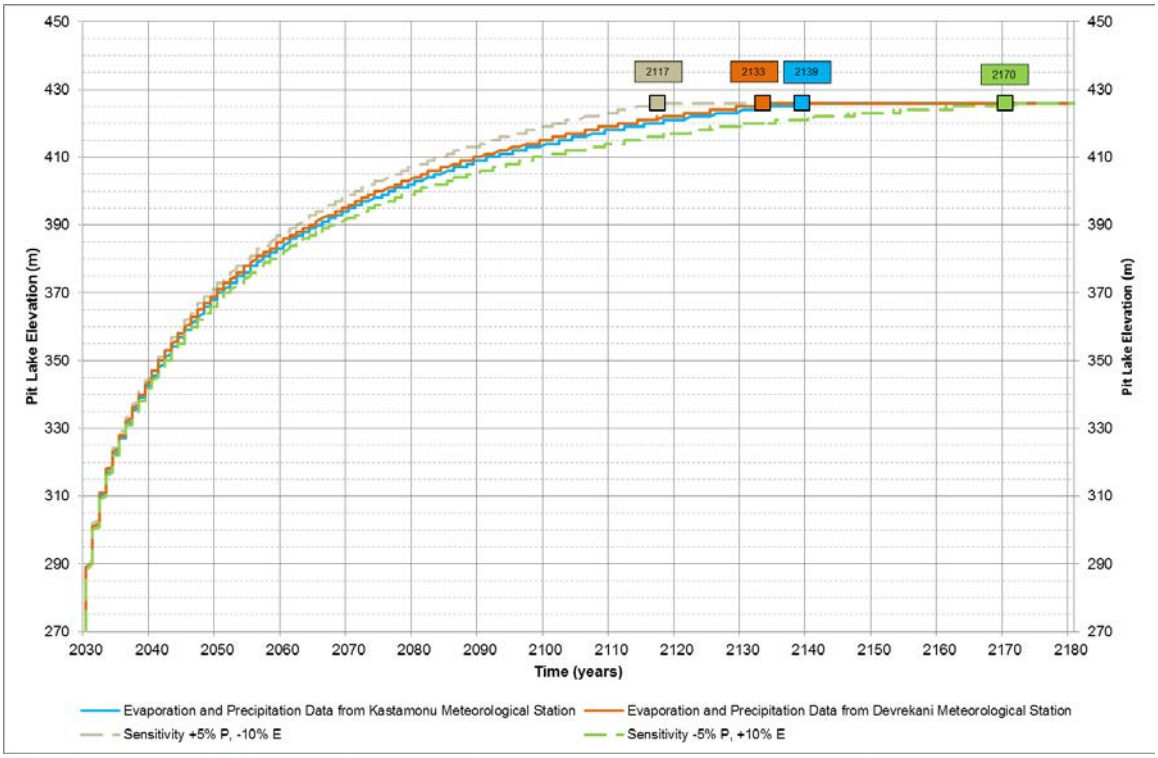


Figure 6-27 Pit Lake Level Change within Time for Scenario 2

In addition to these runs, a second set of simulations were completed by modifying the climate data – for the wet and dry future conditions.

- *Scenario 2 – Simulation 1:* Kastamonu Stations evaporation was decreased by 10% and precipitation was increased by 5% to simulate relatively wet conditions and the simulation result indicated that the pit lake will reach to 426 m level within 87 years.
- *Scenario 2 – Simulation 2:* Devrekani Stations evaporation was increased by 10% and precipitation was decreased by 5% to simulate relatively dry conditions and the simulation result indicated that the pit lake will reach to 426 m level within 140 years.

All runs indicate that a pit lake will be formed and will rise to 426 m level. After this level the pit lake will start to flow out of its reservoir area to the Gökırmak River Bed and will act as a source to the Gökırmak River.

Table 6-52 shows the estimated monthly discharge rates from the pit lake as a result of each simulation.

Table 6-52: Estimated Monthly Discharge Rates from the Pit Lake According to Scenario 2

Months	Kastamonu Meteorolog. Station (L/s)	Devrekani Meteorological Station (L/s)	Scenario 2 Simulation 1 (L/s)	Scenario 2 Simulation 2 (L/s)
January	10.4	11.8	12.1	10.1
February	10.4	11.7	12	10.2
March	10.1	10.3	10.8	9.7
April	3.6	0.0	1	2.1
May	1.8	3.0	5	0
June	0.0	0.0	0.5	0
July	0.0	0.0	0	0
August	0.0	0.0	0	0
September	0.0	0.0	0	0
October	3.8	3.5	4.8	2.8
November	7.7	7.1	7.8	7.3
December	11.0	13.4	13.8	10.7

Scenario 3

The third scenario on the other hand, is allowing the open pit to be flooded by the Gökırmak River within a relatively short period of time compared to the first two scenarios. This scenario involves the demolishment of the cofferdams and considers the Gökırmak River being reset to its original course during the closure and allowing the river to flow directly into the open pit. In estimation of the river water income to the pit, long term average monthly discharge rates measured in the Gökırmak River were used.

A controlled pit lake formation strategy that minimizes potential impacts on downstream water quantity and water users will be implemented. Scenario 3 is based upon the rapid fill of the open pit with the excess water which is the remainder after the baseflow and Demirci HEPP's water requirements are satisfied. Following assumptions were applied to build up Scenario 3.

- In reference to long term average monthly discharge rates, baseflow in the Gökırmak River is assumed to be 5 m^3/s. As a conservative approach, baseflow is then multiplied by a factor of 1.5 making it 7.5 m^3/s.
- In order to evaluate different amounts of water that Demirci HEPP would require, 3 different runs were conducted with varying amounts of 10 m^3/s, 15 m^3/s and 20 m^3/s. The time needed to fulfill the rapid fill scenario was separately estimated by taking the account of these three different rates.
- River water that flows into the pit is assumed to be the excess water that remains after the above-mentioned portions of water is transferred to downstream and/or water users.
- The climatic components of this scenario has significantly low impact for the filling period estimation, thus only Devrekani Meteorology Station's climate data was used for the completion of the simulations of the third scenario.

Conceptual closure condition for Scenario 3 is shown in Figure 6-28. Figure 6-29 shows the pit lake level changes demonstrating the rapid fill scenario as the Gökırmak River is diverted back to its original course. According to three runs and assuming different amounts of water need for the Demirci HEPP, the pit lake level will stabilize ~4 months (Demirci HEPP water use = 10 m^3/s), ~4 months (Demirci HEPP water use = 15 m^3/s) and ~2.5 years (Demirci HEPP water use = 20 m^3/s), respectively, after the closure of mine.

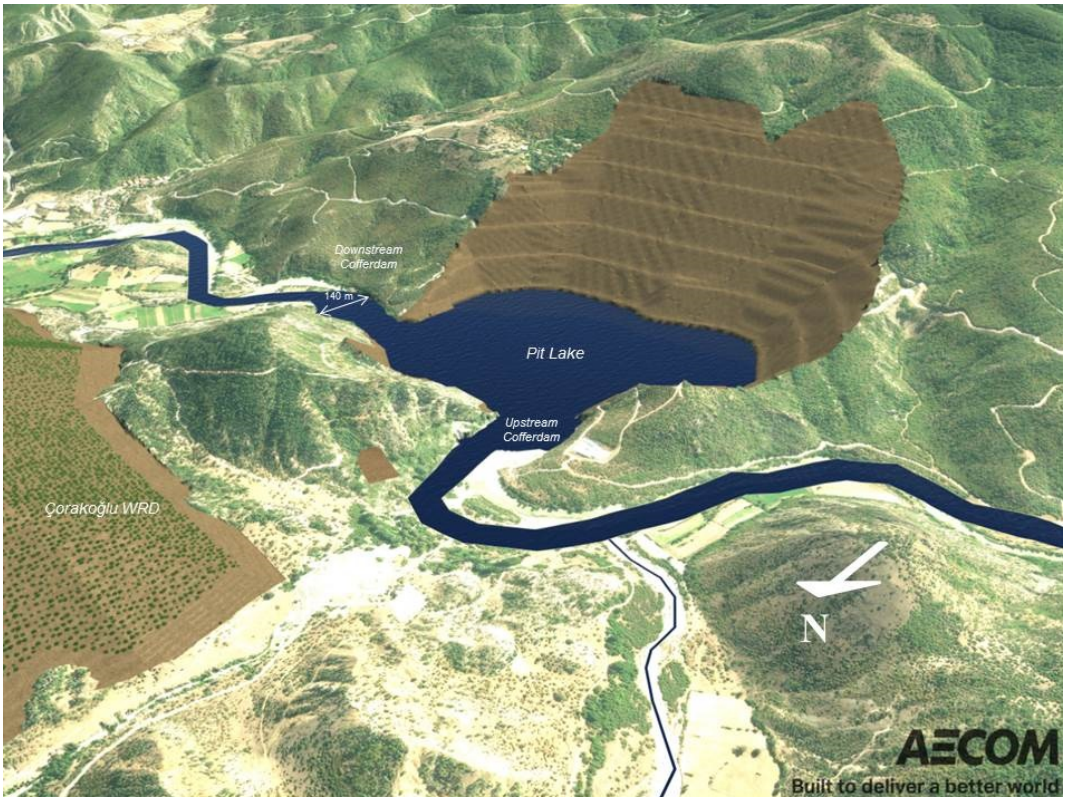


Figure 6-28 Conceptual Closure Conditions for Scenario 3

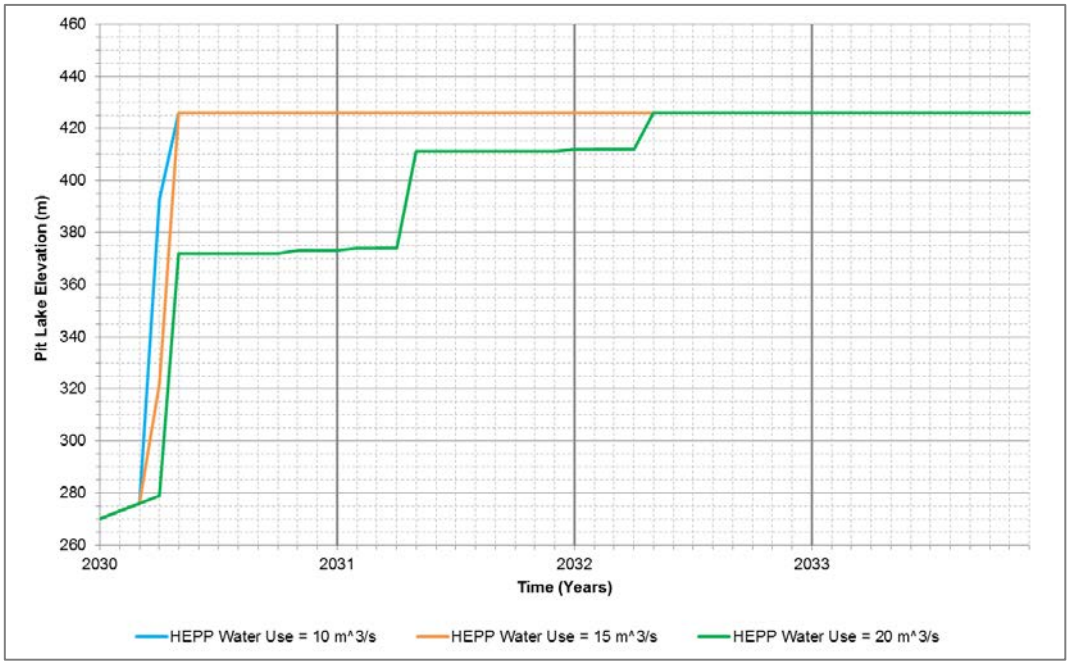


Figure 6-29 Pit Lake Level Change within Time for Scenario 3

6.7.2.1.3 Groundwater Extraction for Water Supply

In reference to the operational water budget estimations received from Acacia, the amount of water that is planned to be supplied from water supply wells is 123.5 m^3/hour (35 L/s). Within the scope of the Water Supply Study, AECOM has conducted various constant rate pumping test separately in water supply wells, including a 12 day, 190 L/s 3 well simultaneous pump test. .

During these tests, the wells produced high yields (up to 66 L/s) with comparatively smaller drawdowns, even on the production well (maximum 6 m drawdown). The individual test results can be summarized as follows;

- ST-1A was tested with 60 L/s and the maximum drawdown was measured as 3.5 m in the pump test well. The drawdowns in the observation wells were also measured during the test (drawdown of 0.60, 0.33, 0.26 and 0.14 m at distance of 29.5, 121.6, 156.4, 224.5 m, respectively). The radius of influence for ST-1A was calculated as 300m.
- ST-4 was tested with 66.6 L/s and the maximum drawdown was measured as 6 m in the pump test well. The drawdowns in the observation wells were also measured during the test (drawdown of 0.28, 0.24, 0.19, and 0.17 m at distance of 118, 182, 225 and 254 m, respectively). The radius of influence for ST-4 was calculated as 380m.
- ST-5 was tested with 66.6 L/s and the maximum drawdown was measured as 5.2 m in the pump test well. The drawdowns in the observation wells were also measured during the test (drawdown of 0.32, 0.23, 0.24, 0.26 m at distance of 122, 141, 182 and 187 m, respectively). The radius of influence for ST-5 was calculated as 290m.

Considering that the maximum allowable drawdown is more than 30m (for each test well) and fresh water requirement is 35 L/s; it should be noted that the water can be supplied from even a single well, located at the mobilization area. The tests have been performed during the driest period of the year which corresponds to the lowest groundwater recharge for the alluvium aquifer. Therefore, the results of the tests performed during the season of lowest groundwater levels indicate the worst case scenario.

As provided in Section 6.8.4 an extensive field survey was carried out for the aquifer where the water supply wells were drilled and installed. This study was completed to identify any water users that might be affected by the groundwater pumping from water supply wells. As a result of this study, it was noted that no water user is present within the close vicinity that supply water from the alluvial aquifer. Furthermore, the closest settlement to the well field, Çaylı Village, supply its water from a developed spring on the valley of Sarıkaya Creek, located 3.7 km upstream of mobilization area, having more than 150m elevation difference with the water supply wells. Since this source is far from the mobilization area, the fresh water supply for the mining operations is not expected to have an adverse impact on the community water resources and nearby water users.

In addition to the water supply wells drilled and completed in 2016, AECOM has also performed pumping tests in three caisson wells (which were previously-constructed by Acacia before AECOM's involvement to the GCP) located along the Gökırmak River, northwest of the mobilization site (locations of the water supply wells are shown on the map provided in Figure 5-34). The wells were identified to be permitted in 2014. Although the caisson wells are not planned to be used for the Project, the tests completed in these wells indicate over 40 L/s water that can be pumped from these wells. These wells are hydraulically connected with the Gökırmak River and the impact of water supply from these wells (during the emergency cases) would be negligible considering the discharge rate of Gökırmak River (Base flow of Gökırmak River is 5 m3/s).

6.7.2.1.4 Tailings Storage Facilities and Waste Rock Dumps

Numerical groundwater flow model was also run to simulate seepage transport from the bottom of the WRD and TSFs. As the worst case scenario, advective transport of the particles was introduced to the model.

As the operations cease, groundwater level starts to rise back to its original position. Also presented in Section 6.7.2.1.2, the pit lake is expected to reach its maximum elevation at 431 masl, approximately 45 years after the closure phase starts. Hence, the progressive pit lake elevations were introduced to the model as time-variable constant heads for the first 45 years of closure.

WRD and TSFs were introduced to the model as a potential source of contamination that was simulated by particle tracking process starting from the outer boundaries of each project unit. Nearest receptors were taken into consideration in assessing the potential impacts of the contaminant transport on water resources. The nearest receptors were identified as:

- Gökırmak River for the Bağdere TSF,
- Yılanlı Stream for the Kepezkaya TSF,
- Gökırmak River for the Çorakoğlu WRD.

Once the initial conditions are specified, a 100-year simulation was run under transient conditions to estimate the time for potential seepages for each project unit to reach the nearest receptors. MODPATH Particle Tracking module was used to simulate the transport processes assuming that the particles are transported via advection as a conservative approach. Particles were introduced as the potential contaminants directly to the saturated zone without any travel through the unsaturated zone. This makes the approach more conservative as the mobilization of the contaminants in the unsaturated zone will take some additional time as well.

Tailings Storage Facilities

Potential damages/defects on the impervious bottom liner can create seepages from the bottom of TSFs that may further reach to groundwater. Resultant waters can involve pollution and ARD/ML-related impacts which have been assessed within the scope of the Geochemical Impact Assessment by Geochemico. This section presents the prediction of potential leakage rate beneath the TSFs and the results for the numerical modeling of TSF seepages and material transport through the saturated zone. Similar conservative approach for WRD seepages was also followed for the TSF seepages that the particles were introduced to the model directly to the saturated zone.

Prediction of Potential Leakage Rate beneath the Tailings Storage Facilities (TSFs) During the Operational Period

Potential seepages from the TSFs are directly related with (1) the quality of the material that was used during the construction, (2) the construction quality and (3) operational maintenance of the TSFs.

Prediction of potential leakage rate beneath the TSFs during operational period is calculated with a series of calculations that was developed by Giroud and Bonaparte (1989) and an approach that is used by US - EPA.

The proposed design of TSFs include from bottom to top, 50 cm thick compacted clay layer overlain by 1 cm geosynthetic clay layer and 2 mm thick high density polyethylene (HDPE) liner. The liner will be covered by 50 cm thick gravel, where drainage pipes with a diameter of 11 cm will be inserted (Figure 6-30). Although the HDPE liner is practically impervious, manufacturing and application errors may cause leakage and subsequent contamination of groundwater.

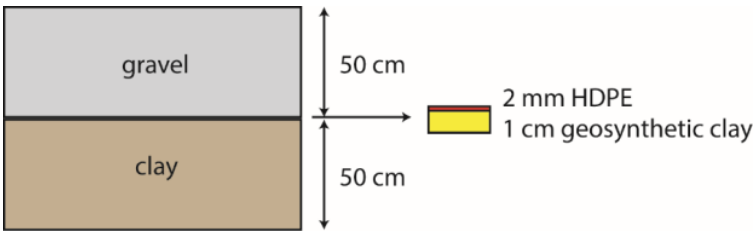


Figure 6-30 Proposed Design of the Composite Liner System beneath the TSFs

In order to predict potential leakage rate beneath the Kepezkaya and Bağdere TSFs, analytical model developed by Giroud and Bonaparte (1989) was used. According to this model, the leakage rate per unit area is calculated as:

$$\frac{Q}{A} = n \times 0.976 \times C_{q0} \times [1 + 0.1 \times (h/t_s)^{0.95}] \times d^{0.2} \times h^{0.9} \times {k_s}^{0.74}$$

Where:

- Q : leakage rate (m^3/s)
- A : area (m^2)
- n : number of defects
- C_{q0} : contact quality factor
- h : head of liquid on top of geomembrane (m)
- t_s : thickness of the low permeability soil component (m)
- d : diameter of circular defect (m)

The good and poor contact conditions are described as follows:

- The good contact condition is achieved if the geomembrane is laid down without wrinkling on low permeability clay material which is compacted according to the standards and have a smooth upper surface (without any sharp edges, angular or coarse gravel). In this case, Cq_0=0.21.
- The poor contact condition, on the other hand, refers to the geomembrane layer that contains certain amount of wrinkles laid down on low permeability clay material which is not well-compacted and does not have a smooth upper surface. In this case, Cq_0=1.15, and calculated leakage rate will be 5 times higher compared to the good contact conditions.

According to the analytical model, the factors affecting the leakage rate are (i) the size of the hole, (ii) hydraulic conductivity of the lower clay layer, and (iii) the hydraulic head above the liner. The criteria defined by the U.S. Environmental Protection Agency (U.S. EPA) are used to calculate the leakage rate. U.S. EPA recommends to use 1 hole with a standard hole area of 10 mm^2 (hole diameter assumed as 3.57 mm in accordance with applicable international criteria) for a surface area of 4000 m^2 in such calculations.

The holes in the liner arise from manufacturing and application errors. The holes formed by manufacturing errors are generally as large as the thickness of the geomembrane in the form of a pinhole for a surface area of 4,000 m^2. The holes formed during the application depend on the quality of the application, the condition of the ground, and quality assurance and quality control (QA/QC) procedures. In general, the number of holes where good practice is applied is one in 4,000 m^2. On the other hand, the number of holes is increased to 20 in 4,000 m^2 where bad practice is applied. In order to evaluate the performance of the liner system, both good contact and good application conditions and poor contact and poor application conditions were considered. The hydraulic head value above the liner is taken as 11 cm, which equals to the diameter of the drainage pipes within the gravel layer. The calculations were also repeated by considering the hydraulic head value of 50 cm, which is the thickness of the gravel layer above the liner. For different hydraulic conductivity values of the clay layer (i.e. 1E-7 m/s and 1E-8 m/s), the leakage rates were calculated using the above equation (Table 6-53and Table 6-54).

Table 6-53 Calculated leakage rates for hydraulic head above the liner equals to 0.11 m

Hydraulic Conductivity of the Clay Layer (m/s)	**Leakage Rate ($m^3/s/m^2$)**	
	Good contact and good application (1 hole in 4,000 m^2)	Poor contact and poor application (20 hole in 4,000 m^2)
1.00E-07	1.54E-11	1.69E-09
1.00E-08	2.80E-12	3.07E-10

Table 6-54 Calculated leakage rates for hydraulic head above the liner equals to 0.5 m

Hydraulic Conductivity of the Clay Layer (m/s)	Leakage Rate ($m^3/s/m^2$)	
	Good contact and good application (1 hole in 4,000 m^2)	Poor contact and poor application (20 hole in 4,000 m^2)
1.00E-07	6.47E-11	7.08E-09
1.00E-08	1.18E-11	1.29E-09

The total area that will be lined and tailings will be stored is calculated as 254,800 m^2 and 360,700 m^2 for Kepezkaya and Bağdere TSFs, respectively. Considering that an independent, specialized consultant is on site for the QA/QC of the construction, the facility is being built in accordance with the relevant legislation and codes, and also taking the account that the hydraulic conductivity of the clay layer to be used in the construction of the TSFs are lower than 1.00E-08 m/s, the potential discharge rate from the Kepezkaya and Bağdere TSFs are calculated as 3.0E-03 L/s and 4.26E-03 L/s assuming that the hydraulic head above the liner is 0.5 m. Furthermore, this insignificant amount can be decreased about five fold with good operation of the drainage mechanism (i.e. 0.11 m hydraulic head above the liner).

Further model runs were also completed for a single particle that can pass through the liner and clay layer, travel through unsaturated zone and reach to groundwater. These runs were completed to estimate the tracking time of a single particle that is released to groundwater (from the TSF) and that can reach to nearest sensitive receptors. The details of these runs are given below.

Kepezkaya TSF

Located on a valley to the east of Hanönü, the closest receptor to Kepezkaya TSF is determined to be the Yılanlı Stream. An initial run was completed to simulate the particle transport from the perimeter of the TSF. The fastest flow path that reaches to the Yılanlı Stream was determined to be the western side of the TSF (embankment zone). Three particles were introduced to this area assuming that there is no travel time for the unsaturated zone. Simulations indicated that the fastest particle will not reach even halfway to the Yılanlı Stream within 100 years in the case of the scenario described above. The flow conditions for Kepezkaya area were re-evaluated and it was noted that the groundwater flow in this area stays steady during the 100-year transient run. Thus, a second steady state run was completed to estimate the travel time of a single particle that is released from Kepezkaya. It was noted that it will take more than 300 years for a particle released to groundwater from the TSF to reach to the Yılanlı Stream (see Figure 6-31).

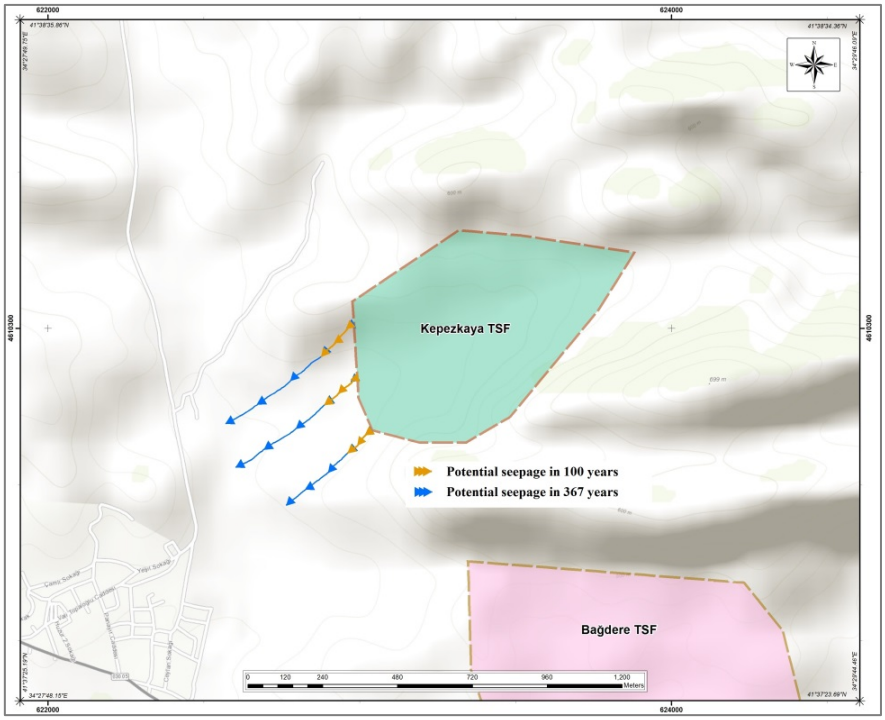


Figure 6-31 Potential Seepage Pathways for the Kepezkaya TSF

Bağdere TSF

Located on the southern side of the Kepezkaya TSF, the closest receptor to Bağdere TSF is determined to be the Gökırmak River. An initial run was completed to simulate the particle transport from the perimeter of the TSF. The fastest flow path that reaches to the Gökırmak River was determined to be the southern side of the TSF (embankment zone). Three particles were introduced to this area assuming that there is no travel time for the unsaturated zone. Simulations indicated that the fastest particle will reach to the Gökırmak River within 64 years in the case of the scenario described above (see Figure 6-32).

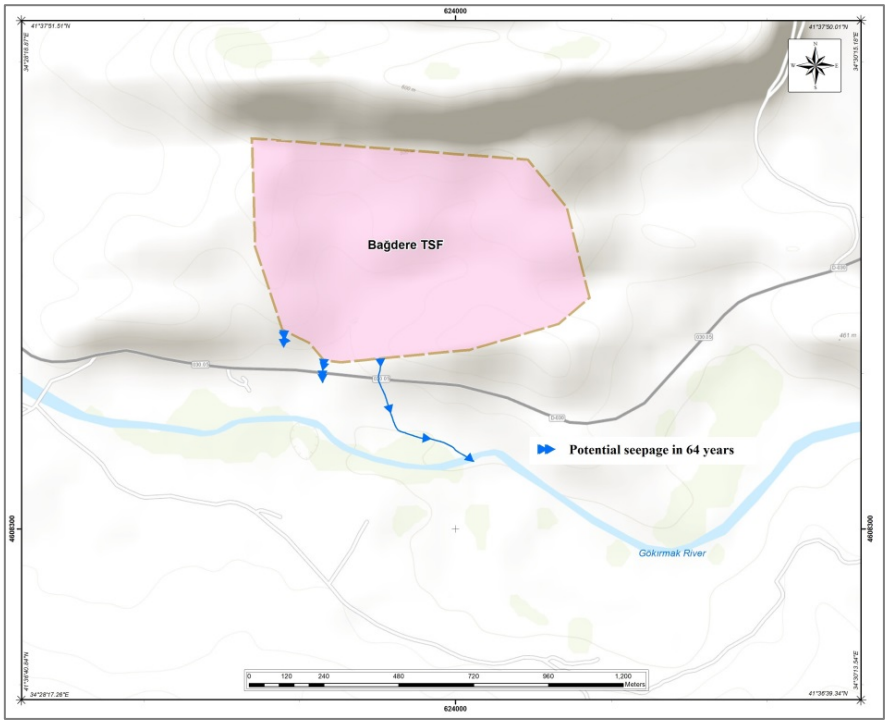


Figure 6-32 Potential Seepage Pathways for the Bağdere TSF

Information on nearest receptors to the TSFs, their distance to seepage source and particle transport time are summarized in Table 6-55. A groundwater monitoring will need to be implemented to monitor groundwater quality on the critical flow paths. Details on monitoring locations are given in Hydrogeological Impact Assessment Report in Volume-III of the ESIA Disclosure Package.

Table 6-55: Information on Nearest Receptors, Their Distance and Estimated Travel Times for the Potential TSF Seepages

Project unit	Nearest receptor	Receptor's distance to Project Unit (m)	Particle transport time (years)
Kepezkaya TSF	Yılanlı Stream	450 m	> 300
Bağdere TSF	Gökırmak River	350 m	64

Çorakoğlu Waste Rock Dump

Waste rock generated from the open pit will be deposited in the Çorakoğlu WRD. Located in the north of the open pit, the closest receptor to Çorakoğlu WRD is determined to be the Gökırmak River. An initial run was completed to simulate the particle transport from the perimeter of the WRD. The fastest flow path that reaches to the Gökırmak River was observed to be the southwestern corner of the dump. Three particles were introduced to this area assuming that there is no travel time for the unsaturated zone. Simulations indicated that the fastest particle will reach to Gökırmak River within 79.1 years in the case of the scenario described above (Figure 6-33). The ultimate point for the particles to reach is assumed to be the Gökırmak River for the closure period.

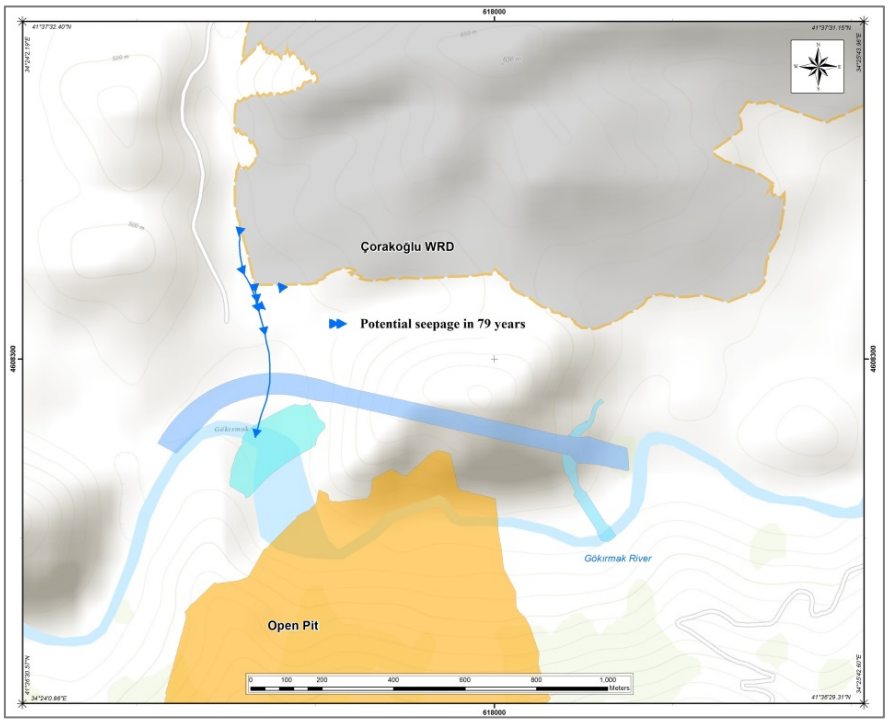


Figure 6-33 Potential Seepage Pathways for the Çorakoğlu WRD

Information on nearest receptor to the Çorakoğlu WRD, its distance to seepage source and particle transport time is summarized in Table 6-56. A groundwater monitoring will need to be implemented to monitor groundwater quality on the critical flow paths. Details on monitoring locations are provided in Hydrogeological Impact Assessment Report in Volume-III of the ESIA Disclosure Package.

Table 6-56 Information on Nearest Receptors, Their Distance and Estimated Travel Times for the Potential WRD Seepages

Project unit	Nearest receptor	Receptor's distance to project unit (m)	Particle transport time (years)
Çorakoğlu WRD	Gökırmak River	280 m	79.1

6.7.2.1.5 Project (GCP) Water Balance

This chapter presents the mine water balance developed for the Gökırmak Copper Project. The study combines groundwater and surface water components to evaluate the quantity of water entering and leaving various project facilities, namely open pit, waste rock dump, tailings storage facilities, process plant and sedimentation ponds. The water balance has been prepared taking the account of issues specified in the Reference Document on Best Available Techniqes for Management of Tailings and Waste-Rock in Mining Activities published by the European Commision. These issues cover but are not limited to hydrology, process water, discharge, water supply, pit dewatering and other mine water demands (i.e. dust suppression). Ongoing monitoring on mine water use for operational activities (i.e. ongoing data collection for the process plant and TSF water balance calibration purposes) will also be performed to maintain an up-to-date mine water balance and develop, if necessary.

Water balance was evaluated in two sections;

1. Mine Area: Representative for the Open Pit, Çorakoğlu WRD and their associated sedimentation ponds.
2. Process Plant Area: Representative for the Process Plant, fresh water tank, thickeners and tailings storage facilities

These two areas will have separate water balances and will not have any water transfer in between as these areas are distantly separated. The details of water inflows and outflows for each facility are explained below.

6.7.2.1.5.1 Mine Area

Open Pit

The main sources of water inflow to the open pit are groundwater inflows and rainfall runoff, whereas evaporation and pit dewatering comprise the outflow components. In order to assess the inflow and outflow components, the pit area has been divided into two sub-catchments referenced to 440 mRl elevation. For the inflows above 440m, the water will be channeled out with gravity drainage. On the other hand, water inflows below 440 mRl is planned to be collected at the pit sump, and pumped out of the pit (RPS, 2015).

A three-dimensional groundwater flow model developed by AECOM (AECOM, 2017) is used to assess the amount of groundwater inflow during 13 years of operation period. According to the model results, on average, the groundwater inflow rate is predicted as follows;

- 60.7 m^3/h for the elevations below 440 mRl,
- 10.1 m3/h for the elevations above 440 mRl.

Yearly groundwater inflow rates to the open pit are presented in Table 6-57.

Table 6-57 Yearly Groundwater Inflow Rates to the Open Pit

Years	Groundwater Inflow Rates (m^3/h)	
	Below 440 mRl	**Above 440 mRl**
1	8.9	12.1
2	59.5	6.6
3	73.1	6.9
4	90.1	7.0
5	70.4	12.6
6	64.6	13.2
7	66.5	11.9
8	65.3	12.5
9	58.3	11.4
10	56.3	9.0
11	57.3	7.9
12	59.8	8.4
13	59.4	11.4

In order to predict the average annual surface water inflow to the pit, mean annual precipitation data measured at Hanönü Meteorological Station (492 mm) and runoff coefficient (RoC) values were used. Runoff coefficient is required to estimate the proportion of total rainfall that actually runs offs, and depends on rainfall intensity, topography and ground conditions. The inflow volume from rainfall runoff is calculated according to Equitation 1.

$$Inflow\ Volume\ (m^3) = RoC * Area(m^2) * Rainfall(m) \quad (1)$$

The runoff coefficient value considering average annual rainfall is taken as 0.45 for pit and external catchment area (RPS, 2015). The corresponding areas for above and below 440 mRl elevation are determined from yearly pit progress drawings. In Table 6-58, the catchment areas for elevations below and above 440 mRl and corresponding rainfall runoff inflows during operation period are summarized. On average, the surface water runoff rate is calculated as follows;

- 8.3 m3/h for the elevations below 440 mRl,
- 16.3 m^3/h for the elevations above 440 mRl.

Table 6-58 Pit Catchment Areas and Average Annual Rainfall Runoff Inflow Rates for Operation Period

Years	Pit Catchment (km^2)		Average Annual Rainfall Runoff Inflow (m^3/year)	
	Below 440 mRl	Above 440 mRl	Below 440 mRl	Above 440 mRl
1	0.00	0.41	0	89756
2	0.13	0.48	28583	105696
3	0.21	0.59	47202	130914
4	0.21	0.72	47269	160028
5	0.33	0.71	73748	157615
6	0.33	0.75	74036	166404
7	0.33	0.77	73726	169592
8	0.45	0.67	99763	147320
9	0.45	0.66	99874	147209
10	0.45	0.66	99874	147209
11	0.45	0.66	99874	147209
12	0.45	0.66	99874	147209
13	0.45	0.66	99874	147209

Evaporation from the open pit can be expected from the pit sump, which will have a negligible rate compared to other components, hence is not considered herein.

Sedimentation Ponds

According to RPS (2015) the mine water is planned to be managed by separating ‘non-contact water’ and ‘contact water’.

- Non-contact water comes from non-impacted catchments, whereas; contact water comes from catchments impacted by the Project developments. Non-contact water derived from rainfall runoff from the non-impacted catchments will directly discharged to the receiving surface waters as they will not have any contact with project units and thus will not potentially get impacted from the operations. Accordingly, non-contact water is not included in the water balance.
- Contact water derived from rainfall runoff from the impacted catchments is planned to be directed to sedimentation ponds to be used in the mining activities (drilling, dust suppression, etc) after satisfying regulatory discharge criteria.

In the mine area, there will be two groups of sedimentation ponds; in the Pit Area and in the Çorakoğlu WRD area.

Pit Area Sedimentation Ponds: Contact waters for the pit area will be collected in the main pond that will be located at the downstream coffer dam area. There will be another interim pond located on the upstream coffer dam area, but the water from this pond will either be used at this area or will be forwarded to the main pond on the downstream coffer dam area.

Water input to sedimentation ponds is evaluated for waters representative for the areas below and above 440 mRI elevation;

- for the area below 440 m, 69 m3/h. and
- for the area above 440 m, 26.4m3/h.

Thus, the total average inflow to the pit sedimentation ponds, is calculated as 95.4 m^3/h.

WRD Area Sedimentation Pond: Sedimentation ponds to be constructed in the Çorakoğlu WRD will act as the main control of discharge from the WRD area. As this water will not be used to satisfy water need for the mining activities, it will be discharged to downstream surface waters after meeting effluent discharge criteria specified in Section 7.8.5. In reference to previous studies carried out by RPS, the total capacity of WRD sedimentation ponds is approximately 1200 m^3 based on the minimum size required (RPS 2015). On the other hand, evaporation losses from the sedimentation ponds negligible, therefore not included in water balance calculations. Surface area for each sedimentation pond is provided in Table 6-59. Each sedimentation pond will have about 1.6m depth (or sufficient depth to sufficiently settle suspended solids). Final design for each sedimentation pond will be determined prior to start of the operation phase.

Table 6-59 Çorakoğlu WRD Sedimentation Ponds

Sedimentation Basin	Surface Area Required (m2)	Width (m)	Length (m)
SDN01	71	5	15
SDN02	170	8	24
SDN03	47	4	12
SDN04	29	4	12
SDN05	37	4	12
SDN06	21	3	9
SDN07	4	3	9
SDN08	170	8	24
SDN09	19	3	9
SDN10	14	3	9
SDN11	79	6	18
SDN12	99	6	18

Dust Suppression

In order to minimize the dust generation on the dirt roads of GCP, the roads will be wetted with the water sprinkler trucks. This practice is actively being used for a period of time in the mine site. With the current water consumption, Acacia completed a projection for the annual water consumption for road wetting operation when the mine site and the ore transport road is in operation (see Table 6-60). According to this projection, the daily average water consumption for road wetting is 1,110 m^3/day (46.3 m^3/h) whereas the maximum daily average water consumption is 1,800 m^3/day (75 m^3/h).

Table 6-60 Daily Water Demand for Dust Suppression during the Operational Phase (RPS, 2015)

	Daily Water Consumption (m3/day)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Total	540	540	1080	1080	1440	1440	1800	1800	1440	1080	540	540

As a result, on average, 49.1 m^3/h water will be discharged to environment from the open pit operations.

Open pit contractor has its facilities between the pit and the WRD area. These facilities supply its drinking water from the bottled water suppliers and the domestic water is being supplied from the Hanönü Municipality. Thus these facilities are not included in the water balance.

6.7.2.1.5.2 Process Plant Area

Main water for the processing activities will be supplied from Fresh Water Tank while overall water will be cycled through different components that act as input and output the Process Plant. Water balance for Process Plant is evaluated in three main components as Process Plant, Thickeners and Tailings Storage Facilities. Water in this mechanism will be recirculated through these components as a closed system to maintain sustainable use of water. Process Plant

The process plant water tank receives water from;

- Fresh water tank,
- Concentrate thickener,
- Tailings thickener and
- TSF return water.

The total amount of water inflow to the process water tank is determined as 811.5 m^3/h. Based on the water budget estimations received from Acacia, the amount of water inflow;

- From fresh water tank 65.9 m3/h
- (19.9 m3/h Make up water + 46 m3/h Gland Seal Water)
- From TSF return 115.8 m3/h
- From tailings thickener return 564.7 m3/h
- From concentrate thickener return 65.1 m3/h

The amount of water outflow from the plant is;

- To tailings thickener 744.7 m3/h
- To concentrate thickener 66.8 m3/h

Thickeners

There will be two thickening units on site for tailings and for the concentrate.

Tailings thickener will receive 744.7 m^3/h (including seal return water) from the process plant and will forward 564.7 m^3/h back to plant as return water. On the other hand 179.9 m^3/h will be forwarded to TSF with the tailings.

Concentrate thickener will receive 66.8 m^3/h from the process plant and will forward 65.1 m^3/h back to plant as return water. Approximately 1.5 m^3/h water will leave the system with a concentrate at about 15 t/h concentrate production with %9 moisture.

Tailings Storage Facilities

There are two tailings storage facilities within the project area, namely Kepezkaya and Bağdere TSFs. Assuming that TSFs will be operated sequentially the inflows and outflows are calculated. The TSFs receive water from process plant (179.9 m3/h) and returns some of the water as input to the process water tank (115.8 m^3/h). The entrained water amount in TSF is estimated as 65 m^3/h. Since TSFs are planned to be lined, the seepage losses are ignored.

The net inflow to the TSFs (from precipitation gain and evaporation loss) for average and wet years is also calculated based on the assumptions below:

- For average annual rainfall values, the long-term average monthly rainfall values for the Hanönü Meteorological Station is used. For the wet year analysis, the rainfall data from Kastamonu Meteorological Station has been examined and the wettest year in the period of record has been used.
- Kepezkaya and Bağdere TSFs are independently and sequentially filled without any overlapping period.
- The total internally draining area of the TSFs has been estimated as 254,800 m2 and 360,700 m2 for Kepezkaya and Bağdere, respectively.
- The tailings pond surface area has been assumed as 50 % of the total internally draining catchment area.
- Runoff coefficients (RoC) for average year are taken as 1 and 0.5 for pond area and remaining catchment, respectively.

Total rainfall runoff volumes have been calculated using the following formula:

$$Rainfall\ Runoff\ Volume\ (m^3) = RoC * Area(m^2) * Rainfall(m) \quad (2)$$

- Mean open surface evaporation data from Devrekani Meteorological Station has been used for the monthly evaporation values.
- There is always a tailings water pond on the TSFs on which evaporation can act.
- Evaporation volumes have been calculated by the follow formula:

$$Evaporation\ Volume\ (m^3) = Pond\ Catchment\ Area(m^2) * Evaporation(m) \quad (3)$$

- Net inflow volumes have been calculated by subtracting rainfall runoff volume from the evaporation volume.

For the average year conditions, the calculated net inflow volumes for Kepezkaya and Bağdere TSFs are given in Table 6-61 and Table 6-62, respectively. As can be seen in these tables, the average year net inflow amounts to TSFs are 0.8 m^3/h and 1.1 m^3/h for Kepezkaya and Bağdere tailings storage facility, respectively. Hence, the average year net inflow for TSFs can be taken as 0.9 m^3/h.

Table 6-61 Calculated Net Inflow Rates for the Kepezkaya TSF for Average Annual Rainfall

	Month	Hanönü Avg. Rainfall Amount (mm)	Rainfall Inflow Volume (m3)	Evaporation Volume (m3)	Net Inflow Volume (m3)
Kepezkaya TSF	January	38.85	7424	0	7424
	February	29.42	5622	0	5622
	March	34.11	6518	0	6518
	April	54.77	10467	459	10008
	May	66.77	12760	12689	71
	June	52.1	9956	15161	-5204
	July	31.22	5966	19378	-13411
	August	29.44	5626	19327	-13701
	September	27.41	5238	13390	-8152
	October	37.99	7260	6638	622
	November	39.56	7560	153	7407
	December	50.41	9633	0	9633
	Annual/Total	492.05	94031	87193	6838

Table 6-62 Calculated Net Inflow Rates for the Bağdere TSF for Average Annual Rainfall

	Month	Hanönü Avg. Rainfall Amount (mm)	Rainfall Inflow Volume (m3)	Evaporation Volume (m3)	Net Inflow Volume (m3)
Bağdere TSF	January	38.85	10510	0	10510
	February	29.42	7959	0	7959
	March	34.11	9228	0	9228
	April	54.77	14817	649	14167
	May	66.77	18063	17963	100
	June	52.1	14094	21462	-7367
	July	31.22	8446	27431	-18985
	August	29.44	7964	27359	-19395
	September	27.41	7415	18955	-11540
	October	37.99	10277	9396	881
	November	39.56	10702	216	10486
	December	50.41	13637	0	13637
	Annual/Total	492.05	133112	123432	9680

To estimate the net inflow rates for a wet year, the long-term rainfall data from Kastamonu Meteorological Station has been examined and the monthly data corresponding to the wettest year (2014) has been used to estimate the net inflow rates. The calculated net inflow rates for the wettest year rainfall amounts for each TSF are shown in Table 6-63 and Table 6-64, for the Kepezkaya and Bağdere Tailings Storage Facilities, respectively. The wettest year net inflow amounts are 9 m^3/h and 12.7 m^3/h for Kepezkaya and Bağdere tai

Table 6-63 Calculated Net Inflow Rates for the Kepezkaya TSF for Wettest Annual Rainfall

	Month	Kastamonu 2014 Rainfall (mm)	Rainfall Inflow Volume (m3)	Evaporation (mm)	Evaporation Volume (m^3)	Net inflow Volume (m^3)
Kepezkaya TSF	January	14	2675	0	0	2675
	February	27.2	5198	0	0	5198
	March	47.8	9135	0	0	9135
	April	80.3	15345	3.6	459	14887
	May	133	25416	99.6	12689	12727
	June	139.6	26678	119	15161	-5204
	July	60	11466	152.1	19378	-13411
	August	24.8	4739	151.7	19327	-13701
	September	175.4	33519	105.1	13390	20129
	October	47.8	9135	52.1	6638	2497
	November	35.8	6841	1.2	153	6689
	December	81.4	15556	0	0	15556
	Annual	867.1	165703	684.4	87193	78510

Table 6-64 Calculated Net Inflow Rates for the Bağdere TSF for Wettest Annual Rainfall

	Month	Kastamonu 2014 Rainfall (mm)	Rainfall Inflow Volume (m3)	Evaporation (mm)	Evaporation Volume (m^3)	Net Inflow Volume (m^3)
BağdereTSF	January	14	3787	0	0	3787
	February	27.2	7358	0	0	7358
	March	47.8	12931	0	0	12931
	April	80.3	21723	3.6	649	21074
	May	133	35980	99.6	17963	18017
	June	139.6	37765	119	21462	16304
	July	60	16232	152.1	27431	-11200
	August	24.8	6709	151.7	27359	-20650
	September	175.4	47450	105.1	18955	28495
	October	47.8	12931	52.1	9396	3535
	November	35.8	9685	1.2	216	9468
	December	81.4	22021	0	0	22021
	Annual	867.1	234572	684.4	123432	111141

All components of the mine water balance, and input output mechanisms are summarized in schematic mine water balance is given in Figure 6-34.

Rainfall runoff that is in contact with the Process Plant area will be captured and diverted to downstream sedimentation ponds for further treatment prior to discharge. Sedimentation ponds will allow sufficient settling of total suspended solids to meet the regulatory discharge criteria. Until then, the water collected in sedimentation ponds will subject to treatment. Non-contact waters on the other hand, will directly be discharged to receiving surface waters as they will be isolated from the Process Plant via perimeter ditches.

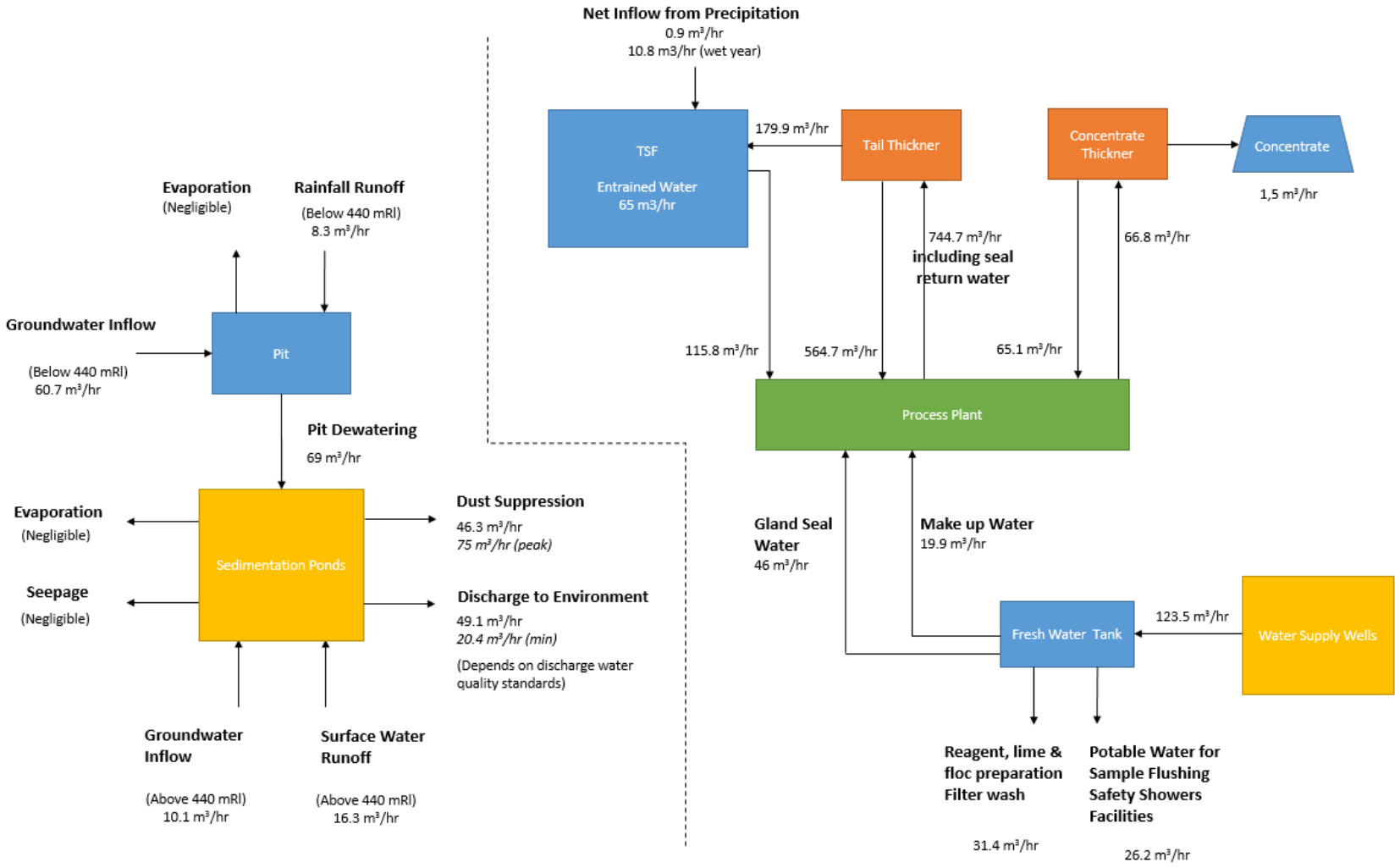


Figure 6-34 Schematic Mine Water Balance

6.7.2.2 Impacts on Water Quality

GCP's potential impacts on the quality of groundwater and surface waters are listed below while assessments for each potential impact are provided in the following sections.

- Impact of diversion tunnel construction on the Gökırmak River during construction phase,
- Transport of sediments due to top soil disturbance during construction and operation phases,
- Discharge of mine waters during operation phase,
- Impacts of mining wastes (incl. potential seepages from WRD / TSFs and poor quality of pit lake) during operation and post-operation phases

6.7.2.2.1 Impact of Diversion Tunnel Construction on the Gökırmak River during Construction Phase

AECOM has carried out different surface water sampling surveys along the Gökırmak River in order to identify the temporal change in water quality, if any. Water sampling locations along the Gökırmak River is shown in Figure 6-35. Sampling locations were selected on the downstream and upstream of the Project Area to understand the overall baseline water quality and assess the overall potential impacts of the Project's existing activities (see Figure 6-35).

Along with the other water quality parameters (See Section 5.7.7), collected samples were analyzed for Total Suspended Solids (TSS) in order to monitor the year-long trend in suspended solid load in surface waters. Analysis results show relatively high suspended solid concentrations in surface waters particularly during the spring season, indicating the likely impact of increased rainfall and surface runoff on surface waters. Likewise, TSS concentrations were observed to decrease during the August, September and November samples as the rainfalls and the runoff decrease. Figure 6-35 presents the TSS concentrations and flow rate values measured in the Gökırmak River during the wet and dry periods.

It is also important to note that the sampling surveys were partially overlapped with the diversion tunnel construction which was started on 8th September 2015 and lasted until the Diversion Tunnel Project Delivery date of 12th December, 2017. In addition to the above findings, relatively high suspended solid concentrations during September 2015 and May 2016 suggest a short term effect on the Gökırmak River, indicating potential impact of tunnel construction works. Based on the water quality data obtained during the starting period of diversion tunnel construction (September 2015), suspended solid concentration in downstream Gökırmak River (SW-5) was found to be more than three-fold compared to upstream sample (SW-1) (see Figure 6-35). As the construction progresses, the difference between the downstream and upstream sediment loads was identified to be even higher. May 2016 samples indicate that the suspended solid load increases significantly along the course of the Gökırmak River, indicating a combined impact of relatively high rainfall runoff and construction-borne sediment input. Based on the Gökırmak River upstream (YS-2) and downstream (SW-5) samples collected in May 2016, suspended solid load was identified to increase significantly at the Project Area's downstream (see Figure 6-35).

As the construction work ceases and the river is diverted in Quarter 3 of year 2016, the suspended solid load was observed to decrease significantly. Surface water samples collected from upstream and downstream of the Gökırmak River were found to reflect similar suspended solid concentrations starting from August 2016 (Figure 6-35). Although the November 2016 samples reflect relatively high suspended solid concentrations compared to August 2016 samples, both upstream and downstream suspended solid concentrations were identified to show similar values, indicating an overall decrease in suspended solids along the course of the Gökırmak River.

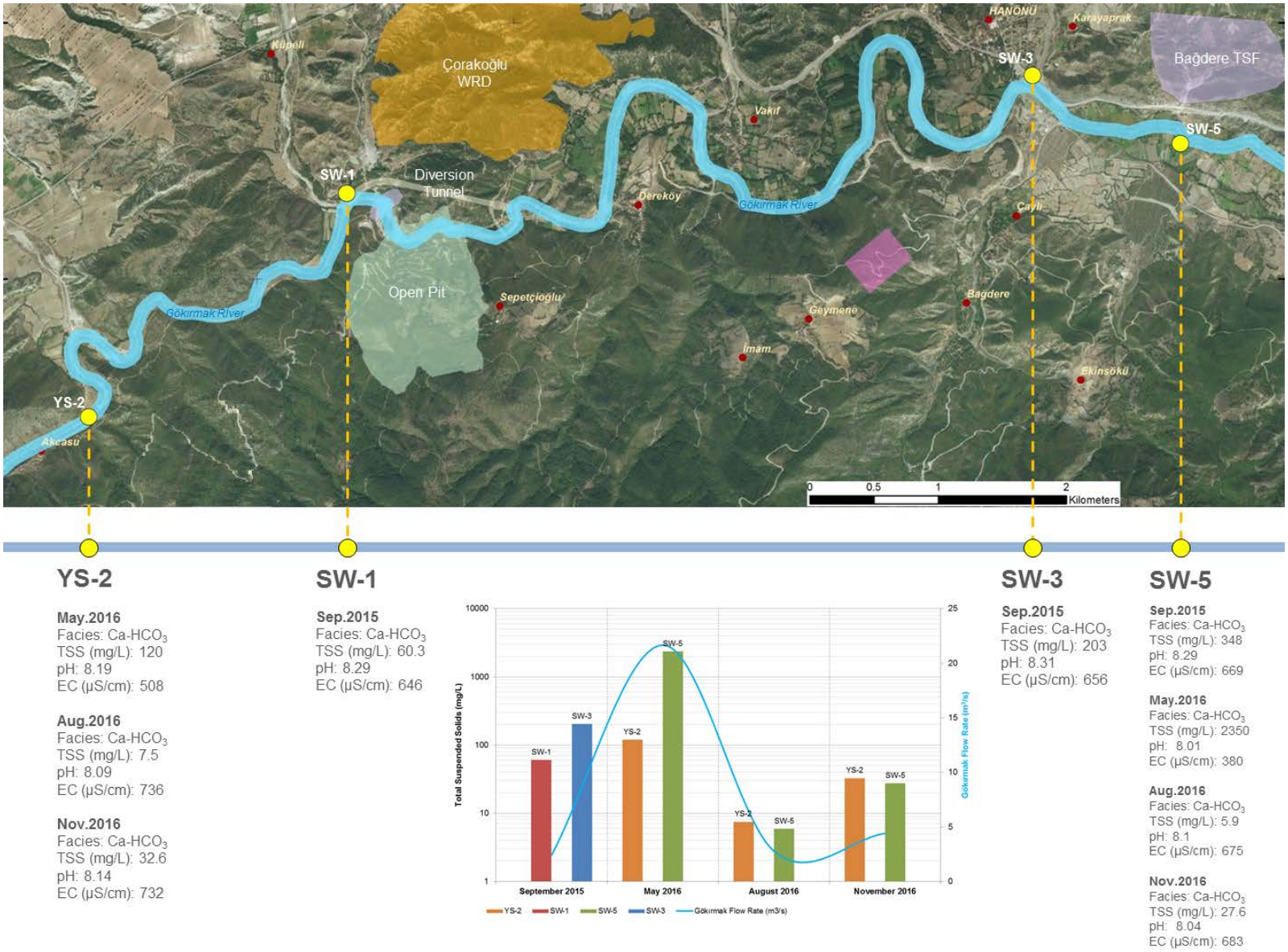


Figure 6-35 Facies Types and Total Suspended Solid (TSS) Values along the Gökırmak River

6.7.2.2.2 Transport of Sediments due to Top Soil Disturbance

Disturbance of original top soil will occur mainly due to construction activities and partially to activities that will be carried out during the operation phase. Disturbance of top soil would trigger mobilization of soil and sediments that further contributes to sediment load in downstream surface waters. Uncontrolled disturbance of soil might lead to transport of relatively large quantities of sediments into local streams which further feed downstream surface waters and cause river pollution. The most significant impact will be the transport of uncontrolled sediments to downstream surface waters with runoff and local stream beds.

Associated potential impacts on water resources are expected to be limited with the WRD and access roads during the operation phase. The rehabilitation works to be done during the closure phase of the Project would minimize associated impacts for the post-closure phase.

6.7.2.2.3 Discharge of Mine Waters during Operation Phase

6.7.2.2.3.1 Waters Derived from Pit Dewatering

As the open pit progresses deeper during the operation phase, groundwater inflow to the pit is to be managed and removed from the pit for safe working environment. Depending on its quality, the water derived from pit dewatering can be used for water need for mining activities (i.e. dust suppression) or can be discharged to the environment, if the water quality meets regulatory discharge criteria.

Discharge of dewatering waters may create adverse impacts on downstream surface waters as they may contribute to sediment loads during the operation phase of the Project. Receiving waters might be impacted to contain relatively increased levels of total suspended solids and/or metals.

6.7.2.2.3.2 Runoff waters that are in contact with Project Units

As the Project units (Open Pit, WRD, TSFs and Process Plant), are developed, runoff waters will become in contact with the Project units. These contact waters might potentially affect downstream receptors in the case of poor surface water management. Upon discharge of the contaminated waters, receiving resources might potentially be impacted to contain relatively increased levels of total suspended solids and/or metals.

6.7.2.2.4 Impacts of Mining Wastes during Operation and Post-Operation Phases

This section presents the impact assessment for mining waste geochemistry of GCP's mining lithologies. The information and data sources were taken from the following documents which were prepared by Geochemico Consulting Inc.

- Results of Mass Balance/PHREEQC Modelling of the Waste Rock Dump at the Gökırmak Copper Project, Kastamonu, Turkey
- Results of Mass Balance/PHREEQC Modelling of the Open Pit Sump and Lake at the Gökırmak Copper Project, Kastamonu Turkey
- PHREEQC Modeling of the Kepezkaya Tailings Storage Facility Seepage at the Gökırmak Copper Project, Kastamonu, Turkey

Potential geochemical impacts of mining wastes (incl. waste rock dump, tailings storage facilities, open pit lake) were identified through geochemical modeling studies which were given in above-mentioned reports in detail whereas the summary of geochemical studies are provided in below sections.

6.7.2.2.4.1 Çorakoğlu Waste Rock Dump

Mass balance/PHREEQC modelling of waste rock and low grade copper ore (LCU) and leachate chemistry was carried out for the Gökirmak Copper Project (GCP) in order to:

- Predict probable leachate chemistry and precipitate mineralogy in both the core of the waste rock dump (WRD) and the toe of the dump;
- Compare predicted leachate chemistry with EU, Turkish and Canadian regulatory parameters, and
- Optimize the WRD and cover design.

The input to the mass balance/PHREEQC modelling, for all models, was the static and kinetic test data generated on samples of lithologies submitted to Global ARD Laboratories, located in Burnaby, BC, which are described in a separate ARD/ML characterization report (Geochemico, 2016a, 2016b). Loading rates (mg/kg/L/year) were generated from the laboratory testing data and used, together with projected WRD geometry, hydrogeological modelling and known climatic data to estimate the waste rock loading or the within dump loading. The estimated loading was then diluted using the climatic (rainfall and evaporation) data. The mass of precipitating phases were calculated and the resultant solution chemistry was equilibrated with the atmosphere in order to model either WRD inner core chemistry or toe of dump chemistry, as appropriate. Modeling assumptions and modeling methodology were provided in detail in Volume III of the ESIA Disclosure Package.

Potential Impacts of WRD Drainage on Surface Drainage

The environmental impact of the waste rock dump leachate was determined by modelling the mixing of the Gökırmak River with the leachate streams from the waste rock dump at the median (base case) and 95th percentile (worst case) loading rates using the same mass balance/PHREEQC approach as previously.

It should be noted that the median sulphate concentration of the Gökırmak River, without any discharge from the WRD exceeds the EU regulatory standard by a factor of almost two and the median V concentration in the river is very close to the Canadian regulatory standard.

Table 6-65 provides modelled maximum and minimum concentrations expected to occur in the Gökırmak River for the full period of mining operations and after mine closure, for 27 years. The modelled concentrations are compared with Turkish, EU and Canadian standards and any exceedances are highlighted in yellow.

Table 6-65 Modelled Maximum and Minimum Concentrations in the Gökirmak River for Base Case and Worst Case Loading Rates, Compared to Turkish, EU and Canadian Water Quality Standards

	YEAR		pH	S(6)	F	N	Alkalinity	Ag	Al	As
	TURKISH	mg/L	6.5 to 9	250.00000	1.50000				0.20000	0.01000
	EU	mg/L	6.5 to 9.5	250.00000	1.50000				0.20000	0.01000
	CANADA	mg/L	6.5 to 9						0.75000	
BASE	ALL YEARS	MAX	8.00	495	0.28	0.040	227	0.00050	0.0053	0.0027
CASE	ALL YEARS	MIN	8.00	485	0.27	0.030	223	0.00049	0.0049	0.0025
WORST	ALL YEARS	MAX	8.00	495	0.29	0.041	227	0.00050	0.0060	0.0037
CASE	ALL YEARS	MIN	8.00	487	0.27	0.030	223	0.00049	0.0049	0.0025

	YEAR		B	Ba	Ca	Cd	Co	Cr	Cu	Fe
	TURKISH	mg/L	1.000			0.00500		0.050	2.0	0.20
	EU	mg/L	1.000			0.00500		0.050	2.0	0.20
	CANADA	mg/L				0.00050			0.0050	
BASE	ALL YEARS	MAX	0.55	0.033	103	0.00020	0.0010	0.00050	0.0010	0.0024
CASE	ALL YEARS	MIN	0.51	0.033	87	0.00020	0.00098	0.00049	0.00098	0.0024
WORST	ALL YEARS	MAX	0.64	0.033	142	0.00020	0.0010	0.00056	0.0010	0.0024
CASE	ALL YEARS	MIN	0.51	0.033	87	0.00020	0.00098	0.00049	0.00098	0.0024

	YEAR		Hg	K	Mg	Mn	Mo	Na	Ni	P
	TURKISH	mg/L	0.001			0.050		200	0.02	
	EU	mg/L	0.001			0.050		200	0.02	
	CANADA	mg/L					0.07300		0.15	0.03
BASE	ALL YEARS	MAX	0.0	5.2	41	0.0013	0.0014	173	0.0011	0.0050
CASE	ALL YEARS	MIN	0.0	4.6	40	0.0012	0.00098	170	0.00098	0.0049
WORST	ALL YEARS	MAX	0.0	6.0	43	0.0013	0.0018	177	0.0015	0.0050
CASE	ALL YEARS	MIN	0.0	4.6	40	0.0012	0.00098	170	0.00098	0.0049

	YEAR		Pb	Se	Sb	Si	Sn	Sr	Tl	U	V	Zn
	TURKISH	mg/L	0.010	0.010	0.0050							
	EU	mg/L	0.010	0.010	0.0050							
	CANADA	mg/L	0.007								0.0060	0.030
BASE	ALL YEARS	MAX	0.0025	0.0050	0.0050	7.0	0.0	0.0079	0.0050	0.0000023	0.0054	0.0019
CASE	ALL YEARS	MIN	0.0025	0.0049	0.0049	6.9	0.0	0.0000	0.0049	0.0	0.0049	0.00098
WORST	ALL YEARS	MAX	0.0025	0.0055	0.0050	7.2	0.0	0.038	0.0050	0.000024	0.0068	0.0018
CASE	ALL YEARS	MIN	0.0025	0.0049	0.0049	6.9	0.0	0.0000	0.0049	0.0	0.0049	0.00098

According to the model results the only parameter expected to exceed Turkish, and EU water quality standards is sulphate. Sulphate is currently already exceedant in the river, by a factor of almost two. Discharge of leachate into the river is expected to reduce sulphate concentrations in the river by approximately 9.7 mg/L for the base case and 8.5 mg/L for the worst case loading rates.

Apart from sulphate, which is naturally exceedant, and is expected to be slightly diluted by the WRD leachate discharge, no other parameters are expected to exceed the EU, Turkish or Canadian regulatory standards for the base case or worst case.

Potential Impacts of WRD Leachate on Groundwater Beneath the Waste Rock Dump

The impact that can be related with the storage of the waste rock to groundwater, will originate from the infiltration of precipitation from WRD to unsaturated zone and then to the saturated zone. The following calculations were completed to estimate the potential impact to groundwater;

- Precipitation will infiltrate to WRD and buildup a groundwater body until the closure. As the closure will be completed, the WRD will be closed and infiltration will stop. The mass balance/PHREEQC modelling estimates that, after the closure, approximately 100 years will be required to permit the pore water within the WRD to drain completely to residual water content. After this time contamination of the pore water is not possible, since effectively no pore water remains to infiltrate to the water table.
- The WRD area is completely underlain by silty/clay till varying in depth from approximately four to ten meters. Three drill holes were completed to estimate the permeability of the till layer (CZ-1, CZ-2, CZ-3). According to the previously completed studies, the overburden is as of moderate infiltration, which corresponds to a hydraulic conductivity of between 2.7E-07 m/s and 8.7E-08 m/s. A calculation was completed with these permeability and measured hydraulic gradient values and the minimum and maximum travel times for pore water seeping beneath the Corakoglu WRD to reach the water table was obtained as 41 and >200 years respectively.
- Based on the seepage transport rate estimated through numerical groundwater flow model (See Section 7.8.3.4), the fastest flow path that reaches to the Gökırmak River was observed to be the southwestern corner of the dump within 79.1 years.

Thus, the potential contaminant originate from the WRD will reach to Gökırmak River will be more than 79.1 years. On the other hand, with a conservative approach, the trave time in the unsaturated zone was neglected and PHREEQC run was competed with the concentrations seeping from the WRD, directly introduced to the groundwater for 100 years.

The run was competed to estimate the quality of groundwater that can reach to Gökırmak for the median (base case) and 95th percentile (worst case). As can be seen from Table 6-66, the predicted total mg/quarter of each element modelled are generally very small, and will cause no exceedances of element concentrations in the Gokirmak River, except for a very small increase in sulphate concentrations in the river, which are already naturally exceedant.

Table 6-66 Calculated Base Case and Worst Case Total Mg/Quarter Entering the Gokirmak River from Year 79 to Year 179 after WRD Construction

Total mg per quarter										
	S(6)	F	N	Alkalinity	Ag	Al	As	B	Ba	Ca
BASE CASE	0.54	0.0086	0.0010	0.034	0.0	0.00039	0.00080	0.0014	0.0000014	2.38
WORST CASE	2984	47	6	194	0.0	6.2	4.4	7.8	0.0	13036
	Cd	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo
BASE CASE	8.9E-07	4.4E-07	6.0E-07	2.92E-06	2.9E-05	1.8E-07	0.39	0.11	0.00064	0.00071
WORST CASE	0.0050	0.0092	0.0055	0.060	0.61	0.0010	2160	618	6.2	3.9
	Na	Ni	P	Pb	Se	Sb	Si	Sn	Sr	Tl
BASE CASE	0.33	0.00010	1.7E-05	2.84E-06	2.89E-05	3.3E-05	7.68163E-05	8.7E-08	0.0015	1.1E-06
WORST CASE	1817	0.57	0.35	0.015	0.16	0.18	14	0.0018	8.0	0.0059
	U	V	Zn							
BASE CASE	5.5E-06	0.00017	0.00027							
WORST CASE	0.034	0.95	1.5							

As can be seen from Table 6-66, the predicted total mg/quarter of each element modelled are generally very small, and will cause no exceedances of element concentrations in the Gokirmak River, except for a very small increase in sulphate concentrations in the river, which are already naturally exceedant.

It should be noted that due to the low hydraulic conductivity of the overburden' almost all of the pore water will exit the WRD through the containment ditches and subsequently the settling ponds. Furthermore the groundwater mound that will develop within the WRD, will seep from the toe of the dump as well as it seeps to the underlying low permeable till.

Conclusions of Impact Assessment for WRD

Following conclusions were noted as a result of the modeling studies completed for the Çorakoğlu WRD.

- Ferrihydrite (FeOOH, Hfo) will probably precipitate from the WRD leachate when it emerges from the toe of the dump. Adsorption of both anions and cations to the precipitating FeOOH will provide a measure of mitigation for As, sulphate, Cd and base metals provided the precipitate is allowed to settle;
- Loading rates for Mixed Schist and Greenschist were compared for static and kinetic testing data and found to be very similar, although a higher proportion of some parameters (e.g. sulphate) was found to dissolve from the mixed schist;
- Loading rates were calculated for the median (base case) and 95th percentile (worst case) in order to provide conservative modelling scenarios. Pore water and toe of dump leachate concentrations were calculated for the Corakoglu waste rock dump for each of the two loading rate cases;
- Base case principal contaminants of concern were found to be pH, As, Mn, Mo, Sb, V and Zn.
- For the base case, mineral phases that are likely to precipitate within the core of the dump include: Ag2Se, Ba3(AsO4)2, CoFe2O4, Cr2O3, cuprousferrite, diaspore, hydroxylapatite, hausmannite, hematite, HgSe, and SnSO4;
- Mineral phases that are likely to precipitate at the toe of the dump for the base case include: diaspore, FCO3apatite, and pyrolusite;
- Worst case principal contaminants of concern were found to be sulphate, pH, sulphate, F, As, B, Mn, Mo, Na, Se, Sb, Ni, V, and Zn;
- For the worst case, mineral phases that are likely to precipitate within the pore water of the dump include: Ba3(AsO4)2, CaMoO4, CoFe2O4, fluorite, gypsum, kaolinite, Cr2O3, cuprousferrite, diaspore, hausmannite, hydroxyapatite, hematite, HgSe, and SnSO4;
- For the worst case, mineral phases that are likely to precipitate at the toe of dump leachate include: CoFe2O4, diaspore, and pryolusite;
- Adsorption to Hfo provides an order of magnitude decrease in As concentrations at the toe of the dump for both the base and worst cases;

- The environmental impact of the Corakoglu waste rock dump leachate on the Gökırmak River was modelled. The naturally exceedant sulphate levels in the river were reduced slightly through dilution by the waste rock leachate for both loading rate cases and no other exceedances were observed; and
- Modelling of infiltration rates of the waste rock dump pore water into the underlying overburden by combining the hydrogeological model with the mass balance/PHREEQC modelling reported herein showed that only very small quantities of pore water reach the Gokirmak River receptor 79 years after WRD construction. No elements will exceed EU regulatory guidelines, except for sulphate, which is naturally exceedant in the river.

6.7.2.2.4.2 Open Pit Lake

The proposed open pit will incorporate greenschist and mixed schist together with small proportions of mineralized vein waste or ore in the pit walls, floor and constructed benches. Mass balance/PHREEQC modelling of leachate chemistry was carried out in order to predict probable leachate chemistry and precipitate mineralogy in the proposed open pit for three closure scenarios:

- Scenario 1: both coffer dams remain (as during mining operations) and the pit is allowed to flood from rainfall and upwelling groundwater. The pit is expected to overflow into the Gökirmak River approximately 42 years after mine closure at 431 masl;
- Scenario 2: Coffer dams will be removed, but the river will remain diverted. The pit will flood with reduced rainfall input, and groundwater inflow. The flooded pit is expected to overflow into the Gökirmak River approximately 106 years after mine closure, at 426 masl; and
- Scenario 3: Both coffer dams will be removed and the pit will flood quickly (4 months to 2.5 years) with input from rainfall, upwelling groundwater and the Gökirmak river. The flooded pit overflow into the old course of the Gökirmak river at 426 masl.

The input to the mass balance/PHREEQC modelling, for all models, was the static and kinetic test data. Loading rates (mg/kg/L/year) were generated from the laboratory testing data and used, together with projected open pit geometry, hydrogeological modelling and known climatic data to estimate the waste rock loading. The estimated loading was then diluted using the climatic (rainfall and evaporation) data. The mass of precipitating phases were calculated and the resultant solution chemistry was equilibrated with the atmosphere in order to model pit lake and Gökirmak River chemistry.

Water quality of the pit lake was modelled for three scenarios.

- Scenario 1 resulted in pit sump/pit lake exceedances for pH, sulfate, F, Mn, Al, As, B, Fe, Pb, Na, Ni,Se, Sb, Cr, and Cd during both the opening years of mining and during pit lake flooding. The exceedant Al, As and Mn were persistent through much of the life of the pit sump/pit lake;
- Scenario 2 resulted in pit sump/pit lake exceedances for pH, sulfate, F, Al, As, B, Cr, Fe, Hg, Na, Ni, Pb, and Se during both the opening years of mining and during pit lake flooding. Al, As and Fe exceedances were somewhat persistent through the life of the pit sump/pit lake;
- Scenario 3 resulted in fewer parameter exceedances in the pit sump compared to the other scenarios (pH, sulfate, F, Al, As, Na, Ni, Se and Sb) and these only occurred during the initial few years of mining;

The potential impacts of pit lake water on the Gökırmak River was modelled. Mass balance/PHREEQC models were used to calculate predicted parameter concentrations in the Gokirmak River as the pit lake discharges into the river after the end of open pit flooding, following the end of mining operations at the end of year 13. Similar to the previous runs, three different scenarios were modelled;

Scenario 1; The summary statistics (maxima only presented as the minima are not exceedant) for both the base case and worst case loading rates are provided as Table 6-67. Sulfate data are also included as it is exceedant in the current Gokirmak River. Na concentrations, after the pit lake enters the river are exceedant, however, sulfate, which is naturally exceedant in the river, is diluted below the Turkish and EU standards by the pit lake water.

Table 6-67 Pertinent Gökırmak River Exceedances

Exceedant parameter	Statistic	Na	Sulfate	F
Turkish Standard		200	250	1.5
EU Standard		200	250	1.5
Base Case	Maximum	442	183	1.4E-05
Worst case	Maximum	442	183	0.20
Natural	Maximum	173	495	-

Scenario 2; Minimum sulfate concentrations in the Gokirmak River are markedly reduced to 183 mg/L for both loading rates; in other words the pit lake water dilutes the naturally exceedant sulfate and fluoride concentrations in the Gokirmak River as the pit lake eventually discharges into the river. Predicted Na concentrations are 442 mg/L for both the base case and worst case loading rates, which exceeds both the Turkish and EU regulatory guidelines.

Scenario 3; Only maximum sulfate concentrations (490 mg/L) in the Gokirmak river are predicted to exceed the Turkish and EU guidelines for the base case of scenario 3. The exceedant values are very close to the natural maximum sulfate concentrations in the river (495 mg/L). Only maximum pH values (9.54) are predicted to exceed for the worst case loading rate for scenario 3 and they are exceedant by only 0.04 pH units.

Conclusions of Impact Assessment for Open Pit Lake

- Modeling of the environmental impact of the three scenarios on the Gokirmak river showed that scenarios one and two reduced the sulfate content of the river, but developed Na exceedance. Maximum pH values in the river, from scenario three, slightly exceeded the EU guidelines and the natural sulfate exceedance in the river was reduced very slightly;
- On balance, scenario 3 (allowing the Gokirmak river to flow through the open pit after closure, appears to be the optimal scenario, however, engineering aspects of the sedimentation should be investigated before selecting this option.
- The pit lake is extremely unlikely to contaminate the groundwater present in pore spaces of the host lithologies due to the upwelling of groundwater into the pit lake.

6.7.2.2.4.3 Tailings Storage Facilities

In case of any seepage event from the TSFs, the water within the tailings (TSF pore water) and the pore water of the host rock will interact. Modeling study for the characterization of geochemical interactions was done in consideration of Kepezkaya TSF's design information. Once the design of Bağdere TSF is completed, modeling study will be done for this facility as well.

The results of the geochemical interactions between these two fluids were modelled for Kepezkaya TSF using PHREEQC, to examine the potential extent of geochemical environmental impact caused by seepage from the Kepezkaya TSF, which is planned to contain tailings capable of generating acid rock drainage and metal leaching (ARD/ML).

Kinetic testing was carried out on one, one kg sub-sample of float tailings. The ninety-fifth percentile of the final five weeks of data generated from the humidity cell testing was used herein to estimate the probable pore water geochemistry of the tailings, once ARD/ML generation had reached equilibrium. The TSF pore water is the product of acid rock drainage, and is not only extremely acidic but also contains high concentrations of (and exceedant compared to Turkish and EU drinking water regulations) in pH,sulfate, Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Zn and Ni.

On the other hand the bedrock pore water estimated water quality was calculated as the median of shake flask extraction leachates from ten samples (plus two duplicate samples) of the sandstone/claystone collected from drill hole cores. The estimated bedrock pore water is circum-neutral and only exceedant in sulfate, compared to Turkish and EU drinking water quality standards.

The other important consideration, with respect to the geochemistry of the TSF pore water/bedrock interaction is the neutralization potential (NP) of the sandstone/claystone. The median NP for the 12 samples collected is 160 kg CaCO3/tonne; indicating a considerable carbonate content. Fe is also relatively high in the bedrock, with median content of 3.58 %.

PHREEQC Modeling Results of TSF Leachate/Bedrock Pore Water and Bedrock Geochemical Interaction

The series of dissolution and precipitation reactions discussed in the preceding section were modelled using PHREEQC, and the PHREEQC code used to achieve this. The PHREEQC modeling was conducted in pH stages, in order to obviate undesirable modeling feedback. The dissolution of calcite and the precipitation of mineral phases were then summed over the entire sequence of reactions and are presented as Table 6-68.

The volume of dissolved calcite required to bring the mixed pore water into equilibrium with the bedrock pore water (at pH 7.1) was found to be 1.28E-5 m3 L-1. The mineral phases found to precipitate from the mixed solution are detailed as Table 6-68. The minerals that are most likely to precipitate from the mixed solutions include: Ag2Se, barite, CoFe2O4, CuFeO2, CuSe, Fe(OH)2.7Cl0.3, hematite (or its precursors, lepidocrocite and ferrihydrite), SnSO4, alunite, diaspore, magnetite, MnHPO4, UO2, Cr2O3, FCO3 apatite, CdS, rhodocrosite, greenockite, sphalerite, and zinc carbonate.

The important fact to note from Table 6-68 is that the volume of precipitated minerals far exceeds the volume of dissolved carbonate.

Table 6-68 is based solely based on thermodynamic chemistry that is from a thermodynamic perspective it is highly likely that all of the listed minerals will dissolve or precipitate from the mixed solutions. The rapidity with which the identified minerals will dissolve or precipitate, however, cannot be determined by PHREEQC; it is determined from a knowledge of the kinetic (or rate of reaction) chemistry. The kinetics for most of the minerals identified in Table 6-68 has not yet been determined. The mineral phases identified by yellow highlighting are known to have rapid reaction kinetics. Calcite is known to react rapidly (within 60 to 100 seconds) in the presence of acidity.

Likewise, barite, lepidocrocite (precursor precipitant for hematite), and diaspore are all known to precipitate within approximately 300 seconds after appropriate thermodynamic conditions are achieved. It is a conservative measure, therefore, to only use the known rapidly reacting mineral phases in this assessment of the results of the mixing of TSF leachate and the bedrock pore water and the bedrock itself.

Table 6-68 PHREEQC calculated masses and volumes of dissolved and precipitated minerals as TSF leachate mixes with bedrock and bedrock pore water. Yellow highlighted minerals indicate those known to react rapidly from a kinetic perspective

MINERAL PHASE	MOLES/L	MINERAL FORMULA	MASS (g/L)	VOLUME (cm3/L)
Calcite (dissolved)	3.47E-03	CaCO3	3.48E-01	1.28E-01
PRECIPITATED PHASES				
Ag2Se	2.09E-09	Ag2Se	3.90E-07	5.41E-08
Barite	3.35E-08	BaSO4	7.83E-06	1.84E-06
CoFe2O4	7.90E-06	CoFe2O4	1.85E-03	3.64E-04
Cuprousferrite	1.32E-03	CuFeO2	2.00E-01	4.01E-02
CuSe	4.51E-08	CuSe	6.43E-06	9.18E-07
Fe(OH)2.7Cl.3	1.51E-02	Fe(OH)2.7Cl.3	1.70E+00	4.25E-01
Hematite	3.00E+01	Fe2O3	4.79E+03	9.10E+02
SnSO4	5.07E-08	SnSO4	1.09E-05	2.72E-06
Alunite	5.46E-05	KAl3(SO4)2(OH)6	2.26E-02	8.23E-03
Diaspore	1.46E-04	AlOOH	6.27E-03	1.93E-03
Magnetite	6.95E-04	Fe3O4	1.61E-01	3.12E-02
MnHPO4	5.86E-07	MnHPO4	8.84E-05	2.68E-05
Uraninite	1.28E-07	UO2	3.48E-05	1.29E-05
Cr2O3	1.36E-06	Cr2O3	2.07E-04	5.76E-05
FCO3Apatite	6.79E-09	Ca9.316Na0.36Mg0.144(PO4)4.8(CO3)1.2F2.48	6.52E-06	2.07E-06
Greenockite	8.67E-07	CdS	1.25E-04	2.59E-05
Rhodochrosite	2.48E-04	MnCO3	2.85E-02	7.70E-03
Sphalerite	2.69E-06	ZnS	2.62E-04	6.39E-05
ZnCO3:1H2O	2.31E-04	ZnCO3:1H2O	3.32E-02	7.48E-03
		TOTALS (PRECIPITATED LESS DISSOLVED)	4.79E+03	9.11E+02

The total volume of calcite that is required to dissolve to bring the mixed solutions to circum-neutral pH is 1.28 e-1 cm3 L-1. The total mass of rapidly precipitating mineral phases was found to be 9.11E2 cm3 L-1. The volume of rapidly precipitating mineral phases therefore greatly exceeds the volume of carbonate dissolved. The inevitable result of this is that the pore spaces within the bedrock will be occluded very rapidly after mixing of the TSF leachate and the bedrock and its pore water. The kinetics of the geochemical situation as the TSF leachate mixes with the bedrock and its porewater is presented as Figure 6-36.

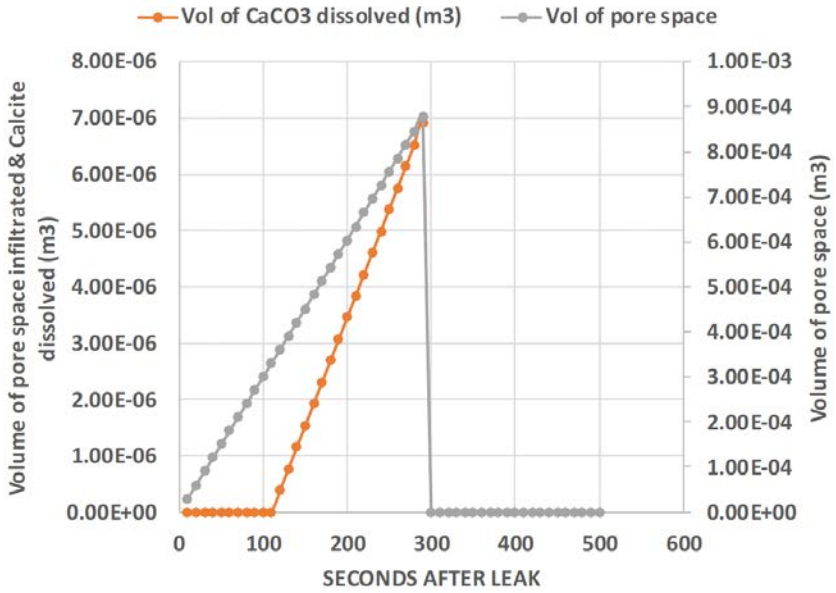


Figure 6-36 Graphical representation of the dissolution of calcite (orange line) and the volume of rapidly precipitating mineral phases with time (seconds) after mixing of TSF leachate and bedrock/bedrock pore water. The grey line shows the available volume of pore space within the bedrock host lithology

In other words, the geochemical reactions between the TSF leachate and the bedrock/bedrock pore water, consisting of initial carbonate dissolution followed by a marked rise in pH and subsequent precipitation of mineral phases within the bedrock pore spaces, will prevent any TSF leachate ever reaching an environmental receptor.

Conclusions of Impact Assessment for Kepezkaya TSF

The following conclusions may be drawn from the PHREEQC modeling performed for the Kepezkaya TSF.

- PHREEQC modeling of the interaction between the tailings and bedrock pore water and the bedrock mineralogy indicate that there will be an initial rise in solution pH as carbonate minerals in the bedrock lithologies are dissolved, followed by precipitation of numerous mineral phases within the bedrock pore spaces;
- Calculation of the rate of rapid dissolution of calcite as the tailings pore water meets bedrock and bedrock pore water, as well as the mass of rapidly precipitating mineral phases caused by the subsequent rise in pH of the groundwater, indicates that the bedrock pore spaces beneath a perforation in the geosynthetic liner will become clogged very rapidly, thus preventing further migration of the tiny contaminant plume;
- Based on the PHREEQC modeling described above, it is extremely unlikely that any tailings seepage will migrate more than a very small distance from a geosynthetic liner perforation and therefore will be unable to cause any environmental impact regarding nearby environmental receptors.

6.7.3 Mitigation

Mitigation measures to be taken to manage impacts on water resources are listed in Table 6-69 for the potential impacts identified in the previous sections. Significance of impacts before and after mitigation (residual impacts) is also identified in the table.

As a part of Project's mitigation plan, a comprehensive Mine Water Monitoring Plan will be implemented to avoid and/or minimize impacts of the Project on water resources. Details of the plan that cover construction, operation and closure phases are provided in the following section.

Table 6-69 Summary of Impacts, Mitigation and Residual Impacts for Water Resources

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Impact on water supply resources (wells) of the local communities due to open pit dewatering during operation phase	Sepetcioglu village Küpeli and Aşağıküreçay villages	High -Local -Long-term -Long-term reversible -High in magnitude -Continuous	Low	Moderate	• Implement Water Resources Management Plan • Alternative Water Supply Plan will be developed for Sepetçioğlu, Küpeli and Aşağıküreçay settlements based on the results of a Water Supply Study to be conducted. • Ongoing monitoring on groundwater levels, discharge rates and water quality (open pit monitoring wells, village springs and village water depots/fountains) will be continued during the operation. • Ongoing monitoring on mine water use for operational activities will be performed to maintain an up-to-date mine water balance. • Water derived from pit dewatering will be used for dust suppression (after satisfying discharge criteria defined by IFC Effluent Discharge Criteria for mine waters and National Discharge Standards specified in Turkish Water Pollution and Control Regulation – Table 7.1. The strictest limit value will be used among these three criteria in comparison of the discharge water quality of mine waters). • A detailed Technical Study on Pit Dewatering will be conducted (to be completed until end of 2018 Q2) to determine the number of the dewatering wells and dewatering strategy. The findings of the numerical modeling study will be compared with the hydrogeological conditions in the open pit during the operation phase. The numerical groundwater flow model will be calibrated with the actual rates to be obtained during pit dewatering for successful water management of the open pit.	Negligible
	Dereköy and Geymene,village; Hanönü district	Negligible -Local	Low	Negligible	• No action required.	Negligible

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
		-Long-term -Long-term reversible -Negligible in magnitude -Continuous				
Impact on water supply resources of the local communities due to groundwater extraction from Project's water supply wells (35 L/s)	Community water resources (e.g. Çaylı village)	Negligible -Local -Long-term -Long-term reversible -Negligible in magnitude -Continuous	Low	Negligible	• No action required.	Negligible
Impacts associated with pit lake formation	Local hydrological and hydrogeological conditions Gökırmak River Downstream water users	High -Local -Long-term -Irreversible -Medium to High in magnitude (depending on the pit closure alternative to be selected) -Continuous	Low	Moderate	• Taking into the account that the information on pit lake water quality is currently limited, three scenarios will be reevaluated during the operation phase of the Project. The optimal closure of the pit will be decided during the operational phase based on long term on-site data to be collected. • Evaluation of the dewatering data throughout the operation phase will be done to improve the mine closure plan for detailed assessment of pit lake formation and strategy for open pit closure. • Monitoring of Gökırmak River flow upstream and downstream of the open pit area will be carried out to improve the long term understanding of the flow rates and water quality during the closure phase of the Project. • Ongoing monitoring on pit lake water level, groundwater levels in monitoring wells, and water quality will be	Minor

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
					continued 10 years after the closure phase starts unless any significant change in water quality during the closure is observed (monitoring frequency for different locations will be in accordance with the EIA Report)	
Impacts on the quality of nearby water resources due to seepage transport from the bottom of the TSFs due to a potential liner failure during the operation phase	-Gökırmak River (Bağdere TSF) -Yılanlı Stream (Kepezkaya TSF) -Groundwater	Medium -Local -Long-term -Short-term reversible -Low in magnitude -One-off	Low	Moderate	• Kepezkaya and Bağdere TSFs will be lined. The composite liner system design will include, from top to bottom, 50 cm gravel, 2 mm HDPE liner, 1 cm geosynthetic clay, and 50 cm gravel. • An independent, specialized quality control consultant will be on site to ensure good contact conditions are achieved during the installation of liner system. • A groundwater monitoring will need to be implemented to monitor groundwater quality on the critical flow paths. • A modeling study for the characterization of geochemical interactions will be done for Bağdere TSF, the operational approach for the TSF is confirmed.	Negligible
Impacts on the quality of surface water resources due to WRD drainage and leachate (during operation and post-operation phases)	-Gökırmak River -Groundwater	Medium -Local -Long-term -Short-term reversible -Low in magnitude -Intermittent	Low	Minor	• Application of engineered WRD cover at the WRD site upon closure (see Section 6.8.1.6 for details of cover design and assessment of residual impacts). • Use of vegetation cover at the top to reduce infiltration. • Mine Water Monitoring Plan developed in the scope of the ESIA will be implemented (see Section 6.7.3.1).	Negligible
Impacts on water quality (increased levels of total suspended solids and/or metals) due to discharge of mine waters (waters derived from pit dewatering and runoff waters that are	-Downstream surface water resources	High -Local -Long-term -Long-term reversible -High in magnitude -Intermittent	Low	Moderate	• Interception channels will be constructed around the Open Pit, WRD, TSFs and Process Plant to divert runoff and prevent rainwater interaction with Project units. This non-contact water will be drained to downstream surface waters. • Impervious sedimentation ponds will be constructed in the Open Pit and Çorakoğlu WRD areas. Runoff that is in	Negligible

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
in contact with Project Units) during operation phase					contact with waste rock and open pit walls will be captured and diverted to sedimentation ponds for further treatment prior to discharge. • Excess water derived from pit dewatering (including rainfall runoff component) will be used in dust suppression (after satisfying discharge criteria defined by IFC Effluent Discharge Criteria for mine waters and National Discharge Standards specified in Turkish Water Pollution and Control Regulation – Table 7.1. The strictest limit value will be used among these three criteria in comparison of the discharge water quality of mine waters) or collected in downstream sedimentation ponds for further treatment prior to discharge. • Water in sedimentation ponds will not be discharged unless its quality meets discharge criteria defined by IFC Effluent Discharge Criteria for mine waters and National Discharge Standards specified in Turkish Water Pollution and Control Regulation – Table 7.1. The strictest limit value will be used among these three criteria in comparison of the discharge water quality of mine waters. Sedimentation ponds will allow complete settling of precipitated ferrihydrite (for WRD and Open Pit contact waters) and total suspended solids. • Quality data obtained from dewatering waters will be used to improve and update the mine closure plan for detailed evaluation of pit lake formation and strategy for part of the Project's mine water management. • No discharge of settled effluent will be carried out to the Gökırmak River during low flow conditions. • Periodic monitoring will be performed on quality of discharge waters. • Rainfall runoff that is in contact with the Processing Plant	

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
					will be captured and diverted to downstream sedimentation ponds for further treatment prior to discharge. Non-contact waters will directly be discharged to receiving surface waters as they will be isolated from the Processing Plant via perimeter ditches.	
Impacts on water quality due to transport of uncontrolled sediments to downstream surface waters (during construction)	-Downstream surface water resources	High -Local -Medium-term -Short-term reversible -High in magnitude -Intermittent	Low	Moderate	• All required and effective drainage and construction procedures will be applied in order to minimize the impacts on soil hydrology and to benefit soil infiltration. Interception channels around the Open Pit, WRD, TSFs and Processing Plant will be built to divert runoff waters and to prevent/minimize erosion caused by water. • Impacted runoff waters will be treated in compliance with the discharge limits specified in IFC Effluent Discharge Criteria for mine waters and National Discharge Standards specified in Turkish Water Pollution and Control Regulation – Table 7.1. The strictest limit value will be used among these three criteria in comparison of the discharge water quality of mine waters. Sedimentation ponds will allow complete settling of total suspended solids. • Exposed ground and steeply inclined outer walls will be stabilized to minimize/prevent soil - river bank erosion and sediment load in accordance with the Erosion and Sedimentation Control Plan. • Exposed ground that will be disturbed during the construction phase activities will be minimized (unnecessary soil stripping will not be carried out). • Limiting construction activities during adverse weather conditions to reduce potential wind and water erosion will be considered. • Natural vegetation along the local streams and the Gökırmak River will be preserved in non-exposed ground	Negligible
Impacts on water quality due to transport of uncontrolled sediments to downstream surface waters (during operation)		Medium -Local -Long-term -Short-term reversible -Medium in magnitude -Intermittent	Low	Minor		Negligible
Impacts on water quality due to construction of diversion tunnel on Gökırmak River		Medium -Local -Short-term -Short-term reversible -Medium in	Low	Minor		Negligible

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
		magnitude -Intermittent			areas for effective sediment and erosion control. • Re-vegetation or otherwise rendering non-dust forming of surfaces in inactive/decommissioned Project areas will be performed to minimize dust generation. • Vehicle movements will be restricted to designated roads to avoid disturbance of soils adjacent to the roads. • Water sprinkling will be implemented on ore transport, waste rock transport and access roads (initially, based on the air quality model results, water sprinkling will be conducted for at least 5 trips a day during dry season and the frequency will be increased if the monitoring results require so) . • An up-to-date Erosion and Sedimentation Control Plan will be maintained to prevent/minimize the impacts that might potentially arise due to increased turbidity and suspended solid load. • Mine Water Monitoring Plan developed in the scope of the ESIA will be implemented (see Section 6.7.3.1). • Water Resources Management Plan will be implemented.	

6.7.3.1 Mine Water Monitoring Plan

A monitoring program was developed for water resources in order to prevent/minimize potential risks that might arise during the construction, operation and closure phases of the Project. The monitoring plan will comprise both in situ measurements and field samplings that aim to monitor the quantity and quality of the surface waters and groundwater over the project phases. Water monitoring plan will be implemented in compliance with the relevant regulatory criteria for surface waters and groundwater. Monitoring will be continued 10 years after the closure phase starts unless any significant change in water quality during the closure is observed. Locations for the monitoring locations are shown through Figure 6-37 and Figure 6-39. Monitoring plan and monitoring frequencies are provided in Table 6-70 and Table 6-71 while the details are presented below.

6.7.3.1.1 Surface Waters

Gökırmak River and its sidelong branches

Surface water locations along the Gökırmak River and its sidelong branches will be monitored to ensure there is no adverse impact which might originate from the mining activities. Field parameters / flow rate measurements and water quality sampling will be carried out. Analysis results and field measurements will be compared with relevant EU criteria and the quality criteria specified in Turkish Surface Water Quality Regulation"s Annex 5 – Table 5.

Open pit lake

In order to evaluate groundwater inflow to the open pit during the operational phase, flow rate measurements and field parameters will be carried out monthly. Pit lake water quality will be monitored by collecting samples from the pit lake quarterly in a year.

As the mining activities are terminated and the groundwater level starts to rebound back to its original position, monthly measurements of flow rate, pit lake water level and field parameters will be carried out. Samples from the open pit lake will be collected quarterly in the first two years of the post-closure phase, semi-annually between 2^{nd} and 4^{th} years of the post-closure and annually for the latter periods of the post-closure phase. Analysis results will be evaluated in accordance with the discharge criteria given in Table 7.1 of the Turkish Water Pollution and Control Regulation.

Diversion tunnel inlet and outlet flow rates

Flow rate and field parameters will be measured at the inlet (DT-1) and outlet (DT-2) of the diversion tunnel to monitor the amount of water that will be diverted. This will further provide a long term dataset for the Gökırmak River within the Project Area.

Sedimentation ponds

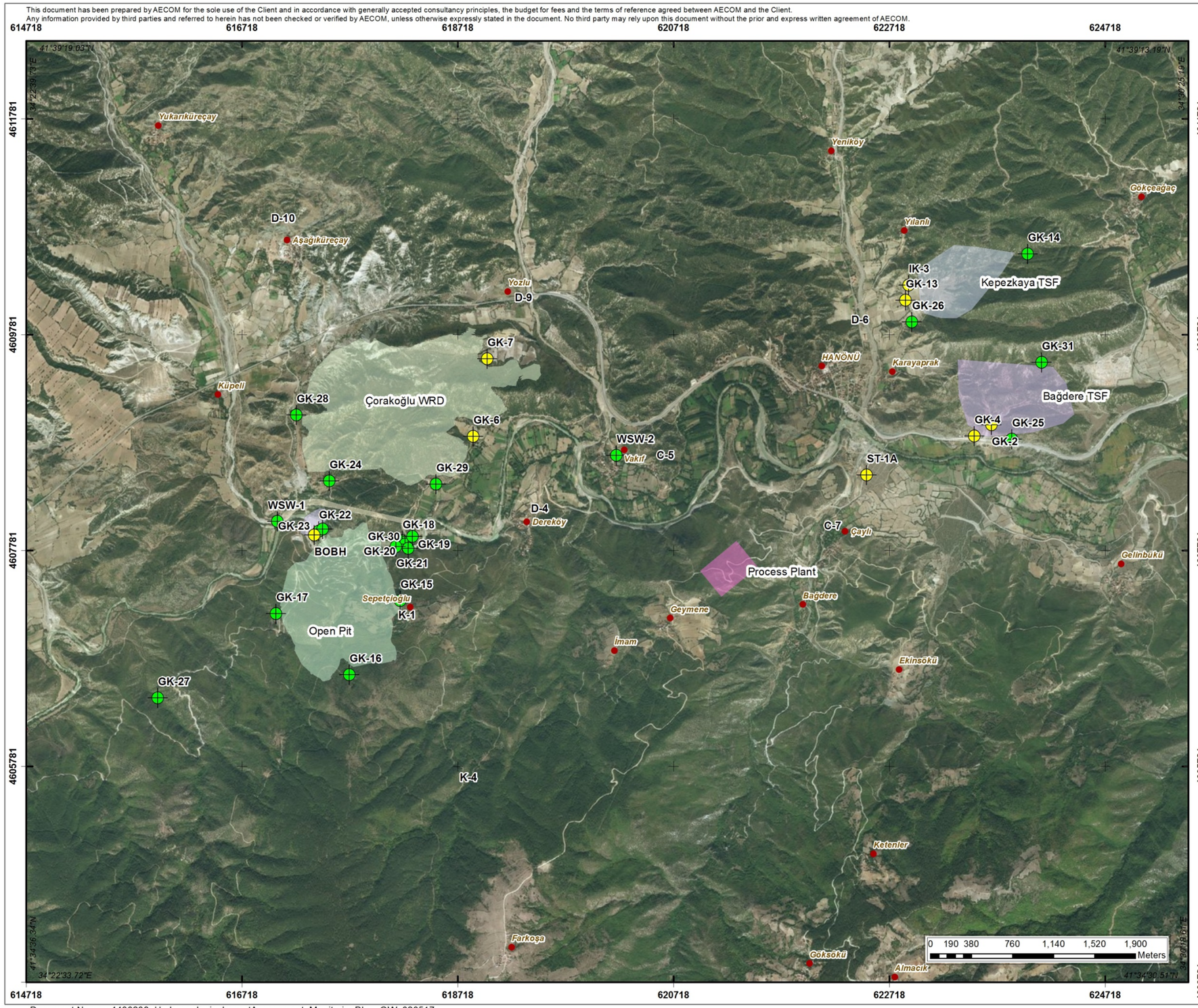
In reference to Mine Water Management Report prepared by RPS Aquaterra (RPS, 2015 - See Volume-III of the ESIA Disclosure Package), pit dewatering / pit wall runoff waters, WRD seepage waters and process plant contact waters will be captured in downstream sedimentation ponds. As for the selection of sedimentation ponds that will be used for monitoring purposes, locations and Station IDs specified in RPS Aquaterra's Mine Water Management Report was used. In order to determine the quantity and quality of seepage waters, collected water volumes will be measured monthly along with field parameters. Sampling surveys will be carried out quarterly.

The runoff from the impacted catchments will be drained to sedimentation ponds in order to facilitate the settlement of suspended sediment prior to discharge to the environment. A minimum sedimentation basin depth of 1.2 m is recommended, incorporating a minimum settling depth of 0.6 m with an additional depth provided for the storage of settled sediment between maintenance.

The runoff from the WRD is expected to require sediment treatment at these points prior to discharge to the environment. Similarly, water derived from the open pit dewatering will also require sediment treatment prior to discharge to the environment or to pumping to Process Plant, if needed. Sedimentation ponds will allow complete settling of total suspended solids and precipitated ferric oxyhydroxides.

Analysis results will be evaluated in accordance with the Effluent Discharge Criteria for Mining Industry Wastewaters (prior to discharge, if any) specified in Turkish Water Pollution and Control Regulation.

This document has been prepared by AECOM for the sole use of the Client and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client.
Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.



LEGEND

Status

- Springs and village water depots
- Existing monitoring wells
- Monitoring wells to be completed
- Settlement Areas

AECOM
Tel: +90 312 442 98 63
Fax: +90 312 442 98 63
environment.turkey@aecom.com
www.aecom.com
Mustafa Kemal Mah.
Dumlupınar Bulvarı No: 266
Tepe Prime B Blok Suite No:51
06800 Çankaya/Ankara Turkey

Project Name:	Hydrogeological Impact Assessment for the GCP
Map Title:	Mine Water Monitoring Program
Client:	Acacia Maden İşletmeleri A.Ş.
Project Group: Environment	Project Code: 440.02.08
Design: A. Korkmaz	Last Update: 23/08/2017 - 05:50 (korkmaz / TRAKRPC31746)
Coordinate System: Projection: Transverse Mercator Coordinate System: ED 1950 UTM Zone 36N	Sheet Size: A3

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Name : 4400208_HydrogeologicalImpactAssessment_MonitoringPlan_GW_020517

Figure 6-37 Groundwater (Monitoring Wells, Sprigs and Water Depots) Monitoring Locations for the Project Area

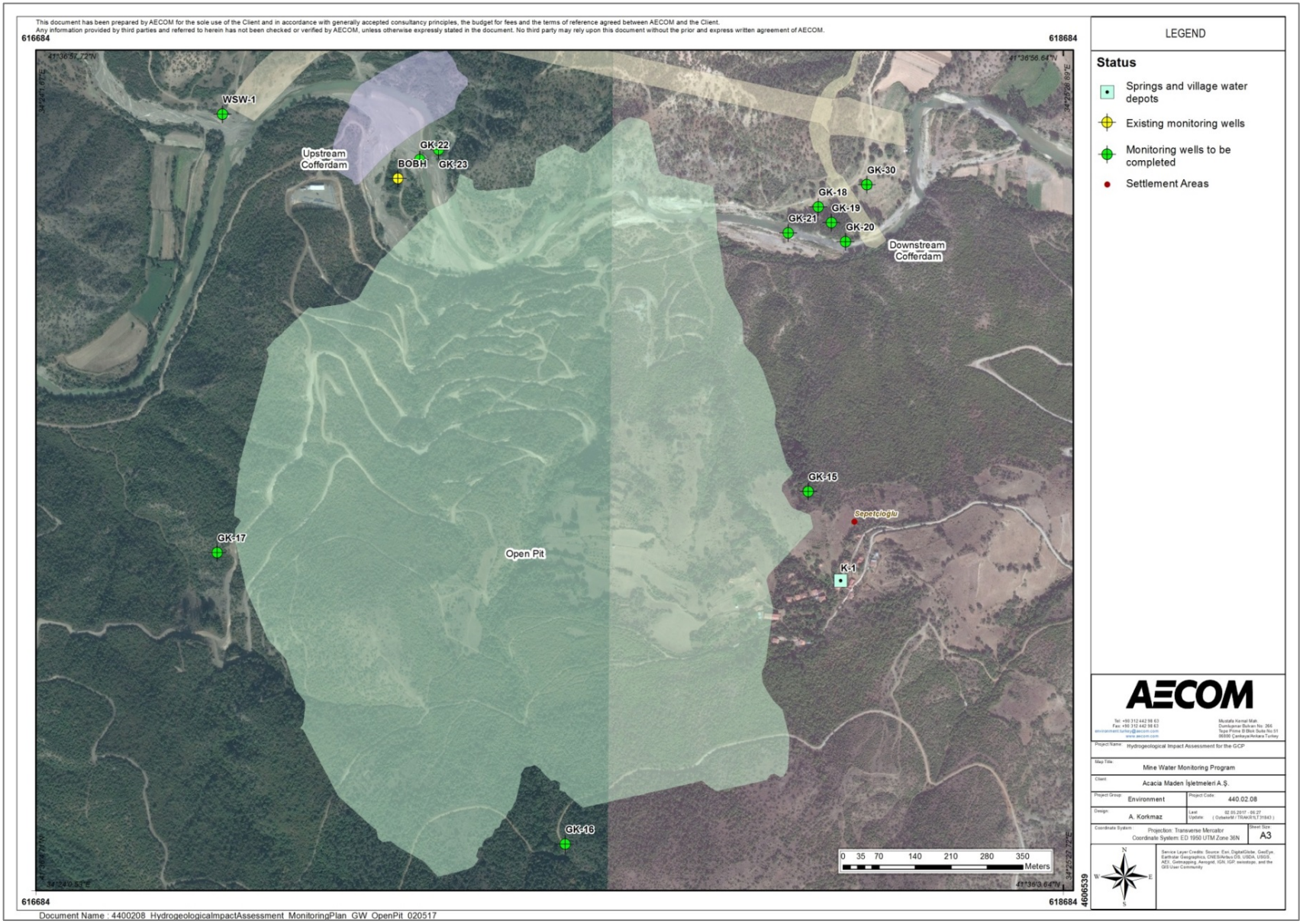
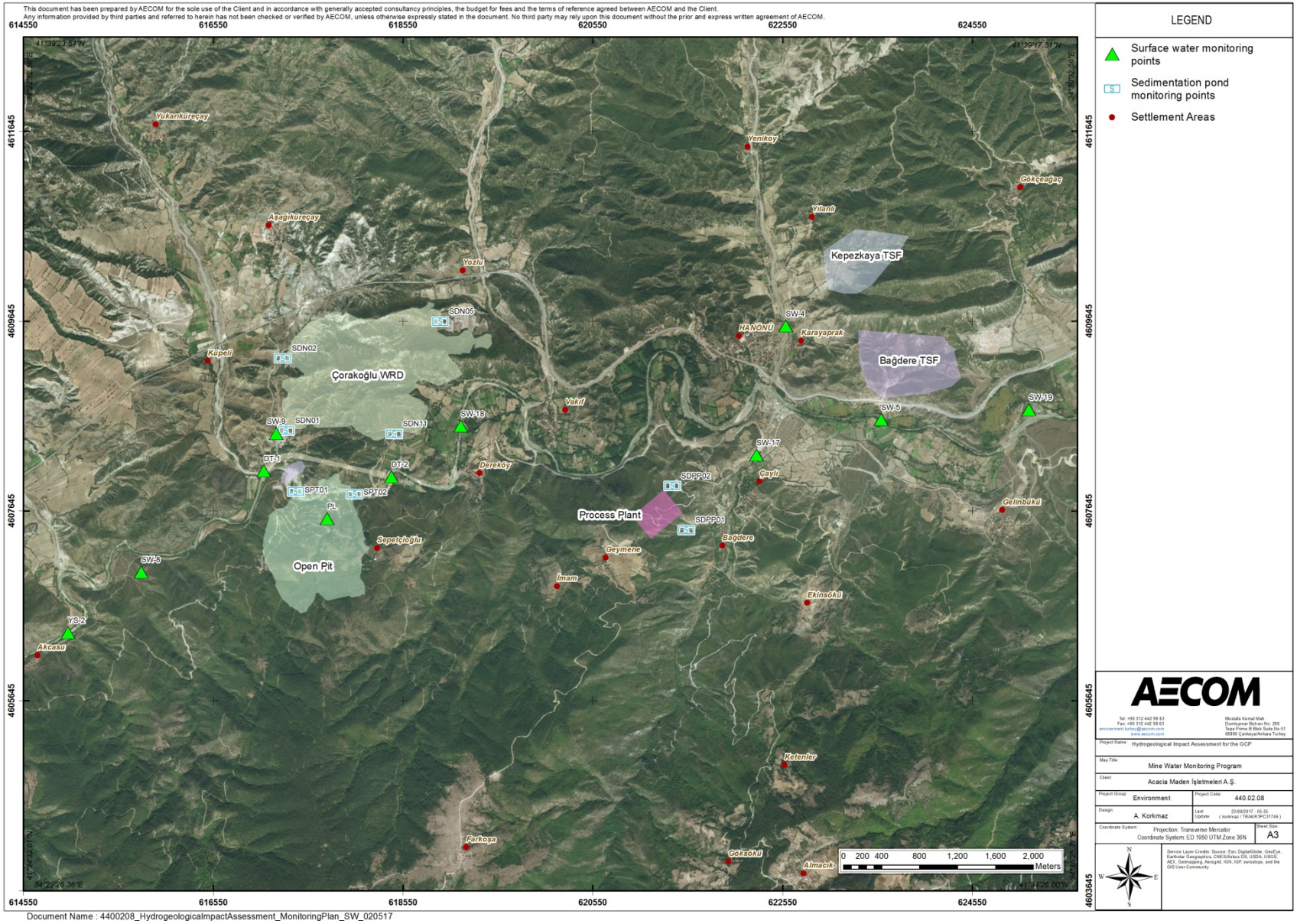


Figure 6-38 Groundwater (Monitoring Wells, Sprigs and Water Depots) Monitoring Locations for the Open Pit



Document Name : 4400208_HydrogeologicalImpactAssessment_MonitoringPlan_SW_020517

Figure 6-39 Surface Water Monitoring (Pit Lake, Streams and Sedimentation Ponds) Locations for the Project Area

Table 6-70 Water Monitoring Plan for the GCP

	Monitoring Location	Objective of Monitoring	Monitoring Frequency	Monitoring Parameters	Project Phase
Surface Waters	Gökırmak River (YS-2, SW-5, SW-18, SW-19, DT-1, DT-2)	Gökırmak River flow rate and water quality monitoring (downstream sections of WRD, TSF and the Open Pit)	**Construction and Operational Phases** Field parameter and flow measurements: Monthly Field sampling: Quarterly **Post-closure Phase** Field parameters, flow measurements and field sampling: Quarterly (first two years of closure), semi-annually (2 to 4 years of closure), and annually (4 years after closure).	• Turkish Surface Water Quality Regulation, Annex 5 - Table 5: Quality Criteria for the Inland Surface Water Resources	Construction, Operational and Post-Closure Phases
	Gökırmak River sidelong branches (SW-4, SW-8, SW-9, SW-17)	Gökırmak River sidelong branches flow rate and water quality monitoring (downstream sections of WRD, TSF and the Open Pit)	**Construction and Operational Phases** Field parameter and flow measurements: Monthly Field sampling: Quarterly **Post-closure Phase** Field parameters, flow measurements and field sampling: Quarterly (first two years of closure), semi-annually (2 to 4 years of closure), and annually (4 years after closure).	• Turkish Surface Water Quality Regulation, Annex 5 - Table 5: Quality Criteria for the Inland Surface Water Resources	Construction, Operational and Post-Closure Phases
	Open pit lake (PL)	Pit lake water level and water quality monitoring	**Operational Phase** Field parameter and pit inflow measurements: Monthly Field sampling: Quarterly **Post-closure Phase** Field parameter and pit inflow measurements: Monthly Field sampling: Quarterly (first two years of closure), semi-annually (2 to 4 years of closure), and annually (4 years after closure).	• Turkish Surface Water Quality Regulation, Annex 5 - Table 5: Quality Criteria for the Inland Surface Water Resources	Operational and Post-Closure Phases
	Sedimentation Ponds (SPT01, SPT02, SDN01, SDN02, SDN05, SDN11)	Water quantity and quality monitoring for waters that are captured in sedimentation ponds	**Construction and Operational Phases** Field parameter and flow measurements: Monthly Field sampling: Quarterly	• Turkish Surface Water Quality Regulation, Annex 5 - Table 5: Quality Criteria for the Inland Surface Water Resources	Operational and Post-Closure Phases
Groundwater	**Monitoring Wells** Open pit (WSW-1, GK-15, GK-16, GK-17, GK-18, GK-19, GK-20, GK-21, GK-22, GK-23, GK-30, BOBH) Çorakoğlu WRD (GK-6, GK-7, GK-24, GK-28, GK-29, Kepezkaya TSF (GK-13, GK-14, IK-3, GK-26) Bağdere TSF (GK-2, GK-4, GK-25,GK-31)	Groundwater level and quality monitoring in existing and planned monitoring wells.	**Construction and Operational Phases** Field parameter and static water level measurements: Monthly Field sampling: Quarterly **Post-closure Phase** Field parameters, static water level, flow measurements and field sampling: Quarterly (first two years of closure), semi-annually (2 to 4 years of closure), and annually (4 years after closure).	• Turkish Water Pollution and Control Regulation, Table 1: Inland Water Quality Criteria • EU Groundwater Directive 2006/118/EC (includes min parameter list, provides limits for nitrates and pesticides)	Construction, Operational and Post-Closure Phases
Drinking Waters	**Springs, fountains and village water depots** (K-1, K-4, C-5, C-7, D-4, D-6, D-9, D-10)	Groundwater flow rate and quality monitoring (springs located in the downstream of WRD, TSFs and the open pit, if any). Drinking water quantity and quality monitoring (fountains and village water depots located within the Project Area)	**Construction and Operational Phases** Field parameter and flow measurements: Monthly Field sampling: Quarterly **Post-closure Phase** Field parameters, flow measurements and field sampling: Quarterly (first two years of closure), semi-annually (2 to 4 years of closure), and annually (4 years after closure).	• Regulation on Waters Intended for Human Consumption (RWIHC), Chemical Parameters and Indicator Parameters – Turkish Ministry of Health, 2005 • EU Quality Criteria for Waters Intended for Human Consumption – Council Directive 98/83/EC of 3 November 1998 • WHO Drinking Water Guidelines, 2011	Construction, Operational and Post-Closure Phases
Discharge Waters	Discharge Waters	Discharge water quality monitoring, if any.	Prior to discharge, if any.	• Turkish Water Pollution and Control Regulation, Table 7.1: Effluent Discharge Criteria for Mining Industry Wastewaters • IFC Effluent Discharge Criteria for mine waters • EU Urban Wastewater Treatment Directive	Operational Phase

Table 6-71 Monitoring Plan for the Operational Water Structures

Monitoring Location	Objective	Monitoring Frequency	Monitoring Parameters	Project Phase
Process tailings discharge	Monitoring of site water balance	Daily measurements	Tailings discharge rate	Operation
Process tailings	Monitoring chemical composition of the tailings material	Annual analysis	Physical parameters and metals	Operation
TSF embankment	Monitoring physical stability of the TSF	Daily observations, monthly measurements	Consolidation and stress	Operation and Post-Closure
Diversion channels and Sedimentation ponds	Monitoring sustainability of the diversion channels	Weekly observations	Water level and stability	Operation and Post-Closure
Culvert structures and waterways	Monitoring sustainability of the culvert structures waterways	Weekly observations	River flow rate and culvert stability	Operation and Post-Closure

6.7.3.1.2 Groundwater

Open Pit Monitoring Wells

Groundwater wells located in the upstream and downstream locations of the open pit will be monitored for field parameters and groundwater levels. Water quality sampling surveys will be carried out in the monitoring wells. A total of 11 new monitoring wells will be installed in the pit area to monitor groundwater quantity and quality while one well, already drilled within the schists, will also be used for monitoring purposes. Three wells will be installed on the western, eastern and southern boundaries of the pit while seven wells will be installed in the areas where the cofferdams are located. These wells will be completed prior to commence production. Monitoring purpose for the open pit wells are provided below:

- Three monitoring wells (GK-15, GK-16, GK-17) to monitor water levels and water quality. Dewatering impacts will also be monitored from these wells during the operational phase. The wells are recommended to be completed with a casing and screen diameter of 175 mm or greater. The well depths should extend 20 m lower than the ultimate pit bottom at each well location.
- Three monitoring wells next to upstream cofferdam to monitor water levels and water quality within the alluvium (GK-22 and GK-23) and schist (BOBH). Alluvium wells are recommended to be constructed with larger diameter (Ø >= 280 mm) for an additional purpose of emergency dewatering, if needed. Monitoring wells within the schist are recommended to be completed with a casing and screen diameter of 175 mm or greater.
- 5 monitoring wells next to downstream cofferdam to monitor water levels and water quality within the alluvium (GK-18, GK-19, GK-20 and GK-30) and schists (GK-21). Alluvium wells are recommended to be constructed with larger diameter (Ø >= 280 mm) for an additional purpose of emergency dewatering, if needed. Monitoring wells within the schist are recommended to be completed with a casing and screen diameter of 175 mm or greater.

In addition to the above-mentioned 10 monitoring wells, one pumping well (WSW-1), currently being used for water supply purposes for the Küpeli and Aşağıküreçay villages, will also be monitored in terms of water levels and water quality.

Waste Rock Dumps Monitoring Wells

Groundwater monitoring in the Çorakoğlu WRD will be carried out in 5 monitoring wells to detect any potential seepage in downstream. Since the groundwater table forms an irregular mound in the Çorakoğlu Hill and groundwater flow occurs radially from the zone of groundwater high, potential flow paths will be monitored in the wells. In addition to the previously-drilled GK-6 and GK-7 wells, three more wells will be drilled for monitoring purposes. Field parameters and water levels will be monitored and water quality samplings will be performed in the monitoring wells.

Tailings Storage Facilities Monitoring Wells

Groundwater monitoring in the Kepezkaya TSF will be carried out in 4 monitoring wells to detect any potential seepage in downstream. In addition to the previously-drilled GK-13 and IK-3 wells, one monitoring well will also be drilled in downstream to monitor southwest end of the TSF. One monitoring well (GK-14) will be installed in the upstream of the Kepezkaya TSF in order to collect data from un-impacted zone. Field parameters and water levels will be monitored and water quality samplings will be performed in the monitoring wells. As for the Bağdere TSF, in addition to previously-drilled wells, one monitoring well in the unimpacted upstream zone (GK-31) will be installed. Furthermore, one more downstream monitoring well on critical flow path (GK-25) will be needed.

Therefore monitoring in Bağdere TSF will be conducted in four monitoring wells.

A total of 28 monitoring wells (8 existing wells, 20 additional wells) will be installed in the Project Area to monitor groundwater levels and groundwater quality representative for each project unit. Rreal time monitoring (groundwater levels, pH and EC) in the TSF monitoring wells will be implemented in order for Acacia to detect any potential impact early enough to take action.

Springs, Fountains and Village Water Depots

In order to monitor any potential impact of the mining activities on drinking water, springs, fountains and village water depots located in the downstream of the project units will also be monitored. These locations will be monitored for field parameters and flow rate measurements. Water quality sampling surveys will also be carried out in accordance with the intervals specified in Table 6-70.

6.7.3.1.3 Process Waters and Operational Structures

Tailings samples will be collected and analyzed in accordance with relevant regulatory criteria. In order to monitor site water balance, daily flow rates of the process tailings that is to be transmitted to TSFs will be measured. Stability and durability of the operational structures such as TSF embankments, diversion channels, sedimentation ponds and culvert structures will be inspected regularly to ensure if they function properly throughout the project lifetime. This will ensure that the stability of the structures is maintained over long term.

6.8 Mining Waste

This section presents the impact assessment for mining waste geochemistry of GCP's mining lithologies. The information and data sources were taken from the following documents which were prepared by Geochemico Consulting Inc.

- Results of Mass Balance/PHREEQC Modelling of the Waste Rock Dump at the Gökırmak Copper Project, Kastamonu, Turkey
- Results of Mass Balance/PHREEQC Modelling of the Open Pit Sump and Lake at the Gökırmak Copper Project, Kastamonu Turkey
- PHREEQC Modeling of the Kepezkaya Tailings Storage Facility Seepage at the Gökırmak Copper Project, Kastamonu, Turkey
- Addendum for Mining Waste Impact Assessment on Soil/Overburden (received via email on 21st September, 2017)

Potential geochemical impacts of mining wastes (incl. waste rock dump, tailings storage facilities, open pit lake) were identified through geochemical modeling studies which were given in above-mentioned reports in detail whereas the summary of geochemical studies are provided in below sections.

6.8.1 Çorakoğlu Waste Rock Dump

Mass balance/PHREEQC modelling of waste rock and low grade copper ore (LCU) and leachate chemistry was carried out for the Gökirmak Copper Project (GCP) in order to:

- Predict probable leachate chemistry and precipitate mineralogy in both the core of the waste rock dump (WRD) and the toe of the dump;
- Compare predicted leachate chemistry with EU, Turkish and Canadian regulatory parameters, and
- Optimize the WRD and cover design.

The input to the mass balance/PHREEQC modelling, for all models, was the static and kinetic test data generated on samples of lithologies submitted to Global ARD Laboratories, located in Burnaby, BC, which are described in a separate ARD/ML characterization report (Geochemico, 2016a, 2016b). Loading rates (mg/kg/L/year) were generated from the laboratory testing data and used, together with projected WRD geometry, hydrogeological modelling and known climatic data to estimate the waste rock loading or the within dump loading. The estimated loading was then diluted using the climatic (rainfall and evaporation) data. The mass of precipitating phases were calculated and the resultant solution chemistry was equilibrated with the atmosphere in order to model either WRD inner core chemistry or toe of dump chemistry, as appropriate. Modeling assumptions and modeling methodology were provided in detail in Volume III of the ESIA Disclosure Package.

6.8.1.1 Potential Impacts of WRD Drainage on Surface Drainage

The environmental impact of the waste rock dump leachate was determined by modelling the mixing of the Gökırmak River with the leachate streams from the waste rock dump at the median (base case) and 95th percentile (worst case) loading rates using the same mass balance/PHREEQC approach as previously.

It should be noted that the median sulphate concentration of the Gökırmak River, without any discharge from the WRD exceeds the EU regulatory standard by a factor of almost two and the median V concentration in the river is very close to the Canadian regulatory standard.

Table 6-65 provides modelled maximum and minimum concentrations expected to occur in the Gökırmak River for the full period of mining operations and after mine closure, for 27 years. The modelled concentrations are compared with Turkish, EU and Canadian standards and any exceedances are highlighted in yellow.

Table 6-72 Modelled Maximum and Minimum Concentrations in the Gökirmak River for Base Case and Worst Case Loading Rates, Compared to Turkish, EU and Canadian Water Quality Standards

	YEAR		pH	S(6)	F	N	Alkalinity	Ag	Al	As
	TURKISH	mg/L	6.5 to 9	250.00000	1.50000				0.20000	0.01000
	EU	mg/L	6.5 to 9.5	250.00000	1.50000				0.20000	0.01000
	CANADA	mg/L	6.5 to 9						0.75000	
BASE	ALL YEARS	MAX	8.00	495	0.28	0.040	227	0.00050	0.0053	0.0027
CASE	ALL YEARS	MIN	8.00	485	0.27	0.030	223	0.00049	0.0049	0.0025
WORST	ALL YEARS	MAX	8.00	495	0.29	0.041	227	0.00050	0.0060	0.0037
CASE	ALL YEARS	MIN	8.00	487	0.27	0.030	223	0.00049	0.0049	0.0025

	YEAR		B	Ba	Ca	Cd	Co	Cr	Cu	Fe
	TURKISH	mg/L	1.000			0.00500		0.050	2.0	0.20
	EU	mg/L	1.000			0.00500		0.050	2.0	0.20
	CANADA	mg/L				0.00050			0.0050	
BASE	ALL YEARS	MAX	0.55	0.033	103	0.00020	0.0010	0.00050	0.0010	0.0024
CASE	ALL YEARS	MIN	0.51	0.033	87	0.00020	0.00098	0.00049	0.00098	0.0024
WORST	ALL YEARS	MAX	0.64	0.033	142	0.00020	0.0010	0.00056	0.0010	0.0024
CASE	ALL YEARS	MIN	0.51	0.033	87	0.00020	0.00098	0.00049	0.00098	0.0024

	YEAR		Hg	K	Mg	Mn	Mo	Na	Ni	P
	TURKISH	mg/L	0.001			0.050		200	0.02	
	EU	mg/L	0.001			0.050		200	0.02	
	CANADA	mg/L					0.07300		0.15	0.03
BASE	ALL YEARS	MAX	0.0	5.2	41	0.0013	0.0014	173	0.0011	0.0050
CASE	ALL YEARS	MIN	0.0	4.6	40	0.0012	0.00098	170	0.00098	0.0049
WORST	ALL YEARS	MAX	0.0	6.0	43	0.0013	0.0018	177	0.0015	0.0050
CASE	ALL YEARS	MIN	0.0	4.6	40	0.0012	0.00098	170	0.00098	0.0049

	YEAR		Pb	Se	Sb	Si	Sn	Sr	Tl	U	V	Zn
	TURKISH	mg/L	0.010	0.010	0.0050							
	EU	mg/L	0.010	0.010	0.0050							
	CANADA	mg/L	0.007								0.0060	0.030
BASE	ALL YEARS	MAX	0.0025	0.0050	0.0050	7.0	0.0	0.0079	0.0050	0.0000023	0.0054	0.0019
CASE	ALL YEARS	MIN	0.0025	0.0049	0.0049	6.9	0.0	0.0000	0.0049	0.0	0.0049	0.00098
WORST	ALL YEARS	MAX	0.0025	0.0055	0.0050	7.2	0.0	0.038	0.0050	0.000024	0.0068	0.0018
CASE	ALL YEARS	MIN	0.0025	0.0049	0.0049	6.9	0.0	0.0000	0.0049	0.0	0.0049	0.00098

According to the model results the only parameter expected to exceed Turkish, and EU water quality standards is sulphate. Sulphate is currently already exceedant in the river, by a factor of almost two. Discharge of leachate into the river is expected to reduce sulphate concentrations in the river by approximately 9.7 mg/L for the base case and 8.5 mg/L for the worst case loading rates.

Apart from sulphate, which is naturally exceedant, and is expected to be slightly diluted by the WRD leachate discharge, no other parameters are expected to exceed the EU, Turkish or Canadian regulatory standards for the base case or worst case.

6.8.1.2 Potential Impacts of WRD Leachate on Groundwater beneath the Waste Rock Dump

The impact that can be related with the storage of the waste rock to groundwater, will originate from the infiltration of precipitation from WRD to unsaturated zone and then to the saturated zone. The following calculations were completed to estimate the potential impact to groundwater;

- Precipitation will infiltrate to WRD and buildup a groundwater body until the closure. As the closure will be completed, the WRD will be closed and infiltration will stop. The mass balance/PHREEQC modelling estimates that, after the closure, approximately 100 years will be required to permit the pore water within the WRD to drain completely to residual water content. After this time contamination of the pore water is not possible, since effectively no pore water remains to infiltrate to the water table.

- The WRD area is completely underlain by silty/clay till varying in depth from approximately four to ten meters. Three drill holes were completed to estimate the permeability of the till layer (CZ-1, CZ-2, CZ-3). According to the previously completed studies, the overburden is as of moderate infiltration, which corresponds to a hydraulic conductivity of between 2.7E-07 m/s and 8.7E-08 m/s. A calculation was completed with these permeability and measured hydraulic gradient values and the minimum and maximum travel times for pore water seeping beneath the Corakoglu WRD to reach the water table was obtained as 41 and >200 years respectively.
- Based on the seepage transport rate estimated through numerical groundwater flow model (See Section 7.8.3.4), the fastest flow path that reaches to the Gökırmak River was observed to be the southwestern corner of the dump within 79.1 years.

Thus, the potential contaminant originate from the WRD will reach to Gökırmak River will be more than 79.1 years. On the other hand, with a conservative approach, the trave time in the unsaturated zone was neglected and PHREEQC run was competed with the concentrations seeping from the WRD, directly introduced to the groundwater for 100 years.

The run was competed to estimate the quality of groundwater that can reach to Gökırmak for the median (base case) and 95th percentile (worst case). As can be seen from Table 6-66, the predicted total mg/quarter of each element modelled are generally very small, and will cause no exceedances of element concentrations in the Gokirmak River, except for a very small increase in sulphate concentrations in the river, which are already naturally exceedant.

Table 6-73 Calculated Base Case and Worst Case Total Mg/Quarter Entering the Gokirmak River from Year 79 to Year 179 after WRD Construction

Total mg per quarter										
	S(6)	F	N	Alkalinity	Ag	Al	As	B	Ba	Ca
BASE CASE	0.54	0.0086	0.0010	0.034	0.0	0.00039	0.00080	0.0014	0.0000014	2.38
WORST CASE	2984	47	6	194	0.0	6.2	4.4	7.8	0.0	13036
	Cd	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo
BASE CASE	8.9E-07	4.4E-07	6.0E-07	2.92E-06	2.9E-05	1.8E-07	0.39	0.11	0.00064	0.00071
WORST CASE	0.0050	0.0092	0.0055	0.060	0.61	0.0010	2160	618	6.2	3.9
	Na	Ni	P	Pb	Se	Sb	Si	Sn	Sr	Tl
BASE CASE	0.33	0.00010	1.7E-05	2.84E-06	2.89E-05	3.3E-05	7.68163E-05	8.7E-08	0.0015	1.1E-06
WORST CASE	1817	0.57	0.35	0.015	0.16	0.18	14	0.0018	8.0	0.0059
	U	V	Zn							
BASE CASE	5.5E-06	0.00017	0.00027							
WORST CASE	0.034	0.95	1.5							

As can be seen from Table 6-66, the predicted total mg/quarter of each element modelled are generally very small, and will cause no exceedances of element concentrations in the Gokirmak River, except for a very small increase in sulphate concentrations in the river, which are already naturally exceedant.

It should be noted that due to the low hydraulic conductivity of the overburden' almost all of the pore water will exit the WRD through the containment ditches and subsequently the settling ponds. Furthermore the groundwater mound that will develop within the WRD, will seep from the toe of the dump as well as it seeps to the underlying low permeable till.

6.8.1.3 Potential Impacts of WRD Operations on Underlying Soil/Overburden

Although the waste rock dump will be circumscribed by a collection ditch to ensure that all run-off and toe-of-dump leachate will be directed to the settling pond, and therefore not able to contaminate the soils and overburden in the immediate vicinity of the waste rock dump, the pore water could conceivably migrate downwards into soil/overburden beneath the dump, causing unwanted environmental impact to these materials.

The estimated volume of pore water contained within the Çorakoglu WRD at maximum saturation is approximately 3.29 x 10^{10} L, almost all of which will slowly drain through the toe(s) of the WRD and travel along the circumscribing ditch to the settling pond due to the relatively high hydraulic conductivity of the waste rock. The low hydraulic conductivity of the unsaturated soil/overburden beneath the WRD means that only a very small proportion of the pore water within the WRD will percolate through the soil/overburden. The estimated maximum volume of pore water percolating into the unsaturated soil/overburden underlying the Çorakoglu WRD is approximately 0.09 L m^{-2} $quarter^{-1}$. Therefore approximately 36 L^{-1} m^{-2} of pore water will percolate into the overburden over the estimated period of approximately 100 years required to completely drain the covered WRD. Table 4 compares the median soil/overburden content of parameters that are exceedant in the WRD pore water (except for pH) with the calculated increase in these parameters caused by the percolation of pore water into the soil/overburden, making the conservative assumption that all the exceedant parameters are adsorbed into clay minerals, organic matter and iron oxyhydroxides resident within the soil/overburden and using worst case (95^{th} percentile) loading rates. It should be noted that, in contrast to the situation below the Kepezkaya TSF, the pore waters are basic and therefore will not react with carbonate minerals in the overburden and are extremely unlikely therefore to precipitate secondary mineral phases within the pore spaces of the soil/overburden.

It may be observed that the highest increase in exceedant parameters below the Çorakoglu WRD after 100 years of pore water percolation is for sulphate, with a relative percent increase (compared to baseline sulphate content) of only 1.38% corresponding to a median increase of 1.38 mg/kg. The smallest increase in exceedant parameters below the Çorakoglu WRD is for Zn with a barely perceptible increase of 0.000040 relative percent.

Table 6-74: Predicted Increase in Overburden Concentrations of Exceedant Parameters below the Corakoglu WRD after 100 Years of Percolation of Worst Case WRD Pore Water

	MAXIMUM CONCENTRATION IN WRD PORE WATER FOR WORST CASE	Baseline Median Soil Content	Overburden content after 100 years	Relative % increase
	mg/L	mg/Kg	mg/Kg	%
Sulfate	1063	100	101.38	1.38
F*	1.826	0.48	0.48	0.49
As	6.8E-01	7.45	7.45	0.012
B*	0.82544079	0.072	0.073	1.48
Mn	0.2751	2109	2109.00	0.000017
Mo	0.2751	0.62	0.62	0.057
Na	215.5	17800	17800.28	0.0016
Se	0.02847	12	12.00	0.00031
Sb	0.04279	0.7	0.70	0.0079
Ni	0.085	74.75	74.75	0.00015
V	1.2E-01	197.65	197.65	0.00008
Zn	0.0403	131.5	131.50	0.000040

6.8.1.4 Potential Impacts Related to Capacity, Transportation Management and Erosion

Potential impacts that might originate from WRD transportation, capacity and WRD erosion will be negligible as the following measures will be in place for the GCP.

- Waste rock material will directly be transported to the Çorakoğlu WRD with designated haulage vehicles.
- Drainage channels will be constructed to manage rainfall run off.
- The surfaces of the WRD will subject to compaction with a cylinder after truck dumping; which further prevents/minimizes rain and wind erosion.
- There will be safety benches between each subsequent lifts, to hold the washouts and prevent further migration of material and prevent erosion after heavy rainfall events.

There will be sedimentation ponds on the downstream of the WRD to have another safe barrier of the erosion.

6.8.1.5 Conclusions of Impact Assessment of WRD

Following conclusions were noted as a result of the modeling studies completed for the Çorakoğlu WRD.

- Ferrihydrite (FeOOH, Hfo) will probably precipitate from the WRD leachate when it emerges from the toe of the dump. Adsorption of both anions and cations to the precipitating FeOOH will provide a measure of mitigation for As, sulphate, Cd and base metals provided the precipitate is allowed to settle;
- Loading rates for Mixed Schist and Greenschist were compared for static and kinetic testing data and found to be very similar, although a higher proportion of some parameters (e.g. sulphate) was found to dissolve from the mixed schist;
- Loading rates were calculated for the median (base case) and 95th percentile (worst case) in order to provide conservative modelling scenarios. Pore water and toe of dump leachate concentrations were calculated for the Corakoglu waste rock dump for each of the two loading rate cases;
- Base case principal contaminants of concern were found to be pH, As, Mn, Mo, Sb, V and Zn.
- For the base case, mineral phases that are likely to precipitate within the core of the dump include: Ag2Se, Ba3(AsO4)2, CoFe2O4, Cr2O3, cuprousferrite, diaspore, hydroxylapatite, hausmannite, hematite, HgSe, and SnSO4;
- Mineral phases that are likely to precipitate at the toe of the dump for the base case include: diaspore, FCO3apatite, and pyrolusite;
- Worst case principal contaminants of concern were found to be sulphate, pH, sulphate, F, As, B, Mn, Mo, Na, Se, Sb, Ni, V, and Zn;
- For the worst case, mineral phases that are likely to precipitate within the pore water of the dump include: Ba3(AsO4)2, CaMoO4, CoFe2O4, fluorite, gypsum, kaolinite, Cr2O3, cuprousferrite, diaspore, hausmannite, hydroxyapatite, hematite, HgSe, and SnSO4;
- For the worst case, mineral phases that are likely to precipitate at the toe of dump leachate include: CoFe2O4, diaspore, and pryolusite;
- Adsorption to Hfo provides an order of magnitude decrease in As concentrations at the toe of the dump for both the base and worst cases;
- The environmental impact of the Çorakoglu waste rock dump leachate on the Gökırmak River was modelled. The naturally exceedant sulphate levels in the river were reduced slightly through dilution by the waste rock leachate for both loading rate cases and no other exceedances were observed; and
- Modelling of infiltration rates of the waste rock dump pore water into the underlying overburden by combining the hydrogeological model with the mass balance/PHREEQC modelling reported herein showed that only very small quantities of pore water reach the Gokirmak River receptor 79 years after WRD construction. No elements will exceed EU regulatory guidelines, except for sulphate, which is naturally exceedant in the river.

6.8.1.6 Application of Engineered Cover at the WRD

In order to minimize impacts on water quality of the nearby water resources, an engineering cover design will be applied at the WRD site. The purposes of an adequate WRD cover design at the GCP are:

- To allow for re-vegetation of the WRD at mine closure;
- To minimize the influx of precipitation into the WRD, therefore minimizing the flow of leachate at the toe of the dump and maximising dilution by run-off;
- To prevent erosion; and
- To prevent pore water present in the WRD from rising upwards, thereby forming a vadose zone in the upper zone of the WRD and potentially killing vegetation as well as mobilising secondary alteration minerals.

There are three material types at the GCP that may be utilized for a cover design, overburden/soil (shown by static testing to not be PAF (See Section 5.8), clay, and locally available gravel.

6.8.1.6.1 WRD Cover Design

The proposed cover design, is formed of a ‘sandwich’ of a lower layer of gravel (nominal thickness 15 cm), itself covered by a layer of clay (nominal thickness 0.5 m) with an additional upper layer of gravel (nominal thickness 10 cm), which is itself covered by soil/overburden to facilitate re-vegetation (see Figure 6-40). Rainfall on the WRD will pass through the upper vegetated soil layer, some of it evaporating and a portion of the rainfall will be transpired into the atmosphere.

The upper layer of gravel will transport rain water through it to the layer of clay, while also protecting the clay layer from erosion and from desiccating. Most of the rain water passing into the upper gravel layer will move horizontally and report to the seepage collection pond via the seepage collection ditches surrounding the WRD, where it will dilute any leachate from the WRD. The clay layer, remaining saturated, will allow throughput of a very small amount of rainwater into the lower gravel layer. The lower gravel layer receives a small increment of water each quarter from rainfall and a small increment from WRD pore water moving vertically by capillary action up into the gravel. Modelling of the capillary movement of water upwards through the lower gravel layer indicates the pore water will not reach the lower gravel/clay interface. Effectively, no rain water will be able to percolate through the three cover layers. Modelling of the engineered cover indicates that the design is very resilient to any changes to climate patterns that may be caused in the future by climate change.

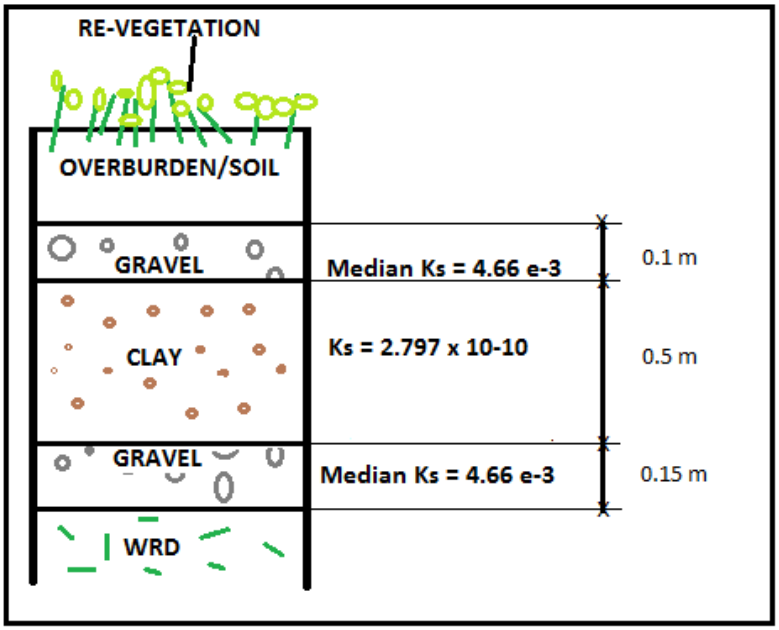


Figure 6-40 Proposed WRD Cover Design

6.8.1.6.2 Cover Design Modeling

The flow of water through the proposed cover design was carried out using the laboratory measured saturated hydraulic conductivities, mean rainfall data, calculated unsaturated hydraulic conductivities (for gravel) and assuming a run-off coefficient of 0.7. The evaporo-transpirative effect of the soil cover or the vegetation was not modelled in order to maintain a conservative model with the following assumptions;

- No rainfall (median rainfall of 49 L/m^2/quarter) enters the waste rock dump (through the designed cover).
- The clay layer remains permanently saturated.
- Seasonal evaporation is accounted for using the mean data supplied from the Devrekani meteorological station.

Hydrogeological modelling of the WRD shows that almost all of the pore voids will be saturated by rainfall by the time that WRD construction is complete. The WRD will require re-contouring following its completion, after which the engineered cover may be put in place. After the engineered cover is in place the pore water within the dump will continue to exit from the toe of the dump for a number of years until the interior of the WRD becomes unsaturated. New rainfall deposited on the covered WRD will pass predominantly through the upper layer of gravel and exit at the toe of the dump.

The gravel is composed of approximately 54% Green Schist, 46% Mixed Schist and small percentages of Mineralized Vein Waste Rocks and alluvium, therefore the rainwater passing through it will dissolve some of the minerals within the gravel however, the mass of gravel is much less than the mass of waste rock within the dump, so eventually the engineered cover will reduce the PCoC (potential contaminants of concern) exiting at the toe of the dump.

6.8.1.6.3 Assessment of Residual Impact after Mitigation (i.e. Application of Engineered Cover at Çorakoğlu WRD)

The designed, engineered cover for the Corakoglu waste rock dump restricts the volume of rain water entering the waste rock dump. This has three principal effects:

- Less water is available to leach elements from the waste rock resulting in a lower mass of waste rock being leached, however, because the volume of water is lower the concentrations of parameters are generally higher;
- The volume of water emanating from the toe of the dump is much less; and
- The volume of run-off is greater and therefore greater dilution of the toe of dump leachate is possible.

The combined impact of these three effects may be assessed by comparing the total mass of any given parameter that could be released to the environment without the cover installed, to the total mass of the same parameter with the engineered cover installed.

When the engineered cover is installed there is a considerable volume of leachate present in the WRD, which gradually leaves the WRD through seepage at the toe of the dump. The effectiveness of the engineered cover therefore increases with time. Furthermore, because the amount of dilution in the seepage collection pond varies with the rainfall, the effectiveness of the cover also varies seasonally. There are five PcoC for the base case (not including pH); As, B, Se, V, Zn. The change in the effectiveness (percent reduction of PcoC) effected by the engineered cover is shown below for As and B as Figure 6-41 and Figure 6-42. The maximum effectiveness of the engineered cover (for the modelled period) is presented as Table 6-75 for year 40 of operations (i.e. 27 years after the cover is installed) for all five PCoC.

Table 6-75 Percent Reduction in PCoC Toe of Dump Leachate Concentrations Effected by the Engineered Cover for The Base Case 27 Years after the Cover is Installed

PCoC	As	B	Se	V	Zn
Year 27	70.29	68.24	74.25	66.6	75.3

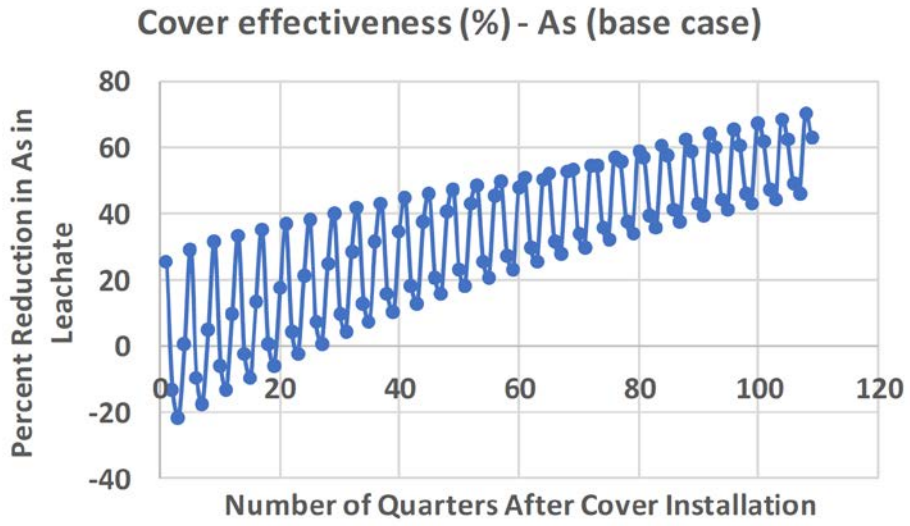


Figure 6-41 Effectiveness of Engineered Cover for Base Case As

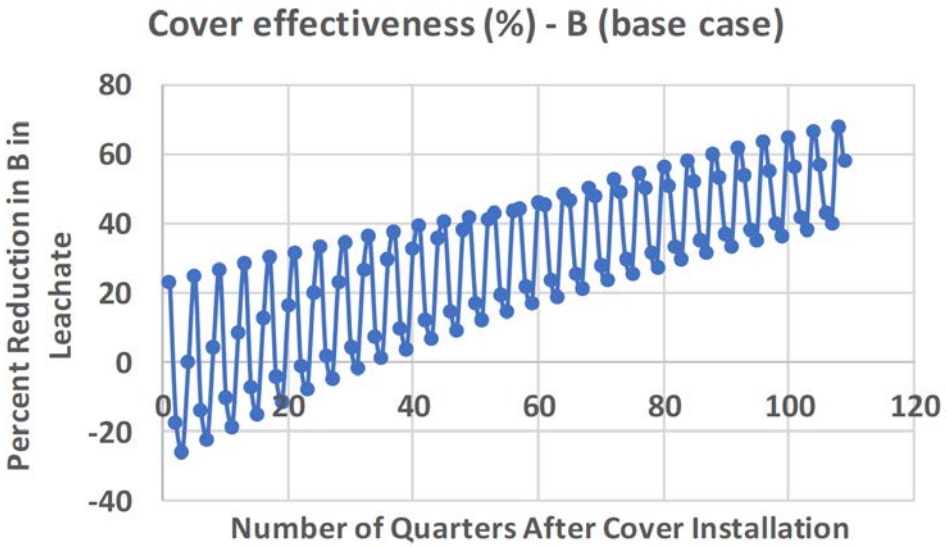


Figure 6-42 Effectiveness of Engineered Cover for Base Case B

The percent reduction in the eight PCoC for the 95th percentile (worst case) of As, B, Na, Ni, Se, Sb, V, and Zn caused by the installation of the engineered cover is presented in Table 6-76.

Table 6-76 Percent Reduction in PCoC Toe of Dump Leachate Concentrations Effected by the Engineered Cover for the worst case, 27 years after the Cover is Installed

PCoC	As	B	Na	Ni	Se	Sb	V	Zn
Year 27	70.89	67.9	68.95	71.00	72.36	70.64	67.2	75.82

The summary statistics for the WRD mass balance/PHREEQC models described herein are summarized as Table 6-77 for the period from cover installation to the end of the modelled period.

Table 6-77 Summary Statistics for the Mass Balance/Phreeqc Models Toe of Dump Maximum and Minimum Concentrations for the Period of Cover Installation Compared To Turkish, EU and Canadian Water Quality Standards

LOADING RATE	COVER?	Statistic	pH	F	As	B	Na	Ni	Se	Sb	V	Zn
		TURKISH	6.5 to 9	1.5	0.01	1	200	0.02	0.01	0.005		
		EU	6.5 to 9.5	1.5	0.01	1	200	0.02	0.01	0.005		
		CANADA	6.5 to 9					0.15			0.006	0.03
Base case	No	MAXIMUM	8.81	1.19	0.024	3.51	161	0.012	0.011	0.0016	0.042	0.098
(median)		Minimum	6.19	1.74E-01	0.0032	0.49	23	0.0015	0.0012	0.00021	6.1E-03	1.1E-02
Base case	Yes	MAXIMUM	8.93	0.47	0.012	1.85	88	0.0054	0.0051	0.00078	0.024	0.038
(median)		Minimum	5.72	3.80E-02	0.00070	0.11	5.03	0.00033	0.00026	4.583E-05	1.3E-03	2.5E-03
Worst case	No	MAXIMUM	9.65	1.27	0.17	16.15	875	0.076	0.078	0.017	0.23	0.12
(95th percentile)		Minimum	8.47	2.31E-01	0.015	1.60	84	0.0069	0.0064	0.0015	2.3E-02	9.6E-03
Worst case	Yes	MAXIMUM	9.58	0.70	0.060	6.74	348	0.027	0.038	0.0060	0.098	0.033
(95th percentile)		Minimum	8.41	1.60E-01	0.014	1.52	80	0.0065	0.0059	0.0014	2.2E-02	8.8E-03

In conclusion;

- The initially proposed waste rock cover design (local gravel) was determined from modelling to be inadequate;
- A waste rock cover design consisting of a ‘sandwich’ of a layer of local clay (0.5 m) between a capillary break layer of gravel (0.15 m) and an upper protective layer of gravel (0.1 m), the whole covered with overburden to provide a medium for re-vegetation was found by hydrogeological studies to be satisfactory;
- The Corakoglu waste rock dump (for both loading rate cases) were remodeled utilizing the proposed engineered cover design. The engineered cover was found to reduce PCoC leaching by between 66% and 75% for both the base and worst case loading rates.

6.8.2 Open Pit Lake

6.8.2.1 Potential Impacts of Pit Lake Water on the Gökırmak River

The proposed open pit will incorporate greenschist and mixed schist together with small proportions of mineralized vein waste or ore in the pit walls, floor and constructed benches. Mass balance/PHREEQC modelling of leachate chemistry was carried out in order to predict probable leachate chemistry and precipitate mineralogy in the proposed open pit for three closure scenarios:

- Scenario 1: both coffer dams remain (as during mining operations) and the pit is allowed to flood from rainfall and upwelling groundwater. The pit is expected to overflow into the Gökirmak River approximately 42 years after mine closure at 431 masl;
- Scenario 2: Coffer dams will be removed, but the river will remain diverted. The pit will flood with reduced rainfall input, and groundwater inflow. The flooded pit is expected to overflow into the Gökirmak River approximately 106 years after mine closure, at 426 masl; and
- Scenario 3: Both coffer dams will be removed and the pit will flood quickly (4 months to 2.5 years) with input from rainfall, upwelling groundwater and the Gökirmak river. The flooded pit overflow into the old course of the Gökirmak river at 426 masl.

The input to the mass balance/PHREEQC modelling, for all models, was the static and kinetic test data. Loading rates (mg/kg/L/year) were generated from the laboratory testing data and used, together with projected open pit geometry, hydrogeological modelling and known climatic data to estimate the waste rock loading. The estimated loading was then diluted using the climatic (rainfall and evaporation) data. The mass of precipitating phases were calculated and the resultant solution chemistry was equilibrated with the atmosphere in order to model pit lake and Gökirmak River chemistry.

Water quality of the pit lake was modelled for three scenarios.

- Scenario 1 resulted in pit sump/pit lake exceedances for pH, sulfate, F, Mn, Al, As, B, Fe, Pb, Na, Ni,Se, Sb, Cr, and Cd during both the opening years of mining and during pit lake flooding. The exceedant Al, As and Mn were persistent through much of the life of the pit sump/pit lake;
- Scenario 2 resulted in pit sump/pit lake exceedances for pH, sulfate, F, Al, As, B, Cr, Fe, Hg, Na, Ni, Pb, and Se during both the opening years of mining and during pit lake flooding. Al, As and Fe exceedances were somewhat persistent through the life of the pit sump/pit lake;
- Scenario 3 resulted in fewer parameter exceedances in the pit sump compared to the other scenarios (pH, sulfate, F, Al, As, Na, Ni, Se and Sb) and these only occurred during the initial few years of mining;

The potential impacts of pit lake water on the Gökırmak River was modelled. Mass balance/PHREEQC models were used to calculate predicted parameter concentrations in the Gokirmak River as the pit lake discharges into the river after the end of open pit flooding, following the end of mining operations at the end of year 13. Similar to the previous runs, three different scenarios were modelled;

Scenario 1; The summary statistics (maxima only presented as the minima are not exceedant) for both the base case and worst case loading rates are provided as Table 6-67. Sulfate data are also included as it is exceedant in the current Gokirmak River. Na concentrations, after the pit lake enters the river are exceedant, however, sulfate, which is naturally exceedant in the river, is diluted below the Turkish and EU standards by the pit lake water.

Table 6-78 Pertinent Gökırmak River Exceedances

Exceedant parameter	Statistic	Na	Sulfate	F
Turkish Standard		200	250	1.5
EU Standard		200	250	1.5
Base Case	Maximum	442	183	1.4E-05
Worst case	Maximum	442	183	0.20
Natural	Maximum	173	495	-

Scenario 2; Minimum sulfate concentrations in the Gokırmak River are markedly reduced to 183 mg/L for both loading rates; in other words the pit lake water dilutes the naturally exceedant sulfate and fluoride concentrations in the Gokırmak River as the pit lake eventually discharges into the river. Predicted Na concentrations are 442 mg/L for both the base case and worst case loading rates, which exceeds both the Turkish and EU regulatory guidelines.

Scenario 3; Only maximum sulphate concentrations (490 mg/L) in the Gokırmak river are predicted to exceed the Turkish and EU guidelines for the base case of scenario 3. The exceedant values are very close to the natural maximum sulfate concentrations in the river (495 mg/L). Only maximum pH values (9.54) are predicted to exceed for the worst case loading rate for scenario 3 and they are exceedant by only 0.04 pH units.

6.8.2.2 Potential Impacts of Open Pit Operations on Soil/Overburden

All soil/overburden from the footprint of the open pit will be removed prior to excavation of the open pit. The soil/overburden has been tested for its potential to generate ARD/ML and none of the samples were found to be potentially acid generating (Geochemico, 2016). The soil and overburden removed from the proposed location of the open pit is therefore safe for use in eventual remediation of the mine site and will be sequestered upgradient from the open pit at a dedicated dump for this purpose. The soil and overburden at the open pit location will therefore be completely unaffected by the open pit operations.

Geochemico (2017) report mass balance/PHREEQC modelling of all three scenarios (sections 5.0, 6.0, 7.0) and compare the pit lake discharge for both base case and worst case loading rates with Turkish and EU drinking water standards. It should be noted that comparison with drinking water standards is an extremely rigorous test as drinking water regulatory standards are much stricter than accepted mine discharge water quality regulatory standards. Of the 34 parameters modelled only three (Table 1) were found to exceed the drinking water

standards: Na for scenario 1 base case and worst case; Na for scenario 2 base case and worst case, and; sulfate for the scenario 3 base case and pH for the scenario 3 worst case. All other parameters modelled showed no exceedances compared to the rigorous drinking water standards and therefore will have no environmental impact on soils or overburden downstream of the open pit discharge.

Table 6-79: Summary of Gökırmak River Exceedances (Compared to Turkish and EU Drinking Water Regulatory Standards) for all Three Pit Lake Flooding Scenarios

SCENARIO	CASE	pH	sulfate	Na
1	Base case	-	-	442
	Worst case	-	-	442
2	Base case	-	-	442
	Worst case	-	-	442
3	Base case	-	490	-
	Worst case	9.54	-	-

The Gökirmak River naturally exceeds EU drinking water quality guidelines for sulfate (median 495 mg/l) concentration and therefore, although scenario 3 base case is exceedant compared to the Turkish and EU drinking water standards it represents an improvement in water quality compared to the baseline concentration of 495 mg/L. The exceedant scenario 3 base case sulphate will therefore gradually improve soil and overburden quality as the closed open pit discharge flowing along the Gökirmak river interacts with soil/overburden alongside and underneath the river.

The impact of the exceedant Na concentrations may be assessed by comparing the predicted Na concentrations with measured soil/overburden Na content. The maximum exceedant Na concentration in the river water is 442 mg/L whereas the maximum Na content of the soil is 29,900 mg/kg and the minimum Na content of the soil is 5,300 mg/kg (Geochemico 2016a). A typical soil along the route of the Gökırmak river therefore contains between 60 and 11 times the Na content of the river. As the higher Na content of the Gökirmak river (compared to baseline concentration) interacts with the soil and overburden along its route the increased Na will be adsorbed onto clay minerals and organic matter in the soil, gradually reducing the Na content of the river water. The cation exchange capacity (CEC) and, therefore the soil pH and its fertility, will not, however, be affected, since the CEC is affected only by changes in the concentrations of Ca, Mg and K (Cornell, 2007).

The predicted maximum pH of the Gökirmak river is 9.54 for scenario 3, which represents an exceedance of only 0.04 pH units compared to the EU framework drinking water quality standards (pH 9.5). The predicted pH is well within the expected modeling error of 0.1 pH units and is therefore not expected to have any significant environmental impact on soils or overburden downstream, especially when the adsorption of hydrogen ions onto clay minerals and organic matter is taken into account.

It must be concluded therefore that none of the proposed potential open pit closure scenarios will have a negative impact on soils or overburden downstream of the open pit.

6.8.2.3 Conclusions of Impact Assessment for Open Pit Lake

- Modeling of the environmental impact of the three scenarios on the Gokirmak river showed that scenarios one and two reduced the sulfate content of the river, but developed Na exceedance. Maximum pH values in the river, from scenario three, slightly exceeded the EU guidelines and the natural sulfate exceedance in the river was reduced very slightly;
- On balance, scenario 3 (allowing the Gokirmak river to flow through the open pit after closure, appears to be the optimal scenario, however, engineering aspects of the sedimentation should be investigated before selecting this option.
- The pit lake is extremely unlikely to contaminate the groundwater present in pore spaces of the host lithologies due to the upwelling of groundwater into the pit lake.

6.8.3 Tailings Storage Facilities

In case of any seepage event from the TSFs, the water within the tailings (TSF pore water) and the pore water of the host rock will interact. Modeling study for the characterization of geochemical interactions was done in consideration of Kepezkaya TSF's design information. Once the design of Bağdere TSF is completed, modeling study will be done for this facility as well.

The results of the geochemical interactions between these two fluids were modelled for Kepezkaya TSF using PHREEQC, to examine the potential extent of geochemical environmental impact caused by seepage from the Kepezkaya TSF, which is planned to contain tailings capable of generating acid rock drainage and metal leaching (ARD/ML).

Kinetic testing was carried out on one, one kg sub-sample of float tailings. The ninety-fifth percentile of the final five weeks of data generated from the humidity cell testing was used herein to estimate the probable pore water geochemistry of the tailings, once ARD/ML generation had reached equilibrium. The TSF pore water is the product of acid rock drainage, and is not only extremely acidic but also contains high concentrations of (and exceedant compared to Turkish and EU drinking water regulations) in pH,sulfate, Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Zn and Ni.

On the other hand the bedrock pore water estimated water quality was calculated as the median of shake flask extraction leachates from ten samples (plus two duplicate samples) of the sandstone/claystone collected from drill hole cores. The estimated bedrock pore water is circum-neutral and only exceedant in sulfate, compared to Turkish and EU drinking water quality standards.

The other important consideration, with respect to the geochemistry of the TSF pore water/bedrock interaction is the neutralization potential (NP) of the sandstone/claystone. The median NP for the 12 samples collected is 160 kg CaCO3/tonne; indicating a considerable carbonate content. Fe is also relatively high in the bedrock, with median content of 3.58 %.

6.8.3.1 PHREEQC Modeling Results of TSF Leachate/Bedrock Pore Water and Bedrock Geochemical Interaction

The series of dissolution and precipitation reactions discussed in the preceding section were modelled using PHREEQC, and the PHREEQC code used to achieve this. The PHREEQC modeling was conducted in pH stages, in order to obviate undesirable modeling feedback. The dissolution of calcite and the precipitation of mineral phases were then summed over the entire sequence of reactions and are presented as Table 6-68.

The volume of dissolved calcite required to bring the mixed pore water into equilibrium with the bedrock pore water (at pH 7.1) was found to be 1.28E-5 m3 L-1. The mineral phases found to precipitate from the mixed solution are detailed as Table 6-68. The minerals that are most likely to precipitate from the mixed solutions include: Ag2Se, barite, CoFe2O4, CuFeO2, CuSe, Fe(OH)2.7Cl0.3, hematite (or its precursors, lepidocrocite and ferrihydrite), SnSO4, alunite, diaspore, magnetite, MnHPO4, UO2, Cr2O3, FCO3 apatite, CdS, rhodocrosite, greenockite, sphalerite, and zinc carbonate.

The important fact to note from Table 6-68 is that the volume of precipitated minerals far exceeds the volume of dissolved carbonate.

Table 6-68 is based solely based on thermodynamic chemistry that is from a thermodynamic perspective it is highly likely that all of the listed minerals will dissolve or precipitate from the mixed solutions. The rapidity with which the identified minerals will dissolve or precipitate, however, cannot be determined by PHREEQC; it is determined from a knowledge of the kinetic (or rate of reaction) chemistry. The kinetics for most of the minerals identified in Table 6-68 has not yet been determined. The mineral phases identified by yellow highlighting are known to have rapid reaction kinetics. Calcite is known to react rapidly (within 60 to 100 seconds) in the presence of acidity.

Likewise, barite, lepidocrocite (precursor precipitant for hematite), and diaspore are all known to precipitate within approximately 300 seconds after appropriate thermodynamic conditions are achieved. It is a conservative measure, therefore, to only use the known rapidly reacting mineral phases in this assessment of the results of the mixing of TSF leachate and the bedrock pore water and the bedrock itself.

Table 6-80 PHREEQC calculated masses and volumes of dissolved and precipitated minerals as TSF leachate mixes with bedrock and bedrock pore water. Yellow highlighted minerals indicate those known to react rapidly from a kinetic perspective

MINERAL PHASE	MOLES/L	MINERAL FORMULA	MASS (g/L)	VOLUME (cm3/L)
Calcite (dissolved)	3.47E-03	CaCO3	3.48E-01	1.28E-01
PRECIPITATED PHASES				
Ag2Se	2.09E-09	Ag2Se	3.90E-07	5.41E-08
Barite	3.35E-08	BaSO4	7.83E-06	1.84E-06
CoFe2O4	7.90E-06	CoFe2O4	1.85E-03	3.64E-04
Cuprousferrite	1.32E-03	CuFeO2	2.00E-01	4.01E-02
CuSe	4.51E-08	CuSe	6.43E-06	9.18E-07
Fe(OH)2.7Cl.3	1.51E-02	Fe(OH)2.7Cl.3	1.70E+00	4.25E-01
Hematite	3.00E+01	Fe2O3	4.79E+03	9.10E+02
SnSO4	5.07E-08	SnSO4	1.09E-05	2.72E-06
Alunite	5.46E-05	KAl3(SO4)2(OH)6	2.26E-02	8.23E-03
Diaspore	1.46E-04	AlOOH	6.27E-03	1.93E-03
Magnetite	6.95E-04	Fe3O4	1.61E-01	3.12E-02
MnHPO4	5.86E-07	MnHPO4	8.84E-05	2.68E-05
Uraninite	1.28E-07	UO2	3.48E-05	1.29E-05
Cr2O3	1.36E-06	Cr2O3	2.07E-04	5.76E-05
FCO3Apatite	6.79E-09	Ca9.316Na0.36Mg0.144(PO4)4.8(CO3)1.2F2.48	6.52E-06	2.07E-06
Greenockite	8.67E-07	CdS	1.25E-04	2.59E-05
Rhodochrosite	2.48E-04	MnCO3	2.85E-02	7.70E-03
Sphalerite	2.69E-06	ZnS	2.62E-04	6.39E-05
ZnCO3:1H2O	2.31E-04	ZnCO3:1H2O	3.32E-02	7.48E-03
		TOTALS (PRECIPITATED LESS DISSOLVED)	4.79E+03	9.11E+02

The total volume of calcite that is required to dissolve to bring the mixed solutions to circum-neutral pH is 1.28 e-1 cm3 L-1. The total mass of rapidly precipitating mineral phases was found to be 9.11E2 cm3 L-1. The volume of rapidly precipitating mineral phases therefore greatly exceeds the volume of carbonate dissolved. The inevitable result of this is that the pore spaces within the bedrock will be occluded very rapidly after mixing of the TSF leachate and the bedrock and its pore water. The kinetics of the geochemical situation as the TSF leachate mixes with the bedrock and its porewater is presented as Figure 6-36.

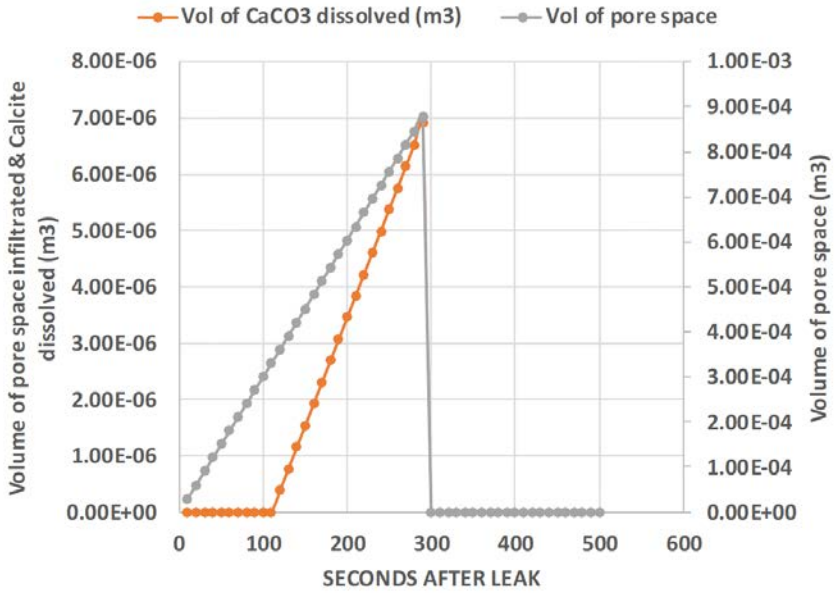


Figure 6-43 Graphical representation of the dissolution of calcite (orange line) and the volume of rapidly precipitating mineral phases with time (seconds) after mixing of TSF leachate and bedrock/bedrock pore water. The grey line shows the available volume of pore space within the bedrock host lithology

In other words, the geochemical reactions between the TSF leachate and the bedrock/bedrock pore water, consisting of initial carbonate dissolution followed by a marked rise in pH and subsequent precipitation of mineral phases within the bedrock pore spaces, will prevent any TSF leachate ever reaching an environmental receptor.

6.8.3.2 Potential Impacts of TSF on Underlying Soil/Overburden

Potential damages/defects in the impervious bottom liner of TSFs can create seepages from the bottom of the TSF that may penetrate to the underlying overburden. Potential seepages from the TSFs are directly related with (1) the quality of the material that was used during the construction, (2) the construction quality and (3) operational maintenance of the TSFs. The proposed design of TSFs include from bottom to top, 50 cm thick compacted clay layer overlain by 1 cm geosynthetic clay layer and a 2 mm thick high density polyethylene (HDPE) liner. The liner will be covered by 50 cm thick gravel, where drainage pipes with a diameter of 11 cm will be inserted. Although the HDPE liner is practically impervious, manufacturing and application errors may cause leakage and subsequent contamination of underlying soil and groundwater.

Geochemical reactions between the TSF leachate and the overburden and bedrock/bedrock pore water, consisting of initial carbonate dissolution followed by a marked rise in pH and subsequent precipitation of mineral phases within the overburden/bedrock pore spaces will minimize environmental impact to overburden or bedrock within a very small zone (less than one millimetre) below the TSF liner.

As shown in Figure 6-36, calcite will begin to dissolve within 100 seconds of the TSF leachate meeting the relatively high NP overburden and/or bedrock (orange line). The precipitating mineral phases lag behind the carbonate dissolution reaction, but as they begin to precipitate approximately 300 seconds after the time of initial mixture they rapidly fill all available pore spaces and prevent the TSF leachate from migrating further into either overburden or bedrock.

6.8.3.3 Conclusions of Impact Assessment for Kepezkaya TSF

The following conclusions may be drawn from the PHREEQC modeling performed for the Kepezkaya TSF.

- PHREEQC modeling of the interaction between the tailings and bedrock pore water and the bedrock mineralogy indicate that there will be an initial rise in solution pH as carbonate minerals in the bedrock lithologies are dissolved, followed by precipitation of numerous mineral phases within the bedrock pore spaces;

- Calculation of the rate of rapid dissolution of calcite as the tailings pore water meets bedrock and bedrock pore water, as well as the mass of rapidly precipitating mineral phases caused by the subsequent rise in pH of the groundwater, indicates that the bedrock pore spaces beneath a perforation in the geosynthetic liner will become clogged very rapidly, thus preventing further migration of the tiny contaminant plume;

Based on the PHREEQC modeling described above, it is extremely unlikely that any tailings seepage will migrate more than a very small distance from a geosynthetic liner perforation and therefore will be unable to cause any environmental impact regarding nearby environmental receptors.

6.8.4 Process Plant

The hydraulic conductivity of underlying overburden and bedrock are very similar to those observed below the Çorakoglu WRD. Therefore, the modelling carried out for the overburden below the WRD dump is also applicable to the overburden and bedrock below the process plant, although the water able to percolate into underlying overburden and bedrock is not expected to be of similar poor quality to the WRD pore water for a number of reasons:

- Ore stored at the process plant will only be present for a short period of time, in contrast to the WRD, where MVW, MS and GS are permanently stored for hundreds of years;
- Rainwater incident on the process plant area will be captured and diverted to settling ponds prior to treatment and discharge;
- Rainwater will be diverted away from storage locations, effectively preventing leaching of stored material; and,
- A perimeter ditch will capture any runoff, thus preventing lateral migration into nearby environmental receptors such as soils, overburden etc.

The potential for environmental impact of overburden and soils in the vicinity of the process plant is therefore considered to be much lower than that modelled for the Çorakoglu WRD, which has been demonstrated, in the discussion above, to cause a maximum impact (for sulfate) of approximately 1.38 relative percent.

6.8.5 Mitigation

Given that the issues addressed in above sections might potentially create impacts mainly on water quality, direct impacts of mining wastes and associated measures are provided under Water Resources, Section 6.7.3. As part of Project's mitigation plan, a comprehensive Mine Water Monitoring Program has also been prepared to prevent/minimize potential impacts on water resources (See Section 6.7.3). Monitoring requirements for the mining wastes has therefore been given within the Mine Water Monitoring Program in Section 6.7.3 as the mining waste-related impacts are mainly be observed in receiving waters, in terms of quality.

Mining wastes might also create potential impacts on soil/overburden that are situated beneath or in the near vicinity of the Project units. Potential impacts of mining wastes on soil and relevant mitigation measures are therefore presented in Section 6.3.2 for the Project Area soil/overburden.

6.9 Wastewater

This section of the Report assesses the potential impacts of domestic wastewater discharges during construction and operation phases of the Project in line with national legislation, EU Directive 91/271/EEC on Urban Wastewater Treatment and IFC EHS Guidelines as GIIP.

These discharge limits provided in the abovementioned relevant legislation are presented below. It should be noted that the reference method of measurements is also provided in the respective national legislation and EU Directive.

Table 6-81 Applicable Limits for Domestic Wastewater Discharge

	WPCR Table 21.1 Domestic Wastewater (BOD Load 5-120 kg/day; Population 84-2000)		**IFC General EHS Guidelines: Wastewater and Ambient Water Quality – Table 1.3.1 Indicative Values for Treated Sanitary Sewage Discharges**	**Directive EU 91/271/EEC on Urban WWT (discharge limits for agglomerations of 2000 p.e. and more)**
Parameter	**Limit (2 hr Composite Sample)**	**Limit (4 hr Composite Sample)**	**Limit [(a)]**	**Limit [(b)]**
BOD (mg/L)	50	45	30	25 (as BOD5, without nitrification)
COD (mg/L)	180	120	125	125
Total Suspended Solids (mg/L)	70	45	50	60
pH	6-9	6-9	6-9	-
Total Nitrogen (mg/L)	-	-	10	15 [(c)]
Total Phosphorus (mg/L)	-	-	2	2 [(c)]
Oil and Grease (mg/L)	-	-	10	-
Total Coliform Bacteria (Most Probable Number/100 ml)	-	-	400	-

(a) Sewage discharge from industrial facilities to surface waters. Averaging period not defined.

(b) Minimum % reduction in relation to the load of the influent is also given in Table 1 and Table 2 of the Directive. Reference methods for monitoring and evaluation fo results are given in Annex I to Directive 91/271/EEC. Flow-proportional or time-based 24-hour samples shall be collected at the same well-defined point in the outlet and if necessary in the inlet of the treatment plant in order to monitor compliance with the requirements for discharged wastewater laid down in the Directive 91/271/EEC.

(c) Applicable for 10,000 – 100,000 p.e. Note that Directive 98/15/EEC amending Table 2 of Annex I to Directive 91/271/EEC should be used. Total nitrogen means the sum of total Kjeldahl nitrogen (organic and ammoniacal nitrogen), nitrate-nitrogen and nitrite-nitrogen. Annual mean of the samples for each parameter shall conform to the relevant parametric values (Please refer to Annex I to Directive 91/271/EEC)

Project will comply with the stringent limits available (the averaging time and the method of measurement should be taken into account as well).

6.9.1 Construction Phase

During the construction phase of the Project, water is required for construction works, dust suppression and for domestic need of the personnel. Water that is used for construction activities and dust suppression will not return as wastewater. Therefore, only domestic wastewater is generated throughout the construction period of the Project.

According to Turkish Statistical Institute (TÜIK) Regional Statistics (2014) wastewater generation rate per person in Kastamonu Province is 144 liters/person-day. The number of personnel (peak) during the construction phase will be 798 people. Accordingly, the total wastewater generation during construction phase is estimated as follows:

0.144 m^3/person-day x 798 persons = 114.9 m^3/day (peak)

The wastewater generated is treated in three package wastewater treatment plants at the construction site. Two of the treatment plants have 40 m^3/day capacities each and the other one has 50 m^3/day capacity. Considering the 114.9 m^3/day peak capacity requirement for the construction phase, the existing capacity of treatment plants is sufficient to treat the wastewater generated.

Currently, the treated wastewater is discharged to Gökırmak River after the discharge limits of WPCR are satisfied. Wastewater analysis results are provided (for 50 m^3/day WWTP) below.

Table 6-82 Wastewater Quality Analysis

	WPCR Table 21.1 Domestic Wastewater (BOD Load 5-120 kg/day; Population 84-2000)		**WWTP Influent 11 Jan 2017 (Sample No. SA175383)**	**WWTP Effluent 11 Jan 2017 (Sample No. SA175384)**	**WWTP Influent 12 Jan 2017 (Sample No. SA175389)**	**WWTP Effluent 12 Jan 2017 (Sample No. SA175388)**	**WWTP Influent 13 Jan 2017 (Sample No. SA175394)**	**WWTP Effluent 13 Jan 2017 (Sample No. SA175395)**
Parameter	**Limit (2 hr Composite Sample)**	**Limit (4 hr Composite Sample)**	**2 hr composite sample**	**2 hr composite sample**	**2 hr composite sample**	**2 hr composite sample**	**2 hr composite sample**	**2 hr composite sample**
BOD (mg/L)	50	45	70	<10	35	<10	32	<10
COD (mg/L)	180	120	211.2	<40	99.2	<40	83.6	<40
Total Suspended Solids (mg/L)	70	45	100	<5	30	<5	30	6
pH	6-9	6-9	7.68	8.27	7.76	8.10	7.61	7.95

The Project currently fulfills the requirements as stipulated by WPCR Table 21.1.

6.9.2 Operation Phase

During the operation phase of the Project domestic wastewater will be generated due to the Project personnel. The number of peak personnel during operation will be 496. Thus, domestic wastewater generation will be:

0.144 m^3/person-day x 496 persons = 71.4 m^3/day

The generated wastewater will be treated in package wastewater treatment plants as in the case of construction period. The construction phase WWTPs will also serve the operation phase needs.

The treated wastewater will be discharged to Gökırmak River after the Project Standards are satisfied. The treated wastewater will be analyzed periodically to ensure the Project standards are met at all times

Identified impacts and mitigation measures for discharge of domestic wastewater are summarized below in Table 6-83 Table 6-84for the construction and operation phases of the Project.

Table 6-83 Domestic Wastewater Discharge Impact Summary for Construction Phase

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Discharge of treated domestic wastewater to Gökırmak River.	Living organisms and ecosystems	Low - Short term reversible - Restricted in geographical extent - Low in magnitude	Medium	Minor	-Monitoring of wastewater discharge periodically. -Maintenance/Improvement of process of treatment if the discharge parameter values are above limit values.	Negligible

Table 6-84 Domestic Wastewater Discharge Impact Summary for Operation Phase

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Discharge of treated domestic wastewater to Gökırmak River.	Living organisms and ecosystems	Low - Short term reversible - Restricted in geographical extent - Low in magnitude	Medium	Minor	-Monitoring of wastewater discharge periodically. -Maintenance/Improvement of process of treatment if the discharge parameter values are above limit values.	Negligible

6.10 Non-Mining Waste

This section of the Report assesses the potential impacts of non-mining waste generation during construction and operation phases of the Project.

Currently the construction phase non-mining waste management is done in line with the applicable national waste legislation as listed below. It should be noted that Annex 4 of the Regulation on Waste Management includes the waste codes which are entirely same with the European Waste Codes (EWC).

The related national legislation applicable to the Project is:

- Regulation on Waste Management, Official Gazette No: 29314 dated April 2, 2015
- Regulation on Control of Excavation, Construction and Demolition Waste, Official Gazette No. 25406 dated March 18, 2004
- Communique on Recovery of Some Non-Hazardous Wastes, Official Gazette No. 27967 dated June 17, 2011
- Communiqué on Temporary Waste Storage Facilities Official Gazette No. 27916 Date 26.04.2011
- Communique on Transportation of Wastes by Highway, Official Gazette No. 29301 dated March 20, 2015
- Regulation on Control of Waste Oils, Official Gazette No. 26952 dated July 30, 2008
- Regulation on Control of Waste Vegetable Oils, Official Gazette No. 29378 dated June 6, 2015
- Regulation on Control of Packaging Waste, Official Gazette No. 28035 dated August 24, 2011
- Regulation on Control of Waste Batteries and Accumulators, Official Gazette No. 25569 dated August 31, 2004
- Regulation on Control of Waste Tires, Official Gazette No. 26357 dated November 25, 2006
- Regulation on Control of Medical Waste, Official Gazette No. 29959 dated January 25, 2017
- Regulation on Control of End-of-Life Vehicles, Official Gazette No. 27448 dated December 30, 2009
- Regulation on Control of Waste Electrical and Electronic Equipment, Official Gazette No. 28300 dated May 22, 2012

AMI will continue management of Project related non-mining wastes in line with national legislation, EU Waste Framework Directive 2008/98/EC and IFC EHS Guidelines as GIIP.

6.10.1 Hazardous Waste

6.10.1.1 Construction Phase

The hazardous wastes expected to be generated during construction phase of the Project are listed below:

- Waste oils
- Waste vegetable oils
- Used batteries and accumulators
- Contaminated wastes (cables, PPEs, packages),
- Electronic wastes, fluorescents
- Medical wastes

The maintenance of construction vehicles and appurtenances is performed outside the construction site; at authorized services. In case it is inevitable to perform the maintenance of the construction vehicles on site, minor amount of waste oil can be generated at the site. These liquid wastes are collected in leak-proof and safe containers and stored in an area with a concrete surface and a proper secondary containment to prevent potential spills and leakages reaching to the soil and groundwater. "Hazardous waste" label is placed on the containers, which also indicate the amount of stored waste as well as the storage time of the waste.

There is a cafeteria at the construction site and vegetable waste oil is generated. Generated oil is collected in leak-proof containers, transported by licensed entities and sent to a licensed facility.

In addition to the liquid wastes, waste batteries and accumulators, electronic wastes, contaminated wastes are also generated during construction. These wastes are collected separately from domestic wastes and are transported by licensed companies and sent to licensed facilities.

There is an infirmary unit at the construction site, where medical waste is generated.Medical wastes are temporarily stored on site in line with the provisions of Regulation on Control of Medical Wastes. The special medical waste bags are allowed to be filled three fourths at most and roped tightly. If necessary, double bags are used for imperviousness. Medical wastes are collected and disposed of by authorized health services.

The Ministry of Environment and Urbanization (MoEU) has an online web based system for the declaration of hazardous wastes (TABS – Tehlikeli Atık Beyan Sistem/Hazardous Waste Declaration System). The HW declarations are made based on NACE codes of the facilities. The information inserted into the UATF (National Waste Transportation Form) should be registered into the TABS (it is accessed through https://online.cevre.gov.tr/).

Waste generators producing less than 1,000 kg of hazardous waste per month are exempted from a storage permit for storage areas/containers. However, if the waste generators produce 1,000 kg or more hazardous waste per month, then they must obtain a temporary storage permit for the storage areas/containers from the Provincial Directorate of Environment and Urbanization (PDoEU). A temporary storage permit is given permanently. If there are any modifications to the storage area, the permit must be renewed. The general specifications regarding the temporary storage area is also provided by the Ministry.

Hazardous wastes can only be stored in a temporary waste storage area for up to 180 days. Before the 180 day period expires, wastes must be sent to licensed waste disposal facilities.

Non-hazardous waste producers are not obliged to obtain a permit for temporary storage of waste. They may temporarily store non-hazardous wastes up to 1 year in the storage area. Before the 1 year period expires, wastes must be sent to a licensed disposal facility.

Regardless of the waste amount, i.e. for any hazardous waste amount, information related to the temporary storage area must be given in an Industrial Waste Management Plan. Industrial Waste Management Plan includes both hazardous and non-hazardous wastes. The Plan is obligatory for all facilities producing industrial waste. The format of the Plan is provided by the MoEU. The industrial waste generators submit their plans to the MoEU.

6.10.1.2 Operation Phase

The total amount of hazardous waste to be generated during the operation phase of the Project is not known yet. The filter cake from the processing plant will not be disposed of as waste but sold as a product.

The hazardous waste will be collected in a waste storage area constructed according to the specifications provided in the Turkish Waste Management Regulation. Transportation of the wastes will be done by licensed companies. The hazardous wastes will be sent to a licensed disposal facility. All health and safety precautions including for staff responsible for activities such as transport and temporary storage of wastes will be in place.

During the operation phase of the Project the main hazardous waste expected to be generated is waste oil from maintenance of the vehicles operating in the mining area. As in the construction phase, waste oil will be collected in leak-proof and safe containers and stored in an area with a concrete surface and a proper secondary containment to prevent potential spills and leakages reaching to the soil and groundwater. Proper labelling will be provided.

The vegetable waste oil from the cafeteria will be collected in leak-proof containers, transported by licensed entities and sent to a licensed facility.

An infirmary will also be present in the mining area during the operation phase. The medical wastes generated in the infirmary will be stored in special bags according to the specifications provided in Turkish Regulation on Control of Medical Wastes.

6.10.1.3 Closure Phase

During the closure phase, potential impacts of hazardous wastes are similar in type and scale to those associated with construction phase. Therefore, standards, impacts and mitigation provided for construction phase are also applicable for closure phase.

6.10.2 Non - Hazardous Waste

6.10.2.1 Construction Phase

During the construction phase, the following non-hazardous solid waste is generated:

- Recyclable solid wastes generated by workers (e.g. paper, glass, plastics, etc.);
- Organic solid wastes generated due to catering services provided for the employees;
- Construction wastes;
- Empty drums, cans, containers, etc. (according to the Turkish regulations, if they are used to contain hazardous chemicals, then the containers are considered as hazardous waste); and
- Scrap metal, packing material and cardboards, wood and timber scraps.

According to Turkish Statistical Institute Regional Statistics (2014) waste generation rate per person in Kastamonu Province is about 1.72 kg/day/person. The peak number of personnel during the construction phase is 798, thus total domestic waste generation is:

1.72 kg/person/day x 798 people = 1,373 kg/day

Recyclable wastes like cement bags, metal scraps, packing boxes and wooden crates, etc. is segregated from other wastes and stored temporarily on site for eventual recycling process. AMI currently works with a licensed company for the disposal of recyclable wastes. Any other solid wastes that are non-recyclable and non-hazardous are collected within closed containers and disposed by Hanönü Municipality.

6.10.2.2 Operation Phase

The peak number of personnel will be 496 during the operation phase of the Project. Thus, total domestic generation will be:

1.72 kg/person/day x 496 people = 853 kg/day

Similar to construction phase, non-recyclable and non-hazardous solid wastes will be collected within closed containers and these wastes will be disposed by Hanönü Municipality.

6.10.2.3 Closure Phase

During the closure phase, potential impacts of non-hazardous wastes are similar in type and scale to those associated with construction phase. Therefore, standards, impacts and mitigation provided for construction phase are also applicable for closure phase.

Identified impacts and mitigation measures for generation of non-mining waste during construction and operation phases of the Project are summarized below.

Table 6-85 Non-Mining Waste Generation Impact Summary for Construction and Closure Phases

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Potential negative impacts on soil and groundwater due to improper management of generated non-mining hazardous wastes	Living organisms and ecosystems	Medium -- Long term reversible - Restricted in geographical extent - Low in magnitude	Medium	Moderate	• Provision of appropriate storage areas including secondary containment where necessary • Segregation of hazardous and non-hazardous wastes at source, ensure proper storage conditions are in place including container types, labelling, classifying • Routine control of hazardous waste containers to ensure they are not damaged and no spill exists • Hazardous waste transportation and disposal by licensed companies • Implementation of the Waste Management and Pollution Prevention Plan • Training of staff on waste handling • Implementation of the Hazardous Materials and Chemical Usage Management Plan	Minor
Potential negative impacts on soil and groundwater due to improper management of generated non-mining non-hazardous wastes	Living organisms and ecosystems	Low - Short term reversible - Restricted in geographical extent - Low in magnitude	Medium	Minor	• Provision of appropriate storage areas including secondary containment where necessary • Segregation of hazardous and non-hazardous wastes at source, ensure proper storage conditions are in place including container types, labelling, classifying • Solid wastes that can be recycled will be separated and stored temporarily on site for eventual recycling process. • Solid wastes that are non-recyclable and non-hazardous will be collected and properly disposed via the Municipality. • Training of staff on waste handling • Implementation of the Waste Management and Pollution Prevention Plan	Negligible

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Loss of valuable material through improper waste management practices (losing recycling and reusing opportunities)	Ecosystems	Low - Short term reversible - Restricted in geographical extent - Low in magnitude	Medium	Minor	• Solid wastes that can be recycled will be separated and stored temporarily on site for eventual recycling process. • Implementation of the Waste Management and Pollution Prevention Plan	Negligible

Table 6-86 Non-Mining Waste Generation Impact Summary for Operation Phase

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Potential negative impacts on soil and groundwater due to improper management of generated non-mining hazardous wastes	Living organisms and ecosystems	Medium -- Long term reversible - Restricted in geographical extent - Low in magnitude	Medium	Moderate	- Provision of appropriate storage areas including secondary containment where necessary - Segregation of hazardous and non-hazardous wastes at source, ensure proper storage conditions are in place including container types, labelling, classifying - Routine control of hazardous waste containers to ensure they are not damaged and no spill exists -Hazardous waste transportation and disposal by licensed companies -Implementation of the Waste Management and Pollution Prevention Plan	Minor
Potential negative impacts on soil and groundwater due to improper management of generated non-mining non-hazardous wastes	Living organisms and ecosystems	Low - Short term reversible - Restricted in geographical extent - Low in magnitude	Medium	Minor	- Provision of appropriate storage areas including secondary containment where necessary - Segregation of hazardous and non-hazardous wastes at source, ensure proper storage conditions are in place including container types, labelling, classifying -Solid wastes that can be recycled will be separated and stored temporarily on site for eventual recycling process. -Solid wastes that are non-recyclable and non-hazardous will be collected and properly disposed via the Municipality. -Implementation the Waste Management and Pollution Prevention Plan	Negligible

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Loss of valuable material through improper waste management practices (losing recycling and reusing opportunities)	Ecosystems	Low - Short term reversible - Restricted in geographical extent - Low in magnitude	Medium	Minor	-Filter cake from processing plant will be sold as a by-product -Solid wastes that can be recycled will be separated and stored temporarily on site for eventual recycling process. -Implementation of the Waste Management and Pollution Prevention Plan	Negligible

6.11 Biodiversity

Mining has the potential to affect biodiversity throughout the life cycle of a project, both directly and indirectly. Direct or primary impacts from mining can result from any activity that involves land clearance (such as access road construction, exploration drilling, overburden stripping or tailings impoundment construction) resulting habitat loss, habitat fragmentation and habitat alteration or direct discharges to water bodies (riverine tailings disposal, for instance, or tailings impoundment releases) or the air (such as dust emissions). Direct impacts are usually readily identifiable. Indirect or secondary impacts can result from social or environmental changes induced by mining operations and are often harder to identify immediately.

6.11.1 Impacts

This section assesses the possible impacts of the Project of both directly due to mining and mining-associated (impacts of auxiliary or associated facilities such as ETL, access roads, office buildings, etc.) on biodiversity and living natural resources and provides the mitigation measures for these impacts.

The relationships between various mining activities of the Project and potential impacts on biodiversity that is modified from the illustrative example in Good Practice Guidance for Mining and Biodiversity, ICMM is given in Table 6-87.

Table 6-87 Potential Impacts on Biodiversity of Mining Activities on Various Stages

MINING ACTIVITIES	Exploration and construction	Early stages of exploration	Exploration drilling	Access road construction	Land clearance	Obtaining construction materials	Construction related infrastructure	**Construction of ancillary infrastructure**	Roads, rails & export infrastructure	Pipelines for slurries or concentrates	Energy/power and transmission lines	Water sources / waste water treatment	Transport of hazardous materials	**Ore processing and plant site**	Plant site, materials handling, etc.	Extraction and waste rock storage	Rock blasting and ore removal	Mine dewatering	Ore stockpiling	Hydrometallurgical processing	Use and storage of process chemicals	Tailings containment/disposals
POTENTIAL IMPACTS																						
Impacts on terrestrial biodiversity																						
Loss of ecosystems and habitats			x	x	x	x			x	x	x		x		x	x						x
Loss of rare and endangered species			x	x	x	x	x		x	x	x		x		x	x						x
Effects on sensitive or migratory species			x	x	x	x	x		x	x	x		x		x	x	x			x		x
Effects of induced development on biodiversity				x	x		x		x				x									
Aquatic biodiversity & impacts of discharges																						
Altered hydrologic regimes				x	x	x	x		x		x	x	x		x	x	x	x		x		x
Altered hydrogeological regimes			x			x										x	x	x		x		x
Increased heavy metals, acidity or pollution			x		x	x	x		x		x	x	x		x	x	x	x	x	x	x	x
Increased turbidity (suspended solids)			x	x	x	x	x		x	x	x	x	x		x	x	x		x	x		x
Risk of groundwater contamination			x			x	x		x	x		x	x		x	x	x	x	x	x	x	x
Air quality related impacts on biodiversity																						
Increased ambient particulates (TSP)			x	x	x	x	x		x		x		x		x	x	x		x			x
Increased ambient sulfur dioxide (SO2)							x				x		x									
Increased ambient oxides of nitrogen (NOx)							x				x		x									
Increased ambient heavy metals											x				x	x	x		x			x
Social interfaces with biodiversity																						
Loss of access to fisheries					x	x			x	x	x				x	x						x
Loss of access to fruit trees, medicinal plants					x	x	x		x	x	x				x	x						x
Loss of access to forage crops or grazing				x	x	x	x		x	x	x					x		x	x	x		x
Restricted access to biodiversity resources					x	x			x	x	x					x						x
Increased hunting pressures			x	x	x	x	x		x		x		x		x							
Induced development impacts on biodiversity				x	x	x	x		x		x		x									

Source: Good Practice Guidance for Mining and Biodiversity, ICMM

The Project impacts on biodiversity have been assessed under the following topics:

- habitat loss / alteration / fragmentation
- impacts on biodiversity elements due to water pollution, reduced water quality, changes in morphology and hydrology
- impacts on biodiversity elements due to emission of gaseous pollutants and dust
- impacts on biodiversity elements due to noise, vibration and lighting
- Impacts on biodiversity due to population growth and increased vehicular traffic
- introduction of invasive alien species, and
- bird and bat collisions with ETL.

The main biodiversity features (receptors) considered to be potentially affected from the Project are grouped as:

- Priority biodiversity features (PBF) (Plant and animal species)
- Critical habitat features (CHF) (Plant and animal species)
- Endemic plant species
- Important habitats (Broad-leaved forest, coniferous forest, mixed forest, transitional woodland-shrub and natural grasslands that are identified as natural habitats using the Corine Land Cover map)
- Gökırmak River (including the aquatic life)
- Ecosystem services

According to EBRD PR6 (Article 13), based on biodiversity assessments, if “significant, adverse and irreversible impacts” to PBF are identified, then Project activities should not be implemented unless:

- There are no technically and economically feasible alternatives
- The overall benefits outweigh the project impacts on biodiversity
- Stakeholders are consulted in accordance with PR 10
- The project is permitted under applicable environmental laws, recognizing priority biodiversity features
- Appropriate mitigation measures are put in place, in accordance with the mitigation hierarchy to ensure no net loss and preferably a net gain of priority biodiversity features over the long term to achieve measurable conversion outcomes

EBRD PR 6 requires the clients not to implement any Project activities in areas of critical habitat unless all of the following are met :

- No other viable alternatives within the region exist for development of the project in habitats of lesser biodiversity value;
- Stakeholders are consulted in accordance with PR 10 (Information Disclosure and Stakeholder Engagement);
- The project is permitted under applicable environmental laws, recognizing the priority biodiversity features;
- The project does not lead to measurable adverse impacts on those biodiversity features for, which the critical habitat was designated;

- The project is designed to deliver net gains for critical habitat impacted by the project;
- The project is not anticipated to lead to a net reduction in the population of any endangered or critically endangered species, over a reasonable time period; and
- A robust and appropriately designed, long-term biodiversity monitoring and evaluation program aimed at assessing the status of critical habitat is integrated into the client's adaptive management program.

Table 6-88 and Table 6-89 shows the Project status corresponding to these conditions in order not to have significant, adverse and irreversible impacts to PBF and CH respectively.

Table 6-88 Conditions to Operate in an Area Covering Priority Habitat Features

PR6 Condition (Article 13)	Project Status
There are no technically and economically feasible alternatives	As the Project is based on mine extraction, the open pit location is stable. The other Project units have been planned considering the location of the open pit (see chapter on Project Alternatives).
The overall benefits outweigh the project impacts on biodiversity	Overall benefits have been discussed and assessed under Project Alternatives section.
Stakeholders are consulted in accordance with PR 10	Stakeholder consultations have been carried out in line with PR10 within the scope of the SIA studies.
The Project is permitted under applicable environmental laws, recognising the priority biodiversity features	All the permits are in place. Moreover, the ones that will be required during the operation phase will be obtained as required.
Appropriate mitigation measures are put in place, in accordance with the mitigation hierarchy, to ensure no net loss and preferably a net gain of priority biodiversity features over the long term, to achieve measurable conservation outcomes.	In addition to the mitigation measures following mitigation hierarchy, the following will be in place: Biodiversity Management Plan (BMP); Biodiversity Action Plan (BAP), the Reforestation Plan to ensure no net loss and preferably a net gain of priority biodiversity features over the long term, to achieve measurable conservation outcomes.

Table 6-89. Conditions to Operate in a Critical Area

PR6 Condition	Project Status
No other viable alternatives within the region exist for development of the Project in habitats of lesser biodiversity value	As the Project is based on mine extraction, the open pit location is stable. The other Project units have been planned considering the location of the open pit (see chapter on Project Description and Project Alternatives for various options considered).
Stakeholders are consulted in accordance with PR 10	Stakeholder consultations have been carried out in line with PR10 within the scope of SIA studies.
The Project is permitted under applicable environmental laws, recognising the priority biodiversity features	All the permits are in place. Moreover, the ones that will be required during the operation phase will be obtained as required.
The Project does not lead to measurable adverse impacts on those biodiversity features for which the critical habitat was designated as outlined in paragraph 14	The Project Area is not located on a nationally protected or internationally recognised areas but determined to have a potential to affect critical habitats. The biodiversity features mentioned in Article 14 are assessed in Section 6.9.5.1 and a Project specific Biodiversity Action Plan will be prepared and implemented together with experienced external experts in order to ensure no net loss and ideally net gain
The Project is designed to deliver net gains for critical habitat impacted by the project	The BAP, Reforestation Plan and restoration activities within the scope of Mine Closure and Rehabiliation Plan will be designed also for delivering net gains in local level for the critical habitat impacted by the Project. Moreover, the replantation of the endemic flora species existing in the Project Area following the seed collection will be done enabling the increase population sizes of rare endemic flora.

PR6 Condition	Project Status
The project is not anticipated to lead to a net reduction in the population of any endangered or critically endangered species, over a reasonable time period	The EN plant species, Tuff Carnation and Bieberstein's Crocus determined to exist in the Project Area and its vicinity and one EN bird species, Egyptian Vulture is considered to exist based on the observations of the ornithologist studied the Project Area. · No nest of an Egyptian Vulture has been determined within the Project Area and it has a very large territory, the species is not anticipated to expose to a net reduction in its population especially together with the mitigation measures given in the following of this section. · The seeds of Tuff Carnation and Bieberstein's Crocus will be collected and sprinkled to the sloping forest clearings to the east of Sirkeköy although there will be no Project related activities at the locations where the species has been determined. More detail will be given BMP and BAP.
A robust and appropriately designed, longterm biodiversity monitoring and evaluation programme aimed at assessing the status of critical habitat is integrated into the client's adaptive management programme	The relevant long term biodiversity monitoring and evaluation programmes are integrated in AMI's adaptive management programme with additions as on-going update of BMP and BAP to be prepared.

The Project will be in compliance with the EBRD PR6 when the existing BMP is implemented and the Biodiversity Action Plan, Reforestation Plan and Restoration activities within the scope of the Mine Closure and Rehabilitation Plan are developed and implemented considering the abovementioned conditions.

Following, a table showing the mining activities corresponding to the potential biodiversity impacts evaluated regarding the recent status of the given activities of the Project is given (see Table 6-90).

Table 6-90 Potential Biodiversity Impacts per Mining Activities

Activity	Potential Impact	The Project Status of the Activity	Dates of Given Project Activity Status
Extraction	Loss of habitat, introduction of plant disease, siltation of watercourses	Land clearing for open pit has started and will continue during operation phase.	Extraction activities started in November 2016
Blasting	Smothering stomata, disturbance of fauna	Limited scale blasting operations for construction phase is ongoing. More frequent blasting will be conducted during operation phase. The method selected for controlled blasting operations uses delayed (ms) detonators, which results in smaller ground vibrations, noise and dust impacts compared to other methods.	Blasting activities started in March 2015 during Plant construction.
Digging and Hauling	Disruption of watercourses, impacts on aquatic ecosystems due to changes in hydrology and water quality, Dust and noise disturbance to the terrestrial species	Will start with operation phase and will continue during decommissioning phase.	Digging and hauling activities started in February 2015
Waste Management Activities	Loss of habitat or species, soil and water contamination, sedimentation, acid rock drainage, encouragement of pests, disease transfer, contamination of groundwater and soil	Started with construction activities, will continue during operation and decommissioning phases. There are 3 currently operational WWTPs for construction phase with sufficient capacity and there will be 3 operational WWTPs during the operation phase. The number of WWTPs will be increased if necessary. The production process does not require industrial waste water treatment. All generated waste will be disposed of by the Municipality or licensed disposal firms. No landfilling activities will be conducted.	Waste management activities started in February 2015

Processing / Chemical use	Loss of species (fish kills, for example) or reproductive impacts, soil pollution, water pollution and hence disturbance to terrestrial habitats and species.	During operation phase.	Processing activities and chemical use will start in April 2018
Tailings Management	Loss of habitat, toxicity, sedimentation, water quality and streamflow	During operation phase.	Management of tailings will start in July 2018
Air emissions	Loss of habitat or species	Started with construction activities, will continue during operation and decommissioning phases.	Started with the digging and hauling activities in February 2015
Building workshops, and other structures	Loss of habitat, contamination from fuel, waste disposal	Land clearing started with construction activities, other impacts may occur during operation and decommissioning phases.	Started in November 2015
Building power lines	Loss or fragmentation of habitat, bird/bat collision risk	Power lines have been built.	Power lines have been built in April, 2016
Provision of accommodation	Loss of habitat, sewage disposal and disease impacts pets, disturbance of wildlife	New structure and infrastructure have been built in order to support the accommodation of construction phase personnel.	Started in February 2015
Roads	Habitat loss or fragmentation, waterlogging upslope	There are finished, on-going and planned road constructions.	Road construction has started in May 2017 and will continue until January 2018
Population growth	Loss of habitat or species, stress on local and regional resources, pest introduction, clearing	Started with construction activities, will continue during operation and decommissioning phases.	Started in February 2015 together with the construction activities.
Water supply (potable or industrial)	Loss or changes in habitat or species composition	Starting with the construction activities.	Started in February 2015

Source: Good Practice Guidance for Mining and Biodiversity, ICMM (with minor changes and additions related to the Project)

According to the EBRD PR6 GN6, Biodiversity Management Plans (BMPs) and Biodiversity Action Plans (BAPs) are documents aiming to be practical work plans that capture all actions necessary to achieve desired project outcomes (such as no net loss/net gain) on biodiversity. They clearly capture the tasks, expected timelines, responsible parties and measures for success that allow these plans to be auditable. They allow for adaptive management in response to results from project monitoring and evaluation of mitigation measures.

Although two of them have overlaps in their intention and structure, there are significant differences. In general, a BMP is a compilation of all objectives and actions related to managing biodiversity risks within the overall ESMP. A BMP requires updates based on changing circumstances and information.

A BAP is a stand-alone plan that often builds on a BMP. However, it offers additional information. This generally includes a summary of biodiversity context, issues and partnerships. A BAP may also describe additional time-bound actions required of bringing the Project into compliance with PR6. Some of these actions could also include additional conservation actions to ultimately achieve no net loss/net gain conservation outcomes. Some elements of a BAP may need to be updated less frequently than a BMP. BAPs are typically required in projects where there are high biodiversity risks and/or a complex context (for example, when there are many stakeholders or complex issues).

In addition to the mitigation measures given below in this section, the existing BMP has been updated and will be implemented and a BAP will be prepared and implemented due to the Project's potential to affect the biodiversity within and the vicinity of the Project Area as given in detail in baseline section.

Below, in Table 6-91, a detailed explanation of each potential biodiversity impact (both mining-related and non-mining-related) is given. The methodologies, the surveys and studies based on of impact assessment of the components are also given in the table.

Table 6-91 Impact Assessment for Biodiversity and Living Natural Resources

Potential Impact	Description
Habitat loss and alteration (land clearing and removal/disturbance of topsoil)	During the construction phase of the Project, the vegetation present within the direct footprint of the Project units will be cleared and the topsoil will be removed for site preparation (for some units such as the Corakoğlu WRD, vegetation clearing will be conducted gradually during the operation phase). Top soil available at the Project sites (i.e. open pit, WRD, TSF, process plants, access roads, etc.) will be stripped before the start of construction activities. If not stored under suitable conditions, there would be a risk of losing vegetative structure of the soils. According to the results of the soil investigations and baseline studies, top soil thickness has been estimated as 50 cm for the agricultural lands and 10 cm for the forestlands found in the Project Area. In consideration of the footprint areas of the Project units total volume of the top soil to be stripped from the Project Area has been calculated as 566,000 m^3 According to the georeferenced data supplied by AMI referring to each Project unit given in the feasibility report dated June 2017, the habitat losses due to the Project activities has been calculated using Corine Land Cover map and ArcGIS and the results are as following; (i) non-irrigated arable land, (ii) rice fields, (iii) complex cultivation patterns, (iv) land principally occupied by agriculture with significant areas of natural vegetation, (v) broad-leaved forest, (vi) coniferous forest, (vii) mixed forest, (viii) natural grasslands, (ix) transitional woodland-shrub and (x) sparsely vegetated areas. The habitat loss due to the Project is evaluated within three different categories as following; · The polygons with Currently On-going Construction/Excavation Activity · The polygons of Planned Future Construction/Excavation/Extraction Activity · Limited area corresponding to the ETL pylons As first two categories are given in detail in Table 6-92, the third category has been considered to be almost negligible due to their small sizes.

Table 6-92 Land Cover Assessment due to Terrestrial Habitat Loss

Category of the Habitat Loss due to the Project	Corine Land Cover Code	CORINE Land Cover Class	Code (2016)	Habitat Loss / Alteration (ha)
The Habitats with Existing/ On-going Construction / Excavation Activity (Administrative buildings, Closed Ore Storage, Çorakoğlu WRD, Gökırmak Diversion System, Downstream Coffer Dam, Upstream Coffer Dam, Spillway, Kepezkaya TSF and Kepezkaya TSF Surface Soil Storage Area, TSF Pipeline, Küpeli Storage Area, Open Pit and Related, Ore Road, Process Plant, Process Plant – Surface Soil Storage Area)*	Agricultural areas	Arable Land	211, 212, 213	0.1
		Pastures	231	0
		Heterogeneous agricultural areas	241, 242, 243, 244	72
	Forests and semi natural areas	Forests	311, 312, 313	313.6
		Shrub and/or herbaceous vegetation associations	321, 322, 323, 324	25
The Habitats of Planned Future Construction / Excavation Activity	Agricultural areas	Arable Land	211, 212, 213	0.04
		Pastures	231	0

(Bagdere TSF, Topsoil Storage Areas)**		Heterogeneous agricultural areas	241, 242, 243, 244	0
	Forests and semi natural areas	Forests	311, 312, 313	4.3
		Shrub and/or herbaceous vegetation associations	321, 322, 323, 324	69
				484
* activities dated due to September 2017 ** activities to be conducted September 2017 onforward				

- The total habitat loss of both existing / on-going construction/excavation activity and the planned future construction/excavation activity is 484 ha.
- The habitat loss of forest and semi natural areas considering both the on-going and planned activities, the total area is 411.9 ha. As 317.3 ha of it consists of broad-leaved forests, coniferous forests and mixed forests while 94.6.of it consists of natural grasslands and transitional woodland-shrubs.

While the calculations of the habitat loss in general is much, the percentage of the loss is very low comparing to total surface area of the related habitats in Turkey. Therefore, the impact of habitat loss is considered to be high for the local biodiversity and low for Turkey in general. The implementation of the determined mitigation measures following in this section plays an important role for its residual impacts.

Local fauna might be directly impacted by the vegetation clearing and topsoil disturbance activities performed during site preparation.

In particular, species characterized by low mobility (Spur-thighed Tortoise, the juveniles of many fauna species) are not able to move ahead of construction and some individuals might be accidentally hurt/killed during the construction operations. The removal of vegetation will also involve the alteration of suitable habitats for many fauna species that use the vegetation as food (Brown Bear, Marbled Polecat, Greater White-fronted Goose, European Pond Turtle), shelter or nesting site (Common Quail, larks, wagtails).

The non-forest habitats will be back into its original stage as possible together with the Mine Closure Period with the restoration activities. The habitat loss on the forest areas will be compensated preferable by the lost species together with the Reforestation activities in an area that will be determined by the local governmental authorities. All these activities will be done considering the no net loss of habitats. These activities will apply for the flora species directly and will apply for the terrestrial fauna following the vegetation to be back to its original stage as possible.

Habitat fragmentation	The presence of mine facilities and new infrastructures, especially the haulage roads and access roads constructed for exploration drills cause habitat fragmentation for terrestrial species within the Project Area. The level of the impact of the fragmentation depends on the mobility and on the sensitivity of the species to anthropic disturbance.
Impacts on Aquatic Life due to Water Pollution, Reduced Water Quality, Changes in Morphology and Hydrology	During construction and operation, changes in local morphology and surface hydrology especially for Gökırmak River could occur in relation to the construction of Project facilities and progression of relevant operation phase activities such as gradual expansion of the WRD as more waste rock is stored. Along with the construction of river diversion system, the local morphology has changed and local surface drainage features are altered. In addition to that, the drainage system planned to prevent water from entering the Project units, such as the open pit and the WRDs, might increase the change in local morphology and soil erosion may occur. This is particularly the case on steep slopes and in the absence of adequate vegetation cover. However, changes have been done only within a very limited area and slope stability measures, which also act as measures against erosion have been implemented along the steep slopes by AMI as a mitigation. If not correctly mitigated and monitored, the localized erosion may indirectly impact flora and habitats outside the Project footprint. Local fauna may also be

	indirectly impacted by the degradation of habitat. loss of aquatic habitat, disruption of flow, reduced recharge of wetlands could reduce biomass of amphibians and availability of habitat for wetland birds. Waste rock material will be piled on the sidelong branches of the Gökırmak River that flow intermittently throughout the year. Any seepage water that may leach from the toe of the WRDs will be captured with sedimentation ponds and be discharged (if any) in accordance with the effluent discharge criteria specified by related national and EU legislation. Unless managed properly, the GCP will have potential impacts on the quality of groundwater and surface waters as there will be seepages that originate from WRDs. Waste rock material will be exposed to atmospheric oxygen and precipitation during the operational phase of the Project. As the precipitated water infiltrates through the waste rock, it will either infiltrate further through the unsaturated zone to the groundwater or discharges as seepage waters at the base of the waste rock piles. The former may create impacts on baseline groundwater chemistry while the latter alters the chemical quality of receiving surface waters.
Impacts on Aquatic Life due to Emission of Gaseous Pollutants and Dust	Construction and operation activities such as rock blasting, surface levelling and grading and the temporary stockpiling of resulting material, and transportation of soil, construction materials and the ore will cause emission of dust and gaseous pollutants (mainly NO_x and CO_2) to air. In particular, dust emissions could impact vegetation directly by covering leaf surface and indirectly through impacts on soil composition and structure (Farmer A.M., 1993). Dust can block stomata on the leaf surface, affect photosynthesis, respiration, transpiration, and may cause leaf injury symptoms. As a result, the productivity of plants can decline. With the consequent reduction in vegetation growth, abundance and species loss, fauna species that depend on them for food and shelter can be indirectly affected. An important amount of impact on the ecosystem services is considered to occur due to the dust emission both for terrestrial and aquatic biodiversity and natural resource receptors such as plant/crop/tree species that are grown for economic purposes, pasture, water, and fish locations that are benefitted by the local people. The dust and the chemicals in the air pathway include the inhalation and ingestion of animals, the water and soil concentrations.
Impacts on Aquatic Life due to Noise, Vibration and Lighting	All construction activities such as the operation of large machinery, transportation of construction materials, soil and rock movement, etc. generate noise and vibration. In addition, any rock blasting activities required during site preparation produce loud noise even though the use of delayed (ms) detonators and although limited in time. Operation phase activities, especially blasting and ore haulage will also cause noise and vibration impacts. Most fauna species, including birds, tend to habituate to constant steady noise and vibration levels, such as road traffic, even of a relatively high level, in the order of 70-80 dBA. Once animals become habituated to noise, especially when it is steady and associated with clearly non-threatening activities, they suffer very little adverse response. However sudden and discontinuous loud noises like rock blasting may cause an adverse response in many fauna species present in the surroundings of the construction site even though controlled blasting method that is used delayed (ms) detonators is used. In addition to the noise and vibration, lighting for security and extending work hours may disrupt animal behavior patterns, particularly for species active at night, early dawn or dusk.
Impacts on Biodiversity due to Population Growth and Increased Vehicular Traffic	Starting with the construction activities, the population growth and therefore, human related impacts on environment is inevitable. In particular, as the population density plays the most important role in shaping the socio-economic environment, Its effects are also felt on the natural environment. The population growth may lead to loss of habitat or species, stress on local and regional resources, pest introduction, invasive alien species introduction and etc. The construction of new roads and increase of traffic load in the Project Area and its vicinity may lead to accidental collisions with wildlife even if the event is expected to be unlikely. Road kill can have a significant impact on wildlife populations. Animals subject to road kill are attracted to roads for a variety of reasons. Reptiles and other ectotherms go there to bask in the sun, some birds use roadside gravel to aid their digestion of seeds, mammals go to eat de-icing salts, browsing herbivores are attracted to the vegetation of roadside edge, rodents proliferate in the artificial grasslands of road verges, and many large mammals find roads to be efficient travel ways. Songbirds come to dust bathe on dirt roads, where they are vulnerable to vehicles as well as predators. Vultures, crows, foxes and other scavengers seek

	out roadkill and often become roadkill themselves. Therefore, increased vehicular traffic may result in a direct mortality for fauna species.
Introduction and Spread of Alien Species	The accidental introduction of invasive alien species, particularly flora species, could potentially have an adverse indirect effect on flora, fauna and habitats, although the probability of this impact is expected not to be high. Removal of natural vegetation cover and soil disturbance could facilitate the spreading of invasive alien (non-native) species accidentally introduced. These species tend to have an advantage in disturbed ecosystems, and if they penetrate into a habitat they can potentially change its functionality and species composition, including priority biodiversity species. Local fauna that depend on those ecosystems could also be indirectly affected. Although unlikely to occur and usually localized to areas of disturbed soil and vegetation, this impact could have a potential long term duration on flora, fauna and ecosystems.
Bird and Bat Collisions with ETL	As relatively different from the rest of the Project components, the ETL part of the Project could potentially have an impact especially on birds and bats. The combination of the height of transmission towers and distribution poles and the electricity carried by transmission and distribution lines can pose potentially fatal risk to birds and bats through collisions and electrocutions. Avian collisions with power lines can occur in large numbers if groups are traveling at night or during low light conditions (e.g. dense fog). In addition, bird and bat collisions with power lines may result in power outages and fires.

6.11.2 Mitigation

The actions undertaken at sites should be designed to outweigh the inevitable disturbances and impacts associated with mining and mineral processing. It should be aimed to achieve the following goals:

- Avoiding unacceptable impacts to biodiversity
- Reducing the impacts that may occur
- Restoring impacted ecosystems
- Compensating for residual impacts through offsets
- Seeking additional opportunities to contribute to local conservation

This approach is identified as the “mitigation hierarchy”. Mitigation efforts are expected to follow a mitigation hierarchy described in EBRD Guidance Note for PR6, starting with avoidance, minimisation, restoration and, finally, offsetting.

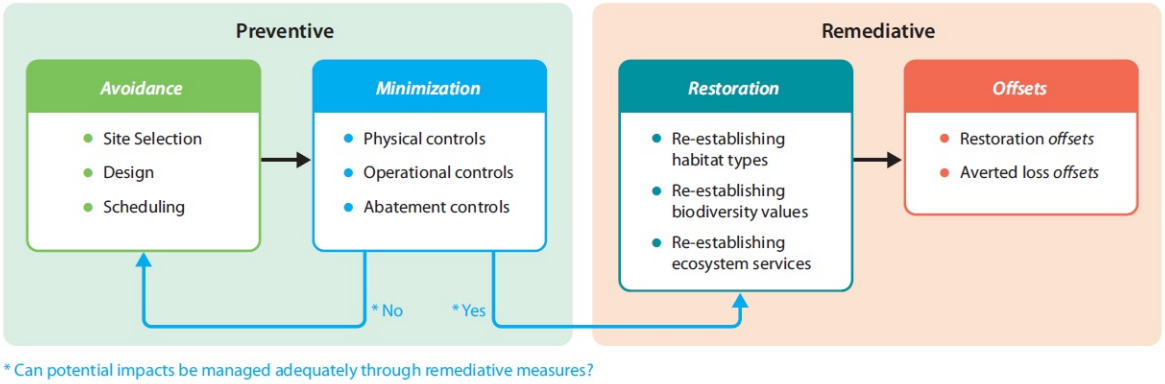


Figure 6-44 Schematic Diagram Showing the Implementation of the Mitigation Hierarchy

- **Step 1: Avoidance** includes activities that change or stop actions before they take place, in order to prevent their expected negative impacts on biodiversity and decrease the overall potential impact of an operation. For example, adjusting the location, scope or timing of a development could avoid negative impacts to a vulnerable species or sensitive ecosystem. Avoidance not only makes good business sense, for example by reducing later steps in the mitigation hierarchy, but is imperative for protecting the integrity of valuable and threatened biodiversity and ecosystem services
- **Step 2: Minimisation** measures are taken to reduce the duration, intensity, extent and/or likelihood of impacts that cannot be completely avoided.
- **Step 3: Restoration** involves altering an area in such a way as to re-establish an ecosystem’s composition, structure and function, usually bringing it back to its original (pre-disturbance) state or to a healthy state close to the original. This is a holistic process aiming to return an ecosystem to a former natural condition and to restore ecological function. Restoration is preferred to rehabilitation which implies putting the landscape to a new or altered use to preserve a particular human purpose.
- **Step 4: Biodiversity offsets** are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate avoidance, minimisation and restoration measures have been taken. Biodiversity offsets are effectively a ‘last resort’. A biodiversity offset should be designed and implemented to achieve measurable conservation outcomes that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity; however, a net gain is required in critical habitats – habitats with high biodiversity value, as defined by EBRD.

As the offsetting is a later process in the case of the determination of the necessity and to be implemented within the frame of the relevant management and action plans. The offsetting measures will be defined if and when necessary following the results of the monitoring and management activities suggested in the BMP and the actions given in the BAP.

The mitigation measures listed below follow the mitigation hierarchy and are proposed for the on-going and the future processes of the all Project related activities and considering the impacts determined within this report related to biodiversity.

It should be noted that the mitigation measures identified in the following sections are biodiversity component and site specific mitigations and the mitigation measures identified related to air, water, soil and relevant components for a healthy environment mentioned within the relevant sections and the ESMP.

A Project specific BAP will be prepared and implemented. In addition, the existing BMP as a living document has been updated in the extent of the ESIA Disclosure Package.

BAP is a document that typically includes a series of goals, objectives and management measures to mitigate residual impacts to achieve no net loss/net gains of especially critical habitat triggering features. The goal/objectives should outline a series of actions and include completion indicators or monitoring targets, and the responsible party and a time frame. BAPs should be developed in consultation with relevant stakeholders, including government, external experts, local/international conservation organisations and Project-affected communities.

The features specific (critical habitat triggering features) actions following the steps of the mitigation hierarchy will be given in detail in the BAP.

The scope of the BAP and the BMP also covers the major ecosystem services issues. Predicting Project impacts on biodiversity and ecosystem services over the long term is a complex process and therefore, the adaptive management should be adopted in which the implementation of mitigation and management measures are responsive to changing conditions and the results of monitoring throughout the Project's lifecycle.

The impact mitigation measures given below in Table 6-93 cover the all activities of AMI, including the contractor activities.

Both the below given measures and the Project specific BMP, BAP, Reforestation Plan and Restoration activities within the scope of the Mine Closure and Rehabilitation Plan will serve the role for No Net Loss on biodiversity and preferably Net Gain if possible (see Section 5.9.5.1 for detailed Critical Habitat Assessment).

Since the details of the impacts categorised within certain topics are written inTable 6-91, they are given as main topics in Table 6-93. In addition to that, it should be noted that most of the mitigation measures for ecosystem services are parallel to the other receptors since the ecosystem services depend on these other five main receptors and the general monitoring plan related to the main receptors and other biodiversity subjects are given in the ESIA.

Table 6-93 Mitigation Measures for Biodiversity Impacts

Impact	Receptor	Magnitude	Sensitivity / Value of Resource / Receptor	Impact Significance	Mitigation Measure	Residual Impact
Habitat loss / alteration / fragmentation	-PBF -CHF -Endemic plant species -Important habitats -Gökırmak River -Ecosystem services	High -Loss of resource and quality and integrity of resources -Irreversible -Long-term duration -Wide in geographical extent -High magnitude -Continuous	High	Major	**Avoidance** • Avoidance of damage caused to natural vegetation and habitats if not absolutely required by Project activities. • Temporary facilities will be carefully sited. The design of the WRDs has been optimized and the area to be used has been decreased following the updated feasibility report dated June 2017 comparing to the previous Project unit alternatives. • Pre-construction checks (surveys) by a qualified biodiversity expert will be carried out immediately prior to ground disturbance of the possible future construction/excavation/ habitat alteration activities to confirm that the biodiversity baseline as reported in the ESIA (Volume I) has not changed significantly and that there are no additional features that will be avoided. • Where applicable, fencing will be installed during the construction and operation areas to secure areas with priority biodiversity features. Currently, the open pit, closed ore stock area, downstream cofferdams and partially Çorakoğlu WRD are fenced following the topography lines. When necessary (during ore storage period) the active mining areas, WRDs, Process Plant, TSFs and where the heavy machinery will be operating will be fenced. • AMI will ensure that the areas of construction/ excavation activities are unsuitable for nesting birds (for example by using bird repellent tape) ahead of the nesting season (around mid-end April). • No further changes to the Gokimark riverbed introduced. • Further disruption of the natural drainage systems will be avoided. **Minimisation** • A Project specific Biodiversity Management Plan will be developed and implemented to address any potential impacts on priority biodiversity features. • Tuff carnation, Bieberstein's Crocus and the endemic plant species that are present within 100 m from the Project facilities, and therefore potentially subject to indirect impacts, will be monitored and conservation actions detailed in the Biodiversity Management Plan will be taken to address any potential impacts on critical habitats. • There are 4 culverts planned to be built along the ore haulage road at the locations where the road coincides with the riverbed. Although the aim of the culverts is the surface run off, they are considered to be efficient also for the use of reptiles and small mammals to minimize the effects of habitat fragmentation. • Direct impacts on the important habitats will be limited to the areas cleared during site preparation, corresponding to the mine facilities, roads, pipeline footprints and lay down areas temporary occupied during construction. • The fauna species with limited mobility that cannot move ahead of construction (such as Spur-thighed Tortoise) will be translocated to the closest undisturbed suitable areas by an assigned person(s) or sufficient time will be allowed for these species' mobility.	Moderate

Impact	Receptor	Magnitude	Sensitivity / Value of Resource / Receptor	Impact Significance	Mitigation Measure	Residual Impact
					• Awareness training for relevant personnel in order to raise awareness of the critical habitats and priority biodiversity features will be conducted. It will include every possible wildlife-human conflicts in order to minimise the possible harm to both sides. • An animal rescue procedure will be developed for the safe translocation of any faunal species found to be at risk from mining operations or posing a threat to mine operations. • If during pre-construction survey nests are observed, AMI will undertake their best efforts to preserve the vegetation in place; **Restoration** • The seed collection will need to commence at least a year or two before the seed is actually used, so that the volumes needed and the collection sources can be identified. Wherever possible, local species will be used, and seed will be collected locally, because it will usually be best adapted to the conditions, and this will avoid introducing different genetic provenances. After collection, seed must be cleaned and stored under conditions that will maintain maximum viability over the period of storage and that minimize damage due to pests, fungi, and so on. Details are included in the Biodiversity Management Plan and Biodiversity Action Plan • Effective site preparation will be implemented. • (Effective site preparation refers to the procedures that take place prior to seeding or planting to help ensure that optimal conditions exist for the establishment of healthy, botanically diverse and sustainable vegetation. These procedures include soil and waste characterization, selective handling of materials, construction of stable landforms, topsoil handling, ripping, fertilizing and soil amendment and seed bed preparation, e.g. scarifying). • A Reforestation Plan and a Mine Closure and Rehabilitation Plan will be developed and implemented **Biodiversity Offset** · To be identified following the appropriate avoidance, minimisation and restoration measures are taken and following the further monitoring since off-set measures are to compensate for significant residual adverse biodiversity impacts arising from project development and persisting.	
Impacts on Biodiversity due to Population Growth and Increased Vehicular Traffic	-PBF -CHF -Endemic plant species -Important habitats -Gökırmak River -Ecosystem services	High -Long-term duration, -Restricted in geographicale xtent, -high magnitude	Medium	Major	**Avoidance** • The damage caused to natural vegetation will be avoided , if not absolutely required by Project activities. • Trainings (including the possible wildlife human conflict) will be provided to relevant personnel in order to raise awareness of the PBF, critical habitats and endemics. Training records that will follow the training programme as suggested in the BMP will be kept. • Hunting and collection of wildlife animals will be forbidden. • Collection of wildlife plants and especially the endemic and protected ones will be forbidden. • The construction areas will be properly marked up with banning off-road driving or banning waste disposal in undesignated areas, in order to avoid/reduce the impact outside the construction areas.	Moderate

Impact	Receptor	Magnitude	Sensitivity / Value of Resource / Receptor	Impact Significance	Mitigation Measure	Residual Impact
					• All vehicles will drive on designated routes unless otherwise authorised; • All vehicles will follow the installed speed limits **Minimisation** • The activity that might affect the river conditions (such as oxygen deficiency due to turbidity) will be avoided when possible. • The mitigations related to biodiversity due to changes on water resources, geological and hydrogeological impacts on surface water as given in detail in related sections of this report will be implemented. • Waste rock seepage waters will be captured and controlled in sedimentation ponds and monitored prior to discharge, if any. Depending on its chemistry, seepage water will be treated in compliance with the discharge limit values specified by related national and EU legislation. • Further disruption of the natural drainage systems will be avoided. • Air quality measures specified in this report will be implemented. • Animal crossing signs will be placed on the access roads. • The fauna species with limited mobility that cannot move ahead of construction (such as Spur-thighed Tortoise) will be translocated to the closest undisturbed suitable areas by an assigned person(s) or sufficient time will be allowed for these species' mobility. • There are 4 culverts planned to be built along the ore road at the locations where the road coincides with the riverbed. Although the aim of the culverts is the surface run off, they are considered to be efficient also for the use of reptiles and small mammals to minimize the effects of habitat fragmentation. • Awareness training for relevant personnel in order to raise awareness of the critical habitats and priority biodiversity features will be conducted. It will include every possible wildlife-human conflicts in order to minimise the possible harm to both sides. • An animal rescue procedure will be developed for the safe translocation of any faunal species found to be at risk from mining operations or posing a threat to mine operations. **Restoration** • Effective site preparation will be implemented. • (Effective site preparation refers to the procedures that take place prior to seeding or planting to help ensure that optimal conditions exist for the establishment of healthy, botanically diverse and sustainable vegetation. These procedures include soil and waste characterization, selective handling of materials, construction of stable landforms, topsoil handling, ripping, fertilizing and soil amendment and seed bed preparation, e.g. scarifying). • A Reforestation Plan and a Mine Closure and Rehabilitation Plan will be developed and implemented (see Reforestation Section below for the fundamental requirements for the plan). **Biodiversity Offset** · To be identified following the appropriate avoidance, minimisation and restoration measures are taken and following the further monitoring since off-set measures are to compensate for significant residual adverse biodiversity impacts arising from project	

Impact	Receptor	Magnitude	Sensitivity / Value of Resource / Receptor	Impact Significance	Mitigation Measure	Residual Impact
					development and persisting.	
Impacts on biodiversity elements due to water pollution, reduced water quality, changes in morphology and hydrology	-PBF -CHF -Endemic plant species -Important habitats -Gökırmak River -Ecosystem services	High -Long-term reversible -Long-term duration -Restricted in geographical extent -High Magnitude	Medium	Major	**Avoidance** • Currently, the open pit, closed ore stock area, downstream cofferdams and partially Çorakoğlu WRD are fenced following the topography. When necessary (during ore storage period), the active mining areas, WRDs, Process Plant, TSFs and where the heavy machinery will be operating will be fenced. • Where applicable, fencing will be implemented during the construction and operation areas and especially where these features exist in order to reduce the risk of footprint. Avoidance of damage caused to natural vegetation, if not absolutely required by Project activities • The remaining riverbed will not be altered and no siltation will be allowed for the period of the water flow. • The activity that might affect the river conditions (such as oxygen deficiency due to turbidity) will be avoided whenever possible. • The mitigation measures related to biodiversity due to changes in water resources, geological and hydrogeological impacts on surface water as given in detail in related sections of the ESIA report will be implemented. • Waste rock seepage waters will be captured and stored in sedimentation ponds and monitored prior to discharge, if any. Depending on its chemistry, seepage water will be treated in compliance with the discharge limit values specified by related national and EU legislation. **Minimisation** • A Project specific BAP will be developed and implemented. • There are 4 culverts planned to be built along the ore road at the locations where the road coincides with the riverbed. Although the aim of the culverts is the surface run off, they are considered to be efficient also for the use of reptiles and small mammals to minimize the effects of habitat fragmentation. • Collection of wildlife plants and especially the endemic and protected ones will be forbidden. • Direct impacts on the important habitats will be limited to the areas cleared during site preparation, corresponding to the mine facilities, roads, pipeline footprints and lay down areas temporary occupied during construction. • The water flow in the tunnel will be no less than 25 cm/s in order to ensure the suitable flow rate of the original river environment for the fish species living in the river. • Changes in the riverbed were done only within a limited area with slope stability measures in place that will be maintained. **Restoration** • Effective site preparation will be implemented. • (Effective site preparation refers to the procedures that take place prior to seeding or planting to help ensure that optimal conditions exist for the establishment of healthy, botanically diverse and sustainable vegetation. These procedures include soil and waste characterization, selective	Moderate

Impact	Receptor	Magnitude	Sensitivity / Value of Resource / Receptor	Impact Significance	Mitigation Measure	Residual Impact
					handling of materials, construction of stable landforms, topsoil handling, ripping, fertilizing and soil amendment and seed bed preparation, e.g. scarifying). • A Reforestation Plan and a Mine Closure and Rehabilitation Plan will be developed and implemented **Biodiversity Offset** • To be identified following the appropriate avoidance, minimisation and restoration measures are taken and following the further monitoring since off-set measures are to compensate for significant residual adverse biodiversity impacts arising from project development and persisting.	
Impacts on biodiversity elements due to emission of gaseous pollutants and dust	-PBF -CHF -Endemic plant species -Important habitats -Gökırmak River -Ecosystem services	Medium -Short-term reversible, -Medium term duration, -Restricted in geographical extent, -Low magnitude	Medium	Moderate	**Avoidance** • Dust management control measures specified in this report will be implemented. **Minimisation** • A Project specific BMP and BAP will be developed and implemented. • The controlled blasting operation uses delayed (ms) detonators method is selected resulting in smaller ground vibrations, noise and dust impacts compared to other methods. • All vehicles will drive on designated routes unless otherwise authorised.	Minor
Impacts on biodiversity elements due to noise, vibration and lighting	-PBF (mainly the animal species) -CHF (mainly the animal species) -Important habitats -Gökırmak River	Medium -Long term reversible, -Long term duration, -Wide in geographical extent, -Low Magnitude	Medium	Moderate	**Avoidance** • AMI will ensure that the areas of construction/ excavation activities are unsuitable for nesting birds (for example by using bird repellent tape) ahead of the nesting season (around mid-end April) in order to avoid damages on these animals. • Activities resulting in disturbing amount of noise, vibration and lighting (such as blasting and activities of the large vehicles) will be limited at night and measures will be in place as discussed in relevant sections within respective sections of the ESIA reports. **Minimisation** • The controlled blasting operation uses delayed (ms) detonators method is selected resulting in smaller ground vibrations, noise and dust impacts compared to other methods.	Minor
Introduction of invasive alien species	-PBF -CHF -Endemic plant species -Important habitats -Gökırmak River -Ecosystem services	Medium -Long term reversible, -Short term duration, -Wide in geographical extent, -Low	Medium	Moderate	**Avoidance** • Avoidance of damage caused to natural vegetation and habitats if not absolutely required by Project activities. • Temporary facilities will be carefully sited. • Trainings (including the possible wildlife human conflict) will be provided to relevant personnel in order to raise awareness of the PBF, critical habitats and endemics. Training records that will follow the training programme as suggested in the BMP will be kept. • Collection of wildlife plants and especially the endemic and protected ones will be forbidden. • As the Project activities are intense and in a relatively large scale, site surveys will be conducted	Negligible

Impact	Receptor	Magnitude	Sensitivity / Value of Resource / Receptor	Impact Significance	Mitigation Measure	Residual Impact
		Magnitude, (since no current introduction of IAS is determined due to Project related activities, the magnitude is given considering the worst case.)			in order to monitor the Project area for the possible existence of invasive alien species every 2 year in suitable seasons for terrestrial flora and fauna and aquatic life (ideally in spring season) as outlined in the BMP	
Bird and bat collisions with ETL	Bird and bat species	High -Irreversible, -Long-term duration, -Restricted in geographical extent, -High magnitude	Medium	Major	Since the ETL has already been built, the measures start from the minimisation step. **Minimisation** • Bird and bat monitoring surveys will be conducted following international standards in order to define the relevant mitigation measures within the monitoring reports following the results of the surveys detailed in the BMP and BAP. Carry out collision monitoring during important seasons for birds in the Project Area (winter, spring and summer) and bats (spring, summer and autumn), and introduce bird and bat repellent devices if required based on monitoring results.	Moderate

Outline of the Planned Reforestation Activities

An outline of the planned reforestation activities has been developed as a part of the ESIA to meet the requirements of the mitigation hierarchy described in EBRD PR6 (paragraph 5, footnote 9), outlining a no net loss and net gain. This Framework defines the process to be followed for the planned voluntary reforestation activities of AMI.

The reforestation processes in Turkey is under the authority and control of the Ministry of Forestry and Water Affairs (General Directorate for Afforestation). At the local level, Regional Forestry Directorates and their sub-directorates are responsible from the relevant processes.

The national Forest Law (numbered 6831) and the regulations promulgated under the Law, defines the procedures to be followed for reforestation activities. In this scope, private companies, who are willing to conduct reforestation activities (on a voluntarily basis) on forest lands that are under the responsibility of forestry authorities, are provided by legislation with two main alternatives as follows:

- Establishment of Memorial Forests:

In this alternative, on behalf of the company, reforestation is conducted by the Regional Forestry Directorate in a previously designated area (can be in the same province or the district), where the related costs are born by the company. Area to reforested is decided in coordination with the Regional Forestry Directorate. Signboards can be placed at the memorial forest area after reforestation in line with the relevant provisions of the applicable law and regulations. The company does not have any right on the forest products from the trees to be planted in this alternative.

- Private Reforestation:

Private reforestation is conducted on degraded forest lands (where existing canopy cover rate is lower than 10%) that are under the authority of Forestry. In this alternative, area to be reforested is to be identified by the company in consultation with the local communities. If found suitable by the authorities, the area is then allocated to the company for being reforested within an agreed schedule. The company, in coordination with the Regional Forestry Directorate, may involve in the selection of the type of trees to be planted. Forest products from the trees to be planted in this alternative will belong with the company who conducts private reforestation, while the land ownership still remains with the Ministry.

AMI can select one of the two alternatives or a combination of both for their planned reforestation activities. However, regardless of the selected alternative, a Reforestation Protocol has to be made with the related Regional Forestry Directorate, in this case Taşköprü Forestry Directorate. Accordingly, the process that will be initiated with AMI's official application in line with this Reforestation plan Framework is summarized below:

1. AMI will apply to Kastamonu Regional Forestry Directorate with an official letter stating its willingness to conduct voluntary reforestation activities and allocation of available and suitable forestlands that can be reforested.

2. Regional Forestry Directorate, in consultation with the Ministry of Forestry and Water Affairs, will evaluate the application and identify potential areas (can be separate areas) that can be reforested in accordance with the selected reforestation alternative (can be a combination of both).

3. Based on the areas proposed by the Regional Forestry Directorate, AMI will select the suitable reforestation alternative(s) in terms of location of reforestation area proposed by authorities, costs, etc.

4. A Reforestation Protocol will be signed between AMI and the Ministry of Forestry and Water Affairs/Regional Forestry Directorate (the party will depend on internal procedures). Species to be used for reforestation, their ages and abundances will be identified by the authorities of the within this Protocol in consultation with AMI and their flora and fauna consultants. A reforestation programme (can be evened out within a period of a couple of years) will also be developed by the authorities in consideration of their own Forestry Management Plans and this programme will be specified in this Protocol. The Protocol will also clearly define the roles and responsibilities of the Regional Forestry Directorate and the AMI.

5. AMI will implement reforestation activities in accordance with the Protocol signed with the Ministry of Forestry and Water Affairs/Regional Forestry Directorate and under the control and supervision of the authorities.

Responsibilities of AMI in the scope of this Protocol will include, at minimum, the following:

- Keeping the track of the official letters (regarding the start of tree plantation and the completion of tree plantation) that will be given by Regional Forestry Directorate,
- Paying amount of money that will be defined by the Regional Forestry Directorate,
- Providing the relevant equipment for land preparation before the plantation that will be given as a list by the Regional Forestry Directorate.

AMI commits to start this process by making the relevant official application to the Kastamonu Regional Forestry Directorate in the last quarter of 2017. In line with this ESIA Report, an area of minimum 400 ha is planned to be reforested (modifications may be done in accordance with the BAP study to be prepared, if the BAP indicates such as necessity). To ensure effectiveness of the monitoring activities, AMI will develop a monitoring committee and prepare annual reports to document location and size of the areas reforested, type of species used, success of plantation, etc. Where required, AMI will cooperate with the Kastamonu Regional Forestry Directorate and involve their experts in the monitoring process.

Restoration Activities

The objective of the proposed restoration activities will be within the scope of the Mine Closure and Rehabilitation Plan is to return the land and watercourses to an acceptable standard of productive use, ensuring that any landforms and structures are stable, and any watercourses are of acceptable water and ecological quality and basicly, to rebuild the ecosystem that existed at the mine site (where applicable) before it was disturbed. It will involve a number of activities such as removing any hazardous materials, reshaping the land, restoring topsoil, and planting native plants.

6.12 Health and Safety

Health and safety related impacts of a project on workers and communities are the subject of EBRD PR4 – Health and Safety. Existing conditions related to occupational health and safety ("H&S", "HS") and community H&S; H&S risk assessment and H&S impact identification; and prevention/mitigation measures proposed for management of HS risks of the Project are provided in this section. It should be noted that occupational health and safety (OHS) assessments were conducted by AECOM, whereas community health and safety issues were mainly compiled and summarized from SRM's "Acacia Mining Gökırmak Copper Project Social Impact Assessment (SIA) Report", in addition to AECOM's input for some specific community H&S subjects. The full SIA, and therefore the full impact assessment with regards to community health and safety, is presented in Volume-II of the ESIA Disclosure Package.

The section consists of the following sub-topics:

- Occupational Health and Safety
- Community Health and Safety
- Infrastructure, Building, and Equipment Design and Safety
- Hazardous Materials Safety
- Product and Services Safety
- Traffic and Road Safety
- Natural Hazards
- Exposure to Disease
- Emergency Preparedness and Response

6.12.1 Occupational Health and Safety

6.12.1.1 Occupational Health and Safety Setting in Turkish Mining Sector

Over the past decade, Turkey has been engaged in a process of reform of its national OSH system, harmonizing it with international and regional standards regarding national as well as enterprise level requirements for prevention and risk assessment reflected, inter alia, in the ILO Occupational Safety and Health Convention, 1981 (No. 155) ratified by Turkey in 2005. Turkey also ratified the Occupational Health Services Convention, 1985 (No. 161) in 2005 and has been a party to the Labour Inspection Convention, 1945 (No. 81) since 1951. Most recently, in 2014, Turkey ratified the Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187). This reform process has involved a reshaping of national OSH legislation and has included the adoption of a new stand-alone OSH Act (No. 6331 of 20 June 2012). This Act, which is generally applicable across all sectors, attributes central importance to prevention and risk assessment and is aimed at continuous improvement of national OSH conditions for all workers. Since its adoption a number of related OSH regulations have been revised or updated (ILO website, www.ilo.org).

Following 2014's workplace accidents, especially the Soma tragedy where the fire in an underground mine in Soma resulted in the death of 301 miners, increased focus was placed on the need to step up the national efforts to improve OHS, in particular in the areas of mining and construction. Within this regard, Turkey ratified the Safety and Health in Construction Convention, 1988, (No. 167) and the Safety and Health in Mining Convention, 1995 (No. 176) on 23 March 2015 (ILO website, www.ilo.org).

In Turkey, occupational accident rates, for the total of all sectors, presented a continuous decline in the last 20 years until 2013 (See Table 6-94). In the year 2013, OHS incidents notification system was revised and the increase in recorded number of accidents may be the result of that change (ILO Occupational Safety and Health Profile – Turkey, 2016).

Table 6-94 Occupational Accidents in Turkey (1995-2014)

Year	Number of workers (x1000)	Number of occupational accidents	Occupational accident per 100 workers	Number of deaths	Mortality rate per 100,000	Fatality** rate per 1000
1995	4 411	87 960	1.99	919	20.8	10.4
2000	5 254	74 847	1.42	731	13.9	9.8
2005	6 919	73 923	1.06	1 048	15.1	14.2
2006	7 819	79 027	1.01	1 583	20.2	20.0
2007	8 505	80 602	0.94	1 043	12.3	12.9
2008	8 803	72 963	0.82	865	9.8	11.9
2009	9 030	64 316	0.71	1 171	13.0	18.2
2010	10 031	62 903	0.63	1 444	14.4	23.0
2011	11 031	69 227	0.63	1 700	15.4	24.6
2012	12 527	74 871	0.60	744	5.9	9.9
2013	11 940	191 389	1.60	1 360	11.4	7.1
2014	13 967	221 366	1.58	1 626	11,6	7.3

Source: Social Security Institution, Statistics Yearbooks; from ILO Occupational Safety and Health Profile -Turkey, 2016

According to the same stats, accidents in mining sector constituted 23.5% of all recorded accidents. For the year 2015, a tptal of 10,201 accidents with work day losses occurred in the coal mining sector, whereas the number of is 1024 in metal mining sector. This proportion is consistent with the data provided by the Social Security Institution in the former years.

Table 6-95. Deaths due to Occupational Accidents by Economic Activities in Turkey (2014)

Economic activity	Number of deaths	Percent
Construction	501	30.8
Production	230	14.1
Transportation	211	13.0
Mining	382	23.5
Other	302	18.6
Total	1626	100.0

Source: Social Security Institution, Statistics Yearbook, 2013; from ILO Occupational Safety and Health Profile – Turkey, 2016

Number of deaths that occurred in the mining industry between the years 2002 and 2013 as given in the 2014 dated Soma Mining Disaster Report of Union of Turkish Bar Associations is presented in Figure 6-45. As can bee seen here, the number of deaths that occur in mining industry occupational accidents in Turkey is in a general increasing trend.

On the other hand, a graphic presenting the change in number of work days lost in metal ore mining sector occupational accidents between the years 2008 and 2015 is provided in Figure 6-46. According to the data published by the Social Security Institution in its Statistics Yearbooks, the number of accidents presented a steady increasing trend between 2008-2012, which can be attributed to the increase in total number of workers employed in the sector. Therefore, rates in terms of total accidents and total deaths per 100,000 workers are required to identify the trend in occupational accidents in the sector. However, no such data was published by Turkish Statistical Institute or Social Security Institution. Still, with the number of work day losses reaching up to 1000s between the years 2013 and 2015 and the fact that number of deaths in the sector is increasing, it is clear that better OHS management in compliance with international labour standards is required generally in the sector.

It should also be noted that these numbers are provided by Social Security Institution and therefore reflect the number of accidents experienced only by insured workers. As per the Labour Law, it is mandatory in Turkey to insure every worker; however, considering the fact that some workers may still be employed without an insurance, the actual number of accidents in the sector may be somewhat above the statistics published by Social Security Institution.

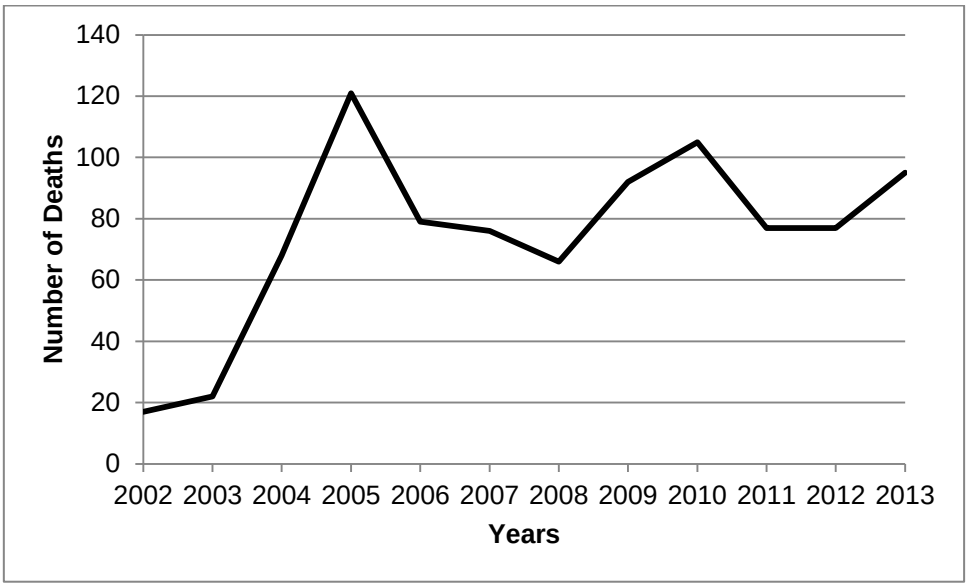


Figure 6-45 Number of Deaths Occurred in the Mining Industry (2002- 2013) (Union of Turkish Bar Associations, 2014)

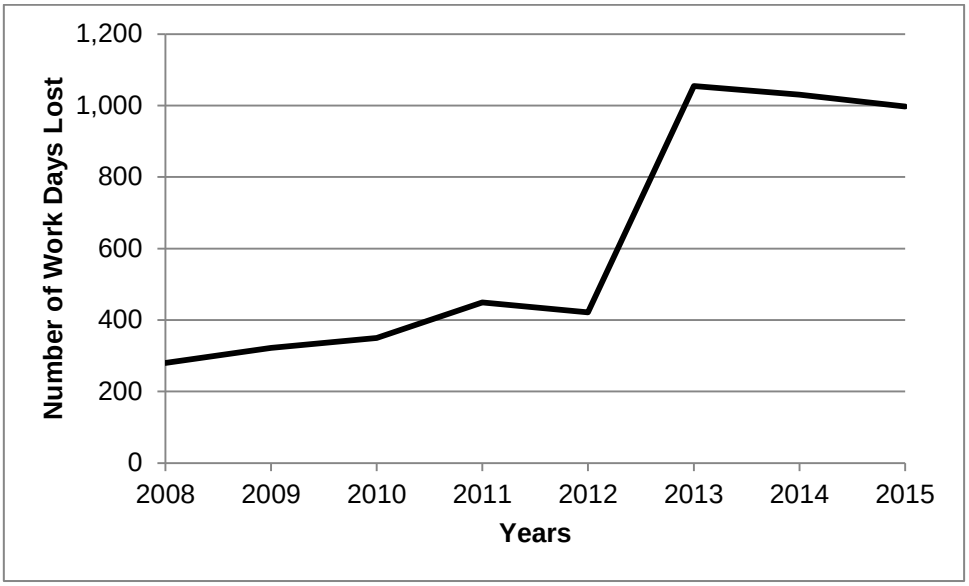


Figure 6-46 Number of Work Days Lost in Metal Ore Mining Sector Occupational Accidents (2008-2015) (Social Security Institution, Statistics Yearbooks)

6.12.1.2 Project OHS Management and Existing Conditions

Identification of occupational health and safety (OHS) risks related to the mining sector is a complex process, affected mainly by the mineral/ore to be mined and processed (e.g. metals mining, coal mining etc.) opted mining alternative (i.e. open pit or underground) and the activities of a mine, listed below, that require risk assessment and management (ICMM, 2016):

- exploration
- design
- construction
- operation/extraction
- processing
- engineering services and maintenance
- closure
- rehabilitation/remediation

AMI employs an HS Manager and an HS Supervisor for H&S management. The HS Manager and HS Supervisor had received trainings from the National Examination Board in Occupational Safety and Health (NEBOSH) and obtained the related International General Certificate; in addition to the Class A Safety Expert Certificate for the HS Manager and the Class B Safety Expert Certificate for the HS Supervisor, which are issued by the Ministry of Labour and Social Security. The HS Manager and an HS Supervisor are responsible of assessing and implementing all processes related to OHS, in compliance with requirements of ILO, NEBOSH and national legislation.

AMI currently has an Occupational Health and Safety Policy, an Occupational Health and Safety Plan prepared based on requirements of ILO - OSH 2001 Health and Safety Management System, a Health, Safety and Environmental Manual for Sub-Employers which covers OHS management of contractors and subcontractors and other related plans including but not limited to the Transport/Traffic Management Plan and Fire Prevention and Fire Protection Plan. In addition to these, multiple other management plans are also developed within the scope of the ESIA Disclosure Package. The Company also has various detailed OHS documents such as procedures and forms for smaller scale OHS management, which are either in place or currently being prepared.

In addition to the above mentioned H&S documents, AMI prepared an action plan to address all issues identified in the Occupational Health and Safety Legal Compatibility Audit Report, which was prepared as a result of an external OHS audit conducted on August 1 and 4, 2016, by Bureau Veritas. The aim of this report, which analyzed the then existing OHS conditions of all workplaces and contractor workplaces, was to determine any issues and potential improper conditions regarding OHS and to address and/or improve any such identified subject, as well as reviewing and improving the OHS policy and targets of the Company. The audit summary states that the company has established, good OHS practices, which are governed by its OHS policy, implemented in all levels of the organization. It is also stated that the policy is applied to all contractors. On the other hand, conclusions section of the report states the following: “In conclusion, the OHS practices of Acacia Maden İşletmeleri A.Ş. and its subcontractors can be regarded as satisfactory in general terms. Acacia Maden İşletmeleri A.Ş. can become a company that sets an example in terms of occupational health and safety should the nonconformities and deficiencies that are explained hereunder are corrected and followed up, up-to-date OHS regulations and national and international standards are observed, and the company’s OHS unit organization is arranged.”

The report listed corrective, preventive and control measures for nonconformities identified during the audit. The nonconformities included various detailed, specific OHS site observations such as; areas where additional OHS markings and signage are required, lack of fencing around the generators and transformers located in different parts of open mine plants, problems with locationing of fire extinguishers, failure to ground all metal fittings in electrical installations, unsuitability of arrangement, order and cleaning of the boiler room, etc. Following the completion of the report, AMI prepared an action plan to implement the measures proposed by the audit report. As of August, 2016, all of the proposed actions are completed.

GCP will continually be audited by adequate 3rd party auditors throughout Project life.

It should be noted that OHS management for exploration phase of GCP was not included in the assessments conducted in the scope of this report, since exploration phase is already finalized.

6.12.1.3 Construction and Closure Phases

Construction phase OHS risks associated with mine projects are similar to OHS risks stemming from construction activities of most types of other projects. All identified construction phase OHS risks/impacts and proposed measures are also applicable to closure phase since closure activities consist of decommissioning and dismantling/uninstalling of existing Project units and rehabilitation activities (i.e.identified construction phase impacts such as ergonomic injuries and illnesses, work at heights, slips and falls, etc. are also valid for closure phase). Therefore, the assessment for construction phase is also valid for closure phase.

Potential OHS risks and impacts associated with earthworks/construction and closure phases and the proposed mitigation measures are presented in Table 6-96. It should be noted that all contractor and subcontractor personnel are also required to comply with these provisions.

Table 6-96 OHS Impacts and Mitigation for Construction and Closure Phases

Risk/ Impact	Description	Measures
Ergonomic Injuries and Illnesses	Ergonomic injuries and illnesses include any type of injury and illness that may be caused by manual handling, repetitive motion and over-exertion associated with various work activities, such as musculoskeletal disorders. Ergonomic injuries and illnesses are the most common OHS issue during construction phase.	• Providing OHS trainings to workers on handling heavy equipment/materials • Periodic health examinations by the workplace doctor • Implementation of limits on manual lifting/handling • Implementation of the Occupational Health and Safety Management Plan • Implementation of Health, Safety and Environment Manual for Sub-Employers
Work at Heights	Falls from at least 2 meter high work environments into ground, construction equipment, water or other liquids and hazardous substances, is one of the major OHS issues during the construction phase, in cases where working with ladders, scaffolding and partially built structures is required. The hazard is caused in most cases by lack of protective equipment use, such as full body harnesses and proper barriers and rails.	• Installation of guard rails, signs • Use of related PPE such as body harnesses and belts • Provision of related OHS trainings • Ensuring sufficient illumination when required • Implementation of the Procedure for Working at Height • Implementation of the Occupational Health and Safety Management Plan • Implementation of Health, Safety and Environment Manual for Sub-Employers • All personnel that conduct works at height are subject to Competency for Working at Heights trainings. An examination is applied to the personnel following the training and only personnel deemed sufficient as a result of this exam are allowed to conduct works at height. No other personnel will be allowed to conduct such work. • A doctor's approval is required for all personnel that will conduct works at height.
Slips and Falls	Generally caused by slips on excavation material debris and/or work equipment left unattended on site, as well as due to lack of attention to objects such as cables and ropes on ground, slips and falls are one of the most frequent types of accidents that occur in construction sites.	• Ensuring good housekeeping practices • Encouragement of PPEs use • Provision of sufficient illumination where required.
Collisions with Objects and Moving Machinery	Injury or death can occur by being struck by moving equipment, being struck by sprayed materials and/or fire sparks during use of power tools such as drills and being struck by falling objects. Being trapped and/or entangled by machinery parts or heavy equipment can also lead to fatal and nonfatal injuries, especially since heavy equipment operators have limited fields of view of the area close to the equipment they use.	• Providing specialized OHS trainings to workers that will operate heavy machinery and workers that are required to work in the close vicinity of such equipment • Restricting operation of heavy machinery to those that are trained and competent (licensed if required) • Use of related PPEs such as safety glasses and use of high visibility workers clothing • Ensuring safe distance of personnel during blasting operations

Risk/ Impact	Description	Measures
		• Ensuring sufficient illumination when required • Use of contrast coloring and reflective markings on equipment / machinery • Implementation of the Occupational Health and Safety Management Plan • Implementation of Health, Safety and Environment Manual for Sub-Employers
Air Quality	Direct exposure of personnel to dust generated by construction vehicles' movement and improper soil and rock excavation and transportation practices, as well as exposure to other air pollutants generated by working construction equipment and vehicles can result in respiratory problems, which may lead to further illnesses.	• Use of related PPEs such as dust masks where on site monitoring results of dust and particulate matter (PM) measurements are in excess of required levels • Personal dust exposure and ambient dust measurements will be monitored based on Time Weighted Average Limit Value, Short Term Exposure Limit (STEL) Value • Mitigation measures for air quality proposed in "6.4 Air Quality" section of this report are also applicable for mitigation of impacts on personnel health
Noise and Vibration	Exposure to excessive levels of noise generated by construction equipment and activities may cause OHS problems such as hearing loss; whereas use of vibrating equipment such as ground drillers or hand held drillers and whole body vibration caused by contact with large vibrating surfaces may potentially cause occupational illnesses such as hand-arm vibration syndrome and other musculoskeletal consequences.	• Use of related PPEs at works sites where noise monitoring results are in excess of required limits or where grievances by the personnel regarding noise are received • Periodic medical checks by the site doctor, focused on measuring the hearing ability degradation progress of each exposed worker • Considering changing equipment or implementing time limits in case of a grievance regarding vibration is relayed by a worker • Implementation of the Occupational Health and Safety Management Plan • Implementation of Health, Safety and Environment Manual for Sub-Employers
Site Traffic	Since construction vehicle operators and truck drivers have limited fields of view around their equipment, systematic and well laid out traffic management practices are required to ensure safety. The Company will conduct an on-site traffic risk assessment and will implement various measures depending on the results of this assessment.	• Implementation of the Transport/Traffic Management Plan • Implementation of the Procedure on Road Safety and Driving • Providing general and specialized traffic trainings for all personnel and providing specialized trainings to personnel that will operate specific industrial vehicles • Allowing only personnel with sufficient competency to operate heavy vehicles (personnel with relevant driving license and training) • Inclusion of traffic issues for trainings that site visitors will receive and limiting site visitors' mobility on construction sites • Conducting periodic medical checks of drivers • Installation and maintenance of signage and other traffic regulating means (including speed controls with radar) • Other traffic management practices such as setting speed limits, right of

Risk/ Impact	Description	Measures
		way practices, periodic vehicle maintenance and measures to be applied during winter conditions • Implementation of Health, Safety and Environment Manual for Sub-Employers
Other Physical Hazards	Other OHS risks the construction personnel are potentially prone to are; working with electrical equipment, eye hazards caused by splatter of solid particles and/or liquid substances, welding and other hot work, working environment temperature which may potentially lead to heat exhaustion, dehydration, hypothermia and various other health effects and excessive exposure to sun which may potentially cause dermal problems.	• Prociding general and specialized OHS trainings • Mandatory use of PPE and encouragement of othe PPE use • Encouregement of use of other personal protection means such as sun blockers • Implementation of the Occupational Health and Safety Management Plan • Implementation of the Waste Management and Pollution Prevention Plan • Implementation of the the Health, Safety and Environment Manual for Sub-Employers
Diseases	Communicable and vector borne diseases present a heightened risk both for the personnel since a large number of workers is involved during construction and for the communities due to interaction of personnel and the local communities.	• Providing Adequate accommodation arrangements with good housekeeping practices • Conducting periodic medical checks for personnel and provision of vaccination and/or other mitigating measures in the case where monitoring results present heightened risk or grievances regarding a general disease outbreak is received • Implementation of appropriate waste management practices and implementation of the Waste Management and Pollution Prevention Plan • Keeping a suitable patient transport vehicle on site

6.12.1.4 Operation Phase

Identification of OHS risks stemming from operation phase activities of GCP was based on review of international standards and guidance such as the International Labour Organization's (ILO) code of practice for open cast mines (1991), IFC's Environmental Health and Safety Guideline for Mining (2007), good practice documents such as International Council on Mining and Metals' (ICMM) Good Practice Guidance on Occupational Health Risk Assessment (2016) and expert knowledge.

Identified operation phase OHS Risks and measures proposed for prevention/mitigation of these risks are detailed below in Table 6-97. It should be noted that all contractor and subcontractor personnel are also required to comply with these provisions.

Table 6-97 OHS Impacts and Mitigation for Operation Phase

Risk/ Impact	Description	Measures
Air Quality	Emissions sourced from Project operation phase activities, especially dust generation, constitute a significant risk not only in terms of OHS but also for community health and safety and environmental health and safety. Emission source activities of the Project operation phase are; PM generated by open pit activities such as drilling, blasting, loading of material to trucks; PM and other emissions generated by transportation activities such as ore transportation from the open pit to the processing plant, waste rock transportation from the open pit to the waste rock dump areas and personnel transportation; PM generated by ore crushing and screening operations and PM generated by impact of erosion in the lack of proper erosion management practices. Odors that may potentially be sourced from the waste water treatment plant of the Project on the other hand can be considered a source of nuisance for the Project personnel and is important in terms of being indicative of a potential disease source related to waste water management.	• Use of related PPEs such as dust masks where on site monitoring results of dust and particulate matter (PM) measurements are in excess of required levels • Personal dust exposure and ambient dust measurements will be monitored based on Time Weighted Average Limit Value, Short Term Exposure Limit (STEL) Value • Mitigation measures for air quality proposed in ”6.4 Air Quality” section of this report are also applicable for mitigation of impacts on personnel health
Explosive Use	Poor coordination during blasting operations and accidental explosions may potentially result in injuries and even loss of life and therefore require very strict, structured management measures.	• Blasts will be conducted only by trained, competent, certified blasters or explosives experts • Blasting sites will be checked for unexploded agents only by trained, competent, certified blasters or explosives experts • Specialized trainings will be provided to personnel involved with blasting activities • Active on-site management at all times during blasting activities will oversee all blasting operations to ensure appropriate and safe loading, firing and timing • Blasting operations will strictly be based on schedules and change in schedule will be kept to a minimum to the extent possible. Personnel will be informed of the blasting schedule periodically and in any case of a timing change • Warning devices will be used (flashing lights, alarms, signals as appropriate) and a procedure will be followed to inform all personnel and potential third parties in the vicinity of the area where blasting will be conducted. To inform local communities, the district announcement system will be used prior to blasting activities. • Implementation of the Occupational Health and Safety Management Plan

Risk/ Impact	Description	Measures
Geotechnical Safety	The feasibility report of the Project states that overall slopes are expected to be stable and localized failures may be anticipated on foliation and faults, which will largely be contained on the berms. 2D limit equilibrium and finite element modelling was conducted for sections selected on the open pit. According to the model results, all slopes modelled without the inclusion of water in the analysis are stable. Some slopes indicate unstable conditions when water is included in the analysis. Moving the piezometric surface behind the wall, by simulating the installation of depressurization and dewatering holes, improves the stability of the slopes to values above the acceptance criteria. Separate modelling studies conducted for waste rock dump sites indicated that overall waste dump slopes are also stable (Factor of Safety above 1.3). Therefore overall impact of geotechnical stability on OHS is assessed to be minor, when related design and stability measures are in place.	• To avoid any potential health and safety issue that may be caused by geotechnical instabilities, geotechnical safety will mainly be ensured by safe slope design to be planned by experts. Open pit slope design will incorporate newly interpreted faults and discontinuities in to the process as excavation goes on. Therefore the open pit design may evolve during the life time of the open pit and the waste rock dump areas. • Stability monitoring will be conducted • Special attention will be given to slope stability following heavy rain/snow events, seismic events and blasting operations • Appropriate drainage systems will be utilized to prevent excess loads caused by water entry to related Project units • Any rock mass remaining partially suspended on slope surfaces will be dropped in a controlled environment or a barrier will be constructed at the area where it is anticipated to fall. • Slope dewatering and depressurization measures will implemented, especially on the open pit southern walls and alluvium, where they are deemed to be necessary • Implementation of the Emergency Action Plan • Implementation of the Mine Water and Stormwater Management Plan
Noise and Vibration	Operation of heavy equipment, haulage trucks and other mobile vehicles, blasting activities and crushing activities are the major sources of noise and vibration during the operation phase.	• Use of related PPEs at works sites where noise monitoring results are in excess of required limits or where grievances by the personnel regarding noise are received • Mandatory use of related PPEs during blasting activities • Periodic medical checks by the site doctor, focused on measuring the hearing ability degradation progress of each exposed worker • Considering changing equipment or implementing time limits in case of a grievance regarding vibration is relayed by a worker • Implementation of the Occupational Health and Safety Management Plan • Implementation of Health, Safety and Environment Manual for Sub-Employers • Implementation of the Transport/Traffic Management Plan • Mitigation measures proposed for noise and vibration management in “Section 6.6 of this report are also applicable for mitigation of impacts on personnel health
Site Traffic	As is the case with the construction phase, since vehicle operators and truck drivers have limited fields of view around their equipment, systematic and well laid out traffic management practices are required to ensure safety. However, impact significance of improper traffic management is considerably more	• Implementation of the Transport/Traffic Management Plan • Implementation of the Procedure on Road Safety and Driving • Providing general and specialized traffic trainings for all personnel and providing specialized trainings to personnel that will operate specific

Risk/ Impact	Description	Measures
	important during operation phase, since a large number of haulage trucks will be utilized.	industrial vehicles • Allowing only personnel with sufficient competency to operate heavy vehicles (personnel with relevant driving license and training) • Inclusion of traffic issues for trainings that site visitors will receive and limiting site visitors' mobility on construction sites • Conducting periodic medical checks of drivers • Installation and maintenance of signage and other traffic regulating means (including speed controls with radar) • Other traffic management practices such as setting speed limits, right of way practices, periodic vehicle maintenance and measures to be applied during winter conditions • Implementation of Health, Safety and Environment Manual for Sub-Employers
Hazardous Materials Management	Some hazardous materials will be used for or generated as a result of Project activities, including mine tailings and explosives. An Oil and Chemicals Spill Response Plan, an Emergency Action Plan, an Emergency Preparedness Plan for the Kepezkaya Tailings Storage Facility and a Procedure for Working with Chemicals are in place and all storage areas will be constructed in line with related legislation, which lays out detailed specifics of containment structures and storage areas. In addition, specific training will be provided to personnel for handling of hazardous substances together with enforcement of mandatory use of protective equipment. Impacts of hazardous materials management on OHS are assessed to be negligible with these measures in place and therefore no additional measures are proposed. It should be noted that impacts sourced from hazardous materials management are assessed to be "negligible" only for occupational health and safety and not for impacts on environment or community health and safety.	• Implementation of the Oil and Chemicals Spill Response Plan • Implementation of the Emergency Action Plan • Implementation of the Emergency Preparedness Plan for the Kepezkaya Tailings Storage Facility • Implementation of the Procedure for Working with Chemicals
Physical Hazards	Physical hazards listed above in "Section 6.12.1.3" are also of concern during operation phase.	• All mitigations listed under respective subheadings for these risk sources in "Section 6.12.1.3" are also applicable during operation phase.
Diseases	As is the case with construction phase, communicable and vector borne diseases present a heightened risk both for the personnel and for the local communities.	• Providing Adequate accommodation arrangements with good housekeeping practices • Conducting periodic medical checks for personnel and provision of vaccination and/or other mitigating measures in the case where monitoring results present heightened risk or grievances regarding a

Risk/ Impact	Description	Measures
	It should be noted that the Project will have an infirmary established in the administrative and social building area and regular medical checks both for diseases common to mining sector and communicable and vector borne diseases will be provided by the workplace doctor. Development and implementation of vaccination and other measures will be the responsibility of the workplace doctor, who will be employed full time.	general disease outbreak is received • Implementation of appropriate waste management practices and implementation of the Waste Management and Pollution Prevention Plan • Keeping a suitable patient transport vehicle on site

6.12.2 Community Health and Safety

This Section identifies and assesses the major community health and safety issues for the Project based on GIIP approaches, expert knowledge of the sector and a review of the impacts caused by or expected to occur due to activities of similar projects and complements the community health and safety assessments contained in the SIA Report, which is presented as Volume-II of the ESIA Disclosure Package.

It should be noted that some measures proposed in Section 6.12.1 apply also to community health and safety impacts and are therefore not repeated here.

The Project will have a Community Health, Safety and Security Management Plan to provide a framework for management of community H&S issues.

Air Quality

The construction works to be carried out and the construction of the haul and access roads will lead to dust generation during the construction phase. On the other hand, during the operation phase, the use of the haul road between the Open Pit and the Process Plant, and the extraction, storage and haulage of waste rock are the activities that will cause dust emissions that may potentially have impacts on local communities. Measures proposed by the SIA for both construction and operation phases are presented in Volume-II of the ESIA Disclosure Package, whereas related measures proposed by this report (i.e. Volume-I) are presented in Section 6.4 and Section6.12.1.

Hazardous Materials Management

The main hazardous material use in the scope of the Project is explosives. Explosive materials will be obtained from Çankırı province during both construction and operation phases. During the construction phase, explosives are not stored, but used on a daily basis. AMI stated that the same method will be utilized during the operation phase and the explosives brought to the mine will be used as planned. However, in case a variation occurs in the amount of explosives to be used during the operation phase, the excess materials will be stored in a secure, proper explosives storage as required by related legislation, which will be built in a non-residential area.

Since the amount of explosive use will increase during the operation phase, vehicles loaded with explosives will also increase. This, in turn, necessitates special measures to be designed for traffic safety that are in line with related legislation regarding transportation of hazardous materials on state roads.

In addition, other hazardous materials will also be used in drilling works, construction activities and operation activities. Therefore, the measures regarding storage and transport of explosives will also be valid for chemical substances.See Volume-II for measures proposed by the SIA.

Blasting Activities

The noise and dust to be generated by explosive materials, as well as the landslides may trigger important impacts that are of concern for public health and safety. Regarding the issue of landslides, Sepetçioğlu locality of Vakıfgeymene neighborhood is located in close proximity to the Open Pit. There are 16 households in this locality. In the event that blastings create a landslide risk, there is a possibility that these houses and the households inhabiting them will be exposed to potential risks. Currently, there are households complaining about the blasting operations carried out for diversion tunnels. As the number and intensity of the blastings during the operation phase will be higher, such grievances will likely increase. See Volume-II for measures proposed by the SIA.

Water Resources

Mining operations include risks such as partial loss of water resources (natural springs, fountains and etc.), reduction in water quantity, and hampering access to drinking water. See Volume-II for measures identified by the SIA and section on Water Resources for measures identified by this report.

Noise and Vibration

As described in Section 6.6 of this report, no noise and vibration impacts on local communities in excess of EU, IFC, EPA or national legislation limits was identified. Therefore, monitoring is sufficient and additional measures will only be developed in case of a grievance or in case the monitoring results are above limits.

Traffic and Road Safety

The Traffic activity on roads is expected to increase during both construction and operation phases. This will in turn require increasing road safety and security measures. In addition to the local communities that may potentially be affected by dust generation and increased traffic load, some communities may also be affected by the traffic load increase on the highway connecting Samsun port and Hanönü district, since this road will be used for transport of concentrated metal (see Transport/Traffic Management Plan of the Project for detailed traffic load estimations).

AMI has in place a “Road Risk Assessment”. Related measures and rules specified by this assessment will also be applicable for community traffic and road safety. See Volume-II for measures identified by the SIA.

Natural Hazards

Communities may potentially be affected by natural hazards that may affect the Project units or natural hazards may potentially be induced by Project activities. These include the following:

- Blasting operations may potentially induce seismicity and landslides
- Slope stability problems may cause failure of WRDs
- A potential flooding or failure of the TSFs may cause serious health impacts

It should be noted that mitigation/prevention measures for natural hazards are generally design controlled measures and are stated mainly below in Section 6.12.3 and Section6.12.7 Natural Hazards and in other relevant sections of Chapter 6. See Volume-II for additional measures proposed by the SIA.

Disease

The Project may elevate levels of communicable and vector borne diseases and the work load of healthcare personnel in the district will possibly increase as a result of population growth due to the Project. Moreover, the population growth will increase the applications to the hospital in Taşköprü district, which in turn may intensify the work load of the hospital. The measures proposed in the SIA Report are similar to those proposed by AECOM:

- Providing trainings to the employees on healthcare within the scope of safety, health and environment works in order to reduce the intensity of current healthcare services
- Employing a workplace doctor and allied health personnel
- Establishing an infirmary to be used during construction and operation phases
- Keeping a patient transport vehicle available on site at all times
- In case a healthcare facility is planned to be opened in the district, providing in-kind and financial support to this facility

6.12.3 Infrastructure, Building and Equipment Design and Safety

EBRD states “incorporation of health and safety considerations into the design, construction, operation and decommissioning of the structural elements or components of the project in accordance with GIP, taking into consideration safety risks to third parties and affected communities” as a requirement in PR4. All units in the scope of the Project were designed in full compliance with related national legislation such as “Regulation on Structures in Disaster Areas, Official Gazette No. 26582 dated July 14, 2007”, “Regulation on Buildings Constructions in Earthquake Zones, Official Gazette No. 26454 dated March 06, 2007”, “Regulation on Health and Safety Signs, Official Gazette No. 28762 dated September 11, 2013” etc. and the technical specification documents related to any such regulation. It should be noted that these regulations and technical specifications provide highly detailed design requirements with regards to infrastructure, building and equipment design and safety, including earthquake and natural hazards resistant design.

As listed in “Chapter 3” and detailed in other relevant chapters of this report, multiple elaborate design alternative studies and design risk studies were conducted or commissioned by AMI to ensure design safety. The PR 4 states that “when structural elements or components, such as dams, tailings dams or ash ponds, are situated in high-risk locations and their failure or malfunction may threaten the safety of workers and communities, the client will engage one or more qualified experts with relevant and recognised experience in similar projects, separate from those responsible for the design and construction, to conduct a review as early as possible in project development and throughout the stages of project design, construction, operation and commissioning”. Regarging the issue, following studies was completed:

- TSF Siting study prepared by Hidromark
- TSF Design Study prepared by Hidrodizayn
- Risk Assessment for the Kepezkaya Tailings Storage Facility prepared by Golder Associates
- Emergency Preparedness Plan for the Kepezkaya Tailings Storage Facility prepared by Golder Associates
- Kepezkaya TSF Failure Analysis by DHI

The discharge capacity of the diversion system is based initially on 100 year peak flow (Q100), which is in excess of State Hydraulic Works’ (DSİ) discharge capacity advice of 50 year peak flow. Following the submission of “Gökırmak – Hanönü Diversion Planning Report” to DSİ, DSİ’s Dams and HEPPs Department requested the protection of upstream cofferdam against flood events based on 10,000 years peak flow (Q10,000). Due to this requirement, a spillway was added to the design, the upstream cofferdam was altered to raise five meters and the embankment was equipped with proper instrumentation. An emergency warning system was also provided for the safety of the personnel and equipment in the mine, as well as the local communities residing downstream of the Project.

In addition, all communal Project units were designed in compliance with universal access concept and principles.

The SIA Report, where potential impacts on infrastructure and subsequently to communities are assessed, states that damage to drinking water infrastructure (mains and reservoir), damage to irrigation water infrastructure and damage to roads/highways are Project’s potential impacts on local and regional infrastructure. Following measures are proposed by the SIA, for prevention/mitigation of impacts that may potentially arise from damage to infrastructure:

- It is necessary to monitor drinking water resources regularly, to track whether there is a reduction in water resources, and to counteract any effect inflicting damage on water resources and infrastructure
- The company will be responsible of repairing the roads, in case a damage is caused by the Project
- It is recommended that new roads which are not open to public use are built at proper locations to meet the requirements of the facility

6.12.4 Hazardous Materials Safety

As described above in Section6.12.1, some hazardous materials will be used for or generated as a result of Project activities, including mine tailings. Organizational management practices, risk assessment and prevention and mitigation measures for Hazardous Materials Safety is described under various sections in this report, including above, under Section6.12.1.4 where OHS risks stemming from hazardous materials management are described.

6.12.5 Product and Services Safety

The GCP Project does not involve production of and/ or trade in consumer products or provision of services to communities. Therefore, product and services safety requirements are not applicable to the Project.

6.12.6 Traffic and Road Safety

As described in detail in Section 6.12.1 and Section 6.12.2, the main risks related to traffic and road safety stem from potential accidents that may be sourced due to limited fields of view of operators and drivers. The Project will utilize all mitigation measures proposed in related chapters of this report and the national EIA report for prevention of accidents and mitigation of dust generation. In addition, a Transport/Traffic Management Plan is in place.

6.12.7 Natural Hazards

According to the Earthquake Zones map of Kastamonu province, the Project is located on 2nd and 3rd degree earthquake zones. To remain on the safe side, the feasibility study of the Project considered the whole Project to be located on a 2nd degree earthquake zone and concluded that the potential for the area to be subjected to a peak ground acceleration of 0.1 g for a 10% probability of exceedance in 50 years and therefore, the open-pit slopes are unlikely to be affected by regional earthquakes. The design of Kepezkaya TSF, which will be utilized during the first 4.5 years of the operation phase, the design of the open pit, the design of the WRD and the design of the river diversion systems all included detailed studies for earthquake resistant design, as well as considerations for potential landslide, instability and flooding events. As described in detail above under Section 6.12.3 the Project units are designed in full compliance with related natural hazards legislation and legislative technical specification documents, in addition to the specific natural hazard resistent design studies conducted for each Project unit. In addition the Project has an Emergency Plan in place, which includes natural hazards as a subject.

Potential impacts of natural hazards on communities and measures proposed by the SIA Report are described above under Section 6.12.2.

6.12.8 Exposure to Disease

Management of communicable and vector borne diseases are described above in detail under Section 6.12.1 for personnel health and safety and under Section6.12.2 for local communities.

6.12.9 Emergency Preparedness and Response

As described in the related sections above, the Project has the following management plans in place for emergency preparedness and response:

- Emergency Action Plan
- Emergency Preparedness Plan for the Kepezkaya Tailings Storage Facility
- Oil and Chemicals Spill Response Plan
- Fire Prevention and Fire Protection Plan
- Mine Rescue Team Operational Procedure

Table 6-98 Summary of Impacts, Mitigation and Residual Impacts for Health and Safety / Construction and Closure Phases

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
OHS/ Hazards due to Accidents and Incidents (e.g. Ergonomic injuries, falls from height, slips and falls, collisions with objects, exposure to sun, etc.)	Personnel	Medium -Short to long term -Short term reversible to long term reversible -Low to high in magnitude -One-off	Medium (Medium importance and rarity)	Moderate	• Impelemntation of the OHS Plan • Implementation of the Contractor Control Management Plan • Implementation of the Emergency Action Plan • Implementation of the Fire Prevention and Fire Protection Plan • Implementation of related procedures • Provision of general and specialized OHS trainings • Use of related PPEs and encouragement of other protective means such as sunblockers • Implementation of limits on manual lifting/handling • Installation of guard rails, signs • Ensuring sufficient illumination • Allowing only competent personnel to conduct works at height • Regular visual checks and maintenance/cleanup of excavation debris and other potential risk sources such as cables and ropes • Restricting operation of heavy machinery to those that are trained and competent (licensed if required) • Ensuring sufficient illumination • Periodic medical checks	Minor
OHS/ Air Quality: -Health impacts caused by exposure of personnel to dust and other emissions generated by construction activities	Personnel	Medium -Medium to long term -Long term reversible or irreversible	High (High importance and rarity)	High	• Implement dust suppression techniques identified in “6.4 Air Quality” section of this report • Implement Air Quality Management Plan • Use related PPEs • Monitor personal dust exposure and ambient dust measurements, based on Time Weighted Average	Minor

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
		-Medium to high in magnitude -One-off or continous			Limit Value, Short Term Exposure Limit (STEL) Value	
OHS/ Noise and Vibration: -Exposure to excessive levels of noise and vibration generated by construction activities	Personnel	Medium -Short to long term -Short term reversible or irreversible -Low to high in magnitude -One-off or continous	Medium (Medium importance and rarity)	Moderate	• Use of related PPEs (where noise monitoring results are in excess of required limits or where grievances are received) • Periodic medical checks • Considering changing equipment or implementing time limits in case of a grievance regarding vibration	Negligible
OHS/ Site Traffic: -Accidents that may potentially be sourced from improper traffic management	Personnel	Medium -Short term -Short term reversible or irreversible -Low to high in magnitude -One-off	Medium (Medium importance and rarity)	Moderate	• Implementation of the Transport/Traffic Management Plan • Providing traffic trainings for all personnel and providing specialized trainings to personnel that will operate industrial vehicles and workers • Inclusion of traffic issues for trainings that site visitors will receive and limiting site visitors' mobility on construction sites • Restricting operation of industrial vehicles to those that are trained and competent (licensed if required) • Conducting periodic medical checks of drivers • Installation and maintenance of signage and other traffic regulating means • Setting speed limits, right of way practices, periodic vehicle maintenance and other traffic management practices where required • Implementation of the Procedure on Road Safety and Driving	Negligible

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
OHS/ Diseases: -Heightened risk of exposure to diseases in both the workforce and the local communities	Personnel	Low -Short term -Short term reversible -Low to medium in magnitude -One-off	Low (Low or medium importance and rarity)	Minor	• Adequate accommodation arrangements • Periodic medical checks for personnel and provision of vaccination and/or other mitigating measures when required • Implementation of appropriate waste management practices and the Waste Management Plan • Keeping a suitable patient transport vehicle on site • Awareness raising for workers on communicable diseases • Training tor workers on appropriate interaction within the local community • Health awareness raising of community	Negligible
Community HS/Blasting -Use of ANFO above 2,500 t/yr upper tier	Communities	Medium -Short term -Short term reversible or irreversible -Low to high in magnitude -One-off	Medium (Medium importance and rarity)	Moderate	• Ensure compliance with the requirements of SEVESO III Directive • Ensure all sections of the community are informed in advance about the programme for blasting. • See entry under noise and blasting and vibration	Minor
Community HS/ Air Quality: -Emissions affective on community health, sourced from construction phase activities	Communities	Low -Medium to long term -Long term reversible -Low in magnitude - One-off or continous	Medium (medium importance and rarity)	Minor	• Implement dust suppression techniques identified in related sections of this report. • See SIA Report given in Volume-II of the ESIA Disclosure Package for further mitigation.	Negligible
Community HS/ Traffic and Road Safety: -Accidents that may potentially be sourced	Communities	Low -Short term -Short term	Meidum (Medium importance and	Moderate	• Implement measures related to traffic management identified in related sections of this report.	Negligible

Impact Description	Receptor	Magnitude	Sensitivity/ Value of Resource/ Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
from improper traffic management -Increase in traffic load		reversible or irreversible -Low to high in magnitude -One-off	rarity)		• Implement the Transport/Traffic Managament Plan • Ensure appropriate signage and other traffic control measures especially around areas of high community activity and also sensitive areas such as schools and hospitals. • Carry out regular checks to ensure that drivers are aware of and implementing safety measures. • Training Acacia Mining and subcontractor employees on traffic, defensive driving techniques etc., • Checking whether speed limits are abided by, • Design protocols regarding the haulage of mine concentrate and hazardous substances, and • Building escape ramps on the haul road between the open pit mine and mining facility, • Placing traffic warning signs within the facility and surrounding areas, • Building two underpasses on the entrance and exit of the same road and bringing them into service of local residents, • See SIA Report given in Volume-II of the ESIA Disclosure Package for further mitigation.	
Community HS/ Diseases: -Heightened risk of exposure to diseases in the local communities -Increased work load of local healthcare services	Communities	Low -Short term -Short term reversible -Low to medium in magnitude -One-off	Low (Low or medium importance and rarity)	Minor	• See SIA Report given in Volume-II of the ESIA Disclosure Package for mitigation. • Community awareness raising on health issues including communicable disease • Review demand and capacity of health care facilities as a part of influx management plan.	Negligible

Table 6-99 Summary of Impacts, Mitigation and Residual Impacts for Health and Safety / Operation Phase

Impact Description	Receptor	Expected Potential Impact Severity	Sensitivity Value of Resouce Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
OHS/ Air Quality: -Emissions affective on personnel health, sourced from open pit activities, transportation activities, crushing and screening activities and erosion	Personnel	Medium -Medium to long term -Long term reversible or irreversible -Medium to high in magnitude -One-off or continous	High (High importance and rarity)	High	• -Implementation of dust suppression techniques identified in “6.4 Air Quality” section of this report • -Use of related PPEs • -Monitor personal dust exposure and ambient dust measurements, based on Time Weighted Average Limit Value, Short Term Exposure Limit (STEL) Value	Minor
OHS/ Explosives Use: -Injuries and loss of life due to poor explosives management	Personnel	Medium -Short term -Short term reversible or irreversible -Low to high in magnitude -One-off	Medium (Medium importance and rarity)	Moderate	• -Blasts will be conducted only by trained, competent, certified blasters or explosives experts • -Blasting sites will be checked for unexploded agents only by trained, competent, certified blasters or explosives experts • -Specialized trainings will be provided to personnel that is involved in the blasting activities • -Active on-site management will be in place at all times during blasting activities will • Blasting operations will strictly be based on schedules and personnel will be informed of any schedule change • -Warning devices will be used prior to any blasting • - Occupational Health and Safety Management Plan will be implemented • -Requirements of SEVESO III Directive will be complied with.	Minor
OHS/ Geotechnical Safety:	Personnel	Medium	High	Moderate	• -Implementation of drainage systems	Negligible

Impact Description	Receptor	Expected Potential Impact Severity	Sensitivity Value of Resouce Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
-Injuries and loss of life due to failure of open pit and waste rock disposal slopes, either due to design or due to vibration caused by blasting		-Short term -Short term reversible or irreversible -Medium to high in magnitude -One-off	(Medium to high importance and rarity)		• -Implementation of slope dewatering and depressurization measures • Implementation of the Emergency Action Plan	
OHS/ Noise and vibration: -Noise and vibration sourced from operation of heavy equipment, haulage trucks and other mobile vehicles, blasting activities and crushing activities	Personnel	Medium -Short to long term -Short term reversible or irreversible -Low to high in magnitude -One-off or continous	Medium (Medium importance and rarity)	Moderate	• -Use of related PPEs at works sites where noise monitoring results are in excess of required limits or where grievances by the personnel regarding noise are received • -Mandatory use of related PPEs during blasting activities • -Periodic medical checks by the site doctor • -Considering changing equipment or implementing time limits in case of a grievance regarding vibration • -Implementation of the Occupational Health and Safety Management Plan • -Implementation of Health, Safety and Environment Manual for Sub-Employers • -Implementation of the Transport/Traffic Management Plan	Negligible
OHS/ Site Traffic: -Accidents that may potentially be sourced from improper traffic management	Personnel	Medium -Short term -Short term reversible or irreversible -Low to high in magnitude -One-off	Medium (Medium importance and rarity)	Moderate	• -Implementation of the Transport/Traffic Management Plan • -Providing traffic trainings for all personnel and providing specialized trainings to personnel that will operate industrial vehicles and workers • -Inclusion of traffic issues for trainings that site visitors will receive and limiting site visitors' mobility on construction sites	Negligible

Impact Description	Receptor	Expected Potential Impact Severity	Sensitivity Value of Resouce Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
					• -Restricting operation of industrial vehicles to those that are trained and competent (licensed if required) • -Conducting periodic medical checks of drivers • -Installation and maintenance of signage and other traffic regulating means- Setting speed limits, right of way practices, periodic vehicle maintenance and other traffic management practices where required • -Implementation of the Procedure on Road Safety and Driving • -Only personnel with sufficient competency will be allowed to operate heavy vehicles (personnel with relevant driving licenses)	
OHS/ Hazardous Materials Management: -OHS risks arising from improper management/handling of hazardous materials	Personnel	Medium -Short term -Short term reversible to irreversible -Low to high in magnitude -One-off	Medium (Medium importance and rarity)	Moderate	• -Specific trainings will be provided to related personnel • -Enforcement of mandatory use of protective equipment • -Implementation of the Oil and Chemicals Spill Response Plan • -Implementation of the Emergency Action Plan • -Implementation of the Emergency Preparedness Plan for the Kepezkaya Tailings Storage Facility	Minor
OHS/ Hazards due to Accidents and Incidents (e.g. Ergonomic injuries, falls from height, slips and falls, collisions with objects, exposure to sun, etc.)	Personnel	Medium -Short to long term -Short term reversible to long term reversible -Low to high in magnitude -One-off	Medium (Medium importance and rarity)	Moderate	• -Impelemntation of the OHS Plan • -Implementation of the Contractor Control Management Plan • -Implementation of the Emergency Action Plan • -Implementation of the Fire Prevention and Fire Protection Plan • -Implementation of related procedures • -Provision of general and specialized OHS trainings • -Use of related PPEs and encouragement of other	Minor

Impact Description	Receptor	Expected Potential Impact Severity	Sensitivity Value of Resouce Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
					protective means such as sunblockers • -Implementation of limits on manual lifting/handling • -Installation of guard rails, signs • -Ensuring sufficient illumination • -Allowing only competent personnel to conduct works at height • -Regular visual checks and maintenance/cleanup of excavation debris and other potential risk sources such as cables and ropes • -Restricting operation of heavy machinery to those that are trained and competent (licensed if required) • -Ensuring sufficient illumination • -Periodic medical checks	
OHS/ Diseases: -Heightened risk of exposure to diseases in both the workforce and the local communities	Personnel	Low -Short term -Short term reversible -Low to medium in magnitude -One-off	Low (Low or medium importance and rarity)	Minor	• -Adequate accommodation arrangements • -Periodic medical checks for personnel and provision of vaccination and/or other mitigating measures • -Implementation of appropriate waste management practices and the Waste Management Plan • -Keeping a suitable patient transport vehicle on site	Negligible
Community HS/ Air Quality: -Emissions affective on community health, sourced from open pit activities, transportation activities, crushing and screening activities and erosion	Communities	Low -Medium to long term -Long term reversible -Low in magnitude - One-off or continuous	Medium (medium importance and rarity)	Moderate	• -Implement measures related to air quality identified in relevant sections of this report. • -See SIA Report given in Volume-II of the ESIA Disclosure Package for further mitigation.	Minor

Impact Description	Receptor	Expected Potential Impact Severity	Sensitivity Value of Resouce Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Community HS/ Hazardous Materials Management: -OHS risks arising from improper management/handling of hazardous materials (including tailings management)	Communities	Low -Short to long term -Short term reversible to irreversible -Medium to high in magnitude -One-off	High (High importance and rarity)	Moderate	• -No additional measures required, other than measures proposed in relevant sections of the ESIA.	Negligible
Community HS/ Blasting Activities: -Potential landslides that may be induced by blasting activities	Communities	Medium -Short term -Short term reversible -Low to medium in magnitude -Intermittent	High	High	• -See SIA Report given in Volume-II of the ESIA Disclosure Package for further mitigation. • -Ensure compliance with the requirements of SEVESO III Directive.	Minor
Community HS/ Water Resources: -Potential decrease in water quantity -Prevention of access to water resources due to restriction of mobility of communities by the Project	Communities	Low -Short term -Short term reversible to irreversible -Low to medium in magnitude -One-off	Low (Low or medium importance and rarity)	Minor	• -Implement measures related to water resources management identified in related sections of this report. • -See SIA Report given in Volume-II of the ESIA Disclosure Package for further mitigation.	Negligible
Community HS/ Traffic and Road Safety: -Accidents that may potentially be sourced from improper traffic management -Increase in traffic load	Communities	Low -Short term -Short term reversible or irreversible -Low to high in magnitude -One-off	Meidum (Medium importance and rarity)	Moderate	• -No additional measures required, other than measures proposed in relevant sections of the ESIA.	Negligible

Impact Description	Receptor	Expected Potential Impact Severity	Sensitivity Value of Resouce Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Community HS/ Diseases: -Heightened risk of exposure to diseases in the local communities -Increased work load of local healthcare services	Communities	Low -Short term -Short term reversible -Low to medium in magnitude -One-off	Low (Low or medium importance and rarity)	Minor	• -See SIA Report given in Volume-II of the ESIA Disclosure Package for further mitigation.	Negligible
Community HS/ Natural Hazards: -Induced seismicity and landslides -WRD failures -Flooding and failure of TSF -Other floods	Communities	Medium -Short to long term -Short term reversible to irreversible -Low to high in magnitude -One-off	Medium (Medium importance and rarity)	Moderate	• -No additional measures required, other than measures proposed in relevant sections of the ESIA.	Minor

6.13 Cultural Heritage

Information presented in this section regarding the impact assessment and mitigation measures for cultural heritage within the Project area and its vicinity is taken from the “Gökırmak Copper Project Archaeological and Immovable Cultural Heritage Current State Impact Assessment Report” and “Gökirmak Copper Mine Project Intangible Cultural Heritage Report (2017)” prepared by Regio. The reports are presented in Volume-III of the ESIA Disclosure Package.

During the construction phase; potential impacts on chance finds may occur due to improper management of earthworks activities, potential impacts on existing immovable cultural heritage may occur due to dust and vibration generation and potential impacts on intangible cultural heritage may occur due to various factors such as worker influx. Since the operation phase of the Project will involve further earthworks and land alteration such as expansion excavations at the open pit area and land alteration in the WRD area, and since a large number of employees will remain on site for operation activities, Project’s construction phase potential impacts on cultural heritage are also of concern for the operation phase.

6.13.1 Immovable Cultural Heritage

Gökırmak Copper Project area is located in a territory covered with oak and pine forests stretching in two sides of the valley of Gökırmak, a tributary of Kızılırmak River. It was observed that the project activities have already begun in certain sites, where the installations will be built, and physical intervention was made on the ground. At the time of the field survey conducted in January 5-7, 2017, there were no construction activities on the locations of Bağdere TSF, Bağdere Surface Soil Storage, Pipeline and Process Plant-Closed Ore Stock Area. These areas could not be surveyed since they were covered with forests. Construction activities were under progress in other project areas.

As determined by Gökırmak Copper Project Archaeological and Immovable Cultural Heritage Current State Impact Assessment Report (Regio, 2017), no archaeological remains were encountered within the surveyed Project areas and there are no identified cultural heritage sites within the ETL and River Diversion corridors. However, earthworks and land alteration activities may damage chance finds during construction and operation phases, in case the Chance Find Procedure that is already in place is not implemented.

Some examples of civil architecture and a cemetery used until 19th Century were observed in the close vicinity of the Project area (none are classified as cultural heritage by Ankara Regional Board No:1 for Conservation of Cultural Assets). Of these, some of The Sepetçioğlu houses will be directly impacted by Project activities since some coincide with the open pit and the others are located very close to the open pit. As no archeological remains were encountered in the Project area, these houses and the Aşağıküreçay Cemetery located northwest of Çorakoğlu WRD emerge as the only immovable cultural heritage sites that will/may be affected by Project impacts such as dust and vibration during construction and operation.

For the future construction works in areas, which are currently not being used, an archaeological field survey will be conducted prior to any intervention.

6.13.2 Intangible Cultural Heritage

Among local communities, both positive and negative attitudes are common towards social and economic impacts of the Project. The area is generally poor and demographic figures show that existing economy does not provide a base for even keeping existing population. Accordingly, participant observations and interviews show that the attiude is leaning more towards positive side, due to expected economic impact of cadastral payments as well as job opportunities to be created. However, there are also concerns about disturbance of routine life due to expected mining traffic of heavy load vehicles, noise pollution of the explosions and most importantly losing some pasture areas used by their animals for grazing. These pastures usually belong to the state (not in private ownership) but used by the local settlers as "köy merası (common village pasture)”, especially by Dereköy and Sepetçioğlu settlement residents. The issue is particularly important for whom animal husbandry is their livelihood.

Residents of Sepetçioğlu do not reside in this settlement throughout the whole year, i.e. they occupy the settlement seasonally and all 16 houses are used as summerhouses. This settlement is very close to core activity area and will be resettled in the future.

Apart from these social and economic concerns, no site related to intangible cultural heritage of local communities was found to be intersected or destroyed by GCP.

6.13.3 Mitigation

For the management of potential archaeological and immovable cultural heritage and Project's impacts on these, the following mitigation measures will be in place:

- The Chance Find Procedure developed by Regio will be implemented by the Project owner and the contractors'/subcontractors' E&S teams throughout the construction and operation phases of the Project. All AMI, contractor and subcontractor personnel will be informed with regards to implementation of the Chance Finds Procedure.
- In case of a chance find, all activities that may potentially harm the archeological find will be ceased and the chance find will be recorded. The Museum Directorate will be contacted immediately for further actions.
- In case of a chance find, and if deemed necessary by the representative of the museum archeologist, the Project Management will be responsible of providing an archeological study team for the chance find to be investigated under the supervision of the museum archeologist and a report will be prepared.
- As part of Project ESMS, capacity building of construction workers on the implementation of "Chance Finds Procedure" for the conservation of potential cultural heritage will be conducted by the E&S teams of the Project owner.
- As construction works are currently underway in the Project area and some of the Sepetçioğlu houses coincide with the open pit and the remaining are very close, it is strongly recommended that measured drawings and pictures of these houses be prepared and submitted to the Ankara Regional Board No: 1 for Conservation of Cultural Assets for their archive. The technical documentation process will be carried out upon start of operations and to be finalized by the end of 2018. Before this process is completed, any application that may cause vibration such as use of explosives, drilling and rock crushing with heavy machines should be avoided in the site and its close vicinity.
- For the future construction works in areas which are currently not being used, an archaeological field survey will be conducted prior to any intervention.
- A Stakeholder Engagement Plan is in place. Ongoing information disclosure within the scope of stakeholder engagement will include any chance finds. In addition, awareness raising activities to be conducted will cover cultural heritage if required, such as the case of multiple chance finds in the area. Consultations with local communities will also be ensured in case of a chance find.
- A grievance mechanism is in place. In case of any grievance regarding immovable cultural heritage or intangible cultural heritage, the grievance will be responded to appropriately in compliance with the grievance procedure and additional measures will be developed to ensure that impacts on immovable or intangible cultural heritage is prevented.
- As stated above, no site related to intangible cultural heritage of local communities was found to be intersected or destroyed. Implementation of the Influx Management Plan, Stakeholder Engagement Plan and Livelihood Restoration Plan will provide for management and protection of intangible cultural heritage.

Summary of impacts and proposed mitigation measures are provided in Table 6-100.

Table 6-100 Summary of Impacts, Mitigation and Residual Impacts for Cultural Heritage

Impact Description	Receptor	Expected Potential Impact Severity	Sensitivity Value of Source Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
Damage to existing cultural heritage due to construction and operation activities (noise, dust, vibration)	Immovable cultural heritage	Low -Short term -Short term reversible -Low to medium in magnitude -Continuous	Low (Low or medium importance and rarity, local scale of importance)	Minor	• Ensure continual implementation of mitigation measures for noise, dust and vibration control for occupational and community H&S • Ensure drawings and pictures of identified civil architecture examples (identified houses) be prepared and submitted to the Ankara Regional Board No: 1 for Conservation of Cultural Assets for their archive at least by the end of 2018. Before these activities are completed, any application that may cause vibration such as use of explosives, drilling and rock crushing with heavy machines will be avoided in the site and its close vicinity.	Negligible
Damage to cultural heritage	Chance finds and immovable cultural heritage	Medium -Short term -Long term reversible or irreversible -Low to high in magnitude -One-off	Medium (Medium importance and rarity, regional scale of importance)	Moderate	• Implement the Chance Finds Procedure • Provide cultural heritage and its conservation trainings to AMI, contractor and sub-contractor personnel be conducted by the E&S teams of the Project owner. • In case of a chance find, stop all activities that may potentially harm the archaeological find and record the chance find. • Depending on the categorization of the chance find, take related measures and contact the Museum Directorate immediately for further actions. • In case of a chance find, and if deemed necessary by the representative of the museum archaeologist, provide an archaeological study team for the chance find to be investigated under the supervision of the museum archaeologist. Prepare a report based on the archaeological study, including any additional actions and mitigation measures to be taken regarding the	Negligible

Impact Description	Receptor	Expected Potential Impact Severity	Sensitivity Value of Source Receptor	Impact Significance (prior to mitigation or with existing mitigation)	Proposed Mitigation Measures	Residual Impact Significance
					chance find. • Ensure consultations with local communities in case of a chance find. • Include any chance finds within the scope of ongoing information disclosure to be conducted in the extent of stakeholder engagement. • If required, conduct awareness raising activities for cultural heritage, such as the case of multiple chance finds in the area. • Implement the grievance mechanism. In case of any grievance regarding immovable cultural heritage or intangible cultural heritage, the grievance will be responded to appropriately in compliance with the grievance procedure and additional measures will be developed to ensure that impacts on immovable or intangible cultural heritage is prevented.	
Loss of Intangible Cultural Heritage	Local Communities	Medium -Long term -Long term reversible -Low to medium in magnitude -Continuous	Low (Low or medium importance and rarity, local scale of importance)	Minor	• Implement the Influx Management Plan • Implement the Stakeholder Engagement Plan • Implement the Livelihood Restoration Plan • Implement Cumulative Impact Management Plan • Ensure that the project does not duly impact on local practices and skills	Negligible

6.14 Closure and Rehabilitation Impacts

This section explains potential impacts that might occur during the post-mining land use of the mine units and mine closure implementation for the Gökırmak Copper Project and provides an overview of rehabilitation plans for the open pit, the waste rock dump, the processing plant, the tailings dam, and other related facilities. Mine closure needs to be progressively updated over the course of mining operations as more site- specific information is acquired. It is also proposed that progressive remediation will be implemented throughout the mine life, including the re-grading, cover placement, and re- vegetation of exposed final surfaces at the open pit and the waste rock storage area.

There are strict rules which regulate land use in long term. The land use rights of privately owned lands belong to owner under laws and regulations. The rehabilitation plans for forest, pasture, and public properties should be submitted before starting to use the land for mining purposes. These lands cannot be rehabilitated for different purposes without permission from Kastaonu Regional Directorate of Forestry.

As part of the application for forestry permits, the Rehabilitation of Degraded Forests (RDF) requires a rehabilitation plan which includes conceptual details for mine closure. Forestry law clearly describes the principal decrees that are to be complied in using forest areas. According to the forestry law, forest areas are unsalable and not able to be indefinitely transferred. Forest areas will temporarily be leased by AMI to carry out mining activities and will be delivered back to the Regional Directorate of Forestry after all rehabilitation work is completed.

Details on closure objectives and post-mining land use for each Project Unit are given in Preliminary Mine Closure Plan in Volume IV of the ESIA Disclosure Package while completion criteria to prevent/minimize the closure impacts are provided in the following sections.

Closure and rehabilitation impacts will depend on the issues related to long term physical and chemical stability,, land use, visual impact assessment, implementation and long term success of progressive rehabilitation and human health concerns.

6.14.1 Physical Stability of Project Units

6.14.1.1 Open-Pit and Çorakoğlu WRD Stability

After the mine closure, open pit walls should be physically stable in long term. During the operational phase, short term slope stability optimization takes place but optimal slope angles in short term are not always the same as long term stability conditions. Therefore, slope angles should be rearranged for long term stability conditions with additional excavation or blasting.

Open pit rehabilitation is expected to take 2 to 3 years and is planned to start once the ore extraction is completely over. The open pit will be allowed to be flooded by the Gökırmak River by removal of the cofferdams of Gökırmak River Diversion resetting the Gökırmak River to its original course and allowing the river to flow directly into the open pit (see Figure 6-47). According to three runs and assuming different amounts of water need at the downstream, the pit lake level will stabilize ~4 months (Demirci HEPP water use = 10 m^3/s), ~4 months (Demirci HEPP water use = 15 m^3/s) and ~2.5 years (Demirci HEPP water use = 20 m^3/s), respectively, after the closure of mine.

Details on flooding the open pit by Gökırmak River, pit lake modelling study, impacts and related measures are provided in “Section 6.7 Water Resources”.

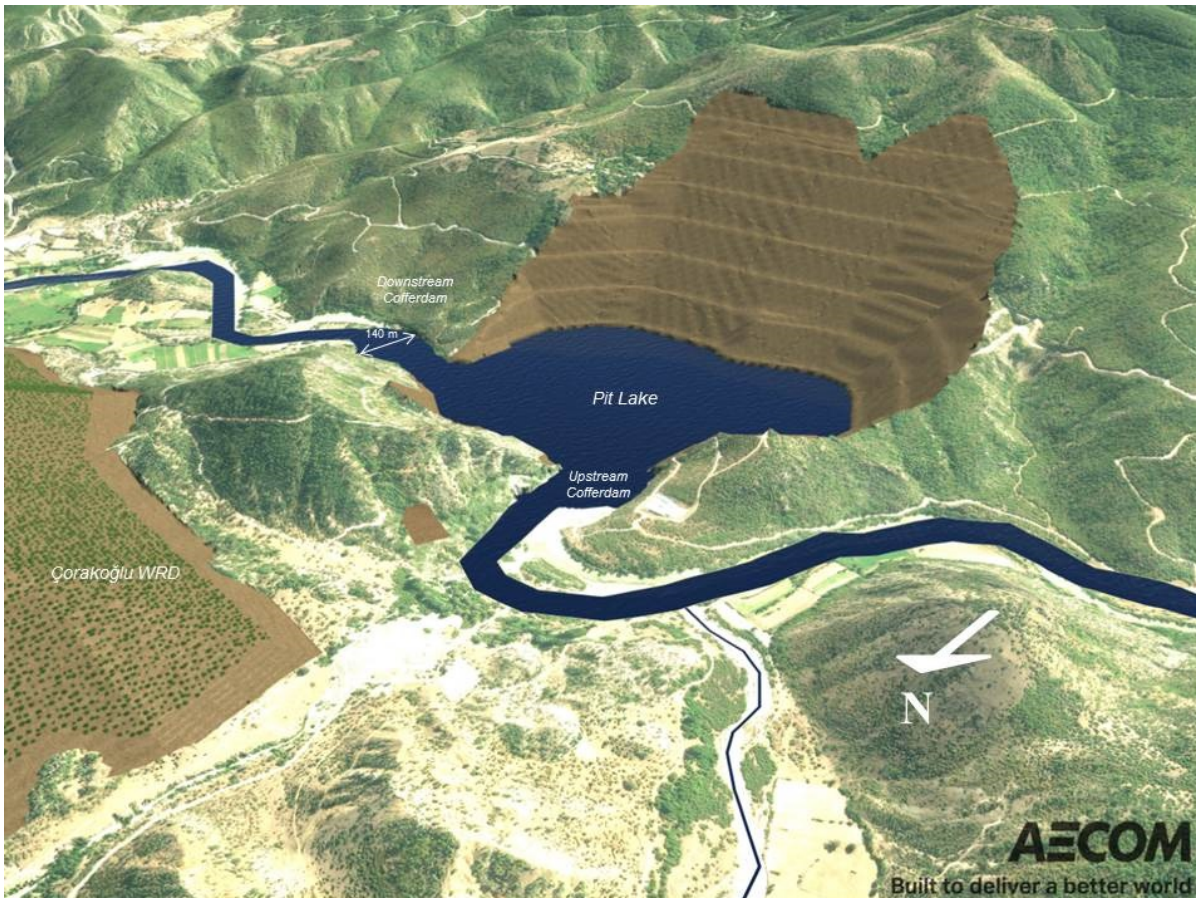


Figure 6-47 Conceptual closure scenario for the open pit to be flooded by the Gökırmak River

As is the case with the open pit, Çorakoğlu WRD shall also be physically stable in the long term. This unit will be progressively remediated during its lifetime, meaning that as disposal of the planned total amount of wasterock at its certain sections is completed, these sections will immediately be rehabilitated, including re-grading, cover placement, and re- vegetation of exposed final surfaces.

Potential impacts related to open pit and WRD physical stability are described below:

- Since open pit closure activities will be conducted once all ore production activities are finalized, non-rehabilitated open pit benches will remain in direct contact with surface waters for a long time. Therefore, until rehabilitation commences, water erosion may cause damage to open pit walls. This in turn may heighten the risk of geotechnical unstability and failure potential prior to during the closure phase. It may also increase difficulties in implementation of closure activities and raise closure phase costs related to slope stability.
- Slope stability problems and failure of open pit walls during closure activities and in the long term may result in OHS risks, community health and safety risks and economic losses (i.e. loss of agricultural land and crops, loss of equipment, loss of structures, etc.)
- In case a large scale failure of open pit walls occur after the open pit is converted into a lake by diverting the Gökırmak River into the open pit, the failure may cause flooding in the vicinity. As this would be a flashflood, it may result in community health and safety risks and economic losses such as loss of crops.
- The only potential impact source related to WRD closure activities is slope stability problems and failure during closure activities and in the long term, which may result in OHS risks, community health and safety risks and economic losses.

6.14.1.2 Kepezkaya TSF Stability

Regarding a chance of dam break, Risk Assessment for the Kepezkaya Tailings Storage Facility Report (April 2017, Golder) states that “the TSF has a sufficient factor of safety based on the conservative geotechnical parameters used in the stability analysis and the risk assessment for the operational phase is satisfactory”.

To ensure highest possible safety of the Kepezkaya TSF, a stabilising buttress has been added to design, which resulted in the following:

- The stabilizing buttress has reduced the risk associated with slope failure of the TSF during the post closure phase by 2 orders of magnitude.
- The risk associated with tailings release from the TSF during post closure was reduced by a significant 88%.

Annual probability of tailings release is 1/32,928 (3.04x10-5) during post closure prior to capping, 1/ 679,462 (1.47x10-6) during post closure after capping and 1/761,202 (1.13x10-6) during post closure after capping together with Emergency Drainage System.

It should be noted that Golder’s risk assessment states that $1x10^{-6}$ probability of dam failure means almost impossible or negligible and 1x10-5 probability of dam failure means highly improbable. As stated above, the highest dam failure probability identified for Kepezkaya TSF is $3.04x10^{-5}$, which corresponds to highly improbable. Therefore, existing design measures are sufficient for the TSF’s closure phase stability.

6.14.2 Chemical Stability of Project Units

As described in “Section 6.8 Mining Waste”, the proposed cover design for the Çorakoğlu WRD that will be implemented during the closure phase is formed of a lower gravel level with nominal thickness of 15 cm, a layer of clay with nominal thickness of 50 cm on top of the lower gravel level and an additional upper layer of gravel with nominal thickness 10 cm. In addition, the upper gravel layer will be covered by soil/overburden to facilitate re-vegetation. Therefore, rainfall on the WRD will pass through the upper vegetated soil layer, some of it evaporating and a portion of the rainfall will be transpired into the atmosphere.

Following closure of the Kepezkaya TSF, the facility will be capped with a system consisting of a geomembrane and a crest capping layer which will be equipped with a drainage collection system. The cap is some 1.8 m thick and would infill the majority of the operational freeboard. Therefore, at closure, there is only a limited capacity for the facility to retain water, however, if this water is not allowed to drain, it could overtop the dam resulting in erosion which if not dealt with, could result in exposure and release of tailings (Risk Assessment for the Kepezkaya Tailings Storage Facility, April 2017, Golder). It should be noted that although design studies for Bağdere TSF has not been initiated yet, as this unit is required to be operational approximately after 5 years of production, it will also utilize similar impermeability and drainage measures.

Modelling studies for the open pit, the WRD and the TSFs, chemical stability and acid rock drainage impacts, design based measures and additional mitigation measures are described in detail in “Section 6.7.2 Impacts on Water Resources”.

6.14.3 Land Use and Visual Amenity

Progressive rehabilitation is proposed throughout the life of the Project. The final land use objectives will be stable and self-sustainable native grass and woodlands consistent with the surrounding undisturbed areas will be used. Rehabilitated landscapes are unlikely to look the same as they did prior to the existence of the mine. However, they will potentially blend more consistently into their wider surroundings than they would if left un-rehabilitated. The colours visible in these rehabilitated landscapes are also likely to be noticeably different to that which currently exists. This is due to the new growth of grass seed and juvenile trees, which may stand out as being somewhat greener than surrounding areas. It should be also noted that the residual impacts would only be mitigated to acceptable levels once afforestation and rehabilitation works show their effectiveness within years after implementation.

Even though there is no regulatory requirement, visual amenity of rehabilitated mine sites can be subjected to use for tourism purposes. Rehabilitated mine sites can be used especially by the local community. Visual amenity for the rehabilitated areas also brings in an extra reputation for the company.

See Section 6.2 for details on visual impacts and mitigation measures related to rehabilitation.

6.14.4 Other

According to the greenhouse gas emissions calculations, an estimated 11,654 tonnes CO_2-e will be released to the atmosphere during the closure phase. This corresponds to approximately 0.9% of the Project's estimated lifetime GHG emissions. Details on closure phase GHG emissions and general mitigation measures are provided in the relevant section on Greenhouse Gas Emissions.

Other than the specific impacts described above, remaining closure phase impacts of the Project stem from dismantling/uninstalling of Project units and infrastructure and transportation activities. These impacts are the same with or very similar to construction phase impacts, since these activities are basically construction activities. Therefore, impact assessment and mitigation measures provided for construction phase air quality, noise, wastewater management, non-mining waste management and occupational health and safety are also applicable for closure phase.

6.14.5 Development of Completion Criteria

Within the scope of the closure issues, the mine closure and completion criteria for GCP was identified to eliminate and/or reduce the impacts of mining and mineral processing and to reach a long-term stability of the mine units after mine closure and reclamation. The ultimate objective of the closure is to leave the Project Area in a condition that meets national and international environmental regulatory requirements and satisfies other stakeholder expectations.

The completion criteria outlining the closure objectives are summarized below while detailed information on each issue is given in Table 6-101.

- Compliance with regulatory requirements,
- Compatibility with agreed post-mining land use,
- Physical safety,
- Physical and chemical stability,
- Revegetated or otherwise improved,
- Satisfactory visual amenity.

Table 6-101 Gökırmak Copper Mine Compliance Criteria

Issues of Concern Regarding Potential Impacts	Criterion Objective	Mine Unit	Criterion Standard or Milestone	Verification Procedure / Mitigation Measures
Final Land Use	Agreed final land use will be applied.	All	End land use for the open pit area will be partially an open pit lake and partially forestry land. The final land use of waste rock dump areas, Kepezkaya Processing Plant, and tailings storage areas will be forestry land. However, there would be a continuous consultation work with relevant stakeholders, and administering authority during the life of the mine for final land use of Project units.	Land use and objectives are documented in the Mine Closure Plan and will be verified by a mine closure audit during final cessation of mine operations.
Safety	The site is safe for use by humans and wildlife under the agreed final land use.	All	All hazards that could endanger the safety local communities or biodiversity features will be identified and eliminated where possible, or will be controlled through appropriate active control measures (e.g. fences, warning signs, etc.).	All relevant Turkish safety regulations will be applied. Safety of all mine unit sites will be controlled by related regulatory body via an audit for safety of human use.
Geotechnical Stability	Reclaimed mine units are physically and chemically stable.	All	Mine units will be rehabilitated as described in criterion “Final Land Use”. Their structural stability will be checked and no significant or failure of constructed slopes or berms will be allowed. The physical and chemical stability of mine units will be controlled especially for erosion, water leakage, ARD occurrence. Inspections of the rehabilitated mine units will be conducted to monitor their physical and chemical stability over time. AMI will collect large amounts of site specific stability data regarding the open pit walls. This data will continuously be used for redesign and re-contouring of pit walls in a way that ensures highest level of stability in the long term. Slope angles will also be selected and modified where	Reports on mine unit rehabilitation and required maintenance will be prepared. These proposals will be controlled via rehabilitation inspections.

Issues of Concern Regarding Potential Impacts	Criterion Objective	Mine Unit	Criterion Standard or Milestone	Verification Procedure / Mitigation Measures
			required to ensure long term stability. These measures will prevent any large scale failure after mine closure, rendering a flooding event that may occur from pit lake after such an event improbable.	
Visual Amenity	Visual amenity of rehabilitated mine units will be harmonious with that of regional landforms.	All except Open Pit Lake	All mining units will be rehabilitated in a manner that they are blending into the surrounding landscape and are similar to the existing local landforms.	Report on rehabilitation works and rehabilitation inspections will be validated the final visual amenity.
Sustainability	Rehabilitation is sustainable and the land capability for the agreed end land use. Surface and groundwater quality will be similar to pre- mining conditions or better.	All where relevant mine units.	Monitoring, research data and site inspections will indicate that the rehabilitation will be sustainable and will continue to fulfil rehabilitation objectives relating to the agreed final land use in terms of flora, vegetation, and fauna. Additionally, surface water and groundwater quality is similar to pre-mining conditions or better.	This data will be documented in relevant monitoring and research reports; and verified by site inspections.
Vegetation Development	Vegetation is suited to the agreed final land use.	All with revegetation	Established vegetative cover should be self-sustaining and similar to the surrounding undisturbed vegetation. Monitoring of rehabilitated areas will be undertaken until it can be demonstrated that the landscape and vegetation is progressing towards a self-sustaining state. A target for revegetation cover will be developed.	Monitoring of rehabilitation development vegetation. Monitoring results will be reported in site inspections and rehabilitation monitoring sites to assess whether criteria have been met.
Surface Water	Rehabilitation drainage patterns have been established and impacts on natural surface water flows minimized.	All where relevant	The quality and quantity of water returned to local and regional surface water resources will be in similar prior to mining. Surface water quality should fall within same Turkish Water Quality standards similar to conditions prior to mining. Water quality monitoring of surface water will be undertaken after significant rainfall events, and	Monitoring results will be reported. Site inspection to verify no unplanned impacts on surrounding natural drainage patterns.

Issues of Concern Regarding Potential Impacts	Criterion Objective	Mine Unit	Criterion Standard or Milestone	Verification Procedure / Mitigation Measures
			monitoring results will be reported. There are no significant, physical off-site impacts. A drainage management plan will be prepared, showing the inputs, outputs and control structures needed for surface water flow.	
Groundwater	Mining-related impacts on groundwater will be minimized.	All where relevant	In the event that monitoring identifies a contamination of groundwater resources in the open pit, waste rock dump areas, processing plant, and tailing storage facilities, an investigation will be conducted to determine whether the contamination is the result of mining related activities; and where this is the case, management measures will be implemented to decontaminate the affected area.	Review compliance of operations with the relevant water extraction license(s) issued by DSI. Review of water monitoring reports to ensure there are no unplanned impacts to receptors.
Infrastructure	Infrastructure will be decommissioned and removed (as not otherwise agreed by the stakeholder consultations)	All infrastructure exists	Final usage of some infrastructures (make-up water pipeline, haulage roads, etc.) will be decided by stakeholder consultations. Afterwards required arrangements will be signed with the related governing bodies. Infrastructure not required will be removed (recycled/reused where possible) and the site will be rehabilitated to the approved post-mining land use.	Site inspection and documentation of infrastructure removal and related rehabilitation operations.
Contaminated Sites with hydrocarbons	Sites with hydrocarbons contamination will be documented and rehabilitated according to the Turkish regulations	All where relevant	All commitments relating to the identification and management of contaminated sites, as per Regulation on Soil Pollution Control and Point Source Contaminated Sites 2010 will be fulfilled.	Report documenting compliance with specific requirements.

6.14.6 Closure Implementation

This preliminary plan will be revised every three years and will be finalized at least two years prior to the planned end of Gökırmak Copper Project, a revised Mine Closure Plan to contain more specific detail on the planning and implementation of the decommissioning phase. Any issues and programs regarding mine closure should be reviewed and updated regularly to implement any change that might occur during the operation phase of the Project.

In addition to the topics provided in previous sections, information obtained from operational activities and ongoing environmental monitoring (mine water quality and quantity, onsite meteorological data, air quality, soil quality and etc.) will help to improve strategies on rehabilitation. A progressive rehabilitation needs to be implemented by taking the account of;

- Updated design of final landforms,
- Design of drainage structures for successful management of mine waters,
- Revision on source and amount for different type of earthwork materials to be used during rehabilitation,
- Effective re-vegetation of the disturbed mining units,
- Ongoing monitoring on rehabilitation.

Taking into account that GCP is currently in construction phase, existing level of detail on strategy and activities on decommissioning phase of the Project is limited. Therefore, several other issues should be further refined for the decommissioning phase of the Project. Some of these include but are not limited to:

- Demolition decommissioning of mining facilities and infrastructure,
- Review of monitoring plan for finalizing the post closure monitoring and maintenance program,
- Completion of rehabilitation,
- Ongoing consultation with stakeholders.

7. CUMULATIVE ENVIRONMENTAL IMPACT ASSESSMENT

This section of the EIA Report presents the Cumulative Impact Assessment (CIA) of Gökırmak Copper Project (GCP) within the scope of its impacts. The CIA takes into account the projects which currently exist and are reasonably foreseeable near the Project, in an area where these Projects have the potential to cause cumulative impacts with the Project.

EBRD PR 1 references the need for the environmental and social assessment process to consider cumulative impacts of the project in combination with impacts from other relevant past, present and reasonably foreseeable developments as well as unplanned but predictable activities enabled by the project that may occur later or at a different location. Requirements for conducting a CIA are also included in PR 3 - Resource Efficiency and Pollution Prevention and Control and PR 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources.

The Good Practice Handbook “Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets” defines cumulative impacts as; “impacts that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones” and states that “multiple and successive environmental and social impacts from existing developments, combined with the potential incremental impacts resulting from proposed and/or anticipated future developments, may result in significant cumulative impacts that would not be expected in the case of a stand-alone development” (IFC, 2013).

The concept of CIA has been recently inserted into Annex 3 (General Format of the EIA) of the Turkish EIA Regulation (Official Gazette No. 28784, dated 3 October 2013). However, the description requirements or methods of CIA are still not provided in the current EIA Regulation (Official Gazette No. 29186, dated 25 November 2014) or in any other regulations. In defining the process for implementing a CIA, international guidelines and standards are taken into consideration.

7.1 Approach to Undertaking Cumulative Impact Assessment

Potential cumulative environmental impacts associated with the Project and other existing and reasonably foreseeable projects, in a spatial context which have the potential to create cumulative impacts together with the Project, are assessed.

- CIA Study Area: The Project is located towards the western border of Hanönü district with Taşköprü district. The northern, southern and eastern borders of Hanönü district on the other hand are located significantly far to the Project area. Therefore, for the purposes of this CIA, Hanönü and Taşköprü districts were selected as the CIA study area.
- Determination of projects to be included in CIA: In order to assess the cumulative environmental impacts, existing projects (under construction or in operation as of 2017) and reasonably foreseeable future projects (at planning/(pre)feasibility/design stage as of early 2017) located in Hanönü and Taşköprü districts that will potentially create cumulative impacts were identified. Projects located at a considerable distance from the Project area (i.e. over 25 km) were not included in the study.
- Definition of temporal boundary: The CIA assessed the potential cumulative environmental impacts for construction and operation phases of the Project. It should be noted that both construction and operation phases of most of the projects identified in the former CIA step is considerably shorter than the GCP’s and therefore the timeframes they will contribute to cumulative impacts are also shorter.
- Identification of key environmental issues: The reasonably foreseeable future projects that are likely to generate cumulative impacts together with the GCP were screened in terms of all environmental issues considered within this study to determine the key environmental issues where potential cumulative impacts could occur.

Eventhough the environmental effects of any single project upon any single receptor/ resource may not be significant, the resulting cumulative effect may be significant when individual effects are considered in combination. The focus in assigning significance to cumulative effects should be determined by the extent to which the impacts can be accommodated by the receptor/resource. Thresholds (limits beyond which cumulative change becomes a concern) and indicative levels of acceptable performance of a receptor/resource may also aid the assessment process (UK HA 205/08: co.uk /ha/standards/dmrb/). The matrix to be used for the assessment of cumulative impacts' significance is presented in Table 7-1.

Table 7-1 Criteria for Determining Significance of Cumulative Impacts

Significance	Impact
Severe	Impacts that the decision-maker must take into account as the receptor/resource is irretrievably compromised.
Major	Impacts that may become key decision-making issue
Moderate	Impacts that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performance.
Minor	Impacts that are locally significant.
Not Significant	Impacts that are beyond the current forecasting ability or are within the ability of the resource to absorb such change.

Source: UK HA 2005/08; co.uk /ha/standards/dmrb/).

7.2 Limitations of the Cumulative Impact Assessment

In this CIA study, potential cumulative environmental impacts were assessed for (i) the construction phase and (ii) operation phase of the Project. There are a number of limitations to the assessment of the cumulative impacts of the Project with other projects over a wide area and over a long period of time. Most of these limitations would apply to many projects of similar scale and duration. The main limitations are:

- The available information on future projects is variable and in many cases very limited. Therefore, their physical characteristics are uncertain or subject to change. The timing of many future projects may be subject to change.
- Some of the other projects have not been subject to environmental and social impact assessments (or the assessments are not accessible) as yet and the effects of these possible developments have therefore not been documented.
- Cumulative impacts will be influenced by policies and developments outside of the study area.

Given the limitations described above, this CIA has been prepared to establish at a very broad level the types of effects that could occur as a result of the Project in addition to other projects.

It should be noted that mitigating the potential negative cumulative impacts are not solely the responsibility of AMI. Therefore, other project owners, relevant local and national authorities should also take responsibility to mitigate the potential impacts identified.

7.3 Identified Projects

Cumulative impacts can occur when there is "spatial crowding" or "temporal crowding". "Spatial crowding" occurs as a result of overlapping impacts from various actions on the same valued environmental or social component in a limited area (e.g. CIA area), while "temporal crowding" occurs when there is "temporal crowding" as impacts on a VEC from different actions occur in a shorter period of time than the VEC needs to recover (IFC, 2013).

To assess “spatial crowding”, existing and reasonably foreseeable future projects located/planned within the specified CIA area have been identified based on a review of the public databases of relevant governmental institutions (i.e. Ministry of Environment and Urbanization) and findings of the site surveys. Figure 7-1 shows the locations of the projects included in the CIA assessment, while details of the projects are provided in the following sections.

With regard to “temporal crowding”, individual schedules of the identified projects/activities have been collectively assessed in consideration of the schedule of Gökırmak Copper Project. In this scope, information contained in the readily available Project Description Files of the reasonably foreseeable projects has been analyzed. When overlapping the individual schedules, it has been assumed that the implementation of projects (construction or operation depending on the nature of the activity) have started immediately following the issuance of relevant EIA decisions. When there is no precise information about the operational life of the mining or exploration projects, durations of the existing licenses have been assumed as the operational life of the activity. It should be however noted that the license duration may be extended by the owner if applied and approved by authorities in accordance with relevant national legislation. Table 7-2 provides an overlapped schedule of the projects/activities that would contribute to the potential cumulative impacts within the CIA area.

7.3.1 Existing Projects

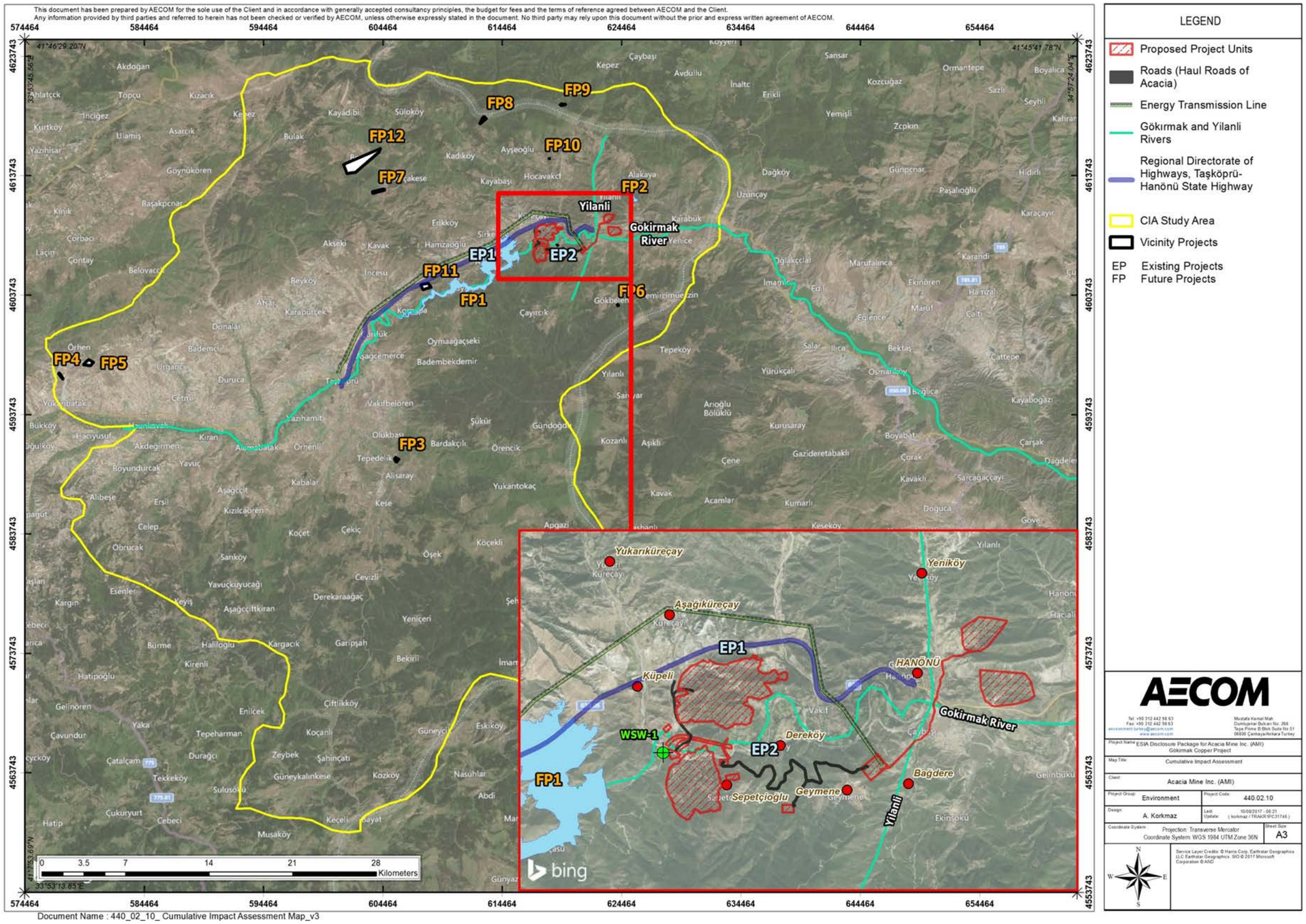
Existing projects are defined as projects under construction or in operation as of 2017 which have the potential to create cumulative environmental impacts together with GCP. These projects are:

- Regional Directorate of Highways, Taşköprü-Hanönü State Highway (In operation - Construction of the highwayin the vicinity of GCP completed)
- Türkerler Enerji, Demirci HEPP (In operation - located at approximately 8 km distance to the eastern border of the Project Area)

7.3.2 Reasonably Foreseeable Future Projects

Reasonably foreseeable future projects are defined as projects at planning/(pre)feasibility/design phase as of 2017 which have the potential to create cumulative environmental impacts together with GCP. EIA Reports/Project Description Reports of the following projects were identified via the website of Kastamonu Provincial Directorate of Environment and Urbanization Projects with denied, cancelled and terminated licenses/permits, which in future may regain the licenses/permits required for their activities are also categorized as reasonably foreseeable projects. No such project was identified.

- Taşköprü Dam
- Gökçeağaç Pond (including material borrow sites)
- Alisaray Sandstone Quarry
- Örhen Stone Quarry and Crushing Screening Plant
- Yaşar Böyük Marble Quarry
- Demir Export Mine Exploration Activities for the 201200756 License Numbered 4th Group Mining Site
- 4th Group Mines Mining License Survey for Kastamonu Province, Taşköprü District, Bürnük Neighborhood
- 4th Group Mines Exploration License Survey for Three License Sites
- 4th Group Mines Exploration License Survey for License Site 201200025 (ER:3157349)
- IIA Group Stone (Limestone) Quarry and Crushing Screening Plant



LEGEND

- Proposed Project Units
- Roads (Haul Roads of Acacia)
- Energy Transmission Line
- Gökırmak and Yilanli Rivers
- Regional Directorate of Highways, Taşköprü-Hanönü State Highway
- CIA Study Area
- Vicinity Projects

EP Existing Projects
FP Future Projects

AECOM

Project Name: ESIA Disclosure Package for Acacia Mine Inc. (AMI) Gökırmak Copper Project
Map Title: Cumulative Impact Assessment
Client: Acacia Mine Inc. (AMI)
Project Group: Environment
Project Code: 440.02.10
Design: A. Korkmaz
Coordinate System: Projection: Transverse Mercator; Coordinate System: WGS 1984 UTM Zone 36N
Sheet Size: A3

Document Name : 440_02_10_ Cumulative Impact Assessment Map_v3

Figure 7-1 Cumulative Impact Assessment Map

Table 7-2 Overlapped Schedule of Projects/Activities that may contribute to Potential Cumulative Impacts

Code	Projects/Activities	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
GCP	**Gökırmak Copper Project**																		
	Other Existing Projects																		
EP1	Taşköprü-Hanönü State Highway																		
EP2	Demirci HEPP																		
	Reasonably Foreseeable Future Projects																		
FP1	Taşköprü Dam																		
FP2	Gökçeağaç Pond																		
FP3	Alisaray Sandstone Quarry																		
FP4	IA Group Stone (Limestone) Quarry and Crushing Plant																		
FP5	Örhen Stone Quarry and CS Plant																		
FP6	Yaşar Böyük Marble Quarry																		
FP7	Demir Export Mine Exploration Activities																		
FP8	4th Group Mining License Survey																		
FP9	4th Group Mines Exploration License Survey for 3 Sites																		
FP10	4th Group Mines Exploration License Survey for License Site 201200025																		
FP11	IIA Group Stone (Limestone) Quarry and Crushing Screening Plant																		

Color Code:

- Issuance of EIA Decision
- Construction
- Operation
- Closure

7.4 Valued Environmental and Social Components

The good Cumulative Impact Assessment (CIA) practice suggests that the CIA studies are conducted with a focus on the valued ecosystem components that would be environmentally or socially important in assessing the risks of a Project, which are in this report referred to as valued environmental and social components (VESCs).

Accordingly, the CIA studies should be looked at “from the VESCs point of view” in which the combined (i.e., cumulative) effects of various projects/activites on each VESC are assessed, instead of a Project-centered perspective as in the case in the ESIA studies. As suggested by IFC in its Good Practice Handbook on CIA, the Project-centered perspective of the ESIA and the VEC-centered perspective of Cumulative Impact Assessment processes are comparatively illustrated in Figure 7-2.



ESIA Perspective (Project-centered)

CIA Perspective (VEC/VESC-Centered Perspective)

Figure 7-2 Project-centered perspective of ESIA and VESC-centered perspective of CIA

In line with the good CIA perspectives as explained above, the CIA study for the GCP will focus on the effects on the selected VESCs that are to be affected by the GCP activities. In other words, any VESC that would be affected by other projects/activites identified to be located in the CIA study area, but not by the GCP, will not be assessed in the scope of the CIA. This approach of the study is illustrated in the sketch given in Figure 7-3. As can be seen, although the fish is affected by one of the other actions, it should not be considered as VEC in the scope of a cumulative impact assessment to be done for the proposed project, because it is not affected by the proposed action under review.

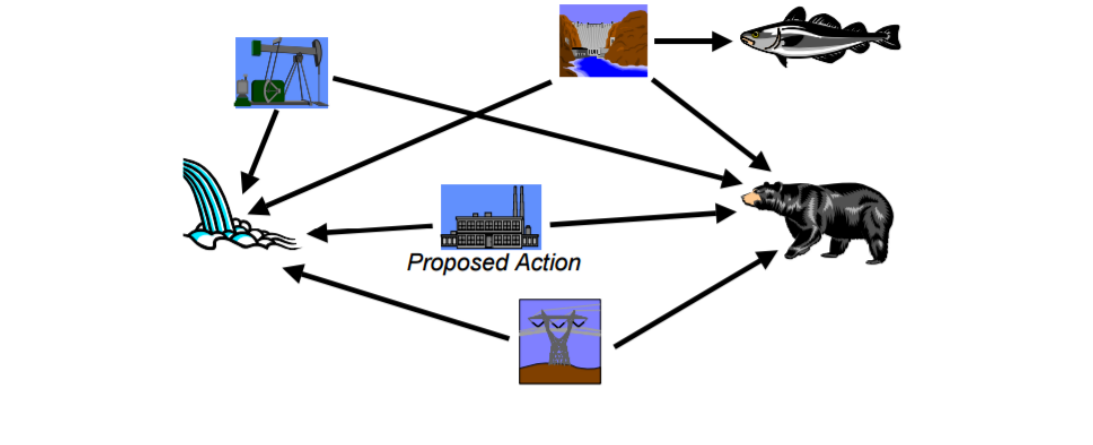


Figure 7-3 Focusing on Effects on VECs

Source: Effects Assessment Working Group for the Canadian Environmental Assessment Agency; Hegmann, G. C. Cockling, R. Creasey, S. Dupuis, Kennedy, L. Kingsley, W. Rodd, H. Spaling and D. Stalker, February 1999

In line with the VESC-centered approach of good CIA practice, firstly, key environmental issues that are likely to be subject of potential cumulative impacts have been identified for the GCP as follows:

- Air emissions
- Greenhouse gas emissions
- Noise
- Water use
- Water Quality
- Land Use, Biodiversity and Living Natural Resources
- Landscape and Visual features

Under these key environmental issues, the valued environmental or social components (VESCs) that would be subject to the potential cumulative impacts have been determined based on the assessments done in the previous chapters of this ESIA Report. The valued environmental and social components to be considered in the scope of the CIA are summarized in Table 7-3.

Table 7-3 Valued Environmental and Social Components in the scope of the CIA

Key Issue	Valued Environmental/Social Component
Air Emissions	Local communities (Hanönü, Küpeli, Bağdere, Dereköy, Geymene, Aşağıküreçay)
Noise	Local communities (Hanönü, Küpeli)
Water Use	Water resources of local communities: Kupeli and Aşağıküreçay's water supply well (WSW-1)
Water Quality	Gökırmak River, Yılanlı Stream, Taskopru Reservoir
Land Use, Biodiversity and Living Resources	Forests (Broad-leaved, coniferous, mixed) Shrubs (Transitional woodland-shrub) Gökırmak River Agricultural areas (with regard to ecosystem services)
Landscape and Visual Features	Hanönü district center, Yukarıküreçayı, Aşağıküreçayı, Yeniköy

7.5 Assessment and Management of Cumulative Impacts

Potential interactions of the GCP and other projects/activities identified in the CIA study area with the selected VESCs are summarized in the matrix provided in Table 7-4. As can be seen, on the VESCs that are to be potentially affected by the GCP, mainly existing Taşköprü-Hanönü State Highway and the Demircili HEPP and the planned Taşköprü Dam are likely to introduce additional impacts. Other quarry/mining and exploration activities identified in the CIA study area are relatively small-scale projects when compared to GCP. Since these quarry/mining and exploration projects are located comparably far from the GCP units (except the IIA Group Stone (Limestone) Quarry and Crushing Screening Plant), it is not likely that they would affect the same environment and social components and cause cumulative impacts with the GCP. They will only contribute to the changes in the land use and bidoviersity (mainly forests and shrubs, limitedly agricultural areas) within the CIA study area, but their contribution levels will be relatively insignificanct (due to their limited footprints) when compared to Gökırmak Copper and Taşköprü Dam projects.

Project-level impacts (soil disturbance, dust, noise, etc.) of Taşköprü Dam will mainly occur during its construction phase, thus once it is commissioned, Taşköprü Dam will not contribute to impacts to be caused by the operation of GCP such as dust or noise. On the other hand, Taşköprü Dam's reservoir will be another important contributor of the changes in the land use and bidoversity/habitat alteration in the region.

As known, the planned open-pit in the scope of the GCP will mine-out an area under the current Gökırmak River bed. Thus, a river diversion system has been installed at the river section corresponding to the open pit area to allow mining operations to take place. The diversion consists of two cofferdams, with tunnels connecting the upstream and downstream sides of the river. Taşköprü Dam Project, which has received EIA Positive Decision in January 2017, will be operated at the upstream of the river diversion system. In addition, Demirci HEPP is also being operated on the same water resource at the downstream. Thus, once the Taşköprü Dam is constructed and taken into operation, Gökırmak River would be subject to cumulative impacts (hydrology, water quality and biodiversity) of the GCP, Taşköprü Dam, and Demirci HEPP. It should be noted that the capacity of the spillway of the Taşköprü Dam will be higher than the discharge capacity of the river diversion, which may result in an increase of the dam's tailwater and thus operation of the dam and HEPP (Acacia, June 2017, Feasibility Study Report). On the other hand, the Final EIA Report (November 2016), which is the basis for the EIA Positive Decision issued for the dam project, has already acknowledged and assessed Gökırmak River Diversion activity as a project planned at the downstream of the Taşköprü Dam and approved by the competent authority, the State Hydraulic Works-DSI. Taşköprü Dam's EIA Report also states that the operation of the dam will provide benefits to the River Diversion System in terms of flood protection, flow regulation, etc.

The fact that GCP facilities are located at the downstream of Taşköprü Dam's spillway poses risks on the health and safety of GCP personnel working on-site. Additionally, the Taşköprü dam and the the upstream cofferdam of the GCP's river diversion system are the risk factors for the downstream communities. To avoid and control the Project-level risks of the GCP, approvals have been received from the relevant authorities for the planning, final design and detailed design phases of the river diversion system. Both the Turkish Standards and seismic design regulations have been followed for the tunnels, cofferdams, and infrastructure. Similarly, design of the Taşköprü Dam is also subject to the approval of DSI. Eventhough the risks on the downstream communities have already been minimized by design measures, it is important to ensure that the managements of GCP and the Taşköprü Dam and HEPP, as well as Demirci HEPP, maintain good communication lines and cooperation once the Taşköprü Dam and HEPP is taken into operation, to avoid health and safety risks on the GCP site personnel and the downstream communities in case of extreme flow conditions.Taşköprü Dam may also be beneficial for the GCP's river diversion system as it will prevent/minimize accumulation of sediments.

In addition, GHGs will be emitted from the equipments, mobile sources and stationary sources to be employed in the scope of the projects. Due to its scale and nature of the activity, GCP will be the main contributor of the GHG emissions in the CIA study area. On the other hand, once the reservoir impoundment is completed. In addition, GHGs are also known to be released into the atmosphere from reservoir that flood forests. Thus, Taşköprü Reservoir would also be a contributor of the GHGs to be emitted in the CIA study area.

Cumulative social impacts are separately assessed by SRM in Volume II of the ESIA Report.

AMI is responsible for the implementation of Project-specific mitigation measures that would allow the mitigation of Project-level impacts. It should be noted that mitigating the potential adverse cumulative impacts is not solely the responsibility of AMI. Since the Taşköprü Dam is the main Project, with which the GCP would cause cumulative impacts, cooperation with Taşköprü Dam and HEPP's management and relevant local and national authorities is essential to mitigate the potential cumulative impacts.

Settlements such as Hanönü, Küpeli, Dereköy and Aşağıküreçay may experience cumulative air quality and noise impact by the operation of GCP and the Taşköprü-Hanönü State Highway. The impacts at these settlements will be monitored throughout the project and Project-level measures will be taken to reduce Project's contribution to cumulative impacts. If further mitigation is needed, AMI will collaborate with the relevant state authorities whenever requested. Other measures to be taken to mitigate Project-level impacts of the GCP in the aspects of water quality, biodiversity, community and occupational health and safety are described in the relevant chapters of this ESIA. Since, the GCP is the largest activity in the CIA study area, it is likely that the effective management of GCP's impacts may be sufficient to mitigate cumulative impacts on the selected VESCs. AMI is committed to contribute to any additional CIA study to be conducted by the third parties (e.g. state authorities, NGOs, etc.), if further mitigation besides the Project-level management mitigation, is required to be applied. Additionally, a Cumulative Impact Management Plan (under the scope of Community Development Plan) will be developed in cooperation with local authorities during the first year of the Project's operation.

Table 7-4 Potential Cumulative Interactions

Key Environmental Issues		Air Quality for Local Communities								Noise for Local Communities		Water Use	Water Quality			Landscape and Visual Features				Land Use, Biodiversity and Living Natural Resources							Project Personnel (OHS)	Community Health and Safety					
Code	Projects/Activities	Hanönü	Küpeli	Bağdere	Dereköy	Geymene	Aşağıküreçay	Hanönü	Küpeli	Küpeli and Aşağıküreçay's Water Supply Well	Gökırmak River and its Tributaries	Hanönü district center	Yukarıküreçayı	Aşağıküreçayı	Yeniköy	Forests	Shrubs	Gökırmak River Ecosystem	Taşköprü Reservoir	Agricultural Areas	GCP Personnel/Contractors/ Sub-contractors on Site	Hanönü	Bağdere	Dereköy	Geymene	Vakıf	Çaybaşı
GCP	**Gökırmak Copper Project (inc. Gökırmak River Diversion and ETL)**																										
	Other Existing Projects																										
EP1	Taşköprü-Hanönü State Highway																										
EP2	Demirci HEPP																										
	Reasonably Foreseeable Future Projects																										
FP1	Taşköprü Dam																										
FP2	Gökçeağaç Pond																										
FP3	Alisaray Sandstone Quarry																										
FP4	IA Group Stone (Limestone) Quarry and Crushing Plant																										
FP5	Örhen Stone Quarry and CS Plant																										
FP6	Yaşar Böyük Marble Quarry																										
FP7	Demir Export Mine Exploration Activities																										
FP8	4th Group Mining License Survey																										
FP9	4th Group Mines Exploration License Survey for 3 Sites																										
FP10	4th Group Mines Exploration License Survey for License Site 201200025																										
FP11	IIA Group Stone (Limestone) Quarry and Crushing Screening Plant																										
	Cumulative Impact Significance*	**Minor**	**Minor**	**None**	**Minor**	**None**	**Minor**	**Minor**	**Minor**	**None**	**Mod.**	**NS**	**None**	**NS**	**None**	**Mod.**	**Minor**	**Mod.**	**Mod.**	**Minor Mod.**		**Mod.**	**None**	**Mod.**	**Mod.**	**Mod.**	**Mod.**

8. PROJECT SPECIFIC ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM

The aim of the Gökırmak Copper Project (GCP) Environmental and Social Management System (ESMS) is to provide processes for E&S (environmental and social) management to be implemented throughout all phases of the Project to achieve AMI's E&S objectives and to ensure full compliance with EBRD requirements. The purposes of the ESMS are as follows:

- Defining environment, health, safety and social objectives of AMI,
- Providing a framework management tool to achieve these objectives in the most effective way in all phases of the Project, in compliance with national legislation, EBRD requirements and other international standards and GIIP,
- Assigning responsibilities and personnel for ESMS implementation,
- Providing a guide for reassessment of and when required update of existing management processes such as the ESMS itself and the sub-management plans.

The policy framework was described and potential environmental and health and safety risks associated with the Project activities were assessed and related prevention/mitigation measures and monitoring practices were proposed as part of the ESIA studies. To help assess, control and continually improve the overall environmental and social performance of the Project, the ESMS is structured to include the following subjects in a comprehensive, yet compact and integrated manner:

- Project Standards and National Legislation Requirements and EBRD Requirements
- Management Programs and Plans
- Organizational Capacity and Competency
- Monitoring
- Review
- Stakeholder Engagement and Disclosure

8.1 Project Standards and Requirements

GCP commits to following the Project standards and requirements that form the basis of this ESMS. The Project standards and requirements are defined in detail by "Chapter 2" of this report and are listed below:

- EBRD Environmental and Social Policy and Performance Requirements (PRs),
- National legislative requirements and all national permits, licenses and approvals applicable to the Project,
- European Union legislative requirements and Best Available Techniques (BAT) applicable to the Project,
- UN Guiding Principles Business and Human Rights
- Other good international industry practices (GIIP),
- International Conventions and Protocols Turkey is a party to, and
- AMI Environment, Health and Safety and Social Policies.

In addition to the Project standards set by AMI and the ESIA Disclosure Package, AMI is also planning to have ISO 9001 Quality Management System, ISO 14001 Environmental Management System and OHSAS 18001 Occupational Health and Safety Management System certifications in place for quality management, environmental management and OHS management during the operation phase. Regarding the issue, AMI stated that training programs for 2015 versions of the systems will be initiated prior to October, 2017 and that it will begin the process of document preparation required for certifications on October, 2017.

8.2 Overall ESMS Approach and Implementation Documents

The main approach in ESMS implementation is provision of consistency of all adopted E&S processes and procedures throughout the Project phases, with the required adaptation flexibility to ensure a management system that can cater to any transforming E&S issue related to the Project.

The general structure of ESMS implementation hierarchy is presented in the chart given in Figure 8-1 below. As can be seen from this chart, ESMS implementation will provide for the EBRD and Company HSE policies by utilizing management plans and implementation documents such as procedures, standard operation procedures, forms, lists and tables. Existing management documents have been directly integrated or revised and included within the E&S management and multiple other are currently being prepared.

AMI has in place the following HSE policies:

- Corporate Human Resources Policy
- Corporate Land Acquisition Policy
- Environmental Protection Policy
- Health and Safety Policy
- Human Rights Policy
- Occupational Health and Safety Policy

Management plans currently in place for E&S management of GCP are listed below:

- Environmental and Social Management and Monitoring Framework Plan (ESMMFP)
- Air Emissions Management Plan
- Biodiversity Management Plan
- Community Health and Safety Management Plan
- Erosion and Sediment Control Plan
- Noise and Vibration Management Plan
- Oil and Chemicals Spill Response Plan
- Preliminary Mine Closure and Rehabilitation Plan
- Transport/Traffic Management Plan
- Waste Management and Pollution Prevention Plan
- Contractor Control Management Plan/Procedure
- Cultural Heritage Management Plan
- Emergency Action Plan
- Fire Prevention and Fire Protection Plan
- Hazardous Materials Management Plan
- Labour Management Plan
- Local Procurement Plan
- Occupational Health and Safety Plan
- Supply Chain Management Plan
- Influx Management Plan
- Livelihood Restoration Plan (LRP)
- Stakeholder Engagement Plan (SEP)

In addition to these plans, additional management plans will also be prepared in the following phases; including Biodiversity Action Plan, Mine Water Management Plan, Water Resources Management Plan, Emergency Preparedness Plan for Kepezkaya TSF, Local Employment Plan, Community Development (Investment) Plan and Security Management Plan.

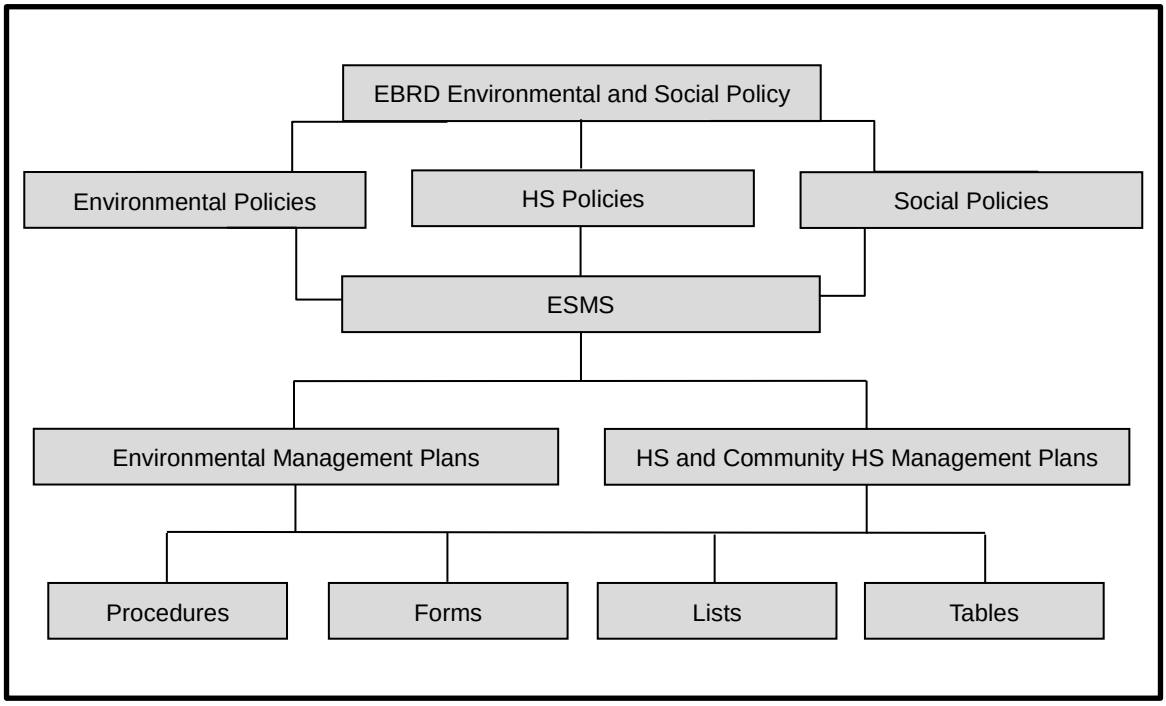


Figure 8-1 ESMS Implementation Hierarchy

8.3 Roles and Responsibilities

AMI will take full responsibility of E&S management through its Project specific HSE team and its contractors employed for various phases of the Project will be responsible of implementation of the ESMS as required by contractual agreements and by the Project's Health Safety and Environmental Manual for Sub-Employees. AMI's social commitments will be managed by the Public relations department. Public Relations department will be in direct communication with HSE team and Project management. Roles and responsibilities for implementation of the GCP policies and the Project ESMS are summarized in Table 8-1 and organizational structure of GCP is provided in Figure 8-2.

Table 8-1 EMS Roles and Responsibilities

Roles	Responsibilities
AMI Chief Executive Officer	-Approve implementation of updated/reviewed HSE policies and management processes.
GCP Operations Manager	-Reports to CEO. -Provide authority for implementation of AMI policies and the EMS. -Assign adequate resources for effective implementation of AMI policies and the EMS.
GCP Supply Chain Manager	- Reports to CEO. -Direct contract oversight in ensuring that the GCP receives the deliverables and services identified in the contracts including full compliance with the Project ESMS. -Overall supervision on proper implementation of the requirements under the contracts by the contractors. -Assess contractor HSE performance.
GCP Human Resources Manager	-Reports to CEO. -Ensure management of the workforce and working relations at the GCP is in compliance with national legislation and EBRD requirements -Ensure HR management tools such as internal grievance mechanism are in place and clearly communicated to staff, in line with EBRD requirements -Consult with the PR Manager in terms of application of the Local Employment Plan -Ensure resources are made available for HR management

Roles	Responsibilities
GCP Environmental and Public Relations Coordinator	-Reports to CEO. -Ensure the management of environmental and public relations issues at the GCP is in compliance with the national legislation and EBRD requirements as reflected in the Project ESAP and ESIA commitments. -Ensure resources are made available for HSE and PR management
GCP Health and Safety Manager	-Reports to Operations Manager. -Oversee H&S issues through implementation, review, update and monitoring of the ESMS. -Conduct internal H&S reporting for upper management. -Oversee contractors H&S compliance with Project requirements through review contractor monitoring and reports. -Conduct HS awareness and competency trainings. -Complete medical assessment (“fit for work”) of the personnel prior to commencement of work if required.
GCP Environmental Supervisor	-Reports to Environmental and Public Relations Coordinator. -Oversee environmental issues through implementation, review, update and monitoring of the ESMS. -Conduct internal environmental reporting for upper management. -Oversee contractors HSE compliance with Project requirements through review contractor monitoring and reports. -Conduct EHS awareness and competency trainings.
GCP Health and Safety Supervisor /Environmental Engineer	-HS Supervisor reports to Health and Safety Manager. -Environmental Engineer reports to EHS Chief. -Execute implementation of specific actions in accordance with the HSE policies of the Project, in line with the EMS. -Prepare, review and update detailed and specific HSE Management Plans and related documents, in compliance with national legislation, EBRD requirements and, GCP policies and the EMS.
GCP Public Relations Supervisor	- Reports to Environmental and Public Relations Coordinator. - Develop, implement and monitor Social Management System. -Coordinate the Social Management System throughout Project components, ensure that system is functioning not only in AMI but also throughout main contractors and subcontractors -Ensure land usage of the Project abides by AMI Corporate Policy, EBRD requirements and commitments made at LRP -Undertake all internal social reporting for the Project and ensure that monthly KPIs are set and monitored . -Review and assess monthly contractor monitoring for social issues including local labor force, internal grievances, workers accommodation, and labor influx
GCP Construction Manager	-Reports to Operations Manager. -Provide leadership for construction phase personnel in terms of compliance with GCP policies and effective EMS implementation.
GCP Mining Manager	- Reports to Operations Manager. -Provide leadership for operation phase personnel in terms of compliance with GCP HSE policies and effective EMS implementation.
GCP Personnel	-Comply with GCP HSE processes -Complete all required trainings
Subcontractor HSE Managers/HSE Teams	-Under the supervision of HS Manager, EHS Chief and PR Chief. -Ensure compliance with GCP HSE policies, the EMS and management processes. -Prepare monthly HSE review and incident reports for GCP HSE Manager.

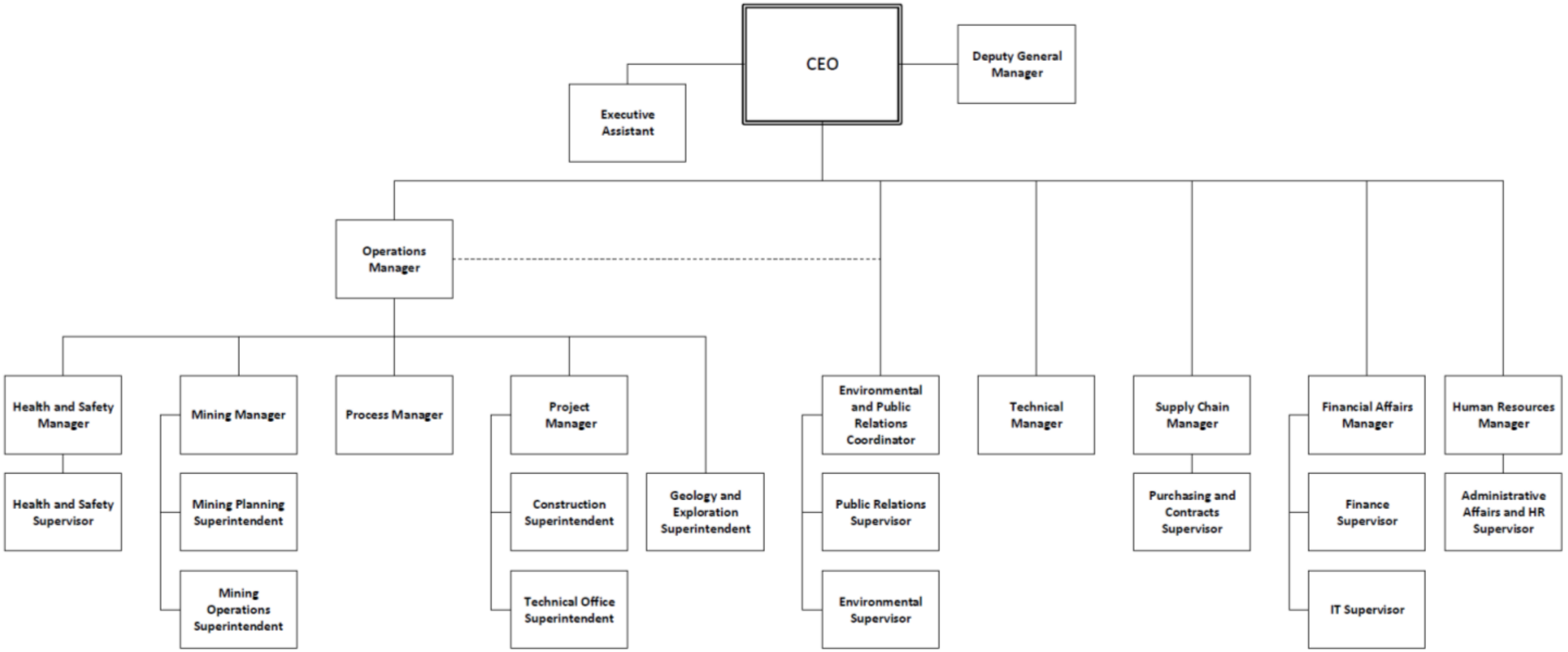


Figure 8-2 GCP Management Structure

8.4 Monitoring

For the purposes of effective implementation of the ESMS, regular monitoring and review will be conducted at the GCP. Monitoring, at a minimum, will involve the following

- Check if major elements of the ESMS are in place,
- Check if the plans and other sub-management documents are being implemented by both GCP and contractor personnel,
- Ensure continuous compliance with laws, regulations and other Project standards, and
- Check progress towards overall objectives and targets set out by the Project ESIA and ESAP

An ESMMFP has been prepared as part of the ESIA Package carried out by Acacia Mine to supplement the local EIA with additional studies in line with EBRD requirements for Category A projects. The ESMMFP was developed to reflect mitigation measures addressing identified environmental and social impacts respectively in Volume I (EIA) and Volume II (SIA) by AECOM and SRM consultants and to outline overall approach to these impacts monitoring. This is a framework plan which is a summary of and is implemented jointly with individual environmental and social management plans that are prepared for specific issues. Management plans are disclosed as part of the ESIA Disclosure Package Volume IV, but are living documents that are subject to changes and amendments as they are implemented under the Company's Environmental and Social Management System of the life of the project. Implementation effectiveness of the environmental and social mitigation measures and compliance with Project standards will be identified by using the Key Performance Indicators (KPIs) defined in the ESMMFP.

For the monitoring of certain mitigation measures, an environmental monitoring plan has been developed for the construction and operation phases, which presented in Table 8-2. This monitoring program will constitute the base for internal auditing processes of the Project. For quantitative monitoring items such as air emission levels and noise levels, monitored values will be compared against the stricter limit values provided by EU and national legislation.

In case any non-compliance with Project standards or any measurement above limits provided by related legislation or standard is identified during monitoring of key environmental, OHS and community HS performance indicators, the non-compliance will be recorded and reported. Follow up activities in any such case will include investigation of the non-compliance immediately and in the next monitoring term to ensure E&S safety. Monitoring of performance of any recommended action proposed against a non-compliance by the Project HSE team and if related, in consultation with the contractor HSE team or equivalent, will also be monitored and recorded in the following monitoring terms.

In this scope, monthly HSE performance and progress reports will be prepared by the Project HSE team for senior management.

In order to ensure compliance with EBRD standards, there will be regular monitoring of social impacts. There is a monitoring mechanism established with the scope of SIA as a Social monitoring plan. Internal monitoring of social issues is the responsibility of the Public Relations department. Public Relations department will prepare monthly performance and progress reports for Social Monitoring. There will be quarterly external monitoring for evaluation of social impacts by an external consultant.

Following the environmental and social monitoring studies to be conducted in accordance with the ESMMFP, reports will be prepared to document the results and these reports will be disclosed to affected communities and third parties by means of appropriate methods (i.e. on the basis of annual sustainability reports, etc.).

Table 8-2 Environmental Monitoring Plan for Construction and Operation Phases

Environmental/ Social Subject	Monitoring Parameters/Method	Monitoring Location	Monitoring Frequency
ESMS Implementation	Control of ESMS implementation documents to be prepared/updated (plans, procedures etc.)	Project office	Biannually
Landscape and Visual Impacts	Site conditions of stored excavation material, waste storage areas and housekeeping conditions	On-site	Continuous
Soils	Amount of stripped and stored topsoil Topsoil storage integrity and stability conditions	On-site	Weekly
	Topsoil health (moist, vegetation etc.)	On-site	Monthly
	Spillage/leakage sites and records	Project office/ On-site	After incident
Air Environment	PM_{10}, Dust, NO_x	Hanönü District Centre, Bağdere, Dereköy, Geymene and Aşağıküreçay neighborhoods	Monthly
	PM_{10}, Dust, NO_x, SO_2	Sepetçioğlu neighborhood	Continuous
	Visual control of dust suppression measures and road conditions	On-site	Continuous
	Grievance records (for odor)	Project office/ Community Relations Office/ Source location of grievance	In case of grievance
Noise	Grievance records	Project office/ Community Relations Office/ Source location of grievance	In case of grievance
Vibration	Peak particle velocities for given frequency range	On-site	During each test blasting activity
	Grievance records	Project office/ Community Relations Office/ On-site	In case of grievance
Wastewater	Monitor/record wastewater parameters	Discharge point	Conduct wastewater monitoring to comply with the stricter of national and EU requirements: - 12 samples during the first year. Four samples in subsequent years, if it can be shown that the water during the first year complies with the provisions of the EU Urban Waste Water Directive; if one sample of the four fails, 12 samples must be taken in the year that follows -In frequency to be required by Environmental Permit in compliance with the Turkish Wastewater Pollution Control Regulation
	Wastewater disposal documents	Project office	Annual

Environmental/ Social Subject	Monitoring Parameters/Method	Monitoring Location	Monitoring Frequency
Waste Management	Waste management applications (containers, labeling, waste storage area, visual inspection of potential leakages/spills, general housekeeping etc.)	On-site	Daily
	-Waste disposal documents (waste inventory, transportation and disposal agreements, waste declaration form, waste related forms and records) -Waste Management Plan -Control of training records	Project office	Annually
Health and Safety	Visual control of OHS signs and other related equipment Control of personal protective equipment	On-site	Biannually
	Air emissions - outdoor (PM_{10} and dust)	On-site	Monthly
	Noise levels - outdoor (in case of related grievance)	On-site	In case of grievance
	Indoor air quality, noise, vibration, lighting, thermal comfort (to be conducted depending on risk assessment results)	Indoor locations	Annually
	Accident records and other OHS forms OHS grievance records Scope and number of trainings Training hours per person	Project Office	Every three months or in case of major risks/accidents
Cultural Heritage	Chance finds records	Project Office	Continuous

8.5 Review and Update of the ESMS

The ESMS will be reviewed annually and additionally in case assessed to be required in the event of important changes to Project HSE conditions, to ensure the highest continuous performance in compliance with changing Project HSE requirements and legislation and standards. As stated above in Table 8-1, the GCP HSE manager will be responsible of review and updates and the AMI Chief Executive Officer will approve implementation of the updated ESMS. The social components of ESMS will be reviewed annually to reflect any changes in the Project. Public Relations Manager is responsible for revising and updating ESMS.

8.6 Stakeholder Management and Information Disclosure

AMI has developed a stakeholder engagement plan (SEP) in order to manage the relations with all of its stakeholders. The plan has a grievance management system in order to handle the grievances throughout the project life. Grievance system has a separate module for the management of internal grievances. Information disclosure and dissemination procedures and modes of communication and frequency are embedded into the SEP as a separate section. All project related documentation will be disclosed according to EBRD standards as part of the disclosure package and timing will be determined by the project management. SEP will be updated annually in order to reflect the monitoring and evaluation recommendations and needs of the Project.

Reports, including E&S performance monitoring reports, will be shared with Project affected communities and the third parties by means of appropriate methods (i.e. on the basis of annual sustainability reports, etc.)

Appendix A Species List

Appendix Table 1 Fish Species within and the Vicinity of the Project Area

Family	Scientific Name of the Species	English Name of the Species	Turkish Name of the Species	Endemism	BERN	IUCN	CITES	Habitat Directive
Cyprinidae	*Alburnoides fasciatus* (=*Alburnoides bipunctatus*)	Transcaucasian Spirlin	Noktalı inci balığı	_	_	LC	_	_
Cyprinidae	*Squalius cephalus*	European Chub	Tatlısu Kefali	_	_	LC	_	_
Cyprinidae	*Capoeta tinca*	Western Fourbarbel Scraper (Anatolian Khramulya)	Siraz Balığı (Karabalık)	Endemic	_	LC	_	_
Cyprinidae	*Capoeta sieboldii*	Nipple-lip Scraper (Colchic khramulya)	Siraz Balığı	_	_	LC	_	_
Cyprinidae	*Chondrostoma angorense*	Black Sea Nase (Ankara Nase)	-	Endemic	_	LC	_	_
Cyprinidae	*Barbus tauricus*	Crimean Barbel	Bıyıklı Balık	_	_	VU	_	_
Cyprinidae	*Alburnus chalcoides*	Danube Bleak (Caucasian Sprilin)	Tatlısu Kolyozu	_	Annex III	LC	_	Annex II
Nemacheilidae	*Oxynoemacheilus banarescui*			Endemic	_	NT	_	_
Nemacheilidae	*Oxynoemacheilus angorae* (=*Nemacheilus angorae*)	Sakarya Loach (Angora Loach)	Çöpçü Balığı	_	_	LC	_	_

Appendix Table 2 Amphibian Species within and in the Vicinity of the Project Area

Scientific Name of the Species	Turkish Name of the Species	English Name of the Species	IUCN	BERN	CITES	Hab. Dir.
Ommatotriton ophryticus	Şeritli Karadeniz semenderi	Northern Banded Newt	NT	-	-	-
Triturus karelinii	Pürtüklü Semender	Southern Crested Newt	LC	App-II	-	An-II
Pelobates syriacus	Toprak Kurbağası	Syrian Spadefoot	LC	App-II	-	An-IV
Pseudepidalea viridis (=Bufo viridis)	Gece Kurbağası	Green Toad	LC	App-II	-	An-IV
Pseudepidalea variabilis (=Bufo variabilis)	Değişken Desenli Gece Kurbağası	Variable Toad	LC	App-III	-	-
Bufo bufo	Siğilli Kurbağa	Common Toad	LC	App-III	-	-
Hyla arborea	Ağaç Kurbağası	Tree Frog	LC	App-II	-	An-IV
Rana ridibunda (=Pelophylax ridibundus)	Ova Kurbağası	Euroasian Marsh Frog	LC	App-III	-	-
Rana dalmatina	Çevik Kurbağa	Agile Frog	LC	App-II	-	An-IV
Rana macrocnemis	Uludağ Kurbağası	Long-legged Wood Frog	LC	App-III	-	-

Appendix Table 2 Reptile Species within and in the Vicinity of the Project Area

Scientific Name of the Species	Turkish Name of the Species	English Name of the Species	IUCN	BERN	CITES	Hab. Dir.
Testudo graeca	Tosbağa	Spur-thighed Tortoise	VU - A1cd	App-II	App-II	An-II
Emys orbicularis	Benekli Kaplumbağa	European Pond Turtle	LR/NT	App-II	-	An-II
Mauremys rivulata	Çizgili Kaplumbağa	Western Caspian Turtle	NE	App-III	-	-
Mediodactylus (=Cyrtopodion) kotschyi	İnce Parmaklı Keler	Kotschy's Gecko	LC	App-II	-	An-IV
Anguis fragilis	Yılanımsı Kertenkele	Slow Worm	NE	App-III	-	-
Pseudopus apodus	Oluklu Kertenkele	European Glass Lizard	NE	App-II	-	An-IV
Ablepharus kitaibeili	İnce Kertenkele	Juniper Skink	LC	App-II	-	An-IV
Ophisops elegans	Tarla Kertenkelesi	Snake-eyed Lizard	NE	App-II	-	An-IV
Lacerta viridis	Yeşil Kertenkele	Green Lizard	LC	App-II	-	An-IV
Lacerta media	Ortanca Yeşil Kertenkele	Medium-sized Green Lizard	LC	App-III	-	-
Lacerta (=Podarcis) muralis	Duvar Kertenkelesi	Common Wall Lizard	LC	App-II	-	An-IV
Lacerta (=Darevskia) rudis	Trabzon Kertenkelesi	Spiny-Tailed Lizard	LC	App-III	-	-
Eirenis collaris	Uysal Yılan	Anatolian Dwarf Racer	LC	App-III	-	-
Elaphe sauromates	Sarı Yılan	East-Four-lined Ratsnake	NE	App-III	-	-
Zamenis (=Elaphe longissima)	Eskülap Yılanı, Küpeli Yılan	Aesculapian Ratsnake	LC	App-II	-	An-IV

Coronella austriaca	Avusturya Yılanı, Taçlı Yılan	Smooth Snake	NE	App-II	-	An-IV
Coluber (=Dolichophis) caspius	Hazer Yılanı	Caspian Whipsnake	NE	App-II	-	An-IV
Natrix natrix	Yarı Sucul Yılan, Küpeli Su Yılanı	Grass Snake	LC	App-III	-	An-IV
Natrix tessellata	Su Yılanı	Tessellated Water Snake	NE	App-II	-	An-IV
Vipera ammodytes	Boynuzlu Engerek	Horned Viper	LC	App-II	-	An-IV

Appendix Table 3 Bird Species within and in the Vicinity of the Project Area

Scientific Name of the Species	Turkish Name of the Species	English Name of the Species	IUCN	BERN	RDB	Timing	Bird Dir.
Podiceps cristatus	Tepeli Batağan	Great crested grebe	LC	App-III	A.5	Y	
Tachybaptus ruficollis	Küçük Batağan	Little grebe	LC	App-II	A.3.1	Y	
Phalacrocorax carbo	Karabatak	Great cormorant	LC	App-III	A.4	Y	
Egretta garzetta	Küçük Akbalıkçıl	Little egret	LC	App-II	A.3.1	Y	An-I
Ardea alba	Büyük Akbalıkçıl	Great egret	LC	App-II	A.3	Y	An-I
Ardea cinerea	Gri Balıkçıl	Grey heron	LC	App-III	A.3.1	Y	
Ciconia nigra	KaraLleylek	Black Stork	LC	App-II	A.3	YZ, Y	An-I
Ciconia ciconia	Leylek	White Stork	LC	App-II	A.3.1	YZ,Y	An-I
Anser albifrons	Ak Alınlı Kaz	Greater white-fronted goose	LC	App-III	B.5	KZ	An-I- An-II/2- An-III/2
Anas strepera	Boz Ördek	Gadwall	LC	App-III	A.5	Y	An-II-1
Anas crecca	Çamurcun	Common teal	LC	App-III	A.5	Y	An-II-1 An-III/2
Anas platyrhynchos	Yeşilbaş	Mallard	LC	App-III	A.5	Y	An-II-1 An-III/1
Anas clypeata	Kaşıkgaga	Northern shoveler	LC	App-III	A.4	Y	An-II-1 An-III/2
Aythya ferina	Elmabaş Patka	Common pochard	LC	App-III	A.5	Y	An-II-1

Scientific Name of the Species	Turkish Name of the Species	English Name of the Species	IUCN	BERN	RDB	Timing	Bird Dir.
							An-III/2
Aythya fuligula	Tepeli Patka	Tufted duck	LC	App-III	A.5	Y	An-II-1 An-III/2
Mergus albellus	Sütlabi	Smew	LC	App-II	B.3	KZ	An-I
Pernis apivorus	Arı Şahini	European-honey buzzard	LC	App-II	A.3	Y	An-I
Neophron percnopterus	Küçük Akbaba	Egyptian vulture	EN	App-II	A.3	Y	An-I
Circaetus gallicus	Yılan Kartalı	Short-toed-snake-eagle	LC	App-II	A.3	Y	An-I
Circus aeruginosus	Saz Delicesi	Western-marsh- harrier	LC	App-II	A.3	Y	An-I
Accipiter nisus	Atmaca	Eurasian sparrowhawk	LC	App-II	A.3	Y	An-I
Accipiter gentilis	Çakır	Northern goshawk	LC	App-II	A.1.2	Y	An-I
Buteo rufinus	Kızıl Şahin	Long-legged buzzard	LC	App-II	A.3	Y	An-I
Buteo buteo	Şahin	Common buzzard	LC	App-II	A.3	Y, KZ	
Aquila chrysaetos	Kaya Kartalı	Golden eagle	LC	App-II	A.1.2	Y	An-I
Hieraaetus pennatus	Küçük Kartal	Booted eagle	LC	App-II	A.3	Y	An-I
Falco tinnunculus	Kerkenez	Common kestrel	LC	App-II	A.2	Y	
Coturnix coturnix	Bıldırcın	Common quail	LC	App-III	A.3	YZ,Y	An-II/2
Rallus aquaticus	Su Yelvesi	Water rail	LC	App-III	A.3	Y	An-II/2

Scientific Name of the Species	Turkish Name of the Species	English Name of the Species	IUCN	BERN	RDB	Timing	Bird Dir.
Crex crex	Bıldırcın Kılavuzu	Corncrake	NT	App-II	A.1.2	Y	An-I
Gallinula chloropus	Su Tavuğu	Common moorhen	LC	App-III	A.3.1	Y	An-II/2
Fulica atra	Sakarmeke	Common coot	LC	App-III	A.5	Y	An-II/1 An-III/2
Himantopus himantopus	Uzunbacak	Black-winged stilt	LC	App-II	A.3	Y	An-I
Burhinus oedicnemus	Kocagöz	Stone curlew	LC	App-II	A.3	YZ,Y	An-I
Charadrius dubius	Küçük halkalı cılıbıt	Little ringed plover	LC	App-II	A.3	Y	
Scolopax rusticola	Çulluk	Eurasian woodcock	LC	App-III	B.3	KZ,T	An-II/1
Tringa ochropus	Yeşil Düdükçün	Green sandpiper	LC	App-II	B.2	KZ,T	
Larus ridibundus	Karabaş martı	Black-headed gull|	LC	App-III	B.5	KZ,Y	An-II/2
Sterna caspia	Hazar sumrusu	Caspian tern	LC	App-II	A.2	Y	An-I
Columba livia	Kaya güvercini	Rock pigeon	LC	App-III	A.5	Y	An-II/1
Columba palumbus	Tahtalı	Wood pigeon	LC	App-III	A.4	Y	An-I An-II/1 An-III/1
Streptopelia decaocto	Kumru	Collared dove	LC	App-III	A.5	Y	An-II/2
Streptopelia turtur	Üveyik	Turtle dove	LC	App-III	A.3.1	YZ	An-II/2
Cuculus canorus	Guguk	Cuckoo	LC	App-III	A.2	YZ	

Scientific Name of the Species	Turkish Name of the Species	English Name of the Species	IUCN	BERN	RDB	Timing	Bird Dir.
Athene noctua	Kukumav	Little Owl	LC	App-II	A.2	Y	
Apus apus	Ebabil	Common Swift	LC	App-III	A.3.1	YZ	
Alcedo atthis	Yalıçapkını	Kingfisher	LC	App-II	A.2	Y	An-I
Merops apiaster	Arıkuşu		LC	App-II	A.3.1	YZ	
Upupa epops	İbibik	Bee-eater	LC	App-II	A.2	YZ	
Picus viridis	Yeşil ağaçkakan	Green Woodpecker	LC	App-II	A.2	Y	
Dryocopus martius	Kara ağaçkakan	Black Woodpecker	LC	App-II	A.1.2	Y	An-I
Dendrocopus major	Büyük alaca ağaçkakan	Great-spotted Woodpecker	LC	App-II	A.3	Y	
Dendrocopus syriacus	Alaca ağaçkakan	Syrian Woodpecker	LC	App-II	A.2	Y	
Dendrocopus minor	Küçük ağaçkakan	Lesser Spotted Woodpecker	LC	App-II	A.1.2	Y	
Melanocorypha calandra	Boğmaklı toygar	Calandra Lark	LC	App-II	A.5	Y	An-I
Galerida cristata	Tepeli toygar	Crested Lark	LC	App-III	A.3	Y	
Lullula arborea	Orman toygarı	Woodlark	LC	App-III	A.3	Y	An-I
Alauda arvensis	Tarlakuşu	Eurasian Skylark	LC	App-III	A.3	Y	An-II/2
Hirundo daurica	Kızıl kırlangıç	Red-rumped Swallow	LC	App-II	A.3	YZ	
Hirundo(Ptyonoprogne) rupestris	Kaya kırlangıcı	Crag Martin	LC	App-II	A.5	YZ	
Delichon urbica	Ev kırlangıcı	House Martin	LC	App-II	A.3	YZ	

Scientific Name of the Species	Turkish Name of the Species	English Name of the Species	IUCN	BERN	RDB	Timing	Bird Dir.
Anthus trivialis	Ağaç incirkuşu	Tree Pipit	LC	App-II	A.3	YZ	
Anthus pratensis	Çayır incirkuşu	Meadow Pipit	LC	App-II	A.3	YZ	
Anthus cervinus	Algerdan İncirkuşu	Red-throated Pipit	LC	App-II	A.2	YZ	
Motacilla flava	Sarı kuyruksallayan	Yellow Wagtail	LC	App-II	A.3.1	YZ	
Motacilla alba	Ak kuyruksallayan	Pied Wagtail	LC	App-II	A.3.1	Y	
Cinclus cinclus	Derekuşu	Dipper	LC	App-II	A.1.2	Y	
Troglodytes troglodytes	Çit kuşu	Wren	LC	App-II	A.1.2	Y	An-I
Erythropygia(Cercotrichas) galactotes	Kızıl Çalıbülbülü	Rufous Bush Robin	LC	App-II	A.3	YZ	
Erithacus rubecula	Kızılgerdan	Robin	LC	App-II	A.3	Y	
Luscinia megarynchos	Bülbül	Common Nightingale	LC	App-II	A.2	YZ	
Phoenicurus ochruros	Kara kızılkuyruk	Black Redstart	LC	App-II	A.2	Y	
Phoenicurus phoenicurus	Kızılkuyruk	Redstart	LC	App-II	A.3	Y	
Saxicola torquata	Taşkuşu	Stonechat	LC	App-II	A.3	Y	
Oenanthe oenanthe	Kuyrukkakan	Northern Wheatear	LC	App-II	A.3	YZ	
Turdus merula	Karatavuk	Blackbird	LC	App-III	A.3	Y	An-II/2
Turdus philomelos	Öter ardıç	Song Thrush	LC	App-III	A.2	Y	An-II/2
Turdus viscivorus	Ökse ardıcı	Mistle Thursh	LC	App-III	A.2	Y	An-II/2

Scientific Name of the Species	Turkish Name of the Species	English Name of the Species	IUCN	BERN	RDB	Timing	Bird Dir.
Cisticola juncidis	Yelpazekuyruk	Fan-tailed Warbler	LC	App-II	A.2	Y	
Hippolais pallida	Ak mukallit	Olivaceous Warbler	LC	App-II	A.3	YZ	
Sylvia melanocephala	Maskeli ötleğen	Sardinian Warbler	LC	App-II	A.3	Y	
Sylvia curruca	Akgerdanlı ötleğen	Lesser Whitethroat	LC	App-II	A.2	YZ	
Phylloscopus collybita	Çıvgın	Chiffchaff	LC	App-II	A.3.1	Y	
Phylloscopus trochilus	Söğüt bülbülü	Willow Warbler	LC	App-II	A.3.1	T	
Phylloscopus nitidus	Ardıçbülbülü	Willow warbler	LC	App-II	A.2	YZ	
Regulus regulus	Çalıkuşu	Goldcrest	LC	App-II	A.1.2	Y	
Muscicapa striata	Benekli Sinekkapan	Spotted Flycatcher	LC	App-II	A.3	YZ,Y	
Aegithalos caudatus	Uzunkuyruklu Baştankara	Long-tailed Tit	LC	App-III	A.2	Y	
Parus palustris	Bataklık Baştankara	Marsh Tit	LC	App-II	A.2	Y	
Parus ater	Çam baştankarası	Coal Tit	LC	App-II	A.3	Y	An-I
Parus caeruleus	Mavi baştankara	Blue Tit	LC	App-II	A.2	Y	
Parus major	Büyük baştankara	Great Tit	LC	App-II	A.3.1	Y	
Sitta europaea	Sıvacı	Nuthatch	LC	App-II	A.3	Y	
Sitta krüperi	Anadolu sıvacısı	Krüper's Nuthatch	NT	App-II	A.2	Y	
Oriolus oriolus	Sarıasma	Golden Oriole	LC	App-II	A.2	YZ	

Scientific Name of the Species	Turkish Name of the Species	English Name of the Species	IUCN	BERN	RDB	Timing	Bird Dir.
Lanius collurio	Kızılsırtlı örümcekkuşu	Red-backed Shrike	LC	App-III	A.3	YZ	An-I
Lanius minor	Karaalınlı örümcekkuşu	Lesser Grey Shrike	LC	App-III	A.3	YZ	An-I
Lanius senator	Kızılbaşlı örümcekkuşu	Woodchat Shrike	LC	App-III	A.2	Y	
Garrulus glandarius	Alakarga	Eurasian Jay	LC	--	A.3.1	Y	An-II/2
Pica pica	Saksağan	Magpie	LC	--	A.5	Y	An-II/2
Corvus frugilegus	Ekin kargası	Rook	LC	--	A.5	Y	An-II/2
Corvus corone	Leş kargası	Carrion Crow	LC	--	A.5	Y	An-II/2
Corvus corax	Kuzgun	Raven	LC	App-III	A.5	Y	
Sturnus vulgaris	Sığırcık	Common Starling	LC	--	A.5	Y	An-II/2
Passer domesticus	Ev serçesi	House Sparrow	LC	--	A.5	Y	
Passer montanus	Ağaç serçesi	Tree Sparrow	LC	App-III	A.3	Y	
Fringilla coelebs	İspinoz	Chaffinch	LC	App-III	A.4	Y	An-I
Fringilla montifringilla	Dağ ispinozu	Brambling	LC	App-III	A.3	KZ	
Serinus serinus	Küçük iskete	Serin	LC	App-II	A.3	Y	
Carduelis chloris	Florya	Greenfinch	LC	App-II	A.3	Y	
Carduelis carduelis	Saka	Goldfinch	LC	App-II	A.3.1	Y	
Carduelis cannabina	Ketenkuşu	Common Linnet	LC	App-II	A.3	Y	

Scientific Name of the Species	Turkish Name of the Species	English Name of the Species	IUCN	BERN	RDB	Timing	Bird Dir.
Loxia curvirostra	Çaprazgaga	Red Crosbill	LC	App-II	A.3	Y	
Carpodacus erythrinus	Çütre	Common Rosefinch	LC	App-III	A.2	YZ	
Emberiza cirlus	Bahçe kirazkuşu	Cirl Bunting	LC	App-III	A.2	Y	
Emberiza cia	Kaya kirazkuşu	Rock Bunting	LC	App-II	A.2	Y	
Emberiza hortulana	Kirazkuşu	Ortolan Bunting	LC	App-III	A.2	YZ	An-I
Emberiza melanocephala	Karabaşlı kirazkuşu	Black-headed Bunting	LC	App-II	A.4	YZ	
Emberiza calandra	Tarla kirazkuşu	Corn Bunting	LC	App-III	A.6	Y	

Appendix Table 4 Mammal Species within and in the Vicinity of the Project Area

Scientific Name of the Species	Turkish Name of the Species	English Name of the Species	IUCN	BERN	CITES	HAB. DIR.
Erinaceus concolor	Kirpi	Eastern Hedgehog	LC	-	-	-
Sorex volnuchini	Volnuchin'in Sivriburunlufaresi	Caucasian Pygmy Shrew	LC	An-III	-	-
Sorex satunini	Kafkas Sivriburunlufaresi	Caucasian Shrew	LC	An-III	-	-
Neomys teres	Sivriburunlu Sufaresi	Transcaucasian Water Shrew	LC	An-III	-	-
Crocidura leucodon	Sivriburunlu Tarlafaresi	Bi-Coloured White-Tooted Shrew	LC	An-III	-	-
Crocidura suaveolens	Sivriburunlu Bahçefaresi	Lesser White-Tooted Shrew	LC	An-III	-	-
Talpa levantis	Karadeniz Köstebeği	Levant Mole	LC	-	-	-
Lepus europaeus	Yabani Tavşan	European Hare	LC	An-III	-	-
Sciurus anomalus	Sincap	Persian Squirel	LC	An-II	-	An-IV
Cricetulus migratorius	Cüce Avurtlak	Gray Hamster	LC	-	-	-
Myodes glareolus	Kırmızısırtlı Fare, Kırmızı Fare	Bank Wole	LC	-	-	-
Microtus levis (=M. rossoiameridionalis)	Tarlafaresi	Sibling Vole	LC	-	-	-
Arvicola terrestris (=Arvicola amphibius)	Susıçanı	Water Vloe	LC	-	-	-
Apodemus mystacinus	Kaya Faresi	Rock Mouse	LC	-	-	-
Apodemus flavicollis	Sarıboyunlu Ormanfaresi	Yellow-Neck Mouse	LC	-	-	-
Rattus rattus	Sıçan	Black Rat	LC	-	-	-

Scientific Name of the Species	Turkish Name of the Species	English Name of the Species	IUCN	BERN	CITES	HAB. DIR.
Rattus norvegicus	Göçmen Sıçan	Brown Rat	LC	-	-	-
Mus domesticus	Evfaresi	Western House Mouse	LC	-	-	-
Mus macedonicus	Sarı Evfaresi	Balkan Short-tailed Mouse	LC	-	-	-
Nannospalax nehringi	Anadolu Körfaresi	Nehring's Mole Rat	DD	-	-	-
Dryomys nitedula	Hasancık, Ağaç Yediuyuru	Forest Dormouse	LC	An-III	-	An-IV
Muscardinus avellanarius	Fındık Faresi	Common Dormouse	LC	An-III	-	An-IV
Rhinolophus ferrumequinum	Büyük Nalburunlu Yarasa	Greater Horseshoe Bat	LC	An-II	-	An-II
Rhinolophus hipposideros	Küçük Nalburunlu Yarasa	Lesser Horseshoe Bat	LC	An-II	-	An-II
Rhinolophus mehelyi	Mehely'in Nalburunlu Yarasası	Mehely's Horseshoe Bat	VU - A4c	An-II	-	An-II
Myotis myotis	Büyük Farekulaklı Yarasa	Greater Horseshoe Bat	LC	An-II	-	An-II
Myotis blythii	Küçük Farekulaklı Yarasa	Lesser Mouse-Eared Bat	LC	An-II	-	An-II
Myotis daubentonii	Farekulaklı Su Yarasası	Daubenton's Bat	LC	An-II	-	-
Myotis mystacinus	Bıyıklı Siyah Yarasa	Whiskered Bat	LC	An-II	-	-
Myotis emarginatus	Kirpikli Yarasa	Geoffroy's Bat	LC	An-II	-	An-II
Pipistrellus pipistrellus	Cüce Yarasa	Common Pipistrelle	LC	An-III	-	-
Hypsugo savii	Savi'nin Cüce Yarasası	Savi s Pipistrelle	LC	An-II	-	-
Plecotus auritus	Kahverengi Uzunkulaklı Yarasa	Brown Long-eared Bat	LC	An-II	-	-

Scientific Name of the Species	Turkish Name of the Species	English Name of the Species	IUCN	BERN	CITES	HAB. DIR.
Miniopterus schreibersii	Uzunkanatlı Yarasa	Common Bent-wing Bat	NT	An-II	-	An-II
Tadarida teniotis	Buldog Yarasa	European Free-tailed Bat	LC	An-II	-	-
Canis lupus	Kurt	Grey Wolf	LC	An-II	An-II	An-II
Canis aureus	Çakal	Golden Jackal	LC	-	-	An-V
Vulpes vulpes	Tilki	Red Fox	LC	-	-	-
Mustela nivalis	Gelincik	Least Weasel	LC	An-III	-	-
Vormela peregusna	Alaca Sansar	Marbled Polecat	VU - A2c	An-II	-	An-II
Martes foina	Kaya Sansarı	Beech Marten	LC	An-III	-	-
Meles meles	Porsuk	European Badger	LC	An-III	-	-
Lutra lutra	Susamuru	Eurasian Otter	NT	An-II	An-I	An-II
Ursus arctos	Bozayı	Brown Bear	VU - C2a(i)	An-II	An-II	An-IV
Lynx lynx	Vaşak	Eurasian Lynx	LC	An-III	An-II	An-II
Felis silvestris	Yaban Kedisi	Wildcat	LC	An-II	An-II	An-IV
Sus scrofa	Yabandomuzu	Wild Boar	LC	-	-	-
Cervus elaphus	Kızılgeyik	Red Deer	LC	An-III	-	An-II
Capreolus capreolus	Karaca	Roe Deer	LC	An-III	-	-

Appendix Table 5 Freshwater Algea Species in the Project Area and its Vicinity

BACILLARIOPHYCEAE	*Nitzschia sigmoidae*
Achnanthes sp.	*Nitzschia tryblionella*
Amphora ovalis	*Nitzschia recta*
Aulacoseria granulata	*Nitzschia palea*
Caloneis bacillum	*Nitzschia fonticola*
Cocconeis sp.	*Pinnularia gibba*
Cocconeis placentula	*Rhoicosphaenia abbreviata*
Cyclotella meneghiniana	*Rhoipalodia gibba*
Cyclotella comta	*Stauroneis anceps*
Cyclotella ocellata	*Surirella ovalis*
Cymatopleura elliptica	*Surirella brebissonii*
Cymatopleura solea	**CHLOROPHYCEAE**
Cymbella affinis	*Chlorella vulgaris*
Cymbella cistula	*Closterium dianaea*
Cymbella minuta	*Coelastrum microporum*
Cymbella prostrata	*Crucigenia sp.*
Cymbella amphicephala	*Mougetia sp.*

Diploneis ovalis	*Oedogonium sp.*
Diatoma vulgaris	*Oocystis borgei*
Epithemia sorex	*Oocystis parva*
Fragilaria vauchaeria	*Pediastrum dublex*
Fragilaria ulna	*Scenedesmus quadricauda*
Fragilaria dilatata	*Spirogyra spP.*
Fragilaria arcus	*Staurastrum sp.*
Gomphonema angustatum	*Tetraedron minimum*
Gomphonema parvalum	**CYANOPHYCEAE**
Gomphonema gracile	*Anabaena affinis*
Gomphonema clavatum	*Chroococcus limneticus*
Gomphonema olivaceum	*Lyngbya sp.*
Hantzschia amphioxys	*Merismopedia glauca*
Mastogloia recta	*Oscillatoria rubescens*
Melosira varians	*Oscillatoria tenuis*
Meridion circulare	*Pseudoanabaena sp.*
Navicula bacillum	*Spirulina laxillima*
Navicula halophila	*Spirulina major*

Navicula pupula	**EUGLENOPHYCEAE**
Navicula radiosa	*Euglena sp.*
Navicula cuspidata	*Phacus sp.*
Navicula cryptocephala	**PYRROPHYCEAE**
Nitzchia amphibia	*Peridinium sp.*

Appendix Table 6 Zooplanktonic Organisms in the Project Area and its Vicinity

ROTIFERA
Brachionus calyciflorus
Brachionus quadridentatus
Polyarthra vulgaris
Filinia longiseta
Asplanchna priodonta
Conochilus unicornis
Colurella obtusa
Lepadella patella
Euchlanis dilatata
COPEPODA
Eucyclops serrulatus

Appendix Table 7 Flora Species in the Project Area and its Vicinity

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
PTERIDOPHYTA																
ASPLENIACEAE																
Asplenium onopteris L.	Kalkan Eğreltisi	Irish Spleenwort		X	X		X				Widespread					2
Asplenium ruta-muraria L.	Duvar Saçağı	Wallrue			X		X				Widespread					2
Asplenium trichomanes L.	Esmer Sürgünlü Şerit Eğreltisi	Bristle-Fern			X						N, W and S Turkey					1
Ceterach officinarum DC.	Pul Eğrelti	Scale-Fern	X		X	X					N, W and S Turkey					1
ATHYRIACEAE																
Athyrium filix-femina (L.) Roth	Yel Eğreltisi	Lady fern	X	X	X						Widespread					1
Cystopteris fragilis (L.) Bernh.	Gevrek Eğrelti	Brittle Bladder-Fern			X						Widespread					1
EQUISETACEAE																
Equisetum palustre L.	Bataklık Atkuyruğu	Marsh Horsetail					X				N Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Equisetum ramosissimum Desf.	Dallı Atkuyruğu	Branched Horsetail			X		X				Widespread					2
Equisetum telmateia Ehrh.	Çayır Atkuyruğu	Great Horsetail					X				Widespread					2
HYPOLEPIDACEAE																
Pteridium aquilinum (L.) Kuhn	Kartal Eğreltisi	Bracken		X	X		X				Widespread					2
POLYPODIACEAE																
Polypodium vulgare L. subsp. *vulgare*	Besbaye	Common Polypody			X		X				N Turkey					1
SPERMATOPHYTA																
GYMNOSPERMAE																
PINACEAE																
Pinus brutia Ten.	Kızıl Çam	Turkish Pine	X	X		X				Medit.	N, W and S Turkey					4
Pinus nigra Arn. subsp. *nigra* var. *caramanica* (Loudon) Rehder	Anadolu Kara Çamı	Anatolian Black Pine			X						N, W, C and S Turkey					4

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Pinus sylvestris L.	Sarı Çam	Scotch Pine						X	X	Eu.-Sib.	N and C Turkey					2
CUPRESSACEAE																
Cupressus sempervirens L.	Servi	Italian Cypress							X		N, W and S Turkey					1
Juniperus excelsa M.Bieb.	Boylu Ardıç	Grecian Juniper	X	X	X	X					N, W, C and S Turkey					2
Juniperus foetidissima Willd.	Kokar Ardıç	Foetid Juniper			X	X					N, W, C and S Turkey					1
Juniperus oxycedrus L. subsp. *oxycedrus*	Küçük Kozalaklı Katran Ardıcı	Prickly Juniper	X	X	X	X					Widespread					3
EPHEDRACEAE																
Ephedra major Host	Hum	Joint-Pine	X			X					N, W, C and E Turkey					1
ANGIOSPERMAE																
DICOTYLEDONEAE																
RANUNCULACEAE																

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Adonis flammea Jacq.	Cinlalesi	Large Pheasant's-Eye				X			X		Widespread					2
Anemone blanda Schott & Kotschy	Yoğurt Çiçeği	Balkan Anemone			X						N, W and S Turkey					1
Clematis vitalba L.	Akasma	Old Man's Beard	X	X	X	X					N, W and S Turkey					2
Consolida orientalis L.	Morçiçek	East Larkspur				X			X		Widespread					2
Consolida regalis Gray subsp. *paniculata* (Host) Soó *var. paniculata*	Çatal Mahmuzotu	Branching Larkspur				X					N, W, C and S Turkey					1
Delphinium venulosum B oiss.	Hezaren	Larkspur				X				Ir.-Tur.	N and C Turkey			**End / LC**		1
Helleborus orientalis Lam.	Çöpleme	Lenten Rose		X	X		X			Eu.-Sib.	N Turkey					2
Nigella latisecta P.H.Davis	Ekin Çörekotu	Cumin				X		X	X	Ir.-Tur.	N,E and C Turkey					2
Nigella segetalis M.Bieb.	Kara Çörekotu	Fennel Flower				X			X		N, C and E Turkey					1
Ranunculus arvensis L.	Mustafaçiçeği	Corn Buttercup					X		X		Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Ranunculus chius DC.	Meremcik	Buttercup					X				N, W and S Turkey					1
Ranunculus constantino politanus (DC.) d'Urv.	Kâğıthane Çiçeği	Plenus		X	X		X		X		Widespread					2
Ranunculus marginatus d'Urv. subsp. *trachycarpus* Hay ek	Çırnıkotu	Margined Buttercup			X		X				N, W and S Turkey					1
Ranunculus muricatus L.	Kutsaldefne	Spinyfruit Buttercup					X		X		N, W and S Turkey					1
Ranunculus oxyspermus Willd.	Kır Yağlaçanağı	Buttercup				X			X		N, C and E Turkey					1
Ranunculus repens L.	Sürünücü Düğünçiçeği	Creeping Buttercup					X		X		Widespread					1
Ranunculus sericeus Poi r.	Çınarcık	Buttercup					X			Ir.-Tur.	N, C, S and E Turkey					2
Ranunculus trichophyllus Chaix	Suluçanak	Thread Leaf Crowfoot		X		X			X		Widespread					2
Thalictrum lucidum L.	Çayırsedefi	Meadow Rue					X				N, W and S Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats								
Thalictrum minus L. var. *majus* (Crantz) Crepin	Kaytaran	Meadow Rue		X	X		X				N and E Turkey					1
BERBERIDACEAE																
Berberis vulgaris L.	Dağ Kadıntuzluğu	Common Barberry	X	X		X			X		N Turkey					2
Epimedium pubigerum (DC.) Moren & Decaisne	Azgıntekeotu	Barrenwort		X						Eu.-Sib.	N Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats								
PAPAVERACEAE																
Chelidonium majus L.	Kırlangıçotu	Celandine		X	X		X			Eu.-Sib.	N Turkey					1
Corydalis solida (L.) Clairv. subsp. *solida*	Rumeli Kazgagası	Spring Fumewort	X		X	X					N, W and S Turkey					2
Fumaria officinalis L.	Şahtere	Fumitory			X				X		N, W, C and S Turkey					1
Fumaria vaillantii Loisel.	Güvercin Göğsü	Few-Flowered Fumitory				X		X	X		Widespread					2
Glaucium corniculatum (L.) Rud. subsp. *refractum* (Nab.) Cullen	Kırmızı Boynuzlu Gelincik	Horned Poppy				X			X	Ir.-Tur.	N, C and E Turkey					1
Hypecoum imberbe Sm.	Boynuzlu Kimyon	Horned Cumin							X		Widespread					1
Papaver rhoeas L.	Gelincik	Common Poppy				X			X		Widespread					2
BRASSICACEAE (CRUCIFERAE)																
Alliaria petiolata (M.Bieb.) Cavara & Grande	Sabırotu	Hedge Garlic			X		X				Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Alyssum desertorum Stapf. var. *desertorum*	Dumanotu	Desert Madwort	X		X	X			X		Widespread					1
Alyssum minus (L.) Rothm. var. *micranthum (*E.Mey.) Dudley	Sade Kuduzotu	European Alyssum				X			X		Widespread					2
Alyssum sibiricum Willd.	Kedidili	Alyssum				X					Widespread					2
Arabidopsis thaliana (L.) Heynh.	Farekulağı Teresi	Mousear Cress				X			X		N and W Turkey					1
Arabis sagittata (Bertol.) DC.	Kaz Teresi	Wall Cress	X			X					N and S Turkey					1
Brassica oleracea L.	Lahana	Cabbage							X		Cultivation					1
Capsella bursa-pastoris (L.) Medik.	Çobançantası	Mother’s Heart				X			X		Widespread					1
Cardamine hirsuta L.	Acıtere	Bittercress					X				Widespread					1
Cardamine quinquefolia (M.Bieb.) Schmalh.	Hanımgömleği	Bittercress		X	X					Eu.-Sib.	N Turkey					2
Cardaria draba (L.) Desv. subsp. *draba*	Kediotu	Hoarycress							X		Widespread					1
Conringia orientalis (L.) Andrz.	Kocatelkari	Hare's Ear Mustard							X		Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Erophila verna (L.) DC. subsp. *verna*	Çirçirotu	Shadflower	X			X	X		X		Widespread					2
Erysimum crassipes Fisch. & C.A.Mey.	Zarifeotu	Blister Cress	X		X	X		X			Widespread					2
Erysimum cuspidatum (M.Bieb.) DC.	Kuyruklu Zarife	Treacle Mustard				X		X			N, C and E Turkey					1
Fibigia eriocarpa (DC.) Boiss.	Güneşotu	Gig	X	X							Widespread					2
Hirschfeldia incana (L.) Lag.-Foss.	Nadas Turpu	Greek Mustard				X		X	X		N, W and S Turkey					2
Iberis taurica DC.	Hünkârbeğendi	Candytuft				X					Widespread					1
Lepidium ruderale L.	Tuzık	Peppergrass					X		X		Widespread					1
Lepidium sativum L.	Tere	Cress							X		Cultivation					1
Nasturtium officinale R.Br.	Suteresi	Watercress					X		X		Widespread					2
Raphanus raphanistrum subsp. *sativus* (L.) Domin	Turp	Radish							X		Cultivation					1
Rapistrum rugosum (L.) All.	Kediturpu	Turnipweed							X		N, W and S Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Sinapis arvensis L.	Hardal	Mustard							X		Widespread					1
Sisymbrium officinale (L.) Scop.	Ergelen Hardalı	Hedge Mustard	X	X		X					N, W and S Turkey					1
Thlaspi arvense L.	Ekin Dağarcığı	Field Pennycress				X	X	X	X		N, W and S Turkey					2
Thlaspi perfoliatum L.	Çayır Akçaçiçeği	Claspleaf Pennycress					X		X		N, W, C and S Turkey					2
RESEDACEAE																
Reseda lutea L. var. *lutea*	Muhabbet Çiçeği	Yellow Mignonette							X		Widespread					1
Reseda luteola L.	Eşekçitlimi	Dyer's Rocket							X		N, W, C and S Turkey					1
CISTACEAE																
Cistus creticus L.	Laden	Pink Rock-Rose	X	X						Medit.	N, W and S Turkey					3
Cistus laurifolius L.	Defne Yapraklı Karağan	Laurel-Leaved Rock-Rose			X					Medit.	N, W, C and S Turkey					2
Fumana procumbens (D unal) Gren. & Godr.	Yer Güneşotu	Needle Sunrose				X					N, W, C and S Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Helianthemum nummularium (L.) Mill. subsp. *nummularium*	Sarı Altınçiçeği	Common Rock-Rose				X					N, W and S Turkey					3
VIOLACEAE																
Viola alba Besser	Ak Menekşe	White Violet	X	X	X	X					N, W and S Turkey					2
Viola kitaibeliana Schult.	Yabani Menekşe	Dwarf Pansy	X	X		X	X		X		N, W and S Turkey					2
Viola odorata L.	Kokulu Menekşe	Sweet Violet	X	X	X						N, W and S Turkey					1
Viola sieheana W.Becker	Çayır Menekşesi	Common Dog Violet		X	X						N, W and S Turkey					2
POLYGALACEAE																
Polygala anatolica Boiss. & Heldr.	Anadolu Sütotu	Anatolian Milkwort				X					Widespread					1
Polygala supina Schreb.	Sütotu	Milkwort		X	X						Widespread					1
CARYOPHYLLACEAE																
Agrostemma githago L.	Karamuk	Common Corncockle							X		Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Arenaria serpyllifolia L.	Kumotu	Sand-Wort	X			X			X		Widespread					2
Cerastium anomalum Waldst. & Kit.	Boynuzotu	Mouse - Earchick-Weed	X						X		N, W and S Turkey					1
Cerastium glomeratum T huill.	Boynuzotu	Clammy Chickweed				X			X		N, W and E Turkey					2
Dianthus aculeatus Hamzaoğlu	Tüf Karanfili	Tuff Carnation	X								N, W and C Turkey			**End / EN**		2
Dianthus carmelitarum R eut. ex Boiss.	Karadeniz Karanfili	Black Sea Carnation			X					Eu.-Sib.	N Turkey			**End / LC**		1
Dianthus kastembeluens is Freyn & Sint.	Kastamonu Karanfili	Kastamonu Carnation	X	X						Eu.-Sib.	N Turkey			**End / LC**		1
Dianthus calocephalus Boiss.	Güzelbaşlı Karanfil	Beautiful-Headed Carnation		X	X	X					Widespread					1
Holosteum umbellatum L. subsp. *umbellatum*	Şeytanküpesi	Jagged Chickweed	X		X			X	X		N, C and S Turkey					2
Minuartia montana L. subsp. *wiesneri* (Stapf) McNeill	Demet Tıstısı	Mountain Sandwort				X				Ir.-Tur.	N, C, S and E Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Moehringia trinervia (L.) Clairv.	Keleşot	Three-Veined Sandwort		X	X		X				N, C, S and E Turkey					1
Moenchia mantica (L.) Bartl. subsp. *mantica*	Dördüz	Upright Chickweeds					X				N, W, C and E Turkey					1
Saponaria officinalis L.	Sabunotu	Soapwort			X		X				Widespread					1
Silene alba (Mill.) E.H.L.Krause subsp. *eriocalycina* (Boiss.) Walters	Gıcıgıcı	White Campion	X	X	X	X					Widespread					1
Silene compacta Fisch.	Kanlıbasıra Otu	Oriental Silene	X		X	X					Widespread					1
Silene italica (L.) Pers.	Yuğuşyüreği	Italian Silene			X						Widespread					1
Silene supina M.Bieb. subsp. *pruinosa* (Boiss.) Chowdhuri	Fırat Nakılı	Catchfly				X					Widespread					3
Silene vulgaris (Moench) Garcke var. *vulgaris*	Gıvışgan	Bladder Campion		X							Widespread					1
Stellaria holostea L.	Circamuk	Addersmeat		X			X			Eu.-Sib.	N Turkey					1
Stellaria media (L.) Vill. subsp. *media*	Serçedili	Common Chickweed	X	X	X		X				N, W and S Turkey					1
ILLECEBRACEAE																

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Herniaria incana Lam.	Gri Kırık Otu	Gray Rupturewort				X					Widespread					1
POLYGONACEAE																
Polygonum aviculare L.	Köyotu	Common Knotgrass					X				N, W and S Turkey					1
Polygonum lapathifolium L.	Söğütotu	Pale Persicaria			X		X				Widespread					2
Rumex acetosella L.	Kuzukulağı	Sheep's Sorrel				X			X		Widespread					2
Rumex crispus L.	Labada	Curly Dock					X				Widespread					1
Rumex tuberosus L. subsp. *tuberosus*	Yumrulu Labada	Tuberous Dock			X						N, W and S Turkey					1
CHENOPODIACEAE																
Atriplex rosea L.	Gül Unluca	Saltbush							X		Widespread					1
Chenopodium album L. subsp. *album* var. *album*	İnce Pulotu	Lamb's Quarters				X			X		N Turkey					1
Chenopodium botrys L.	Kızılbacak	Feather Geranium							X		N, W, C and S Turkey					2
Chenopodium foliosum Asch.	Cülek	Leafy Goosefoot				X		X	X		Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Kraschenninnikovia cerat oides (L.) Gueldenst.	Fırçasirken	Pamirian Winterfat				X					N, C and E Turkey					3
Salsola ruthenica Iljin	Soda Otu	Tumbleweed							X		Widespread					2
AMARANTHACEAE																
Amaranthus retroflexus L.	Tilkikuyruğu	Red-root Amaranth							X		Widespread					2
PHYTOLACCACEAE																
Phytolacca americana L.	Şekerciotu	Pokeweed	X		X	X					S and N Turkey					1
TAMARICACEAE																
Myricaria germanica (L.) Desv.	Harbakotu	False Tamarisk					X				N, C and E Turkey					2
Tamarix smyrnensis Bun ge	Ilgın	Salt Cedar					X				Widespread					2
HYPERICACEAE																
Hypericum bithynicum B oiss.	Uludağ Koyunkıranı	St John's-Wort		X						Eu.-Sib.	N Turkey					1
Hypericum lydium Boiss.	Cayesancıyan	St John's-Wort	X	X		X					Widespread					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Hypericum montbretii Spach	Çay Kantaronu	St. John's-Wort	X		X	X		X			N, W, C and S Turkey					2
Hypericum perforatum L.	Sarı Kantaron	Perforate St John's-Wort		X			X				Widespread					2
Hypericum scabrum L.	Karahasan Çayı	Rough St John's-Wort				X				Ir.-Tur.	Widespread					2
MALVACEAE																
Alcea pallida (Willd.) Waldst. & Kit.	Soluk Hatmi	Hollyhock							X		N, W, C and S Turkey					1
Malva neglecta Wallr.	Ebegümeci	Mallow							X		N, W, C and S Turkey					1
Malva sylvestris L.	Büyük Ebegümeci	Big Mallow							X		Widespread					1
TILIACEAE																
Tilia rubra DC. subsp. *caucasica* (Rupr.) V.Engl.	Felamur	Red Twigged Lime		X	X		X			Eu.-Sib.	N and W Turkey					1
LINACEAE																
Linum austriacum L. subsp. *austriacum*	Zeyrek	Austrian Flax				X					N, W, C and E Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Linum bienne Mill.	Deli Keten	Pale Flax		X		X				Medit.	N, W and S Turkey					2
Linum nodiflorum L.	Yabani Keten	Flax				X				Medit.	Widespread					1
GERANIACEAE																
Erodium cicutarium (L.) L'Hér. subsp. *cicutarium*	Çobaniğnesi	Redstem Filaree	X		X	X	X		X		Widespread					2
Geranium asphodeloides Burm.f.	Yaramerhemi	Asphodel Crane's Bill		X	X					Eu.-Sib.	N, W and S Turkey					1
Geranium lucidum L.	Dakkaotu	Shiny Geranium	X		X		X	X	X		N, W and S Turkey					2
Geranium macrostylum Boiss.	Turnagagası	Cranesbill		X	X					Medit.	N, C and S Turkey					2
Geranium pyrenaicum Burm.f.	Gelin Çarşafı	Berg-Storchschnabel	X	X	X						Widespread					2
Geranium robertianum L.	Dağ Itırı	Herb Robert			X						Widespread					1
ZYGOPHYLLACEAE																

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Peganum harmala L.	Üzerlik	Esfand				X			X		Widespread					1
Tribulus terrestris L.	Çobançökerten	Maltese Cross				X					Widespread					1
ACERACEAE																
Acer campestre L. subsp. *campestre*	Ova Akçaağacı	Hedge Maple		X	X					Eu.-Sib.	N Turkey					2
STAPHYLEACEAE																
Staphylea pinnata L.	Ağızlıkçalısı	European Bladdernut		X	X						N and S Turkey					1
VITACEAE																
Vitis vinifera L.	Üzüm	Common Grape							X		Widespread					2
RHAMNACEAE																
Frangula alnus Mill. subsp. *alnus*	Barutağacı	Alder Buckthorn			X		X			Eu.-Sib.	N, C and S Turkey					1
Paliurus spina-christi Mill.	Kara Çalı	Garland Thorn	X	X		X			X		Widespread					3
Rhamnus rhodopea Velen.	Balkan Cehrisi	Balkan Buckthorn	X			X					N, W and C Turkey					1
ANACARDIACEAE																

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Cotinus coggygria Scop.	Boyacı Sumağı	Smoketree			X	X					N, S and E Turkey					1
Pistacia terebinthus L. subsp. *palaestina* (Boiss.) Engler	Menengiç	Terebinth	X	X		X				Medit.	Widespread					3
Rhus coriaria L.	Sumak	Sumach	X			X					N, W, C and S Turkey					1
CELASTRACEAE																
Euonymus europaeus L.	İğcik Ağacı	Spindle		X						Eu.-Sib.	N, W and S Turkey					1
FABACEAE (LEGUMINOSAE)																
Astragalus glycyphyllos L. subsp. *glycyphyllos*	Dev Geven	Liquorice Milkvetch			X					Eu.-Sib.	N and W Turkey					1
Astragalus microcephalus Willd.	Anadolu Kitresi	Anatolian Milk Vetch				X				Ir.-Tur.	Widespread					1
Astragalus micropterus Fisch.	Serçe Geveni	Milk Vetch				X				Ir.-Tur.	N and C Turkey			**End / LC**		1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Astragalus pseudocaspius Fisch.	Geyik Geveni	Milk Vetch				X					N and W Turkey					3
Astragalus sigmoideus Bunge	Güdük Geven	İnclude milkvetch	X			X					N Turkey			End / LC		1
Chamaecytisus hirsutus (L.) Link	Altın Çalısı	Hairy Broom		X							N, W and S Turkey					1
Colutea cilicica Boiss. & Balansa	Patlangaç	Cilician Bladder-Senna	X			X					Widespread					2
Coronilla scorpioides (L.) Koch	Akrep Burçağı	Annual Scorpion				X	X		X		N, W, C and S Turkey					2
Coronilla varia L. susbp. *varia*	Taçlı Fiğ	Crownvetch		X							Widespread					1
Dorycnium graecum (L.) Ser.	Kaplan Otu	Canary Clover	X		X	X			X	Eu.-Sib.	Widespread					2
Dorycnium pentaphyllum Scop. subsp. *herbaceum* (Vill.) Rouy	Zehirli Yonca	Prostrate Canary Clover	X		X				X		N, W, C and E Turkey					1
Galega officinalis L.	Keçisedefi	Galega				X				Eu.-Sib.	Widespread					1
Genista tinctoria L.subsp. *tinctoria*	Boyacı Katırtırnağı	Dyer's Broom			X	X				Eu.-Sib.	N, W and E Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Glycyrrhiza glabra L.var. *glandulifera* (Waldst. & Kit.) Boiss.	Meyan	Licorice							X		Widespread					1
Hedysarum varium Willd.	Batalak	Sweet Vetch			X					Ir.-Tur.	N, W, C and S Turkey					1
Lathyrus aphaca L. var. *biflorus* Post	Sarı Burçak	Yellow-Flowered Pea						X	X		Widespread					2
Lathyrus aureus (Steven) D.Brandza	Koru Mürdümüğü	Golden Pea			X	X				Eu.-Sib.	N, W, C and E Turkey					1
Lathyrus laxiflorus (Desf.) Kuntze subsp. *laxiflorus*	Deli Burçak	Vetch	X	X	X	X					Widespread					2
Lathyrus pratensis L.	Yılan Gürülü	Meadow Pea					X		X	Eu.-Sib.	Widespread					2
Lens ervoides (Brign.) Grande	İnce Mercimek	Lentil				X				Medit.	N, W and S Turkey					2
Lotus angustissimus L.	Kurtluot	Manjimup Clover		X	X						N, W and S Turkey					2
Lotus corniculatus L. var. *tenuifolius* L.	Sarı Çiçekli Gazel Boynuzu	Bird's Foot-Trefoil					X		X		Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Medicago falcata L.	Kart Yonca	Yellow Alfalfa			X				X		N, C and S Turkey					2
Medicago minima (L.) L. var. *minima*	Gurnik	Bur Medick				X					Widespread					2
Medicago lupulina L.	Bitçikotu	Black Medick				X			X		Widespread					1
Medicago orbicularis (L.) Bartal.	Yonca	Lucerne				X			X		N, W and S Turkey					1
Medicago sativa L. subsp. *sativa*	Yonca	Lucerne							X		Widespread					1
Melilotus alba Desr.	Aktaşyoncası	White Melilot			X		X				Widespread					2
Onobrychis caput-galli (L.) Lam.	Pıtrak Korunga	Cockshead Sainfoin				X			X	Medit.	Widespread					2
Onobrychis oxyodonta Boiss.	Kır Korungası	Sainfoin				X					N, W, C and S Turkey					1
Ononis spinosa L. subsp. *leiosperma* (Boiss.) Sirj.	Öküzçanı	Tall Rest-Harrow							X		Widespread					1
Phaseolus vulgaris L.	Fasülye	Beans							X		Cultivation					1
Pisum sativum L.	Bezelye	Pea							X		Cultivation					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Psoralea bituminosa L.	Katran Yoncası	Pitch Trefoil		X	X					Medit.	N, W, C and S Turkey					2
Trifolium angustifolium L. var. *angustifolium*	Nefel	Narrow Clover	X		X	X			X		Widespread					1
Trifolium arvense L. var. *arvense*	Tarla Üçgülü	Rabbitfoot Clover		X		X					Widespread					2
Trifolium campestre Schreb.	Üçgül	Field Clover		X	X						Widespread					2
Trifolium hybridum L. subsp. *hybridum*	Melez Yonca	Alsike Clover					X		X		Widespread					2
Trifolium medium L. var. *medium*	Köse Yonca	Zigzag Clover		X	X		X		X		N and W Turkey					2
Trifolium pannonicum Jacq. subsp. *elongatom* (Willd.) Zohary	Uzun Yapraklı Üçgül	Hungarian Clover		X	X						Widespread			**End / LC**		1
Trifolium physodes M.Bieb. subsp. *physodes*	Meşe Üçgülü	Clover		X	X	X			X		Widespread					2
Trifolium pratense L. var. *pratense*	Çayır Üçgülü	Beebread					X		X		Widespread					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Trifolium resupinatum L. var. *resupinatum*	İran Üçgülü	Persian Clover			X		X		X		Widespread					2
Trigonella spicata Sm.	Başak Boyotu	Greek-Clover				X				Medit.	N, W and S Turkey					2
Vicia ciliatula Lipsky	Saçaklıfiğ	Vetch			X					Eu.-Sib.	N Turkey					2
Vicia crocea (Desf.) Fritsch	Safran Fiği	Vetch		X	X					Eu.-Sib.	N Turkey					1
Vicia hirsuta (L.) Gray	Bozfiğ	Hairy Vetch	X	X		X					N, W and S Turkey					2
ROSACEAE																
Agrimonia eupatoria L.	Küçük Kasıkotu	Agrimony					X				Widespread					1
Alchemilla mollis (Buser) Rothm.	Su Keltatı	Giant Lady's Mantle		X			X				N and C Turkey					1
Cotoneaster nummulariu s Fisch. & C.A.Mey.	Dağmuşmulası	Coinwort Cotoneaster		X	X	X					Widespread					2
Crataegus microphylla K.Koch	Alıç	Haw Thorn	X		X	X		X			Widespread					2
Crataegus monogyna Ja cq. subsp. *monogyna*	Yemişen	Maythorn		X	X	X			X		N, C and E Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Crataegus pentagyna W aldst. & Kit. ex Willd.	Kömüş Dikeni	Small Flowered Black Hawthorn		X	X	X				Eu.-Sib.	N, W and S Turkey					1
Filipendula vulgaris Moe nch	Dropwort	Ergeç Sakalı			X		X			Eu.-Sib.	Widespread					2
Fragaria vesca L.	Dağçileği	Wild Strawberry		X	X						Widespread					1
Geum urbanum L.	Yelliceotu	Wood Avens		X			X			Eu.-Sib.	Widespread					2
Malus domestica L.	Elma	Apple							X		Cultivation					1
Malus orientalis Uglitzk. ex Juz.	Doğu Elması	Orient Apple		X		X	X				Widespread					1
Mespilus germanica L.	Beşbıyık	Medlar		X	X					Eu.-Sib.	Widespread					1
Potentilla inclinata Vill.	Beşparmak Otu	Silver-Weed					X				N, W, C and E Turkey					1
Potentilla micrantha Ra mond ex DC.	Cüce Parmakotu	Pink Barren Strawberry		X			X				N, W and S Turkey					1
Potentilla recta L.	Parmakotu	Cinquefoil		X					X		Widespread					1
Potentilla reptans L.	Sürünücü Parmakotu	Creeping Cinquefoil					X				Widespread					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Prunus armeniaca L.	Kayısı	Apiricot							X		Cultivation					1
Prunus avium (L.) L.	Kiraz	Cherry							X		Cultivation					1
Prunus cerasus L.	Vişne	Sour Cherry							X		Cultivation					1
Prunus divaricata Ledeb. subsp. *divaricata*	Yaban Eriği	Wild Plum	X			X	X		X		Widespread					2
Prunus domestica L.	Erik	Plum							X		Cultivation					1
Prunus persica (L.) Batsch	Şeftali	Peach							X		Cultivation					1
Prunus spinosa L. subsp. dasyphylla (Schur) Domin	Çakal Eriği	Blackthorn	X	X		X				Eu.-Sib.	N, W, C and S Turkey					1
Pyracantha coccinea M.Roem.	Ateşdikeni	Firethorn	X				X				N, S and C Turkey					2
Pyrus communis L. subsp. *caucasica* (Fed.) Browicz	Yaygın Ahlat	Common Pear	X		X	X					N and S Turkey					1
Pyrus elaeagnifolia Pall. subsp. *elaeagnifolia*	Ahlat	Wild Pear	X			X					N, W, C and S Turkey					1
Rosa canina L.	Kuşburnu	Dog Rose	X	X	X				X		Widespread					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Rosa horrida Fischer	Beyaz Yabangülü	White Rose			X	X					N, W and S Turkey					1
Rubus discolor Weihe & Nees	Himalaya Böğürtleni	Himalayan Blackberry	X	X		X	X				N, W and S Turkey					3
Rubus sanctus Schreb.	Böğürtlen	Blackberry					X				Widespread					2
Sanguisorba minor Scop. subsp. *muricata* (Spach) Briq.	Çayır Düğmesi	Small Burnet		X		X			X		W, S, and E Turkey					1
Sorbus aucuparia L.	Kuş Üvezi	Mountain Ash		X	X					Eu.-Sib.	N, C and E Turkey					2
Sorbus torminalis (L.) Crantz var. *torminalis*	Akçaağaç Yapraklı Üvez	Wild Service Tree			X					Eu.-Sib.	Widespread					1
LYTHRACEAE																
Lythrum hyssopifolia L.	Aklarotu	Hyssop Loosestrife			X						Widespread					1
Lythrum salicaria L.	Hevhulma	Purple Loosestrife					X			Eu.-Sib.	Widespread					2
ONAGRACEAE																
Epilobium angustifolium L.	Yakıotu	Fireweed		X	X						Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Epilobium lanceolatum Seb. & Mauri	Dil Yakıotu	Spear Leaved Willowherb			X						Widespread					1
Epilobium tetragonum L.	Köşeli Gövdeli Yakıotu	Square-Stemmed Willowherb					X		X		N, W and S Turkey					2
CUCURBITACEAE																
Citrullus lanatus (Thunb.) Matsum. & Nakai	Karpuz	Watermelon							X		Cultivation					1
Cucumis melo L.	Kavun	Melon							X		Cultivation					1
Cucumis sativus L.	Hıyar	Cucumber							X		Cultivation					1
Cucurbita pepo L.	Sakız Kabağı	Marrow							X		Cultivation					1
Cucurbita maxima Duchesne	Helvacı Kabağı	Pumpkin							X		Cultivation					1
CRASSULACEAE																
Sedum acre L.	Acı Damkoruğu	Stonecrop	X			X		X			N and C Turkey					
Sedum album L.	Çobankavurgası	White Stonecrop				X					Widespread					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Sedum hispanicum L. var. *hispanicum*	Damkoruğu	Tiny Buttons Sedum	X		X	X		X			Widespread					2
Sedum pallidum M.Bieb. var. *bithynicum* (Boiss.) Chamb.	Koyunörmece	Stonecrop	X	X		X				Eu.-Sib.	N and W Turkey					1
SAXIFRAGACEAE																
Saxifraga rotundifolia L.	Benli Taşkıran	Round-Leaved Saxifrage		X	X					Eu.-Sib.	N Turkey					1
APIACEAE (UMBELLIFERAE)																
Anethum graveolens L.	Dere Otu	Dill							X		Cultivation					1
Angelica sylvestris L. var. *sylvestris*	Melekotu	Masterwort			X		X			Eu.-Sib.	N and W Turkey					1
Anthriscus nemorosa (M.Bieb.) Spreng.	Peçek	Chervil	X	X	X		X				Widespread					2
Artedia squamata L.	Karabenek	Crown Flower							X		Widespread					2
Bupleurum boissieri Post	Şeytankirpiği	Boissier's Bupleurum				X					N and S Turkey					1
Bupleurum rotundifolium L.	Soluk Şeytanayağı	Griffithii							X		Widespread					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Caucalis platycarpos L.	Kavkal	Burr Parsley				X			X		Widespread					1
Chaerophyllum byzantinum Boiss.	Hılakotu	Byzantine Chervil			X		X			Eu.-Sib.	N and W Turkey					1
Cnidium silaifolium (Jacq.) Simonkai subsp. *orientale* (Boiss.) Tutin	Galyobişotu	Cnidium			X						Widespread					1
Conium maculatum L.	Baldıran	Poison Hemlock		X			X				Widespread					2
Eryngium campestre L. var. *virens* Link	Boğadikeni	Field Eryngo				X			X		Widespread					2
Eryngium giganteum M. Bieb.	Boğadikeni	Tall Eryngo		X	X					Eu.-Sib.	N Turkey					2
Falcaria vulgaris Bernh.	Orakotu	Sickleweed			X						Widespread					1
Ferulago thirkeana Boiss.	Sarıçakşır	Ferulago				X					N Turkey			**End / LC**		1
Foeniculum vulgare Mill.	Rezene	Fennel					X				N, W and S Turkey					2
Heracleum platytaenium Boiss.	Öğrekotu	Cow Parsnip					X			Eu.-Sib.	N, W and C Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Laserpitium hispidum M. Bieb.	Saçlı Enguban	Sermountain			X					Eu.-Sib.	N and C Turkey					1
Myrrhoides nodosa (L.) Cannon	Hacıkuş	Blasenstengel		X			X				Widespread					2
Petroselinum crispum (Mill.) Fuss	Maydanoz	Parsley							X		Cultivation					1
Peucedanum longifolium Waldst. & Kit.	Domuz Rezenesi	Milk-Parsley			X					Eu.-Sib.	N Turkey					1
Sanicula europaea L.	Dermanotu	Sanicle		X			X			Eu.-Sib.	N, W and S Turkey					1
Scandix pecten-veneris L.	Çobantarağı	Venus Komb				X			X		Widespread					1
Tordylium maximum L.	Kocadavulotu	Tordile							X		N and W Turkey					1
Torilis arvensis (Huds.) Link subsp. *neglecta* (Sprengel) Thellung	Dercikotu	Common Hedge Parsley				X			X		Widespread					1
Torilis leptophylla (L.) Rchb.f.	Ince Dercikotu	Bristlefruit Hedge Parsley							X		Widespread					1
Zosima absinthifolia Link	Peynirotu	Zosima				X					Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
ARALIACEAE																
Hedera colchica (K.Koch) K.Koch	Kara Sarmaşık	Colchis Ivy		X	X		X			Eu.-Sib.	N Turkey					2
Hedera helix L.	Duvar Sarmaşığı	Common Ivy		X	X		X				Widespread					3
CORNACEAE																
Cornus sanguinea L. subsp. *australis* (C.A.Mey.) Jav.	Kiren	Dogwood		X	X					Eu.-Sib.	N, S and E Turkey					1
Cornus mas L.	Kızılcık	Cornelian Cherry			X					Eu.-Sib.	Widespread					2
CAPRIFOLIACEAE																
Lonicera caucasica Pall. subsp. *orientalis* (Lam.) Chamb. & Long.	Çakkana	Honeysuckle			X						N, W, C and E Turkey			**End / LC**		2
Sambucus ebulus L.	Bodur Mürver	Danewort		X	X		X		X	Eu.-Sib.	Widespread					1
VALERIANACEAE																
Centranthus longiflorus Steven subsp. *longiflorus*	Mahmuzçiçeği	Kiss-Me-Quick				X					Widespread					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats								
Valerianella coronata (L.) DC.	Taçlı Kuzugevreği	Crowned Corn Salad				X			X		Widespread					2
MORINACEAE																
Morina persica L.	Merdiven Çiçeği	Prickly Whorlflower						X	X	Ir.-Tur.	Widespread					1
DIPSACACEAE																
Dipsacus laciniatus L.	Fesçitarağı	Cutleaf Teasel					X		X		Widespread					1
Scabiosa argentea L.	Yazı Süpürgesi	Silver Scabious				X					Widespread					2
Scabiosa columbaria L. subsp. *columbaria* var. *columbaria*	Küçük Uyuzotu	Small Scabious			X		X				Widespread					1
Scabiosa micrantha Desf.	Kavurotu	Scabious			X						Widespread					1
ASTERACEAE (COMPOSITAE)																
Achillea biebersteinii Afan.	Sarı Civanperçemi	Yellow Milfoil				X		X	X	Ir.-Tur.	Widespread					2
Achillea biserrata M.Bieb .	Aksırıkotu	Yarrow		X	X					Eu.-Sib.	N Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Achillea setacea Waldst. & Kit.	Ayvabala	Bristly Yarrow Eng				X	X		X	Eu.-Sib.	Widespread					2
Anthemis austriaca Jacq .	Babuççа	Austrian Chamomile				X					N, W, C and S Turkey					1
Anthemis cretica L. subsp. *pontica* (Willd.) Grierson	Boyacı Papatyası	Chamomile				X					Widespread					2
Anthemis tinctoria L. var. *pallida* DC.	Beyaz Boyacı Papatyası	Golden Chamomile			X	X					Widespread					1
Anthemis tinctoria L. var. *tinctoria*	Boyacı Papatyası	Golden Chamomile	X	X		X					Widespread					2
Arctium minus (Hill) Bernh. subsp. *pubens* (Bab.) Arenes	Löşlek	Lesser Burdock				X			X	Eu.-Sib.	N, C and E Turkey					1
Artemisia scoparia Wald st. & Kitam.	Kara Süpürge	Redstem Wormwood					X		X		Widespread					1
Artemisia absinthium L.	Acı Pelin	Absinth Wormwood				X	X		X		Widespread					1
Artemisia spicigera K.Ko ch	Bozkır Yavşanı	Wormwood				X				Ir.-Tur.	N, C and E Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Bellis perennis L.	Koyungözü, Çayırgüzeli	Daisy	X		X	X	X			Eu.-Sib.	Widespread					2
Bidens tripartita L.	Şeytansaçı	Burr Marigold					X				Widespread					1
Carduus acanthoides L. subsp. *acanthoides*	Saka Dikeni	Plumeless Thistle				X			X	Eu.-Sib.	N and W Turkey					1
Carduus nutans L. subsp. *nutans*	Eşek Dikeni	Chardon Penche					X	X	X		Widespread					2
Carduus pycnocephalus L. subsp. *albidus* (M.Bieb.) Kazmi	Sık Başlı Kangal	Slender Thistle				X			X		Widespread					2
Carthamus lanatus L.	Sarıdiken	Woolly Distaff Thistle							X		Widespread					1
Centaurea consanguine a DC.	Tezdüğme	Centaury				X					N and E Turkey			**End / LC**		2
Centaurea depressa M. Bieb.	Gökbaş	Iranian Knapweed							X		Widespread					2
Centaurea hypoleuca DC.	Boz Tülübaş	Cornflower	X	X		X				Eu.-Sib.	N Turkey					1
Centaurea iberica Trevir. ex Spreng.	Yanardöner	Cornflower			X		X				Widespread					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Centaurea salicifolia M.Bieb. subsp. *salicifolia*	Serçebaşı	Centaury					X			Eu.-Sib.	N Turkey					2
Centaurea solstitialis L. subsp. *solstitialis*	Çakırdikeni	Barnaby's Thistle							X		Widespread					1
Centaurea triumfettii All.	Dağ Peygamber Çiçeği	Squarrose Knapweed	X		X	X		X	X		N, C, S and E Turkey					1
Chondrilla juncea L. var. *juncea*	Kondrilla	Chondrilla				X			X		Widespread					2
Cichorium intybus L.	Yabani Hindiba	Chicory					X		X		Widespread					2
Cirsium hypoleucum DC.	Vişne Kangalı	Thistles		X	X					Eu.-Sib.	N and W Turkey					1
Cirsium arvense (L.) Scop. subsp. *vestitum* (Wimmer & Grab.) Petrak	Köy Göçüren	Canada Thistle					X		X		Widespread					3
Cirsium vulgare (Savi) Ten.	Devedikeni	Thistle			X		X				N, W and S Turkey					1
Cnicus benedictus L. var. *kotschyi* Boiss.	Topdiken	Holy Thistle				X			X		Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Conyza canadensis (L.) Cronquist	Kanada Pireotu	Canadian Fleabane					X		X		Widespread					3
Crepis foetida L. subsp. *rhoeadifolia* (M.Bieb.) Čelak	Hindiba	Stinking Hawk's-Beard				X			X		Widespread					2
Crepis micrantha Czerep.	Yedi Kıskıs	Hawk's-Beard		X	X				X		N, W and S Turkey					1
Crepis pulchra L. subsp. *pulchra*	Zarif Kıskıs	Smallflower Hawk's-Beard	X	X		X	X				Widespread					2
Crepis sancta (L.) Babcock	Tatlı Hindiba	Hawk's-Beard	X	X		X			X		Widespread					1
Crupina crupinastrum (Moris) Vis.	Gelindöndüren	Southern Crupina				X			X		Widespread					2
Doronicum orientale Hoffm.	Orman Kaplanotu	Leopard's Bane		X	X						N, W, C and S Turkey					1
Echinops galaticus Freyn	Orman Topuzu	Globe-Thistle	X	X	X	X				Eu.-Sib.	N C and S Turkey					2
Echinops ritro L.	Topuz	Southern Globe Thistle				X		X	X		N, W, C and S Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Filago pyramidata L.	Ateşpamuğu	Broad-Leaved Cudweed		X	X	X					N, W, C and S Turkey					2
Filago vulgaris Lam.	Yaygın Ateşpamuğu	Common Cudweed				X			X		N and W Turkey					2
Gnaphalium luteo-album L.	Sarıbeyaz Bozağan	Jersey Cudweed					X				N, W and S Turkey					1
Helichrysum graveolens (M.Bieb.) Sweet	Hencecalik	Strawflower			X						N, W, C and E Turkey					1
Hieracium bornmuelleri Freyn	Pala Şahinotu	Hawkweed		X	X						N, C, S and E Turkey			**End / LC**		1
Hieracium paphlagonicum Freyn & Sint.	Havlı Şahinotu	Hawkweed				X		X			N and C Turkey			**End / LC**		1
Inula germanica L.	Ekin Andızotu	Deutscher Alant					X			Eu.-Sib.	Widespread					1
Inula salicina L.	Söğütsü Andızotu	Willowleaf Yellowhead					X			Eu.-Sib.	N, W, C and E Turkey					1
Jurinea consanguinea D C.	Geyikgöbeği	Jurinea				X										2
Lactuca sativa L.	Marul	Everlasting							X		Cultivation					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Lactuca serriola L.	Eşek Helvası	Prickly Lettuce				X			X	Eu.-Sib.	Widespread					2
Lapsana communis L. subsp. *intermedia* (M.Bieb.) Hayek	Tavşan Salatası	Common Nipplewort	X	X		X			X		Widespread					2
Leontodon hispidus L. var. *hispidus*	Gulikazer	Yellow Dandelion				X				Eu.-Sib.	Widespread					1
Logfia arvensis (L.) Holub	Tarla Pamukotu	Field Cottonrose	X		X	X		X	X		Widespread					2
Mycelis muralis (L.) Dumort.	Divar Marulu	Wall Lettuce		X	X					Eu.-Sib.	N, W and S Turkey					1
Onopordum acanthium L.	Galagan	Scotch Thistle				X		X	X		N, C and E Turkey					2
Petasites hybridus (L.) G.Gaertn., B.Mey. & Scherb.	Vebaotu	Common Butterbur					X			Eu.-Sib.	N Turkey					2
Picnomon acarna (L.) Cass.	Kılçıkdiken	Yellow Plumed Thistle					X		X		Widespread					1
Picris hieracioides L.	Deli Şiro	Hawkweed Oxtongue					X		X	Eu.-Sib.	Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Pilosella auriculoides (Láng) Arv.-Touv.	Kulaklı Turnakotu	Auricled Hawkweed	X			X					Widespread					1
*Pilosella hoppeana (*Schult.) F.W.Schultz & Sch.Bip. subsp. *pilisquama* (Nägeli & Peter) P.D.Sell & C.West	Saplı Tırnakotu	Hawkweed	X	X	X	X					N, C and E Turkey					2
Pulicaria dysenterica (L.) Gaertn.	Pireotu	Common Fleabane					X		X		Widespread					2
Rhagadiolus stellatus (L.) Gaertner var. *stellatus*	Yıldızlıot	Star Hawkbit				X				Medit.	N, W and S Turkey					1
Scariola viminea (L.) F.W.Schmidt	Çukurçıtlığı	Scariola				X					Widespread					2
Scolymus hispanicus L.	Ateşdikeni	Golden Thistle							X	Medit.	N, W and S Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Scorzonera mollis M.Bieb. subsp. *szowitzii* (DC.) D.F.Chamb.	İskorçina	Oyster				X					Widespread					1
Senecio aquaticus Hill subsp. *erraticus* (Bertol.) V.A.Matthews	Su Kanaryaotu	Water Ragwort			X		X			Eu.-Sib.	Widespread					1
Senecio vernalis Waldst. & Kit.	Yaygın Kanaryaotu	Cineraria	X			X	X		X		Widespread					1
Sonchus asper (L.) Hill subsp. *glaucescens* (Jordan) Ball	Kuzu Gevreği	Prickly Sowthistle				X			X		Widespread					1
Sonchus oleraceus (L.) L.	Kuzugevreği	Sow Thistle							X		N, W and S Turkey					1
Tanacetum parthenium (L.) Sch.Bip.	Beyaz Papatya	Feverfew					X		X		N, W and S Turkey					1
Tanacetum poteriifolium Grierson	Dişlek Pireotu	Garden Tansy	X	X	X					Eu.-Sib.	N, W, C and S Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Taraxacum scaturiginosum G.E.Haglund	Kıvırkıvır	Dandelion		X			X		X		N and E Turkey					1
Taraxacum serotinum (Waldst. & Kit.) Fisch.	Karahindiba	Common Dandelion				X			X		Widespread					2
Tragopogon pratensis L.	Çayır Tekesakalı	Meadow Salsify				X				Eu.-Sib.	N and W Turkey					1
Tripleurospermum tenuif olium (Kit.) Freyn ex Freyn	Saçaklı Beybunik	Mayweed			X					Eu.-Sib.	N, W and S Turkey					2
Tussilago farfara L.	Öksürükotu	Cough-Wort					X		X	Eu.-Sib.	Widespread					1
Urospermum picroides (L.) Scop. ex F.W.Schmidt	Acıyemlik	Prickly Goldenfleece				X			X	Medit.	N, W and S Turkey					2
Xanthium strumarium L. subsp. *cavanillesii* (Schouw) D.Löve & Dans.	Pıtrak	Cocklebur					X		X		Widespread					2
Xeranthemum cylindrace um Sm.	Deli Kâğıtçiçeği	Immortelle			X	X					Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats								
CAMPANULACEAE																
Asyneuma limonifolium (L.) Janch. subsp. *limonifolium*	Tavşanekmeği	Harebell			X	X				Eu.-Sib.	Widespread					2
Asyneuma virgatum (La bill.) Bornm. subsp. *virgatum*	Çiçekli Değnek	Harebell				X					Widespread					1
Campanula glomerata L. subsp. *hispida* (Witasek) Hayek	Yumak Çanı	Clustered Bellflower	X	X	X	X				Eu.-Sib.	Widespread					1
Campanula rapunculoides L. subsp. *rapunculoides*	Elmacık	Creeping Bellflower		X	X					Eu.-Sib.	N, C, S and E Turkey					2
Campanula rapunculus L. var. *lambertiana* (A.DC.) Boiss.	Firenk Salatası	Rampion		X	X					Eu.-Sib.	N Turkey					2
Legousia pentagonia (L.) Thell.	Kadınaynası	Venus's Looking Glass	X			X			X	Medit.	Widespread					1
ERICACEAE																

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Arbutus andrachne L.	Sandalağacı	Grecian Strawberry Tree		X	X						N, W and S Turkey					1
Arbutus unedo L.	Koca Yemiş	Strawberry Tree	X	X							N, W and S Turkey					2
Monotropa hypopithys L.	Sarı Kuşyuvası	Pinesap	X		X						N, W, C and S Turkey					1
PRIMULACEAE																
Anagallis arvensis L. var. *arvensis*	Kırmızı Fare Kulağı	Scarlet Pimpernel		X					X		Widespread					1
Anagallis arvensis L. var. *caerulea* (L.) Gouan	Mavi Fare Kulağı	Blue Pimpernal	X	X		X			X		Widespread					1
Androsace maxima L.	Tavukkursağı	Greater Rockjasmine	X		X	X		X	X		Widespread					3
Cyclamen coum Mill. var. *coum*	Yersomunu	Eastern Cyclamen	X	X	X						S and N Turkey	●	●			1
Lysimachia vulgaris L.	Karga Otu	Yellow Loosestrife					X				Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Primula vulgaris Huds. subsp. *sibthorpii* (Hoffmanns.) W.W.Sm. & Forrest	Çuha Çiçeği	Primrose	X	X	X		X			Eu.-Sib.	N Turkey					2
OLEACEAE																
Fontanesia phillyreoides Labill. subsp. *phillyreoides*	Cılbırtı	Drooping Leucothoe	X							Medit.	N, W and S Turkey					1
Jasminum fruticans L.	Yaban Yasemini	Wild Jasmine	X	X	X	X				Medit.	Widespread					2
Ligustrum vulgare L.	Kurtbağrı	Wild Privet		X			X			Eu.-Sib.	N, W and C Turkey					1
Phillyrea latifolia L.	Akça Kesme	Labernago	X	X						Medit.	Widespread					4
APOCYNACEAE																
Vinca herbacea Waldst. & Kit.	Otsu Cezayir Menekşesi	Herbaceous Periwinkle				X					Widespread					1
ASCLEPIADACEAE																
Vincetoxicum scandens Sommier & Levier	Mor Gavurbiberi	Swallow-Wort			X	X					N and E Turkey					1
GENTIANACEAE																

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Blackstonia perfoliata (L.) Huds. subsp. *perfoliata*	Deli Şıra	Yellow Wort	X	X	X		X				N, W and S Turkey					2
Centaurium erythraea Rafn subsp. *ertyhraea*	Kırmızı Kantoron	Bitter Bloom		X		X				Eu.-Sib.	N, W and S Turkey					1
Gentiana asclepiadea L.	Sütlü Güşad	Willow Gentian		X	X						Widespread					3
CONVOLVULACEAE																
Calystegia silvatica (Kit.) Griseb.	Boyatan Sarmaşık	Great Bindweed		X	X						N, W and S Turkey					2
Convolvulus arvensis L.	Tarla Sarmaşığı	Redge Glorybind			X				X		Widespread					2
Convolvulus cantabrica L.	Gündüz Sefa	Dwarf Morning Glory	X	X		X			X		N, W and S Turkey					1
CUSCUTACEAE																
Cuscuta planiflora Ten.	Göktenyağan	Smallseed Dodder							X		N, W and S Turkey					1
BORAGINACEAE																
Alkanna orientalis (L.) Boiss. var. *orientalis*	Sarı Sormuk	Alkannet				X					Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Anchusa azurea Mill. var. *azurea*	Sığırdili	Garden Anchusa				X			X		Widespread					2
Asperugo procumbens L.	Nevazilotu	Madwort							X	Eu.-Sib.	Widespread					2
Buglossoides arvensis (L.) I.M.Johnst.	Tarla Taşkeseni	Corn Gromwell							X		Widespread					1
Cerinthe minor L. subsp. *auriculata* (Ten.) Domac	Livarotu	Lesser Honeywort				X	X		X		Widespread					2
Cynoglossum creticum Mill.	Mavi Köpekdili	Blue Hound's Tongue				X			X		N, W, C and S Turkey					1
Cynoglossum montanum L.	Dağ Köpekdili	Green Hound's-Tongue	X	X	X					Eu.-Sib.	Widespread					2
Echium vulgare L.	Engerek Otu	Blueweed				X			X	Medit.	N, W and S Turkey					1
Heliotropium europaeum L.	Bozot	Heliotrope				X			X	Medit.	Widespread					2
Lappula squarrosa (Retz .) Dumort.	Sülün Gürke	Bluebur				X					N, C and E Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Lithospermum officinale L.	Taşkesen	Common Gromwell		X	X				X	Eu.-Sib.	N, C and E Turkey					1
Myosotis lithospermifolia (Willd.) Hornem.	Taş Boncukotu	Forget Me Not			X	X		X			Widespread					2
Myosotis ramosissima R ochel subsp. *ramosissima*	Kuşgözü	Early Forget-Me-Not	X		X	X					Widespread					2
Myosotis sylvatica Hoffm . subsp. *cyanea* (Hayek) Vestergr.	Unutmabeni	Wood Forget-Me-Not	X	X							N, C, S and E Turkey					1
Onosma sericeum Willd.	Emzikotu	Golden Drop				X				Ir.-Tur.	Widespread					2
Onosma taurica Willd.	Emzikotu	Golden-Flowered Onosma			X	X					Widespread					1
Trachystemon orientalis (L.) D.Don	Kaldırık	Early-Flowering Borage		X	X					Eu.-Sib.	N Turkey					2
SOLANACEAE																
Capsicum annuum L	Biber	Pepper							X		Cultivation					1
Datura stramonium L.	Boru Çiçeği	Jimson Weed					X		X		Widespread					1
Hyoscyamus niger L.	Banotu	Henbane							X		Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Lycopersicon esculentum Mill.	Domates	Tomato							X		Cultivation					1
Physalis alkekengi L.	Yahudi Kirazı	Ground Cherry		X			X				Widespread					1
Solanum dulcamara L.	Sofur	Snakeberry			X					Eu.-Sib.	Widespread					1
Solanum melongena L.	Patlıcan	Eggplant							X		Cultivation					1
Solanum nigrum L. subsp. *nigrum*	İtüzümü	Black Nightshade							X		Widespread					1
Solanum tuberosum L.	Patates	Patato							X		Cultivation					1
SCROPHULARIACEAE																
Digitalis ferruginea L. subsp. *ferruginea*	Arıkovanı	Rusty Foxglove			X					Eu.-Sib.	N, W and S Turkey					1
Digitalis lamarckii Ivanin a	Yüsükotu	Lamarck's Foxglove	X	X	X					Ir.-Tur.	N, C and E Turkey			**End / LC**		2
Euphrasia pectinata Ten.	Gözotu	Large-Bract Eyebright	X			X	X			Eu.-Sib.	Widespread					1
Linaria corifolia Desf.	Tarla Nevruzotu	Field Toadflax				X				Ir.-Tur.	Widespread			**End / LC**		2
Melampyrum arvense L. var. *arvense*	İnekbuğdayı	Field Cow-Wheat		X	X				X	Eu.-Sib.	N and E Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Parentucellia latifolia (L.) Caruel subsp. *latifolia*	Kırmızı Yapışkanotu	Red Bartsia		X						Medit.	N, W and S Turkey					1
Rhynchocorys elephas (L.) Griseb.	Filburnu	Elefantina					X			Eu.-Sib.	N Turkey					1
Scrophularia canina L. subsp. *bicolor* (Sm.) Greuter	İt Sıracaotu	Dog Figwort				X				Medit.	N, W and S Turkey					2
Scrophularia scopolii Hoppe ex Pers. var. *scopolii*	Tüylü Sıracaotu	Italian Figwort		X					X		Widespread					1
Verbascum blattaria L.	Ay Sığırkuyruğu	Moth Mullein	X		X	X					N, W and S Turkey					2
Verbascum cheiranthifolium Boiss. var. *asperulum* (Boiss.) Murb.	Bozkulak	Mullein	X		X	X			X		Widespread			**End / LC**		2
Veronica anagallis-aquatica L.	Sugedemesi	Water Speedwell					X				Widespread					2
Veronica serpyllifolia L.	Güzel Nane	Thymeleaf		X			X		X		N, C and E Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Veronica chamaedrys L.	Cancan	Germander Speedwell			X					Eu.-Sib.	N and W Turkey					2
Veronica triphyllos L.	Bahçe Mavişi	Finger Speedwell	X		X	X	X		X		N, W, C and S Turkey					2
Veronica triloba (Opiz) Kerner	Üç Maviş	Trilobed Speedwell				X			X		N, W and S Turkey					1
OROBANCHACEAE																
Orobanche cernua Loefl.	Deli Yergöbeği	Nodding Broomrape							X		Widespread					1
Orobanche nana (Reut.) Beck	Veremotu	Hemp Broomrape				X			X		N, W and S Turkey					1
GLOBULARIACEAE																
Globularia trichosantha Fisch. & C.A.Mey.	Köseyayılımı	Globe Daisy				X					Widespread					3
VERBENACEAE																
Verbena officinalis L.	Mine Çiçeği	Vervain							X		Widespread					1
LAMIACEAE (LABIATAE)																

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats								
Ajuga chamaepitys (L.) Schreb. subsp. *chia* (Schreb.) Arcang. var. *chia*	Acıgıcı	Ground-Pine				X					Widespread					2
Ajuga reptans L.	Dağ Mayasılotu	Blue Bugle		X	X		X			Eu.-Sib.	N Turkey					2
Ballota nigra L. subsp. *anatolica* P.H.Davis	Grip Otu	Black Horehound					X		X		Widespread					1
Calamintha nepeta (L.) Savi subsp. *glandulosa* (Req.) P.W.Ball	Türk Melisası	Blue Cloud				X					N and W Turkey					2
Calamintha grandiflora (L.) Moench	Kaba Fesleğeni	Large-flowered Calamint			X		X			Eu.-Sib.	N, W and C Turkey					2
Clinopodium vulgare L. subsp. *vulgare*	Yabani Fesleğen	Wild Basil			X	X					N, W, C and S Turkey					2
Lallemantia iberica (M.Bieb.) Fisch. & C.A.Mey.	Ajdarbaşı	Dragon's Head				X		X	X	Ir.-Tur.	Widespread					2
Lamium amplexicaule L. var. *amplexicaule*	Baltutan	Henbit Dead-Nettle			X		X		X	Eu.-Sib.	Widespread					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats								
Lamium garganicum L. subsp. *reniforme* (Montbret & Aucher ex Benth.) R.R.Mill	Bol Balıcak	Dead Nettle				X		X	X		Widespread					2
Lamium purpureum L. var. *purpureum*	Ballıbaba	Red Deadnettle		X	X					Eu.-Sib.	Widespread					3
Mentha aquatica L.	Su Nanesi	Water Mint					X				N, W and S Turkey					2
Mentha × *piperita* L.	Bahçe Nanesi	Peppermint							X		Cultivation					1
Mentha pulegium L.	Yarpuz	Pennyroyal					X				Widespread					2
Mentha longifolia (L.) Hudson subsp. *longifolia*	Pünk	Horsemint					X			Eu.-Sib.	N and E Turkey					2
Nepeta nuda L. subsp. *nuda*	Morküncü	Catnip			X						N, W, C and S Turkey					1
Origanum vulgare L. subsp. *vulgare*	Karakınık	Oregano			X	X				Eu.-Sib.	N Turkey					1
Phlomis armeniaca Willd.	Boz Şavlak	Sage				X				Ir.-Tur.	Widespread			**End / LC**		2
Phlomis russeliana (Sims) Lag. ex Benth.	Akbaşlı Çalba	Russel's sage		X	X					Eu.-Sib.	N and W Turkey			**End / LC**		1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Prunella laciniata (L.) L.	Bodur Fesleğen	Cutleaf Self-Heal			X	X			X	Eu.-Sib.	Widespread					1
Prunella vulgaris L.	Yaygın Erikotu	Common Self-Heal			X	X	X			Eu.-Sib.	Widespread					2
Salvia candidissima Vahl subsp. *candidissima*	Galabor	Sage			X	X			X	Ir.-Tur.	Widespread					2
Salvia cyanescens Boiss . & Balansa	Mor Galabor	Blue Turkish Sage				X				Ir.-Tur.	Widespread			**End / LC**		1
Salvia sclarea L.	Paskulak	Clary Sage		X					X		Widespread					1
Salvia tomentosa Mill.	Şalba	Balsamic Sage			X	X				Medit.	N, W and S Turkey					2
Salvia virgata Jacq.	Fatmana Otu	Wand Sage		X	X				X	Ir.-Tur.	Widespread					1
Salvia viridis L.	Zarif Şalba	Annual Clary				X	X	X	X	Medit.	N, W and S Turkey					2
Satureja hortensis L.	Sater	Summer Savory				X			X		Widespread					2
Scutellaria albida L. subsp. *albida*	Akkaside	Skullcap		X	X					Medit.	N, W and S Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats								
Scutellaria orientalis L. subsp. *pinnatifida* J.R.Edm.	Kırbaç Sırımı	Skullcap				X		X			Widespread					1
Scutellaria salviifolia Benth.	Has Kaside	Skullcap	X		X	X					Widespread					2
Sideritis germanicopolitana Bornm. subsp. *germanicopolitana*	Karakurbağa Çayı	Ironwort				X					N Turkey			End / LC		2
Sideritis montana L. subsp. *montana*	Karaçay	Mountain Ironwort				X				Medit.	Widespread					2
Stachys annua (L.) L. subsp. *annua* var. *annua*	Hacıosman Otu	Annual Yellow-Woundwort	X		X	X			X		Widespread					2
Stachys byzantina K.Koch	Boz Karabaş	Lamb's Ear				X				Eu.-Sib.	N and W Turkey					2
Stachys iberica M.Bieb. subsp. *iberica*	Tok Deliçay	Woundwort			X	X	X	X		Ir.-Tur.						2
Teucrium chamaedrys L. subsp. *chamaedrys*	Kısamahmut	Wall Germander	X	X	X	X				Eu.-Sib.	N, W, C and S Turkey					2
Teucrium orientale L. var. *puberulens* Ekim	Kirve Otu	Oriental Germander			X					Ir.-Tur.	N and E Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Teucrium polium L.	Acı Yavşan	Hulwort	X			X					Widespread					3
Thymus longicaulis C.Presl subsp. *longicaulis* var. *subisophyllus* (Borbás) Jalas	Aş Kekiği	Long Thyme			X	X					N Turkey					2
PLUMBAGINACEAE																
Plumbago europaea L.	Karakına	Plumbago				X			X	Eu.-Sib.	Widespread					2
PLANTAGINACEAE																
Plantago lanceolata L.	Mızrak Yapraklı Sinirotu	English Plantain		X		X	X				Widespread					1
Plantago major L. subsp. *major*	Geniş Yapraklı Sinirotu	Greater Plantain			X		X		X		Widespread					1
THYMELAEACEAE																
Daphne pontica L.	Yabani Defne	Twin Flowered Daphne			X					Eu.-Sib.	N Turkey					2
Thymelaea passerina (L.) Coss. & Germ.	Çekem	Mezereon							X		Widespread					2
ELAEAGNACEAE																

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Elaeagnus angustifolia L.	İğde	Oleaster					X				Widespread					2
Hippophae rhamnoides L.	Yalancı İğde	Sea Buckthorn					X				N, C, E and S Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats								
SANTALACEAE																
Thesium divaricatum Jan ex Mert. & W.D.J.Koch	Çatal Güvelek	Branched Bastard Toadflax				**X**				Eu.-Sib.	N and W Turkey					1
LORANTHACEAE																
Viscus album L. subsp. *austriacum* (Wiesb.) Vollm	Ökseotu	Mistletoe			**X**						N, W, C and S Turkey					2
ARISTOLOCHIACEAE																
Aristolochia pontica Lam.	Gangırdak	Dutchman's Pipe					**X**			Eu.-Sib.	N Turkey					1
EUPHORBIACEAE																
Andrachne telephioides L.	Duvarnohutu	Bastard Orpine			**X**						Widespread					1
Euphorbia amygdaloides L. var. *amygdaloides*	Zerena	Golden Glory Spurge			**X**		**X**			Eu.-Sib.	N and W Turkey					2
Euphorbia cardiophylla Boiss.& Heldr.	Sütleğen	Spurge	**X**			**X**					N, W, C and S Turkey			**End / LC**		1
Euphorbia falcata L. subsp. *falcata*	Eğri Sütleğen	Sickle Spurge	**X**		**X**	**X**					Widespread					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Euphorbia macroclada Boiss.	Neblul	Spurge	X		X	X		X		Ir.-Tur.	N, C, W and E Turkey					2
Euphorbia peplus L. var. *peplus*	Mor Sütleğen	Petty Spurge	X	X		X					N, W and S Turkey					2
Euphorbia rigida M.Bieb.	Sütleğen	Gopher Spurge	X			X			X	Medit.	N, W and S Turkey					2
Euphorbia stricta L.	Sıkı Sütleğen	Upright Spurge			X		X			Eu.-Sib.	N, W and S Turkey					1
Mercurialis annua L.	Parşen	Annual Mercury			X				X		N, W and S Turkey					1
URTICACEAE																
Urtica dioica L.	Isırgan	Stinging Nettle					X		X	Eu.-Sib.	Widespread					1
MORACEAE																
Ficus carica L. subsp. *carica*	İncir	Fig Tree	X								Widespread					1
Morus alba L.	Ak Dut	White Mulberry							X		Cultivation					1
ULMACEAE																
Celtis australis L.	Çitlembik	Nettle Tree	X			X				Medit.	N, W and S Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Ulmus minor Mill. subsp. *minor*	Ova Karaağacı	Field Elm					X				N, C and E Turkey					1
JUGLANDACEAE																
Juglans regia L.	Ceviz	Walnut							X		Cultivation					1
PLATANACEAE																
Platanus orientalis L.	Doğu Çınarı	Oriental Plane					X				Widespread					2
FAGACEAE																
Fagus orientalis Lipsky	Doğu Kayını	Oriental Beech		X						Eu.-Sib.	N, C and W Turkey					2
Castanea sativa Mill.	Kestane	Sweet Chestnut		X						Eu.-Sib.	N, C and W Turkey					1
Quercus cerris L. var. *cerris*	Saçlı Meşe	Turkish Oak		X	X					Medit.	Widespread					2
Quercus infectoria G.Oli vier subsp. *infectoria*	Mazı Meşesi	Aleppo Oak			X					Eu.-Sib.	N Turkey					3
Quercus petraea (Matt.) Liebl. subsp. *iberica* (Steven ex M.Bieb.) Krassiln.	Sapsız Meşe	Cornish Oak			X						N and W Turkey					3

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Quercus pubescens Will d.	Tüylü Meşe	Downy Oak	X	X	X	X					Widespread					4
Quercus robur L. subsp. *robur*	Saplı Meşe	English Oak			X					Eu.-Sib.	N, C and S Turkey					2
CORYLACEAE																
Carpinus betulus L.	Gürgen	European Hornbeam			X		X			Eu.-Sib.	N and W Turkey					2
Carpinus orientalis Mill. subsp. *orientalis*	Doğu Gürgeni	Oriental Hornbeam	X	X		X					N and S Turkey					4
Corylus avellana L. var. *avellana*	Fındık	Hazel-Nut			X		X		X	Eu.-Sib.	Widespread					1
Ostrya carpinifolia Scop.	Firek	Hop Hornbeam		X	X					Medit.	N and S Turkey					2
BETULACEAE																
Alnus glutinosa (L.) Gaertn. subsp. *glutinosa*	Yaygın Kızılağaç	Black Alder			X		X			Eu.-Sib.	Widespread					3
SALICACEAE																
Populus nigra L. subsp. *nigra*	Kara Kavak	Lombardy Poplar					X		X		N Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Populus tremula L.	Titrek Kavak	European Aspen		X			X				Widespread					2
Salix alba L.	Boz Söğüt	White Willow					X			Eu.-Sib.	Widespread					4
Salix babylonica L.	Salkım Söğüt	Weeping Willow					X		X		N, W and S Turkey					1
Salix elaeagnos Scop.	İğde Söğüdü	Hoary Willow					X			Eu.-Sib.	N Turkey					2
RUBIACEAE																
Asperula arvensis L.	Tarla Belumotu	Blue Woodruff			X				X	Medit.	Widespread					1
Asperula glomerata (M.Bieb.) Griseb. subsp. *glomerata*	Yumyum Otu	Globe Woodruff				X				Ir.-Tur.	N, C and E Turkey					2
Asperula pestalozzae Boiss.	Has Belumotu	Woodruff				X				Eu.-Sib.	N and C Turkey			**End / LC**		1
Crucianella angustifolia L.	İnce Hacıotu	Narrowleaf Crucianella			X					Medit.	Widespread					1
Cruciata laevipes Opiz	Sarılıkotu	Crosswort	X	X	X	X				Eu.-Sib.	N Turkey					2
Cruciata taurica (Pallas ex Wılld.) Ehrend.	Kırım Güzeli	Bedstraw				X			X	Ir.-Tur.	Widespread					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Galium album Mill. subsp. *prusense* (K.Koch) Ehrend. & Krendl	Ak İplikçik	Upright Hedge Bedstraw					X		X		N and S Turkey					1
Galium debile Desf.	Bataklık İplikçiği	Slender Marsh-Bedstraw			X		X			Medit.	N and W Turkey					2
Galium incanum Sm. subsp. *elatius* (Boiss.) Ehrend.	Gür İplikçik	Bedstraw				X				Ir.-Tur.	Widespread					3
Galium rotundifolium L.	Koru Yoğurtotu	Round-leaved Bedstraw			X					Eu.-Sib.	N, W and S Turkey					1
Galium tenuissimum M.Bieb. subsp. *trichophorum* (Kar. & Kir.) Ehrend.	Yoz İplikçik	Slender Marsh-Bedstraw				X			X	Ir.-Tur.	N, C and E Turkey					1
Galium verum L. subsp. *verum*	Boyalık	Yellow Bedstraw					X			Eu.-Sib.	Widespread					2
Sherardia arvensis L.	Tarla Kökboyası	Blue Fieldmadder				X				Medit.	N, W and S Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats								
MONOCOTYLEDONEAE																
ARACEAE																
Arum euxinum R.R.Mill	Yılanyastığı	Arum Lilies	X	X						Eu.-Sib.	N Turkey			**End / LC**		2
Arum maculatum L.	Yılanekmeği	Cuckoo Pint		X	X						N and S Turkey					1
LILIACEAE																
Allium ampeloprasum L.	Körmen	Broadleaf Wild Leek	X	X		X			X	Medit.	Widespread					1
Allium cepa L.	Soğan	Onion							X		Cultivation					1
Allium decipiens Fisch. ex Schult. & Schult.f.	Gelin Soğanı	Onion			X					Eu.-Sib.	N and E Turkey					1
Allium kastambulense Kollmann	Küre Soğanı	Küre Onion				X				Eu.-Sib.	N Turkey			**End / LC**		2
Allium paniculatum L. subsp. *paniculatum*	Sürü Salkım	Mediterranean Onion	X		X	X			X	Medit.	Widespread					2
Allium sativum L.	Sarımsak	Garlic							X		Cultivation					1
Asparagus officinalis L.	Kuşkonmaz	Asparagus	X								Widespread					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Asphodeline damascena (Boiss.) Baker subsp. *damascena*	Çekiçlik	Asphodel	X		X	X				Ir.-Tur.	Widespread					2
Colchicum umbrosum St even	Şaşartkovan	Colchicum		X	X		X			Eu.-Sib.	N Turkey					2
Fritillaria pontica Wahlen b.	Eğri Lale	European Fritillaria		X						Eu.-Sib.	N Turkey					2
Gagea villosa (M.Bieb.) Duby var. *villosa*	Tüylü Yıldız	Hairy Star Of Bethlehem	X		X	X			X	Medit.	Widespread					2
Muscari armeniacum Leichtlin ex Baker	Üzüm Sümbülü	Grape Hyacinth	X	X	X	X					Widespread					1
Muscari neglectum Guss . ex Ten.	Arap Üzümü	Grape Hyacinth	X		X	X			X		Widespread					2
Ornithogalum narbonense L.	Akbaldır	Star Of Bethlehem	X		X	X				Medit.	Widespread					2
Ornithogalum orthophyll um Ten.	Bayır Yıldızı	Star Of Bethlehem	X	X	X	X					N, W, C and S Turkey					2
Ornithogalum sigmoideu m Freyn & Sint.	Tükürükotu	Star of Bethlehem	X	X	X					Eu.-Sib.	N, W and C Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Polygonatum orientale D esf.	Hanımsallandı	Solomon's Seal		X	X					Eu.-Sib.	N, W, C and S Turkey					1
Ruscus aculeatus L.	Tavşanmemesi	Butcher's-Broom		X							N, W and S Turkey				●	2
Ruscus hypoglossum L.	Yalova Mercanı	Spineless Butcher's Broom		X	X					Eu.-Sib.	N Turkey					1
Scilla autumnalis L.	Sümbülcük	Autumn Squill	X		X					Medit.	N, W and S Turkey					1
Scilla bifolia L.	Yıldız Sümbülü	Rosy Squill		X	X		X			Medit.	Widespread					2
Smilax excelsa L.	Anadolu Saparnası	Sarsaparilla	X	X	X					Eu.-Sib.	N, W and S Turkey					2
IRIDACEAE																
Crocus speciosus M.Bieb. subsp. *xantholaimos* Mathews	Boğac Çiğdemi	Bieberstein's Crocus			X					Eu.-Sib.	N Turkey			**End / NT**		2
Gladiolus italicus Mill.	Kılıçotu	Italian Gladiolus	X			X					N, W and S Turkey					2
Iris kerneriana Asch. & Sint. ex Baker	Çalı Süseni	Kerner's Iris			X					Eu.-Sib.	N, W and E Turkey			**End / LC**		1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Iris pseudacorus L.	Bataklık Süseni	Yelllow Iris					X				N, W and S Turkey					2
Iris suaveolens Boiss. & Reut.	Bodur Süsen	Iris				X				Medit.	N, W and S Turkey					1
ORCHIDACEAE																
Anacamptis pyramidalis (L.) Rich.	Sivri Salep	Pyramid Orchid		X	X		X				Widespread	●				1
Cephalanthera rubra (L.) Rich.	Çamçiçeği	Red Helleborine		X	X						Widespread	●				2
Dactylorhiza romana (Seb.) Soo subsp. *romana*	Çamkökü	Roman Marsh Orchid		X	X					Eu.-Sib.	N, C and E Turkey	●				1
Epipactis helleborine (L.) Crantz	Bindallı Çiçeği	Broad-leaved Helleborine		X	X						Widespread					1
Epipactis pontica Taubenheim	İnce Bindallı	Helleborine		X						Eu.-Sib.	N Turkey	●		**End / LC**		2
Limodorum abortivum L.	Limador	Violet Limodore	X		X						Widespread					1
Neottia nidus-avis (L.) Rich.	Asalak Salep	Bird's-nest Orchid		X						Eu.-Sib.	N, W and S Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Ophrys oestrifera M.Bieb. subsp. *oestrifera*	Sinek Salebi	Horsefly Orchid	X	X	X						Widespread		●			1
Ophrys apifera Huds.	Arı Salebi	Bee Orchid		X	X						N, W and S Turkey	●				1
Orchis coriophora L.	Pirinç Çiçeği	Fragrant Orchid					X				Widespread	●				2
Orchis mascula (L.) L. subsp. *pinetorum* (Boiss. & Kotschy) E.G.Camus	Çam Salebi	Early Purple Orchid	X	X	X					Medit.	Widespread	●				2
Orchis purpurea Huds.	Hasancık	Lady Orchid		X						Eu.-Sib.	Widespread	●				1
Platanthera chlorantha (Custer) Rchb.	Çarpık Salep	Greater Butterfly Orchid		X	X						Widespread					1
TYPHACEAE																
Typha angustifolia L.	Hasır Otu	Tule Cattail					X				Widespread					3
Typha laxmannii Lepech.	Papur	Graceful Cattail					X			Eu.-Sib.	N, C, S and E Turkey					2
JUNCACEAE																

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Juncus articulatus L.	Camışotu	Jointleaf Rush		X	X		X			Eu.-Sib.	Widespread					2
Juncus bufonius L.	Kamır	Toad Rush		X	X		X				Widespread					2
Juncus capitatus Weigel	Topak Kofa	Leafybract Dwarf Rush					X				Widespread					1
Juncus effusus L.	Has Kofa	Common Rush					X				Widespread					2
Juncus inflexus L.	Sazak	European Meadow Rush					X				Widespread					2
Luzula forsteri (Sm.) DC.	Gevşek Luzul	Southern Woodrush		X	X		X			Eu.-Sib.	N, W, C and S Turkey					1
Luzula multiflora (Ehrh.) Lej.	Kırk Luzul	Common Woodrush		X			X				N, W and C Turkey					2
CYPERACEAE																
Carex distans L.	Sina Ayakotu	Distant Sedge					X			Eu.-Sib.	Widespread					1
Carex hirta L.	Tüylü Çayırsazı	Hammer Sedge			X					Eu.-Sib.	N, W, S and E Turkey					1
Carex otrubae Podp.	Kurusaz	False Fox Sedge		X	X		X			Eu.-Sib.	Widespread					2
Carex ovalis Gooden.	Oval Saz	Oval Sedge		X	X		X		X	Eu.-Sib.	N, W, C and E Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Carex pendula Huds.	Salkım Saparna	Hanging Sedge			X		X			Eu.-Sib.	N, W and S Turkey					1
Cyperus longus L.	Karatopalak	Galingale			X						Widespread					2
Eleocharis palustris (L.) Roemer & Schultes	Delisaz	Common Spikerush		X			X				Widespread					2
Scirpoides holoschoenus (L.) Soják	Top Saz	Roundhead Bulrush					X				Widespread					1
POACEAE (GRAMINEAE)																
Aegilops geniculata Roth	Bodur Buğdayotu	Ovate Goatgrass				X			X	Medit.	N, W and S Turkey					1
Aegilops triuncialis L. subsp. *triuncialis*	Üçkılçık	Barb Goat Grass				X		X	X		Widespread					2
Agrostis capillaris L. var. *capillaris*	Karahasanotu	Common Bent	X	X	X		X			Eu.-Sib.	N, C and E Turkey					2
Alopecurus arundinaceus Poir.	Kamış Tilkikuyruğu	Reed Foxtail					X		X	Eu.-Sib.	Widespread					2
Alopecurus aequalis Sob ol.	Kınalı Tilkikuyruğu	Shortawn Foxtail					X			Eu.-Sib.	N, W, C and E Turkey					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Alopecurus myosuroides Huds. var. *myosuroides*	Tarla Tilkikuyruğu	Black-Grass		X			X			Eu.-Sib.	Widespread					2
Apera intermedia Hack.	Puslu İpek	Windgrass			X	X			X	Ir.-Tur.	Widespread					1
Avena sativa L.	Yulaf	Oat							X		Cultivation					1
Bothriochloa ischaemum (L.) Keng	Sakalotu	Yellow Blue-Stem			X	X			X							3
Brachypodium sylvaticum (Huds.) P.Beauv.	Orman Kılcanı	Slender False Brome		X	X		X			Eu.-Sib.	Widespread					1
Briza maxima L.	Kuşyüreği	Big Quakinggrass	X								N, W and S Turkey					1
Briza media L.	Ortanca Kuşyüreği	Perennial Quakinggrass		X			X				N, W, C and E Turkey					2
Bromus arvensis L.	Tarla Bromu	Field Brome	X	X												2
Bromus hordeaceus L. subsp. *hordeaceus*	Başakotu	Soft Brome				X			X		N, W and S Turkey					2
Bromus japonicus Thunb. subsp. *japonicus*	İyeotu	Japan Brome	X		X	X			X		Widespread					1
Bromus madritensis L.	Kırmızı Brom	Compact Brome				X			X		N, W and S Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Bromus scoparius L.	İbubuk Ekini	Broom Brome					X		X		Widespread					1
Bromus tectorum L.	Kır Bromu	Cheatgrass			X	X			X		Widespread					2
Catabrosa aquatica (L.) P.Beauv.	Çipil	*Water Whorlgrass*					X				Widespread					2
Cynodon dactylon (L.) Pers. var. *villosus* Regel	Bermuda Çimi	Bermuda Grass					X		X		Widespread					2
Cynosurus echinatus L.	Top Tarakotu	Bristly Dogstail Grass		X	X				X		N, W and S Turkey					2
Dactylis glomerata L. subsp. *hispanica* (Roth) Nyman	Domuz Ayrığı	Orchardgrass	X	X	X	X	X				Widespread					2
Echinochloa crus-galli (L.) P.Beauv.	Darıcan	Barnyard Grass					X		X		Widespread					1
Festuca drymeja Mert. & W.D.J.Koch	Çalı Yumağı	Fescue	X	X	X	X				Eu.-Sib.	Widespread					2
Festuca valesiaca Schlei ch. ex Gaudin	Meşe Yumağı	Volga Fescue				X					Widespread					2
Hordeum bulbosum L.	Yumrulu Arpa	Bulbous Barley			X	X					Widespread					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Hordeum murinum L. subsp. *glaucum* (Steud.) Tzvelev	Pisipisi Arpası	Mause Barly				X			X		Widespread					2
Hordeum vulgare L.	Arpa	Barley							X		Cultivation					1
Koeleria cristata (L.) Pers.	Parlakotu	June Grass			X	X					Widespread					2
Lolium perenne L.	İngiliz Çimi	Perennial Rye Grass					X		X	Eu.-Sib.	Widespread					2
Melica ciliata L. subsp. *ciliata*	Kirpikli İnci	Hairy Melic Grass			X	X		X			Widespread					1
Oryza sativa L.	Çeltik	Rice							X		Cultivation					1
Phleum exaratum Hochst. & Griseb. subsp. *exaratum*	Tarla Kelpotu	Timothygrass			X	X					N, W, C and S Turkey					2
Phleum pratense L.	Çayır İtkuyruğu	Common Timothy		X					X	Eu.-Sib.	Widespread					1
Phleum subulatum (Savi) Asch. & Graebn. subsp. *subulatum*	Kelpkuyruğu	Italian Timothy				X					N, W and S Turkey					2

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Piptatherum miliaceum (L.) Coss. subsp. *thomasii* (Duby) Freitag	Pirinçotu	Rice Grass				X					N, W and S Turkey					1
Poa annua L.	Yıllık Salkım Otu	Annual Bluegrass							X		Widespread					1
Poa bulbosa L.	Yumrulu Salkım Otu	Bulbous Bluegrass	X		X	X			X		Widespread					3
Poa trivialis L.	Salkımotu	Bluegrass		X	X		X				Widespread					1
Secale cereale L. var. *cereale*	Çavdar	Cereal Rye			X						Widespread					2
Sesleria alba Sm.	Ak Bozkıryumağı	White Moor Grass	X	X	X						N, W and S Turkey					3
Setaria viridis (L.) P.Beauv.	Yeşil Kirpi Darı	Gren Bristl Grass					X		X		Widespread					2
Stipa bromoides (L.) Dörfl.	Kılaç	Sharp-Awned Feathergrass	X	X	X					Medit.	N, W and S Turkey					2
Trachynia distachya (L.) Link	Tekkılcan	Stiff Brome				X				Medit.	N, W and S Turkey					2
Triticum aestivum L.	Buğday	Wheat							X		Cultivation					1

Scientific Name	Turkish Name	English Name	EUNIS Habitat Types							Flora Region*	Distribution in Turkey**	CITES	BERN / APPENDIX I	Endemic (End) / IUCN Category	Habitat Directive (Annex II, IV or V)	Relative Abundance
			G3.75 - *Pinus brutia* forests	G1.7C2 - *Carpinus orientalis* woods	G4.B - Mixed mediterranean *Pinus* - thermophilous *Quercus* woodland	X16 - Land sparsely wooded with mixed broadleaved and coniferous trees	G1.1 - Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	G3.F12 - Native pine plantations	I - Regularly or recently cultivated agricultural, horticultural and domestic habitats							
Vulpia myuros (L.) C.C.Gmelin	Arsız Kirpikliçim	Annual Fescue	X	X					X		N, W, C and S Turkey					2
Zea mays L.	Mısır	Corn							X		Cultivation					1

Flora Regions (*)
Medit. : Mediterranean Region
E.Medit. : East Mediterranean Subregion
Eu.-Sib. : Euro-Siberian Region
Ir.-Tur. : Irano-Turanian Region

Distribution in Turkey (**)
C : Central
E : East
N : North
S : South
W : West
Widespread: Common in Turkey

Relative Abundance (***)
1 : Very rare
2 : Rare
3 : Relatively abundant
4 : Abundant
5 : Very abundant

Appendix B Visual Impact Assessment

Aecom Turkey Danışmanlık ve Mühendislik Ltd. Şti
Mustafa Kemal Mahallesi Dumlupınar Bulvarı Tepe Prime
No:266 B Blok
No:50-51 06800
Çankaya
Ankara
Turkey

T: +90 312 4429863
aecom.com