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PRINOS OFFSHORE DEVELOPMENT PROJECT

Environmental & Social Impact Assessment (ESIA)

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PRINOS OFFSHORE DEVELOPMENT PROJECT

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT (ESIA)

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ABBREVIATIONS

AARC	Average annual rate of change
ACCOBAMS	Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic
AG	Associated Gas
ALARP	As Low As Reasonable Practicable
API	American Petroleum Institute
AVHRR	Advanced Very High Resolution Radiometer
BA	Breathing Air
BASF	Triethylene glycol
BOP	Blow Out Preventor
BSW	Black Sea waters
BT	Buyoant Tower
CAPEX	Capital Expenditure
CBA	Cost Benefit Assessment
CBD	Convention on Biological Diversity
CCR	Central Control Room
CEM	Continuous Emissions Monitoring
CFS	Climate Forecast System
CLC	Civil Liability Convention
CMD	Common Ministerial Decision
CMS	Conservation of Migratory Species
CWB	Coastal Water Bodies
DC	Coastal Detritic
DES	Drilling Equipment Set
DESFA	Hellenic Gas Transmission System Operator
DIPA	Directorate of Environmental Permitting
DNV	Det Norske Veritas
DTL	Dangerous Toxic Load

E&P	Exploration & Production
E&S	Environmental and Social
EBRD	European Bank for Reconstruction and Development
EE	Environmental Engineer
EEC	European Economic Community
EHS	Environment Health and Safety
EIA	Environmental Impact Assessment
EIS	Environmental Impact Study
EKAB	National Centre for Immediate Response
ELD	Environmental Liability Directive
ELFE	Hellenic Fertilizers
ELSTAT	Hellenic Statistical Authority
ENERGEAN	Energean Oil & Gas S.A.
EO	Environmental Officer
EOR	Enhanced Oil Recovery
EPC	Engineering Procurement Construction
EPER	European Pollutant Emission Register
ERD	Extended Reach Drill
ERM	Environmental Resources Management Limited
ERP	Emergency Response Plan
ESD	Emergency Shut Down
ESIA	Environmental & Social Impact Assessment
ESMMP	Environmental and Social Management and Monitoring Plan
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ESP	Electric Submersible Pump
EU	European Union
EUNIS	European Nature Information System
EUOAG	European Union Offshore Oil & Gas Authorities Group

F&G	Fire and Gas
FEED	Front End Engineering Design
FIREI	Fisheries Research Institutes
GDP	Gross Domestic Product
GES	Good Environmental Status
GG	Government Gazette
GHG	Green House Gas
GIIP	Good International Industry Practice
GOP	Good Oilfield Practices
GSA	Geographical Sub Area
H&S	Health and Safety
HAZID	Hazard Identification
HAZOP	Hazard and Operability
HEDNO SA	Hellenic Electricity Distribution Network Operator SA
HNS	Hazardous and Noxious Substances
HOS	Hellenic Ornithological Society
HR	Hellenic Republic
HS	Health and Safety
HSE	Health, Safety and Environment
HVC	High Voltage Center
HZW	Hazardous Waste
IBA	Important Bird Areas
ICZM	Integrated Coastal Zone Management
IFC	International Finance Corporation
IFI	International Financial Institution
IGB	Interconnector Greece – Bulgaria
ILO	International Labour Organization
IMDG	International Maritime Dangerous Goods Code
IMO	International Maritime Organization

IOR	Improved Oil Recovery
IPPC	Industrial Pollution Prevention Control
IRPA	Individual Risk Per Annum
IUCN	International Union for Conservation of Nature
JMD	Joint Ministerial Decision
LBS	Land Based Sources
LDK	LDK Engineering Consultants S.A.
LFL	Lower Flammable Limit
LONB	Landscapes of Outstanding Natural Beauty
LSIR	Location Specific Individual Risk
MAP	Mediterranean Action Plan
MARPOL	Marine Pollution
MCC	Motor Control Center
MD	Ministerial Decision
MMO	Marine Mammal Observers
MMP	Management and Monitoring Plan
MPA	Marine Protected Area
MPFM	Multi-Phase Flow Meter
MPME	Most Probable Maximum Extreme
MS	Member States
MS	Meteorological Station
MS	Management System
MSFD	Marine Strategy Framework Directive
NAG	Non-Associated Gas
NCEP	National Centres for Environmental Prediction
NDT	Non Distractive Testing
NGO	Non – Governmental Organisation
NHZW	Non-Hazardous Waste
NOAA	National Oceanic and Atmospheric Administration

NORMs	Natural Occurring Radioactive Materials
NPV	Net Present Value
NTG	Net to Gross
NTUA	National Technical University of Athens
NUI	Normally Unattended Installations
O&G	Oil & Gas
ODE	Offshore Engineering Limited
OGP	(International Association of) Oil & Gas Producers
OHS	Occupational Health and Safety
OPRC	Oil Pollution Preparedness Response & Cooperation
OWC	Ocean Wildlife Conservation
PAH	Polycyclic Aromatic Hydrocarbons
PAM	Passive Acoustic Monitoring
PAR	Personnel Access Ramp
PD	Presidential Decree
PEIA	Preliminary Environmental Impact Assessment
PFD	Process Flow Diagram
PIER	Procedure for Preliminary Identification of Environmental Requirements
PLL	Potential Loss of Life
POB	Persons on Board
POP	Persistent Organic Pollutant
PPE	Personal Protected Equipment
PR	Performance Requirements
PRTR	Pollution Release and Transfer Register
QRA	Quantitative Risk Assessment
RBMP	River Basin Management Plan
RD	Royal Decree
REACH	Registration, Evaluation, Authorization and Restriction of Chemicals

REMTH	Region of Eastern Macedonia & Thrace
RFPPSD	Regional Framework of Physical Planning and Sustainable Development
RINT	Rescue and Information Network
RoMH	Report on Major Hazards
ROV	Remotely Operated Vehicle
RU	Regional Unit
SAC	Special Areas of Conservation
SCI	Sites of Community Importance
SEP	Stakeholder Engagement Plan
SIP	Self Installing Platform
SLOD	Significant Likelihood of Death
SLOT	Specified Level of Toxicity
SPA	Special Protection Area
SpEA	Special Ecological Assessment
SPT	SPT Offshore BV
SST	Sea Surface Temperature
STOIIP	Stock Tank Oil Inittialy in Place
TAD	Tender Assist Drilling
TAP	Trans Adriatic Pipeline
TEG	Triethylene Glycol
TL	Transmission Lines
TRA	Toolbox Risk Assessments
TUTU	Topsides Umbillicals Termination Unit
UNCLOS	United Nations Convention on the Law of the Sea
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme
UoA	University of Athens
UPS	Uninterruptible Power Supply

VAT	Value Added Tax
VSP	Vertical Seismic Profile
WAG	Water Alternating Gas
WCMC	World Conservation Monitoring Centre
WEEE	Waste Electrical and Electronic Equipment
WFD	Waste Framework Directive
WFD	Water Framework Directive
WMP	Waste Management Plan
WR	Wildlife Refuges
WW	Waste Water
WWTP	Wastewater Treatment Plant
YPEN	Ministry of Environment and Energy

1 INTRODUCTION

1.1 PROJECT TITLE

The Project covers existing offshore oil and gas production facilities located in the Gulf of Kavala, North Aegean Sea, Greece, planned extensions to these, as well as potential further development projects currently still being studied. Existing offshore facilities have been in operation since they were developed in the period 1979 to 1981. These facilities were developed to allow production of sour-oil and associated gas from the Prinos field and sweet-gas from the South Kavala field. They were later extended to enable the Prinos North field to be developed. Produced hydrocarbons are partly treated offshore before being transported to shore for full treatment to sales specifications. Transportation is via two submarine pipelines that have been in operation since 1981. The fields and associated licenses are owned by Energean Oil and Gas S.A. and operated by its subsidiary Kavala Oil. The Project Owner for the planned extension is Energean Oil and Gas S.A.

This document is the Environmental and Social Impact Assessment (ESIA) for the Project. This document has been prepared in line with existing Greek legislative requirements (reflecting as appropriate European legislative frameworks and relevant international treaties). The Project Owner is seeking finance for certain elements of the Project (the planned extensions defined below) from the European Bank for Reconstruction and Development (EBRD). The ESIA has therefore also called upon the Performance Requirements (PR's) included in EBRD's 2014 Environmental and Social Policy.

Existing Greek legislation and the Performance Requirements of EBRD differ to a degree in the required approach for presenting EISA's for offshore oil and gas facilities. The structure of this document generally reflects the prescriptive format demanded under Greek legislation. However the approach taken to assessing potential environmental and social impacts, the structure of key sections (for example, those describing the Baseline and Impact Assessments) as well as the inclusion of early stakeholder sessions at the scoping stage, have been driven by the requirement to satisfy EBRD's PR's.

1.2 PROJECT OWNER

The Project Owner (operator) is the company **ENERGEAN OIL & GAS** (Address: 32 Kifisias Ave., PC 151 25, Marousi, Telephone: 2108174200).

The supervisors of this EIA, on behalf of the project owner, are:

- Dr. Steve Moore, Technical Director
- Mr. Vasilis Tsetoglou, HSE Manager

Energean is a private oil and gas Exploration and Production (E&P) company focused on Greece, the wider Adriatic and North Africa, with five licenses in Greece and the Mediterranean. Energean is the only oil & gas producer in Greece with a track record of over 35 years as an offshore and onshore operator of oil & gas assets.

In December 2007, Energean acquired the majority shareholding of Kavala Oil, which held 100% interest in the Prinos Concession Agreement. Kavala Oil has been engaged in offshore exploration activities in the Gulf of Kavala since 1999, when it took over operations from the NAPC consortium, which discovered and developed the Prinos field in the early 1980. The full project history of the concession is reported analytically by the aforementioned description of the concession agreements.

1.3 PROJECT TYPE AND SIZE

The extent of the current ESIA is significantly broader than the planned facility extension project that is the subject of funding by the EBRD. The ESIA has been prepared to cover not only these planned extensions, but also all of the existing offshore assets that have been in operation since 1981, as well as potential future extensions that Energean Oil and Gas S.A. is studying, but has not yet committed to implement. Onshore facilities used to treat fluids produced offshore are not included, although they have been described in an attachment, as per EBRD requirements.

For the sake of clarity the following sub-division of assets and projects has been defined. These definitions also provide an explanation as to why they have been included in the current assessment.

1.3.1 Planned extension project

The planned extension project is the work scope that is to be funded by EBRD. This comprises:

- The re-entry of nine (9) existing wells on the Prinos Alpha platform and the sidetracking of these to new bottom-hole locations in the Prinos field. These wells target undrained pools of oil in the A, B and C reservoir units.
- The re-entry of one (1) existing Prinos North extended reach well located on the Prinos Alpha platform, with the objective of side tracking it up dip of the existing bottom hole location to allow attic oil reserves to be drained.
- The design, fabrication, installation, commissioning and subsequent operation of a new well-head jacket platform (called “Lamda”) approximately 3.5 km’s north west of the existing Prinos platforms. The Lamda platform will host between 5 and 9 wells that will

be drilled into and produce from the Epsilon field. This platform has been designed to be normally unmanned. All produced fluids are transported to the Prinos Delta platform where existing equipment is used to separate oil, water and gas

- Three (3) sub-marine pipelines that connect Lamda to Prinos Delta. These comprise one 10" pipeline to carry multi-phase well fluids from Lamda to Delta, and two 6" pipelines to carry injection water and lift gas respectively from Prinos Delta to Epsilon
- Between 5 and 9 new wells to be drilled from the Lamda platform into the Epsilon field. These wells will initially be completed as producers with between 2 to 4 being converted after approximately 18 months to water injectors. The range of well numbers planned reflects the uncertainty in recoverable reserves. The designed platform is equipped with 15 slots.

Energean Oil and Gas S.A. commenced this project in late 2014 when it purchased and renovated the Energean Force drilling rig that will be used to undertake all sidetracks and new wells. Sidetracks commenced in September 2015. Currently (early February 2016) the Company is approximately 50% complete with the second of the planned nine (9) Prinos Alpha side tracks.

1.3.2 Potential further development project

Energean is currently studying an additional development project that would be implemented following successful completion of the planned extension project defined above. This project would introduce a second new wellhead jacket (identical to Lamda). This platform ('Omicron') would be located between the Prinos North and Prinos reservoirs and used to further develop Prinos North in addition to the Kazaviti discovery. Kazaviti will be appraised by the 3rd planned Prinos Alpha sidetrack (well PA-36), allowing a decision to be made on the viability of this potential project subsequently.

Details of the Omicron project and associated wells are included in the ESIA. This project is not currently included in the EBRD finance package. It is covered in the ESIA because Energean Oil and Gas S.A. wishes environmental permits issued by the Greek government to cover this scope.

Also in this additional project would be a campaign to sidetrack up to 5 of the current Prinos Beta wells to new bottom hole locations.

1.3.3 Existing facilities

The existing offshore facilities are presented in detail and the environmental and social impacts associated with them fully assessed even though they remain fundamentally unchanged by either the planned or potential further development projects defined above. For minor extensions such as those planned it would not be normal to reassess facilities that have been operating for 35 years and which are covered by valid environmental permits, in such detail. They have been included in the ESIA at the request of the Greek government. After consultation the government

has advised that it wishes to grant a new environmental permit which covers all offshore facilities rather than; i) grant a new permit to cover only the new facilities or, ii) to extend the existing permits to cover the new facilities. As a new permit is to be issued it has requested Energean to prepare a new ESIA for the entire offshore area. This ESIA should also reflect the requirements of the European Offshore Directive, which has yet to be transposed into the Greek legal framework.

With respect to Greek legislation there is no requirement for Energean to include side-tracks of existing wells in the ESIA. These activities are considered operational activities performed on existing wells and hence are covered by existing operational permits. They are included in the ESIA as they form part of the planned extension project to be funded by EBRD. The Greek government considers side tracks as work over activities.

All of the existing facilities have been designed and permitted at an earlier date at throughputs and capacities exceeding those which will be achieved by execution of the planned or the planned plus potential developments. Prinos facilities have been designed for a notional oil throughput of 27,000 bopd. They are currently processing just 3,000 bopd. Expected P50 production rates following the defined projects are tabulated below.

For the avoidance of doubt the existing facilities described are:

- The Kappa platform located on the sweet, non-associated gas field South Kavala
- The 6” pipeline that transports sweet gas and condensate from South Kavala to Prinos Delta
- The 12-slot production jackets Prinos Alpha and Prinos Beta which form part of the bridge linked Prinos complex
- The Prinos Delta platform that contains all offshore processing facilities and which receives oil, gas, water and condensate produced from Prinos, Prinos North and South Kavala fields. Prinos Delta is bridge linked to Prinos Alpha and Prinos Beta as well as the Prinos flare jacket. New risers will be added to Prinos Delta to allow it to receive fluids from Lamda (and potentially Omicron) and send lift gas and water for injection to Lamda.
- The Prinos flare jacket
- A 12” dry-gas pipeline connecting Prinos Delta to the onshore facilities
- An 8” oil pipeline connecting Prinos Delta to the onshore facilities
- A 5.3” pipeline that transfers seet dry lift gas from the onshore facilities to Prinos Delta
- Two 10kVa submarine power cables that transport electricity from the onshore facility to Prinos Delta

1.3.4 Current and planned oil and gas production

Current and planned oil and gas production are presented in the table below:

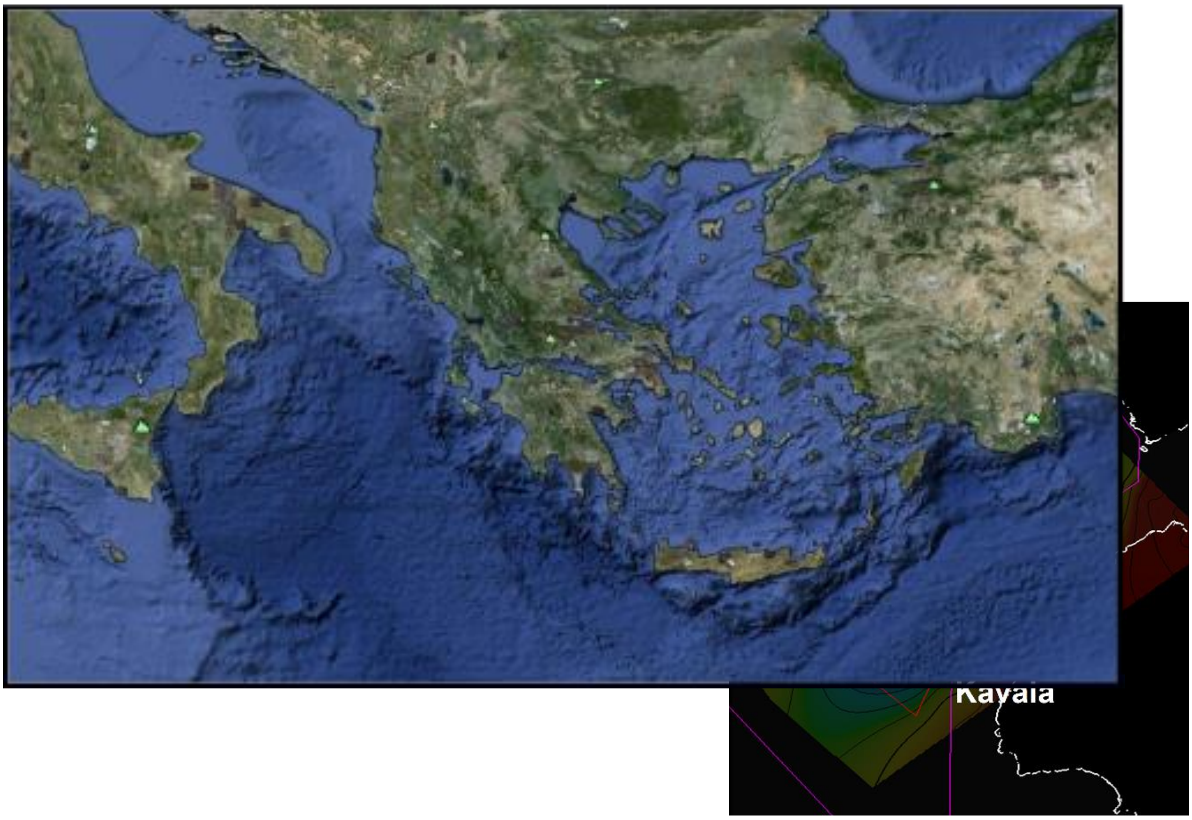
Table 1-1: Prinos field production

Type of product	Quantity				
	Design capacity	Current production (from existing facilities, Prinos / South Kavala fields)	Peak planned production following Prinos Alpha sidetracks (P50 forecast)	Peak planned production following development of Epsilon field (P50 forecast)	Peak planned production following potential Prinos Beta sidetracks and Omicron platform (P50 forecast)
Stabilised crude oil (barrels or bbls/day)	27,000	3,000	10,000	14,000	20,000
Sour gas export (cubic meters or Nm^3/d)	333,000	40,000	110,000	156,000	175,000
Sulphur (megatons or MT/day)	478	40	98	86	115
Condensates (cubic meters or m^3/d	265	40	105	115	150

1.4 GEOGRAPHIC LOCATION AND ADMINISTRATIVE DEPENDENCE OF THE PROJECT

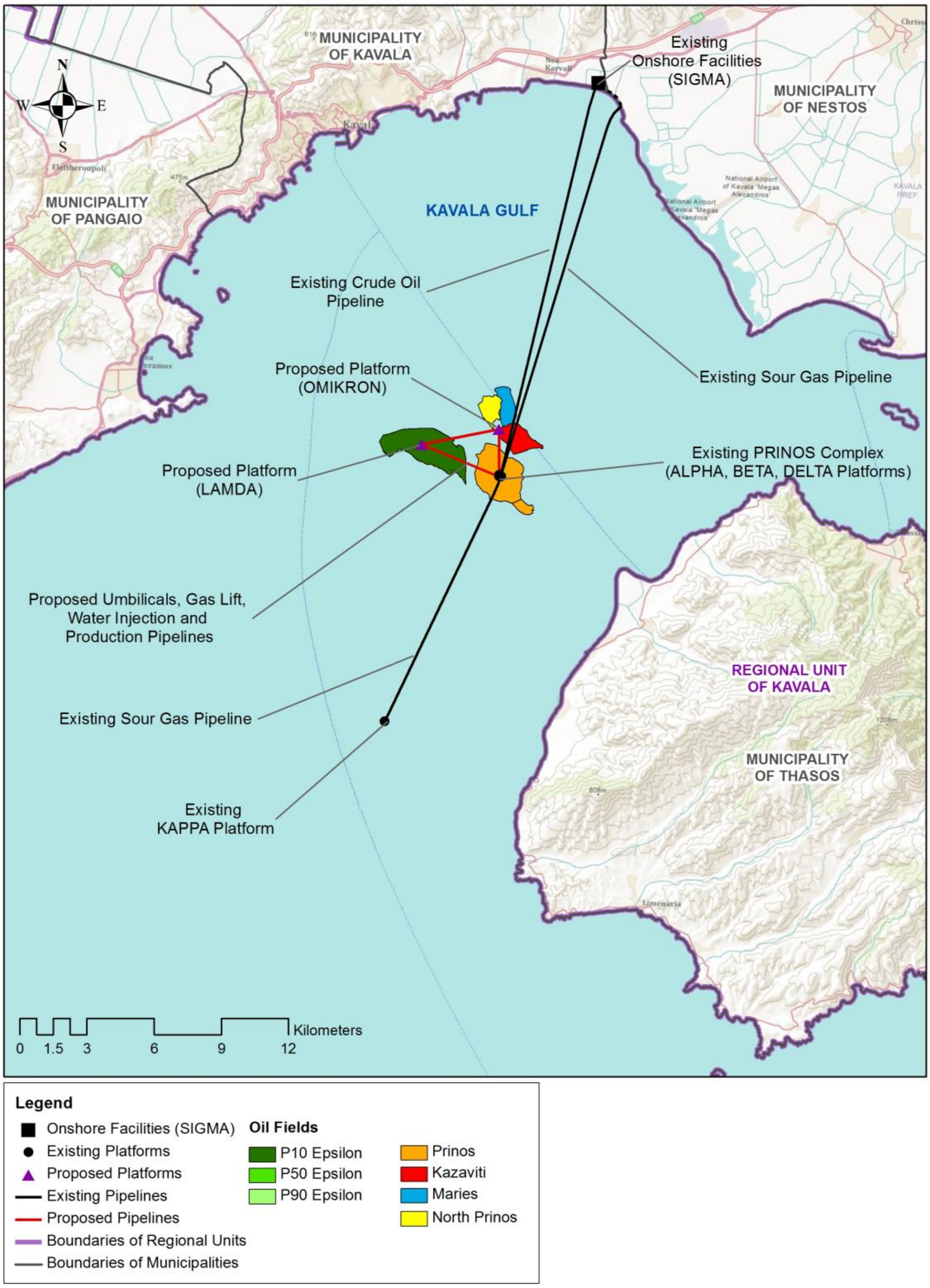
1.4.1 Location

The Prinos facilities and overall development area are located offshore in the Gulf of Kavala, 8 km west of island of Thasos and 18 km south from the main coastline of Kavala. The Gulf of Kavala is part of the Thracian Sea and falls within North East Aegean as presented below.



Map 1-1: Location of the Prinos development area in the Gulf of Kavala.

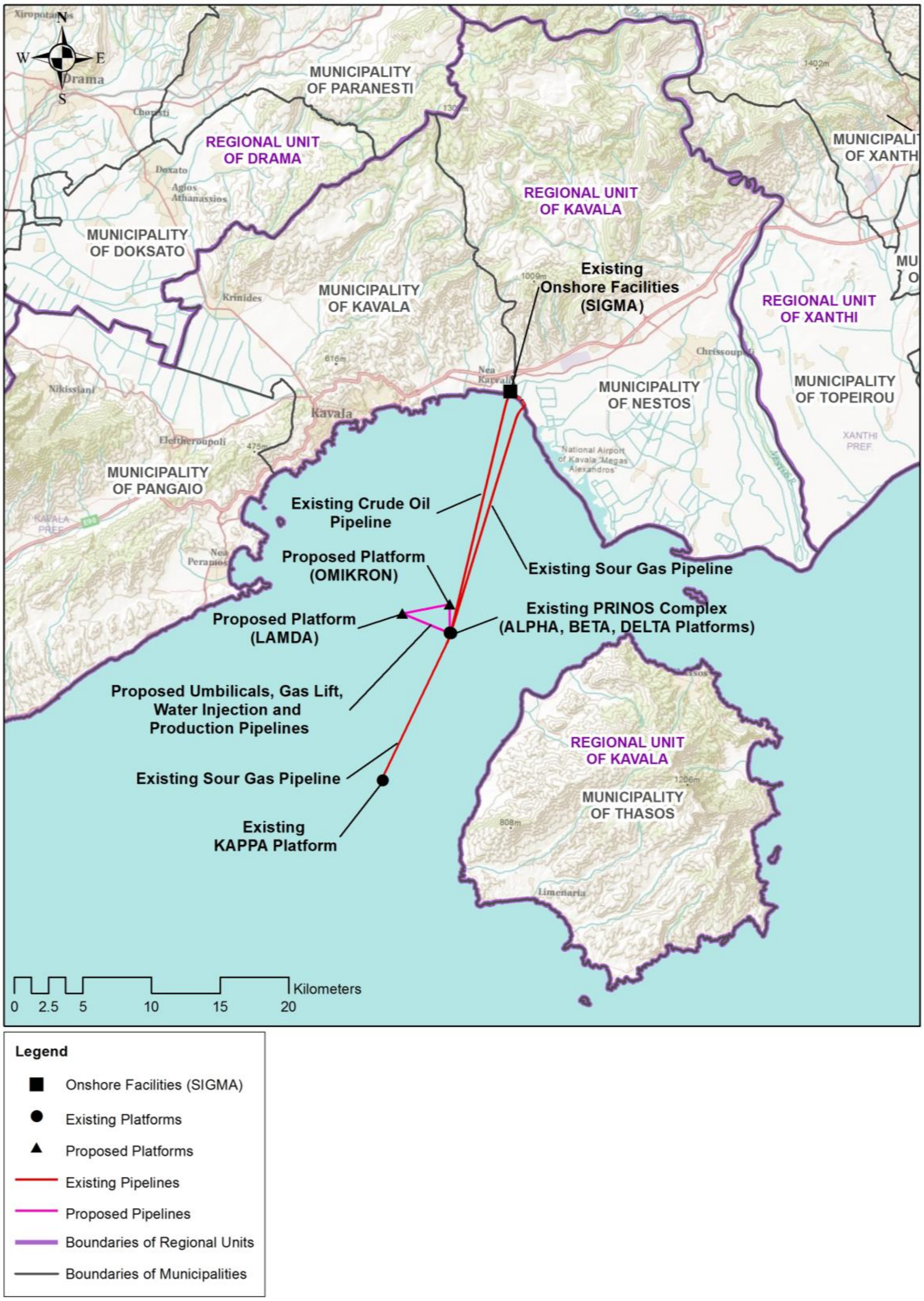
Existing and new proposed facilities are presented in the map below.



Map 1-2: Location of Project facilities (planned and existing)

1.4.2 Administrative dependence of the project

The proposed and existing facilities are located in the East Macedonia and Thrace region, in the southern coastal part of the Regional Unit of Kavala, near the limits of Municipalities of Kavala (on the North), Pangaio (on the North-NorthWest), Nestos (on the North-NorthEast) and Thasos (on the East-SouthEast), following the L.3852/2010 (A’ 87) “Kallikratis” Programme.



Map 1-3: Administrative boundaries of the broader project area and association with the offshore facilities (planned and existing)

Associated onshore facilities (Sigma plant) in particular fall within the Municipality of Kavala bordering with Municipality of Nestos.

1.4.3 Geographical coordinates of the project

The coordinates of the concession area are given in the relevant agreements as ratified by the Greek Parliament. The project in discussion as described above is included within those areas. In the following table the coordinates in two coordinate systems (WGS 84 and WGS 84 UTM 35 North) of the platforms are presented (center point of platforms):

Table 1-2: Coordinates for existing and planned platforms (WGS 84)

Platform	Lat	Long
	Existing	
Delta	24° 29' 50.40"E	40° 47' 54.92"N
Alpha	24° 29' 49.62"E	40° 47' 57.62"N
Beta	24° 29' 54.41"E	40° 47' 55.36"N
Kappa	24° 26' 34.95"E	40° 42' 03.74"N
	Planned	
Lamda	24° 27' 12.97"E	40° 48' 33.55"N
Omikron	24° 29' 45.17"E	40° 49' 06.71"N

Table 1-3: Coordinates for existing and planned platforms (WGS 84 UTM 35 North)

Platform	Lat	Long
	Existing	
Delta	288872.57	4519412.81
Alpha	288856.70	4519496.85
Beta	288967.00	4519423.89
Kappa	283976.50	4508715.00
	Planned	
Lamda	285217.68	4520710.41
Omikron	288813.30	4521630.44

1.5 ASSESSMENT METHODOLOGY AND RISK MITIGATION APPROACH ADOPTED

As outlined above, the Project covered by the current ESIA is complicated by the need to describe not only the planned extension project but the existing facilities that been operational for 35 years. The approach that has been adopted is to include in the Base Line Assessment impacts associated with the existing facilities. These facilities have been in permanent operation for close to four decades. In this period the routine impacts associated with them will have over stamped the environmental and socio-economic conditions that existed before their development.

The potential impact of the described extension projects (planned and potential elements together) is then quantified. These extensions are broken into two phases, namely 1) the construction period associated with the installation of the new platform(s) and 2) the operational phase following installation when the new and existing facilities combine to form a new overall production system. The impact of drilling operations (both side-tracks of existing wells and new wells drilled from top-hole) is included in the operational phase assessment. Drilling has already commenced on the Alpha platform and will continue whilst the new platform(s) are constructed and installed as well as after they are in place. As new potential projects are identified and approved drilling operations could continue for many years. Hence it was considered more logical to overlay the impacts from drilling operations onto facility operations rather than consider them within the platform construction phase, which has a very limited duration (with well defined start and stop points).

As outlined in the section where the existing and planned facility extensions are described in detail, it is clear the new facilities represent a very minor cumulative addition to the overall operational complexity of the area. Environmental and Socio-economic impacts of the existing facilities have been managed successfully over the last 35 years by a system of controls implemented by Kavala Oil staff. The ESIA examines these controls to determine whether they are sufficient to manage the increased complexity as well as any new hazards introduced by the planned and potential extensions. Plans to extend established control systems to mitigate risk from the additional facilities are described where such extensions are necessary. New mitigations are similarly outlined.

Energean has consciously built into the design of the extension facilities specific features that help mitigate risks both in the construction and operational phases of the project. A novel sub-structure design has been adopted. This allows the total platform to be assembled onshore in a location designed for such industrial activities. As a result the installation time offshore is reduced from 6 to 8 weeks to a mater of days. The size of the installation fleet is similarly reduced. The need for permanent offshore manning is avoided. Clearly environmental risk during construction is driven by the extent of the marine fleet required. Another benefit of the selected design is the significant reduction in offshore noise. Energean has selected to use suction piles rather than

conventionally driven piles to hold the new structure in place. This avoids weeks of pile driving activities and the associated noise.

The selected design also provides risk reduction benefits in the operational phase. The topside facilities and sub-marine pipelines have all been designed to withstand the maximum closed in pressure of the wells. This means that when operating at normal conditions the corrosion allowance available is significantly increased. This reduces the calculated frequency of losses of integrity and hence introduction of hydrocarbons into the environment. In addition this conservative approach has also removed the need for a permanently lit flare on the new platforms. Flares clearly introduce significant environmental impact. They are a source of continuous emissions and light pollution. They also represent a significant leak path to introduce liquid hydrocarbons into the environment if process systems fail. The planned and potential new facilities do not need a flare due to the conservative approach taken to rating of process pipework and the avoidance of vessels.

Energean has also selected to link the new facilities to the Delta complex by submarine power cables rather than equip them with diesel powered generators. The selected approach increases initial capex but reduces emissions by allowing efficiently generated power from the public network to be employed rather than lower efficiency locally generated electricity. This approach also reduces noise and local emissions and avoids the need to transfer diesel onto the satellites.

The new facilities have been designed to be unmanned, with control achieved from Delta. Visits will be limited to 2 per week, rather than 3 per day as at the existing facilities. This reduces marine traffic and hence associated environmental impacts. Clearly it also removes the need for additional employment with corresponding negative socio-economic consequences.

The analysis performed in the ESIA has demonstrated that the routine risks associated with the new facilities can be managed at a level that is as low as reasonably practical (ALARP). The most significant risk associated with the new facilities is that associated with potential accidental releases. The only source of a significant spill associated with the new facilities is from a blow-out whilst the new wells are being constructed. The frequency or consequence of other typical leak types has been mitigated, for example:

- Carry over from the flare knock-out drum: no flare is required by design
- Rupture of topside equipment/vessels or mal operation: no vessels are included in the main process system; topside hydrocarbon inventory is limited to 6 m^3 by design. All surface equipment is rated to 235 bar – 215 bar higher than normal operational pressures
- Rupture of the multiphase export line from Lamda (Omicron) to Delta: line is rated to 235 bar and buried to avoid external impacts; system has been designed to allow internal inspection; liquid volume in export line limited to approximately 50 m^3 by use of small diameter and by multiphasing with produced gas

Oil spill modelling has investigated the potential consequences of significant oil spills associated with:

- A blow out from one of the new wells being drilled on Lamda platform;

- A leak while loading processed crude to an oil tanker.
- A large diameter hole in the main export line that takes crude from Delta to Sigma

The location and size of this latter spill has been determined from an analysis of Major Hazards. The worst case scenario is seen to be damage from a fishing trawler at the point just before the pipeline is buried. This point is at a distance of 7 km from Delta. Beyond this point the oil line is buried and hence safeguarded from external impacts that could lead to a large spill. Corrosion related damage in the buried section would result in small leaks that would be detected immediately during routine inspection activities. As the Gulf of Kavala is flat calm for about 40% of the time (summer and winter) detecting minor sheens is very easy and rapid. Shallow depths allow repairs to be affected with routine diving operations that are on call 24 hrs per day.

The Gulf of Kavala benefits from benign weather conditions that largely mitigate the consequences of significant oil spills. Wind speeds are below a “light breeze” for 35% of the time in December and 49% of the time in June. Hence for most of the year a leak, as modelled, moves very slowly. Strong winds (above “strong breeze”) occur for only 1.25% of the time. All such periods are in the winter months. Average wind speeds in directions that could carry oil to shore are between 2.1 and 4.0 m/s in the winter and 2.4 and 3.4 m/s in the summer. These light onshore winds blow for around 25% of the time. Stronger offshore winds (5 to 7.5 m/s on average) dominate for the rest of the period. Winds to the nearest land fall (the tourist beaches on the islands of Thasos) blow for less than 7% of the time and average 2.2 m/s year round. Energean holds oil spill response equipment which can be mobilised to site in 3 hours maximum due to the near shore location. The calm conditions and low winds make booming and skimming activities very effective.

To keep the number of scenarios to a manageable level the areas of particular sensitivity need to be identified and scenarios that look at how these areas could be impacted defined. In this framework the following locations have been defined:

- The coast between Nea Peramos and Nea Karvali – this coast line contains the historic port of Kavala, a number of tourist beaches (to the west and east of Kavala), the commercial port at Fillipos, small industrial based marine facilities (Fertiliser plant, Sigma water intake and loading buoys, Refined product intake buoys).
- The coast between the Sigma plant and the mouth of the delta of the Nestos river – this coast falls under numerous protection provisions (part of Natura 2000, SPA, National park, Ramsar wetlands, IBA). Moreover, it holds a number of small-scale fish farming enterprises. The impact on this coastline would be most significant from the late spring through to the end of summer.
- The north and North West coast of the island of Thasos - Thasos is a major tourist destination. Whilst many of the main beaches are on the east and south of the island there are a number of popular tourist locations on the coast immediately adjacent to Energean’s offshore facilities (Rachoni, Prinos, Kalarachi etc.).

1.6 PROJECT ENVIRONMENTAL PERMITTING AND SCREENING

All Prinos field facilities and operations have undergone a series of environmental licensing and permit dating back in 1997. In more detail:

- The current productive offshore facilities were first licensed with JMD 80994/07-02-2002 issuing environmental terms for the project till 31.12.2010. This Decision was renewed and modified under Decision 46781/1283/12-08-2013 from General Director of Environment and is valid till 12.08.2023;
- The exploration drilling programme of KAVALA OIL was granted an environmental permit with JMD 108879/27.10.2006 that was further renewed with JMD 68098/1880/10-12-2013 until 10-12-2023;
- The onshore facilities were first licensed with Decision 31218/19.09.1997 signed by General Director of Ministry of Environment, Urban Planning and Public Works (ex Ministry of Environment, Climate Change and Energy) and General Director of Ministry of Development; it is noted that this decision was issued for North Aegean Petroleum Co EPE[1]. Following the issuance of Law 2779/99 (ratification of the Agreement 2779/99 between the Greek State and KAVALA OIL S.A.[2]) in 1999, Decision 47628/11.10.2000 modified environmental terms (Decision 31218) regarding the company's trade name. In 2003, the project's environmental terms were renewed - modified with Decision 96213/80994/07.02.2003. Finally, in 2013 with Ministerial Decision 213450/05-12-2013 signed by YPEKA, environmental terms governing onshore project were modified and renewed for ten (10) years viz till 05-12-2023.

  As noted in other parts of the document, the onshore facilities are not included in the scope of work of the present ESIA.

According to Ministerial Decision 1958/13-01-2012 "Classification of public and private works fall into categories and subcategories. In accordance with Article 1(4) of Law 4014/2011" the Project belongs to Group 5 "Mining and similar activities", Serial Number 7 "Pumping of hydrocarbons and exploratory drilling in search of hydrocarbons" and is included in Subcategory A1 since all works of this activity belong to this subcategory.

Category A1, classifies the projects that may have significant effect to the environment, and therefore:

- A detailed Environmental Impact Statement (EIS or EIA) is required as per the specifications set out by JMD 170225/2014 (Annex 2);
- The competent authority that issues the permit is the Ministry of Environment and Energy (YPEN) and particularly Department of Environmental Licensing (DIPA) as per

[1] North Aegean Petroleum Co EPE was founded on December 1976 as operator for the project's activities in Greece.

[2] KAVALA OIL S.A. was comprised of two companies: EUROTECH SERVICES (sharing 67%) and the ASSOCIATION OF EMPLOYEES (sharing 33%).

L.4014/2011;

- An A1 project permitting procedure is set out in Article 3 of L.4014/2014;
- The consultation authorities during the EIS process are predefined in JMD 1649 /45/2014.

The environmental permitting procedure for the Project is defined by the Law 4014/2011 as described below. The contents and the level of detail of the Environmental Impact Assessment study are set out in the Joint Ministerial Decision (JMD) 170225/2014 depending on the Project's classification. This process and the requirements for EIA are aligned with the EU EIA Directive, which has been transposed into Greek legislation.

The EIA process:

- Impact Assessment: the applicant shall provide an EIA of the project to the Ministry of Environment and Energy (YPEN), Directorate of Environmental Permitting (DIPA);
- Check for Completeness: DIPA/YPEN will check the EIA for completeness and may request additional information, prior to distributing for consultation;
- Statutory Consultation: opinion/response from the Central Authorities or other competent Ministries, Regional Authorities and various organizations (the consultees are predefined by the JMD 1649/45/2014 for each project type and category);
- Public Consultation: the project is presented to the Regional Council during an open hearing where people can express their views
- Decision on Approval of Environmental Conditions: DIPA/YPEN will consider the results of the consultation (statutory and public) and will issue its decision, co-signed by other competent Ministries
- Publication of Decision: publication of the decision through the relative Regional Council.

Following consultation with the Greek authorities, it has been agreed that the EIA will be prepared so as to also cover the operation of the existing facilities in the Prinos offshore area since the operations of the new and old offshore facilities will be operationally interlinked.

For completeness, the facilities associated with the depleted South Kavala gas field are included, although these are not linked to the planned new facilities; South Kavala facilities are connected to the existing Delta platform. Although depleted, gas is produced intermittently and Energean is looking at methods to further increase gas and condensate production whilst the Greek authorities formalize plans for converting this field into a strategic gas storage project.

The onshore facilities are covered by a detailed Environmental Impact Assessment, which was renewed and reapproved by the Greek authorities in 2013, (213450/5/12/2013, General Secretariat of Environment, YPEKA – currently YPEN). The existing offshore facilities are also covered by an EIA, which was renewed and reapproved by the Greek authorities in 2013 (46781/12/8/2013).

Appropriate Assessment is mandatory if a development extends into a Natura 2000 area and this assessment usually takes the form of a Special Ecological Study in Greece. The Special Ecological Study considers the potential impacts of a project on a Natura 2000 area (Article 6 of Directive 92/43/EEC – the Habitats Directive). Specifically, it takes into account the conservation

objectives of the protected area, focuses on the consequences of the project under licensing in the area, and examines whether the integrity of this region is compromised. None of the proposed facilities extend into a Natura 2000 area. One of the existing pipelines to shore does cross a Natura 2000 area and therefore a Special Ecology Survey has been undertaken.

The European Bank of Reconstruction and Development (EBRD) is currently considering providing financing for the Project and therefore the EIA has taken into consideration the EBRD's environmental and social requirements. These are the EBRD's Performance Requirements (PR) which form part of the EBRD's Environmental and Social Policy of 2014. As per the Policy, the Project is categorised as A and requires a full Environmental and Social Impact Assessment and disclosure thereof for a minimum of 60 days prior to a financing decision. Rather than producing separate EIA documents, one for permitting and one for financing, the Project has produced an ESIA that serves both purposes and which is supported by various additional documents which together form the ESIA disclosure package. Similarly the Project will combine permitting and financing disclosure requirements. The biggest difference between a permitting EIA in the EU and an ESIA to EBRD standards is a more detailed consideration of social issues in addition to environmental issues. Furthermore the EBRD requires engagement with stakeholders as early in the ESIA process as possible.

1.7 PROJECT ENVIRONMENTAL CONSULTANT

This ESIA was prepared by LDK Engineering Consultants S.A., holder of an Advisory Committee on Designs (GEM) Degree 27 “Environmental Studies”.

The following team participated in the preparation of this assessment:

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Costis Nicolopoulos	Environmental engineer, MSc	Head of LDK Environment, principal, project director
Evie Litou	Chemical engineer, MSc, AIEMA	Principal ESIA / process consultant
Foteini Tsafou	Environmental Engineer, MSc	Senior ESIA consultant
Thomas Kollias	Environmental Scientist, MSc	Senior ESIA / O&G / social / stakeholder engagement consultant
Eleni Avramidi	Environmental Engineer, GIS Analyst	Senior ESIA/GIS consultant
Xenofontas Bakouras	Environmental Engineer, MSc	Senior ESIA consultant
Aliki Panou	Marine Biologist	Senior marine mammal consultant
Dimitra Evaggelakopoulou	Environmental Engineer, MSc	Junior ESIA/ O&G/ social / stakeholder engagement consultant
Eleni Giamakidou	Geography, Nature	Junior ESIA, ecology consultant

Name	Background, expertise	Position
	Management, MSc	

The following scientists - associates participated as associate experts:

Name	Background, expertise	Position
Prof. Dr. Nikolas Markatos	Chemical engineer, PhD, NTUA	Principal risk / safety expert
Prof. Andreas Boudouvis	Chemical engineer, NTUA	Principal risk, scientific coordinator
Dr Michalis Christolis	Civil engineer, DEA, NTUA	Principal risk / safety expert
Dr. Despoina Karadimou	Chemical engineer, PhD	Computational modeling expert
Dr Ioannis Andreou	Chemical engineer, NTUA, PhD	Principal risk / safety expert
Dr. Theopisti Lymberopoulou	Chemist, chemical engineering, PhD	Principal pollution assessment / laboratory analysis
Prof. Artemis Nikolaidou	Marine biologist, UoA	Principal marine biologist expert
Sergio Carlos Garcia Gomez	Benthic ecologist	Senior marine invertebrate biologist expert
Elizabeth Arevalo Corillo	Marine biologist	Field expert – laboratory analysis / species identification
Aglaia Legaki	Marine biologist	Field expert
Spyros Aravantinos	Marine biologist	Field expert – laboratory analysis / species identification
Kalliopi Sigala	Marine biologist	Ecological quality analysis
Dimitris Poursanidis	Marine biologist	Senior marine biologist – special ecological study
Jacob Fric	Physicist, bird ecologist	Ornithologist expert – special ecological study
Kostas Mylonakis	Diver	Ecotopes / species cartography, documentation (underwater photo log, video)

Moreover Environmental Resource Management (ERM Ltd) has also been engaged providing high overview and advisory services in order to align the requirements towards the Greek State and the EBRD requirements, as well as bringing international offshore O&G experience to the present ESIA team.

The following ERM team participated in the preparation of this assessment:

Name	Background, expertise	Position
Nicola Lee	Environmental assessment &	Partner, project director

Name	Background, expertise	Position
	management MSc	
Elena Amirkhanova	Geography MSc	Partner, social/stakeholder engagement expert
Roderick Ellison	Environmental impact assessment MSc BSc CEnv MIEMA	Principal ESIA Consultant, impact assessment/mitigation/ESMMPs expert
Shana Westfall	Chemical engineer	Senior ESIA Consultant
Esmeralda Francisco	Sociologist, urban policy & planning MSc	Senior consultant, impact assessment & planning

In addition, ERM has been the appointed consultant for matters related to the Directive 2013/30/EU (safety of offshore oil and gas operations) and, in particular, for the results of the major accidents prevention studies and plans, the responsibility for the preparation of the studies and plans.

The following team participated in the preparation of this assessment:

Name	Background, expertise	Position
Rob Steer	Risk and safety expert	Partner
David Caine	Mechanical engineer MEng, MBA	Senior Consultant

2 EXECUTIVE SUMMARY

2.1 INTRODUCTION

The Project covers existing offshore oil and gas production facilities located in the Gulf of Kavala, North Aegean Sea, Greece, planned extensions to these, as well as potential further development projects currently still being studied. Oil and gas were first discovered in the Prinos basin in the mid 1970's. Existing offshore facilities have been in operation since they were developed in the period 1979 to 1981. These facilities were developed to allow production of sour-oil and associated gas from the Prinos field and sweet-gas from the South Kavala field. They were later extended to enable the Prinos North field to be developed. Produced hydrocarbons are partly treated offshore before being transported to shore for full treatment to sales specifications. Transportation is via two submarine pipelines that have been in operation since 1981.

The fields and associated licenses are owned by Energean Oil and Gas S.A. and operated by its subsidiary Kavala Oil. The Project Owner for the planned extension is Energean Oil and Gas S.A.

Current recovery from the Prinos field is a little less than 40% of the original hydrocarbons in place. South Kavala is 90% depleted. A number of smaller accumulations were discovered during the exploration phase, but only one of these – Prinos North – has been partly developed to date. Energean acquired the Prinos assets in 2007 and has executed a re-development programme whilst appraising the remaining potential of the Prinos field and its immediate satellite fields (Epsilon and Prinos North). As a result of this work, Energean is now planning to increase oil production from the Prinos area through further development of existing fields and the installation of new facilities and wells.

To achieve this, the Company has purchased and refurbished a 2,000 horse power tender assisted drilling rig (named 'Energean Force'), which embarked September 2015 on a 10-well programme from the existing Prinos Alpha platform to side track existing wells to new bottom-hole locations. Nine of these wells are associated with the Prinos field and one the Prinos North field. This operational work falls under current permits and approvals already granted by the Greek authorities.

The extent of the current ESIA is significantly broader than the planned facility extension project that is the subject of funding by the EBRD. The ESIA has been prepared to cover not only these planned extensions, but also all of the existing offshore assets that have been in operation since 1981, as well as potential future extensions that Energean is studying, but has not yet committed

to implement. Onshore facilities used to treat fluids produced offshore are not included.

2.1.1 Assessment methodology and risk mitigation approach adopted

As outlined above, the Project covered by the current ESIA is complicated by the need to describe not only the planned extension project but the existing facilities that been operational for 35 years. The approach that has been adopted is to include in the Base Line Assessment impacts associated with the existing facilities. These facilities have been in permanent operation for close to four decades. In this period the routine impacts associated with them will have over stamped the environmental and socio-economic conditions that existed before their development.

The potential impact of the described extension projects (planned and potential elements together) is then quantified. These extensions are broken into two phases, namely 1) the construction period associated with the installation of the new platform(s) and 2) the operational phase following installation when the new and existing facilities combine to form a new overall production system. The impact of drilling operations (both side-tracks of existing wells and new wells drilled from top-hole) is included in the operational phase assessment.

As outlined in the section where the existing and planned facility extensions are described in detail, it is clear the new facilities represent a very minor cumulative addition to the overall operational complexity of the area. Environmental and Socio-economic impacts of the existing facilities have been managed successfully over the last 35 years by a system of controls implemented by Kavala Oil staff. The ESIA examines these controls to determine whether they are sufficient to manage the increased complexity as well as any new hazards introduced by the planned and potential extensions. Plans to extend established control systems to mitigate risk from the additional facilities are described where such extensions are necessary. New mitigations are similarly outlined.

Energean has consciously built into the design of the extension facilities specific features that help mitigate risks both in the construction and operational phases of the project.

The analysis performed in the ESIA has demonstrated that the routine risks associated with the new facilities can be managed at a level that is as low as reasonably practical (ALARP). The most significant risk associated with the new facilities is that associated with potential accidental releases.

2.1.2 Environmental permitting roadmap

According to Joint Ministerial Decision 1958/13-01-2012 on the classification of projects and activities, the Project falls into Group 5 “Mining and similar activities”, Serial Number 7 “Pumping of hydrocarbons and exploratory drilling in search of hydrocarbons” and is classified as

Subcategory A1 and requires an Environmental Impact Assessment. The environmental permitting procedure for the Project is defined by the Law 4014/2011. The contents and the level of detail of the Environmental Impact Assessment Study are set out in the Joint Ministerial Decision (JMD) 170225/2014 depending on the Project's classification. This process and the requirements for EIA are aligned with the EU EIA Directive, Following consultation with the Greek authorities, it has been agreed that this ESIA will be prepared so as to also cover the operation of the existing facilities in the Prinos offshore area since the operations of the new and old offshore facilities will be operationally interlinked.

For completeness, the facilities associated with the depleted South Kavala gas field are included, although these are not linked to the planned new facilities; South Kavala facilities are connected to the existing Delta platform in Prinos Complex. Although depleted, gas is produced intermittently and Energean is looking at methods to further increase gas and condensate production whilst the Greek authorities formalize plans for converting this field into a strategic gas storage project. The onshore facilities are covered by a detailed Environmental Impact Assessment, which was renewed and reapproved by the Greek authorities in 2013, (213450/5/12/2013, General Secretariat of Environment, YPEKA – currently YPEN). The existing offshore facilities are also covered by an EIA, which was renewed and reapproved by the Greek authorities in 2013 (46781/12/8/2013).

The European Bank of Reconstruction and Development (EBRD) is currently considering providing financing for the Project and therefore the EIA has taken into consideration the EBRD's environmental and social requirements. These are the EBRD's Performance Requirements (PR) which form part of the EBRD's Environmental and Social Policy of 2014. As per the Policy, the Project is categorised as A and requires a full Environmental and Social Impact Assessment and disclosure thereof for a minimum of 60 days prior to a financing decision. Rather than producing separate EIA documents, one for permitting and one for financing, the Project has produced an ESIA that serves both purposes and which is supported by various additional documents which together form the ESIA disclosure package. Similarly the Project will combine permitting and financing disclosure requirements. The biggest difference between a permitting EIA in the EU and an ESIA to EBRD standards is a more detailed consideration of social issues in addition to environmental issues. Furthermore the EBRD requires engagement with stakeholders as early in the ESIA process as possible.

2.2 PROJECT DESCRIPTION

The Project covered by the current ESIA is sub-divided into three discrete sub-elements, namely:

- **Existing offshore facilities:** will remain fundamentally unchanged during the Project. Minor modifications will be applied to the Prinos Delta platform to allow the planned and potential new platforms to be tied into existing process facilities. The existing facilities include the following components:

- ⇨ The Kappa platform located on the sweet, non-associated gas field South Kavala
- ⇨ The 6" pipeline that transports sweet gas and condensate from South Kavala to Prinos Delta
- ⇨ The 12-slot production jackets Prinos Alpha and Prinos Beta which form part of the bridge linked Prinos complex
- ⇨ The Prinos Delta platform that contains all offshore processing facilities and which receives oil, gas, water and condensate produced from Prinos, Prinos North and South Kavala fields. Prinos Delta is bridge linked to Prinos Alpha and Prinos Beta as well as the Prinos flare jacket. New risers will be added to Prinos Delta to allow it to receive fluids from Lamda (and potentially Omicron) and send lift gas and water for injection to Lamda.
- ⇨ The Prinos flare jacket
- ⇨ A 12" dry-gas pipeline connecting Prinos Delta to the onshore facilities
- ⇨ An 8" oil pipeline connecting Prinos Delta to the onshore facilities
- ⇨ A 5.3" pipeline that transfers seet dry lift gas from the onshore facilities to Prinos Delta
- ⇨ Two 10kVa submarine power cables that transport electricity from the onshore facility to Prinos Delta.

- **Planned extension project:** which includes the side-tracking of 10 existing wells located on the Prinos Alpha platform in addition to the installation of a new satellite platform (Lamda) and the drilling from this facility between 5 and 9 new development wells. It is this part of the Project that is subject to potential funding from the EBRD. This includes the following:
  - ⇨ The re-entry of nine (9) existing wells on the Prinos Alpha platform and the sidetracking of these to new bottom-hole locations in the Prinos field. These wells target undrained pools of oil in the A, B and C reservoir units.
  - ⇨ The re-entry of one (1) existing Prinos North extended reach well located on the Prinos Alpha platform, with the objective of side tracking it up dip of the existing bottom hole location to allow attic oil reserves to be drained.
  - ⇨ The design, fabrication, installation, commissioning and subsequent operation of a new well-head jacket platform (called "Lamda") approximately 3.5 km's north west of the existing Prinos platforms. The Lamda platform will host between 5 and 9 wells that will be drilled into and produce from the Epsilon field. This platform has been designed to be normally unmanned. All produced fluids are transported to the Prinos Delta platform where existing equipment is used to separate oil, water and gas
  - ⇨ Three (3) sub-marine pipelines that connect Lamda to Prinos Delta. These comprise one 10" pipeline to carry multi-phase well fluids from Lamda to Delta, and two 6" pipelines to carry injection water and lift gas respectively from Prinos Delta to Epsilon
  - ⇨ Between 5 and 9 new wells to be drilled from the Lamda platform into the Epsilon

field. These wells will initially be completed as producers with between 2 to 4 being converted after approximately 18 months to water injectors. The range of well numbers planned reflects the uncertainty in recoverable reserves. The designed platform is equipped with 15 slots.

Energean Oil and Gas S.A. commenced this project in late 2014 when it purchased and renovated the Energean Force drilling rig that will be used to undertake all sidetracks and new wells. Sidetracks commenced in September 2015. Currently (early February 2016) the Company is approximately 50% complete with the second of the planned nine (9) Prinos Alpha side tracks.

- **Potential further development project:** which would install a second new satellite platform to allow further development of the Prinos North and Kazaviti fields. This project has yet to be justified and is not associated with the potential EBRD funding.

  Justification would need to have as a prerequisite the successful completion of the planned extension project defined above. This plan would entail the introduction of a second new wellhead jacket (identical to Lamda). This platform ('Omicron') would be located between the Prinos North and Prinos reservoirs and used to further develop Prinos North in addition to the Kazaviti discovery. Kazaviti will be appraised by the 3rd planned Prinos Alpha sidetrack (well PA-36), allowing a decision to be made on the viability of this potential project subsequently.

  Also in this additional project would be a campaign to sidetrack up to 5 of the current Prinos Beta wells to new bottom hole locations.

The onshore facilities (Sigma) are not impacted by the Project or its sub-elements and it is not included in the scope of the EISA.

The facilities have a design capacity of 27,000 barrels or bbls/day production of stabilised crude oil. Current production from existing facilities (Prinos, South Kavala fields) reached about 3,000 bbls/day. Following the planned production through Prinos alpha sidetracks this is expected to reach 10,000 bbls/day. The planned development of Epsilon field is expected to raise production to 14,000 bbls/day whereas further future development could reach a peak production of 20,000 bls/day.

2.3 ALTERNATIVES FOR FUTURE DEVELOPMENTS

The alternative development options addressed by Energean in the Feasibility and Concept stages are discussed and contrasted with the baseline option of not developing the fields at all – the so-called "Do Nothing" option as well as alternative options were assessed against a set of set objectives which are the following:

- Minimize potential impact on the environment;
- Ensure safety risk levels can be brought to ALARP;
- Minimise project risk – focus on simplification of interfaces during installation phase;

- Maximise use of existing facilities, and staff resources;
- Maximise opportunities for Greek companies.

Alternative options were investigated for the planned and potential future development options and were implemented for the following parameters:

- Field development options;
- Drilling options;
- Platform type and installation;
- Topside facilities option and
- Pipelines options

Following analysis of all possible options and assessment against technical, financial and environmental criteria and the aforementioned set of objectives, the most suitable options were selected that best fit the Prinos development needs, safety and environmental requirements.

2.4 CURRENT STATE OF THE ENVIRONMENT

2.4.1 Physical Environment

The prevailing winds through the year are in a north easterly direction and the relative wind speeds are seasonal. In the winter months (October through to April) the average wind speeds range from 3.8m/s to 5.4m/s occurring 60%-70% of the time characterised as 'gentle breezes'. In the summer months (May through to September) the average wind speeds range from 3.8m/s to 4.1m/s occurring 50-60% of the time, which are characterized as 'light breezes'. Based on prediction modelling results, the significant wave height at the LAMDA platform is less than 1m. The highest waves (6.7 m) during the year are from the south despite the predominant wind direction being the north-easterly direction. It is noted that Thassos Island provides shelter from the southerly waves, to a greater extent for the existing platform, and this is reflected in the higher wave heights reported for the new platform location. The tidal ranges at the study site are relatively small.

According to the Geophysical and Geotechnical survey, the bathymetry of the Epsilon/Lamda platform area is characterized by a plateau at the western part, as described above, with water depth ranging from 37 to 41m and a channel (deeper part) at the eastern and northern part of the area. The slope between these two morphological units is low to medium at the southern part and medium at the northern part. The sediment profiles are consistent with very little sub layering up to depths of 30m and the material is silty sand with presence of biogenic fragments. With regards to the sediment quality and based on the surveys "Trace Metal determination and pollution assessment" and "Polycyclic Aromatic Hydrocarbons", the study area shows minor metal (Fe, As, Pb, Cr, Cu, Mn, Ni, Co, Zn) enrichment except cadmium (Cd). Despite this observed anomaly, the quality of the sediments is below baseline metal pollution with the exception of two sites which show increasing pollution levels The conclusion is drawn based on

the average earth crust as reference environment and is considered to be representative of the present situation. The results of the determination of the main PAHs in sediments indicate the non-existence of pollution problems concerning this type of pollutant as the concentrations are below the EU thresholds for Good Environmental Status of marine environment.

With regards to the seawater quality and based on the aforementioned two surveys, all metal and PAHs values were below detection or quantification limit and below the EU thresholds for Good Environmental Status of marine environment. According to the results of the "Monitoring Program of bathing water quality on the coast Greece in accordance to the specification set out in the Directive 2006/7/EC", the quality of bathing waters in the nearest to the project coastal areas for 2014 is characterized “high” and “good”.

Regarding to the air quality, According to the recent annual report 2014 of the onshore and offshore facilities of Energean for 2014, the measurements of the sulphur dioxide (SO_2) and hydrogen sulphide (H_2S) analysers of the Environmental Stations and the results from the 12 air sulfation monitoring stations in the surrounding of area of Kavala and Thasos were all within the permissible limits. The GHG emissions of the offshore facilities during 2014 were 1,684 tn CO_2. With regards to the noise environment, a limitation of 65db is enforced at the border of the facility.

2.4.2 Biotic Environment

Regarding to the plankton and according to the available desk based information, the Aegean Sea, like the rest of the eastern Mediterranean Sea, is an area of low nutrient concentration, plankton biomass and production. The main zooplanktophagus fish in the area is the European anchovy (*Engraulis encrasicolus*) and the main zooplankton groups are Holoplankton (Chaetognaths, Cladocerans, Appendicularians, Copepods, Doliolids, Euphausiids, Medusae, Ostracods, Pteropods, Siphonophores) and Meroplankton (Gastropod larvae, Lamellibranchia larvae).

With regards to the benthic communities and based on the results of the study “Benthic communities in Prinos area”, the benthic communities in the study area are typical of the Mediterranean in the given depths and similar to those described for the area in the past. Moreover, there is an increased number of species and individuals in the area of the installations, which is due to the exclusion of the area of other activities and the resulting protection of the sea bottom. With regards to the marine habitats and according to the field survey of marine ecology, the habitat in the area of proposed and new platforms can be characterized as “Mediterranean communities of muddy detritic bottoms” in accordance to the EUNIS Habitat classification. This habitat type is not characterized as “priority” habitat and is not included in the Annex I of the Habitats Directive 92/43/EEC. Annex I contains the types of habitats whose conservation requires the designation of special areas of conservation and some of them are defined as "priority" habitats (in danger of disappearing). Fish species are typical to the Thracian sea and are not under any protection status.

With regards to the marine mammals and based on the results of the seismic survey, the species

recorded in the project area are Sperm whale, Common bottlenose dolphin, Striped dolphin and Short-beaked common dolphin. Other species likely to be found in the project area according to desk based information are Fin whale, Cuvier's beaked whale, Risso's dolphin, Harbour porpoise and Mediterranean Monk Seal.

The project area is included in the network of Important Bird Areas (IBAs) identified by the BirdLife International i.e. Specifically, the study area is part of the IBA GR 250 "Gulf of Kavala and marine area of Thasos Island". According to the report “Important Areas for Seabirds in Greece, LIFE07 NAT/GR/000285 – Hellenic Ornithological Society (HOS / BirdLife Greece, 2012), this IBA has been designated for its importance for the Mediterranean Shag (Phalacrocorax aristotelis desmarestii) and for the Yelkouan Shearwater (Puffinus yelkouan) which are included in the Annex I of the Directive 2009/147/EC. The species mentioned in Annex I shall be the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution. The importance of the area is further supported by the existence of Natura areas, Ramsar site and National Park in the coastal areas of the Kavala Gulf.

2.4.3 Manmade and Socioeconomic Environment

The primary sector constitutes the main production activity of the RU of Kavala, both in terms of production contribution to the GDP of the REMTH and in terms of the number of persons occupied therein. Agriculture, animal farming, fishing, aquaculture (in sea and fresh water) and beekeeping are developing throughout the area and contribute significantly to its financial figures. Furthermore, tourism (hotels and restaurants) in Kavala and Thasos Island, as part of tertiary sector, contributes significantly to local GDP and employment. It is also noted that the local community of Kavala has received substantial economic benefits over the last seven years through exploitation of the Prinos deposits by Energean and not least the preceding 28 years of oil and gas extraction in the RU of Kavala prior to Energean’s involvement. Over the last seven years Energean has contributed over 40 mil. Euros in Greek government, through the payment of taxes, royalties and VAT, and through the contributions to employee Social Security Funds (healthcare, pension, etc). A percentage of these contributions are retroceded to the Regional Unit (RU) of Kavala. The Company has also contributed more than 90 million euros to the local economy in Kavala through salary payments to staff members; employment of local contractors; procurement of goods through local suppliers; and use of local hotel, conferencing and restaurant facilities.

With regards to the fishing, Kavala Gulf is considered a fishing ground, especially for species such as European anchovy and sardine. One of the largest fish markets of the Mediterranean operates in the city of Kavala, where goods are traded for domestic and international markets. People, directly or indirectly, connected to the fisheries sector are estimated at 2,000 - 2,500. The catch of the Kavala fleet end up in the Kavala Fish Market in order to be auctioned. There, approximately 8,000 to 10,000 tn of fisheries are traded annually, the larger part thereof

comprising small pelagic fishes (sardine and European anchovy). Moreover, various aquacultures operate in the Kavala Gulf.

The density of marine traffic in the Kavala Gulf is high and the number of distinct vessels on a daily basis and count position per square km is more than 140. Safety zones of 500 m surrounding the existing platforms where no unauthorised vessels are permitted are designated, whereas for the existing pipelines a safety zone 200 m is also designated on each side where no anchoring and no trawling is permitted. Kavala Port Authority is the competent Authority for organizing, ensuring, and monitoring the safe navigation terms in the area of the facilities.

With regards to any archaeological findings, the marine area of the Gulf of Kavala is well investigated and there are no signs of archaeological findings that could be of any interests. The shallow waters as well the type of the seabed do not enable the preservation of any possible ruins, through the ages.

2.5 EMERGENCIES AND RISKS TO THE ENVIRONMENT AND PEOPLE – QUANTITATIVE RISK ASSESSMENT (QRA)

This section of the Environmental and Social Impact Assessment (ESIA) describes the Quantitative Risk Assessment (QRA) studies performed to date in order to determine the level of risk (to groups of individuals) associated with the existing and proposed new facilities.

Whilst the current QRA work was undertaken to demonstrate that individual and total facility risk levels have been managed to ALARP as part of Energean's work to prepare a Safety Case for the new and existing facilities (in line with European and Greek legislation) it has also been employed to define a number of oil spill scenarios that have subsequently been modelled deterministically to assess potential environmental impacts.

The purpose of the QRA is to provide a numerical estimate of the level of risk to people, associated with identified and defined Major Accidents. Risk is normally presented as IRPA (Individual Risk Per Annum – the chance each worker has of suffering a fatal accident per year of work) and PLL (Potential Loss of Life: the number of staff that might be killed in a defined period). QRA provides a means to compare the derived risk levels against industry accepted tolerability criteria and also provides a baseline against which potential risk reduction measures can be assessed. For new facilities potential design modifications can be implemented to allow risk levels to be reduced to a level that is demonstrated to be ALARP. For facilities already in operation (such as the Prinos complex which this ESIA also covers), it is clearly more difficult to implement design changes. However risk levels can be reduced, principally by introducing enhancements to the way the facility is operated and/or the response measures to prevent failures from escalating.

The QRA is focused on deriving an estimate of the numerical level of risk associated with the

major accidents. According to article 2 of EU Directive 2013/30 on the Safety of Offshore Oil and Gas Operations (currently being transposed into Member State legislation), Major Accidents are defined as:

a. *an incident involving an explosion, fire, loss of well control, or release of oil, gas or dangerous substances involving, or with a significant potential to cause, fatalities or serious personal injury;*

b. *an incident leading to serious damage to the installation or connected infrastructure involving, or with a significant potential to cause, fatalities or serious personal injury;*

c. *any other incident leading to fatalities or serious injury to five or more persons who are on the offshore installation where the source of danger occurs or who are engaged in an offshore oil and gas operation in connection with the installation or connected infrastructure; or*

d. any major environmental incident resulting from incidents referred to in points (a), (b) and (c).

e. for the purposes of determining whether an incident constitutes a major accident under points (a), (b) or (d), an installation that is normally unattended shall be considered attended.

The Major Accidents for the Prinos QRA were derived based on a review of existing Hazard Identification (HAZID) and risk assessment studies and by review of the processes and activities. The Major Accidents associated with the new SIP facilities are based upon the safety studies performed during the engineering phase.

The Major Accident scenarios considered for the Prinos and Lamda/Omicron QRA can be broadly summarised as follows:

- Release of well fluids, from the wells, during drilling, workover/intervention, production activities. Sources include Alpha, Beta, Lamda, and Omicron platforms. These have the potential to result in fire/explosion/toxic gas effects and/or environmental impact due to oil spillage.
- Release of well fluids, sour gas, sour liquid or sweet gas from the production, export and gas lift subsea pipeline infrastructure. Such releases could result in fire/toxic gas/explosion effects (depending on the location of the release and proximity to platforms). Pipelines containing liquid hydrocarbons have the potential to result in environmental impact.
- Structural failure/collapse, which in addition to the immediate injury/fatality effects, could also result in loss of hydrocarbon containment and hence environmental impacts.
- Ship collision. Impact from attendant or passing vessels have potential to cause immediate injury/fatality effects and also result in loss of hydrocarbon containment
- Loss of control during crew boat operations. A major loss of control (e.g. capsize could result in injury/fatalities. It is noted that personnel logistics activities are conducted by a crew boat, helicopters are not used to support the offshore operations.

It is noted that the Individual Risk Per Annum (IRPA), for the existing facilities resides within the “Tolerable if ALARP” region of the risk management framework.

In addition to the potential impacts on personnel, which as explained above, are the primary focus of the QRA, the major accidents can also affect the environment via the release of quantities of liquid hydrocarbons to sea. The QRA process served to inform a range of credible oil spill cases for which trajectory modelling and impact assessment has been performed.

Oil spill modelling has investigated the potential consequences of significant oil spills associated with:

- A blow out from one of the new wells being drilled on Lamda platform;
- A leak while loading processed crude to an oil tanker.
- A large diameter hole in the main export line that takes crude from Delta to Sigma

The location and size of this latter spill has been determined from an analysis of Major Hazards. The worst case scenario is seen to be damage from a fishing trawler at the point just before the pipeline is buried. This point is at a distance of 7 km from Delta. Beyond this point the oil line is buried and hence safeguarded from external impacts that could lead to a large spill. Corrosion related damage in the buried section would result in small leaks that would be detected immediately during routine inspection activities. As the Gulf of Kavala is flat calm for about 40% of the time (summer and winter) detecting minor sheens is very easy and rapid. Shallow depths allow repairs to be affected with routine diving operations that are on call 24 hrs per day.

The Gulf of Kavala benefits from benign weather conditions that largely mitigate the consequences of significant oil spills. Wind speeds are below a “light breeze” for 35% of the time in December and 49% of the time in June. Hence for most of the year a leak, as modelled, moves very slowly. Strong winds (above “strong breeze”) occur for only 1.25% of the time. All such periods are in the winter months. Average wind speeds in directions that could carry oil to shore are between 2.1 and 4.0 m/s in the winter and 2.4 and 3.4 m/s in the summer. These light onshore winds blow for around 25% of the time. Stronger offshore winds (5 to 7.5 m/s on average) dominate for the rest of the period. Winds to the nearest land fall (the tourist beaches on the islands of Thasos) blow for less than 7% of the time and average 2.2 m/s year round. Energean holds oil spill response equipment which can be mobilised to site in 3 hours maximum due to the near shore location. The calm conditions and low winds make booming and skimming activities very effective.

To keep the number of scenarios to a manageable level the areas of particular sensitivity need to be identified and scenarios that look at how these areas could be impacted defined. In this framework the following locations have been defined:

- The coast between Nea Peramos and Nea Karvali – this coast line contains the historic port of Kavala, a number of tourist beaches (to the west and east of Kavala), the commercial port at Fillipos, small industrial based marine facilities (Fertiliser plant, Sigma water intake and loading buoys, Refined product intake buoys).
- The coast between the Sigma plant and the mouth of the delta of the Nestos river – this coast falls under numerous protection provisions (part of Natura 2000, SPA, National park, Ramsar wetlands, IBA). Moreover, it holds a number of small-scale fish farming enterprises. The impact on this coastline would be most significant from the late spring

through to the end of summer.

- The north and North West coast of the island of Thasos - Thasos is a major tourist destination. Whilst many of the main beaches are on the east and south of the island there are a number of popular tourist locations on the coast immediately adjacent to Energean's offshore facilities (Rachoni, Prinos, Kalarachi etc.).

A deterministic analysis of the potential impacts of worst-case oil spills from the existing and future offshore oil facilities operated by Energean in the Gulf of Kavala has been undertaken. These scenarios modelled a spill of 475 m^3 over a 24 hour period originating from a well blow-out on the planned new Lamda platform, a spill of 410 m^3 over an 8.5 hour period originating due to the impact of a trawling board striking and rupturing the main export line at the point just before the line becomes buried and a spill of 64 m^3 over a 2 minute period due to a failure of the hose connection to a tanker being loaded with crude at the tanker loading point.

Energean has developed structured controls that create "barriers" to both prevent incidents such as these from occurring and if such incidents do occur, preventing them from escalating to a point where significant damage occurs.

2.6 ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

The following table summarises the findings of the detailed ESIA process undertaken in relation to the Energean project and its potential effects on the physical, biotic and human environment. It is noted that no significance or negligible impacts are not included in this table. The potential interactions between project activities and environment and social receptors are subject to either standard recognised best practice mitigation measures or to impact specific. In general the mitigation proposed will be sufficient to reduce the effects of activities to below levels which will cause a significant impact.

Receptor	Activity	Project Rationale	Impact Significance	Mitigation
Construction				
Seabed	Burial of the pipelines and umbilical's	Local change in the morphological characteristics of the seabed.	Minor	It will be investigated the technical feasibility of bundling the three pipelines together so as to minimise the seabed impacted area.
Geological characteristics	Installation of permanent mooring	Smothering of a portion of the seabed, leading to localised decrease in sediment's nutrient content.	Minor	During drilling and with respect to seabed cuttings, conductor of 30" will be used instead of 36" in order to minimize volume of cuttings.
Water environment	Burial of pipelines and umbilical's	Increased turbidity	Minor	It will be investigated the technical feasibility of bundling the three

Receptor	Activity	Project Rationale	Impact Significance	Mitigation
				pipelines together so as to minimise the seabed impacted area.
Benthic species	Installation of permanent mooring Installation of pipelines and umbilical's Burial of pipelines and umbilical's	Disturbance and in some cases relocation of benthic communities due to the increased water turbidity and/or smothering of a portion of seabed	Minor	During drilling and with respect to seabed cuttings, conductor of 30" will be used instead of 36" in order to minimize volume of cuttings It will be investigated the technical feasibility of bundling the three pipelines together so as to minimise the seabed impacted area.
Marine mammals	Operation of support vessels	Noise disturbance and risk of collision. Underwater noise may cause marine animals to alter their behaviour (such as diving, surfacing, vocalizing, feeding, and/or mating), move away from the area of noise, prevent marine animals from hearing important sounds (masking), cause hearing loss (temporary or permanent), or damage tissue.	Moderate	Speed limitation of 20 knots will be defined in all boat movements under the responsibility of Energean. Support vessel will have at least one experienced marine mammal observer (MMO) on-board and will have two if 24 hour operations are expected. The commencement of construction activities will be also advised by the MMO.
Marine mammals	Modifications to Delta (new risers/J tubes)	Noise disturbance	Minor	-
Socioeconomic Environment	Construction/Installation of the new facilities	Employment will increase during the construction phase of the project. Local contractors will be employed to assist in construction activities, thus supporting the local economy	Positive	
Operation				
Seabed	Seabed cuttings (0-400m)	Local change in the morphological characteristics of the seabed.	Minor	-
Water environment	Seabed cuttings (0-400m)	Increased turbidity.	Minor	-
Benthic communities	Maintenance of exclusion zones	The fishing prevention in the exclusion zones will impact positively the	Positive	

Receptor	Activity	Project Rationale	Impact Significance	Mitigation
		benthic community.		
Benthic communities	Seabed cuttings (0-400m)	Disturbance and in some cases relocation of benthic communities due to the increased water turbidity and/or local change in the seabed	Minor	-
Marine mammals	Maintenance of exclusion zones	By maintaining the operation of exclusion zones, fishing activities are prevented within those areas, increasing the fish populations, which in turn are the predominant food supply of marine mammals.	Positive	
Marine mammals	Installation of conductors (new wells) Spudding and drilling of wells, including cementing initial casings	Noise disturbance and risk of collision.	Minor	Conductor driving will not commence if marine mammals detected within 500 m of the activity or until 20 minutes after the last visual detection. Energean will examine the possibility to install conductors with vibropile equipment (lower noise levels.) rather than hammers.
Marine mammals	Operation of support vessels	Noise disturbance and risk of collision	Moderate	Speed limitation of 20 knots will be defined in all boat movements under the responsibility of Energean.
Social infrastructure (waste)	Cuttings treatment and disposal (400 - 3150 m)	Wastes will be managed by Accredited Waste Management Facilities and this may cause negative effect on their capacity for other users	Minor	Energean will audit the waste facility to make sure it has the required capacity before it sends the waste for further management / treatment.
Socioeconomic Environment	Operation of the existing & new facilities	The construction /installation activities will improve the life of the fields, allowing the company to retain the existing employment levels	Positive	
Abandonment phase				
Seabed	Existing platforms: dispersal of seabed cuttings from piles	Local change in the morphological characteristics of the seabed	Minor	-

Receptor	Activity	Project Rationale	Impact Significance	Mitigation
	New platforms: removal of SIPs			
Water environment	Existing platforms: Dispersal of seabed cuttings from piles	Increased turbidity	Minor	Feasibility assessment of trial lifting the cuttings to surface will be executed.
Benthic communities	Existing platforms: dispersal of seabed cuttings from piles New platforms: removal of SIPs	Disturbance to benthic communities on and around them (from direct physical disruption and increased turbidity).	Minor	Feasibility assessment of trial lifting the cuttings to surface will be executed.
Marine mammals	Sever conductors	Noise disturbance and risk of collision.	Moderate	The decommissioning activities will start with the observation of a MMO. Decommissioning will not commence if marine mammals detected within 500m of the activity or until 20 minutes after the last visual detection.
Marine mammals	Operation of support vessels	Noise disturbance and risk of collision	Moderate	Speed limitation of 20 knots will be defined in all boat movements under the responsibility of Energean. Support vessel will have at least one experienced marine mammal observer (MMO) on-board and will have two if 24 hour operations are expected.
Marine mammals	Existing platforms: cut piles	Noise disturbance and harm	Major	Use cold cutting equipment during abandonment rather than explosives for removal of platforms as this method produces low noise levels. Decommissioning will not commence if marine mammals detected within 500m of the activity or until 20 minutes after the last visual detection. Impact will be reassessed and mitigation re-evaluated closer to the time and this is likely to reduce the significance of the impact.
Marine mammals	Existing platforms: remove jacket	Destruction of this man-made habitat	Minor	-

Receptor	Activity	Project Rationale	Impact Significance	Mitigation
	New platforms: removal of SIP	and potentially reduces the quality / abundance of the food supply for marine mammals.		
Socioeconomic environment	All	Following abandonment of all platforms (existing and new), the existing workforce will need to find alternative employment	Minor	
Social infrastructure (waste)	Existing platforms	Wastes will be managed by Accredited Waste Management Facilities and this may cause negative effect on their capacity for other users	Minor	Energean will audit the waste facility to make sure it has the required capacity before it sends the waste for further management / treatment.
Unplanned events *The likelihood of the impact is very low especially the probability to reach the coast is calculated to be $2*10^{-6}$.* ***The impact likelihood was considered for the assessment of the significance.***				
Seabed	Oil spill unplanned event	Elevated concentrations of hydrocarbons may be noticeable in sediments close to the discharge point.	Minor	Facility design and procedures Contingency Plan
Water environment	Oil spill unplanned event	Localized and significant negative effects on the water quality	Minor	Facility design and procedures Contingency Plan
Plankton and fish ecology Marine mammals Avifauna	Oil spill unplanned event	Toxic effects on plankton and fish. An oil spill may affect marine mammals through inhalation, ingestion, and dermal pathways. Each pathway could cause a suite of physiological responses that could compromise health as well as long-term survival and reproduction. Crude oil is toxic to avifauna and may lead severe damage to internal organs and mortality. Additionally, bird contact with oil causes feather	Moderate	Facility design and procedures Contingency Plan

Receptor	Activity	Project Rationale	Impact Significance	Mitigation
		oiling and therefore hypothermia, loss of buoyancy and ability to flight.		
Environmental protected areas	Oil spill unplanned event	Impacts on beaches and environmental protected areas and their objectives	Moderate	Facility design and procedures Contingency Plan
Benthic communities	Oil spill unplanned event	Toxic effects on benthic communities	Minor	Facility design and procedures Contingency Plan
Fishing activities, Tourism and livelihood	Oil spill unplanned event	In case that fish stocks are contaminated, there could be a loss of market confidence as people may be unwilling to buy fish caught in a contaminated area. The oil spill accident would have a long term impact to the wider touristic area of Kavala gulf due to the negative visitors' perception	Moderate	Facility design and procedures Contingency Plan
Marine traffic	Oil spill unplanned event	Shipping longer routes and delays	Minor	Facility design and procedures Contingency Plan
Socioeconomic environment	Oil spill unplanned event	Negative economic impacts on the tourism industry and other livelihoods, fishing activities and shipping	Moderate	Facility design and procedures Contingency Plan
Technical infrastructures	Oil spill unplanned event	Oil spill will be managed by Accredited Management Facilities and may cause negative effect on their capacity for other users	Minor	Facility design and procedures Contingency Plan

2.7 ENVIRONMENTAL & SOCIAL MANAGEMENT AND MONITORING PLAN

The purpose of the Environmental and Social Management & Monitoring Plan (ESMMP) is to:

- Present an overview of the E&S Management System that is being implemented and will accordingly adjusted to continue in the upcoming project phases, to ensure systematic and effective execution of the environmental and social (E&S) commitments relevant to the construction phase of the Project, future operations, potential future developments as well as to the final decommissioning / abandonment phases, presented in the previous paragraph 2.8;
- Provide a summary of the relative role and responsibilities of Energean, the EPC and other contractors throughout the phases.

This document is a “live” document – Energean’s E&S Programme will continue to develop and evolve further in response to the different stages of project development and the outcomes of ongoing stakeholder engagement. This document will be reviewed regularly to ensure the approach to E&S management remains fit-for-purpose and continues to align with relevant good practice.

The ESMMP is supported by the following topic specific Management and Monitoring Plans (MMP).

- Chemical use plan
- Waste management plan
- Stakeholder engagement plan (SEP)
- Chance finds procedure for cultural heritage
- Contingency Plan
- Health, safety and environment (HSE) management plan
- Traffic management plan
- General construction management plan (for your onshore works in pipeline assembly)
- Biodiversity and Wildlife management plan
- Pollution Prevention Management Plan

Energean is responsible for the environmental and social management of the construction and operation activities, to ensure that project commitments are implemented, and conforms to applicable environmental and social legal, regulatory and corporate requirements.

Energean’s current Health, Safety and Environmental (HSE) Management System defines the principles to be followed by all employees and contractors associated with O&G fields exploitation business in Prinos and South Kavala fields and relating facilities and future developments. This system will be adapted to cover the proposed new planned infrastructure / operations.

Energean is committed to the Mitigation Hierarchy (for Health and Safety), and the Mitigation Hierarchy (for Environmental and Social Risks). This hierarchy will be adhered to when devising appropriate mitigation and management strategies and measures.

The 'Energean Force' Rig already used to drill existing wells is managed by a rig management team who has its own independent HSE MS already in place. Alignment of the plans, procedures and reporting requirements of the rig and Energean HSE MS has been achieved through the development of an HSE MS Bridging Document. The document defines clearly how all activities will be managed to ensure compliance with Energean overachieving requirements.

Energean is responsible for the detailed design, procurement, construction and operation of the Prinos Development Project. Energean has appointed design contractors to undertake the detailed design of the project and a drilling contractor to manage the 'Energean Force' Drilling Rig that will drill the wells. In due course, Energean will issue technical invitation to bid documents for the various elements of the construction work scope.

Energean's existing and updated HSE MS will form the framework for managing social and environmental issues throughout construction, prior to the operation of the new facilities.

The aforementioned HSE MS will be used to deliver the Project ESIA commitments and coordinate and review the environmental and social performance of the Project at the construction stage.

Energean will operate the Project facilities using the established HSE MS that will be adjusted as described earlier to cover the construction phase. This will be further adjusted prior to commencement of Project's operations and transition plans will be developed to assist with the movement from the construction to existing HSE MS that will be updated accordingly to fit into the operations the new planned and future development facilities.

The updated HSE-MS will be used to operate the Project facilities in accordance with the ESIA commitments and applicable legal and regulatory standards and Energean's policy.

An outline of the monitoring programmes proposed for the construction and operation phases, is presented in the following tables. Monitoring process will enable Energean to understand how environmental performance will change over time and will facilitate improvements to the environmental and social management system.

Table 2-1: Outline of Monitoring Program during the Construction Phase

Receptor	Monitoring Task	Monitoring Parameter	Timing
Marine environment	Marine ecology inspection	Benthic analysis	Monthly
	Monitoring of marine water quality	Turbidity / Suspended solids Oil and grease	Weekly
	Monitoring of sensitive marine fauna	Presence of marine mammals and birds – visual monitoring	Continuous
	Identification and reporting	Number of leakage events	Continuous

Receptor	Monitoring Task	Monitoring Parameter	Timing
	of leakage events	caused during the construction	
Noise	Noise monitoring at direct interference (within 500 m)	Day and night noise levels	Weekly
Working conditions, health and safety	Health and Safety (H&S) monitoring and audits. H&S Performance evaluation Personal Protected Equipment monitoring	Total recordable incidents, lost time incidents and other H&S indicators. Records verifying the condition of Personal Protected Equipment	Weekly
	Maintain grievance mechanism Analyse workers and community grievance trends Maintaining training records	Grievance mechanism records Training records	Monthly

Table 2-2: Outline of Monitoring Program during the Operation Phase

Receptor	Monitoring Task	Monitoring Parameter	Timing
Marine environment	Monitoring of marine water, seabed morphology, integrity of the pipelines and marine ecology at direct interference (within 500 m)	Physicochemical analysis of seawater and benthos. Analysis of benthic communities Visual inspection via ROV or diving survey	Every 12 months for sample analysis Every 3 years for visual inspection
	Identification and reporting of leakage events	Number of leakage events caused by the activity	Continuous
Air quality	Air emissions monitoring through a Continuous Emissions Monitoring (CEM) System	Temperature Pressure drop H_2S Combustible gases	Continuous Continuous detection monitoring Continuous detection monitoring
Noise	Noise monitoring at direct	Day and night noise levels	Every 6 months for

Receptor	Monitoring Task	Monitoring Parameter	Timing
	interference (within 500 m)		the first two years
Working conditions, health and safety	Inspection of the emergency and detection systems	Maintenance check, services and record verifying the condition of the emergency shutdown, fire detection, H_2S detection, combustible gas detection and fire water systems	According to the manufacturer
	Inspection of the Personal Protected Equipment (PPE) and the safety equipment	Visual inspection and records verifying the condition of the safety equipment (life rafts, life jackets, flares, smoke canisters)	Monthly
	Monitoring of Health and Safety implementation by the workforce		Monthly

Table 2-3: Outline of Monitoring Program during the Decommissioning Phase

Receptor	Monitoring Task	Monitoring Parameter	Timing
Marine environment	Marine ecology inspection	Benthic analysis	Monthly One month after direct interference
	Monitoring of marine water quality	Turbidity / Suspended solids Oil and grease	Weekly One month after direct interference
	Monitoring of sensitive marine fauna	Presence of marine mammals and birds – visual monitoring	Continuous
	Identification and reporting of leakage events	Number of leakage events caused during the construction	Continuous
Noise	Noise monitoring at direct interference (within 500 m)	Day and night noise levels	Weekly
Working conditions, health and safety	Health and Safety (H&S) monitoring and audits. H&S Performance evaluation Personal Protected Equipment monitoring	Total recordable incidents, lost time incidents and other H&S indicators. Records verifying the condition of Personal Protected Equipment	Weekly
	Maintain grievance mechanism Analyse workers and community grievance trends Maintaining training records	Grievance mechanism records Training records	Monthly

3 SUMMARY PROJECT DESCRIPTION

3.1 BASIC ELEMENTS OF THE PROJECT

The ESIA has been prepared to cover all of the existing offshore assets that have been in operation since 1981, the planned extensions as well as potential future extensions that Energean is studying, but has not yet committed to implement as those are described in Chapter 1.3 and its subchapters.

For the sake of clarity the following sub-division of assets and projects has been defined as described below.

- The **existing offshore facilities** that include:
  - ⇨ The Kappa platform located on the sweet, non-associated gas field South Kavala;
  - ⇨ The 12” pipeline that transports sweet gas and condensate from South Kavala to Prinos Delta;
  - ⇨ The 12-slot production jackets Prinos Alpha and Prinos Beta which form part of the bridge linked Prinos complex;
  - ⇨ The Prinos Delta platform that contains all offshore processing facilities and which receives oil, gas, water and condensate produced from Prinos, Prinos North and South Kavala fields. Prinos Delta is bridge linked to Prinos Alpha and Prinos Beta as well as the Prinos flare jacket. New risers will be added to Prinos Delta to allow it to receive fluids from Lamda (and potentially Omicron) and send lift gas and water for injection to Lamda;
  - ⇨ The Prinos flare jacket;
  - ⇨ A 12” dry-gas pipeline connecting Prinos Delta to the onshore facilities;
  - ⇨ An 8” oil pipeline connecting Prinos Delta to the onshore facilities;
  - ⇨ A 5.3” pipeline that transfers seet dry lift gas from the onshore facilities to Prinos Delta;
  - ⇨ Two 10kVa submarine power cables that transport electricity from the onshore facility to Prinos Delta.
- The **planned extension project** (included in the current EBRD funding package) that includes:
  - ⇨ The re-entry of nine (9) existing wells on the Prinos Alpha platform and the sidetracking of these to new bottom-hole locations in the Prinos field. These wells target undrained pools of oil in the A, B and C reservoir units;

- ⇨ The re-entry of one (1) existing Prinos North extended reach well located on the Prinos Alpha platform, with the objective of side tracking it up dip of the existing bottom hole location to allow attic oil reserves to be drained;
- ⇨ The design, fabrication, installation, commissioning and subsequent operation of a new well-head jacket platform (called “Lamda”) approximately 3.5 km’s north west of the existing Prinos platforms. The Lamda platform will host between 5 and 9 wells that will be drilled into and produce from the Epsilon field. This platform has been designed to be normally unmanned. All produced fluids are transported to the Prinos Delta platform where existing equipment is used to separate oil, water and gas;
- ⇨ Three (3) sub-marine pipelines that connect Lamda to Prinos Delta. These comprise one 10” pipeline to carry multi-phase well fluids from Lamda to Delta, and two 6” pipelines to carry injection water and lift gas respectively from Prinos Delta to Epsilon;
- ⇨ Between 5 and 9 new wells to be drilled from the Lamda platform into the Epsilon field. These wells will initially be completed as producers with between 2 to 4 being converted after approximately 18 months to water injectors. The range of well numbers planned reflects the uncertainty in recoverable reserves. The designed platform is equipped with 15 slots.

- The **potential further developments**:
  This would introduce a second new wellhead jacket platform (‘Omicron’), which would be located between the Prinos North and Prinos platforms and used to further develop Prinos North in addition to the Kazaviti discovery. Kazaviti will be appraised by the 3rd planned Prinos Alpha sidetrack (well PA-36), allowing a decision to be made on the viability of this potential project subsequently.

Current and planned oil and gas production are presented earlier in Chapter 1.3.4, to cover all of the above phasings of the project:

- Design capacity;
- Current production (existing facilities);
- Peak planned production following Prinos Alpha sidetracks (P50 forecast);
- Peak planned production following development of Epsilon field; and
- Peak planned production following potential development of Prinos north through Prinos Beta sidetracks and Omicron platform (P50 forecast).

3.2 DEVELOPMENT PHASES

The development phases of the project are governed by the phasing provided in the aforementioned chapters.

These are defined by:

- **Present phase** whereas the current production occurs solely from the existing facilities, Prinos and south Kavala fields;
- **Peak present phase** whereas planned production will be peaking up following Prinos Alpha sidetracks (P50 forecast) (no additional infrastructure to be installed);
- **Peak future planned phase** whereas production following the planned development of Epsilon field, additional to the existing; and
- **Peak planned production phase** following the potential development of Prinos north through Prinos Beta sidetracks and Omicron platform (P50 forecast), additional to the existing and planned as described above.

Apart from those for the better comprehension of the current assessment and to align with both Greek and international standards of environmental assessment and also in line with EBRD's Performance Requirements, the assessment focuses on the cumulative impacts from all operations offshore. Those can be distinguished as follows:

- **Construction phase:** defined by the installation of the new planned and potentially planned facilities, whereas in parallel the current operations on the existing facilities continue to go on;
- **Operation phase:** defined by the operation of all the planned and the potentially planned in the future offshore facilities and
- **Abandonment phase:** defined by the decommissioning activities that will need to take place at the end of the life cycle of the project.

3.3 REQUIRED RAW MATERIAL, RESOURCES AND EXPECTED WASTES

3.3.1 Construction phase

Due to the nature of activities and the short duration of construction, minimal raw material usage will occur during construction. This will consist mainly of the typical materials used for vessel operation (e.g. fuel) and those associated with the presence of a workforce (e.g. water, food).

No significant waste streams are expected in the construction phase. The platform topsides will be fully constructed onshore and hence there will be little need for mechanical operations following platform installation other than the mating of pipelines and risers subsea.

There will be no offshore accommodation in the field and hence no human related waste streams to deal with. Any produced waste (both solid / wastewater) will be managed by the accompanied boats as per their specific waste management plans (MARPOL, Annex IV and V).

3.3.2 Operation phase

3.3.2.1 Raw material

3.3.2.1.1 Chemicals

For the offshore processing that takes place in the Prinos complex and in particular on platform Delta, the following chemicals and their respective annual dosages are presented in the table below:

Table 3-1: Expected dosage rates - Delta

Chemical	Dosage (tn/yr)
Demulsifier	30
Scale inhibitor	4.2
Scale inhibitor	2
Corrosion inhibitor	12
Corrosion inhibitor	15
Antifouling	12
Antifouling	20
Oxygen scavenger	10
Cationic polyelectrolyte	6
Triethylene glycol	6
Hydrate inhibitor (methanol)	0.5
Citric acid	8

The annual consumption (average) rates for planned Lamda platform and potential Omicron platform for the used chemicals are estimated for the time between 2017 and 2034 to be:

- Corrosion inhibitor: 7.4 to 10.0 m^3/annum
- Demulsifier: 1.8 to 2.2 m^3/annum
- Asphaltene inhibitor: peaking at the first years around 9.1 m^3/annum and then decreasing to 1.5 m^3/annum
- Scale inhibitor: 1.4 to 2.0 m^3/annum

3.3.2.2 Resources

The resources used for the operation of the existing offshore facilities, the planned Lamda platform and the potential Omicron platform development are listed below.

3.3.2.2.1 Fresh water

On Delta platform water is used from the network on an average of 10 m^3/d (maximum of 15 m^3/d) and it reaches Delta through the Energean's supply boats.

There is no routine consumption of potable water foreseen on the Lamda platform.

Omicron platform will be equipped with permanent equipment to allow it to wash wells associated with formations that have high formation salinities.

3.3.2.2.2 Fuel

Total natural gas and diesel consumption is currently in the range of 67 tons/month and 79 tons /month respectively.

3.3.2.3 Wastes

The waste (liquid / solid, hazardous / non-hazardous) generation for the operation of the existing offshore facilities, the planned Lamda platform and the potential Omicron platform development are further detailed in the paragraphs below.

3.3.2.3.1 Wastewater generation

Wastewater produced by the offshore facilities consists of the following:

- Produced water removed from the crude oil on existing Delta platform accounting for 1,600 m^3/d on average;
- Produced water removed from condensate on planned Lamda and potential Omicron platforms expected to reach average values of 11,759.6 m^3/annum and 3,570.3 m^3/annum respectively;
- Washing liquids of decks and rain accounting for 0.8 m^3/d on average;
- Washing liquids of wells, vessels and piping accounting for 5,000 to 8,000 m^3 per year or about for 4.1 m^3/d on average;
- Human wastewater accounting for 0.15 m^3/d on average.

3.3.2.3.2 Solid wastes

3.3.2.3.2.1 Hazardous waste

The estimated hazardous waste production, in total from all platforms is:

- Oil-containing drilling muds and wastes (01 05 05*) : 1,000,000 t/yr
- Oil sludges from maintenance operations (05 01 06)* : 60,000 t/yr
- Oily water from oil-water separator (13 05 07*) : 60,000 t/yr
- Absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances (15 02 02*) : 1 t/yr
- Drill cuttings : 4,719 MTs (total)

3.3.2.3.2.2 Non-hazardous waste

The estimated amounts of non-hazardous wastes are:

- Paper and cardboard (20 01 01) : 8,460.80 kg/yr
- Biodegradable kitchen & canteen waste (20 01 08) : 25,404.00 kg/yr
- Plastic (20 01 39) : 2,115.20 kg/yr

- Metals (20 01 40) : 2,115.20 kg/yr
- Mixed municipal wastes (20 03 01) : 4,234.00 kg/yr

3.3.3 Abandonment phase

3.3.3.1 Raw material

Raw material usage will be similar to construction, but with the addition of cement to plug wells and potentially explosives to cut legs for the existing platforms (not the new platforms).

3.3.3.2 Waste

The most significant waste generated in a decommissioning exercise is the marine growth from the jacket structures that it is preferable to be removed with water jets rather than onshore during the scrapping stage. The quantities of the organic matter will need to be estimated when the exact time of the abandonment is known.

Further to that, typical specific waste streams like: scrap metal, batteries, electrical and electronic equipment (WEEE) are expected, however those cannot be determined at this stage in terms of their quantities.

Specifically, with regards to the quantities of scrap metal (that is expected to be the bulk quantity) that will need to be managed will highly depend on the method of decommissioning (i.e. deep water disposal or towing onshore for dismantling).

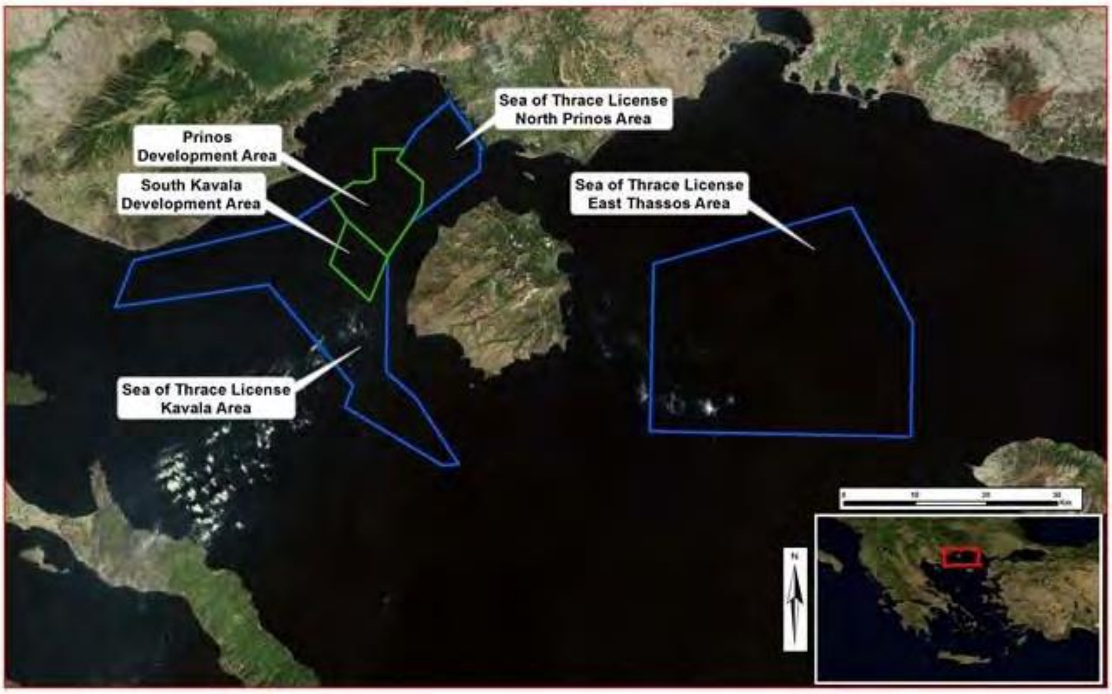
4 OBJECTIVE AND RATIONALE OF PROJECT IMPLEMENTATION

4.1 BACKGROUND

Energean acquired existing oil and gas assets in the Prinos basin, North Aegean Sea, from the Greek authorities in 2007. It already operates, and plans to develop, a number of small oil & gas fields, including:

- Three (3) oil fields (Prinos, Prinos North and Epsilon);
- One (1) gas field (South Kavala);
- Three (3) discoveries (Zeta, Athos and Delta);
- Two (2) prospects (Alfa and Gamma)
- Two (2) leads (Lamda and South Kavala oil upside)

These fields fall within in the Gulf of Kavala. Energean's licence areas are presented in the map below.



Map 4-1: Energean’s licence areas

Associated exploration and production licenses were subsequently extended to allow the company to commence investments.

The company's focus between 2007 and 2013 was quantifying the remaining potential of the mature Prinos field, which represents the largest discovery in the basin, and Greece, to date and determining whether discovered satellite fields could be commercialised. Production decline, which commenced in the mid 80's, was halted by implementation of a sequence of well intervention and work-over activities coupled with the re-start of water injection. A small number of new wells (approximately 1 per year on average) were completed. Drilling efforts focussed on demonstration of upside potential thus allowing new reserves to be booked. Undeveloped primary oil was demonstrated in the deeper/tighter B and C reservoirs of the Prinos field, bypassed oil due to poor sweep in the primary A layers, production recommenced from the Prinos North satellite and the Epsilon field successfully appraised by an ERD well. Work to date has been executed through existing permits granted by the Greek authorities.

In 2007 only 1 mln bbls of reserves were associated with the Prinos area fields. By the end of 2013 Energean had undertaken sufficient activities to increase 2P reserves to approximately 30 mln bbls and 2C Contingent Resources to a similar level. Initial study work to unlock further resources considered unrecoverable (via implementation of additional IOR and EOR techniques) had commenced.

In 2014 Energean commenced activities designed to monetise its booked Reserves. In July 2014 the company acquired a 2nd hand, 2000 HP, tender assisted drilling rig, from KCA-Deutag. This rig was transported to Greece where it was overhauled bringing the barge and rig back into certification. In parallel the company upgraded the Prinos Alpha platform to allow it to accommodate the Drilling Equipment Set (DES) of the rig (the 'Energean Force'). Purchase of an in house drilling resource has allowed the Company to significantly reduce the cost of each required side track and development well. Mature fields like Prinos need continuous infill drilling to maintain production rates. Marginal satellites such as Epsilon require many, cheap wells to ensure commerciality and maximise production rates/reserves. With the Energean Force the Company is equipped with an asset that can drill wells at a cost marginally higher than equivalent onshore wells.

An 8 to 10 well drilling programme commenced on Prinos Alpha mid-2015. This will be completed by early 2017. In parallel with the rig refurbishment project Energean has undertaken conceptual studies to determine the best way of developing the Epsilon field as well as the fields and exploration prospects in the Prinos North area. All potential development options were identified and screened against typical factors (cost, schedule, operability, flexibility, local content and of course safety and environmental risk levels). The selected option, further described below, was taken through FEED during the first half of 2015. The intent of the Company was to develop a design that would work for both initial locations, and potentially at other locations at a later date. This "design one, build many" approach is a well proven technique in the industry. In parallel with FEED, Energean commenced preparation of a detailed EIS for the new platform developments.

After consultation with the Greek authorities the scope of the EIS was expanded to include the existing offshore facilities and platforms in the Prinos basin. The new platforms form an

integrated expansion of the existing infrastructure and hence the authorities required all facilities be covered by a single permit. To grant a permit covering an enlarged portion of the acreage an EIS in line with current European and Greek legislation was requested.

As the onshore facilities are permitted separately the authorities did not require the EIS to cover these. Existing EIS and permits were considered satisfactory, as the planned project does not impact the design intent or operation of these facilities.

Detailed design contracts for the Epsilon development project were awarded in Q3 2015. Quantitative Risk Assessment (QRA) models of the new facilities and pipelines have been developed by the topside/SURF detailed design contractor – ODE. A contract was awarded to ERM to develop a QRA model of the existing facilities including the brownfield tieback scope. This work has allowed major incidents with the potential for environmental harm to be quantified. LDK were contracted to prepare the overall EIS, using input provided by the Company, ODE and ERM.

4.1.1 Prinos field

The Prinos field comprises three main stacked accumulations composed of turbiditic sandstones of Miocene Age. The primary reservoir is approximately 300m thick and is characterized by moderate to good porosity ranging from 12% to 22%, average net to gross ratio (NTG) of about 60%, and permeability up to 440mD. The reservoir has been divided into three main intervals: A, B and C (youngest to oldest). The A reservoir, often subdivided to A1 and A2, contains approximately 82.5% of STOIIP and has produced the majority of the oil to date. B and C reservoirs are underlying the A reservoir and are less developed. The oil from Prinos Field is moderately heavy (27-28° API), under-saturated and sour with a dissolved gas content of 674scf/bbl (120m^3/m^3) and up to 60% mole H_2S in the gas phase and a high wax and asphaltene content. The field was originally over pressurized, the main seal being a basin wide sequence of salts and evaporates up to 1km thick. Seawater has been used for partial pressure support.

The field was developed between 1979 and 1981 with 24 wells, 12 from each drilling platform (Alpha and Beta). Up to 2013, a total of 54 wells have been drilled (including side tracks), 11 of which are currently on production, 3 are injecting seawater and the rest are suspended or abandoned. “Spare” slots will be recovered and used for the planned infill campaign. Further infill drilling, beyond the scope of the current project, will likely require installation of a third drilling platform, bridge-linked to the existing complex.

Crude production commenced in early 1981 at initial rates of 9,000bopd and peaked at about 28,000bopd between 1982 and 1986. Production has since declined and reached an average oil rate of 840bopd (134m^3/d) from 10-12 wells during 2010. Energean increased oil production to above 2,000 bopd by end 2013. Approximately 110MMb of crude oil have been produced from the field.

Prinos field STOIIP has recently been estimated at approximately 290 mmbbls. The average recovery factor to date is therefore 38%.

Although the Prinos Field is relatively mature, there is significant scope for extracting additional value from the area through immediate production optimization, infill drilling, side tracking, recompletions, optimization of existing water flooding and in the medium term implementation of appropriate enhanced oil recovery processes. Although the Prinos field is located offshore its shallow water situation, short distance from the mainland, thick, good quality, compact reservoir structure coupled with favourable tax terms make it an excellent candidate for application of EOR processes.

4.1.2 Epsilon field

The Epsilon discovery is located in the northern part of the Aegean Sea between 2 and 5km northwest of Prinos. Water depth over the field is 35-55m. The Epsilon Oil Field is a fault, dip and stratigraphically closed anticlinal structure, covering an area of approximately 4 km^2. The penetrated reservoir is 70-85 m thick and is characterised by 9% porosity, NTG of 40-90% and permeability (assessed from core) ranging from 1-100mD. The reservoir penetrated to date is the equivalent of the A1 sand in Prinos.

Crude oil from the Epsilon has a light gravity of 36^o API, H_2S of 8-14% and a dissolved gas content of 349scf/bbl (62.1m^3/m^3). Exploration in the Epsilon Area began in the early 1990s.

The Epsilon structure is covered by two partially overlapping 3D seismic surveys, which were acquired in 1993 and 1997. A new basin wide 3D survey has recently been completed and processing of the data has commenced. This new survey will be used to optimise drilling locations for Epsilon wells in 2016. The field was discovered in late 2000 with Epsilon-1 well, which was later successfully sidetracked down-dip along the structure (Epsilon-1As well). Neither well identified an OWC. To date only the equivalent of the Prinos A1 sand has been penetrated. The potential of deeper (A2, B and C) sands has yet to be demonstrated. High gas readings were noted at TD in both exploration wells. Calculated P50 STOIIP in the A1 equivalent sand is some 39mln bbls. Deeper potential could increase this to 59 mln bbls.

Following a period of inactivity, Energean appraised and partially developed Epsilon with an ERD well (EA-H1). This well was completed in 2010 and production commenced at a rate above 2,000bopd. Production declined due to what was thought to be ashphaltene precipitation but a work-over subsequently demonstrated that actually the well had suffered a casing collapse. Attempts to sidetrack the well failed. Some 350,000 bbls were produced from this horizontal appraisal well and the data has been critical in modelling the planned field development wells.

4.1.3 Prinos north area fields

The Prinos North field is located 3km north of Prinos, covering an area of about 1.5km^2. The Prinos North structure was identified as a potential exploration opportunity in 1976, when the Prinos-4 delineation well encountered oil (the Zeta discovery) on the north side of the main fault separating the Prinos and Prinos North structures. This led to the acquisition of 3D seismic in

1993 and the drilling of two Prinos North exploration wells. These identified oil in the main Prinos North field plus the deeper Delta horizon.

Prinos North was appraised and partially developed by an extended reach horizontal well in 1996. PNA-H1 well was produced intermittently until 2004. The well was eventually shut-in due to low rates and high water-cut. A second (up-dip) extended reach horizontal well was drilled in 2009 and has remained in production to date. Total Prinos North production was 3.9 MMb of oil by the end of 2013.

The Prinos North oil field is a three-way fault and dip-closed structure sitting on the northern side of the main Prinos fault, with hydrocarbons in Miocene stacked turbiditic sandstones at depths of between 2,125m and 2,335m TVD SS. Oil is moderately heavy (17-24° API), sour, with a dissolved gas content of 253scf/bbl (45m3/m3), 20-30% H_2S and a high wax and asphaltene content. The field is in contact with a moderately strong, highly saline aquifer. Whilst the aquifer has provided some pressure support, pressures have declined and influx of the highly saline water has caused continuous salt deposition problems in the production tubing leading to significant lost oil and opex spend on routine interventions.

It is planned to drill at least one additional well in the Prinos North field up-dip of the existing horizontal ERD well exploiting remaining reserves in the mapped crest of the field. Current plans are for this new well to be drilled from either the Lamda platform or as a sidetrack of the PN-H3 well on Prinos Alpha.

Energean is currently considering the potential for installing a second new platform between the Prinos and Prinos North fields. This platform, to be called Omicron, would reduce the complexity and cost of Prinos North Development wells, increasing the number that could be justified, and hence the ultimate recovery from this small field. A platform in the location would also allow appraisal wells to be drilled into the Delta and Zeta discoveries and enable other fault blocks in the area to be explored at a low cost. The Zeta discovery will be re-drilled down dip of the initial exploration well from one of the wells included in the Prinos Alpha campaign. A positive result would increase the likelihood of a second platform being installed. This further expansion is fully covered by this ESIA and the associated environmental permit.

4.2 OBJECTIVES & RATIONALE

Energean's development plans are based upon the following strategy for fully exploiting the hydrocarbon resources in the Prinos basin. The objective of the company is to maximise production from the discovered fields whilst progressively exploring the basin's remaining potential. Existing fields, once successfully appraised, plus new discoveries would be gradually tied back to the Prinos complex via the satellite facilities covered by this ESIA. By fully exploring and developing the resources of the Prinos basin the Company will extend the duration of its operation and hence secure employment in this industry for the people of Kavala and Thasos.

Energean's strategy can be summarised as:

- Develop an internal drilling capability (tender assisted drilling rig) to allow well costs to be significantly reduced and to maximize the use of existing work-over rig staff – this has been achieved following the mid-2015 start-up of the Energean Force;
- Use the new drilling rig ('Energean Force') to significantly increase the number of infill wells drilled into the Prinos field. Primary drilling targets will be:
  - ⇨ Poorer quality reservoir layers where bypassed oil has been identified in recent infill wells;
  - ⇨ Field extension areas identified from improvements in 3D seismic (reprocessing, new seismic, VSP's).
- Gather subsurface data whilst drilling these Prinos infill wells to identify opportunities to further promote contingent, prospective and unrecoverable resources sequentially to reserves, namely:
  - ⇨ Assess the potential of the deeper D sand known to be hydrocarbon bearing over parts of the field;
  - ⇨ Re-penetrate the Zeta discovery, gather a new data set (including core) and undertake long term production test – should mobile oil be discovered – to allow a plan to commercialise this 20+ mln bbl STOIIP discovery
  - ⇨ Gather new core and log data to allow EOR studies to be further progressed and hence promote unrecoverable hydrocarbons to contingent resources. Focus of EOR studies is on low-salinity injection, surfactant floods, miscible gas injection (with CO_2 and/or H_2S) and miscible WAG.
- Fully develop, appraised, and partly developed near field satellite discoveries by installation of simple wellhead platforms connected to the main Prinos complex via multiphase production, gas lift and water injection pipelines and utility umbilical cables. Key features:
  - ⇨ Minimise the number of complex ERD wells by shifting to simpler, satellite-platform wells to reduce drilling risk and costs and hence allow more wells to be drilled per development. Increase recovery factors compared with earlier development concepts;
  - ⇨ Employ platform and pipeline fabrication and installation concepts and technologies that allow maximum use of internal resources, maximizes spend in Greece whilst minimizing overall costs, shortening schedules and reducing overall installation risks.
- Obtain a new basin-wide 3D seismic data set to allow un-appraised discoveries to be better mapped, validate/de-risk existing leads and prospects and generate new leads and prospects with a greater focus on stratigraphic rather than structural plays as well as deeper basin potential
- Justify and execute a new exploration/appraisal campaign to fully quantify the basin potential and mature a sequence of development projects that will maintain production

at a new plateau level.

4.3 FINANCIAL DATA

4.3.1 Approximate budget for project implementation

The following table summarises the point forward CAPEX of the projected Prinos area development project:

Table 4-1: Prinos area development project cost estimate

Category	Description	Cost ($mln)
Wells[3]	Prinos infill wells (9 sidetracks)	70.8
	Prinos North up dip well (1 sidetrack)	8.2
	Epsilon development wells (7 new drill)	56.4
	Omicron development wells (6 new drill)	48.3
	Data gathering for IOR/EOR studies	3.2
Facilities	Prinos Delta modifications	3.3
	Lamda topsides	12.6
	Lamda substructure	8.5
	Lamda installation	4.8
	Omicron topsides	12.6
	Omicron substructure	8.5
	Omicron installation	4.8
Subsea	Lamda Pipelines and umbilical cables	7.2
	Lamda SURF Installation	2.7
	Omicron Pipelines and umbilical cables	5.7
	Omicron SURF Installation	2.7
Overheads	Design	7.1
	Project Management	5.2
	Others	4.7
Total		**277.4**

4.3.2 Financing method of the development and operation of the

[3] Wells cost exclude all variable costs related to spread, rig maintenance and staff and only include tangible and intangible costs

project

The project will be funded by a mixture of existing shareholder equity, cash flow from revenues and new debt. Initial Prinos infill drilling and detailed design work associated with the Epsilon development project is funded from existing shareholder funds. Later Prinos infill drilling will be funded by cash flow from increased oil and gas production. Fabrication, construction and installation of Lamda platform and associated pipelines and umbilical will be funded by debt. Epsilon development wells will be funded partly by dept and partly from cash flow. The European Bank for Reconstruction and Development is considering proving finance to the Project

4.4 CORRELATION OF THE PROJECT WITH OTHER PROJECTS

The only facility directly linked in terms of the offshore facilities operations, is the onshore plant facilities so-called Sigma. Apart from this, the project is not directly or indirectly linked or related to other projects in the wider area of study.

However, in the Kavala gulf there are a number of activities such as:

- Kavala ports (‘Philippos II’ commercial port and ‘Apostolos Pavlos’ passenger port)
- Keramoti passenger port
- Hellenic Fertilizers (ELFE), originally founded in 1961 (as Phosphoric Fertilizers Industry SA (PFI) and started operation at Nea Karvali since 1965. Facilities include:
  - ⇨ Ammonia production unit;
  - ⇨ Production unit of nitric acid and nitric fertilizers;
  - ⇨ Sulphuric acid production unit;
  - ⇨ Phosphoric acid production unit;
  - ⇨ Compound fertilizer production unit
- Wastewater treatment plants (WWTPs)
  - ⇨ Kavala WWTP (GR115001016) with sea outfall
  - ⇨ Palaio Tsifliki WWTP (GR 11500101117) with sea outfall
  - ⇨ Philippoi WWTP (GR 1150100118) with stream discharge
  - ⇨ Nea Peramos WWTP (GR 1150030115) with stream discharge
  - ⇨ Chryssoupoli WWTP (GR 115011018) with stream discharge
  - ⇨ Limenas Thasou WWTP (GR 1150040116) with sea outfall

The aforementioned projects are neither directly nor indirectly linked with Energean’s facilities, however, they operate within the project broader area of study and therefore they are considered as potential contributors to overall environmental pressures in the Gulf. Therefore those are essential to be referred and assessed as such.

5 PROJECT COMPATIBILITY WITH THE ESTABLISHED INSTITUTIONAL PROVISIONS OF THE AREA

5.1 CONCESSION AGREEMENT

The project is governed under a concession agreement with the operator (currently Energean) that has been initially signed with the Greek State and then ratified accordingly. Following this initial agreement a number of amendments has been made, that are presented in the table below.

Table 5-1: Legal acts governing the concession agreement

Legal act	Reference number	Subject
Law 98/1975	GG 161/1.8.1975	Ratification of the concession agreement of 14th June 1975, between the Greek State and Oceanic Exploration Co of Greece, Hellenic Oil Company Inc, Wintershall Aktiengellschaft, White Shield Greece Oil Corporation, for exploration and exploitation of hydrocarbons in the marine area of Thracian Sea.
Law 539/1977	GG 39/11.2.1977	Ratification of the concession agreement of 27th September 1977 between the Greek State and Denison Mines Limited, Hellenic Oil Company Inc, Wintershall Aktiengellschaft, White Shield Greece Oil Corporation.
Law 1769/1988	GG 66/7.4.1988	Ratification of the amended concession agreement of 9th December 1987 between the Greek State and Denison Mines Limited, Hellenic Oil Company Inc, White Shield Greece Oil Corporation, Wintershall Hellas S.A. Oil and Public Corporation for Oil – Exploration and Exploitation of Hydrocarbons S.A. and the annexes 1, 2, 3 and 4 and adjustments abut hydrocarbon issues.

Legal act	Reference number	Subject
Law 2159/1993	GG 116/9.7.1993	Ratification of the second amended concession agreement of 23rd February 1993 between the Greek State and Denison Mines Limited, Hellenic Overseas (Holdings) Ltd, White Shield Greece Oil Corporation, Wintershall Aktiengellschaft, Wintershall Hellas S.A. Oil and Public Corporation for Oil – Exploration and Exploitation of Hydrocarbons S.A. and annex 1.
Law 2779/1999	GG 296/30.12.1999	Ratification of: a) The 16.11.1999 agreement between the Greek State and the awarded consortium f L.98/1975 as in power today; b) The 23.11.1999 agreement between the Greek State and Kavala Oil S.A. and the annexes I and II.
Law 4135/2013	GG 69/19.3.2013	Ratification of the first amendment of the concession agreement of 31.10.2012 between the Greek State and the awarded companies Kavala Oil S.A. and Energean Oil & Gas S.A. and annexes I and II.
Law 4296/2013	GG 214/2.10.2014	Ratification of the concession agreement of 30.12.2013 between the Greek State and the companies Kavala Oil S.A. and Energean Oil & Gas S.A. as well as the 3rd contractual party company Hellenic Petroleum S.A. which amends the 23.11.1999 agreement for the exploitation of the offshore area of Thracian Sea between the Greek State and Kavala Oil S.A., which was ratified with L.2779/1999 (A’296).

5.2 LEGISLATIVE FRAMEWORK

5.2.1 Main legislative framework for the environment

5.2.1.1 Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (EIA Directive)

Environmental Impact Assessment (EIA) was introduced for the first time in Europe in 1985 by the EIA Directive (85/337/EEC) and represents the first key instrument in European Union's environmental policy that puts into force the obligation to account the environmental parameter / impact of projects / activities at the stage of implementation of decisions. Some of notable features include:

- The range of projects and activities, ranging from industrial and other productive activities to infrastructure projects such as roads, dams, ports mainly in the form of public investment;
- The requirement to prior (ex ante) impact assessment so that environmental issues can be fully incorporated in the design, implementation and operation;
- Opening up the process to the public which asked to be informed and to participate in decision-making;
- And finally, the requirement for detailed and comprehensive information on the impact on the environment, i.e. environmental impact study.

Twelve years later, and following a whole new service industry on the environmental impact assessment sector and drawing conclusions from the hitherto implemented, the EIA Directive was amended by 97/11/EC in order to:

- Be in line with the Espoo Convention on the assessment of transboundary impacts on the environment;
- Extend the EIA to more types of projects and activities;
- Improving and expanding the criteria against which a project is subject to fall within the obligations of an EIA.

EIA Directive has been further amended twice through Directive 2003/35/EC (harmonized public participation process with provisions of Aarchus Convention) and Directive 2009/31/EC (prescription for CO_2 transport and storage projects). This was eventually codified by Directive 2011/92/EU of 13 December 2011.

The most recent update of the EIA Directive (2014/52/EU) entered into force on 15 May 2014 to simplify the rules for assessing the potential effects of projects on the environment. The member states (MS) need to have finalised the transposition into their legislative frameworks until 16 May 2017.

The update is in line with the drive for smarter regulation, so it reduces the administrative burden. It also improves the level of environmental protection, with a view to making business decisions on public and private investments more sound, more predictable and sustainable in the longer term.

The new approach pays greater attention to threats and challenges that have emerged since the original rules came into force some 25 years ago. This means more attention to areas like resource efficiency, climate change and disaster prevention, which are now better reflected in the assessment process. The main amendments are as follows:

- Member States now have a mandate to simplify their different environmental assessment procedures.

- Timeframes are introduced for the different stages of environmental assessments: screening decisions should be taken within 90 days (although extensions are possible) and public consultations should last at least 30 days. Members States also need to ensure that final decisions are taken within a "reasonable period of time".
- The screening procedure, determining whether an EIA is required, is simplified. Decisions must be duly motivated in the light of the updated screening criteria.
- EIA reports are to be made more understandable for the public, especially as regards assessments of the current state of the environment and alternatives to the proposal in question.
- The quality and the content of the reports will be improved. Competent authorities will also need to prove their objectivity to avoid conflicts of interest.
- The grounds for development consent decisions must be clear and more transparent for the public. Member States may also set timeframes for the validity of any reasoned conclusions or opinions issued as part of the EIA procedure.

If projects do entail significant adverse effects on the environment, developers will be obliged to do the necessary to avoid, prevent or reduce such effects. These projects will need to be monitored using procedures determined by the Member States. Existing monitoring arrangements may be used to avoid duplication of monitoring and unnecessary costs.

According to Article 1 of the Directive, it shall apply to the assessment of the environmental effects of those public and private projects, which are likely to have significant effects on the environment. The EIA Directive applies to a wide range of public and private projects, which are defined in Annexes I and II. Projects included in Annex I are considered as having significant effects on the environment and require an EIA. For projects listed in Annex II the national authorities have to decide whether an EIA is needed through a screening procedure.

Although specific procedures may vary significantly among different Member States, the principal phases of the EIA Process are common to the European Community. Figure below, presents a flow chart of the EIA process phases, distinguishing the compulsory phases (highlighted in yellow) from the optional EIA procedures (not highlighted).

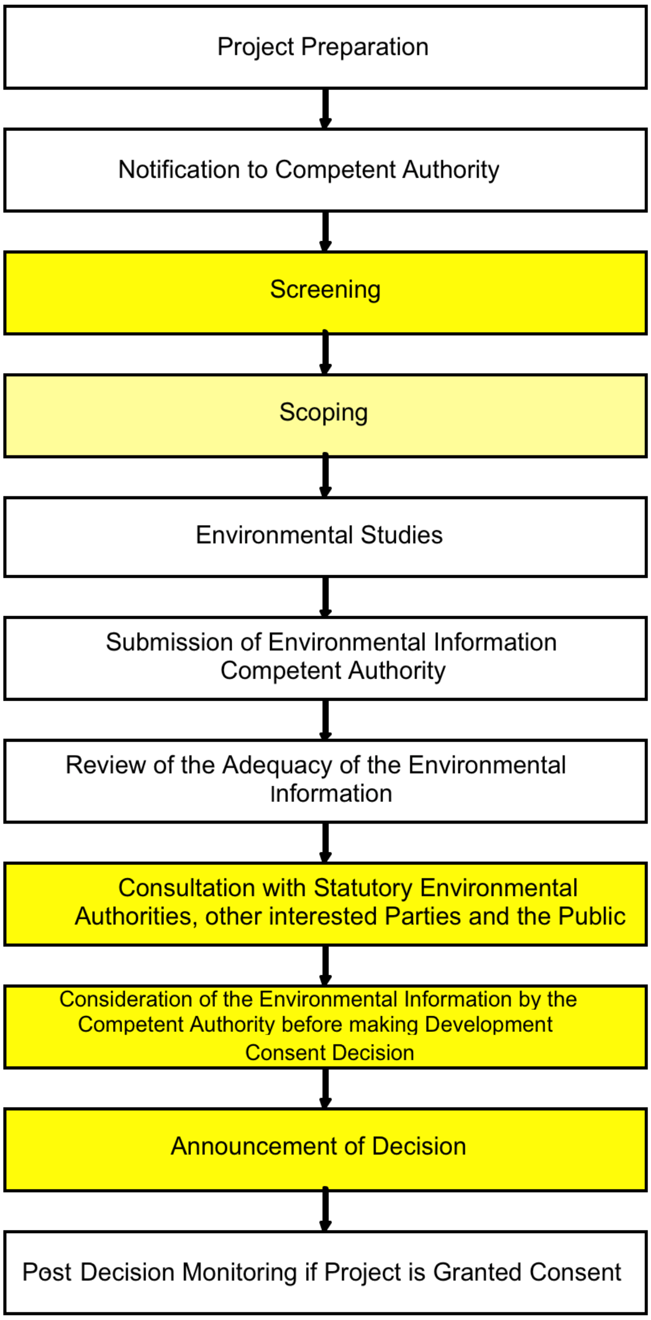


Figure 5-1: Flow chart of EIA process as per EU Directive

Concerning oil and gas extraction, the EIA Directive provides that the conduct of an EIA is mandatory for the ‘extraction of petroleum and natural gas for commercial purposes where the amount extracted exceeds 500 tn/d in the case of petroleum and 500,000 m^3/d in the case of gas’ (Annex I (14) EIA Directive) and ‘pipelines with a diameter of more than 800mm and a length of more than 40km for the transport of gas and oil’ (Annex I (16)). In addition, Annex I makes EIA mandatory for ‘any change to or extension of projects listed in this Annex where such a change or extension in itself meets the thresholds, if any, set out in this Annex’ (Annex I (24)). It is subject to discussion whether all oil and gas activities below the threshold are covered by

Annex II (2)(d) which would mean that, in accordance with Article 4, the Member State determines whether the activity is subject to EIA (screening).

The offshore oil and gas sector has to comply with the provisions of the EIA Directive when the amounts of oil and gas extracted exceed those specified in Annex I of the EIA Directive. The proposed Project in its current production rates (3,000 bbls/d equivalent to about 355 MT), does not trigger Annex I of the Directive. However due to the increase in production from the new investment programme as well as its design capacities, which both exceed the aforementioned thresholds, the Project is required to undergo an ESIA as per Annex I of the Directive including disclosure thereof and approval by the relevant environmental authorities. The Offshore Directive also incorporates operators' obligation to consider environmental impacts: it explicitly states that one of the conditions for operating offshore installations is the submission of a Major Hazard Report which shall contain, amongst others, 'a description of the aspects of the environment likely to be significantly affected, an assessment of the identified potential environmental effects, in particular releases of pollutants to the environment, and a description of the technical and non- technical measures envisaged to prevent, reduce or offset them, including monitoring'.

5.2.1.2 National legislation, based on L1650/1985

Greek legislative framework was enriched with the first attempt to protect the environment in 1986. L.1650/1986 was approximating the first EIA Directive by also regulating a number of environmental matters, which were quite radical for the time. The approximation was quite detailed and the matters that were allowed to the country member states certain degree of flexibility, the above law was leaning to the stricter rendering.

The Directive amendments led to the national legislation amendments introduced by L.3010/2002. Main changes introduced included the compliance with new Directive, decentralization and the introduction of the screening process.

More recently the legal framework was reformed through L.4014/2011. This was accompanied by a number of JMDs, MDs and Circulars aiming together with the main law to improve the overall output and increase the added value of the procedures.

The overall impact assessment – permitting framework in the Greek legislation is governed by the following (including ratifications of the aforementioned conventions as applicable) and is presented in paragraph 5.2.4.

The procedure for the Environmental Impact Assessment in Greece, for projects like the proposed one, can be summarised in the following phases (according to the existing legislation):

- Environmental Impact (and Social) Assessment: the applicant shall provide an E(S)IA of the project to the Ministry of Environment and Energy (YPEN), Directorate of Environmental Permitting (DIPA)[4];

[4] The content of the E(S)IA is prescribed by (a) the project classification (as per MD 1958/2012) and (b) the analytical specifications as set out in the JMD 170225/2014 for each type of project / activity.

- Check for Completeness: DIPA/YPEN will check the E(S)IA for completeness and may request additional information, prior to distributing for consultation;
- Statutory Consultation: opinion/response from the Central Authorities or other co-competent Ministries, Regional Authorities and various organizations[5];
- Public Consultation: the project is presented to the Regional Council during an open hearing where people can express their views
- Decision on Approval of Environmental Conditions: DIPA/YPEN will consider the results of the consultation (statutory and public) and will issue its decision, co-signed by other competent Ministries
- Publication of Decision: publication of the decision through the relative Regional Council.

The main changes that have been introduced from 2011 up to date can be summarized below:

- Preliminary EIA (PEIA) is no longer foreseen to be in the Environmental Permitting Process.
- Instead of the PEIA the new framework introduces the optional Procedure for Preliminary Identification of Environmental Requirements (PIER) – however only if the project proponent requests it. In European and international EIA practice terms, this new optional step could be classified as"Scoping“.
- ESIAs will be evaluated by a new body of Independent Auditors (this has not been applied up to date).
- New procedures for Stakeholder involvement and participation of the Public, prescribed by JMD 1649/45/2014. In this context, all environmental information of the Project will be uploaded to the internet (this has not been applied up to date).
- New procedures for Renewal and Modifications of the Approval of Environmental Terms are defined.
- In case of modifications in the Technical Design of the Project after the issue of the Approval of Environmental Terms, the Owner has to submit a Dossier of Final Design Compliance and in some cases a Technical Environmental Study.
- Appropriate Assessment is mandatory for Natura Area Crossing, as part of ESIA through Special Ecological Study (analytical specifications are provided in JMD 170225/2014).
- Wastewater Treatment and Disposal Permit and Hazardous and Non-Hazardous Waste Management Permits will be part of the Approval of Environmental Terms and relevant Studies as part of the ESIA.

In particular, JMD 1649/45/2014, which sets out and specifies the foreseen in article 19, paragraph 19 of L.4014/2011 provisions for:

- The consultation means between the different authorities and
- The ways of informing the public as well as its participation in the public consultation during the environmental permitting procedure.

The aforementioned JMD specifies further the consultation following the implementation of article 18, paragraph 5 of L.4014/2011 regarding the digital environmental registry. However,

[5] The consultees are predefined by the JMD 1649/45/2014 for each project type and category.

since a transition period is expected until the setup of this registry, the procedures have also been specified for this period. Apart from this, the authorities to be consulted are also identified and stated in Annex B of the JMD.

Overall the procedure is in line with the consultation and dissemination guidelines of the Directive. However, the EBRD standards (PR10) go beyond in terms of the consultation provisions mentioned above in the following ways:

- EBRD's PR 10 requires the stakeholder consultation to take place at the early phases of ESIA development and in particular during scoping, a stage which is not mandatory as per the Greek legislative framework.
- PR 10 requires disclosure of the ESIA to ensure meaningful consultation and disclosure of project information and to allow stakeholders to provide inputs and raise concerns. Consultation and information disclosure should not cease at ESIA disclosure but continue for the life of the Project. Similarly stakeholders should be able to engage with the Project during the life of the project.
- PR10 also requires analytical stakeholder mapping through the stakeholder engagement plan (SEP), which should include a number of interested and affected parties, including the public and vulnerable groups, and not just authorities.
- L.4014/2011 and JMD 1649/45/2014, define the consultation and dissemination procedures to be initiated following the ESIA submission to the Competent Authority, which regulates the whole process instead of the project owner being responsible to do so. PR 10 requires the Project owner to take a lead role in ensuring adequate stakeholder engagement and information disclosure takes place.
- The public has the ability to comment on the ESIA document only during the public hearing that is set out by the regional authority. The EBRD's public information policy requires the ESIA to be disclosed for a minimum of 60 days before the project can be presented to the EBRD's Board of Directors for an investment decision. The ESIA should remain in the public domain for the life of the Project (e.g. online),

The overall procedure of the ESIA permitting as per the Greek legislative framework currently in power is further outlined in the figure below.

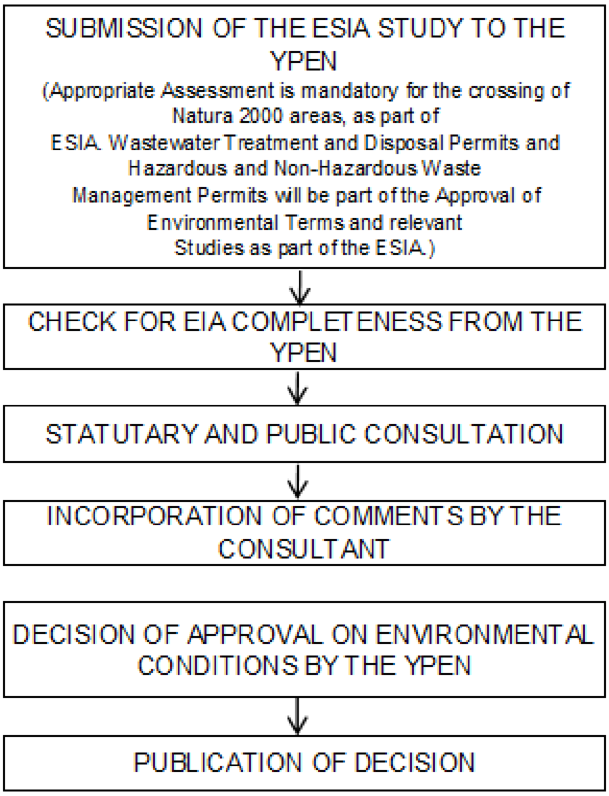


Figure 5-2: Flow chart of EIA process as per National legislative framework

In the case of a requirement to amend an already approved environmental permit, the process requires a new ESIA, in case the project interventions are considered significant and therefore are likely to have a significant effect to the environment.

5.2.1.3 Water framework directive (WFD), 2000/60/EU

The Water Framework Directive (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) is a EU Directive, which commits member states to achieve good qualitative and quantitative status of all water bodies **(including marine waters up to one nautical mile from shore)** by 2015. It is a framework in the sense that it prescribes steps to reach the common goal rather than adopting the more traditional limit value approach.

The Directive aims for 'good status' for all ground and surface waters (rivers, lakes, transitional waters, and coastal waters) in the EU.

The ecological and chemical statuses of surface waters are assessed according to the following criteria:

- Biological quality (fish, benthic invertebrates, aquatic flora)
- Hydromorphological quality such as river bank structure, river continuity or substrate of the river bed
- Physical-chemical quality such as temperature, oxygenation and nutrient conditions

- Chemical quality that refers to environmental quality standards for river basin specific pollutants. These standards specify maximum concentrations for specific water pollutants. If even one such concentration is exceeded, the water body will not be classed as having a “good ecological status”.

The Water Framework Directive stipulates that groundwater must achieve “good quantitative status” and “good chemical status” (i.e. not polluted) by 2015. Groundwater bodies are classified as either "good" or "poor".

Due to distance of the offshore facilities from the shore, the majority of the complex (existing – new facilities) does not fall within the provisions of the WFD. The only ones that do fall are the pipelines reaching on shore.

5.2.1.4 Marine strategy framework directive (MSFD), 2008/56/EC

The Marine Directive (Directive 2008/56/EC) was adopted on 17 June 2008, after several years of preparation and extensive consultation of all the relevant actors and the public, and came into force on 15 June 2008.

The Marine Directive aims to achieve Good Environmental Status (GES) of the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. It is the first EU legislative instrument related to the protection of marine biodiversity, as it contains the explicit regulatory objective that "biodiversity is maintained by 2020", as the cornerstone for achieving GES.

The Directive enshrines in a legislative framework the ecosystem approach to the management of human activities having an impact on the marine environment, integrating the concepts of environmental protection and sustainable use.

In order to achieve its goal, the Directive establishes European marine regions and sub-regions on the basis of geographical and environmental criteria. The Directive lists four European marine regions – the Baltic Sea, the North-east Atlantic Ocean, the Mediterranean Sea and the Black Sea – located within the geographical boundaries of the existing regional sea conventions. Cooperation between the Member States of one marine region and with neighbouring countries, which share the same marine waters, is already taking place through these Regional Sea Conventions.

5.2.1.5 Directive 2008/98/EC on waste and repealing certain Directives (Waste Framework Directive)

The Waste Framework Directive provides the overarching legislative framework for the collection, transport, recovery and disposal of waste. Waste is defined as ‘any substance or object which the holder discards or intends or is required to discard, while ‘treatment of waste’ is defined as ‘recovery or disposal operations, including preparation prior to recovery or disposal. According to the Waste Framework Directive, a distinction should be made between:

- The preliminary storage of waste pending its collection;

- The collection of waste; and
- The storage of waste pending treatment.

Moreover, 'establishments or undertakings that produce waste in the course of their activities should not be regarded as engaged in waste management and subject to authorisation for the storage of their waste pending its collection'. This implies that offshore installations only need to obtain a permit if they treat waste (sewage, garbage) themselves.

Further distinction between collection and treatment notes that 'preliminary storage of waste within the definition of collection is understood as a storage activity pending its collection in facilities where waste is unloaded in order to permit its preparation for further transport for recovery or disposal elsewhere. The distinction between preliminary storage of waste pending collection and the storage of waste pending treatment should be made, in view of the objective of this Directive, according to the type of waste, the size and time period of storage and the objective of the collection. The storage of waste prior to recovery for a period of three years or longer and the storage of waste prior to disposal for a period of one year or longer is subject to Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste'.

Note that Article 2(2)(d) of the Waste Framework Directive provides that, to the extent covered by other EU legislation, 'waste resulting from prospecting, extraction, treatment and storage of mineral resources and the working of quarries covered by Directive 2006/21/EC' is excluded from its scope. Nonetheless, according to Article 2(2)(b) of Directive 2006/21/EC on the management of waste from extractive industries (and amending Directive 2004/35/EC) 'waste resulting from the offshore prospecting, extraction and treatment of mineral resources' (italics added) are excluded from its scope. Consequently, since waste produced on offshore installations (and brought onshore) are not covered by the more specific Directive concerning waste from extractive industries, operators of offshore oil and gas installations would have to comply with the requirements of the more general Waste Framework Directive. This would mean that the 'original waste producer or other holder' (in practice: the operator) would be obliged to carry out the treatment of waste himself or have the treatment handled by a dealer or establishment or undertaking which carries out waste treatment operations arranged by a private or public waste collector in accordance with Articles 4 and 13 (Article 15(1)).

5.2.1.6 Council directive 96/82/EC on the control of major-hazards involving dangerous substances (SEVESO II Directive)

The Seveso II Directive requires EU Member States to identify high-risk industrial sites, take appropriate measures to prevent major accidents involving dangerous substances and limit their consequences for man and the environment. However, Article 4(f) stipulates that the Directive does not apply to 'the offshore exploration and exploitation of minerals, including hydrocarbons' and therefore, the analysis does not cover this Directive.

5.2.2 Main legislative framework for the prevention of marine pollution

5.2.2.1 Directive for the safety of offshore oil and gas facilities (2013/30/EC)

Following the Deepwater Horizon incident in the Gulf of Mexico in April 2010, the European Commission (EC) expressed its initial views on the safety of offshore oil and gas operations in its communication 'Facing the challenge of the safety of offshore oil and gas activities' (published on 13 October 2010). The EC communication concluded that the existing divergent and fragmented regulatory framework applying to the safety of offshore oil and gas operations in Europe, along with current industry safety practices did not provide adequate assurance that risks from offshore accidents were minimised throughout the Union.

On the 28th June 2013, the EC published the Offshore Directive. The objective of this Directive is to reduce as far as possible the occurrence of major accidents related to offshore oil and gas operations and to limit their consequences.

Under the 2013/30/EC Directive, the EU has put in place a set of rules to help prevent accidents, as well as respond promptly and efficiency should one occur:

- Before exploration or production begins, companies must prepare a report on major hazard (RoMH) for their offshore installation. This report must contain a risk assessment and an emergency response plan
- Companies must keep resources at hand in order to put them into operation when necessary
- When granting licenses, EU countries must ensure that companies are well financed and have the necessary technical expertise
- Technical solutions, which are critical for the safety of operators' installations, must be independently verified. This must be done prior to the installation going into operation
- National authorities must verify safety provisions, environmental protection measures, and the emergency preparedness of rigs and platforms. If companies do not respect the minimum standards, EU countries can impose sanctions, including halting production
- Information on how companies and EU countries keep installations safe must be made available for citizens
- Companies will be fully liable for environmental damages caused to marine species and natural habitats under protection status. For damage to marine habitats, the geographical zone will cover all EU marine waters including exclusive economic zones and continental shelves.

To further promote offshore safety, the European Commission works with its international partners on the implementation of the highest safety standards worldwide. The offshore inspectors of EU countries also work together through the European Union Offshore Oil and Gas Authorities Group (EUOAG) to share best practices and improve standards.

5.2.2.2 Barcelona convention

In 1975, 16 Mediterranean countries and the European Community adopted the Mediterranean Action Plan (MAP), the first-ever Regional Seas Programme under UNEP's umbrella.

In 1995, the Action Plan for the Protection of the Marine Environment and the Sustainable Development of the Coastal Areas of the Mediterranean (MAP Phase II) was adopted by the Contracting Parties to replace the Mediterranean Action Plan of 1975.

The Convention's main objectives are:

- To assess and control marine pollution;
- To ensure sustainable management of natural marine and coastal resources;
- To integrate the environment in social and economic development;
- To protect the marine environment and coastal zones through prevention and reduction of pollution, and as far as possible, elimination of pollution, whether land or sea-based;
- To protect the natural and cultural heritage;
- To strengthen solidarity among Mediterranean coastal States;
- To contribute to improvement of the quality of life

The Barcelona Convention has given rise to seven Protocols addressing specific aspects of Mediterranean environmental conservation. These are:

- Dumping protocol
- Prevention and Emergency protocol
- Land based sources (LBS) protocol
- SPA and biodiversity protocol
- Offshore protocol
- Hazardous waste protocol
- ICZM protocol

Prevention of and response to environmental damage from offshore exploration and exploitation activities is an issue to which the EU attaches a lot of importance, as demonstrated by a number of policy documents, including the proposal for a regulation for safety of oil and gas offshore activities, currently under discussion in the EU institutions. On 17 December 2012 the Council approved EU accession to the Offshore Protocol, thus underlining EU commitment to reducing environmental impacts of offshore activities in the Mediterranean through efficient regional cooperation. The legal consequence of this is that the Offshore Protocol now becomes part of EU legislation.

5.2.2.3 Comparative analysis between the offshore protocol (Barcelona Convention) and EU Directive on safety of offshore oil and gas facilities (2013/30/EC)

Even at the early stages of the preparation of the Directive 2013/30/EC, it was identified that those two statutory documents would both need to be implemented by offshore facilities within the territorial waters of EU Member States (MS). Therefore it has been deemed necessary that

a comparative analysis between the two is necessary in order to identify possible overlaps, avoid duplications and ultimately make sure that all provisions from both are covered for a given offshore installation (existing or planned).

While their ultimate objectives are often similar, the two legal acts have a different focus: the Offshore Protocol aims at protecting against pollution from offshore activities whereas the EU draft Regulation intends to ensure the safety of offshore activities.

The parallel adoption of these two legal acts provides a unique momentum to further develop and align actions and measures undertaken to implement their core requirements. The Decision of the Parties to the Barcelona Convention at their 17th meeting (February 2012) to endorse the preparation of an Action Plan to effectively implement the Offshore Protocol, covering a 10-year period underlines the need for harmonisation and guidance for effective implementation.

The EU Mediterranean Member States are the ones most impacted by the parallel implementation, as they have to transpose the requirements from both legal acts in their national legislation. One of the objectives of this study was to compare the requirements set by the Offshore Protocol with the requirements of the proposed draft Regulation to examine what the potential additional national measures are that (depending on their national legislation in place) need to be taken by EU Mediterranean countries.

The EU Regulation, having a more specific scope, namely to ensure the safety of offshore activities, sets clear rules for the EU Member States that cover 'the whole lifecycle of exploration and production activities, from design to the final removal of an oil or gas installation' In other words, both texts cover the exploration and exploitation activities including removal of installations but the content and level of details vary from one text to another. Consequently, the risk-related obligations that are addressed in the Offshore Protocol are mainly covered by the EU draft Regulation. Examples are the requirements to use best practices or establish contingency plans. The 'environmental requirements' set in the Offshore Protocol are to a great extent covered by the applicable EU *acquis*.

The main objective of this section is to discuss the areas where the Protocol requirements are covered by the EU *acquis* but where the requirements set by the EU Regulation or the *acquis* are broader and, consequently, further specifications are necessary to ensure an effective application, or are not covered at all and therefore may require that the EU Mediterranean countries (depending on their national legislation) adopt additional measures. Where possible, the assessment proposes options for a cost-effective fulfilment of the obligations arising from both texts. As mentioned, this depends to a high extent on the national legislation in place in the EU Mediterranean countries.

On the one hand, the Offshore Protocol provides a detailed list of requirements that need to be fulfilled in order to be granted a working authorisation. The majority of these requirements are covered by the EU *acquis* (rather than the EU draft Regulation) – although not in the same level of detail as the *acquis* is rather general and does in most cases not specifically relate to the offshore exploration or exploitation of oil and gas. However, Member States would typically have in place a regulatory system that provides for a work authorisation.

On the other hand, the EU Regulation establishes detailed requirements to ensure the safety of offshore installations, while also covering environmental protection. To implement the EU draft Regulation (now Directive) the Member States will need to build on their existing permitting systems to include these requirements (such as the Major Hazard Report).

A more analytical comparative evaluation of the two, has been made in the report prepared under the European Commission project named: "Safety of offshore exploration and exploitation activities in the Mediterranean: creating synergies between the forthcoming EU Regulation and the Protocol to the Barcelona Convention", under the Contract: Nr. No 070307/2012/621038/SER/D2 (Milieu, 2013).

5.2.2.4 International convention for the prevention of pollution from ships (MARPOL)

The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.

The MARPOL Convention was adopted on 2 November 1973 at IMO. The Protocol of 1978 was adopted in response to a spate of tanker accidents in 1976-1977. As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument entered into force on 2 October 1983. In 1997, a Protocol was adopted to amend the Convention and a new Annex VI was added which entered into force on 19 May 2005. MARPOL has been updated by amendments through the years.

The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes. Special Areas with strict controls on operational discharges are included in most Annexes.

- Annex I Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983)
  - ⇨ Covers prevention of pollution by oil from operational measures as well as from accidental discharges; the 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls, which was subsequently revised in 2001 and 2003.
  - ⇨ Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983)
  - ⇨ Details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk; some 250 substances were evaluated and included in the list appended to the Convention; the discharge of their residues is allowed only to reception facilities until certain concentrations and conditions (which vary with the category of substances) are complied with.
  - ⇨ In any case, no discharge of residues containing noxious substances is permitted within 12 miles of the nearest land.

- Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992).
  - ⇨ Contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications.
  - ⇨ For the purpose of this Annex, "harmful substances" are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code) or which meet the criteria in the Appendix of Annex III.
- Annex IV Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003)
  - ⇨ Contains requirements to control pollution of the sea by sewage; the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land.
- Annex V Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988)
  - ⇨ Deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of; the most important feature of the Annex is the complete ban imposed on the disposal into the sea of all forms of plastics.
- Annex VI Prevention of Air Pollution from Ships (entered into force 19 May 2005)
  - ⇨ Sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances; designated emission control areas set more stringent standards for SO_x, NO_x and particulate matter. A chapter adopted in 2011 covers mandatory technical and operational energy efficiency measures aimed at reducing greenhouse gas emissions from ships.

5.2.2.5 Regulation (EC) No 1907/2006 concerning the registration, evaluation, authorization and restriction of chemicals (REACH)

REACH, which entered into force on 1 June 2007, requires manufacturers and importers of chemicals to evaluate the risk arising from the use of chemicals and to manage such risks. REACH applies to the manufacture, placing on the marker or use of substances on their own, in mixtures or in articles and to the placing on the market of mixtures. A 'substance' is defined as a chemical element and its compounds in the natural state or obtained by any manufacturing process.

Key elements of REACH include registration requirements, whereby it is compulsory to register the manufacture or import of chemicals in quantities of one tonne or more per annum.

Substances of extremely high concern are also subject to authorisation. A procedure of restriction is also put in place by REACH, setting out restrictions relating to the conditions of manufacture, use(s) and/or placing on the market of a substance, or alternatively an outright prohibition on the manufacturing, use or placing on the market of a substance.

While the EU draft Regulation does not specifically refer to REACH, it is considered of relevance, as the Offshore Protocol requires the use of chemicals for the exploration and/or exploitation of resources to be regulated, limited or prohibited.

5.2.2.6 Treaty on oil pollution preparedness, response and cooperation (OPRC)

In July 1989, a conference of leading industrial nations in Paris called upon International Maritime Organization (IMO) to develop further measures to prevent pollution from ships. This call was endorsed by the IMO assembly in November of the same year and work began on a draft convention aimed at providing a global framework for international co-operation in combating major incidents or threats of marine pollution.

Parties to the International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) are required to establish measures for dealing with pollution incidents, either nationally or in co-operation with other countries.

Ships are required to carry a shipboard oil pollution emergency plan, whereas operators of offshore units under the jurisdiction of Parties are also required to have oil pollution emergency plans or similar arrangements which must be co-ordinated with national systems for responding promptly and effectively to oil pollution incidents.

Moreover, ships are required to report incidents of pollution to coastal authorities and the convention details the actions that are then to be taken. The Convention calls for the establishment of stockpiles of oil spill combating equipment, the holding of oil spill combating exercises and the development of detailed plans for dealing with pollution incidents.

Parties to the convention are required to provide assistance to others in the event of a pollution emergency and provision is made for the reimbursement of any assistance provided.

A Protocol to the OPRC relating to hazardous and noxious substances (OPRC-HNS Protocol) was also adopted in 2000.

5.2.2.7 Agreement on the conservation of cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic (ACCOBAMS)

ACCOBAMS, the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area is 'a cooperative tool for the conservation of marine biodiversity in the Mediterranean and Black Seas'.

ACCOBAMS aims to reduce threats to cetaceans in Mediterranean and Black Sea waters and improve our knowledge of these animals, and is the first Agreement binding the countries in the two subregions, enabling them to work together on a matter of general interest. ACCOBAMS was concluded in the auspices of convention on Migratory Species (CMS) in 1996 and entered into force in 2001.

5.2.2.8 UN convention on the law of the sea (UNCLOS)

The United Nations Convention on the Law of the Sea (UNCLOS) also called the Law of the Sea Convention or the Law of the Sea treaty is the international agreement that resulted from the third United Nations Conference on the Law of the Sea (UNCLOS III), which took place between 1973 and 1982. The Law of the Sea Convention defines the rights and responsibilities of nations with respect to their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources. The Convention, concluded in 1982, replaced four 1958 treaties. UNCLOS came into force in 1994.

As of January 2015, 166 countries and the EU have joined the Convention. However, it is uncertain as to what extent the Convention codifies customary international law.

5.2.2.9 Stockholm convention on persistent pollutants (POPs)

Stockholm Convention on Persistent Organic Pollutants is an international environmental treaty, signed in 2001 and effective from May 2004, that aims to eliminate or restrict the production and use of persistent organic pollutants (POPs).

Key elements of the Convention include the requirement that developed countries provide new and additional intentionally produced POPs, eliminate unintentionally produced POPs where feasible, and manage and dispose of POPs wastes in an environmentally sound manner. Precaution is exercised throughout the Stockholm Convention, with specific references in the preamble, the objective, and the provision on identifying new POPs.

5.2.2.10 International convention on the establishment of an international fund for compensation for oil pollution damage (FUND)

Although the 1969 Civil Liability Convention (CLC) provided a useful mechanism for ensuring the payment of compensation for oil pollution damage, it did not deal satisfactorily with all the legal, financial and other questions raised during the Conference adopting the CLC Convention. The 1969 Brussels Conference considered a compromise proposal to establish an international

fund, to be subscribed to by the cargo interests, which would be available for the dual purpose of, on the one hand, relieving the ship owner of the burden by the requirements of the new convention and, on the other hand, providing additional compensation to the victims of pollution damage in cases where compensation under the 1969 Civil Liability Convention was either inadequate or unobtainable.

The Conference recommended that IMO should prepare such a scheme and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage was adopted at a Conference held in Brussels in 1971. It is supplementary to the Civil Liability Convention.

The purposes of the Fund Convention are:

- To provide compensation for pollution damage to the extent that the protection afforded by the 1969 Civil Liability Convention is inadequate.
- To give relief to ship owners in respect of the additional financial burden imposed on them by the 1969 Civil Liability Convention, such relief being subject to conditions designed to ensure compliance with safety at sea and other conventions.
- To give effect to the related purposes set out in the Convention.

Under the first of its purposes, the Fund is under an obligation to pay compensation to States and persons who suffer pollution damage, if such persons are unable to obtain compensation from the owner of the ship from which the oil escaped or if the compensation due from such owner is not sufficient to cover the damage suffered.

Under the Fund Convention, victims of oil pollution damage may be compensated beyond the level of the ship owner's liability. However, the Fund's obligations are limited. Where, however, there is no ship owner liable or the ship owner liable is unable to meet their liability, the Fund will be required to pay the whole amount of compensation due. Under certain circumstances, the Fund's maximum liability may increase.

With the exception of a few cases, the Fund is obliged to pay compensation to the victims of oil pollution damage who are unable to obtain adequate or any compensation from the ship owner or his guarantor under the CLC Convention.

The Fund's obligation to pay compensation is confined to pollution damage suffered in the territories including the territorial sea of Contracting States. The Fund is also obliged to pay compensation in respect of measures taken by a Contracting State outside its territory.

The Fund can also provide assistance to Contracting States, which are threatened or affected by pollution and wish to take measures against it. This may take the form of personnel, material, credit facilities or other aid.

In connection with its second main function, the Fund is obliged to indemnify the ship owner or his insurer for a portion of the ship owner's liability under the Liability Convention.

The Fund is not obliged to indemnify the owner if damage is caused by his wilful misconduct or if the accident was caused, even partially, because the ship did not comply with certain international conventions. Moreover, the Convention contains provisions on the procedure for

claims, rights and obligations, and jurisdiction.

Contributions to the Fund should be made by all persons who receive oil by sea in Contracting States.

5.2.2.11 Environmental liability directive (2004/35/EC)

Environmental Liability Directive (ELD), 2004/35/EC came into force across Europe during 2009. Unlike the 96/82/EC so-called Seveso II Directive which applies to large high risk businesses the Environmental Liability Directive applies to all businesses large and small alike. Directive 2004/35/EC addresses pure ecological damage in terms of ‘protected species and natural habitats’ (biodiversity damage), ‘water pollution damage’ and ‘land damage’. It applies to waters covered by Directive 2000/60/EC23 according to which the term ‘surface waters’ also includes territorial waters (Article 2(1) of Directive 2000/60/EC24).

This means that liability may be attributed for environmental damage occurring within 12 nautical miles from shore.

5.2.2.12 Aarhus convention

The UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters was adopted on 25th June 1998 in the Danish city of Aarhus at the Fourth Ministerial Conference in the 'Environment for Europe' process.

The Convention:

- Links environmental rights and human rights
- Acknowledges that we owe an obligation to future generations
- Establishes that sustainable development can be achieved only through the involvement of all stakeholders
- Links government accountability and environmental protection
- Focuses on interactions between the public and public authorities in a democratic context.

The subject of the Convention goes to the heart of the relationship between people and governments and deals with government accountability, transparency and responsiveness.

The Aarhus Convention grants the public rights and imposes on Parties and public authorities’ obligations regarding access to information and public participation and access to justice.

The Aarhus Convention is also forging a new process for public participation in the negotiation and implementation of international agreements.

Its main three pillars are the following:

- Access to information: any citizen should have the right to get a wide and easy access to environmental information. Public authorities are obliged to provide all the information required and collect and disseminate them and in a timely and transparent manner. This includes information on the state of the environment, policies and measures taken, or

on the state of human health and safety, where this can be affected by the state of the environment. Some information is exempt from release, for example where the disclosure would adversely affect international relations, national defence, public security, the course of justice, commercial confidentiality or the confidentiality of personal data. Information may also be withheld if its release could harm the environment, such as the breeding sites of rare species;

- Public participation in decision-making: the public has a right to participate in decision-making in environmental matters. Arrangements should be made by public authorities to enable the public to be informed and subsequently to comment (if wishing to do so) on proposals for projects affecting the environment, or plans and programmes relating to the environment. Any subsequent comments are to be taken into consideration in the decision-making process. Decision makers can take advantage from people's knowledge and expertise; this contribution is a strong opportunity to improve the quality of the environmental decisions, outcomes and to guarantee procedural legitimacy.
- Access to justice: the public has the right to judicial or administrative recourse procedures in case a Party violates or fails to adhere to and the convention's principles, i.e. i.e. the right to seek redress when environmental law is infringed and the right to access review procedures to challenge public decisions that have been made without regard to the two other pillars of the Convention.

5.2.3 Main legislative framework for the environment and biodiversity protection

5.2.3.1 Convention on migratory species (CMS or Bonn convention)

The Convention on the Conservation of Migratory Species of Wild Animals - more commonly abbreviated to just the Convention on Migratory Species (CMS) or the Bonn Convention-aims to conserve terrestrial, marine and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of UNEP, concerned with the conservation of wildlife and habitats on a global scale. The Convention was signed in 1979 in Bonn, and entered into force in 1983. The CMS is the only global and UN-based intergovernmental organization established exclusively for the conservation and management of terrestrial, aquatic and avian migratory species throughout their range. CMS and its daughter agreements determine policy and provide further guidance on specific issues through their Strategic Plans, Action Plans, resolutions, decisions and guidelines. All maintain on their websites a list of all decisions taken, guidelines issues and Action Plans adopted by the Member States.

5.2.3.2 Ramsar convention

The Ramsar Convention is an international treaty for the conservation and sustainable utilization of wetlands, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. The convention was developed and adopted by participating nations at a meeting in Ramsar, Mazandaran, Iran, on February 2, 1971 and came into force on December 21, 1975.

5.2.3.3 Bern convention

The Bern Convention on the Conservation of European Wildlife and Natural Habitats, also known as the Bern Convention (or Berne Convention), is a binding international legal instrument in the field of Nature Conservation; it covers the natural heritage in Europe, as well as in some African countries. The Convention was open for signature on 19 September 1979 and came into force on 1 June 1982. It is particularly concerned about protecting natural habitats and endangered species, including migratory species.

The convention mainly aims at:

- Conserving wild life flora and fauna and their natural habitats;
- Promoting cooperation between states;
- Giving particular attention to endangered and vulnerable species including endangered and vulnerable migratory species.

5.2.3.4 Convention on biological diversity (CBD)

The Convention on Biological Diversity (CBD), known informally as the Biodiversity Convention, is a multilateral treaty. The Convention has three main goals:

- Conservation of biodiversity;
- Sustainable use of its components; and
- Fair and equitable sharing of benefits arising from genetic resources

In other words, its objective is to develop national strategies for the conservation and sustainable use of biological diversity. It is often seen as the key document regarding sustainable development. The Convention was opened for signature at the Earth Summit in Rio de Janeiro on 5 June 1992 and entered into force on 29 December 1993.

The convention recognized for the first time in international law that the conservation of biological diversity is "a common concern of humankind" and is an integral part of the development process. The agreement covers all ecosystems, species, and genetic resources. It links traditional conservation efforts to the economic goal of using biological resources sustainably. It sets principles for the fair and equitable sharing of the benefits arising from the use of genetic resources, notably those destined for commercial use.

It is noted that the Convention is legally binding; countries that join it ('Parties') are obliged to implement its provisions.

5.2.3.5 Birds directive (2009/409/EC)

The Birds Directive (more formally known as Council Directive 2009/147/EC on the conservation of wild birds) was adopted in 2009. It replaced Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds, which was modified several times and had become very unclear. It aims to protect all European wild birds and the habitats of listed species, in particular through the designation of Special Protection Areas (SPA).

5.2.3.6 Habitats directive (92/43/EEC)

The Habitats Directive (more formally known as Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora) was adopted in 1992 as a response to the Berne Convention. It is one of the EU's two directives in relation to wildlife and nature conservation, the other being the Birds Directive mentioned above.

It aims to protect some 220 habitats and approximately 1,000 species listed in the directive's Annexes. These are species and habitats which are considered to be of European interest, following criteria given in the directive.[3][4]

- Annex I covers habitats,
- Annex II species requiring designation of Special Areas of Conservation,
- Annex IV species in need of strict protection, and
- Annex V species whose taking from the wild can be restricted by European law.

The directive led to the setting up of a network of Special Areas of Conservation, which together with the existing special Protection Areas (SPA) form a network of protected sites across the EU, called Natura 2000.

5.2.4 Main legislative framework for impact assessment

The impact assessment – permitting framework is governed by the following (including ratifications of the aforementioned conventions as applicable).

Table 5-2: Current legal framework for impact assessment – permitting of offshore installations

Law/Decision/Circular/Directive and relevant EU/International documents	Reference number	Subject
Law 4014	GG 209/A/21-09-2011	On environmental permitting
Law 1650	GG 160/A/18-10-1986	On environmental protection
Law 3010	GG 91/A/25-04-2002	Harmonisation of L. 1650 with Directives: 96/61/EC & 97/11/EC
Law 3937	GG 60/A/31-03-2011	On biodiversity conservation
MD 1958 (as modified and in	GG 21/B/13-01-2012	On the environmental classification of

Law/Decision/Circular/Directive and relevant EU/International documents	Reference number	Subject
force)		projects and activities
JMD 15393/2332	GG 1022/B/05-08-22002	Only valid Annex II: on categories of activities and projects subject to Integrated Pollution Protection and Control (IPPC)
MD 48963	GG 2703/B/05-10-2012	On the specifications of Environmental Permit contents
MD 170225	GG 135/B/17-01-2014	On particularisation of indexes for environmental permitting studies
JMD 30651	GG 1817/B/02-06-2014	On particularisation of specifications of the Environmental Electronic Registry
Law 3422	GG 303/A/13-12-2005	Ratification of Aarhus Convention
JMD 1649/45	GG 45/B/15-01-2014	On particularisation of permitting processes and public participation in public hearings and consultations during environmental permitting
MD 21697	GG 224/ΥΟΔΔ/03-05-2012	Composition of Central Council for Environmental Licensing
Law 4042	GG 24/A/13-02-2012	Environmental liability – framework of waste generation and management
Circular	16 / 4095.82	Regarding waste management permits as per article 12 of L. 4014/2011
Commission Decision	2000/479/EC of 17, EC July 2000	On the implementation of a European pollutant emission register (EPER) according to Article 15 of Council Directive 96/61/EC concerning integrated pollution prevention and control (IPPC)
EC Regulation	Regulation (EC) No 166/2006 of the European Parliament and of the Council of 18 January 2006	Concerning the establishment of a European Pollutant Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EC
Guidance Document	European Commission, 31.05.2006	On the implementation of the European PRTR
Law 743	GG 137/A/17.10.1977	On protection of the Marine Environment
P.De. 55/1998	GG 58/A/20.04.1998	On protection of the Marine Environment (codification of L. 743)
P.De. 11/2002	GG 6/A/21-01-2002	National Emergency Action Plan for confrontation of pollution incidents from oil

Law/Decision/Circular/Directive and relevant EU/International documents	Reference number	Subject
		and other detrimental substances
Guidance note	Ref. Ares(2011)1339393 – 12/12/2011	Guidance note on the application of Directive 85/337/EEC to projects related to the exploration and exploitation of unconventional hydrocarbon
Directive	2013/30/EC of 12-06-2013	On safety of offshore oil and gas operations and amending Directive 2004/35/EC[6]
Barcelona Convention 1976 including pollution caused by exploration and exploitation of hydrocarbons • Ratified by Greek Parliament with: ⇨ Law 855 ⇨ Law 3022 incorporated in EU, Directive	GG 235/A/23-12-1978 GG 144/A/19-06-2002 2013/5/EC	Ratification of international convention for the protection of Mediterranean Sea from pollution and amendments
International Convention on Oil Pollution Preparedness Response and Cooperation (OPRC) 1990 • Ratified by Greek Parliament with: ⇨ Law 2252 ⇨ Law 3100	GG 192/A/18-11-1994 GG 20/A/29-01-2003	Ratification of the international conventions OPRC and amendments
International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78) • Ratified by Greek Parliament with L.1269 as amended and in force	GG 89/A/21-07-1982	Ratification of the International Convention for the Prevention of Pollution from Ships and amendments
ACCOBAMS	-	Agreement on the conservation of

[6] The Greek state has recently assigned a technical / legal team with the task to draft the law that will approximate Directive 2013/30/EC into the Greek legislative framework system. It is expected that the draft law will be posted for consultation before the end of 2014 and it is expected that current EIS should be in full compliance with it.
Moreover, the current Greek permitting legislation, (in particular, MD 170225/2014), specifically refers to the aforementioned Directive, as the responsibility of compliance passes through the Environmental Permit.

Law/Decision/Circular/Directive and relevant EU/International documents	Reference number	Subject
		cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area
P.De. 148/2009	GG 190/A/29-09-2009	On environmental liability with regard to the prevention and remedying of environmental damage

5.2.5 International industry and International Financial Institution (IFI) standards

5.2.5.1 Good oilfield practices (GOP) and Good International Industry Practice (GIIP)

The planned project work will be undertaken in line with 'Good Oil Field Practice' and 'Good International Industry Practice'.

'Good Oil Field Practice' is a term used by certain National oil and gas regulators to describe the approach expected from operators working in their countries. Unfortunately it is not a concept that is well defined and hence its meaning can be opened to interpretation.

A commonly used definition is that 'Good Oilfield Practice' means:

'Such practices and procedures employed in the petroleum industry worldwide by prudent and diligent operators under conditions and circumstances similar to those experienced in connection with the relevant aspect or aspects of the Petroleum Operations, principally aimed at guaranteeing:

- *Conservation of petroleum and gas resources, which implies the utilization of adequate methods and processes to maximize the recovery of hydrocarbons in a technically and economically sustainable manner, with a corresponding control of reserves decline, and to minimize losses at the surface;*
- *Operational safety, which entails the use of methods and processes that promote occupational security and the prevention of accidents;*
- *Environmental protection, that calls for the adoption of methods and processes which minimise the impact of the Petroleum Operations on the environment'.*

'Good International Industry Practice' (GIIP) is defined as:

'the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find (relevant) when evaluating the range of pollution prevention and control techniques available to protect may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of

financial and technical feasibility'. World Bank EHS Guidelines introduced in 2007 are technical reference documents, which provide examples of approaches that are based upon IIP. Equator Principles and IFC Performance Standards call upon these guidelines for establishing acceptable levels of performance.

In contrast there are no strict guidelines or rules established that define how 'good oil field practice' is achieved or how performance against such a standard can be measured. Good Oil Field Practice is not about following a specific procedure but about the approach that an operating company takes in discharging its duty to the government that has approved its license to operate. By definition use of GIIP principles would be Good Oilfield Practice.

It is clearly a concept that relates to the way a facility is designed, the methods of construction, its operation and maintenance as well as the way its overall management is discharged and hence is equally applicable at each stage of the asset life cycle.

Good Oilfield Practice is by definition something that changes continuously. It requires operators to monitor successes and failures in the industry and modify their internal practices appropriately. A regulator wants failures that have occurred elsewhere in the world to be avoided whilst ensuring that new, more effective approaches are implemented as quickly as possible. Good Oilfield Practice embraces equally the use of recognized and well tested Standards during the design stage, internal management/control procedures during project execution and application of risk-based inspection systems to manage cost when the facility is in service.

Energean is committed to follow 'Good Oilfield Practices' throughout day to day activities, whether they be the drilling of new wells, the installation of new facilities or the management of existing facilities. This commitment is well illustrated in the way that the current Prinos Area Development Project has been formulated and is being implemented. This project has included:

- The hiring of international staff with a proven track record of developing similar fields
- The use of internationally recognized contractors to undertake specialist technical and non-technical work
- The identification of appropriate international and industry standards to which new facilities will be designed and old facilities verified
- The development of internal controls to allow projects to be reviewed and approved as they pass form decision point to decision pointUpgrade of its newly acquired drilling rig in line with international standards using equipment and staff from Original Equipment Manufacturers
- Early incorporation of risk reduction techniques in the design process
- A desire to maximize the positive impact of the project on the Greek economy by tailoring the design to match local industrial capabilities

Energean senior management and owners are committed to build upon the track-record of operational excellence established by the previous owners of the Prinos basin assets which were acquired when Energean acquired Kavala Oil in 2007. The Prinos assets are technically complex largely because of the ultra-sour nature of the crude and gas produced. Kavala Oil and subsequently Energean have had to establish and maintain world class operational standards

to ensure the safe operation of these facilities during a 30-year period. This can be demonstrated in the excellent safety record of the company and the lack of any incidents that have accidentally released hydrocarbon substances into the environment. The Prinos assets happily co-exist with a vibrant tourism industry and offshore and shore based fishing enterprises.

Although Energean has a strong operational base to call upon it has not executed a significant engineering project previously. To ensure that this new activity is undertaken in line with the principles of "Good Oil Field Practice" it has recruited a team of seasoned professionals with experience from Major upstream oil and gas companies (e.g. Shell) and construction companies (e.g. Saipem). These staff have brought with them the standards and practices used by these entities that are widely recognized as following "Good Oil Field Practice".

The Epsilon project has progressed through a structured stage-gate process with key risks and decisions being recorded and monitored. All typical design stage controls have been applied (e.g. HAZOPS, HAZIDS) and concept design work was driven by QRA and ALARP principles from the start. All design work has been undertaken by established contractors who have an established track record of implementing similar projects successfully. Fabrication, Construction, Installation and Commissioning activities will be managed with similar vigilance. The schedule being followed allows for float and imposes no undue haste on the execution team.

The design of Epsilon enshrines all that is intended by "Good Oil Field Practice". The development's objective is to maximize hydrocarbon extraction whilst using the minimum of facilities that present insignificant risk to people and environment. Provisions have been accommodated in the design for subsequent phases and further development of Prinos area infrastructure. All attempts to ensure that local enterprises can contribute to the project and hence share in its value have been taken.

Subsequently the same applies for the Omicron platform, destined to follow at a later stage of development.

5.2.5.2 EBRD standards

Energean has adopted the EBRD Performance Requirements (PR) for the elaboration of Project's ESIA and for the implementation of the Project. Projects financed by the EBRD need to meet the PRs during construction, operation and decommissioning. The ESIA and generally the environmental and social assessment process are aligned to EBRD Performance Requirements (PR), according to the EBRD Environmental and Social Policy (2014):

- *PR1 – Assessment and management of environmental and social impacts and issues*: This PR applies to all projects directly financed by the EBRD. All relevant requirements of this PR, and how they will be addressed and managed through the project design, construction, operations, and decommissioning have to be identified in the environmental and social assessment process. This project is categorised as A under PR1 and is thus subject to a comprehensive ESIA (this document).
- *PR2 – Labour and Working Conditions:* The PR recognizes that the workforce is a

valuable asset, and that good human resources management and a sound worker-management relationship based on respect for workers' rights, including freedom of association and right to collective bargaining, are key ingredients to the sustainability of business activities. The implementation of the actions necessary to meet the requirements of this PR will be managed under the Company's Environmental and Social Management System (ESMS) and Human Resources (HR) System.

- *PR3 - Resource efficiency and pollution prevention and control:* The PR recognizes that resource efficiency and pollution prevention and control are essential elements of environmental and social sustainability and projects must meet good international practices and best available techniques in this regard. The implementation of the actions necessary to meet the requirements of this PR will be managed primarily in the project design and ultimately under the Company's ESMS.
- *PR4 – Health and Safety:* The avoidance or mitigating adverse health and safety impacts and issues associated with project activities is the main scope of this PR. The requirements have to do with the responsibilities of the Project Owner for provision of safe and healthy conditions for their workers and the community. While the PR is acknowledging the role of relevant authorities in protecting and promoting the health and safety of the public, the Company has the duty to identify, avoid, minimize or mitigate the risks and adverse impacts health and safety of the affected communities that may arise from the project.
- *PR5 – Land acquisition, involuntary resettlement and economic displacement:* The application of this PR is consistent with the universal respect for, and observance of, human rights and freedoms and specifically the right to adequate housing and the continuous improvement of living conditions. Certain requirements have to be addressed during the environmental and social assessment process and generally during the project's lifetime.
- *PR6 - Biodiversity conservation and sustainable management of living natural resources:* This PR recognizes that the conservation of biodiversity and sustainable management of living natural resources are fundamental to environmental and social sustainability. In this context certain requirements have to be addressed during the environmental and social assessment process and generally during the project's lifetime. Also, the implementation of the actions necessary to meet the requirements of this PR will be managed under the Company's Environmental and Social Management System (ESMS).
- *PR7 - Indigenous peoples:* The term is used in a technical sense to refer to a social and cultural group, distinct from dominant groups within national societies. This PR recognizes that projects can create opportunities for Indigenous Peoples to participate in and benefit from project-related activities that may help them fulfil their aspiration for economic and social development. There are no indigenous peoples in Greece as per the definition presented in PR7 and therefore this PR does not apply to the Project.

- *PR8 - Cultural heritage:* This PR recognizes the importance of cultural heritage (tangible and intangible) for present and future generations. The aim is to protect cultural heritage and the project to be developed in a way that will be avoidance or mitigating adverse impacts on cultural. Certain requirements have to be addressed during the environmental and social assessment process and generally during the project's life.
- *PR9 – Financial intermediaries:* This PR is applicable only when Financial Intermediaries are appointed or are operational in a project. This PR does not apply to this Project.
- *PR10 - Information disclosure and stakeholder engagement:* This PR identifies the stakeholder engagement and information disclosure as an ongoing process which involves: (i) public disclosure of appropriate information; (ii) meaningful consultation with stakeholders; and (iii) an effective procedure or mechanism by which people can make comments or raise grievances. The process should begin at the earliest stage of project planning and continue throughout the life of the project. Also, it is an integral part of the assessment, management and monitoring of environmental and social impacts and issues of the project and therefore. Therefore, this PR should be read in conjunction with PR1.

The following table summarizes the EBRD Performance Requirements (PR) and the measures adopted by the Company as well as how those are addressed in the ESIA and in the project design:

Table 5-3: Project compliance of EBRD Performance Requirements (PR)

EBRD PR	Compliance measures adopted by Energean
PR1 – Assessment and management of environmental and social impacts and issues	The Project is classified as a “Category A Project”, according to Appendix 2 of EBRD Environmental and Social Policy (2014). Specifically, it belongs to the sub-category of “extraction of petroleum and natural gas for commercial purposes” and is thus required to undergo an ESIA before a decision on EBRD financing can be made. Energean has established a procedure for the development of this ESIA in line with the international regulations, European and national legislation and according to EBRD PRs. The compliance measures adopted in the ESIA for the scope and objectives of PR1 are: ⇨ Identification and evaluation of impacts: This ESIA and particularly chapters 09 & 11. ⇨ Application of mitigation hierarchy: chapter 12 of ESIA and existing ESM. ⇨ Environmental & Social Management System: chapter 13 of ESIA and existing management

EBRD PR	Compliance measures adopted by Energean
	systems in place at Energean, which will apply to the Project. ⇨ Environmental and Social Policy: The Company has been applying an Environmental and HSE Policy during all the years of its operation. ⇨ Project Monitoring and Reporting: chapter 13 of ESIA; existing ESMS.
PR2 – Labour and Working Conditions	The basic requirements of PR2 is that the Project has to comply with national labour, social security and occupational HS laws and fundamental principles and standards embodied in ILO conventions. It must be emphasized that Greece has ratified most[7] of ILO Conventions and generally workers' rights are protected by the Constitution and are part of the European Acquis. Energean is operating according the European and national legislation for labour and working conditions which are aligned with the requirements of PR2.
PR3 - Resource efficiency and pollution prevention and control	Energean has incorporated from the early project design phases the requirements of PR3. Generally, the objectives of PR3 are met by the following measures: ⇨ Identification of project-related opportunities for energy, water and resource efficiency improvements and waste minimization: Pollution prevention and control measures had been designed in early project phase and have been incorporated in the ESIA. The applied techniques minimize any risk, as has been identified and addressed in the QRA (chapter 10). Regarding water, its use is the minimal required, since there is no process water and seawater is used for injections and as cooling water. ⇨ Adoption of the mitigation hierarchy approach to addressing adverse impacts on human health and the environment arising from the resource: All mitigation measures are presented in chapter 12 of the ESIA. Furthermore, for the purpose of the ESIA

[7] In particular Greece has ratified:
- Fundamental conventions: 8 of 8;
- Governance conventions (priority): 3 of 4;
- Technical conventions: 60 of 177;
- Out of **71** Conventions ratified by Greece, of which 51 are in force, 21 Conventions have been denounced; none have been ratified in the past 12 months.

(source: http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11200:0::NO::P11200_COUNTRY_ID:102658)

EBRD PR	Compliance measures adopted by Energean
	a Chemical Use Plan has been developed. ⇨ Promote the reduction of project-related greenhouse gas emissions: The carbon emissions of the Project will be negligible, because the only fuel combustion, for the new platforms, will take place in the drilling barge.
PR4 – Health and Safety	The way the impacts on the health and safety of local communicates and project workers (routine and non-routine events) are anticipated, assessed, prevented and minimized, are examined in a special session in the ESIA (Annex 06, Annex 07, Annex 09, Annex 10, Annex 14). More specifically, the compliance measures adopted by Energean are: ⇨ General HS requirement: The HS management system, which already existed to cover current facilities and operations, has been expanded to cover the new facilities as well. This is described in the ESMMP (Chapter 13, Annex 19) and is given separately as a separate management plan (Annex). Also, the HS measures have been incorporated in the relevant studies, which are part of the ESIA (Annex 14). ⇨ Occupational HS: The Company has been applying an Environmental and HSE Policy during all the years of its operation, which is in compliance with all the European and national legislation and is aligned with PR3. ⇨ Community HS: The relevant studies (ie. QRA, Oil Spill Modelling) and the Emergency Preparedness and Response are part of the ESIA (Chapter 10, Annex 07). ⇨ Infrastructure, building, and equipment design and safety: HS considerations were taken into consideration during project the design (see par. 5.6) ⇨ Hazardous material safety: A Chemical Use Plan, in accordance with the Offshore Protocol, has been developed (Annex 08). ⇨ Services safety: n/a ⇨ Traffic and road safety: n/a ⇨ Marine traffic: current exclusion zones around the facilities ensure safety and similar zones will be

EBRD PR	Compliance measures adopted by Energean
	established for the future facilities (Chapter 8, 11. Annex 15). ⇨ Product safety: n/a ⇨ Natural hazards: Natural hazards were taken into consideration during project design (see Chapter 6) and a Marine Geophysical Survey took place (Annex 03). Other geological and tectonic hazards have been examined in the baseline (Chapter 8.3). Weather extremes are not anticipated in Kavala Bay. ⇨ Exposure to disease: No endemic diseases are present in the area. Mainly, workforce will be from Kavala area, so the possibility of disease transmission is negligible. ⇨ Emergency preparedness and response: QRA, Oil Spill Modeling etc and generally the Emergency preparedness and response are part of the ESIA (Chapter 10, Annex 07, Annex 18). Furthermore, a Chemical Use Plan, in accordance with the Offshore Protocol, has been developed (Annex 08).
PR5 – Land acquisition, involuntary resettlement and economic displacement	PR5 is applicable only in respect to the possible economic displacement, through limited loss of access to fishing fields. The description of the fishing fields took place in par. 8.8.2, the assessment of impacts and application of mitigation measures are described in chapters 11 and 12, respectively. Furthermore, the consultation with local authorities is presented in SEP (Annex 11). Finally, Energean is establishing a Grievance Mechanism (see Annex 11).
PR6 - Biodiversity conservation and sustainable management of living natural resources	The objectives of the PR are met through the elaboration of baseline studies, consideration of secondary data (Chapter 08 and Annex 05) and of the Special Ecological Study (Annex 04). The precautionary approach was followed in project design, by the examination of various alternative options (Chapter 07) and through specific mitigation measures for biodiversity (chapter 12). Special actions for biodiversity issues are defined in the ESMS (Chapter 13, Annex 19). More specifically, the compliance measures adopted are: ⇨ Assessment of issues and impacts: Baseline conditions were identified for the biotic aspects of the marine and coastal environment, by site surveys, sampling and bibliography (Chapter 08, Annex 04,

EBRD PR	Compliance measures adopted by Energean
	Annex 05). Impact assessment and mitigation took place (Chapters 11 and 12) and special actions for biodiversity issues are defined in the ESMS (chapter 13, Annex 19). ⇨ Biodiversity conservation requirements: Small part of the existing offshore pipelines is entering a Natura 2000 Area and for that reason a Special Ecological Study (Annex 04) was carried out. Additionally, a Marine Ecology Study for the total project was elaborated (Annex 05). For marine mammals ACCOBAMS guidelines and mitigation measures have been followed (Chapter 12). Finally, the responsible Authority (Environmental Department) was consulted (see SEP, Annex 11). ⇨ Legally protected and internationally recognised areas of biodiversity value: As mentioned above a Special Ecological Study (Annex 04) was carried out for the small part of the existing offshore pipelines which enters a Natura 2000 Area. ⇨ Invasive alien species: The issue is covered in the Biodiversity and Wildlife Management Plan included in the current ESIA as Annex 17. ⇨ Sustainable management of living natural resources: n/a
PR7 - Indigenous peoples	n/a
PR8 - Cultural heritage	The Project (existing and future facilities) is developed in an offshore area. The marine area of the Gulf of Kavala, where all offshore facilities (existing and new) are located, is well investigated and there are no signs of archaeological findings that could be of any interests. For the existing facilities there is a positive opinion by the Marine Antiquities Ephorate. For the future facilities, the same Authority will provide its opinion, as part of the environmental permitting process.
PR9 – Financial intermediaries	n/a
PR10 - Information disclosure and stakeholder engagement	Energean has applied a robust stakeholder engagement strategy for institutional stakeholders, has a stakeholder engagement plan (Annex 11) including public disclosure and consultation activities, and has established a Grievance Mechanism. These actions meet the objectives of PR10, which are:

EBRD PR	Compliance measures adopted by Energean
	⇨ Outline a systematic approach to stakeholder engagement that will help clients build and maintain a constructive relationship with their stakeholders, in particular the directly affected communities ⇨ Promote improved environmental and social performance of clients through effective engagement with the project's stakeholders ⇨ Promote and provide means for adequate engagement with affected communities throughout the project cycle on issues that could potentially affect them and to ensure that meaningful environmental and social information is disclosed to the project's stakeholders ⇨ Ensure that grievances from affected communities and other stakeholders are responded to and managed appropriately. The engagement process during the project preparation consisted of: ⇨ Stakeholder identification and analysis ⇨ Stakeholder Engagement planning ⇨ Information disclosure ⇨ Consultation with a selection of institutional stakeholders The Grievance Mechanism is under development (see SEP, Annex 11) and Ongoing Reporting will be developed. The specific compliance measures adopted are presented in SEP (Annex 11). Furthermore, the Company carried out a Scoping exercise (Chapter 09), although it was not a prerequisite of the national legislation.

5.2.6 Emission standards and limits according to the national legislation

5.2.6.1 Wastewater standards

The wastewater standards are defined in the Ministerial Decision E1b/221/65 "Wastewater disposal". The emissions standards and limits of wastewater discharged into water intended for bathing and any other use except from water consumption are the followings:

- pH 6.5-8.5
- Dissolved oxygen 5mg/l
- Coliforms: 0-50/100ml
- Free from floating or settle able solids, oil or sludge deposits derived from sewage or industrial waste
- Nontoxic, harmful, or hot wastewater

Moreover wastewater must be effectively sterilised before discharge into the final recipient.

Specific limits for the wastewater discharge in the Kavala Gulf are defined on detail by the Prefecture of Kavala through a Prefectural Decision.

Table 5-4: Emission limit values for wastewater

Parameters	Emission limit
pH	6.6 – 8.5
Temperature	35°C
Floating material	none
Suspended solids	70mg/l
BOD_5	40 mg/l
COD	120 mg/l
Greases and oils (animal-vegetable)	20 mg/l
Mineral oils - hydrocarbons	10 mg/l
Aluminium	5 mg/l
Arsenic	0.5 mg/l
Barium	2 mg/l
Boron	2 mg/l
Cadmium	0.5 mg/l
Chromium $Cr3^+$	2 mg/l
Chromium $Cr6^+$	0.2 mg/l
Iron	20 mg/l
Dissolved Iron	4 mg/l
Manganese	2 mg/l
Mercury	0.01 mg/l
Nickel	2 mg/l

Parameters	Emission limit
Lead	0.1 mg/l
Copper	2 mg/l
Selenium	0.1 mg/l
Tin	10 mg/l
Zinc	1 mg/l
Cyanides	0.5 mg/l
Chlorine (free)	2 mg/l
Sulphites	2 mg/l
Sulphides	2 mg/l
Fluorides	10 mg/l
Phosphorus	30 mg/l
Total Ammonia	30 mg/l
Nitrogen as N in (NO_3)	3 mg/l
Total Phenols	0.5 mg/l
Aldehydes	1 mg/l
Aromatic solvents	0.4 mg/l
Nitrogenous solvents	0.2 mg/l
Chloride solvents	2 mg/l
Total toxic substances	3 mg/l
Total coliforms	500 K/100ml
Fecal coliforms	100 K/100ml

5.2.6.2 Wastewater from ships, International Convention for the Prevention of Pollution from Ships, MARPOL 73/78, Annex I, IV, V

Annex I Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983)

Covers prevention of pollution by oil from operational measures as well as from accidental discharges; the 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls, which was subsequently revised in 2001 and 2003.

Annex IV Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003)

Contains requirements to control pollution of the sea by sewage; the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land.

Annex V Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988)

Deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of; the most important feature of the Annex is the complete ban imposed on the disposal into the sea of all forms of plastics.

5.2.6.3 Ambient air quality standards

In Greece, there are applicable statutory limit values for pollutants sulphur dioxide, particulate matter (PM10, PM2.5), nitrogen dioxide, lead, ozone, carbon monoxide, benzene, according to the air quality limits established in the European Union. With a series of new directives on air pollution, the European Union adopted new limits for various air pollutants. These limits refer to the protection of human health as well as ecosystems.

The following table lists the directives on air pollution that have been issued and the corresponding legislation incorporating those directives into Greek law.

Table 5-5: European and National Legislation on Air Pollution

EU Legislation	GR Legislation
Directive 2008/50/EC on of the 21st of May, on ambient air quality and cleaner air for Europe (repealing several directives)	MD 14122/549/E.103/2011 (GG 488/B/30.3.2011) Measures to improve air quality, in compliance with the provisions of Directive 2008/50 / EC "on the air quality and cleaner air for Europe "of the European Parliament and of the Council of the European Union May 21, 2008»
Directive 2004/107/EC relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.	JMD 22306/1075/E103, GG 920/B/8.6.07) Establishment of target values and detection limits for concentrations of arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air, in accordance with the provisions of Directive 2004/107/EC

Directive 2008/50/EC defines for each pollutant a limit value for the protection of human health, and the year of entry into force. For some pollutants a margin of tolerance is given, with indicative limit values, which apply in the meantime until the entry into force of the limit. The tolerance decreases every year, so that it is reduced to zero by the date the new limit value is to be met.

The current legislation on air pollutants, the corresponding concentration limits and the year of application are listed below:

Table 5-6: Air Quality limit values according to National and European Legislation

Pollutant	Limit Value	Date by which limit value is to be met	Margin of tolerance
Carbon Monoxide (CO) (mg/m^3) (Directive 2008/50/EC)	10 Maximum 8-hour daily value	1/1/2005	60%
Benzene (C_6H_6) (μg/m^3) (Directive 2008/50/ EC)	5 Mean annual value	1/1/2010	
Sulfur Dioxide (SO_2) (μg/m^3) (Directive 2008/50/ EC)	350 Mean hourly value, not to be exceeded more than 24 times per year	1/1/2005	150 μg/m^3 (43%)
	125 Mean daily value, not to be exceeded more than 3 times per year	1/1/2005	
	500 Alarm limit, for 3 consecutive hours		
Nitrogen Dioxide (NO_2) (μg/m^3) (Directive 2008/50/ EC)	200 Mean hourly value, not to be exceeded more than 18 times per year	1/1/2010	
	40 Mean annual value	1/1/2010	
Particulates PM_{10} (μg/m^3) (Directive 2008/50/ EC)	50 Mean daily value, not to be exceeded more than 35 times per year	1/1/2005	50%
	40 Mean annual value	1/1/2005	20%
Lead (Pb) (μg/m^3) (Directive 2008/50/ EC)	0,5 Mean annual value	1/1/2005	100%
Ozone (O_3) (μg/m^3) (Directive 2008/50/ EC)	120 Maximum daily mean 8-hour value, not to be exceeded more than 25 times in 3 years	1/1/2010	
	180 Notification limit, mean hourly value		

5.2.7 Alert thresholds for short term response measures

The Ministerial Decision 14122/549/E103/2011 has established alert thresholds to limit pollution in cases where mainly due to extremely unfavourable meteorological conditions significant increase is expected in pollution values. The thresholds for the emergency measures established by the above mentioned decisions are related to the pollutants NO_2, SO_2 and O_3. For particulate matter (PM_{10}) an alert limit is not provided by European and Greek legislation. The thresholds for initiation of short-term response measures to address air pollution are presented below:

Table 5-7: Alert thresholds for short term response measures

Pollutant	Averaging period	Threshold
SO_2	1 hour	500 μg/m³ (*)
NO_2	1 hour	400 μg/m³ (*)
O_3	1 hour	240 μg/m³ (*)

(*)To be measured over three consecutive hours

5.2.7.1 Noise standards

The allowable noise limit is specified at 65 dBA at the boundaries of the installation according to the Presidential Decree 1180/81 (article 2, Government Gazette 293 A/81).

5.2.7.2 Hazardous waste

The hazardous waste management is defined in the Ministerial Decision 19396/1546/97 (Government Gazette 604 B/18.7.97) in accordance with the EC Directives 91/689/EEC and 94/904/EEC and 96/350/EC. For temporary storage, storage, handling and exploitation, a prefectural permission is required.

5.2.7.3 Solid and non-toxic waste management

The management of solid and non-toxic waste is defined in the Ministerial Decision 69728/824/96 (Government Gazette 358 B/17.5.96). The management of used mineral oils and non-lead sludge is defined in the Ministerial Decision 98012/2001/96 (Government Gazette 40 B/19.1.96)

5.3 PLANNING FRAMEWORKS (NATIONAL – REGIONAL)

The approved National Spatial Planning Framework and Sustainable Development for the Industrial Sector (JMD 11508 (GG 151/ΤΑΑΠ/13-4-2009, "Approval of special spatial planning framework and sustainable development for the industry and the strategic environmental assessment", classifies the Region in industrial zones aiming at the sustainable development (protection of the environment, social equality and cohesion and economic prosperity).

The important point of the spatial organization of industry is the area along the Egnatia, which includes the existing industrial poles of Kavala – Xanthi – Drama zones (intensification area) and extended regions. New expansion regions may be present in the northern part of Greece, with the integration of free zones in large organized receptors, such as Kavala and Alexandroupoli ports for Free Trade Zone.

Following the Guidelines for spatial organization for industry (Annex I), Kavala Prefecture is the major area of oil extraction and other mining and quarrying activities that have consequently developed the production of chemicals and non-metallic minerals industrial activities.

The spatial organization of industry is based in the southern area of Kavala region between Egnatia Motorway and port of Kavala.

The Industrial Area of Kavala (152D/1981, GG 1465D/2003) is located within the Regional Unit of Kavala. It is developed within an area of 2.08 km^2, in the area of the settlement "Pontolivado", northeast of the city of Kavala, on the (old) National Road Kavala - Xanthi.

The area of aquaculture shown in the draft Special Framework for Spatial Organization of aquaculture activity (GG 2505 B / 04.11.2011) and more specifically in the area B13 and B14. The area of the offshore development is located outside the aquaculture activity area.

The Industrial Park of Kavala was established by the Joint Ministerial Decision (JMD) 22773/1887/24-10-2005 (GG B-1466), which determined the location, extent, limits, the type of Industrial Area, environmental terms and the entities responsible for the establishment and implementation of the Industrial Park.

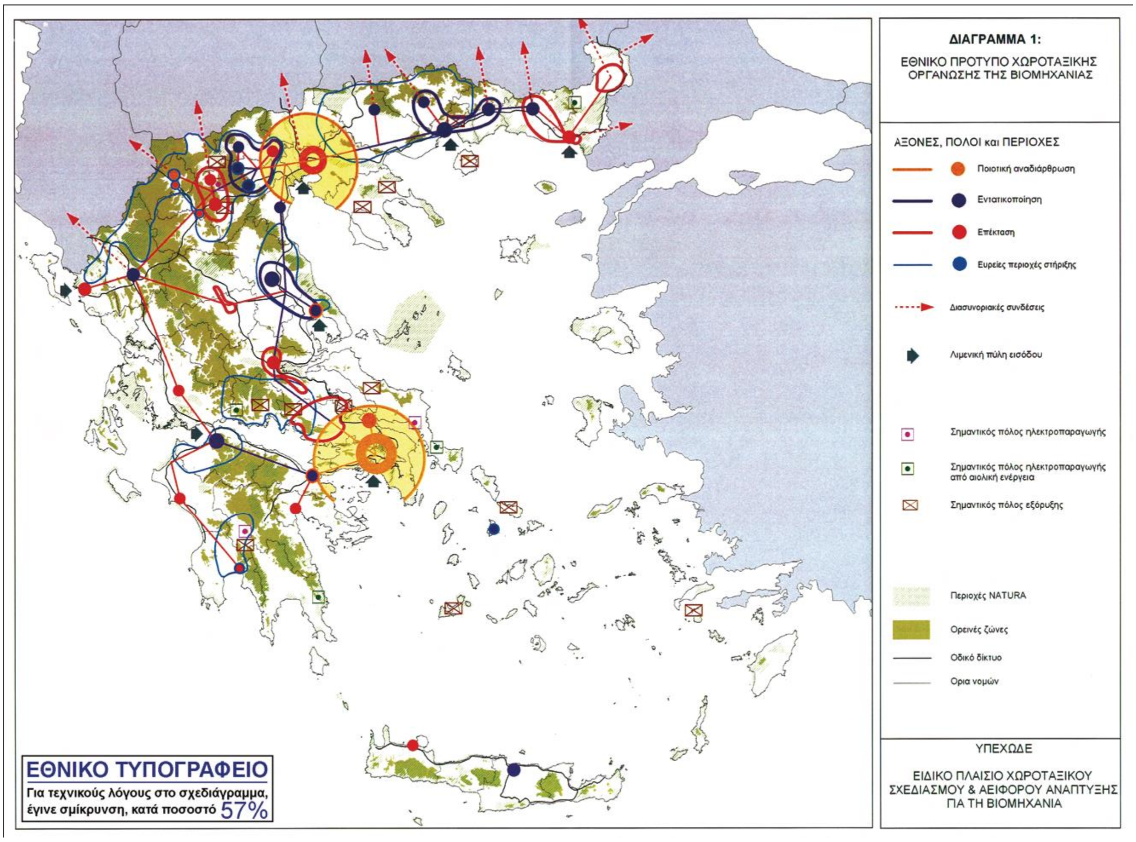
The aforementioned Special Framework for Spatial Planning and Sustainable Development for Industry complements the already approved:

- General framework of Spatial Planning and Sustainable Development (GG 128/3.7.2008)
- Special Framework and Sustainable Development for Aquacultures (GG 2505/B/4.11.2011)
- Special Frameworks for Spatial Planning and Sustainable Development of Tourism (GG 1138B/11.6.2009, GG 3155B/12.12.2013)
- Special Framework and sustainable Development for Renewable Energy Sources (RES) (GG 2464B/3.12.2008);

Finally the existing and future planned oil and gas industry related activities that are situated in the broader area of Kavala and East Macedonia include:

- Underground storage facilities;
- DESFA pipelines;
- Trans Adriatic Pipeline- TAP and
- Gas Interconnector Greece-Bulgaria – IGB.

Finally, the oil transport pipeline of Burgas – Alexandroupoli as well as South Stream, although



approved, are not longer considered as a possible – planned infrastructure facilities.

Map 5-1: National spatial organization of industry (Source: National Spatial Planning Framework and Sustainable Development for the Industrial Sector)

6 PROJECT DETAILED DESCRIPTION

6.1 EXISTING FACILITIES

6.1.1 Overview

Because a unified offshore permit is being sought that combines the existing facilities, which are already permitted, with the new proposed facilities, the existing facilities have been included in this ESIA. Note that because these existing facilities are in their operations phase, this ESIA has considered their potential impacts to resources and receptors through the evaluation of current baseline conditions. For this reason, the only additional activities associated with the existing facilities that will be assessed in the Assessment and Evaluation of Environmental and Social Impacts Chapter will be those that have not yet occurred: any unplanned events such as large oil spills and abandonment. Note that specific abandonment activities for the existing platforms and pipelines are discussed with the abandonment activities for the new facilities.

Energean is currently engaged in the exploration, production and exploitation of hydrocarbons as per the concession agreement ratified by the Greek parliament with Law 2779/1999 (as amended by the ratifying Laws 4135/2013, 4296/2014) covering the offshore areas of Prinos and South Kavala situated within the Gulf of Kavala, Greece.

To date eight separate hydrocarbon deposits have been discovered in the Gulf of Kavala. Three of these (South Kavala, Prinos and Prinos North) are in production. Epsilon has been appraised and is ready to be developed. These deposits contain a wide variety of hydrocarbons. South Kavala contains sweet lean gas with a small volume of API 61 condensate. API refers to an American Petroleum Institute rating system for the density of the hydrocarbon. Two unappraised discoveries (Athos and Zeta) contain light sweet oil and associated gas. The remaining fields contain sour crude (crude oil with high hydrogen sulphide content is referred to as sour crude) and associated gas. Sour crude quality varies from 37 API in Epsilon, through 28 API in Prinos, 21 in Prinos North and 12 in Amotheus. Amotheus sits outside the area operated by Energean and is the only discovery in the Nestos sub-basin.

Initial processing of the produced reservoir fluids is conducted on the offshore Prinos Complex, primarily the Delta platform. Oil, water and gas are separated in a single stage of separation. Produced gas is dried before flowing under available pressure energy to shore for further treatment. Produced crude oil is dehydrated and then pumped to shore to ensure no gas breakout occurs in the pipeline. Produced water is treated and cleaned (of oil and hydrogen sulfide) before being discharged to sea at the seabed in line with environmental permit conditions

and set limits. On the Prinos Complex there is also equipment to abstract seawater, treat it and inject it into reservoirs in order to maintain reservoir pressure. There is also equipment for compressing sweet gas in the wells to assist production, the technique known as gas lift. Partially processed oil and gas are sent to the onshore Sigma plant processing facility via pipelines for further processing and export. Electricity is sent to the offshore complex via two (2) independent medium voltage submarine cables.

The Prinos Complex is made up of four platforms. Alpha and Beta are production or drilling platforms each containing twelve (12) drilling slots, that can be used for production or injection wells. Delta platform contains all of the processing equipment and the control room. A small jacket bridge linked to Delta contains a remote flare. The Prinos North field is exploited via an Extended Reach Well drilled from Alpha platform. South Kavala is exploited via a production platform identical to Alpha and Beta. This platform contains two (2) wells plus equipment to compress and dry produced gas. South Kavala platform is unmanned and operated remotely from Delta.

Kappa platform is located in the Gulf of Kavala, above the sweet (no hydrogen sulfide content) natural gas deposit of South Kavala, 12 km to the southeast of the Prinos platforms complex. Currently the Kappa platform is produced intermittently.

Partially processed oil and gas is transported through submarine pipelines to the onshore plant, called Sigma plant. The Sigma plant includes units for 1) converting produced sour gas to sweet gas producing sulfur by a chemical reaction of hydrogen sulfide, 2) for the dehydration, desalination, stabilization and storage of the produced crude oil and 3) facilities in order to safely load treated oil to tankers.

It is noted that for the current operations described there is a prohibition area of 500 m radius over the pipeline routes and the platforms. This is presented in the official naval charts (map below), where a total area of 39.71 km^2 is defined as an exclusion zone for all marine activities.

Moreover, power and gas are currently imported into Sigma from national infrastructure. Sigma is equipped with a 17 MW power plant but is not operated as all produced gas is used for steam production at Sigma and for gas lifting offshore production wells. If gas production increases significantly, excess gas will either be exported for sale purposes or used for Sigma's energy requirements. Stabilised crude is loaded to tankers through Energean's own offshore loading terminal that lies in a distance of about 3 km to the south of Sigma. Sulphur is sold locally.

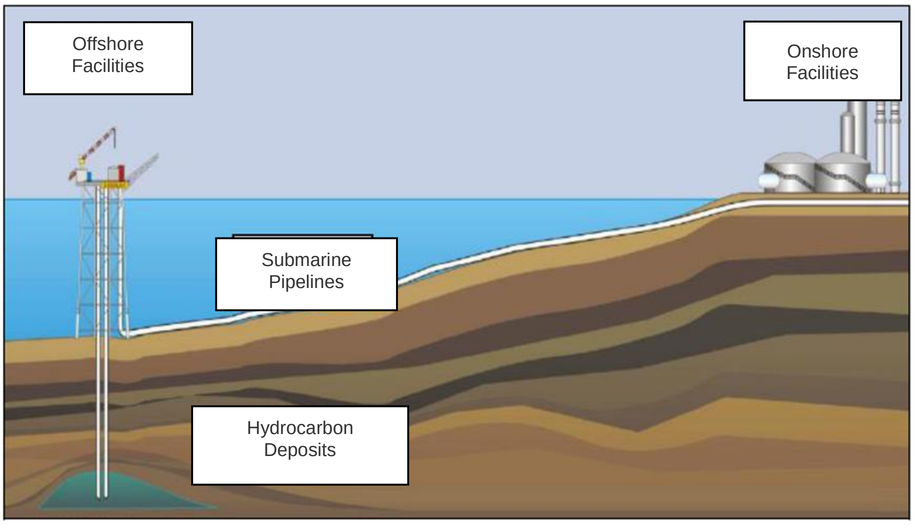
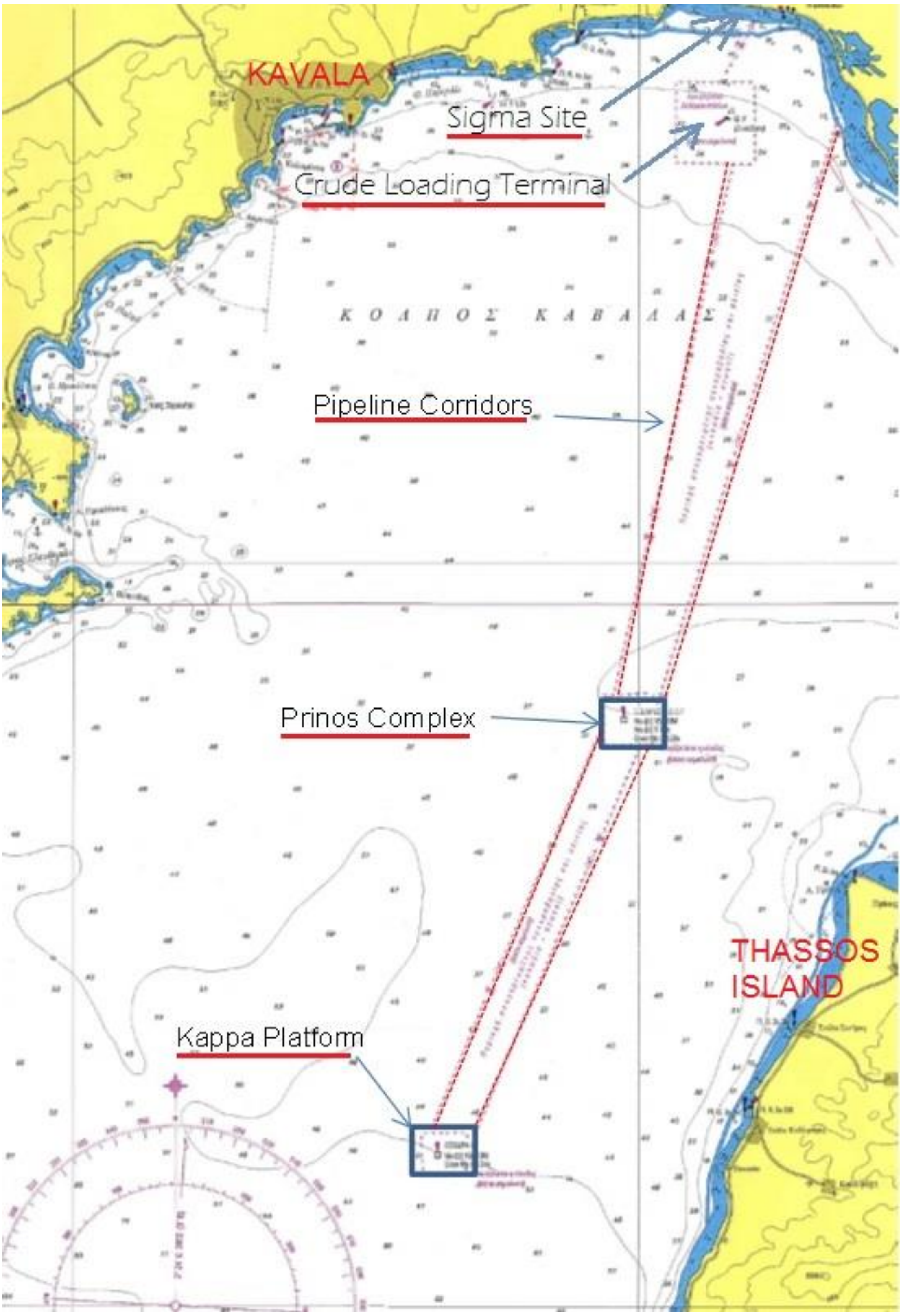


Figure 6-1: Existing facilities arrangements



Map 6-1: Existing facilities of Prinos and South Kavala fields

6.1.2 Hydrocarbon extraction

The reservoir is a geological structure consisting of high porosity rock (commonly sandstone) covered by impermeable rocks (shales or evaporates). Hydrocarbons are located within the porosity of the formation at relatively high pressures and temperatures such that there is often no separation between gaseous and liquid phases (depending on the hydrocarbon fluids phase behaviour). Gas is liberated from the oil as the hydrocarbons flow to surface and the pressure declines. In an oil field produced gas is commonly referred to as Associated Gas (or AG). In a gas field where no oil is present it is referred to as Non-Associated Gas (or NAG).

Hydrocarbons are extracted from a reservoir by wells. A well is effectively a series of pipes of reducing diameter that are cemented into place. A Drilling Rig is used to construct a well. Drilling rigs can be mobile (move from location to location) or fixed (dedicated to a particular structure/field). The existing facilities include wells that have been drilled historically, but there is also ongoing drilling of new wells in these locations, which have already been permitted and assessed in an EIS.

The total number of personnel working onshore is 146 and the total number of personnel working offshore is 90 employees. 3 shifts, each working for 8 hours during the 24 hours day operations. The day working personnel is supported by 31 contractors working in the plant on a permanent base. The offshore crew changes are carried out by the company's crew boats and the onshore crew changes by busses.

6.1.3 Platform 'Kappa'

Kappa platform is located in the Gulf of Kavala, above the sweet (no hydrogen sulfide content) natural gas deposit of South Kavala, 12 km to the southeast of the Prinos platforms complex. The deposit is located at a depth of 1,700 m; produced gas has a methane content (CH_4) exceeding 80%.

The Kappa platform is a 4-legged steel jacket equipped with two (2) decks. Sea depth at the point is reaching 52 m.

Kappa hosts two wells (SK-3B, SK-4) which are located on the lower deck and processing equipment mainly on the lower but also on the upper deck.

Gas from the Kappa wells flows to a horizontal separator where free condensate is removed. The gas is then compressed to 12 bar by a screw compressor and cooled and condensed liquids removed in a discharge separator. Gas is then passed through a glycol contactor to remove water. The combined gas and condensate production stream flows multi-phase to Prinos Delta where it mixes with dried sour gas from that facility. Small quantities of water are removed on Kappa. Entrained condensate is separated by gravity in a skim pile before water (about 150-200lt/d) is discharged to sea.

The process flow diagram (PFD) 523-2700-P-002 is presented in Annex 2.

A small gas compressor (C-666 B) also assists the production and transport of natural gas by

increasing the pressure gradient between the separator (V-171B) and the pipeline (12 and 8 bar respectively). For this operation, there are two generators of 440 KW each (one in operation and one on standby mode).

Kappa is operated remotely from Prinos Delta, without the presence of any local personnel. The two platforms are connected with a 6'' submarine pipeline with a length of 12 km, transporting sweet dehydrated natural gas to Delta upper 20-30 bar operating pressure.

Currently the Kappa platform is produced intermittently. Average production length is about 10 days per month, with durations being longer in the summer months and shorter in the winter. Energean is reviewing options to bring Kappa back into full production.

The operational license for the South Kavala field expired in November 2015. The Greek government is examining options to convert the field into a site for gas storage. It is expected that Energean will be request to manage and maintain the facility and hence although it is not a core asset has been covered by the current EIS.

Focus has been on the fields and facilities containing sour crude as these have significantly more potential for causing environmental impacts than a low-pressure sweet gas field with little free liquid content.

Photo 6-1: Kappa platform

6.1.4 Platforms 'Alpha', 'Beta' and 'Delta'

The Prinos deposit is located in the Kavala Gulf, approximately 8 km to the west - northwest of the Prinos lighthouse of the island of Thasos, at the southern edge of the Kavala Bay and

approximately 18 km to the south of the city of Kavala.

It is a crude oil deposit with dissolved sour natural gas, which means that the deposit has a high content of hydrogen sulfide. This toxic gas and the presence of water, gives corrosive properties to the produced liquids and, in low temperatures, it contributes to the formation of hydrates.

The specifications of the materials that have been used for the construction of the equipment are such that they have the ability to limit the corrosive action of the hydrogen sulfide to a minimum. In addition, all safety equipment of the platforms and the personal safety measures for the personnel have been designed taking into account the presence of hydrogen sulfide, in order to limit and mitigate all possible risks.

The Prinos platforms complex comprises:

- **Two production platforms** - **Alpha** and **Beta**, each one having slots for 12 wells. These platforms have been designed so that they can house Energean's drilling, work-over and service rigs. Alpha has been recently upgraded to allow it to host the Drilling Equipment Set of Energean's tender assisted drilling barge, the 'Energean Force'.

Photo 6-2: Platform Alpha

Photo 6-3: Platform Beta

- **One processing platform - Delta,** where the following procedures are performed:
  - ⇨ Separation of the production phases - sour crude oil, water and natural gas;
  - ⇨ Dehydration of the crude oil via electrostatic separation;
  - ⇨ Transport of sour crude oil to the land facilities by means of a pump and an 8" submarine pipeline;
  - ⇨ Dehydration of sour natural gas with triethylene glycol (TEG);
  - ⇨ Transport of sour natural gas from the platform Delta to the land facilities, via a submarine pipeline with a diameter of 12";
  - ⇨ Processing of the water produced (removal of hydrocarbon residues and removal of hydrogen sulfide) and disposal at sea;
  - ⇨ Injection of sea water into the Prinos reservoir, in order to maintain pressure;
  - ⇨ Compression of sweet gas transported offshore from Sigma to be used as gas lift in the Prinos wells.

Photo 6-4: Platform Delta

Alpha and Beta, as well as the flare structure, are connected to Delta via bridges. These support the pipelines and provide for access to the personnel. The platforms are equipped with all required support systems for proper and safe operation. Power is supplied to the platforms from the land facilities via two submarine cables, each one of which being able to cover the needs of the platforms.

The Prinos Complex has no permanent accommodation. Due to high levels of H_2S content in the deposits and the potential risk in the event of a release, staff sleeping offshore would be subject to unacceptable levels of risk. All staff instead is based onshore transferring to the platforms as dictated by their work shift. Boat transportation is used instead of helicopters to minimize risks. Production staff is split into 5 teams that cover a full 24-hour period in three shifts. Each team comprises 10 people. Maintenance work is undertaken on day shifts only Monday to Friday. Maintenance staff travels to and from shore as required.

Energean's tender assisted barge, the Energean Force, contains accommodation for 126 people. The accommodation unit is located approximately 100m from the platform complex in a location that cannot be impacted by H_2S releases. The accommodation module is pressurized with air inlets protected by CH_4 and H_2S monitors and automatically closing louvres. All staff carries personnel BA equipment in case of emergency. Drilling staff work 12-hour shifts either for 28 days on / 28 days off or 14 days on / 4 days off.

6.1.4.1 Platform "Delta" topside facilities

6.1.4.1.1 Separation of the three oil phases

Three, three-phase separators are located on the upper deck of the Delta: V-101A & B and V-107. V-101A & B separators are operated in parallel and effect primary separation of the combined Alpha and Beta production stream; V-107 is a test separator and is used periodically to evaluate the production of individual wells. The test separator is equipped with instruments for measuring the flow of gas, crude oil and water. Tests can be performed without effecting flow from the other wells. The separators operate at a pressure between 12 and 17 barg and a temperature of 80°C.

Since separation in the 1st stage separators is not perfect, further processing at Delta is necessary. The factors that do not allow perfect separation in the first place are:

- Existence of crude oil/water emulsions, contained in the crude oil phase;
- The separated natural gas is saturated with water vapor;
- The separated produced water is saturated with hydrogen sulfide and contains hydrocarbon droplets.

The process flow diagram (PFD) is presented in 523-2000-P-002A in Annex 2.

6.1.4.1.2 Crude oil dehydration

The dehydrator V-102 is located on the middle deck of Delta; flow to this vessel is by gravity from the 1st stage separators located on the upper deck.

Separated crude oil and emulsions are transported to V-102. Demulsifier chemical is added at the entrance of V-102, while an anti-corrosive agent is added at the exit (for the protection of the 8" pipeline from internal corrosion). The dehydrator operates under a pressure between 12.5 and 17.5 bar (g) and a temperature of 80^{o}C.

Produced water remains in V-102 for approximately 30 minutes, while the crude residence time is 40 minutes. This is a sufficient period to allow the emulsions to be broken. Following dissipation of the emulsions water droplets agglomerate and sink to the bottom, whereas the crude oil rises to the oil layer. The method used for the separation is electrostatic separation.

Crude oil is transported from the dehydrator to the land facilities by means of two centrifugal pumps, (one is a backup pump), through a submarine 8" pipeline, with a length of approximately 18 km.

The process flow diagram is presented in 523-2000-P-002A in Annex 2.

6.1.4.1.3 Dehydration of sour gas

The gas separated in V-101A & B and V-107 (when in operation), is transported to the sour gas dehydration unit, where water is removed. This takes place in order to avoid any issue with internal corrosion of the 12" submarine gas transport pipeline, as well as in order to avoid any issues caused by blockage of the pipeline due to the formation of hydrates.

The gas dehydration process includes the following stages:

- Cooling of the gas at 50^{o}C with the air coolers E-101A & B;
- Collection of concentrates in the container V103A and redirection of the concentrates, by the pumps P-103C & D, to the separators V-101A & B;
- Absorption of the water at tower V-104, where the incoming gas comes into contact with glycol (TEG);
- Recovery and recirculation of the glycol (low pressure separator V-109, filters F-104A & B, reboiler E-102, warm/cool glycol exchanger E-103, recirculation pumps P-105A & B and air cooler E-104).

Following dehydration, the sour gas is mixed with the sweet gas from the Kappa and, flows via the 12” submarine pipeline (without compression) to the shore facilities.

The process flow diagrams are presented in 523-2000-P-002A and 523-2000-P-002B in Annex 2.

6.1.4.1.4 Treatment of produced water

Produced water from separators V-101A & B and V-107 is transported to de-oiler M-111. This is a horizontal vessel (diameter of 1,850 mm x 7.625 mm length) that performs the following functions:

- Separation and removal of small gas and hydrogen sulfide quantities, which are generated as the water flashes from the high pressure of the separators to atmospheric pressure of the de-oiler;
- Separation of oil droplets from the water via gravity and with the help of special agglomerating plastic nets;
- Collection of oil and removal to the oil collector M-166;
- Removal of water and transfer to the second in-line de-oiler, M-111 B.

The agglomerating part of the de-oiler provides a large contact surface, where the oil droplets attach, join each other, rise to the surface and create an oil layer. The oil is collected in the oil collector and from there it is transported to the oil collector M-166 and, subsequently, to the oily water and oil collection vessel V-133.

When a sufficient amount of liquid is collected, the automatic level monitoring system activates one or both pumps, P-133 A & B, depending on the level, which returns the liquids from V-133 to the entrance of separators V-101 A/B.

Water from the coalescence section of the de-oiler is transported to the quiescent zone at the back of the vessel, where any oil droplets are separated through the force of gravity and subsequently it is transported to the hydrogen sulfide stripper V-111.

Despite the fact that the first de-oiler M-111 normally achieves full retention of oil, a second de-oiler is installed in series, of a similar design but with significantly larger capacity, the M-111B de-oiler (diameter 2,700 mm x 6,650 mm length) operates at zero pressure. The second in-line

de-oiler M-111B safeguards the water discharge quality should any mal operation of the upstream separation equipment occur. In normal operation no oil is removed from this vessel.

The capacity of the two de-oilers, currently installed in series, is 164 m^3/hr (3,936 m^3/d). The two de-oilers can operate in parallel with a total capacity of 238 m^3/hr (5,712 m^3/d).

The hydrogen sulfide stripper V-111 is a tower with a height of 30 m with 35 trays, and operates at an almost zero pressure and at a temperature of 77ºC. Residual hydrogen sulfide is removed from the produced water in this tower.

Hydrogen sulfide removal is achieved by means of a sweet natural gas stream. The addition of hydrochloric and citric acid at the entrance of the stripper, contributes to the removal of hydrogen sulfide and the avoidance of the formation of scale inside the stripper.

The stripper has been designed for a total produced water rate of up to 100 m^3/hr (2,400 m^3/d). When the produced water exceeds 100 m^3/hr, the excess quantity of produced water is directed immediately to the skim pile M-164, after having passed through the de-oilers M-111 and M-111 B. Currently and in the future, the quantity of produced water does not exceed 100 m^3/hr.

The high capacity and the good performance of the de-oilers of platform Delta (M-111, M-111 B) means that the water produced at the exit of the de-oilers - which subsequently enters the stripper V-111, contains minimum residue of hydrogen sulfide, which can, in turn, be removed at the separator M-164 (skim pile) and the subsea settlement tank TK-164, where the treated water ends up. This fact permits the avoidance of the operation of the stripper V-111 when water flow is low.

The produced water injection system is designed to reduce the concentration of oil in water to 10 ppm. Routine sampling is undertaken to confirm that this level is achieved. The actual concentration of water discharged to the sea is somewhat below this level as due to residence time in the skim pile and subsea settlement tank additional oil droplets coalesce and segregated oil pumped back to the platform.

The process flow diagrams are presented in 523-2000-P-003, 523-2000-P-045A and P-045D in Annex 2.


Photo 6-5: Skim pile M-111


Photo 6-6: Skim pile M-111B

Photo 6-7: Stripper V-111

Photo 6-8: Skim pile M-164

6.1.4.1.5 Sea water injection system

Seawater is injected to the Prinos reservoir in order to maintain pressure, and hence increase recovery rates. This assembly comprises the following equipment:

- Sea water suction pumps P-121 A/B/C/D, with a capacity of 135 m^3/hr each, with a differential pressure of 9.5 bar;
- Filtering system, which includes three first stage filters S-121 A/B/C, two sand filters of dual flow, the F-121 A/B, and two filters F-122 A/B, equipped with customized special filtration cartridges that allow retention of up to 5 microns;
- In order to control development of marine organisms, chlorination systems are used (hypochlorite generators CH-121 A/B) and supply of special biocides;
- One vacuum degassing tower DA-121, which removes the oxygen and the carbon dioxide dissolved in the seawater, protecting the pipelines and the piping of the production and the injection wells from corrosion.
- Auxiliary seawater injection pumps P-118AA and P-123 AA/BB/CC and main injection pumps P-123 A /B/C, with a capacity of 100 m^3/hr each one, with a final discharge pressure 290 barg.

The process flow diagram is presented in 523-2000-P-008 in Annex 2.

6.1.4.1.6 Gas lift system

Prinos wells require artificial lift to enable them to produce to surface. To date gas lift has been used for artificial lift on Prinos. A gas lift system was retrofitted on the facility in the early 1990's as reservoir pressures fell and water cuts increased.

Sweet gas from Kappa or from the onshore facilities is used in the gas lift system. Injection is normally at 125 bar, though when kicking off wells the pressure can be increased to 178 bar.

The gas lift system comprised the following five (5) compressors and the respective gas distribution network to the production drills:

- C-121: Test gas lift compressor with a supply of 1,120 Nm^3/hr

- C-122: Kick-off gas lift compressor with a supply of 1,120 Nm^3/hr
- C-123: Main gas lift compressor with a supply of 8,956 Nm^3/hr
- C-124: Kick-off gas lift compressor with a supply of 1,532 Nm^3/hr
- C-125: Main gas lift compressor with a supply of 8,043 Nm^3/hr

The process flow diagram is presented in 523-2000-P-002C in Annex 2.

6.1.4.2 Platform "Delta" support systems

6.1.4.2.1 Cooling water system

Cooling water requirements of motors with radiators are satisfied by the use of seawater, drawn by the pump P-171.

In addition, cooling water may be taken from the firefighting water system, from pumps P-161, P-162 and P-163 D. Finally, water may be supplied to the platform Delta from the Valiant Energy supply vessel, with the use of its own pump.

The water from the radiators discharges directly to sea.

Table 6-1: Water use

Source	Average consumption (m^3/d)						Maximum consumption (m^3/d)					
	Distribution network	Surface water	Underground water	Recycling	Total (1+2+3+4)	Seawater	Distribution network	Surface water	Underground water	Recycling	Total (7+8+9-10)	Seawater
Usage	1	2	3	4	5	6	7	8	9	10	11	12
Process	-	-	-	-	-	-	-	-	-	-	-	-
Cooling	-	-	-	-	-	1,200	-	-	-	-	-	1,440
Injection	-	-	-	-	-	1,500	-	-	-	-	-	3,000
Potable	10	-	-	-	10	-	15	-	-	-	15	-
Total	10	-	-	-	10	2,700	15	-	-	-	15	4,440

The process flow diagrams are presented in 523-2000-P-040, P-041 and P-041A in Annex 2.

6.1.4.2.2 Fuel gas system

Natural gas is consumed at Delta:

- By the glycol reboiler for the dehydration of sour natural gas;
- By the produced water stripper V-111;
- By the flare in order to ensure safe operation (pilots and purge);

Gas consumed is sourced either from the inlet line from Kappa or from the line from shore feeding the Prinos gas lift system.

Total gas consumption is presented in the table below (fuel consumption).

6.1.4.2.3 Diesel fuel system

Diesel is stored in the interior of the southeastern leg of Delta. The tank has an internal diameter of 1 m, a height of 7.6 m and a capacity of 5.8 m^3.

It is equipped with a ventilator, a draining system, an overflow, a level sight glass and high and low level switches that activate the respective alarm. The ventilation system consists of a 2" line, a flame catcher and an open-air vent.

Table 6-2: Fuel gas system

Fuel type	Production (tons / month)	Consumption		
		Steam generation (tons / month)	Other usages (tons / month)	Total (tons / month)
Gasoline	-	-	-	-
Diesel	-	-	79	79
Fuel oil 1,500''	-	-	-	-
Fuel oil 3,500''	-	-	-	-
LPG	-	-	-	-
Coal gas	-	-	-	-
Natural gas	-	-	67	67
Solid fuels type	-	-	-	-

The process flow diagram is presented in 523-2000-P-002A in Annex 2.

6.1.4.2.4 Instruments air system

The platform instrument air system comprises three, two stage compressors used, with a capacity of 295 and 370 Nm^3/hr. Each compressor has the capability to cover the needs of the platform independently.

They share an air dryer system.

6.1.4.2.5 Potable water system

The potable water system supplies water to the taps and the eye-washers at each of the platforms. It also supplies water for rinsing the air nozzles at the degasser of Delta. The system includes filling lines, pumps, pressure container, distribution lines and relevant instruments. Potable water is delivered to the platform complex by boat and is bunkered into dedicated storage tanks. Water in the tanks is treated with UV radiation to minimize bacterial growth. Energean's supply boats have dedicated storage tanks for the transfer of potable water. Water is supplied to the boats at the Sigma plant. This water is from the local government distribution system.

6.1.4.2.6 Breathing air system

Specific muster stations exist on all platforms for emergencies, such as hydrogen sulfide leaks, fire, etc. These stations are equipped with 50 lt / 200 bar (g) breathing air cylinder assemblies.

In emergency situations personnel muster at these stations donning their personal breathing apparatus. These cascade systems allow personnel to connect their personal breathing apparatus and have breathing air for a longer period of time, as well as to refill their personal cylinders.

The available capacity of the cascade system is sufficient for the correction of any problems or the evacuation of the platform and the removal of all personnel.

In addition to the fixed breathing air systems, the platforms are also equipped with a large number of independent devices lasting for 30 minutes, in the event of intervention - rescue.

6.1.4.2.7 Storing and handling of hydrochloric acid

Hydrochloric acid is stored in the V-114 tank, which supplies acid to the produced water line at the hydrogen sulfide stripper V-111.

The acid is handled by means of three portable hydrochloric acid storage containers (V-803, V-808, and V-811), which are mounted on the “LIMIN PRINOS” barge.

The process flow diagram is presented in 523-2000-P-019A in Annex 2.

6.1.4.2.8 Emergency generator

A diesel emergency generator is permanently connected to the power network of the Prinos platforms. This starts automatically in case of a power outage at the platforms. It turns on automatically if voltage is lost at the 400 V bar and it is ready to supply power to selected pump motors and all uninterruptible power supply systems (UPS).

The generator is driven by a diesel motor, with a power of 135 KVA and supplies power to the following systems:

- One instruments air compressor;
- One firefighting water electric pump;
- The diesel fuel transport pump;
- The uninterruptible power supply systems (UPS) of the platform;
- The positive pressure conservation system at the housing of the generator itself.

6.1.4.2.9 Power supply substation / network

Power is supplied to the electric network of the platforms via the onshore substation and the two submarine cables at a voltage of 20 KV. At Delta the voltage is transformed to 6.3 KV and subsequently to 400/230 V.

Four uninterruptible power supply systems (UPS) are located on Delta each with a power of 7.5

KW, they operate under 24 VDC, 110 VDC, 110 VAC, and 230 VAC voltages, supplying power to control instruments, the emergency shutdown system, all local switches and the emergency lighting system, respectively. They provide independence for at least 2 hours, in order to allow the emergency generator to start, which normally requires a few seconds and provides powers to the UPS chargers.

Power is supplied to the navigational aids of platform "Delta" through a different batteries assembly, with an independence of 8 days.

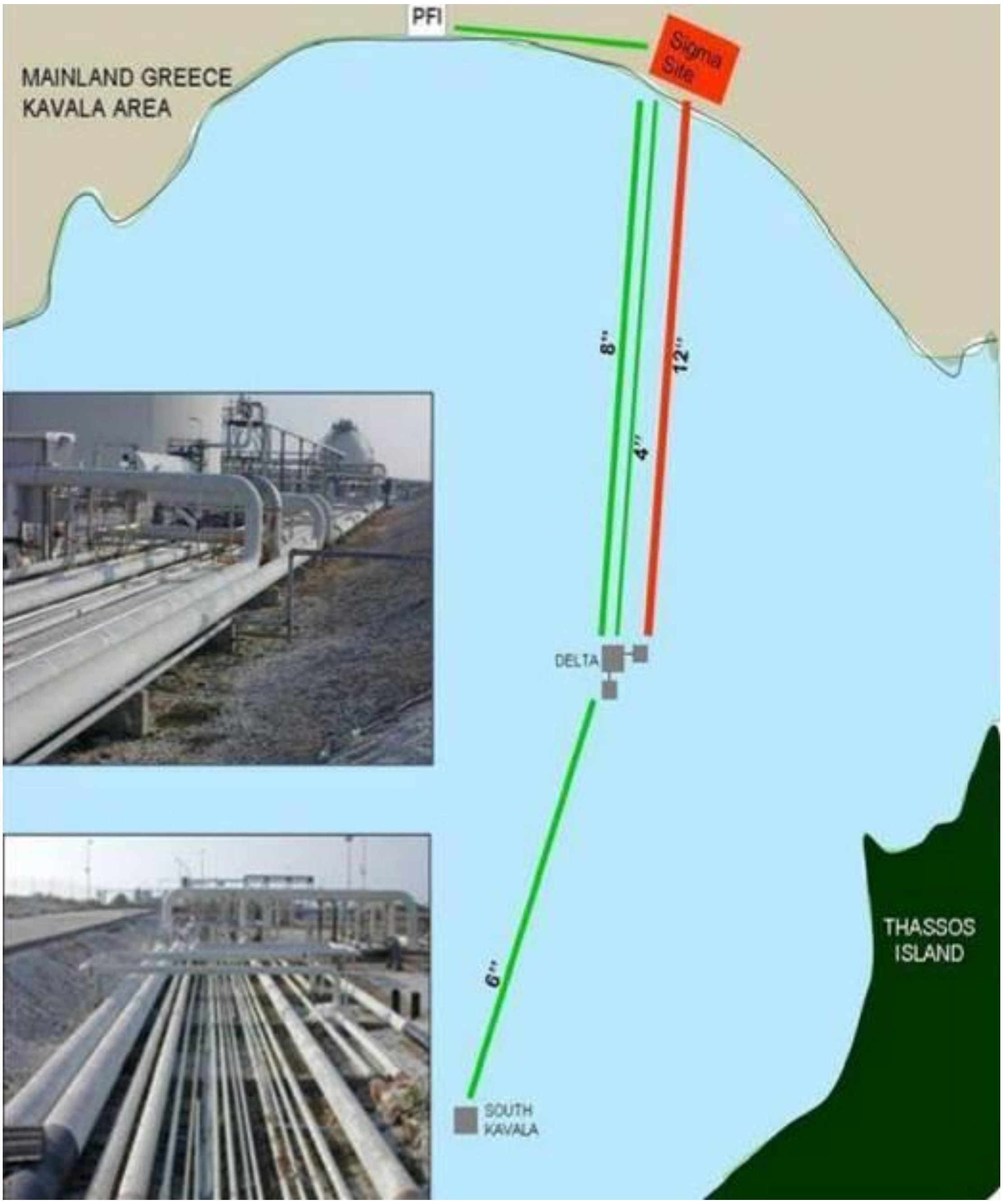
Table 6-3: Power consumption

Installed power	8,000 KW
Maximum power demand	4,000 KW
Average power consumption	96,000 KWh/d
	2,900 MWh / month
Mains voltage (low / medium)	0.4 / 6.3 and 20 KV

6.1.5 Submarine hydrocarbon pipelines

The company uses four pipelines for the transport of hydrocarbons as follows:

- Submarine pipeline with a diameter of 6" and a length of 12 km for the transport of sweet, dehydrated gas from platform "Kappa" to platform "Delta" (operating pressure 8-12 bar (g));
- Submarine pipeline with a diameter of 12" and a length of 18 km for the transport of sour, dehydrated natural gas from platform "Delta" to the land facilities (operating pressure 8-12 bar (g));
- Submarine pipeline with a diameter of 8" and a length of 18 km for the transport of sour, dehydrated sour crude oil from platform "Delta" to the land facilities (operating pressure 25-60 bar (g));
- Submarine pipeline with a diameter of 5.3" and a length of 18 km for the recirculation of sweet natural gas from the land facilities to platform "Delta" for injecting gas to the production drills (operating pressure 20-35 bar (g)).



Map 6-2: Existing submarine pipeline connections between offshore facilities and offshore – onshore facilities

The submarine pipelines for the transport of sour crude oil and sour natural gas are equipped, at both ends, with special type ‘Axelson’ valves, which automatically shut off when the pipeline pressure drops below a predetermined value, protecting thus the sea from any possible leak of oil or gas, in case of partial or total breach.

In addition, automatic valves are installed, which can automatically isolate the pipelines using independent low-pressure switches. In the case of the sour natural gas pipeline, the isolation of the pipeline in the event of low pressure is followed by the transport-controlled combustion of the content pipeline at the flare.

The current pipelines are coated with concrete over their full length for protection from corrosion and external impacts. Close to the platform complex the lines are covered with rock for additional protection from dropped objects including the anchors of the supply boats that approach the platforms. In water depths below 20m (from a location approximately 7 km north of Deltra platform to shore) the lines are buried for additional protection from small boat anchors and trawler “boards”. The oil and sour gas pipelines have been designed so that they can be intelligently pigged to allow internal condition to be assessed. Energean is planning to intelligently pig these lines next in 2016. Previous surveys have shown minimum corrosion. An exclusion zone has been established to prevent fishing over the pipelines but this is not strictly enforced by the local authorities. Routine external inspections of the non-buried sections have identified minor damage to the concrete coating in the past caused most likely by trawler boards. When damage is identified the concrete coating is repaired by divers. No failures of the pipelines have occurred to date due to external impacts.

6.1.6 ‘Limin Prinos’ barge

The enterprise is supported by the towable barge ‘Limin Prinos’, with a length of 54 m, a width of 15,54 m and depth of 3 m.

It is equipped with fifteen compartments (tanks) with a capacity of 150 m^3 each. Four of them always remain empty, six of them contain water and the remaining five serve the platforms Alpha and Beta, when repair or cleaning activities are performed at the wells, in addition at Delta, when vessel cleaning activities take place.

The barge is equipped with a small gas / liquid separator from which flashed gasses are routed via flexible pipe to the Prinos complex flare. Vapors from the fixed compartment are passed through a caustic scrubber to remove hydrogen sulfide before being vented to atmosphere.

Liquid waste is transported from the platforms to the land facilities by the barge for treatment at the existing plant approximately 12-15 times per year (in total 5,000 to 8,000 m^3 per year).

Photo 6-9: Barge ‘Limin Prinos’

6.2 FUTURE FACILITIES

Energean intends to increase oil production from its Prinos concession area by implementing the Prinos Area Development Strategy that includes execution of the Prinos Area Development Project. The relevant Field Development Plan comprises the following elements:

- Development of a drilling resource;
- Infill drilling in the Prinos field;
- Obtain sub-surface data to underpin subsequent development areas; and
- Develop the Epsilon satellite field (with one platform - Lamda).

Further potential activities including the installation of a second platform at Prinos North (Omicron) will depend on interpretation of the newly acquired 3D seismic, data gathered from the ongoing infill campaign as well as studies to investigate the EOR potential of Prinos.

In the following paragraphs, the approach taken for the development and the equipment foreseen to be installed will be described.

6.2.1 Overview

For the development of the new Oil Fields (satellite fields), the plan currently foresees the installation of Self-Installing Platforms (SIP2s) in two different project execution phases. During the first firm phase, the Lamda platform will be installed at the Epsilon field. Subsequently, the Omicron platform might be installed south of the Prinos North field. The two platforms will be essentially identical. The second phase has yet to be approved by Energean as discussed above.

Each SIP2 will be a Normally Unattended Installations (NUI) and thus will contain a base minimum of equipment.

During the development of Epsilon, the Lamda platform will be installed and production drilling will begin. Production flow will be directed to the Delta complex. Gas lift and water injection will not be required initially however relevant pipelines and facilities will be pre-installed.

In total five production and four injection wells are envisaged in the P50 (including deeper volumes) case. If deeper volumes are not proven then two less wells would be required (i.e. 4 producers and 3 injectors). The base plan envisages use of water injection for pressure support. All water injection wells will be back produced initially. This will increase early production rates as well as providing an area of lower pressure into which water can be injected with existing pumps. The facility has been designed to enable conversion of the production wells from gas lift to ESP lift at some point when pressures and water cuts have stabilized. Room for a gas injection compressor has also been allocated should a sour WAG scheme be implemented in the future. The platform will be equipped with a spare set of risers to enable a subsequent satellite (notionally Athos) to be tied back to Delta via Lamda.

The Prinos North area may also be developed in a second phase via an identical SIP2 structure.

This platform, designated Omicron, would be connected back to Delta via a multiphase production line and a power/chemical utility umbilical and to Lamda for the gas lift line and water injection line. The production line will tie in to the production line coming from Lamda to Delta just prior to connection of this line to the Delta riser.

The Prinos oil field reservoirs and planned development layout for Prions area are presented in Annex 2.

The Project Area for the assessment of new facilities is provided in Chapter 1, Introduction.

The Project consists of the following planned and potential installations:

- Planned new Installations in Epsilon Field comprise the following:
  - ⇨ Lambda Platform – SIP2 type (Self-Installing Platform 2) and attendant equipment (topside facilities)
  - ⇨ Connection of Lambda Platform with the existing Delta platform through offshore hydrocarbon pipelines (buried)
  - ⇨ Umbilical between Lambda and Delta Platform transporting power, data and chemicals
  - ⇨ Modifications to Delta Platform
- Potential new Installations at Prinos North Area (later project phase) comprise the following:
  - ⇨ Omicron Platform – SIP2 and attendant equipment (topside facilities)
  - ⇨ Connection of Omicron Platform to existing Delta Platform, through offshore hydrocarbon pipelines (buried)
  - ⇨ Umbilical between Omicron with the existing Delta Platform

The new installations and the Field Layout are provided in diagrams 293902-SPL-SUB-DR-90100-001/002/003 presented in Annex 2.

Similarly to what is currently defined as a prohibition area of 500 m radius over current operations (existing operating facilities in place), the same is expected to be designated for the new additional facilities. Therefore, before the construction of the project, a Navigation new exclusion zone will be defined in collaboration with the Naval Authorities (Port Authority and the Coast Guard under the supervision of the relevant Ministries).

Based on the above, the new planned facilities and the potentially further developments are expected to define an additional area of 8.67 km^2 which when added to the existing ones (excluding overlaps) it will confine a total of 46.34 km^2 (conditional to the naval authorities' decisions).

6.2.2 Project time schedule

6.2.2.1 Overview

The Prinos Area Development project commenced in Q3 2013 when an initial conceptual design

contract was awarded to Exodus (UK) to investigate options for developing the Epsilon field. Exodus proposed a traditional jacket structure with interconnecting pipelines tied back to Delta. Due to the remote nature of Greece and hence the high cost of mobilising support vessels from the North Sea or Persian Gulf, the installation costs associated with such an approach were higher than the fabrication costs. Wells were assumed to be drilled from a hired jack-up.

In early 2014 Energean's technical staff reviewed the Exodus base proposal internally. Options to use move novel platform structures and pipeline installation techniques were investigated. The use of conductor supported platforms, self-installing floating towers monopoles, suction piles etc. were examined. As well as providing significant installation cost savings these approaches also opened up the possibility of employing Greek contractors for significant elements of the scope. With the financial down turn in Greece this represented an opportunity to benefit the local economy and also obtain lower construction costs.

In parallel options to drill the required wells were investigated with the eventual purchase of the Energean Force barge in Q3 2014.

This new drilling facility was upgraded and refurbished between October 2014 and June 2015. In parallel the Prinos Alpha platform was modified to allow the Energean Force DES to be installed. The rig was moved to and rigged up on Prinos Alpha during summer 2014 and drilling commenced September 2014.

FEED work associated with the Lamda and Omicron platforms to be installed at Epsilon and Prinos North respectively, commenced during Q4 2014. This work continued through to the end September 2015. Two sub-structure options were examined in detail with SPT's SIP2 design being selected narrowly ahead of GMC's SIFT. Both represented significant savings over a traditional approach. The SIP2 design was finally adopted as it was seen to offer lower installation risk. The SIFT design was seen to be better suited for slightly deeper waters. Detailed design contracts for topside and sub-structure work were awarded October 2015. Work on the Omicron platform ceased at the end of FEED. Omicron was taken through FEED even though it has yet to be sanctioned as this provided significant cost advantages compared with undertaking a separate FEED later. It ensured that both platforms could be identical.

Work to identify potential local fabricators of the topside, substructure, pipelines and umbilicals commenced at a very early stage of the concept work. A number of well-managed, experienced companies have been identified over the last 18 months and some of these have been awarded small work scopes associated with the upgrade of the Prinos platforms and the tender barge. A comprehensive contracting strategy was developed late 2014 in parallel with FEED work. This was structured to ensure local companies could compete whilst ensuring bids could also still be attracted from foreign entities.

Currently the Epsilon development project is progressing through detailed design. Good budgetary estimates have been obtained demonstrating the significant cost reduction potential of using Greek enterprises. Geophysical and geotechnical studies have been undertaken to define final platform location and confirm pipeline routing. A small, well experienced, Project Management team is in the process of mobilization. Work to finalise the safety and

environmental risk elements of the project are well advanced allowing the ESIA to be prepared ready for submittal to the Greek authorities in early March 2016. Approval of the ESIA and issuing of permits is expected by end of June 2016.

Detailed design is planned to last 6 months, completing end Q1 2016. In parallel the major contracts will be tendered. Contracts will not be awarded until detailed design is complete ensuring no changes in work scopes post award. Where possible lump sum bids will be sought. Transportation and installation contracts are being negotiated with SPT, the sub-structure designer, so as to minimize risks during these critical periods. Procurement will commence following detailed design subject to final funding. Construction and fabrication for the main elements is forecast to be between 6 to 9 months and hence these contracts need to be awarded June 2016 for a January 2017 installation or 4 months later for an April installation. Final installation date will be driven by the number of wells to be undertaken in the Prinos Alpha campaign.

By using the SIP2 design and by installing the pipelines by the towed method from a shore construction site, the installation fleet required will be very small. Required vessels are located in Greece and hence there is no urgency in identifying a firm installation window. The SIP2 is relatively insensitive to weather conditions during installation.

The potential for delaying installation to April introduces significant float into the schedule that will allow risk levels to be reduced and should result in further cost reductions. There is an opportunity to refine the design based upon newly acquired met ocean data that reduces uncertainty on environmental conditions to be employed.

The figure below illustrates the overall schedule assuming the later installation date is finally adopted.

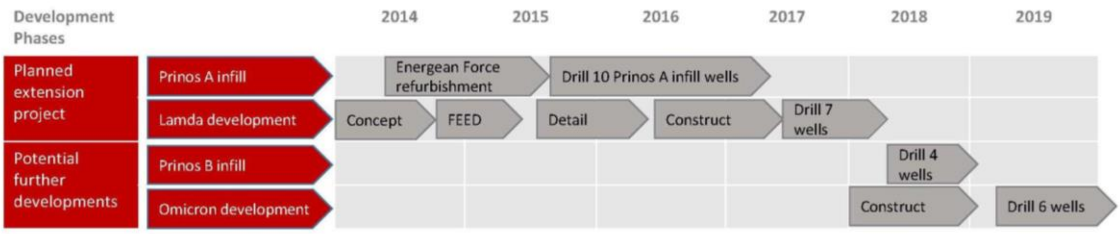


Figure 6-2: Overall schedule of operations in Prinos development area

Note that this ESIA present details on the activities that will occur for the following phases: construction, operation and abandonment. Summaries of the schedules for each phase are provided in the following subsections.

6.2.2.2 Construction schedule

Detailed design contracts were awarded for the topsides, pipeline and sub-structure scopes associated with the Lamda satellite platform in October 2015. Design work is due to last for around six (6) to seven (7) months. Lamda platform has to be installed and ready to accept the Energean Force rig late April 2017. This date could move forward or backwards based upon completion time of the ongoing drilling programme on the Prinos Alpha platform. It is assumed

currently that the Prinos infill campaign will comprise ten (10) wells and that all activities will be completed on the Alpha platform. Detailed design will be therefore be complete approximately twelve (12) to thirteen (13) months earlier than the date installation has to be completed.

Estimates received to date from potential fabrication contractors for the topsides, sub-structure and pipelines indicate a six (6) month construction period with an additional two (2) to three (3) months to procure steel. To meet an installation date of mid-April 2017 construction contracts need to be awarded early July 2016. Currently the project schedule therefore carries roughly three (3) months of float between the end of detailed design and award of the main construction contracts. Part of this float could be eroded if the Prinos drilling campaign progresses more efficiently than expected. Drilling performance will be known well before the end of detailed design. There is therefore currently no foreseen reason to tender and award these contracts in parallel with detailed design, a common practice to accelerate schedule, which introduces a degree of risk. Long lead items (electrical switchgear, platform crane) will be ordered nine (9) to twelve (12) months before required on site, again after detailed design has been completed. It is possible that the pipelines and the umbilical cable can be installed post platform installation moving them well off the critical path. The pipelines and umbilicals are not required until the first well has been drilled: some 10 weeks after platform installation. It is also possible that they may be installed prior to platform installation to avoid clashes with the mooring system. In this case these items would be procured towards the end of detailed design.

6.2.2.3 Operations

Recent inspections of the platform sub-structures have indicated that remaining life (based upon corrosion and fatigue) is greater than 20 years. Planned refurbishment (re-painting) of the topsides structure and the low levels of internal corrosion seen in vessels and pipework give confidence that surface equipment can be operated for the full duration of the planned expansion project.

6.2.2.4 Abandonment

The existing Prinos licenses run to 2034. Considering the future and potential projects that can be expected in the Prinos basin it is unlikely that any of the Prinos complex facilities will be abandoned before this date. The new platforms will serve smaller accumulations but have been designed to allow them to be moved cheaply to other locations in the basin.

The only field that could be abandoned in this time frame would be the Kappa structure on South Kavala gas field. This field is largely depleted. The Greek authorities are considering using the facility as the basis of a gas storage scheme which would mean its abandonment would be delayed indefinitely. Energean is reviewing use of this facility as the basis of developing small oil reserves in the area.

6.2.3 Project Components

6.2.3.1 Lamda / Omicron platforms: Self Installing Platforms 2 (SIP2)

As described above, Energean plans to install up to two (2) new satellite platforms close to its existing Prinos complex. SPT Offshore's SIP2 (Self Installing Platform 2) concept has been selected as the most cost effective type for these new facilities. The first platform (Lamda) will be installed in Q2 2017. The decision as to whether the second platform (Omicron) is required has yet to be taken. Details are provided to allow this potential additional project to be permitted.

Table 6-4: SIP2 platforms Coordinates

Geographic Coordinates (WGS'84)	Longitude	Latitude
Omicron SIP2 platform	24º29'46.84''	40º49'3.81''
Lamda SIP2 platform	24º27'20.45''	40º48'38.34''

The SIP2 platform concept has been developed by a Netherlands based company, SPT Offshore BV. A number of SIP2 platforms have been successfully installed by SPT Offshore in the southern North Sea to date.

Those platform types can be employed cost effectively in shallow water depths up to about 45 m. Some typical examples are shown below:

Stage 10 F3FA As-installed

Calder Installed

Photo 6-10: Examples of SIP2 platforms installed

The SIP2 design allows for installation without the need for mobilization of a large supporting fleet. Traditional jackets with driven piles, particularly in shallow water can cost as much to install as to build. The organization of external resources such as crane barges, piling spreads etc. also increases interfaces and hence schedule risk. The SIP2 platform is assembled onshore and floated to location on a relatively standard barge readily available in most locations. At site the platform "self-installs" in a matter of a few days, rather than a few weeks which is the norm. The installation itself is relatively weather insensitive, particularly when compared with the conditions required for heavy crane lifts, topside float-overs etc. In principle the SIP2 is equivalent to a jack-up drilling unit, except that it is not equipped with sufficient permanent buoyancy to float, and has more substantial suction anchors (suction piles) to enable it to be designed for permanent

installation and does not have permanently installed jacking systems to raise and lower the deck to water level and lift the legs out of the water. Like a jack-up it can be moved from location; making it particularly attractive for fields with a short production life and also facilitating eventual abandonment. Clearly these aspects significantly reduce its environmental footprint, as it is in effect completely recyclable unlike a traditional jacket.

The Lamda and Omicron SIP2's consist of 4 cylindrical legs each equipped with a suction pile to fix the legs (and hence topsides) to the seabed. The legs are made separately and are not attached together as in a traditional jacket. The legs are connected via the topsides deck. The legs, suction anchors and topside structure are built separately and then assembled onshore prior to installation offshore. The size of the topside is driven by the size of the installation barge to be employed. Once assembled, the platform sits on the installation barge with the legs out of the water and the suction cans in the water. The length of the platform therefore has to be slightly greater than the width of the installation barge. Stability of the assembled platform on the installation barge drives the minimum size achievable.

The topside structure can be equipped with multiple decks as per a conventional platform and the maximum weight is again a function purely of the installation barge selected. The largest difference between the SIP2 topsides and a conventional platform is the way in which it mates with the legs. Conventional topside sits on top of a substructure with its main load bearing columns positioned over the sub-structures legs. In the SIP2 the legs slot through cylindrical sleeves incorporated in the topsides. These sleeves pass through the full height of the topside.

The SIP2 assembly onshore involves lifting the legs (one by one) and dropping them through the sleeves and holding them in place at the base of the topside structure. The assembled topside/leg structure is then skidded onto the transportation barge located at a quayside adjacent to the assembly location. The assembled unit sits on a support frame located on the barge. The suction anchors are then welded onto the bottom of the legs whilst the barge sits at the quay. The lower part of the suction anchors sit below the water level increasing the draft and width and hence stability of the installation barge.

Once the suction anchors are fixed, temporary jacking systems are installed to allow the legs to be lowered to the seabed and the topside to be subsequently jacked-up the legs. The unit is then ready for transportation to the installation site.

This is described further in the sections below.

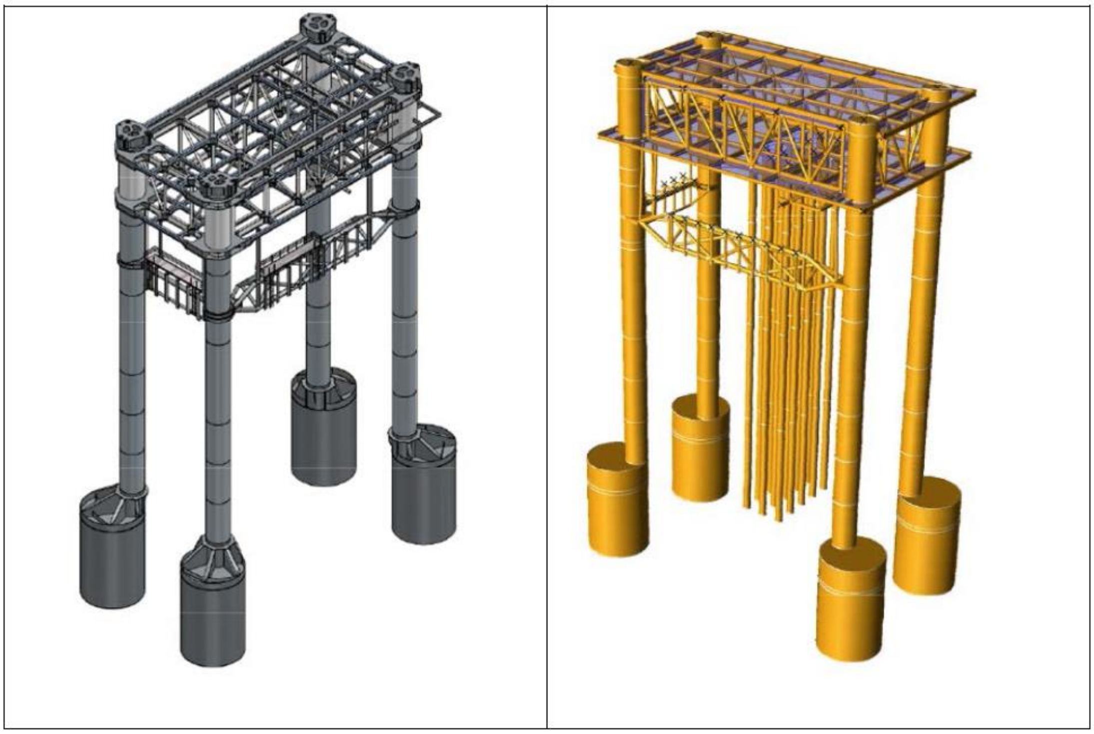


Figure 6-3: General views of initial Lamda SIP2 platform

The platform's overview and general arrangement are provided Annex 2.

The new platforms shall be designed for a minimum operating life of 20 years. The current license for the Prinos area runs until 2034.

Key dimensions of the assembled unit are provided in the table below:

Table 6-5: Summary dimensions of SIP2 platform

Summary key dimensions		
Platform Height overall from Seabed to Top deck	H	55.5m
Max Width of Topside (East to West)	W	22m
Max Length of Topside (North to South)	L	38m
Centre to Centre Distance Legs (East to West)	CCL EW	15m
Centre to Centre Distance Legs (North to South)	CCL NS	32.5m
Leg Length	Lc	53.1m
Leg Diameter	Dc	3m
Diameter Suction Pile	d_sp	8m
Depth Suction Pile	d_sp	11.5m
Thickness Suction Pile	t_sp	0.030m

The Lamda SIP2 platform is designed to be self-installed without the assistance Heavy Lift Vessels.

6.2.3.1.1 SIP2 legs

The SIP2 structure is designed as a typical offshore structure subjected to static equipment loads (including drilling operation loads), waves, wind current and earthquake loadings. Industry standard codes of practice are applied to ensure the structural integrity is maintained throughout

the design life, in place, fatigue, ship impact, seismic and transport analyses will be performed. Since the topsides and substructure are integrated, i.e. similar to a jack up, the structural legs are effectively single unbraced columns. The steel legs are simply large diameter tubes, approximately 3 m in diameter, connecting the suction piles to the topside structure. The southern two legs of the SIP2 will also act as carriers for the platform risers and umbilical j-tubes, i.e. the risers and j-tubes will be permanently contained within the legs, which offer the advantage of protection and no exposure to the ocean wind and waves or vessel impact.

Table 6-6: Weight Estimation (structural steel)

Item	Value	Unit
Legs (4 no.)	856	MT
Suction piles (4 no.)	532	MT
Topside	750	MT
Boat landings	107	MT

6.2.3.1.2 Connection of SIP2 legs to topsides

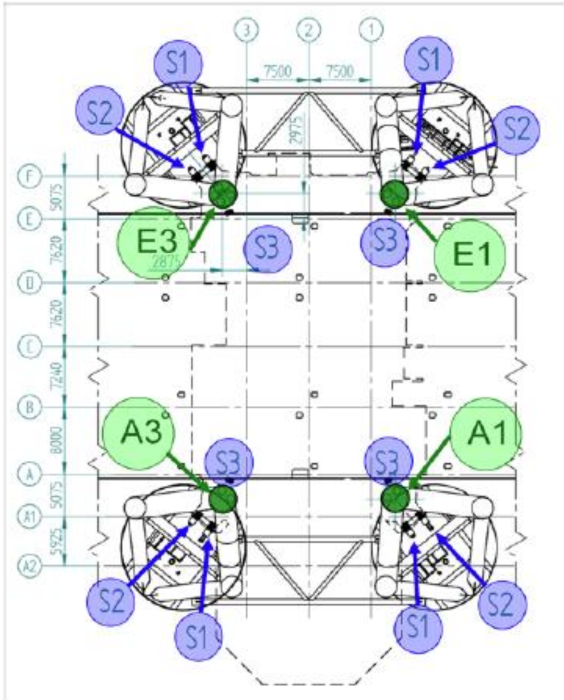
The SIP2 legs will be connected to the topside structure permanently once the topside is in fully elevated position. The legs will be contained within sleeves between the production deck and weather deck elevations, which are an integral part of the topside structure. The sleeves are required to guide the lowering of the legs during installation. Once the topside is at the required height the annulus between the sleeves and the legs will be filled with grout. The connection of the topside primary structure to the legs will be either by high capacity shearpins, or tension bolts.

6.2.3.1.3 Leg jacking system

It is envisaged that the strand jack system for the SIP2 will consist of two (2) no. bundles per leg and twenty four (24) no. jacks providing approximately 500MT capacity per leg. Strands will be connected at the top of each leg (leg head anchor block) and to the top of the suction pile (bottom of leg). The breakdown of the no. of jacks as follows:

- Eight (8) no. jacks for leg lowering (offshore operation)
- Eight (8) no. jacks for topsides lifting (provides 100% contingency) (offshore operation)
- Eight (8) jacks for pre stressing the strand jack bundles (fabrication yard operation)
- The typical speed for lowering / lifting is approximately 12 min per metre.

Strand jacking systems are commonly used in both offshore and onshore structural heavy lifting with well-established specialist companies in the market namely MAMMOET and ALE.



F3FA Top View Strand Jacks and Bundles

F3FA Strand Jacks

Figure 6-4: Leg jacking systems

6.2.3.1.4 SIP2 suction anchors

The new satellite platforms will be fixed to the seabed by the use of suction anchors. Suction anchors have been used widely in the offshore oil industry as an alternative to driven piles. Soil samples have been collected in the location selected for installation of the Lamda platform to enable its load bearing strength to be determined. The size (diameter and depth) is a function of the weight and lateral loads to be supported and soil properties. A large suction anchor will be installed on each of the SIP2 legs as described above. At site the legs and suction anchors will be lowered to the seabed where they will self-penetrate the soil to a limited depth due to their own weight. The final penetration to design depth is achieved by discharging water from the body of the suction pile by pre-installed low-pressure pumps. When the target penetration depth is achieved, the pumps are removed.

Suction piles can be removed by reversing this process, leaving no material in or on the seabed. The main design parameters of the suction anchors is summarised below:

Table 6-7: SIP2 suction pile dimensions

Lamda & Omicron SIP2	
OD [m]	8 (TBC)
Penetration [m]	11 (TBC)
Thickness [mm]	30 (TBC)

6.2.3.1.5 Personnel access and interface with the drilling rig ('Energean Force')

Personnel will access the new satellite platforms by boat. No facility for helicopter access (helipad) will be provided. Each SIP2 platform will be equipped with two boat landings on the North and West faces. Provision of two landings will ensure that access is available with most weather directions.

Eight mooring points will be installed around the structure to which the ‘Energean Force’ drilling rig will be attached when both rigging up and drilling. When rigging up the unit will sit to the west side of the platform. When drilling, it will sit to the north. Access of staff between the drilling barge and the platform will be by gangways and access ramps that form part of the drilling rig equipment.

6.2.3.1.6 Conductors

The platforms will contain a well bay containing fifteen (15) slots (5 x 3 pattern). Wellheads will have a separation of 2.3 m. Currently it is envisaged that the well conductors will be 30” diameter. These will be free standing, i.e. no guide frame will be incorporated sub-sea attached to the SIP2 legs. A template will be installed on the seabed through which the conductors will be driven by the ‘Energean Force’ rig. Surface wellheads and X-mas trees will be employed. These will be located on the lower main deck of the topsides, by locating the conductors on the inside of the platform they are protected by the large legs as well as on the north and west sides by the boat landings. Boat transport will not be able to access the platforms from the south or east to avoid craft from inadvertently passing between the lower deck and hitting the conductors.

6.2.3.1.7 Risers and J-tube for umbilicals

Risers and j-tubes for umbilical connections will be pre-installed. Risers and j-tubes will be located within the southern legs of the platforms, thus giving excellent protection from vessels. They will exit onto the lower deck of the topsides where they will tie in via emergency shutdown (ESD) valves to surface equipment. They will be terminated at the seabed above the suction piles with flanged connections to which the new pipelines will be installed. Umbilical cables will be pulled through provided j-tubes and terminated on the lower main deck. Each platform will be provided with three (3) risers and one (1) j-tube to enable it to connect to Delta. Connections will also be provided to allow Lamda and Omicron to be crossed connected as well as to allow an additional satellite to be tied back to either platform. These spare connections will be pre-installed to prevent the need to retrofit risers outside the legs at a later date.

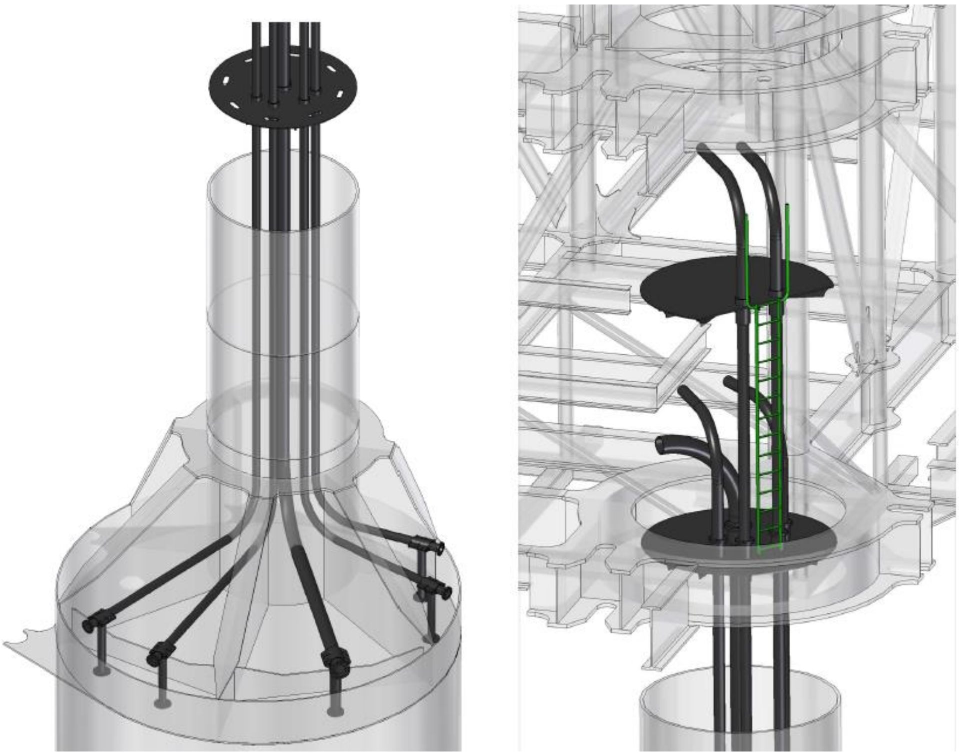


Figure 6-5: Riser and umbilical J-tube configuration

New risers will also be required at Delta. These will be positioned on the south side of the existing jacket structure adjacent to the existing risers.

6.2.3.2 Topsides

The new topsides will comprise two (2) main decks that will fully occupy the space between and around the legs, as well as two (2) smaller partial decks. The lower main deck (production deck) will contain the well bay, flowlines, production, water injection and gas lift manifolds and main electrical and instrument equipment rooms. Provision will be made to extend the east edge of the lower main deck to accommodate future equipment (e.g. ESP control equipment or a gas injection compressor). The upper main deck (or weather deck) will accommodate the crane as well as the skid beams on top of which the 'Energean Force' DES will be located. Hatches above the well bay will allow access to the wells. The deck will be designed to accommodate all necessary equipment for well servicing operations including Coiled Tubing Units.

Below the production deck there will be a small cellar deck that will sit in the splash zone. This will contain the open and closed drain drums and associated pumps. The cellar deck will provide access to the western boat landing. The northern boat landing will be accessible from the western boat landing and the main deck. A mezzanine deck will be located at the south end of the topsides between the two main decks. This will accommodate pig launchers and receivers associated with the risers.

The production deck has been designed to be above the crest of the highest predicted wave. Equipment and platforms located below the main deck will be designed to withstand occasional impact with waves, seawater immersion etc.

The gangway from the 'Energean Force' rig will interface with the SIP2 structure on the production deck. At the north end of the weather deck a support beam will be pre-installed to allow the 'Energean Force' V-door and Personnel Access Ramp (PAR) to be accommodated. Whilst drilling access will be from the north side. The area between the north edge of the weather deck and the rig can be used to store drilling materials or to locate well services equipment whilst drilling is undertaken.

No processing will occur on the satellite platforms. Multiphase well bore fluids (oil, gas and water) will be transferred directly to Delta where separation will occur using existing equipment. Flow from individual wells will be gathered in a manifold linked directly to the export riser. To monitor production either each well will be equipped with a multiphase meter or a test manifold with shared multi-phase meter will be provided. Chokes and valve will be remotely operated from Delta.

Injection water and lift gas imported from Delta will be distributed to individual wells via dedicated manifolds. Chemicals transferred via the new umbilical cable will be injected down-hole or into surface pipework as needed. Control systems will be electro-hydraulic there being no instrument air on the platforms. Power will be imported via the umbilical. No back-up diesel generator will be installed. The platforms will have fixed firewater deluge and breathing air systems. These will only be activated when the facilities are manned, i.e. when they are connected to dedicated support craft ('Energean Force' during drilling and 'Energean Valiant' during well services work).

The platforms have no emergency vent or flare systems and hence no permanently lit flare. All pipework has been rated for closed in well pressures and as there are no installed vessels there is no need for relief valves. Pipework will be welded rather than flanged to minimize leak paths. Intrusive instrumentation will be avoided.

A maintenance flare header and flare is installed but this will normally be disconnected from the live equipment. When surface pipework is to be accessed (maintenance shutdown) the closed drain vessel will be connected by installation of a removable spool. Oil in the topside pipework will be pushed into the export pipeline using a connection from the gas lift import line. Gas lift will then be introduced to the closed drain system and the flare lit. Remaining oil and gas will then be drained to the closed drain vessel with flashed gas sent to flare. Collected oil is stored in the closed drain drum and pumped back to the process system once production commences.

The closed drain flare system can also be used to receive flashed gas from the 'Limin Prinos' barge, when well clean-up operations are undertaken.

Rain and wash down water is caught in an open drain tank. Skimmed oil is pumped to the closed drain vessel. Water is passed via a skim pile to sea.

Plot plans and elevations of the topsides are provided in drawings 20153026-SPT-STR-DRA 0012 to 0019, Annex 2.

6.2.3.3 Pipelines and umbilicals

The pipelines and umbilical cables to be installed have the following features:

Table 6-8: Dimensioning of pipelines and umbilicals

Pipeline / umbilical	Length (m)
Lamda umbilical	3,909
Omicron umbilical	2,693
6" gas lift pipeline from Delta to Lamda	3,537
6" water injection pipeline from Delta to Lamda	3,541
10" production pipeline from Lamda to Delta	3,489
6" water injection pipeline from Lamda to Omicron	3,489
6" gas lift pipeline from Lamda to Omicron	3,489
10" production pipeline from Omicron to Delta	tbd
Wall thickness	
10" pipelines	10.94 mm
6" pipelines	5.29 mm

6.2.3.4 Modifications in 'Delta' platform

Full wellbore fluids will be transported from Lamda and Omicron to Delta as described above. The processing systems on Delta described earlier will be employed to separate and process fluids from the new platforms. The Delta separation system was designed to accommodate up to 30,000 bbls/day of fluids and associated gas. Considering P50 reserves the current development plans see production levels increasing to around 14,000 bopd from the Prinos (Delta platform complex) and Epsilon (Lamda plaftorm) work scopes. The potential development of Prinos North (Omicron platform) would increase peak rates to about 20,000 bopd. **The installed capacity on Delta and at Sigma is therefore sufficient for the new projects with no upgrades.**

The only modifications needed on Delta is the connection of the new Lamda / Omicron riser to the inlet header of the existing 1st stage separators and the connection of the treated injection water and gas lift headers to the export risers. The chemical storage area will be expanded and connected to the umbilical. Power and instrument connections will also interface with the umbilical.

The satellite platforms will make use of the following existing Delta processes:

- Fluid reception equipment, such as:
  - ⇨ Production Separators
- Water Injection equipment, such as:
  - ⇨ Seawater lift pumps;
  - ⇨ Water Treatment;

    - ⇨ Water Injection Pumps;
- Gas lift compression;
- Chemicals;
- Electrical Power;
- Hydraulic fluid;
- Control system;
- Telecoms system.

The following summarises the expected project scope on Delta:

- General:
    - ⇨ All new risers will be installed on the south side of Delta Platform, just west of the existing Kappa 6” pipeline riser;
    - ⇨ Existing idle vessel SC-157 C is not considered a suitable slugcatcher for the new service. However, the Three Phase Production Separators V-101 A/B are considered suitable. It may be possible that one of these vessels is dedicated to Epsilon production;
    - ⇨ A new deck structure will be installed at the Delta Mezzanine level, below the existing slug catchers SC-157 A/B/C, with new beams and grating;
    - ⇨ Existing cable trays are full and new racking will be required for all new electrical & instrumentation wiring;
    - ⇨ Control, ESD & telecoms upgrade is required on Delta Control Room to accommodate Epsilon requirements;
    - ⇨ No new F&G detectors required (existing coverage is adequate).
- Production tie-ins (include for):
    - ⇨ Line from top of Riser to new pig receiver. New riser ESD valve;
    - ⇨ New pig receiver with all DB&B valves and kicker lines, bypass line, PSV and tie-in to flare header;
    - ⇨ Line from the pig receiver to the Production Separators tie-in;
    - ⇨ Wires and cables from the Pig Receiver / Production tie-in to Delta Control Room. New trays required;
    - ⇨ New deck for pig receiver.
- Gas Lift tie-ins (include for):
    - ⇨ 4” gas lift line from the compressor area on the Upper Deck of Delta to the new Epsilon risers;
    - ⇨ Wires and cables from the gas lift headers to Delta Control Room. New tray required
- Water Injection tie-ins (include for):
    - ⇨ The 4” seawater injection line from the WI manifold on the Lower Deck of Delta to the new Epsilon risers;

- ⇨ Wires and cables from the WI manifold to Delta Control Room. New tray required.
- Umbilical tie-ins (include for):
  - ⇨ Install a Topsides Umbilical Termination Unit (TUTU) on Delta deck convenient for connection to umbilical;
  - ⇨ Run all chemical (corrosion inhibitor, demulsifier and methanol) and hydraulic oil lines (HP, LP and return) from source to TUTU;
  - ⇨ Chemicals transfer line from the chemicals area on the Upper Deck to the new Epsilon risers;
  - ⇨ Fibre optic lines from the Delta Control Room to the TUTU. New trays required;
  - ⇨ Cables from the Delta Control Room to the TUTU area.

In addition to the above activities specifically associated with tie back of the Lamda platform a number of above upgrades will be undertaken to ensure that its continued integrity can be assured and to reflect the QRA work undertaken as part of preparing an HSE Case for the facility. The foremost workscope involves the sandblasting and re-painting of the platform structure. During recent years protective paintwork has deteriorated. With low production rates and a limited remaining lifetime only minor repairs were undertaken. Following completion of the tie-ins of Lamda equipment the whole platform will be repainted to ensure continued integrity.

Other works include the further modernization of the control room to minimize manned attendance levels on the process decks of Delta and the refurbishment of the office area to ensure that it can act as a “safe haven” from unplanned H_2S releases.

6.2.3.5 Drilling rig (‘Energean Force’)

All planned new wells will be drilled by the ‘Energean Force’ tender assisted barge. This unit was purchased in August 2014 and mobilized to Greece later that year. The unit was built in 1994 in Singapore and has been owned previously by Pride International and KCA Deutag. It has worked in West Africa and SE Asia for companies such as Nexen and Shell.

Since purchase Energean has fully refurbished the marine, accommodation and drilling systems bringing the unit back into marine classification as well as renewing certification of all drilling systems. In parallel with this refurbishment scope the Prinos Alpha platform has been upgraded to allow the DES set to be accommodated on the weather deck. The unit was rigged up and commissioned Q2/Q3 2015 and is now part the way through the planned Prinos Alpha infill drilling programme.

The rig is planned to move from Prinos Alpha to the Lamda platform early 2017 to drill the development wells of this Prinos satellite field. The technical characteristics of the rig are summarized below:

Table 6-9: Technical characteristics of ‘Energean Force’

Design	Barge non self propelled

Flag	Marshal Islands
Port of registration	Majuro
IMO	8771837
Shipyard	Sabah Shipyard, Labuan, Malaysia
Year of delivery	1994
Classification society	BUREAU VERITAS
Overall length	97.6M or 320FT
Overall width (with anchor rack)	32.0M or 105FT
Breath moulded	21.4M or 70FT
Load line draft	5.8M or 34.5FT
Load line displacement	12,040mT
Light ship weight	4,800Mt
Accommodation	120 persons
Engine maker / model	CATERPILLAR
Quantity	5 PCS
Type	Model 3516 TA turbocharged after cooled
Maximum output per engine	1,615 BHP
Continuous output per engine	1,545 BHP
Rotating speed	1,200 RPM
Starting device	Pneumatic starter (150 PSI)
AC generator maker / model	CATERPILLAR
Quantity	5 PCS
Type	Model SR-4AC generator
Total power from 5 sets	7,000 KW/10,000 KVA
Voltage frequency	600V/60HZ/3 phases

Photo 6-11: 'Energean Force" after refurbishment


Photo 6-12: Preparations for rig up of 'Energean Force' to existing Prinos complex

Photo 6-13: Preparations for rig up of ‘Energean Force’ to existing Prinos complex

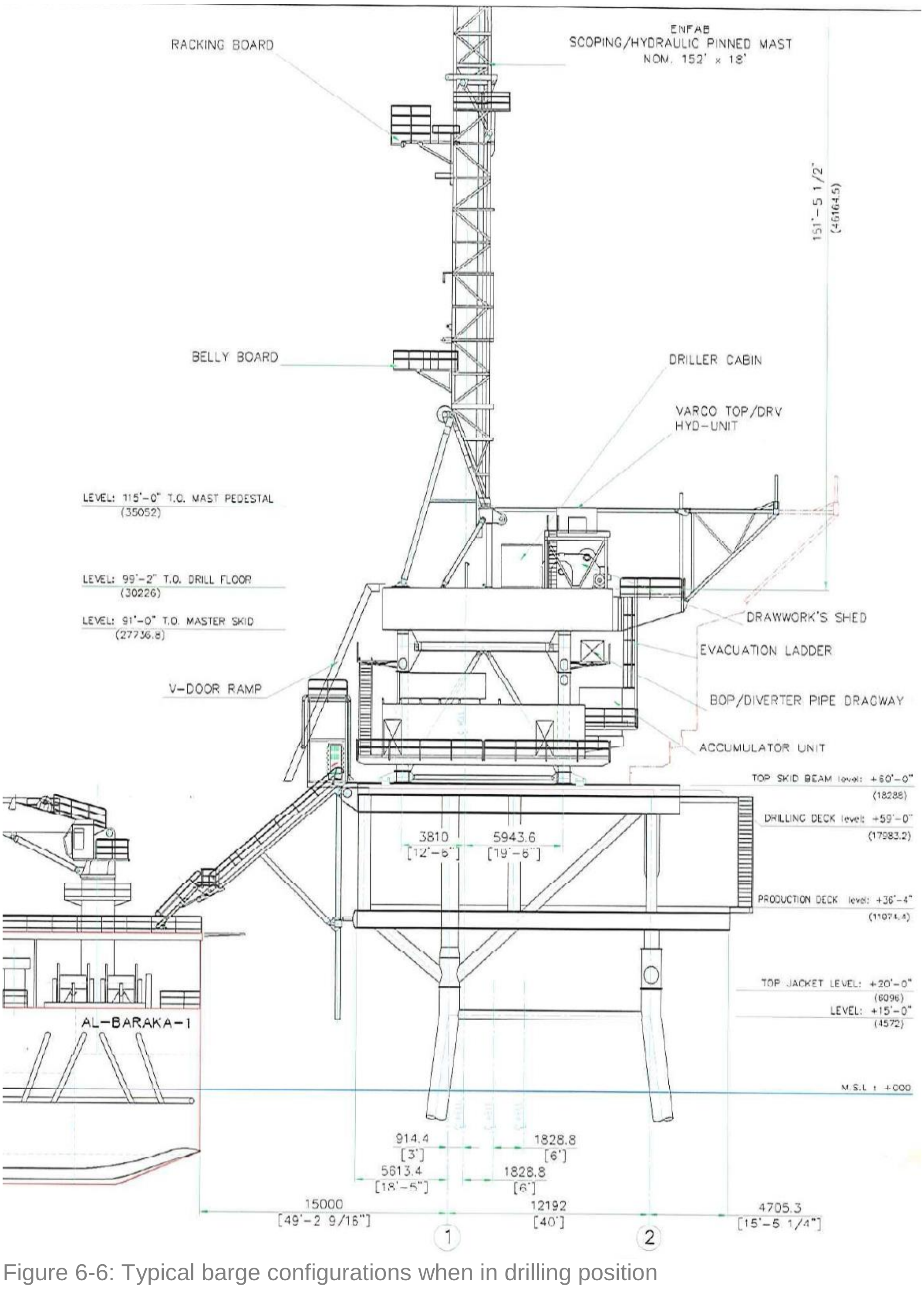


Figure 6-6: Typical barge configurations when in drilling position

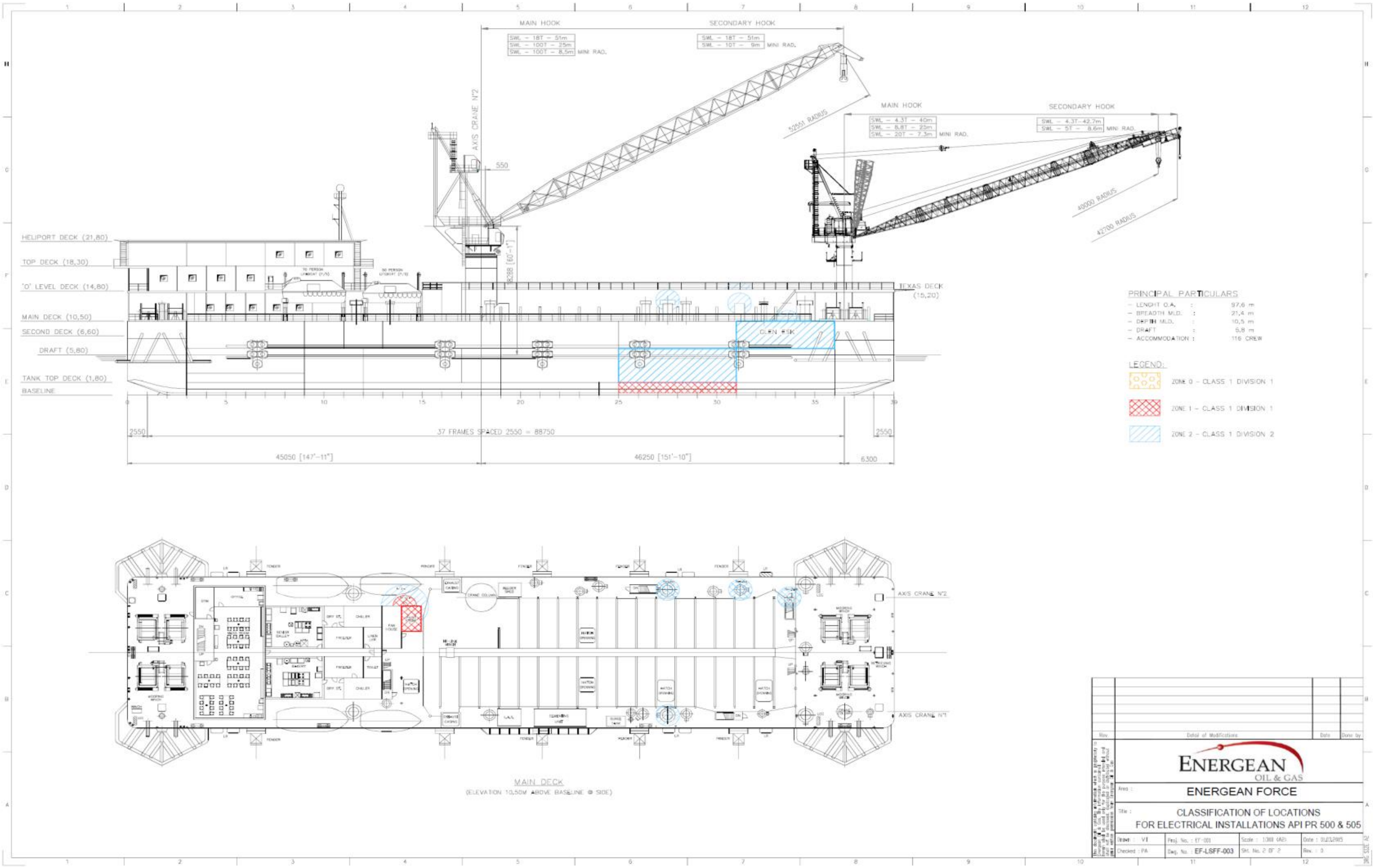


Figure 6-7: 'Energean Force' layout

6.2.3.5.1 'Energean Force' mooring principles

A permanent mooring system has been developed and installed for the 'Energean Force' barge to allow it to stay on location at the Prinos Alpha platform. The system is designed to limit lateral movements of the barge when weather suddenly changes intensity or direction. Movement has to be limited to prevent inadvertent impacts with the jacket. When weather conditions exceed predefined limits the barge pulls off location to a safe distance and drilling ceases. The mooring system has been certified by Bureau Veritas. The same mooring system will be employed at the new satellite locations.

The system is described and illustrated below.

Mooring Line composition: The barge is moored with eight (8) lines, two (2) at each corner. The mooring lines are attached at the barge end to winches capable of holding 1,600 m of wire rope. The winches are equipped with strain gauges to allow the tension on the wire rope to be calculated. The anchoring system attached to each rope is illustrated below. A "flipper-type" anchor is attached by chain to a fixed concrete weight. This in turn is attached by chain to a buoy that floats on the sea surface. The buoy is attached to the winch wire of the barge. The system acts as a spring the buoy being pulled below the surface as the force on the barge increases.

This is a relatively novel mooring system. It was selected to minimize the footprint of the mooring system. In very shallow waters often long chains are used to provide safe anchoring. Such a set-up in the Kavala Bay would have had a significant impact on fishing and other boat related traffic.

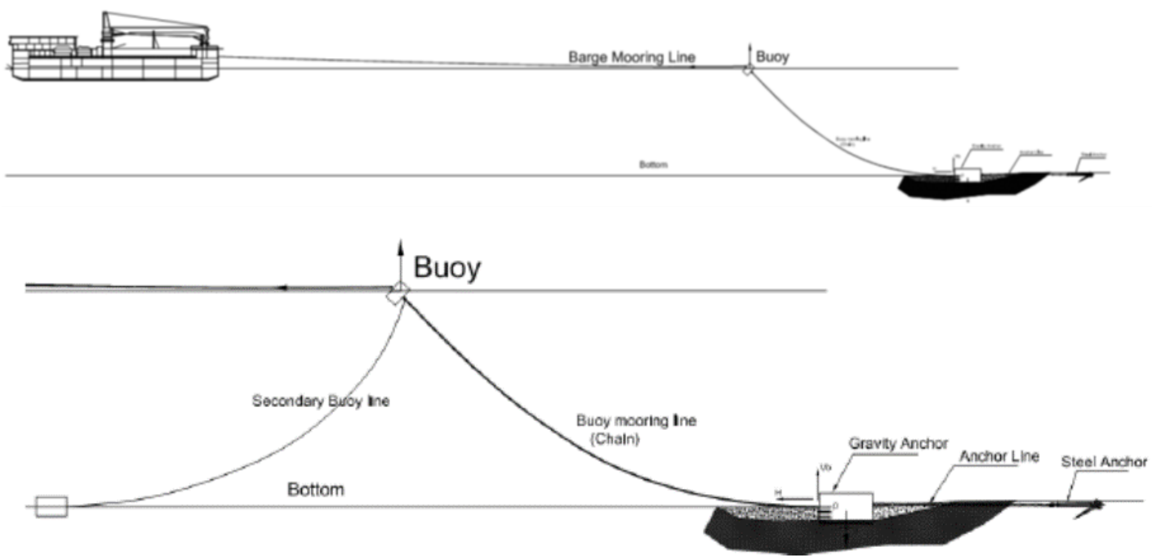


Figure 6-8: Mooring Line compositions

Mooring Spread: The figure below illustrates the overall layout of the mooring spread at Lamda and Omicron platforms. This mooring system could in principle be further reduced in size to six (6) or four (4) lines if the radius of impact needed to be further reduced.

Main dimensions are:

- Wire rope length typically 100 m
- Chain length typically 100 m
- Trash zone around each gravity bloc of 60 m radius

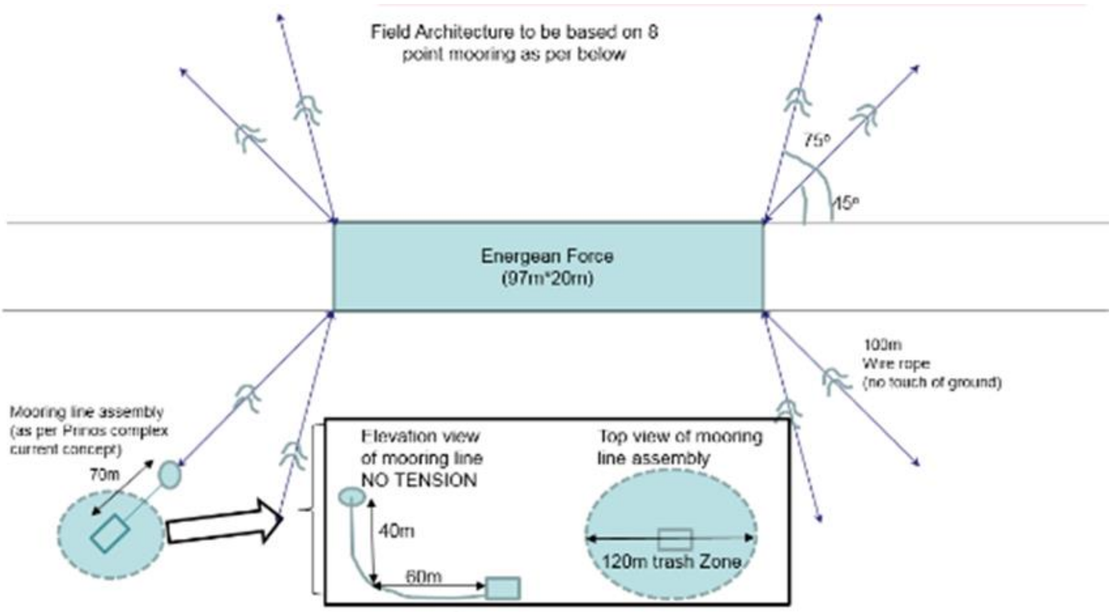


Figure 6-9: 'Energean Force' typical mooring spread

As well as limiting interference with fishing operations and other socio-economic activities a smaller impact area also facilitates the installation of necessary pipelines associated with the development.

6.2.4 Description of Activities by Phase

6.2.4.1 Construction Phase

6.2.4.1.1 SIP2 installation

The location of the new platforms has been selected based upon a review of the wells to be drilled from them in addition to the seabed conditions based upon the detailed geophysical survey completed September 2015. Well bottom-hole locations are determined based upon the constructed static and dynamic reservoir models. A top-hole location is then selected based upon a review of well trajectories and drilling cost/difficulty. This position is then fine-tuned based upon seabed conditions. In the case of Lamda the final platform location was moved 150 m to the southwest to avoid an area with a higher slope.

As mentioned previously, the Lamda SIP2 platform is designed to be self-installed without the assistance of specialist heavy lift vessels. The following steps are associated with the platform

installation:

1. Transport of components and final assembly at a deep-water quay: The topsides and legs of the SIP2 are assembled adjacent to a quayside equipped with a water depth of minimum 8m. The assembly location could be the same as the fabrication location or a different site. It is possible for example for the topsides to be constructed in one location and then transported to the assembly location on the barge to be used during installation. Legs and suction anchors could be transported separately to this final assembly location or alternatively the assembly location could be where these sub structure elements were fabricated. The legs can be installed in the topside prior to load out onto the barge or after load out has occurred. The suction anchors will always be the final item to be added to the assembled platform.

F3FA loadout on barge

F3FA lifting suction piles underneath legs

Photo 6-14: Platform loadout and suction can assembly examples

2. Transport to site: Once the topsides, legs and suction anchors have been assembled on the selected installation barge it is wet towed to the installation site by tugs. The assembled platform and installation barge are inherently stable due to the significant draft and the stability provided by the large buoyant suction anchors. Previous SIP2 platforms have been towed through significant storms in the North Sea on the way to the installation site. With a planned installation date of late April and a short tow through the relatively calm waters of the Aegean no transportation risk is envisaged. A minimum of three tugs will tow the assembled unit (topsides, legs, suction anchors, grillage and installation barge) from the final assembly location to the installation site.

3. Mooring at installation site: Energean intends to install the permanent mooring system for the Energean Force rig prior to the arrival of the assembled Lamda platform on the barge. This mooring system will be used to hold the installation barge at the selected site prior to lowering the legs to the seabed. To ensure accurate positioning, the barge

and support tugs will be equipped with DGPS positioning systems and real-time telemetry.

4. Leg-lowering: Once the assembled unit is moored at the installation location the legs are slowly lowered to the sea bed using temporarily installed strand jacks. No seabed preparation is required. It is noted that seabed surveys to identify exact seabed characteristics and obstructions will have been carried out prior to installation. The substructure will be designed to accommodate variations in seabed level. As the legs touch down on the seabed they will self-penetrate due to their weight.
5. Suction anchor installation: Temporarily installed suction pumps are used to draw water from the top of the suction anchors above the seabed. The suction anchors are pulled by the formation of a differential pressure, which allows the suction cans to penetrate progressively into the seabed to the required depth.
6. Topside jack-up: Once the suction anchors are installed the topsides is progressively raised up the legs using temporarily installed strand jackets. Sand that fills the annulus between the legs and sleeves during transportation is removed. Once the topside is at the correct elevation it is locked in place and the annulus filled with grout. This completes the installation sequence. The installation barge is pulled from between the legs as soon as the topsides are clear.

The platform installation modes are illustrated in next Figures.

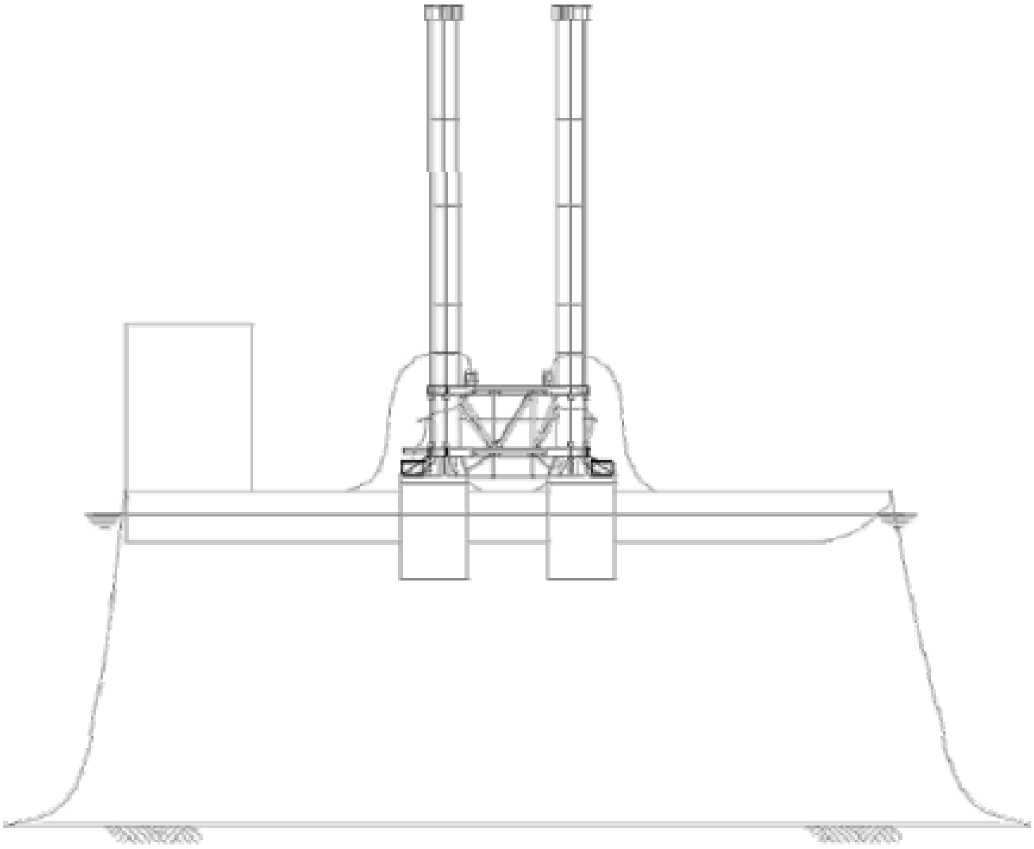


Figure 6-10: Barge in position attached to the pre-installed mooring lines

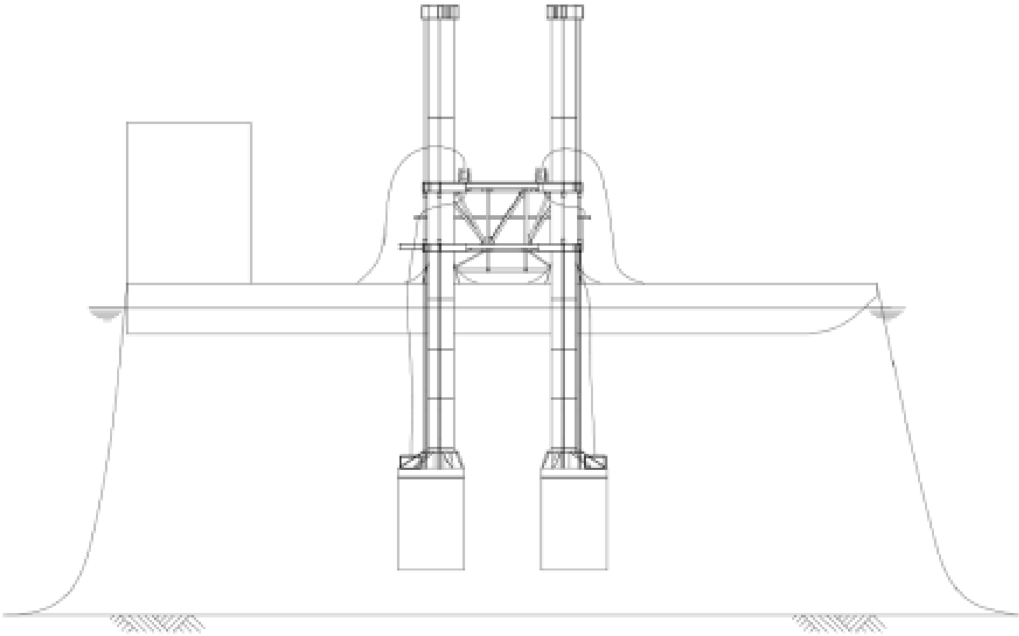


Figure 6-11: Legs lowering and suction can penetration

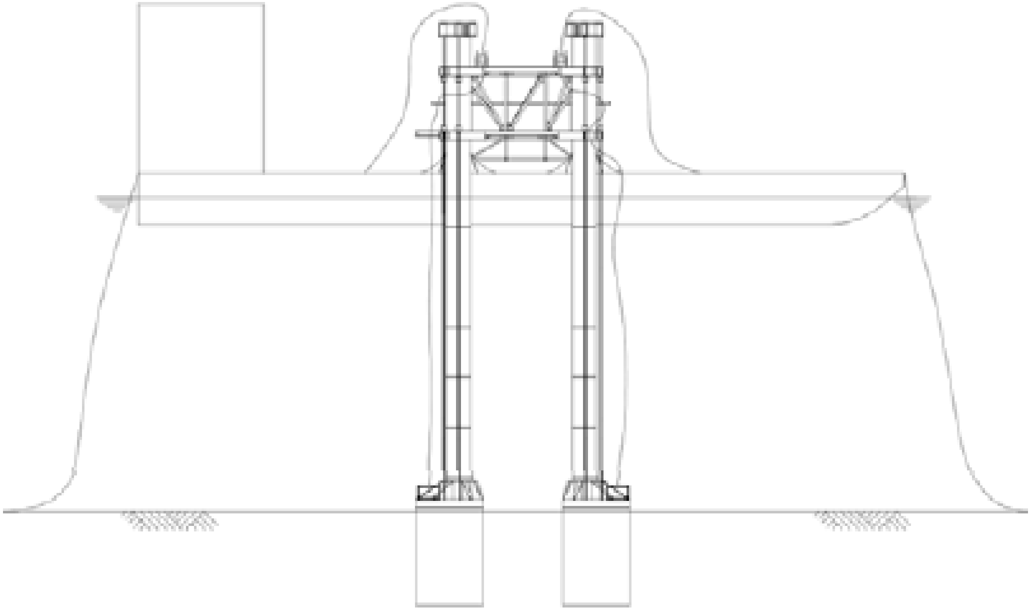


Figure 6-12: Jacking topside into final elevation and barge away

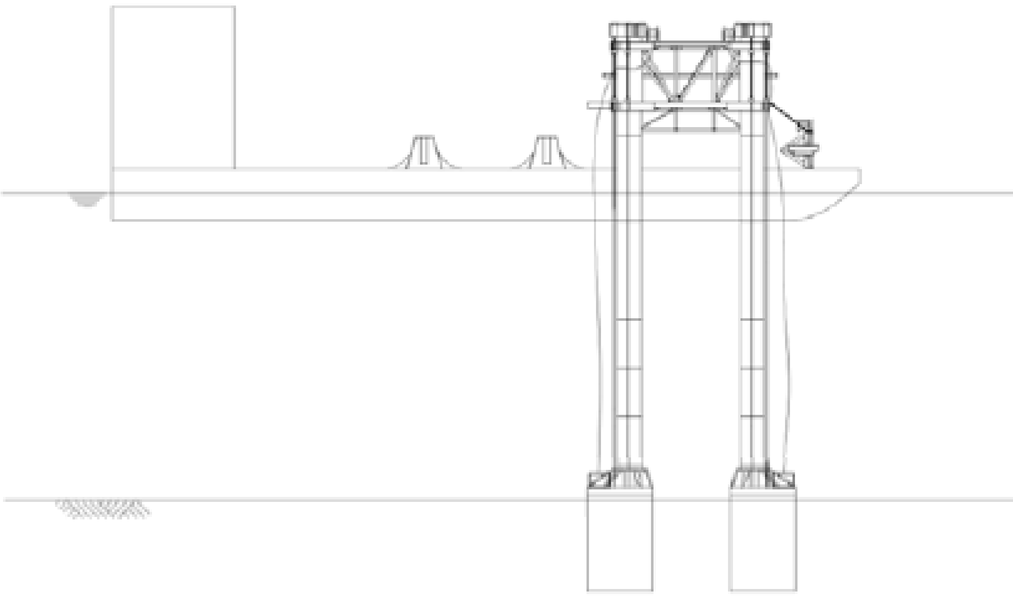
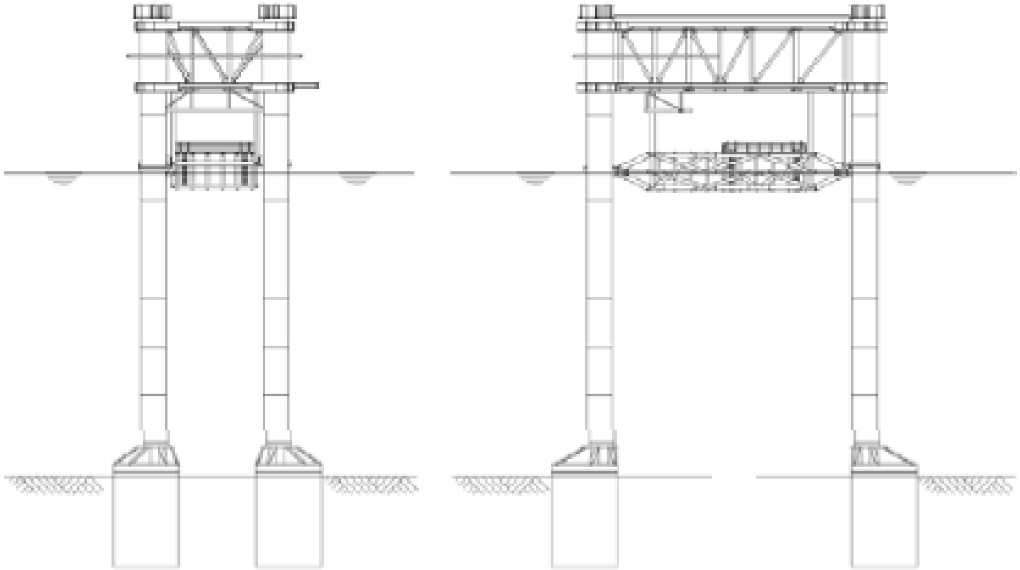


Figure 6-13: Final installed condition and boat landings installed in the raised position



6.2.4.1.2 *Installation of the conductors*

The Lamda and Omicron platforms will be each designed with fifteen (15) drilling slots. Each slot will be capable of accommodating a 30” riser through which a development well will be drilled. The SIP2 substructure does not include a riser support/guide structure partway between the topsides and seabed. The risers therefore have to be freestanding. This is the main reason why 30” conductors will be employed. The conductors will be driven into the seabed to the required depth by the ‘Energean Force’ rig once it is installed. It is probable that five (5) conductors will be installed prior to commencing the drilling of the first well.

6.2.4.1.3 *Connection of pipelines and umbilical cables to the risers*

The risers will be pre-installed in the southern two legs of the SIP2 platforms as previously described. The risers on Delta will be retrofitted. There are no existing spare risers on Delta. Riser clamps will be installed by divers onto the jacket bracing. The clamps will be fitted with hinges for ease of closing and a neoprene liner.

Pipelines and the umbilical cable will be installed by multiple single tows or a bundled tow from an onshore fabrication/stringing location. Final details of the towing and burial methodology of the pipelines will be developed as part of the detailed design.

Spool pieces will be used to connect the risers with the pipelines. Once the risers and pipeline ends are in place and fixed, the divers will perform metrology so that the final tie in spool pieces can be fabricated onshore and installed.

All tie-in connections within the pipelines will be made by means of suitable subsea mechanical connectors or welded. Suitable crossings details will be designed so that there is no interference on any existing pipelines or cables, where the spool or pipeline crosses an existing pipeline/cable or seabed obstruction. If required, subject to detailed design, protection concrete mattresses will be installed over the spools up to a defined distance from the platform, depending on the

outcome of a dropped objects study.

6.2.4.1.4 Installation of topside equipment

All topsides equipment on the Lamda platform will be installed onshore in the construction yard. This will include the maintenance flare. Boat landings will be installed in parallel with the topsides using the same installation barge.

Brown field modifications on Delta will be designed so as to allow installation with the platform live. A short shutdown will be required to accommodate final tie-ins to the 1st stage separator inlet manifold. To avoid extended periods of “hot work”, pipe sections, assemblies and spools will be pre-fabricated on shore and trial fitted before welding commences. For integrity purposes, pipe connections will normally be made by welding as opposed to by means of flanges.

Welding and NDT of field welds, and touch-up painting will be performed in accordance with approved procedures.

As the substructure and installation periods are expected to be short (2 to 3 days maximum) it is not intended to mobilise a dedicated offshore accommodation vessel. Required staff will be accommodated either on the ‘Energean Force’ barge or onshore. They will be transported to and from the installation barge by Energean’s vessels. The total number of staff involved in the installation campaign should be less than 20.

Photo 6-15: Topsides fabricated at quayside

6.2.4.1.5 Installation of pipelines and umbilicals

6.2.4.1.5.1 Pipeline and umbilicals installation assessment

Pipelines and umbilical cables will be installed using the towed method. A preliminary assessment of the required towed length, routing updates and pipe strings fabrication yard capabilities has been completed assuming:

- Maximum wall thickness will be considered (as a conservative approach);

- Pipeline total length is 3.5 km;
- Buoyancy modules properties will be assumed;
- Line pipes towed empty;
- Hold back tension assumed as 5tonnes; and
- Line pipe grade will be considered as X60.

Pipelines will be fabricated onshore in +/- 1 km pipe sections. Individual sections will be pulled into the sea and connected to the next section by welding or by the use of mechanical connectors. The final 3 to 3.5 km pipeline will be towed to site with two tugs (one at each end) and lowered into the defined corridor. Studies to determine the merits of a bundled tow are being undertaken as part of detailed design. The installed pipeline will be connected to the risers with tie-in spools as described above.

Installation by S-lay has been also investigated. The S-Lay installation method is not problematic for the project pipelines. Vessel availability and cost are the only considerations that disqualify this alternative.

6.2.4.1.5.2 Pipelines and umbilical routes

The final pipeline routes between Lamda, Omicron and Delta, will be confirmed during detailed design. A detailed geophysical survey of the seabed between the three platform locations has been completed. This has demonstrated that there are no sea-bed or buried obstructions (man-made or natural) that need to be avoided. There is a natural "valley" between Lamda and Prinos Delta that has a width of almost 500 m and a depth of approximately 15 m. The pipeline route will be determined to give the shallowest possible angle into and out of this feature whilst minimizing overall length. Because the pipelines are being towed into position, it is important to orientate the platforms such that the risers and J-tubes/tie-in connections are in the correct positions (it is not possible to change direction when towing). The routes of the umbilicals between Delta and Omicron and Delta and Lamda were being designed to match the positions of the bottoms of the J-tubes (bell mouths).

6.2.4.1.5.3 Pipelines Towing Route

The towing route has been designed to avoid seabed obstructions. The part of the route that crosses the existing pipelines between Delta and the Sigma Plant was determined such, that they will be protected from the pipelines being towed, while ensuring that the pipelines being towed are likewise protected against damage.

6.2.4.1.5.4 Pipeline Corridors

The pipelines will be installed either in corridors, one at a time, about 20 m apart to accommodate slight variations in the pipeline tow and post-trenching operations or as a bundle. Thus, the maximum width of the corridors could be 100m. The width of the towing corridor will be about 20

m wide. The widths of the corridors will be verified during the design, also taking into consideration the vessels' course and station keeping capabilities.

6.2.4.1.5.5 Vessels

The spread required performing the work and services comprises the following vessels:

- Supply vessel 'Valiant Energy' (used for diving support and installation works);
- Supply vessel 'Epsilon';
- Supply vessel 'Skala Prinos';
- Crew tender 'Akra Prinos'

Photo 6-16: Supply vessel 'Valiant Energy'

Photo 6-17: Supply vessel 'Epsilon'

Photo 6-18: Supply vessel 'Skala Prinos'

Photo 6-19: Crew tender 'Akra Prinos'

The pipeline pulling forces will be relatively low and therefore it is intended to use the supply vessels as tugs. If the bollard pull of the vessels is not known, the company will perform bollard pull tests.

If a bundled installation is demonstrated to be attractive it will be required to mobilise suitable tugs to manage the installation. The existing Energean craft will not be capable of managing such a work scope.

6.2.4.1.5.6 Tie-In Method

The tie-in spools between the risers and the pipelines will be connected by means of flanges or mechanical connectors. The tie-ins will be made in the wet by divers. In the case that flanges

are used, the divers will make use of hydraulic bolt tensioning system when tightening the nuts to the required torque.

6.2.4.1.5.7 Hydraulic Analysis and Pipeline Sizing

Hydraulic analysis has been performed to confirm the throughput of the pipelines (hydraulic profile) and their required internal diameter.

6.2.4.1.5.8 Flooding and Gauging

The pipelines will be flooded with filtered seawater by means of pigs fitted with polyurethane cups and gauge plates with a diameter equal to 95% of the pipeline internal diameter. When flooding is completed, the pipelines will be left in this condition for a period of twenty-four hours to allow the water to stabilise. Tests will be made to check for entrapped air.

6.2.4.1.5.9 Pressure and Tightness Testing

The hydrostatic test comprises two (2) phases:

1. a pressure test for a duration to be agreed with the certifying authority and
2. a tightness test to demonstrate that the system is water tight, lasting twenty-four hours.

The pipelines will be tested individually. Each pipeline will be system-tested between the tie-in with the wellhead manifold and the manifolding adjacent to the pig receiver.

6.2.4.1.5.10 De-Watering

De-watering of the gas line will be achieved by means of a combination of rigid pigs with polyurethane cups and foam pigs. The water injection line will not be dewatered. A small quantity of unfiltered seawater can be accommodated by the injection wells.

As only filtered seawater will be used to flood the pipelines, the floodwater will be dumped into the sea by means of a temporary dumping line. If the floodwater was treated with chemical additives (see below), the dumping will be co-ordinated with local authorities.

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6.2.4.1.5.11 Drying (Gas Lift Pipelines)

The need for drying the gas lift pipelines to a specified dew point, using dry air, will be determined during the design phase.

6.2.4.1.5.12 Laid-Up Condition

The pipelines may be laid up with untreated test water for a period not exceeding thirty days. If the laid up period lasts longer than thirty days, chemical additives such as oxygen scavenger and biocides will be required to be added to the test water. To avoid the release of such chemicals into the sea during dewatering, the scheduling of the pre-commissioning work will be based on a laid up period of less than thirty days.

6.2.4.1.5.13 Preparation of Construction Right of Way (ROW)

The location of the pipeline fabrication site will be confirmed during detailed design. Two sites are currently under consideration. Neither site is owned by Energean. One is owned by the local port authority and one is a public space that would be temporarily used based upon permission from the requisite local authorities. Study work to define the size and facilities required are currently being progressed. An unused road adjacent to the Sigma plant or a location at the rear of the Fillipos Commercial port is being studied. Pipe racks, roller stations, welding and NDT stations, a field joint completion station, pipe-handling gear, winches and crawlers, etc. will be installed at the selected site.

Map 6-3: Indicative onshore construction site location

The pipeline will be made up in its entirety along the selected construction site. The pipe joints, already factory-fitted with the 3-layer PP coating and anodes, will be welded into strings with a length of about 1,000m (82 joints) each, using an external line-up clamp. Multiple welding stations, their number depending on the welding procedures (the number of passes) will be used. The welds will be examined by 100% x-ray at the NDT station downstream of the welding stations. Finally, the field joints will be completed by fitting a heat-shrink sleeve and a protective shield. When the four strings are thus completed, they will be connected together in the manner described above to form the entire pipeline with a total length of approximately 3,500m.

The first string, fitted with a pulling head, will be pulled off the construction ROW by a tug. The tug will pull the string far enough into the water for the end of the string to be positioned in the

firing line where the second string will be mechanically connected to the first string. The tug will keep station at this position. This step will be repeated for the third and fourth strings.

The rear end of the pipeline will also be fitted with a pulling head. This pulling head will be secured to a hawser that is attached to a second, rear tug, which keeps the pipeline under a specified tension to prevent the pipeline from being subjected to compressive forces. The tension force will be monitored continually during the tow by means of a load cell. A support vessel will accompany the tow and correct the position of the pipelines as needed.

The pipeline will be towed into its respective pipeline corridor. The position of the pipeline relative to the seabed will be monitored by divers or ROV. The pulling heads will be placed into their target boxes, also monitored by divers. The ends of the pipeline will be temporarily fixed to the seabed by means of a concrete mattress, again placed with the assistance of divers. Divers will then proceed to remove the floatation bodies (de-ballasting the pipeline). The pipeline is now in its intended position within its respective corridor, resting on the seabed, filled with air.

Just prior to making the tie-ins with the risers, the divers will flood the pipeline. Since the air inside the pipeline is locked in at atmospheric pressure, water will ingress. The air cannot fully escape, however, and will be entrapped until it is driven out by the pigs during the testing activities. The pipeline must not be left in this condition for a period exceeding thirty days.

6.2.4.1.5.14 Installation of umbilicals

The umbilical cable will be installed from reels situated on board the Valiant or an equivalent vessel, which will be modified during the design phase to be able to fit the reeling equipment, including tensioner and chute.

A subsea electrical-chemical umbilical will be installed between each satellite platform and Delta. The umbilical will transfer power, instrument signals and chemicals (such as and corrosion inhibitors) from the Delta platform. The functional components of the umbilical shall be as follows:

- Electrical cables (Voltage level to be determined following a power system study).
- Fibre bundle 1 (containing 24 single mode optical fibres). The number of fibres is to be confirmed.
- Fibre bundle 2 (containing 24 single mode optical fibres)
- 7-off hose/tubes – designated as follows:
    - ⇨ 5x Chemical: supply from Delta of demulsifier, corrosion inhibitor, methanol, asphaltene and scale inhibitor. Batch type treatments during well intervention will be by temporary packages on Lamda.
    - ⇨ 2x Spare

The umbilical will be installed by the reel method. The umbilical will be reeled at the manufacturer’s plant, with towing heads fitted. One reel will be required for each umbilical. The reels will be transported to Fillipos Commercial port and fitted on board the installation vessel.

The vessel will set up at one of the platforms (the lay sequence will be determined later). The towline will be fed through the pre-fitted c.q. retrofitted J-tube with the use of a messenger wire and attached to the pulling head. The umbilical will then be pulled through the J-tube, monitored by a diver. When the pulling head sits in the hang-off clamp at the top of the J-tube, the vessel will lay away to the other platform.

The umbilical will be laid with a bow-out adjacent to the platform to allow sufficient slack (the length of the J-tube plus a few meters) for the pull through the J-tube. The umbilical will be pulled on board the platform in the manner described above.

In the case where the pipelines will be bundled (to be determined during detailed design) the umbilical reel could be set up at the stringing yard, and the umbilical pulled into the pipeline bundle, thus forming part of the bundle arrangement. In this case, the umbilical ends will be looped at both ends of the pipeline bundle ready to be attached to the respective platforms.

6.2.4.1.5.15 Burial of pipelines and umbilicals

The pipelines and umbilical will be buried to protect them against mechanical impact by falling objects and by trawl boards and chains or other fishing gear. The method of burial will be by jetting pressurized water in the area immediately around the pipeline and umbilical corridor to temporarily displace the sand, allowing the infrastructure to partially sink below the surrounding seabed level and then be buried by the settling sand. This method has been selected because it is less invasive than traditional trenching.

6.2.4.1.5.16 Diving support

It is intended to perform the underwater tie-ins "in the wet", requiring extensive intervention by divers. Diving support will be sought from local Contractors. If necessary the Energean supply vessels will be used to support diving operations; they will be fitted with sufficient portable decompression facilities. Procedures will be developed to minimize diving operations and to assure the safety of the divers employed.

6.2.4.1.6 Logistics

Energean will establish and maintain a project-specific logistics plan, covering the following requirements/activities, as a function of QA management:

- Stacking/packing/handling requirements for materials and equipment;
- Planning and scheduling shipments of heavy equipment and vessels from vendors' places of manufacture/fabrication to Energean (marshalling) yards/quay sides;
- Management of materials certificates, certificates of fitness, certificates of origin, and the like;
- Custody transfer of materials and equipment;
- Insurances for handling and transportation;

- Any importation and customs clearance for materials and equipment;
- Storage and maintenance of materials and equipment;
- Calculations for weights and centres of gravity;
- Authorities engineering for handling and transportation of heavy equipment and moving pipe strings over land.

The logistics plan serves to ensure that materials and equipment are delivered undamaged and on time at the Work Sites and in parallel the overland movement of equipment does not cause any damage or nuisance to local residents. The work will be performed by dedicated personnel.

6.2.4.1.7 Transportation and installation sea states

Transportation routes to the Gulf of Kavala will be determined once fabrication and assembly sites have been selected. Work completed to date has demonstrated the feasibility and cost effectiveness of fabricating the legs and suction cans in Greece. Potential fabrication sites for these components are close to deep-water port facilities at Athens, Volos and Thessaloniki. Whilst Energean intends to include Greek companies in the topsides construction tender it is possible that this more specialist piece of work will be awarded to a yard outside the country (in Italy, Turkey, Croatia etc.). An alternative would be to award to a local fabricator and use an experienced foreign company to help establish and manage the fabrication facility.

Even if all work is executed in Greece it is possible that the legs, suction anchors and topsides could be fabricated at different locations.

Preparation of the final assembly before installation will likely occur at the fabrication yard used for legs/suction anchors and/or topside whichever is closest to Kavala. For example if the topsides were fabricated in Volos and the legs in Athens, the legs would be transported to Volos by transportation/installation barge and then the assembled unit to Kavala. It is possible, but not likely that assembly could be undertaken at Fillipos port in Kavala minimizing the towing distance to site.

Map 6-4: Indicative transportation route to Platform Location from Athens

Each transport trip required shall be designed to withstand the loads caused by the most adverse environmental conditions expected for the area and season through which it will pass, taking into account any agreed mitigating measures.

For any relevant phase of transportation or marine operation, the design criteria will be defined, consisting of the design wave, design wind and if relevant, design current. It should be noted that the maximum wave and maximum wind may not occur in the same geographical area, in which case it will be necessary to check the extremes in each area, to establish governing load cases.

Transportation cases will be designed for 10 year monthly extremes for the area and season, on the basis of a 30-day exposure. For the motion analyses, sea states will include all relevant spectra up to and including the design wave height for the most severe areas of the proposed voyage route. A wave height smaller than the design wave height, at the natural period of roll and/or pitch of the tow, should also be checked if necessary. "Long crested" seas will be considered unless there is a justifiable basis for using "short crested" seas. Consideration should be given to the choice of spectrum, which should be applicable to the geographic area, and Hs of the design sea states.

The most probable maximum extreme (MPME) responses will be based on a 3-hour exposure period and shall be used for design. The range of periods associated with the extreme sea state will be calculated analytically in two different ways, with due consideration given to the influence

of swell (General Guidelines for Marine Operations) or they will be taken from the available scatter diagrams. The design wind speed shall be the 1-minute mean velocity at a reference height of 10m above sea level. The 1-hour wind may also be needed in the calculation process. Therefore the transport sea state is a function of the route, season and hydrodynamic characteristics of the platform, barge and towing vessels.

Prior to the departure, a Marine Warranty surveyor will approve the seaworthiness of the marine transport barge.

The installation of the SIP2 structure and associated topsides is relatively tolerant of sea state, however by planning for a date during April 2017 the chance of obtaining benign conditions will be maximized. In all cases, the weather restrictions imposed by the design and installation criteria will be adhered to.

Photo 6-20: Dry tow on transport barge to site

6.2.4.1.8 Personnel during construction / installation

Offshore project execution will take place in stages with the delta brownfield works starting early and the final well hook up ending the execution sequence.

A peak of up to 30 workers (10 of which will be based on nights) can be anticipated for a short period during platform installation. These numbers include contractors and representatives of the Energean project team. Most of the workers will be accommodated on the Energean Force or onshore. A breakdown of the main project execution stages and the associated personnel requirements for each is further presented below:

- Platform Installation: Duration 3d
  - ⇨ Workers are shuttled on 12hr on 12hr off using the KO ships for onshore/offshore transfers or Installation barge/Energean force.
  - ⇨ Number of workers estimated at 20 dayshift, 10 night shifts.
  - ⇨ Staff maybe accommodated on ‘Energean Force’ whilst it is at Alpha.

- Platform Commissioning & Well Hook Up: Duration ~15d per well
  - ⇨ Provided by KO personnel exclusively, crew size of 5 people, dayshift only, working on normal work pattern during each well drilling phase
  - ⇨ 'Energean Force' used for accommodation, as it will be at Lamda.
- Pipeline Installation: Duration 7d
  - ⇨ Day and night shift by marine crew provided by Contractor.
  - ⇨ Accommodation provided by 'Energean Force' off station during this period and located likely at Filipos.
  - ⇨ Crew size ~ 8 dayshift, 8 night shift
- Pipeline Hook Up (Spools & Riser at Delta): Duration ~20d
  - ⇨ Day and night shift
  - ⇨ Installation Crew size ~ 7dayshift, 7 night shift
  - ⇨ Diving Crew size ~ 8 dayshift, 8 night shift
  - ⇨ Crew is fully contracted out to 2 main contractors: diving team and installation team.
  - ⇨ Installation team rotating onshore for accommodation.
  - ⇨ Diving team in chamber on contracted out barge.
  - ⇨ No use of Energean Force.
- Delta Brownfield works: Duration ~120d
  - ⇨ Staged execution with work packs broken in: Chemical area, piping, mezzanine and Riser
  - ⇨ Work only in day shift with crew size of typically 10 people rotating with KO personnel and accommodated onshore or on Energean Force located on Alpha during most of this work.
  - ⇨ Fabrication scope contracted out fully.

6.2.4.2 Operating Phase

6.2.4.2.1 Operation philosophy

The new installations are designed to function as Normally Unmanned Installations (NUIs), remotely operable under all weather conditions. The installations are designed with minimum facilities to safely control production from the satellite fields and to enable drilling and well interventions to take place as required. Oil production from the satellite platforms will be controlled and monitored from Delta CCR. A Local Instrumentation Room is available on the SIP but does not play the role of local control room. No local control room is provided on the satellite facilities.

All equipment includes instrumentation to manage its safety and provide security of operation. The facilities are designed to fail in a safe condition ('fail safe') if power or control functionality is interrupted. Satellite and total field production shall be measured and monitored from Prinos Delta. All necessary process and utility parameters shall be remotely available.

The platforms will be designed for Simultaneous Production and Drilling Operations and Simultaneous Production and Well Operations activities. During the primary drilling phase

completed wells will be brought on stream whilst the 'Energean Force' drills new wells. Only when large components of the Drilling Equipment Set are finally lifted from the platform will a production shutdown be required. Well intervention operations can occur in parallel with production either during or after the primary drilling phase. In this case either the companies Light Work over Rig or Coiled Tubing Unit would be lifted onto the satellite.

Equipment on the satellites is divided into Oil Production, Water Injection, Gas Lift and Chemical Injection systems as well as a number of auxiliary systems. The operational philosophy applied to these systems is outlined below.

Oil Production:

A typical oil gathering system will be built. Individual Well Flow Lines for each well will be installed, with remotely operated chokes, chemical injection points upstream the choke and required manual isolation and check valves. Double block and bleed isolations will be provided to enable choke interventions with minimal production upset.

A Test Manifold will bring together all production wells and guide flow to a Multi-Phase Flow Meter (MPFM) and physical sampling cabin. Flow will then be directed back to the production manifold. Ability to route remotely each individual producer to the test header is required.

The Production Manifold has been designed to accommodate up to eight (8) production wells with gathered fluids discharged to the export pipeline. Chemical injection points are provided on the production header leading to the pipeline inlet. A second MPFM will be provided on the production header outlet in order to monitor gross flow exiting the platform.

A permanent Pig will be supplied on the multiphase export lines from each platform. A new pig receiver will be installed on the mezzanine deck of Prinos Delta. Pigging operations will be supported by use of gas provided by the gas lift system as purge gas. Installed pig launchers are designed for intelligent pig operations.

Water Injection:

Treated injection water will be supplied from the Prinos Delta platform. Injection water will be fully treated and dosed with necessary chemicals on the Delta platform. There is no envisaged need for further treatment or injection facilities on either Lamda or Omicron.

Water will be supplied to Lamda and Omicron through a dedicated high-pressure line. Water will reach Omicron via Lamda. The rated capacity of the seawater treatment and injection system on Delta is 45,000 bwpd. This is envisaged to be sufficient to accommodate forward needs of all envisaged satellites without any upgrades or modifications (current forecasted needs are estimated at 15,000 bwpd).

A Water Injection Manifold will feed up to seven (7) water injection wells. Water is routed from the water pipeline to the manifold and then distributed to each dedicated water injection well. Pressure is monitored at the manifold.

Each Water Injection Flowline is equipped with a flow transmitter, a controlled actuated flow control valve with flow rate control loop and a well head pressure transmitter to monitor flowing injection pressure at the well head. Space for installation of temporary pig traps has been allowed

in the design (cleaning or inspection).

Gas Lift:

Gas lift will be supplied from Prinos Delta. Gas lift is sweet gas consisting mainly of methane (usually CH_4 is more than 75% mol) with an average molecular weight of 21.7 kg/kmol.

Gas lift will be supplied to Lamda and Omicron via a new 6" pipeline that flows over the Lamda platform. This pipeline will be fully rated for the closed in pressure of the Epsilon wells under initial conditions. Gas can be fed to up to eight (8) wells on each platform.

Each Gas Lift Flowline will be provided with an individual gas lift flow control valve. This will automatically control the flow of gas to individual wells based upon a set point entered by the control room operator on Prinos Delta. Flow and pressure measurements will be sent to the Prinos Delta control facility via the installed umbilical cable.

At this stage there is no plan to upgrade the gas lift compressors on Delta. The spare unit currently available will be used in parallel. Gas lift supply to Epsilon is expected to be used for a relatively short duration. Once water cuts and pressures have stabilized the intent would be to install ESP's in the Epsilon wells to better control draw down. Available gas lift could be then used at other potential satellites.

The gas lift system is also used to supply sweet gas to the platform for use in purging operations. A sweet gas supply to the maintenance flare system is available so that the flare can be purged and lit prior to draining operations taking place. Sweet gas connections will also be provided to each flowline to allow sour fluids to be partially evacuated to Delta before a shut down. A gas connection will also be provided to the inlet of the multiphase pipeline that can be used to avoid hydrates during planned shut downs of the line.

Chemical Injection System:

Prinos Delta will be used as the supplier of chemicals to the satellite platforms. Each platform will be connected to an expanded chemical injection system on Delta by a dedicated umbilical cable. New storage tanks and pumps will be required on Delta to enable it to serve the two envisaged satellites. This equipment will be located in an area previously occupied by gas compressors transferred to Kappa platform.

Utilities:

The new facilities require few utility systems. Utilities are either supplied from Delta (power, data) the mobile support vessels (fire water, breathing air) or avoided by design (instrument air). Systems installed are:

- A Closed Drains vessel with associated maintenance flare. No emergency flare system is required as all pipework is fully pressure rated and no relief valves are installed. This system is physically disconnected during normal operations and only lit and used during shutdown, start-up, pigging or well maintenance activities.
- An Open Drains system handles rainwater. An oily water separator together with a skim pile and an oil-in-water analyser and automatic shut-off valve will prevent unintentional discharge of untreated fluids directly to sea.

- Dedicated HPU units with electrically driven pumps, will be installed on each SIP platform. Sufficient redundancy on the HPU pumps will be provided to accommodate the frequent demand of the control valves.
- A diesel driven crane rated to support well services operations. The crane will either be of pedestal type mounted on one of the platform legs or skiddable along the beams used to support the Energean Force. Options to use an electrical crane will be examined during detailed design.

When unmanned, the platform will have no firefighting capability. A dry deluge and ring main shall be provided to give coverage to the wellhead area and the muster area when the platform is manned. Water supply at this time will be from the companies support craft moored alongside.

Electrical power for the satellites will be provided from the Delta platform via the umbilical. There will be no electrical power generation on the SIPs. No stand-by generators will be installed. A UPS system will safely shut the facility down if there is failure of the power supply from Delta.

6.2.4.2.2 Simultaneous operations (SIMOPS)

The upper (drilling) deck has been designed to allow simultaneous drilling or well services and production operations. When lifting on or off the following items associated with the Energean Force DES the wells will be shut down:

- V-door side Master skid
- Draw works side master skid
- Mud package
- MCC
- Drill floor and
- Mast

6.2.4.2.3 Drainage systems

There are two types of drains on Lambda and Omicron platform: open drains and closed drains. More specifically:

- Open drains: these are atmospheric drains collecting the surface waste liquids and all their intakes (entry points) are permanently vented to atmosphere
- Closed drains: these are fully contained drains, hard piped from the equipment to be drained through all the facilities necessary before reprocessing or safe disposal to the environment

Water, which is not expected to contain any oil e.g. from container roofs, exterior wash-down, and laydown areas shall be collected and piped directly overboard below the lowest deck area. These drains need not be directed to the skim pile.

6.2.4.2.3.1 Open drains

Water entering the open drains system should normally not contain oil, but is treated as though it could. Sources of open drains are:

- Bunded areas beneath equipment in hydrocarbon service. These are intended to collect deluge water, washdown water, maintenance spillages, and possible leakage from equipment. Bunded areas are provided where drainage flowrate is significant or where deck plating is used for catching the spillage.
- Drip pans beneath smaller equipment items such as pumps and filters, in water service. These are intended to collect maintenance spillages. Some equipment items such as the chemical injection package, generators, pumps, etc. may be provided with built-in drip retention as part of the skid to contain any leaks or spills.
- Bunded area at the well service chemical storage area on the Production deck (Omicron only)
- Deck drains for contaminated deck areas. These are intended to collect washdown water, fire hose water and rain water.

There is not expected to be any grey water requirement on the satellites as all living quarters and accommodation will be on linked service vessels.

6.2.4.2.3.2 Closed drains

A closed system is installed to collect hazardous fluids from process pipework that has to be opened for maintenance purposes. This drained fluid is routed to a Closed Drains Drum where it is stored before return to the process via the multiphase export line. Pig launchers and receivers can also be drained to this vessel. All equipment to be drained will have been purged with sweet gas to minimize liquid inventories and H_2S levels. Operating procedures will ensure that only one item will be drained to the closed drains system at a time to avoid potential cross pressurisation of equipment.

Closed drains piping shall satisfy the following requirements:

- Closed drains headers are 150# rated irrespective of upstream process equipment or pipe rating
- Upstream system will be blinded during normal operation so as to avoid potential pressurisation of closed drains piping and drum due to mal-operation leading to gas blowby.
- Drain lines shall be self-draining to the closed drains drum i.e. sloped.

The Closed Drains Drum will be located at the lowest point on the platform (cellar deck) to achieve the desired piping slopes required for draining of liquid by gravity.

The gas outlet from the Closed Drains Drum will be connected to the maintenance flare. Thus any gaseous discharges or gas blow-by from process equipment will be flared/vented at the vent tip.

The Closed Drains Drum is designed to hold the full liquid inventory of the topside pipework.

Closed Drains Drum Pumps shall be used to transfer the accumulated liquids to the export line to Prinos Delta once the facility has resumed production.

6.2.4.2.3.3 Drains arrangements

The following typical drains arrangements will be applied:

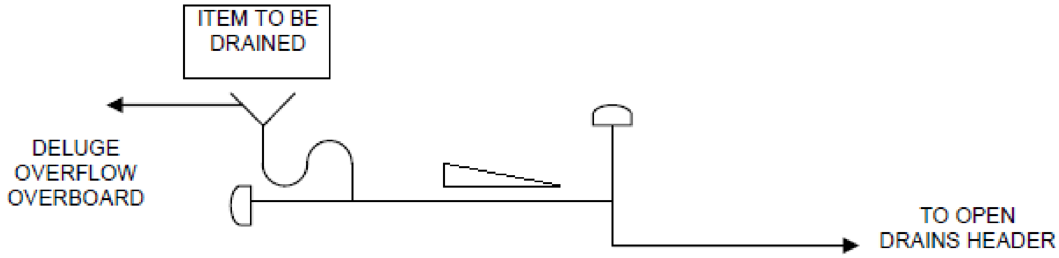


Diagram 6-1: Typical open drain arrangement

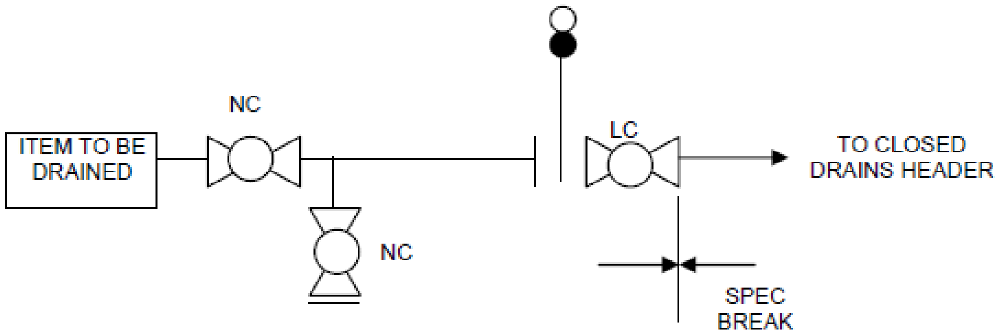


Diagram 6-2: Typical closed drain arrangement

6.2.4.2.4 Safety equipment

To ensure safety of the satellite installation, the following facilities are provided:

- Failsafe emergency shutdown of all process systems.
- Actuated riser ESD valves.
- Provision of a drilling rig interface that include TPS functionality and a link into the Rig's Fire, gas and emergency alarms system.
- A maintenance vent to allow managed (non-emergency) depressurization of the topsides. Ignition provided by means of flare guns after purging with sweet gas from gas lift system
- Cascade air system with external connection at boat landing locations and widow maker bridge area (drilling barge) for supply of pressurized air.
- Hard piped Firefighting ring main with external connection at boat landing locations and widow maker bridge area (drilling barge) for supply of water.
- Fire and gas detection system connected to ESD system.
- Fusible plugs over x-mas trees connected to ESD system.

6.2.4.2.5 Maintenance & inspection

The platform has been designed for minimal maintenance. A maintenance schedule will be developed as part of the detailed design when equipment vendors have been selected and routine maintenance activities defined. Operational visits to the satellites will occur at least once

a month and non-shutdown maintenance activities will be scheduled to occur at the same time. Operational visits would be with a team of two production technicians from Delta. Discipline maintenance technicians could join them as required by the routine tasks to be undertaken. Breakdown maintenance activities will be undertaken during day light hours as and when required.

Shutdown maintenance campaigns will be undertaken every thirty (30) months (normally in conjunction with planned shutdowns of Delta and Sigma) with a support vessel, permanently stationed at the platform. Work shall be possible on a 24-hour basis if needed, although it is unlikely that this would be required.

As there are no relief valves installed on the platform and no process vessels shut-down maintenance requirements will be limited largely to electrical and instrument systems that are not spared. Where internal inspections to pipework or manifolds were required fluids are first pushed to the export pipeline with sweet gas and then drained to the closed drain system.

The Closed Drains Drum can be inspected with the platform live as it is physically isolated from the process at this time. It cannot be inspected during a shutdown as at this point it is in use.

Campaign maintenance and inspection manning level shall be limited to a minimum of two (2) persons (to allow the buddy system to be operated) to maximum 10 persons. The maximum personal is currently seen as follows:

- Operations (1- 2 pers.)
- Mechanical Maintenance (2 to 4 pers.)
- Crane operator (1 pers.)
- Instruments (1-2pers.)
- Electrical (1pers.)
- Safety Spvr (1pers.)

When the 'Energean Force' is attached to the platform maintenance of the power supply system shall be possible without interrupting production.

In addition to the normal maintenance and inspection events, the following operations will require sending people to the SIP platforms:

- Well interventions making use of the light workover rig or rigless interventions (water wash & squeeze jobs).
    - ⇨ Exact frequency will depend of the fluid behaviour (scale, salt/asphaltene deposit). Note that the frequency is reduced by design by allowing for downhole continuous injection. The maximum manning level is expected to be twelve (12) people and will be used for the design of the safety systems.
- Pigging operations foreseen only for the multiphase production pipeline. Exact frequency will depend of the fluid behaviour (wax deposition, hydrate formation). Normal manning level of 2 people similar to routine maintenance and inspection visits.
- Other interventions such as instrumentation tuning, which should occur at low frequency.

Normal manning level of 2-4 people similar to routine maintenance and inspection visits. When staff is on board either of the satellite platforms a support vessel will remain on stand-by at the boat landing. This will be used for evacuation due to emergency, medical or weather. No safe refuge is available on the satellites and hence staff will not be left on location without a stand-by vessel present. During operations such as well services work where the platform will be manned for a number of days with 24-hour work, the standby vessel will be connected to the platform fire and breathing air systems effectively converting it to Temporarily Manned status. Short duration routine visits of up to six (6) people and duration less than six (6) hours will not require the stand-by boat to connect in this manner.

6.2.4.2.6 Production scenarios and profiles

Production forecasts based upon available dynamic simulation models and assumed number of wells has been prepared for P90, P50 and P10 profiles. These have been used to define production scenarios and hence allow equipment, pipework, pipelines, electrical systems etc. to be correctly sized. For each reserve scenario fluid rates at different periods of the fields' production life have been defined. This allows peak loadings to be determined and ensure turn down can also be accommodated. Data associated with the Epsilon field to be exploited via the Lamda platform is more mature than for the fields in the Prinos North Area. These include exploration and appraisal opportunities and hence the range of forecasts is somewhat greater.

As the intent is to "design once, build twice" the analysis performed for Lamda (Epsilon) has been used to size the Omicron facility also.

Table 6-10: Epsilon Production Scenarios

Base Case					
Epsilon field P50 production forecast	**Unit**	**Early Life (2017)**	**Transition (2020)**	**Mid-Life (2023)**	**Late - Life (2030)**
Max. reservoir fluid	kmol/hr (stdbpd)	585 (12,000)	519 (10,642)	209 (4,297)	96 (1,971)
Max formation water	kmol/hr (stdbpd)	1,945 (5,210)	781 (2,091)	2,268 (6,076)	3,874 (10,376)
Max gas lift	kmol/hr (Sm^3/hr)	105 (~2,500)	218 (5,200)	336 (8,000)	336 (8,000)
Flowing Tubing Head Pressure (FTHP)	barg (average of all producers)	42	29	21	21

Current production levels through the offshore Prinos complex and onshore Sigma processing plant range between 2,200 and 3,400 bopd. These rates are typical of those achieved since Energean took over operations. Peak rates of up to 4,000 bopd were achieved immediately following the drilling of ERD wells to Prinos North and Epsilon. Following the completion of the

first Prinos infill well (PA-35A) by the 'Energean Force' rig in November 2015, production rates through the existing facilities will increase. Production from individual wells has been determined based upon Energean's history matched full-field dynamic reservoir model. Initial rates are a function of predicted net pay remaining in each in-fill location coupled with application of good oil field practice (i.e. avoid coning of water through over production and hence loss of ultimate recovery). Low to High forecasts have been prepared for each well. Forecasts for wells with potential at the A reservoir are more uncertain than forecasts for the B/C reservoirs. The reservoirs are more extensively developed and have seen more water injection to date.

The diagram below illustrates the mid case production profile for the overall Prinos Area Development project including wells to be drilled from Prinos Alpha, Lamda, Prinos Beta and Omicron.

As can be seen the 10 planned Prinos infill wells have the potential to increase the production rate to around 10,000 bopd (blue wedge). This increase gains from planned well services and work-over activities including stimulation, water shut-offs, gas lift installations and tubing replacements. It also includes gains from conversion of two closed in production wells to water injection. Production potential is significant because seven (7) of the wells are planned to be equipped with dual completions. Hence the current campaign is equivalent to 17 new wells.

Epsilon development drilling adds the brown production wedge and could increase production to around 14,000 bopd initially. As the Epsilon field contains significantly understaurated crude rates will drop rapidly as reservoir pressures fall. All initial wells will be completed as producers (including water injection wells). Towards the end of the Epsilon drilling campaign these wells will be converted and hence total Epsilon production will fall.

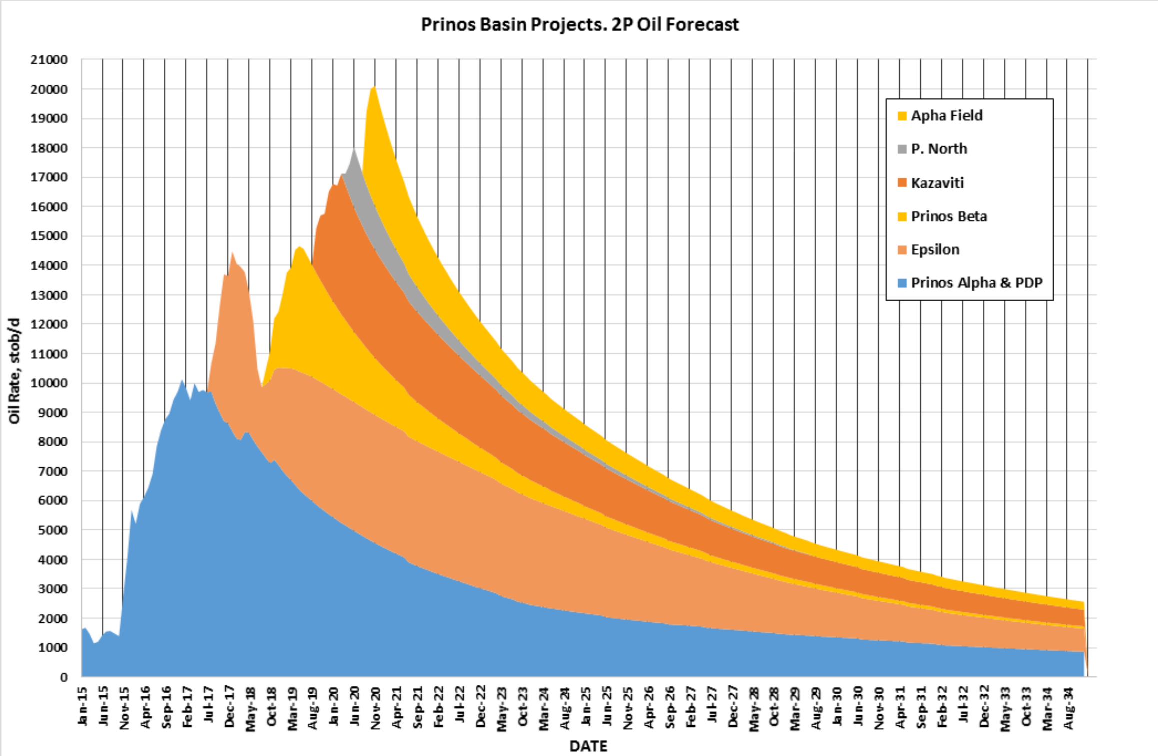


Diagram 6-3: Prinos basin, 2P oil forecasts

Planned wells on Prinos Beta have the potential to reverse this decline in the short term. As illustrated to achieve a long-term stable production above 12,000 bopd additional development activities will be required. Notional tranches of additional production for the discoveries and exploration prospects in the Prinos North Area are illustrated assuming the Omicron platform is installed in 2019 (two years after Lamda).

Currently no forecasts have been prepared for the remaining discoveries in the Prinos license area (Athos and Delta) as well as the heavy oil discoveries in the Nestos basin. Neither has incremental production associated with notional IOR and EOR projects. Implementation of these projects would be targeted to give production from 2021 onwards and hold oil production rates at the type of new plateau rate illustrated.

6.2.4.2.7 Structural stability

The platform is designed for the worse load cases applied when in drilling conditions. It is capable of withstanding the worst 1Y storm condition as well as the design seismic case while the rig is developing full drilling weights (Rig dead weight + worst case active weight: ~1,440T).

For the 100Y storm it is assumed that the rig operation would be suspended in advance of the 100Y storm and that only the dead weights of the rig would apply (Rig dead weight: ~1,020T).

A conservative fatigue assessment assuming a high percentage of time with the heavy rig on the platform over its design life has been made. The structure is designed to provide fatigue life in excess of twice the design life (i.e 40 years plus).

The platform is designed to withstand boat collision impact energy without collapsing. The boat sizes have been selected based on current boats part of company operations and third party fishing boats in close vicinity.

6.2.4.2.8 Drilling operations

6.2.4.2.8.1 Introduction

The existing wells on the Prinos Alpha and Beta platforms will remain operational during the described Prinos Area Development project except those, which have been selected as donor wells for the planned Prinos infill campaign. All existing wells will be managed under existing environmental permits.

In this section the activities associated with the drilling of new wells and the sidetrack of existing wells is described in detail. All drilling activities will be undertaken by the Company's tender assisted rig, the 'Energean Force'. The 'Energean Force' mooring system has been described in earlier section. Further details are not given in this section.

Slim hole wells will not be employed. All new wells and side tracks will be constructed in the traditional manner using telescopic casings of decreasing size with depth. Casings will be cemented in place, the cement being located in the annulus between the casing and rock wall. Wells will be drilled with the aid of a Top Drive and steered with a combination of mud motors and rotary steerable tools depending on angle and inclination required. Cuttings will be circulated out of hole by pumping drilling mud down through the drill string, out through nozzles in the drill bit and then back up the well annulus. This drill mud will be oil based whilst drilling through the evaporitic cap rock section and water based in other sections including the reservoir. Mud weight is varied based upon knowledge of the pressure of the fluids in the strata to be penetrated. Chemicals such as barite are used to add weight. Mud weights can be reduced by passing the returned fluid through an installed centrifuge.

A detailed description of the planned drilling operations is provided in the following paragraphs.

6.2.4.2.8.2 Methodology of typical well drilling

Once the 'Energean Force' is connected to the platform drilling can commence. In the following sections the main elements of the drilling process are described:

- Drilling mud:
- Running of casing:
- Blow Out Prevention (BOP)
- Drilling, Cementing and Completion
- Management of losses

Throughout the drilling of the well it is necessary to use drilling mud, for the following reasons:

- Removes the rock cuttings from the bottom of the well and transfers them to the surface where they are examined to give information regarding the geology of the formation being drilled.

- Protects the walls of the well from subsidence (creates coating to the walls of the well preventing the diffusion and loss of drilling fluids during drilling).
- Cools and lubricates the drilling bit and the drilling column.
- Applies pressure (at or above hydrostatic as required) and therefore controls influx of fluids from the geologic strata being drilled into the well bore.

The drilling mud enters the well through the drill string and then returns to the rig floor area through the annulus formed between the walls of the well and the drill strings. At the rig floor area, the drilling mud passes through a sequence of processes that conditions mud so it can be re-circulated to the well. If present any significant volumes of gas are removed and safely vented. Rock cuttings are then removed in a number of "shale shakers" that are made up of vibrating mesh screens. Sand is removed in settling tanks before small gas bubbles are removed (if present) in a vacuum system. Conditioned mud is returned by gravity through flowlines to the storage tanks on the tender barge, before being pumped back to the rig floor with the high-pressure mud pumps.

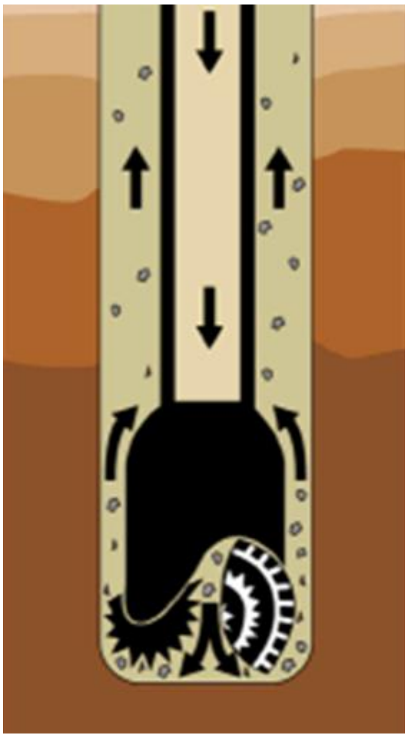


Figure 6-14: Schematic illustration of the movement of the drilling sludge through the drill strings of the drilling machine and the bit

Once a hole section of defined diameter has been drilled a pipe of slightly smaller diameter is lowered into it piece by piece. This casing provides stability to the walls of the drilled hole. This casing pipe is run to the bottom of the drilled section. Once in place cement is pumped through a special tool into the well bore and pushed up the annulus where it dries. The cement should completely fill the annulus between conductor and rock face. Once set a hole of smaller diameter is drilled to the bottom of the next section and the above process repeated. In this manner a

telescopic, stable, well bore is constructed. The length of each section is defined in the drilling programme and is a function of the pressure gradient of formation fluids.

In a new well, as will be constructed on Lamda, the first piece of piping installed will be a conductor. This will have a diameter of 30”. This conductor pipe will be lowered to the seabed and then driven into the seabed a defined distance. The initial hole section will be drilled out of this conductor pipe.

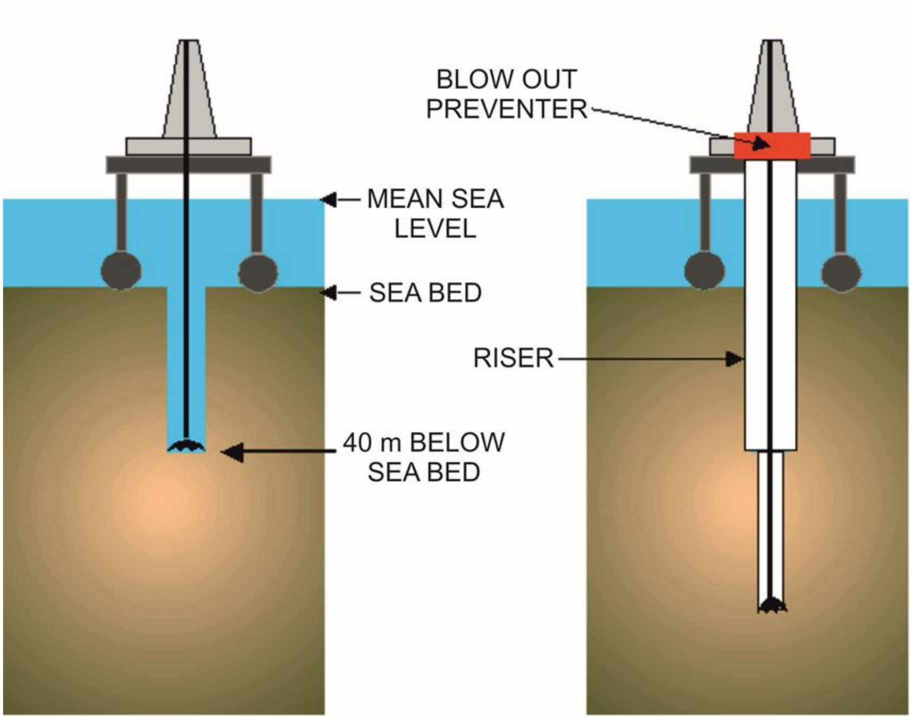
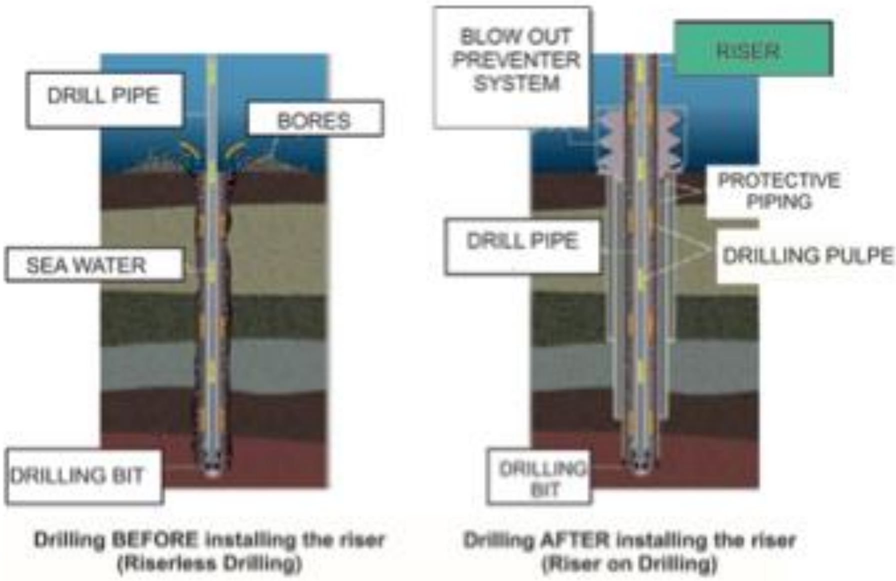


Figure 6-15: Drilling before and after the placement of the riser



Before drilling commences on either a new well or an old well that is to be sidetracked a Blow Out Preventor (BOP) is installed. The BOP is one of the main barriers that ensure that an inflow of fluid into the well whilst drilling cannot reach the drill floor. On a new well the BOP is installed once the surface conductor piping has been driven to the required depth. On an old well, the well is first killed, the Xmas tree removed and the BOP then attached to the wellhead.

Formation fluids can flow into a well bore whilst it is being drilled if the pressure in the formation is greater than the pressure exerted on the formation by the mud employed. The BOP consists of successive valves. When needed, these valves can be closed using a reservoir of hydraulic fluid stored on the drill floor in cylinders or accumulators. These cylinders are kept fully charged at all times. Loss of pressure automatically causes a closure of the BOP. When the valves close, the well is sealed hence preventing the fluids from the formation flowing to the surface. The sudden influx of reservoir fluids into a well bore is called a “kick”. The fluids can be water or hydrocarbons.

Photo 6-21: Typical valves of BOP system and choke manifold valves system

Before the BOP can be re-opened, the fluids in the well bore are circulated out and the mud weight increased to prevent further influx from occurring. Increasing the mud weight increases the static head applied and eventually balances the formation pressure.

For proper and easy operation of this process, special outlet pipes are installed to the BOP. These pipes are positioned on the outer side of the riser and are connected with a remote-control valve system, called choke manifold.

Photo 6-22: Typical choke manifold

6.2.4.2.8.3 Typical drilling and tubing program

A typical program for a new well (Epsilon well drilled from Lamda) including the drilling process of each section until a final depth of **3.150m** is described below. The following paragraphs present a brief description of the stages of drilling, and the figure illustrates the tubing plan.

Driving of 30" diameter conductor to ~ 40m – 100 m

Initially, the **conductor pipe of the well** is set in place, which has a larger diameter than the pipes that will be positioned subsequently. The conductor will be embedded by using a hydraulic hammer. It is expected to be embedded to around 40m - 100m (depending on the subsoil) under the seabed. The conductor pipe will not be threaded, but they will be connected together when restrained.

Drilling of 26" diameter up to ~ 400 m

After setting in place and restraining the 30" conductor, a bit of 26" diameter will wash the conductor internally. Then, a wellbore of 26" will be drilled up to approximately 400 m. pure seawater, and when it is necessary for better washing, limited volumes of high viscosity pulp will be used. Before setting in place and cementing the **18-5/8" casing,** the well will be filled with bentonite mud.

Drilling of 16" diameter up to ~ 1.550 m

A wellbore will be drilled up to approximately 1.550 m with a bit of 16" diameter. Mud of high viscosity will be used regularly to keep the well washed. The wellbore will be purged by fresh high viscosity mud before logging and installation of the **casing 13-3/8"**. The casing will be cemented for 200 m above the bottom of the previous tube.

Drilling of 12-1/4" diameter up to ~ 2.350 m

A bit of 12-1/4" diameter will be used to drill a wellbore up to approximately 2.350 m. The final depth of this phase of the wellbore will be at the bottom of the lowest evaporate, just above the reservoir section. Before installing the **casing 9-5/8"** and cementing the wellbore, logging will be

done and the well will be checked for inclination. The casing will be cemented with a single volume of cement designed to form a cementing column 200 m above the bottom of the previous casing 13-3/8" and cementing along the entire length of the open geological formation. For the Prinos wells that are to be sidetracked, this or the 8 ½" section would be the first to be drilled. The upper sections are inherited from the donor well. To make a sidetrack a whipstock is run into the donor well at the selected depth and a window milled through the casing. The new section is drilled from this window,

Drilling of 8-1/2" diameter up to ~ 3.150 m

A wellbore will be drilled up to approximately 3.150 m with a bit of 8-1/2". The previous drilling mud will be used. Currently it is expected that the Epsilon wells will be completed barefoot, i.e. no liner will be installed. This will allow production from a well bore to be maximised. The reservoir section in Epsilon is made up of consolidated sandstones and sand production is not expected to be an issue. In the Prinos wells a liner will be cemented over the full reservoir section and then perforated where oil pay is assessed as being present.

Table 6-11: Drilling and Tubing Plan

Section	Final depth (from the seabed) (m)	Section's length (m)	Well's diameter (inches)	Casing diameter (inches)
I	40 m	400 m	36''	30''
	400 m		26''	20''
II	1,550 m	1,150 m	16''	13 3/8''
III	2,350 m	800 m	12 1/4''	9 5/8''
IV	3,150 m	800 m	8 1/2''	7''

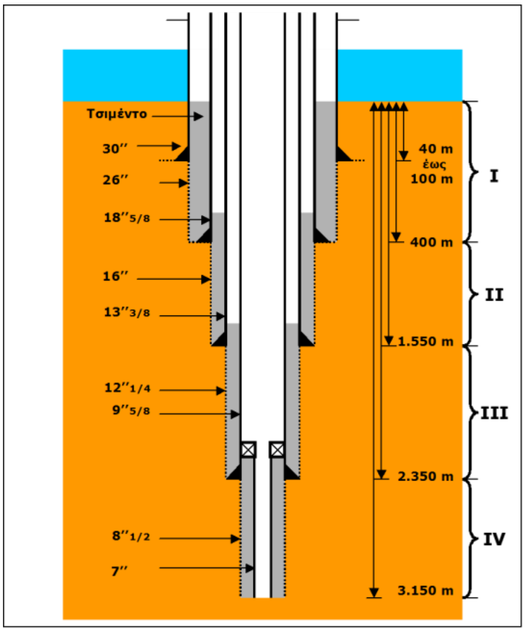


Figure 6-16: Schematic illustration of tubing plan

6.2.4.2.8.4 *Typical drilling mud plan*

Whilst drilling the 26’’ diameter section down to a depth of 400m, a seawater gel will be used as the drilling fluid. Cuttings from this section will be deposited at the seabed. This is unavoidable, as until the first casing string is installed a riser to recover the cuttings cannot be installed. The gel used is selected to be fully biodegradable with no negative impacts on the local environment. Below this depth drilling fluids are returned to surface where the cuttings are removed and the mud is conditioned as described above. Dried cuttings are shipped to shore for disposal.

The total volume of drilling mud as well as the added ingredients (with concentration) is presented in the following table.

Table 6-12: Drilling Sludge Plan per Drilling Section

Section	Well’s diameter (inches)	Estimated volume of drilling mud (m^3)	Mud system
I	26	140	Sea Water + Gel for the cleaning of the well Products: Bentonite (M-I Gel)
II	16	210	M-I Gel / Polymer (Sea water) Products: Bentonite (M-I Gel), POLYPAC UL, CMC-HV
III	12 Ό	180	Saturated Salt (KCl, NaCl) / KLA CURE / POLYMER Products: Saturated salt, POLYPAC UL, POLYDRILL, KLA-Cure, Barite
IV	8 ½	110	FLO-PRO / POTASSIUM FORMATE Products: K-Formate Brine, Flo-Vis, Flo-Trol, Safe Scav HS, Sized Calcium Carbonate
Total		640	

In the following paragraphs the products that are used for the preparation of the drilling mud are described.

- **BENTONITE:** Is a clayey mineral, which is used to increase the specific weight of the drilling mud and to compensate the hydrostatic pressure. It is used with pre-hydration at initial concentrations of 40 - 70 kg/m^3. Bentonite is a mineral and is not considered hazardous to the environment.
- **POLYPAC UL:** Polypac UL Consists of polyanionic cellulose and is a high quality water-soluble polymer that is designed to control the loss of fluids. It is an additive of a very small quantity ("Ultra Low" additive), so causes zero to minimum reduction of liquidity. Usual concentration is 5 - 15 kg/m^3. The POLYPAC UL is biodegradable.
- **CMC HV:** CMC HV is sodium carboxymethyl cellulose of high viscosity, which is designed to control the losses of the drilling mud into the walls of the borehole and

control the liquidity of the water base mud. It is resistant to bacteria and has a wide tolerance in chemical reactions of the mud. The CMC HV is biodegradable.

- **POLYDRILL:** Polydrill is a polymer for water base mud, which controls the fluid loss and the rheology of the mud and is particularly effective at high temperatures, as well as in fluids with high content of electrolytes. Polydrill reduces fluid loss by reducing or blocking the pore diameter. This polymer has significant water-binding capacity, minimizing the loss of fluids.
- **KLA-CURE:** KLA-CURE is a hydration suppressor and consists of a water-soluble environmentally acceptable organic mixture, which is designed to reduce the swelling and dispersion of reactive clay formations. KLA-CURE can be used in systems of fresh or seawater with low or high solids content. Usually the concentration is 11.4 – 22.8 kg / m^3 depending on the diameter of the hole and the length of the drilling section.
- **BARITE:** Barite is used to increase the specific weight of the drilling mud and compensates the hydrostatic pressure. Barite is a mineral and is not considered hazardous to the environment.
- **FLO-VIS:** FLO-VIS is a biopolymer (clarified xanthan gum biopolymer) of high quality, which is able to improve the drill mud rheological characteristics. Not considered as hazardous to the environment.
- **FLO-TROL:** FLO-TROL is a highly modified starch derivative used for fluid loss control and viscosity. Not considered as hazardous to the environment.
- **SAFE SCAN HS:** SAFE-SCAN HS reacts with the hydrogen sulphide and remains soluble even after the chemical reaction therewith. It is based on an organic chemical instead of the commonly use of mixtures of zinc or iron.
- **SIZED CALCIUM CARBONATE:** Sized Calcium Carbonate is produced in different granule sizes that can be used as an increasing factor of the specific weight of the drilling sludge, and to reduce the inflow of fluid formations at the drilling slurry. It is a mineral and is not considered hazardous to the environment.

Table 6-13: Concentration of materials for the preparation of the drilling mud per well section

Section		I	II	III	IV
Bentonite (M-I GEL)	kg/m^3	70,000	50,000	20,000	
Caustic soda	kg/m^3		0,500	2,000	
Soda ash	kg/m^3	1,000	0,500	1,000	
Polypac UL	kg/m^3		4,000	14,000	3,000
CMC HV	kg/m^3		2,000		
Polydrill	kg/m^3			3,000	
Lube 167	ltr/ m^3			20,000	
NaCl	kg/m^3			280,000	
KCl	kg/m^3			80,000	

Section		I	II	III	IV
KLA Cure	kg/m³			15,000	
Barite	kg/m³			680,000	
Defoamex	kg/m³			1,500	
K+-Formate	ltr/ m³				833,000
Flovis	kg/m³				4,000
Flotrol	kg/m³				15,000
Safescav HS	ltr/ m³				5,000
Magnesiumoxide	kg/m³				4,000
Sized $CaCO_3$	kg/m³				70,000

Table 6-14: Estimated quantities of materials for the preparation of the drilling mud per well section

Section		I	II	III	IV
Bentonite (M-I GEL)	kg	40.000	42.000	12.000	
Caustic soda	kg		425	1.250	
Soda ash	kg	575	425	625	
Polypac UL	kg		3.350	8.675	800
CMC HV	kg		1.675		
Polydrill	kg			1.850	
LUBE 167	ltr			12.400	
NaCl	kg			173.650	
KCl	kg			50.000	
KLA Cure	ltr			9.200	
Barite	kg			421.500	
Defoamex	ltr			1.000	
K+-Formate	m³				225
Flovis	kg				1.075
Flotrol	kg				4.050
Safescav HS	kg				1.400
Magnesiumoxide	kg				1.075
Sized $CaCO_3$	kg				18.900

6.2.4.2.8.5 Mitigation of drilling fluid losses

Loss of circulation is defined as the loss of drilling fluids from the well into the surrounding geological formations during drilling. In this case, the bore of the well may not remain filled with drilling material even if the pumps turn off, resulting in reduction of the hydrostatic pressure in the well and therefore the pressure that is applied on the hydrocarbon formation decreases. In this case drilling is out of control. To regain the control of drilling, and in particular pressure control of hydrocarbons formation, the losses must be stopped.

There are several techniques that are applied in case of fluid loss, depending on the severity of the occasion (for more details see next section). The used products seal the drillings and pores of permeable formations, in order to avoid drilling fluid losses during drilling and tubing. These products react with the drilling mud at the bottom of the well, creating a mass, which allows re-drilling and therefore regaining control of the well.

6.2.4.2.8.6 Well control

The planning of a well is made in such a way as to maintain the density of the drilling fluids, so that they apply a static pressure at the rock formations, greater than the formation pressure but not so high that mud losses occur. After research, appropriate depths are selected for the position (depths) of the conductor strings, described above, in order to contain loose rock formations, thereby allowing increases in the pressure of the drilling liquids, as required to exceed the pressure of the rock formations.

In cases where a well kick occurs then the BOP system will be used. In the layers above the evaporitic top seal formation pressures greater than hydrostatic (i.e. the pressure that would be exerted by a column of fresh water) are unlikely to be exceeded. Since the water-based drilling fluids have a greater density than water, there is a very low probability of sudden inflow of fluids of the formation into the well, under normal operating conditions. Nevertheless, the Wellbore Control Plan will be applied, which specifies all the necessary preventive actions, as well as the treatment means, according to Best Practice Guide for Drilling Program. Once drilling through the evaporitic section and the underlying hydrocarbon charged sections pressures in excess of hydrostatic will be encountered as the Epsilon field remains at virgin pressures (which are in excess of the hydrostatic pressure at an equivalent depth). Management of mud weights is therefore very critical in these deeper horizons.

In the Prinos wells the reservoirs penetrated have been significantly depleted over the last 35 years and pressures are now less than hydrostatic. Drilling mud weights therefore are reduced once the cap rock has been penetrated. High-pressure zones remain within the cap rock and hence when drilling this section high mud weights are required. Oil based mud is employed whilst drilling through the evaporates to prevent swelling of embedded clays and hence stuck pipe incidents.

6.2.4.2.8.7 Crew

The normal crew of the Energean Force tender assisted barge is 72 split into two shifts of 12 hours each. All staff is accommodated offshore in an accommodation unit that currently can hold 100 people. Staff travels to and from the rig by boat from Kavala. Whilst drilling is ongoing contractor staff supplement the rig crew. The number of such staff varies considerably and is a function of the activities being undertaken. Typical contractor staff includes directional drillers, mud engineers, geologists, cementing engineers, solids handling crew, etc.

The rig is supported by a fleet of vessels and support ships that are also owned by Energean. These vessels also support ongoing production operations at the rest of the Delta complex,

transfer staff to Kappa and will in future transfer staff to and from Lamda. Approximately 25 people work on these vessels.

The crew that will work during drilling is described below:

- Drilling rig crew 15-20
- Maintenance crew 15-18
- Barge crew 8-10
- Catering crew 5-8
- Work floor area crew 10-15
- Drilling supervision 3-5
- Service staff 4 – 15

The above staff is included in the overall personnel presented earlier.

6.2.4.2.9 Personnel estimate

Energean already employees a number of technical and administrative people to carry out its day to day operations as presented earlier. Those are supported by the contractors' personnel and the personnel on board the drilling rig 'Energean Force' as also presented earlier. The future plans for installing the future platforms Lamda and Omicron ensures the viability of the operations as they are today and continued employment of existing staff. It is not expected that the new projects will increase staffing numbers due to the small size of the new installations.

6.2.4.3 Abandonment Phase

6.2.4.3.1 Abandonment of drilling wells

As mentioned earlier, wells can be abandoned permanently or temporarily.

More specifically:

- Temporary abandonment of drilling wells: the borehole of the well will be protected against any damage. A common practice is the use of a well grout with a proper marking, for easily locating the well in the future. The structures and grout used for temporary abandonment will be monitored for the avoidance of any pollution risks (i.e. by leakages). The seabed disturbance will be minimum and no drilling fluids will be dispersed through the borehole.
- Permanent abandonment of drilling wells: the same procedures and pollution prevention measures will be applied, as in the temporary abandonment of the drilling wells. Furthermore, a well grout in the hydrocarbon zone will be installed, for the prevention of the non-hydrocarbon zone.

6.2.4.3.2 Decommissioning of platforms

Before platform removal, the wells will be abandoned as described above and the process systems will shut down and cleaned.

Generally, the decommissioning of the existing installations is divided in the following discrete modules:

- **Hook-down:** prior to removal of the facilities, a hook-down team will sever all necessary topside-jacket connections and install the necessary padeyes to the topsides. These operations can be done by local resources.
- **Dispersal of drill cuttings:** Accumulated drilling cuts on the piles of the Alpha and Beta drilling platforms will be removed. The cuttings will be removed from around the jacket to prevent their presence hindering jacket removal operations. The dispersal activities will be performed by divers deployed from the platform dispersing the piles using water jetting nozzles. The divers once mobilized to disperse the drill cuttings will, also, disconnect the pipelines from the base of the risers.
- **Removal:** The lift vessel will then be mobilized to site to remove the platforms. Topsides and bridges will be removed first to gain access to the pipe internals. Charges will be run down the inside of the piles and detonated. Once the piles have been cut, the lifting vessel can lift and load the jackets on barges.
- **Disposal:** Following the removal of the platforms it is assumed that either onshore deconstruction or recycling of the material or deep-water disposal will be the preferred disposal route (note: this alternative disposal option is discussed as detailed below).

The new platforms (Lamda and Omicron) employ a design that enables them to be removed and reused at an alternate location using the reverse of the installation procedure. This reduces the cost of abandonment activities significantly and clearly allows for fuller recycling if re-use can be achieved.

More specifically:

The baseline abandonment operation for the existing facilities is to remove the platforms and load them on barges for towing to shore for offloading and dismantlement. It is assumed that all hook down activities have been completed prior to mobilising the crane vessel to site and that all drill cuttings have been dispersed from around the base of the drilling platform jacket.

Typically, the removal operations will involve a crane vessel positioning itself adjacent to the platforms and removing the bridges, topsides and jackets in a pre-determined sequence and placing them on a pre-prepared cargo barges for transport to a suitable final destination. In calculating the size of and number of barges, the dimensions of the platforms are required.

Activities will be scheduled to minimize the crane vessel time on location. Therefore it is proposed to remove bridges and topsides first to allow the DSV/workboat to run explosive charges internally down the piles and perform pile-cutting activities simultaneously to other topside removal operations. Explosive cutting tools are envisaged for pile cutting however other options such as diamonds wire and abrasive waterjet techniques could also be used.

More specifically, the SIP may be decommissioned in two main parts: topsides and hull. The SIP hull can be removed/relocated/decommissioned by deballasting the ballast tanks and reversing the suction operation. The SIP may be relocated to another similar location by towing in the upright position. A small water depth variation is allowed for the SIP relocation. The hull will have

towing pad eyes with a capacity sufficient for vertical tow. The topsides must be independently removed/relocated/decommissioned in a separately operation.

An alternative decommissioning solution is the disposal of the platforms in deep-water. The exact deep-water disposal technique applied will be a result of extensive environmental, legal, social and technical studies.

This deep-water disposal solution had been examined in the past (1998) for the existing offshore facilities. A crane-vessel, a special launch barge and explosive cutting tools will be used.

Proposed sites for the disposal are:

- 100 m depth at distance of 10 km S/SW of Kappa platform
- 200 m depth at distance of 15 km S/SW of Kappa platform
- 500 m depth at distance of 30 km S/SW of Kappa platform

All hook-down activities have to be completed prior to mobilizing the crane-vessels to site. The procedures of drilling wells and drilling cuts are the same with the ones described in the basic decommissioning solution.

In other shallow water oil and gas provinces platform jackets are employed to create artificial reefs to aid the local fishing industry. Once removed jackets are laid horizontally on the seabed in an agreed location. They are covered by wire or rope meshing to give a structure to encourage marine growth. Topsides would not be abandoned in this manner due to the potential for remaining oil contamination.

6.2.4.3.3 Decommissioning of pipelines

All pipelines (i.e. existing and new pipelines) will be flushed with seawater to remove all hydrocarbons. A portion of this water will be discharged into the existing water treatment facilities at the Delta platform and treated to remove contaminates (as verified by monitoring) prior to discharge to the sea. The other portion of the pipeline wash water will be sent through the line for discharge via the Sigma plant. This waste water will be disposed of onshore through an authorized waste disposal/treatment site as managed under the WMP.

6.2.4.3.3.1 Reinstatement of site

Due to the fact that all infrastructures are located offshore, the only reinstatement activities are the prevention measures for elimination of pollution risk and for the minimization of seabed, as described in previous paragraphs.

6.2.5 Emissions and Material Use

6.2.5.1 Construction Phase

6.2.5.1.1 Raw Material Usage

Due to the nature of activities and the short duration of construction, minimal raw material usage will occur during construction. This will consist mainly of the typical materials used for vessel operation (e.g. fuel) and those associated with the presence of a workforce (e.g. water, food).

6.2.5.1.2 Noise emissions

During the construction phase of a typical upstream project noise emissions are associated with two main elements; namely a) the number and size of the vessels employed and the overall duration they are at site and b) the installation of piles to hold the jacket structure to the sea bed. A typical execution strategy involves a heavy lift barge to place the jacket in position, tugs to hold transportation vessel in placed, a piling spread, a floating accommodation unit to house the large number of staff required plus vessels to bring supplies and remove waste to shore. A typical construction activity can last 6 to 8 weeks.

Energean has selected a design concept that minimises the time required to install the new facilities and avoids the use of heavy lift equipment, piling spreads and temporary living quarters. The expected installation time is just 3 days and marine requirements limited to 2 tugs and a dumb cargo barge. The quantity of noise from this spread is expected to be less than 1% of that associated with a typical installation. The tugs to be employed re based in the Kavala area and hence contribute sub-sea and airborne noise to the area currently.

Energean has also selected to use suction piles instead of driven piles to hold the structure in place. When driving piles noise levels in excess of 180 dB are created sub-sea. These can cause permanent damage to mammals within 2 to 10m distance and impact their normal behavioural patterns up to 200m away. The use of suction piles avoids these significant noise emissions. The only item installed subsea that emits noise will be the suction pumps that extract water from the piles. These will operate for around 12 hours. They emit noise at a level of about 40 dB, similar to an idling car. These levels will have no impact on the environment.

Surface noise will also be limited by the fact that no heavy lifting gear is required and hence no diesel engines. The topside structure is lifted into position using hydraulic jacks.

6.2.5.1.3 Emissions to air

Emissions to air during the construction phase are due to the flue gasses associated with the marine spread employed. As described for noise emissions the selection of a Self Installing Platform helps ensure that air emissions are brought to a level significantly lower than a typical platform installation.

6.2.5.1.4 Wastes

No significant waste streams are expected in the construction phase. The platform topsides will be fully constructed onshore and hence there will be little need for mechanical operations following platform installation other than the mating of pipelines and risers subsea.

There will be no offshore accommodation in the field and hence no human related waste streams to deal with.

6.2.5.2 Operating Phase

6.2.5.2.1 Raw material usage

6.2.5.2.1.1 Use of chemicals

The offshore processing on the Prinos complex that takes place in platform Delta consists basically of:

- 3- Phase (oil, gas and water) production separation
- Well production testing
- Crude dehydration
- Crude oil transfer to shore, with high pressure pump via 8'' submarine pipeline
- Gas dehydration (BASF)
- Treatment of waste water for disposal (de oiling and stripping)
- Sea water injection

For the above processes, the following chemicals are used on Delta platform:

Table 6-15: Chemicals currently used on existing facilities

Chemical	MSDS
Demulsifier	EC-2173A
Scale inhibitor	EC-6156A and EC-6187A
Corrosion inhibitor	EC-1175A and EC-1185A
Antifouling	EC-6201A and EC-6388A
Oxygen scavenger	EC-6213A
Cationic polyelectrolyte	EC-6176A
Triethylene glycol	BASF
Methanol	
Citric acid	

For each stage a different chemical is used:

- Demulsifier (EC-2173A): A demulsifier is required to prevent the formation of emulsions within the overall production system
- Scale inhibitor (EC-6156A and EC-6187A): This chemical is required in order to prevent scaling, due to the high salinity of formation of water.
- Corrosion inhibitor (EC-1175A and EC-1185A): For prevention of corrosion, inside the

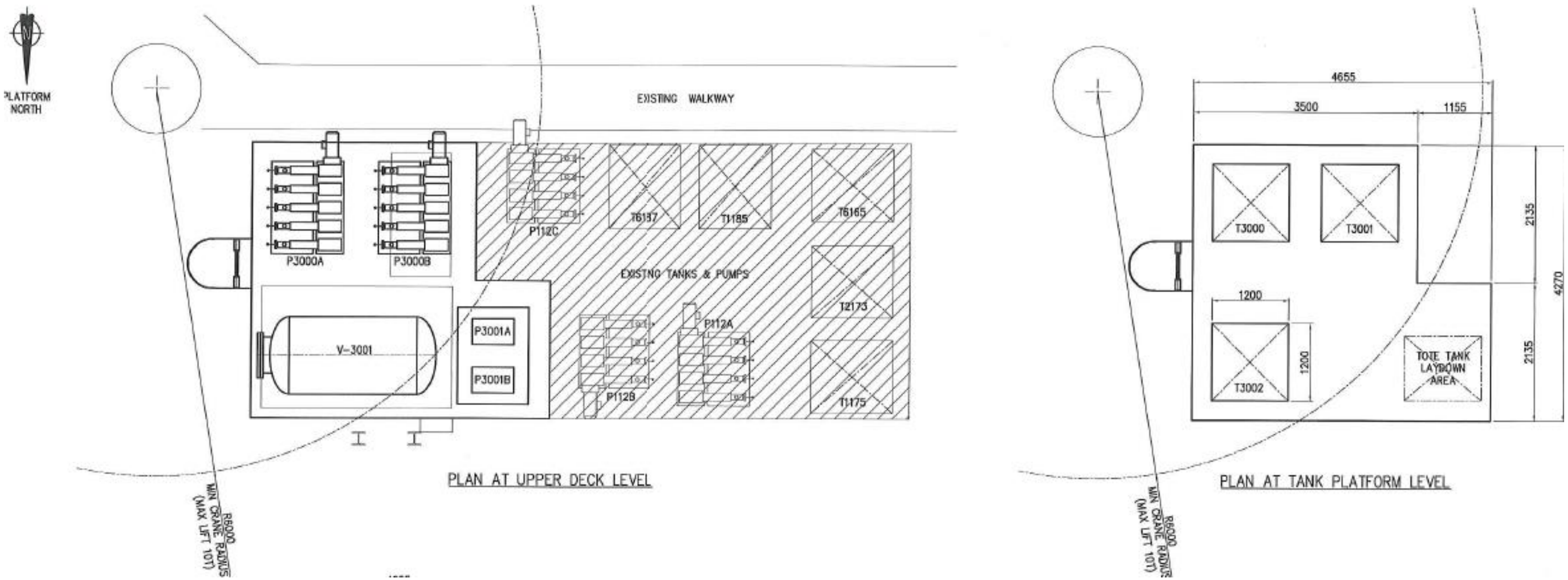
offshore flowlines and pipeline, two types of corrosion inhibitors are used.

- Antifouling (EC-6201A and EC-6388A): Antifouling agents are used for the protection of equipment from algae and bacteria growth.
- Oxygen Scavenger (EC-6213A): Oxygen is removed from the seawater, by the use of oxygen scavenger, for protection of corrosion by the growth of certain bacteria.
- Cationic polyelectrolyte (EC-6176A): This polyelectrolyte is used for flocculation of salts etc.
- Triethylene glycol (BASF): Triethylene glycol is used in order to remove the water from the sour gas and prevent corrosion of the 12” sour gas pipeline.
- Methanol: Methanol is to be used as the hydrate inhibitor.
- Citric acid: This type of acid is used for scaling cleaning

Moreover, Prinos Delta will supply chemicals to the new satellite platforms maximizing the use of the umbilical and minimizing the need to send operators to the platforms. The chemical injection area of Delta platform will be upgraded to accommodate new chemical injection equipment.

The relevant layout plan is presented in the below.

Chemicals will be injected with the wells and platform in flowing status. No chemical injection is required with the wells closed in thus limiting maximum pressures required to inject at Lamda platform. Subsequently, Omicron platform will be installed south of the Prinos North field. The two platforms will be essentially identical.



Drawing 6-1: Accommodation of chemicals

The chemicals that will be used are presented in the following table below.

Table 6-16: Chemicals currently used on existing facilities

Chemical	MSDS
Corrosion inhibitor	EC-1175A
Demulsifier	EC-2173A
Asphaltene	EC-3019A
Hydrate inhibitor (methanol)	
Scale inhibitor	EC-6187A

More specifically:

- The current Prinos Delta corrosion protection scheme will be adopted for use on the new platforms. The current scheme has proven that the use of carbon steel pipework with suitable corrosion inhibitor injection is acceptable. Corrosion inhibitor will be injected continuously at a point upstream of the relevant well choke valve.
- Demulsifier will be injected continuously at the inlet to the export pipeline on both satellites. Demulsifier is required to prevent the formation of emulsions within the overall production system. An additional demulsifier injection point will be installed at the test manifold
- Asphaltene precipitation problems are expected in the Epsilon wells and potentially on wells drilled from Omicron. Asphaltene precipitation is to be mitigated via continuous down hole injection by means of a deep set Chemical Injection Valve (typically 3/8" control line) which will be installed with the injection point set as low as possible along the tubing so as to maximize the effect of the asphaltene inhibitor. The preferred Chemical Injection Valve location is below the production-tubing packer.
- A hydrate inhibitor is required for discontinuous use during start-up and planned shutdowns to prevent hydrate formation in the flowlines and multi-phase pipeline. Methanol is to be used as the hydrate inhibitor. Currently the design assumes a separate Methanol injection system.
- Scale inhibitor is expected on wells with high formation water production, mainly anticipated on Omicron wells, where higher aquifer support is anticipated. Injection is done down hole using the same control line as the asphaltene inhibitor injection. Note that Asphaltene and scale inhibitor will not be injected at the same time.

The injection system scheme between Delta and Lamda / Omicron is provided in the following diagram:

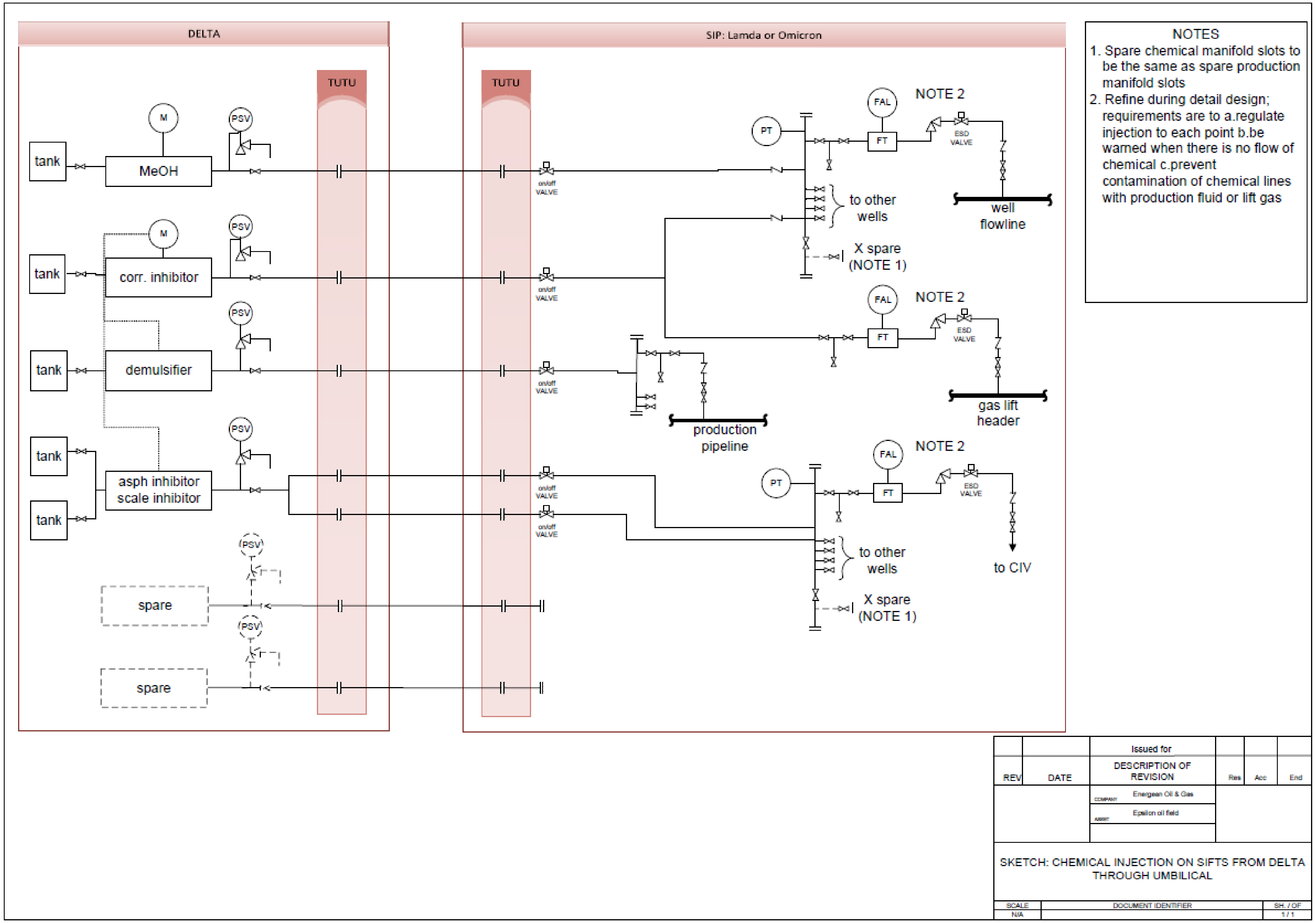


Diagram 6-4: SIP chemical injection scheme

The chemical hazards associated with the selected chemicals will be mitigated via the current Prinos Delta operating procedures. The physical properties of the injection chemicals have been taken from the Nalco Material Safety Data Sheets provided by Energean.

Table 6-17: Chemical properties for the offshore facilities

	Chemical	Nalco No.	Fluid density (kn/m³)	Fluid viscosity (dynamic: cP) (kinetic: cst)	Flash point (°C)	Vapour pressure (kPa)
Existing chemicals	Demulsifier	EC-2173A		23.35 cst	65	
	Scale inhibitor	EC-6156A		4 cst	>93.3	
	Scale inhibitor	EC-6187A		8 cst (0 °C) / 3.6 (25 °C)	80	3.2 (25 °C)
	Corrosion inhibitor	EC-1175A			100	
	Corrosion inhibitor	EC-1185A		1.6 cst (40 °C)	31	
	Antifouling	EC-6201A		1.40 cst (40 °C)	>100	
	Antifouling	EC-6388A	9.6 lb/gal		>93.3	
	Oxygen scavenger	EC-6213A		1.60 cst (20 °C)		3.2
	Cationic polyelectrolyte	EC-6176A		560 cst (21 °C)	>93.3	3.19
	Triethylene glycol	-			177 (closed cup) / 165.5 (open cup)	
	Hydrate inhibitor (methanol)	-			12 (closed cup) / 16 (open cup)	12.3
	Citric acid	-				
Future chemicals	Asphaltene inhibitor	EC-3019A	1100	7.2 cP	70	4.0
	Corrosion inhibitor	EC-1175A	1040	10.4 cP	100	See Note 1
	Demulsifier	EC-2173A	930	7.6 cP	65	3.2
	Scale inhibitor	EC-6187A	1040	21.7 cP	80	See Note 1
	Hydrate	-	See note 2	See note 2	See note 2	See note 2

	Chemical	Nalco No.	Fluid density (kn/m^3)	Fluid viscosity (dynamic: cP) (kinetic: cst)	Flash point (°C)	Vapour pressure (kPa)
	inhibitor (methanol)					

Notes:

1. Water based chemicals, water vapour pressure to be assumed
2. Methanol system to be verified.

Dosage rates have been defined for each chemical that is continuously injected. These are indicated in the tables below:

Dosage rates have been defined for each chemical that is continuously injected. These are indicated in the tables below:

Based upon the above dosage rates and mid case production forecasts the following annual consumption levels for both Lamda and Omicron platforms have been calculated.

Table 6-18: Expected dosage rates - Delta

Chemical	Dosage basis	Dosage (ppm)	Oil/water flow (bpd)	Dosage (tn/yr)
EC-2173A	Oil + water	25 ppm		30
EC-6165A	Oil + water	7ppm		4.2
EC-6187A	Oil + water	25 ppm		2
EC-1175A	Oil + water	8 ppm		12
EC-1185A	Oil + water	8 ppm		15
EC-6201A	Oil + water	Butch: 200 litre twice per week		12
EC-6388A	Oil + water	-		20
EC-6213A	Oil + water	10 ppm		10
EC-6176A	Oil + water	2 ppm		6
Triethylene glycol	Oil + water	Quantity 8 tn in closed loop system with regeneration		6
Hydrate inhibitor (methanol)	Oil + water	Delta plt. actual: Small quantities at winter time		0,5

Chemical	Dosage basis	Dosage (ppm)	Oil/water flow (bpd)	Dosage (tn/yr)
Citric acid	Oil + water			8

Table 6-19: Expected dosage rates - Lamda

Chemical	Dosage basis	Dosage (ppm)	Oil/water flow (bpd)	Dosage (l/h)
Asphaltene inhibitor	Oil	250	12,000	19.9
Corrosion inhibitor	Oil + water	200	18,000	24.0
Demulsifier	Oil + water	50	18,000	6.0
Scale inhibitor	Oil + water	40	18,000	5.0
Hydrate inhibitor	Oil +water	See note 1	See note 1	See note 1

Notes:

1. Methanol will be used on planned shut down and cold restarts. These events will be rare and methanol is only required between October to May period. Total volume injected for each planned event is estimated between 2 to 4 m^3 at typical injection rates of 5-10 m^3/hr (meaning the dosage operation is typically less than 30 mins).

Table 6-20: Expected dosage rates - Omicron

Chemical	Dosage basis	Dosage (ppm)	Oil/water flow (bpd)	Dosage (l/h)
Asphaltene inhibitor	Oil	250	6,000	10.0
Corrosion inhibitor	Oil + water	200	9,000	12.0
Demulsifier	Oil + water	50	9,000	3.0
Scale inhibitor	Oil + water	40	9,000	2.4
Hydrate inhibitor	Oil + water	See note 1	See note 1	See note 1

Notes:

1. Methanol will be used on planned shut down and cold restarts. These events will be rare and methanol is only required between October to May period. Total volume injected for each planned event is estimated between 2 to 4 m^3 at typical injection rates of 5-10 m^3/hr (meaning the dosage operation is typically less than 30 mins).

Diagram 6-5: Chemical consumption per type and year

Table 6-21: Annual chemical consumption rate for Lamda & Omicron (m^3/annum)

Row levels	Average of CI (CK-990G or EC-1175)	Average of Demulsifier (EC-2173A)	Average of Asphaltene Inhibitor (EC-3019)	Average of Scale inhibitor (EC-3019)
2016	3.3	0.8	2.9	0.7
2017	9.0	2.3	8.4	1.8
2018	9.0	2.2	9.1	1.8
2019	10.0	2.5	9.1	2.0
2020	8.3	2.1	6.3	1.7
2021	7.4	1.9	4.7	1.5
2022	7.2	1.8	3.9	1.4
2023	7.4	1.9	3.4	1.5
2024	7.5	1.9	3.0	1.5
2025	7.5	1.9	2.6	1.5
2026	7.6	1.9	2.4	1.5
2027	7.8	1.9	2.2	1.6
2028	7.9	2.0	2.1	1.6
2029	8.1	2.0	2.0	1.6
2030	8.2	2.0	1.9	1.6
2031	8.3	2.1	1.8	1.7
2032	8.4	2.1	1.7	1.7
2033	8.5	2.1	1.6	1.7
2034	8.6	2.2	1.5	1.7

As mentioned previously the hydrate inhibitor (methanol) will be used in a discontinuous way during start-up and planned shutdowns, so as to prevent hydrate formation in the flowlines and multi-phase pipeline. Up to two planned events per year are currently foreseen.

6.2.5.2.1.2 Fresh water use

There is no routine consumption of potable water on the Lamda platform.

Omicron will be equipped with permanent equipment to allow it to wash wells associated with formations that have high formation salinities (Prinos North currently). NaCl salt precipitates in production tubulars due to temperature and pressure changes. These restrict and eventually block affected wells. By installing permanent equipment the time required to execute a water wash will be significantly reduced compared to similar jobs performed on Prinos.

- The fresh water will be supplied by supply boat and bunkered in a ~30m^3 fresh water tank. The fresh water tank will be provided with electrical heater.
- An electrical driven pump will be installed to perform the water wash and/or squeeze jobs. Flow characteristics: max 3 bpm, at 4,500 psi.
- A chemical tank to receive chemical dedicated to squeeze jobs: scale or asphaltene

This permanent equipment will only be installed on Omicron platform.

6.2.5.2.2 Noise emissions

The additional noise sources from the new installations will be mainly due to the drilling operations and the associated marine traffic. Marine traffic requirements are limited by the selection of Normally Unmanned Installations. Visits will occur at most every two weeks using existing vessels that move staff between shore and Prinos or Prinos and South Kavala.

The most significant potential noise emissions during the operational phase are those associated with the installation of the conductors for the new wells to be drilled from Lamda. No conductors are required for the wells to be drilled from Alpha as the planned wells are all side tracks. Conductors are traditionally hammered into the se-bed to a distance of 40 to 50m to support the wells drilled from a platform. These are large diameter (30”) tubes through which the well is drilled.

When hammer driving conductors sound levels up to 180 dB can be generated. This compares with 120 dB from the typical marine craft that service offshore oil and gas platforms. These high levels are potentially hazardous to marine creatures. The hearing of mammals can be damaged at these levels in a range of 3 to 10m (depending on noise frequency) with behavioural modifications noted out to 200m.

To limit the impact of this noise Energean plans to:

1. Undertake all piling required in a single campaign thereby limiting any noise emissions to as short a period as possible. Five conductors will be driven initially. This will take approximately 5 days to complete, although noise would only be generated for about a third of this period.

2. Once soil survey results have been analysed, if the soils are found to be as soft as expected in the shallow strata that have to be penetrated, vibro piling equipment will be employed instead of hammer pile. Vibro piles generate a noise level of about 80 dB and hence is below the level of noise generated by waves etc.

No major noise sources are to be located on the new facilities. No rotating equipment except for small capacity electric pumps is included in the design. The installations include no flares. Hence in the operational phase the facilities themselves should be almost silent. In the first 9 to 15 months of operations drilling activities will take place. The noise from the drilling equipment used will dominate noise emissions in this period.

Naturally occurring noise levels in the ocean as a result of wind and wave action, may range from 90 dBA re 1μPa under very calm, low wind conditions to 110 dB re 1μPa under windy conditions. Certain aspects of drilling campaign could generate noise in excess of the aforementioned ambient conditions. Many measurements have been made around the world regarding noise levels associated with rigs in idle and drilling conditions. Shell Australia conducted detailed studies in 1998 where noise levels for a rig under static conditions were compared with a rig in drilling conditions. The noise levels from a supply boat servicing the unit was also measured and compared with the noise from the rig (R.McCauley, 1998, Radiated underwater noise measured from the drilling rig Ocean General, Rig Tenders, Fishing vessels and natural sources in the Timor Sea, Australia). Noise levels during drilling and non-drilling periods (i.e. the noise from rig generators, human activity only) were similar. 125m from the rig a level of 117 dB was recorded. When offloading activities from support vessels using bow thrusters took place noise levels peaked at 134 dB. Still water background noise levels were recorded at 90 dB.

This data confirmed earlier measurements for production drilling units as tabulated below.

Hence, although the ‘Energean Force’ rig will introduce an increased level of noise above background this level is not expected to be any higher than the noise level generated by other marine craft in the area, including those that service the existing platforms.

Table 6-22: Sound sources from drilling activities

Production drilling	Frequency range (kHz)	Average source level (dB re 1μPa-m)	Estimated received level at different ranges (km) by spherical spreading (dB re 1μPa-m)			
			0.1 km	1.0 km	10.0 km	100.0 km
Production drilling	0.25	163	123	102	77	2
Drill ship	0.01 – 10	175 – 191	127-131	106 – 110	81 – 85	6 - 10

Source: Evans & Nice, 1996; Richardson et al, 1995

6.2.5.2.3 Emissions to air

Emissions to air will be generated from support vessels and the Energean Force. The other source of emissions to air will be from the combustion of sour natural gas during flaring; however, flaring on the new platforms will be extremely limited. No continuous flaring will occur (unlike for the existing Prinos Complex) and flaring will only be used during maintenance activities (i.e. to evacuate lines for safety reasons). Given the limited amount of emissions and distance from receptors for air quality, these emissions are not considered to significantly contribute to reduced air quality.

6.2.5.2.4 Wastes

6.2.5.2.4.1 Wastewater (WW) generation

No wastewater (WW) is generated on the proposed satellite platforms. All water produced from the planned new wells is passed to Prinos Delta where it is separated and treated in existing systems and then discharged to sea. Expected annual produced water volumes for Lamda and Omicron are indicated below

Table 6-23: Produced water forecasts (m^3/annum)

Row levels	Average of avg. water (Lamda)	Average of avg. water (Omicron)
2016	2,169.1	0,0
2017	4,321.7	468.2
2018	1,308.9	2,243.9
2019	2,607.1	2,957.7
2020	4,357.7	2,271.4
2021	5,167.0	2,399.1
2022	6,026.4	2,542.9
2023	6,922.3	2,752.0
2024	7,675.9	2,895.5
2025	8,241.5	2,988.9
2026	8,816.9	3,022.6
2027	9,341.6	3,056.6
2028	9,794.0	3,167.0
2029	10,224.5	3,208.4
2030	10,579.2	3,267.4
2031	10,895.0	3,369.3
2032	11,192.7	3,461.4
2033	11,502.4	3,498.5
2034	11,759.6	3,570.3

The above quantities will be added to the existing flows currently operating in Delta and will not increase further the design capacities.

The only liquid “waste” stream generated on the new satellites is the result of rainwater entering

the closed drain system via bunded areas with the potential to contain hydrocarbon substances. To minimise such volumes the size of bunds has been minimised and shelter to prevent blown rain provided where possible.

An analytical Waste Management Plan, (WMP) that includes both wastewater and solid waste is provided in the Annex 10, that gives analytical guidelines of the management of the project waste quantities.

6.2.5.2.4.2 Naturally occurring radioactive material

Naturally Occurring Radioactive Material (NORM) is not anticipated to be different than those associated with Prinos formations. Most drill cuttings produced historically from the Prinos wells have levels of radioactivity in line with background levels. However occasionally batches of cuttings with levels of up to 600-700 nSv/hr are produced. To date these small volumes have been stored in covered concrete bunkers at the Sigma site. Sigma staff is responsible for managing waste disposal have access to a Geiger counter and routinely check skips of cuttings received onshore. Any with spuriously elevated radioactive levels will be stored in the same way rather than transferred to the normal waste management contractor. Energean are currently discussing with the relevant Greek authority a long-term solution for the small volumes of waste with elevated NORM levels.

6.2.5.2.4.3 Solid waste

As mentioned above, an analytical Waste Management Plan, (WMP) is provided in the Annex 10 that gives analytical guidelines of the management of the project solid and liquid waste quantities.

6.2.5.2.4.4 Non-hazardous waste (nHZW)

A range of non-hazardous waste streams are anticipated to arise during the drilling activities. The generation of non-hazardous waste shall be minimised through the implementation of the waste hierarchy at each stage of the drilling activities. Waste streams shall be segregated and compacted (where suitable facilities exist).

These non-hazardous wastes are mainly generated from the personnel of 'Energean Force'. For the purposes of the ESIA it is assumed that 116 persons (all shifts) will be present for 365 days in 'Energean Force', thus an estimated amount of 42,340 kg/yr of domestic wastes will be generated. Most of them will be biodegradable waste from the kitchen (a percentage of 60% is used for the calculations). The estimated amounts of non-hazardous wastes are:

- Paper and cardboard (20 01 01) : 8,460.80 kg/yr
- Biodegradable kitchen & canteen waste (20 01 08) : 25,404.00 kg/yr
- Plastic (20 01 39) : 2,115.20 kg/yr
- Metals (20 01 40) : 2,115.20 kg/yr

- Mixed municipal wastes (20 03 01) : 4,234.00 kg/yr

Non-hazardous waste must be packaged in suitable containers and securely stored prior to transfer to Sigma Onshore Facilities. The burning or incineration of non-hazardous waste is prohibited on platforms.

Non-hazardous waste generated shall be transferred to Sigma Onshore Facilities and then by means of local municipality, for disposal. All transfers of non-hazardous waste must be accompanied by the required documentation as detailed in WMP.

The domestic waste produced in existing platforms will follow the same methods applied, as in so far.

6.2.5.2.4.5 Hazardous waste (HZW)

From the drillings taken place in Alpha and Beta oil-containing drilling muds and waste (01 05 05*) are produced and will be produced in the same flow in the future.

Hazardous wastes from the current facilities are produced in Delta platform. These are wastes generated during maintenance, which lasts 15 days every 30 months. These hazardous wastes are produced from cleaning of collection vessels V-101 A/B, V-107 και V-102 and consist of oily sludges (mixtures of heavy hydrocarbons containing mainly asphaltenes), oily rags, absorbents etc.

The same type of hazardous wastes will be generated from the maintenance of Lamda and Omicron, though is smaller scale due to the fact that no process activities will take place there.

The estimated hazardous waste production, in total from all platforms is:

- Oil-containing drilling muds and wastes (01 05 05*) : 1,000,000 t/yr
- Oil sludges from maintenance operations (05 01 06)* : 60,000 t/yr
- Oily water from oil-water separator (13 05 07*) : 60,000 t/yr
- Absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances (15 02 02*) : 1 t/yr

All waste oil and water contaminated with oil will be collected to the specific tanks of the ‘Energean Force; and when the capacity will reach the 75% of the total capacity of the dedicated tanks, then the liquids must be transferred. ‘Limin Prinos’ barge can receive the liquid waste, in the same way as receives them from Delta platform, and transported to Sigma Onshore Facilities for disposal as per Facilities Approved Environmental Terms.

Hazardous waste generated offshore is transferred to Sigma Onshore Facilities by a barge.

6.2.5.2.4.5.1 Drill cuttings

A type of hazardous waste produced is the drill cuttings. Drill cuttings need to be treated to remove solids from re-circulating mud stream. Any solids that are not contaminated with toxic

substances are discharged to the sea. Any cuttings contaminated by hydrocarbons from the geological formation or due to the oil-based mud will be separated at the drilling unit. These cuttings will be monitored, handled and treated to ensure no uncontrolled discharge to sea.

Cuttings from the planned wells are removed in the mud package forming part of the 'Energean Force' drilling rig. Wet cuttings are transferred to a rented solids management system that can be located on the 'Energean Force' barge (Prinos drilling) or on the top deck of the satellite (Lamda and Omicron). Cuttings are centrifuged to remove the majority of mud and then dried. Dried cuttings are placed in skips and then transferred onshore for further treatment and disposal via a certified waste management contractor. No cuttings are disposed of at sea.

After on board treatment the contaminated drill cuttings are contained and transported to Sigma Onshore Facilities, from where they are further collected by appropriately licenced company.

In a typical Epsilon well approximately 1,448 tonnes of cuttings will be generated, hence in the P50, seven (7) well programme approximately 9,000 tonnes of solid waste will be generated. The waste generated from drilling operations on Omicron will be less, as the fields in this area are shallower. Drilling operations at Prinos generate small volumes of cuttings, as all currently planned wells are small diameter sidetracks.

The overall waste management plan provides analytical the projected types, quantities and management means of all produced and expected to be produced wastes.

The full fledge waste management plan is included as part of the ESIA, in the Annex 10.

6.2.5.3 Abandonment Phase

6.2.5.3.1 Raw Material Usage

Raw material usage will be similar to construction, but with the addition of cement to plug wells and potentially explosives to cut legs for the existing platforms (not the new platforms).

6.2.5.3.2 Noise Emissions

As per the construction phase, noise levels are largely dominated by the size of the construction fleet used. For the existing traditional jackets the scope and duration of the abandonment exercise will be relatively significant lasting more than a month. It will require the use of a heavy lift crane mobilised to the area. Offshore accommodation will be required. Noise levels would be expected to be similar to continuous marine activities in the area. These activities will generate noise levels that could disturb marine creatures in the local area.

The other major source of noise is due to any cutting of the structures required. As the Prinos platforms are located in shallow waters the only cutting required would be immediately above the seabed. Historically explosives have been used. The current expectation is that explosives would not be required. Water jetting or the use of abrasive wire cutters techniques is now available and it is anticipated that these techniques would be employed, although slower to implement.

Abandonment of the new facilities would have a much lower impact as they will be refloated and

either moved to a new location of dismantled on shore.

6.2.5.3.3 Emissions to Air

Emissions to air will be similar to those generated during construction.

6.2.5.3.4 Wastes

The most significant waste generated in a decommissioning exercise is the marine growth from the jacket structures. Studies from the North Sea (BP, Miller decommissioning EIA) have concluded that it is preferable to remove organic matter offshore with water jets rather than onshore during the scrapping stage. The marine environment is better able to cope with a large influx of organic waste material than an onshore site.

7 ALTERNATIVE SOLUTIONS

7.1 INTRODUCTION

This section presents details of the alternative development options investigated by Energean when preparing the planned and potential extension projects outlined above. As per international good oilfield practice Energean uses a formal stage gate process through which it progresses its projects. This process commences with Feasibility. In the Feasibility stage the company examined all potential approaches to developing the identified satellite fields. This is undertaken by preparing tables that list for each element of the field development the viable alternatives and then selecting from these to prepare extreme (or end point) development scenarios. These development scenarios are often driven by a theme, which can be technology based ("maximum use of Extended Reach Drilling"), execution related ("maximize potential for local content in the execute stage") or driven by consideration of the existing facilities ("maximize use of existing infrastructure"). With "end points" defined these scenarios are combined and adjusted to give as wide a selection of options as possible.

Based upon this work each potential development option is studied at a high level and then compared on the basis of a number of screening priorities. These priorities include typical fiscal measures ("total capex", "NPV", "annual operating costs"), measures such as "Flexibility" and "Percievd Risk" – that relate to the executability and operability – plus of course "impact" parameters such as "environmental", "manning", "safety" etc. Based upon this analysis between 3 to 6 potential scenarios are carried forward into the next stage (Concept), where they are studied in more detail allowing the best option to be determined. The best option is the one that is seen to be best able to meet the established objectives, namely:

- Minimize potential impact on the environment
- Ensure safety risk levels can be brought to ALARP
- Minimise project risk – focus on simplification of interfaces during installation phase
- Maximise use of existing facilities, and staff resources
- Maximise opportunities for Greek companies

Whilst of course also meeting or exceeding the economic thresholds required to allow the projects to be sanctioned.

When developing fields close to existing infrastructure, particularly where that existing infrastructure has spare capacity, the number of valid "end point" scenarios that can be identified is normally limited. Clearly the most economic approach is to develop these fields as simple satellites. In this case the focus of the Feasibility phase is the optimization of the satellite concept

with the same core objectives in mind.

In the context of an Environmental and Social Impact Assessment this early phase of the project is critical as this is the point where the largest opportunity to reduce overall impacts occurs. It is commonly understood that Feasibility and Concept is where "Value" is created. Later stages are about preservation of Value or minimization of Value erosion. The same is clearly true with regards to Environmental (and Safety) impacts. It is much more effective to engineer out Environmental risks at the commencement of a project, than attempt to mitigate these during the Execution and Operations phases.

In this section the alternative development options addressed by Energean in the Feasibility and Concept stages are discussed and contrasted with the baseline option of not developing the fields at all – the so-called "Do Nothing" option.

7.2 'DO NOTHING' OPTION

The "do nothing" option would represent a decision by Energean to make no further development investments in the Prinos Area licenses. New wells would be drilled from the existing Prinos assets and the discovered satellites would not be developed. No new exploration activities would be undertaken. In the "do nothing" option production from the existing well stock would gradually decline until a "break-even" production rate were reached. At current oil prices current production is insufficient to cover ongoing operating costs. Hence if the "do nothing" option had been selected the company would have had to either significantly reduce operating costs to enable the venture to remain economically viable or shut down the facilities immediately.

A decision to significantly reduce operating costs whilst endeavouring to maintain production at profitable levels would have the following consequences:

- Immediate impacts: those expected from the time Energean announces a halt to its planned investments:
    - ⇨ Technical / environmental:
        - Facilities would work under the design capacity, impacting equipment efficiency, operational, safety and environmental performance.
        - Spend on maintenance would be reduced as the facilities are "wound down". This would increase the chance of failures potentially with a negative impact on environmental performance.
    - ⇨ Socioeconomic:
        - Immediate ending of new investments, with knock-on socioeconomic impact to the local market associated (directly/indirectly) with hydrocarbon exploitation;
        - Immediate end to hiring and investing in new people and expertise;
        - Release of personnel to allow operating costs to be reduced and to reflect gradual shut down of operating systems. Staff associated with expansion projects would be laid off immediately

- Long term impacts:
  - ⇨ Technical / environmental:
    - A large volume of hydrocarbons would remain unexploited, shutdown and abandonment of the existing facilities would likely mean these discovered volumes would never be produced.
  - ⇨ Socioeconomic:
    - Socioeconomic impacts due to the loss of employment for a significant number of people, mostly employed from the local market;
    - Expertise loss, since the type of facility is unique in the Greek territory, the experienced personnel will not be able to be absorbed by the market and therefore they either have to change career direction or move abroad.
    - Moreover, financial loss resulted from a number of businesses that are dealing either directly (subcontractors, suppliers) or indirectly (service providers), to support the facilities, operations. More specifically, this means that in regional and municipal level there will be a revenue loss (ie. local suppliers, salaries) of about 2,6 m€ per annum (based on data by Energean[8]) and in national level there will a revenue loss (ie. taxes, social insurances, public utilities) of about 3,2 m€ per annum (based on data by Energean[9]).
    - The Project will offer technological, research and educational opportunities both at local and at national levels. A 'do nothing option' would deny the transfer of these opportunities.

Based on the above the '"do nothing" option was not considered as a viable way forward for the assets discussed in the ESIA. Energean has invested substantial capital in demonstrating the further potential of the Prinos Area. Whilst oil prices are currently low the best forward plan for the company is to develop these discovered resources whilst the existing facilities have integrity. This approach is also the most favourable from a socio-economic perspective whilst not introducing unacceptable environmental threats.

7.3 FIELD DEVELOPMENT OPTIONS

7.3.1 Alternative Epsilon field development options

A number of potential development options for the Epsilon field were examined. These include:

- **Option 1** – Minimum facility platform with dry Christmas trees at Epsilon & subsea pipeline to Delta
- **Option 2** – Extended Reach Drilling (ERD) from the Delta platform

[8] It is noted that those data are based on existing financial data (2008 to 2014) and do not include the potential revenues from the exploitation of Epsilon and north Prinos fields, which are expected to increase further the contribution to the local and national economy.
[9] As above.

- **Option 3** – Subsea installation at Epsilon (wet Christmas trees) and tieback to Delta

Option 1 is the preferred solution and is described in section 5 of the ESIA.

Option 2 is considered viable but less optimal than option 1. ERD wells drilled from Prinos would be significantly more expensive and would generate more solid waste whilst presenting more risks (for blowouts) whilst being drilled. The Prinos complex has a limited number of existing well-slots. Use of 5 to 11 of these for the exploitation of Epsilon would have limited options for further drilling at Prinos. Realistically a new drilling platform would have had to be installed at the Prinos complex to allow Epsilon and Prinos infill projects to be executed. It was clearly better to install this platform at the Epsilon field to reduce well complexity at the expense of a small number of short pipelines. The Prinos North Area fields cannot justify the cost of ERD wells and hence under this option these resources would not be developed. By designing and building the Lamda platform the Company has the opportunity to build a second identical unit (Omicron).

Option 3 is to drill conventional wells but dispense with the requirement for a jacket and topsides by installing subsea wellheads, manifold and wet Christmas trees, which are tied back to Delta platform via subsea pipeline (in common with that of the chosen concept). This option is shown in the following figure. This option was rejected as sub-sea wells present significant hazards to the environment compared with surface wells on a new platform, particularly in shallow water. This option would have required the use of two different drilling rigs and would have prevented Energean purchasing its own rig and hence offering additional employment opportunities in the region. The cost of this option was comparable with a surface development but was rejected due to the perceived high environmental risks. Operating costs would have been significantly higher.

7.3.2 Alternative Prinos North field development options

The fields in the Prinos North area will be developed in a future phase after exploitation of Epsilon. Although this subsequent project has yet to be approved Energean has considered three alternatives, similar to the ones examined for Epsilon field development:

- **Option 1 -** Minimum facility platform with dry Christmas trees located between the various discoveries and prospects and subsea pipelines to Delta or to/from Lamda.
- **Option 2 -** Extended Reach Drilling from the Delta platform.
- **Option 3 -** Subsea installation south of Prinos North with individual manifolds (wet Christmas trees) located at each field and a tieback to Delta.

Option 1 is the preferred solution and is described in section 5 of the ESIA.

Option 2 has the same drawbacks as for the development of Epsilon. Clearly a larger platform could have been installed at Prinos to allow all new wells to be drilled from one location. However this would have necessitated a delay in developing Epsilon until the Prinos North area had been further appraised and in any case was shown to be less economic than installing two identical platforms. Design costs are significant compared with fabrication costs and hence the "design one, build two" approach represents significant savings.

Option 3 has the same disadvantages as discussed for Lamda. Sub-sea tiebacks are normally

only commercially and technically viable in deepwater areas where platform substructure costs are large.

7.3.3 Evaluation of field development options

7.3.3.1 Evaluation of alternative options for Epsilon field development

The criteria for the selection of the best field development option were:

- Safety and Environmental:
  - ⇨ Risk
  - ⇨ Extent of constructions / total coverage of facilities
- Technological:
  - ⇨ Maximum use of existing facilities
  - ⇨ Simplicity
  - ⇨ Flexibility
  - ⇨ Ease in maintenance
- Financial
  - ⇨ Capital costs
  - ⇨ Operating costs

Table 7-1: Evaluation of alternative field development options

Criteria	Option 1 - Minimum facility platform with dry Christmas trees at Epsilon & subsea pipeline to Delta	Option 2 - Extended Reach Drilling (ERD) from the Delta platform	Option 3 - Subsea installation at Epsilon (wet Christmas trees) and tieback to Delta
Environ-mental	A minimum facility platform is a robust and conventional solution that has a minimal environmental risk and a small environmental footprint, due to the fact that: • No fluid process will take place in the new platform. • No production facilities will be installed. • The new facilities cover little area • All production fluids, water injection, gas for	Extended Reach Drilling increases the risk that problems will occur during well construction activities. This leads to an increased risk of blowouts compared with more conventional drilling from a satellite platform. ERD drilling however avoids the need for installing new pipelines. ERD wells produce significantly more solid waste	A subsea development, particularly in shallow water significantly increases the risk of incidents resulting in release of toxic hydrocarbons to the sea. Regular well interventions are required because of scale and asphalt precipitation. These activities are better performed with dry trees. Clearly a subsea development would limit risks to personnel but at the expense of increased

Criteria	Option 1 - Minimum facility platform with dry Christmas trees at Epsilon & subsea pipeline to Delta	Option 2 - Extended Reach Drilling (ERD) from the Delta platform	Option 3 - Subsea installation at Epsilon (wet Christmas trees) and tieback to Delta
	artificial lift, chemicals, and power will be transferred by subsea pipeline and umbilical, which the safest option		danger to the environment.
Technical	It requires minimum structures and has flexibility towards future well maintenance operations (including well intervention requirements). Furthermore this option allows early development and full-field development wells to be drilled with a platform rig, rather than jack-up, hence substantially reducing drilling costs.	The option has many technical complications. More specifically: Drilling extended reach wells represents an increase in length of approximately 50% over their equivalent vertical version and, given the technical complexity involved, the period for delivering each more than doubles from 40 days to 90 days. Drilling extended reach wells also increases risk levels and hence the chance that one or more of the planned wells cannot reach their target. Furthermore, extended reach wells would also have to be completed with an east-west trajectory in the reservoir section, which would appear perpendicular to the ideal orientation (i.e. with respect to fracture orientation).	This option requires the drilling with a jack-up rig. In addition, use of sub-sea wells would make subsequent access to the Epsilon wells only possible via a jack-up, i.e. Energean's own work-over rig could not be employed. Due to expected issues with scale and asphaltene precipitation regular interventions are envisaged.
Financial	It has the potential for further cost optimisation by employing more novel platform types and	The drilling cost will be between 135 MM € and 189 MM €, which is more than the total cost of the platform	Initial capex was comparable but subsequent operating costs greater than either of the other options.

Criteria	Option 1 - Minimum facility platform with dry Christmas trees at Epsilon & subsea pipeline to Delta	Option 2 - Extended Reach Drilling (ERD) from the Delta platform	Option 3 - Subsea installation at Epsilon (wet Christmas trees) and tieback to Delta
	installation techniques.	of option 1.	

The selected solution is option 1 (Minimum facility platform with dry Christmas trees at Epsilon & subsea pipeline to Delta), because:

- It has the smaller environmental footprint;
- It has better economics than the other options considered;
- It presents a robust and conventional solution and hence minimal risk;
- It presents flexibility towards future well maintenance operations (including well intervention requirements);
- It allows early development and full-field development wells to be drilled with a platform rig, rather than jack-up, hence substantially reducing drilling costs;
- It has the potential for further cost optimisation by employing more novel platform types and installation techniques.

7.3.3.2 Evaluation of alternative options for Prinos North field development

Option 1 was also selected for the potential development of the Prinos North area fields for the same reasons as discussed for Epsilon. An additional advantage is that the same design would be used for both platforms. This reduces cost and risk.

Having two identical platforms reduces the chance that operators make errors due to confusing operating procedures for one facility with the other.

7.4 DRILLING OPTIONS

7.4.1 Environmental criteria for drilling locations

According to MD 170225/14 (Annex 4.5 / par. 8.1.1.10) the evaluation of drilling locations needs to take into consideration environmental factors, on top of any technical / financial parameters.

An initial assessment showed that there would be very little or no variation in the environmental parameters in possible alternate drilling locations, for the following reasons:

- Drilling associated with the Epsilon and Prinos North area field developments will take place in the same marine area that the existing offshore facilities are located;
- The new infrastructure will be connected to the existing offshore facilities;
- The baseline analysis showed that the adjacent marine areas of the fields exploited (in present and in future) by Energean are contiguous and very similar;
- The physiochemical analyses and the use of benthic bioindicators (as part of the ESIA)

did not show any disturbances from existing facilities;

The planned drillings satisfies all criteria set by the law, as shown in the following table:

Table 7-2: Environmental criteria for drillings, according to MD 170225/14

Environmental criterion	
1) Environmental sensitivity (ecological significance, water quality, benthos, protected areas etc)	The physiochemical analyses and the use of benthic bioindicators (as part of the ESIA) did not show any disturbances from existing facilities. The wells are far from protected areas. The benthic and marine communities are common, without any significant ecological importance.
2) Correlation of the planned wells with present wells, so as to avoid cumulative impacts in the marine environment	The criterion is fully satisfied
3) Important culture heritage findings	There are no marine antiquities
4) Offshore pipelines and other infrastructures	There drillings will take place outside of the offshore pipeline safety zones
5) Minimization of impacts to other activities, i.e. fishery, navigation	There is a safety zone of 500 m around the existing facilities where fishing is prohibited. Navigation routes and fishing grounds are not in the direct vicinity of the project.

7.4.2 Drilling options for Epsilon field

7.4.2.1 Alternative options

The development of the Epsilon field has introduced the opportunity to revisit the way drilling operations in the Prinos area are undertaken. The number of wells required for an effective development of Epsilon ruled out the use of extended reach wells from Prinos.

Three drilling options were examined:

- Jack-up drilling rig
- Tender assisted drilling rig
- Modular platform drilling rig

Jack-up drilling rigs have been used for Prinos drilling to date. These have been mobilized to drill small batches of wells from the existing Prinos drilling platforms – including medium-reach ERD wells to both Prinos North and Epsilon. Jack-up drilling can only be achieved with small

jackets with no more than twelve (12) well slots.

Tender assisted rigs are barge based mobile drilling units where the heaviest equipment (tanks, pumps, accommodation) are located on the barge and the remaining equipment on the platform. They include a heavy lift crane, which erects the drilling equipment set on the platform where wells are to be drilled. The barge and platform are connected together by hoses and cables. The area on the barge used to transport the drilling equipment acts as a lay down area once the drilling equipment is erected on the platform. There is no limit to the number of well slots that can be accessed from a tender rig. The required platform sub-structure is comparable with that needed for jack-up drilling.

Modular platform drilling rigs are platform-drilling rigs that are designed so that they can be moved from location to location. Once fully erected on a platform they are fully self-contained needing no support from a barge or tender. This type of rig necessitates the use of a larger/heavier platform substructure, as all weight has to be supported.

7.4.2.2 Evaluation of alternative drilling options for Epsilon field

The criteria for the selection of the best field development option were:

- Environmental: mainly in terms of extent of constructions / total coverage of facilities;
- Technical;
- Financial.

The number of wells required for an effective development of Epsilon ruled out the use of extended reach wells from Prinos. Not only were the costs prohibitive compared with wells drilled from a satellite platform but there were insufficient spare slots available at Prinos. Extended Reach Drilling would have required a new well jacket to be installed at Prinos. In shallow water depths a satellite platform and associated pipelines is normally cheaper and more effective than just two to three (2-3) ERD wells. Field development studies undertaken for Energean confirmed this.

The rig selection was driven by the need to keep overall weights within the limits of what could be accommodated on the existing platforms, in order to:

- Avoid large expansions and
- Have the minimum structures in the marine environment

Prinos area reservoir fluids contain significant quantities of wax and ashphaltenes and formation waters have high salt contents. Well completions therefore need regular interventions involving the ability to pull installed completions. Whilst the Epsilon wells could have been drilled by a jack-up, minimizing the size of the substructure, the platform had to be sufficiently large so that it could accommodate both a work-over rig and coiled-tubing equipment to facilitate routine interventions. A platform designed for a jack-up normally contains no more than 12 wells. Fifteen (15) well slots were considered as optimal for the Epsilon development.

In shallow water, benign-weather, offshore areas with multiple medium sized drilling centres a tried and tested alternative is the use of tender assisted drilling barges. After analysis it became

clear that such an approach would be ideal offshore Northern Greece, because it satisfies several criteria:

- Environmental: The use of a modular drilling rig at Epsilon would not increase structure size over that required and could be applied at the existing Prinos platforms with minimal modifications. There is no interaction between the rig and the sea bed in the vicinity of the platform
- Technical: Metocean data for the Prinos area shows that wind and sea conditions are ideally suited to this type of drilling technology. The modular drilling equipment sets employed in tender assisted drilling are of similar weight to the medium rig already employed on Prinos Alpha and re normally designed to operate on platforms with a similar deck space as that required to accommodate a work-over rig.
- Financial: The costs of a jack-up drilling rig are significantly higher than the ones of a tender assisted drilling.

As an alternative to the use of a tender assisted barge the Company also investigated the use of a modular platform rig. The use of this technology would have necessitated use of a large structure for the Lamda platform. The existing Prinos Alpha and Beta platforms could not be upgraded to support such a rig.

Based on the above, Energean purchased a tender assisted drilling asset ('Energean Force' drilling rig) and refurbished this to internationally recognised standards during the winter of 2014/15.

7.4.3 Drilling options for future Prinos North field development

7.4.3.1 Alternative options

The intent of the Company is to use the same approach for Prinos North as selected for Epsilon. Both areas are virtually identical (water depth, distance from Prinos and the coast and number of wells required). Therefore whatever was demonstrated to be ideal for Epsilon would be employed for Prinos North.

7.4.3.2 Evaluation of alternative drilling options for future field development

As discussed previously, similar drilling options to Epsilon field development will be applied and therefore the same assessment of alternatives applies.

7.5 PLATFORM TYPES

7.5.1 Alternative options

As discussed previously, a minimum facility platform was selected as the best solution for the

development of the new fields. There are a variety of such structures, used worldwide and the following platform types were examined:

- Monopile: Monopiles comprise a single (approximately 2.0 m to 3.0 m) column supported on a 4.0 m to 5.0 m diameter pile driven into through the column into the seabed. It normally is used in shallow locations, typically in 20m - 40m of water.
- Monotower: This platform is similar to a Monopile, but supported on a suction anchor rather than driven pile.
- Vierendeel Tower: This structure type is commonly used for small platforms without wells in relatively benign shallow water environments. It comprises a square-legged jacket with external bracing for strength.
- Conductor supported platform: installed with and only usable with a jack-up rig. Would not support weight of existing work-over rig and hence not investigated in detail
- Self-installing platforms: a variety of self-installing platforms have been applied world wide. These designs avoid the need for using a crane barge during installation. They can be broken into two sub-classes: designs that self float (are buoyant); designs that require use of a temporary installation/transportation barge.

Examples of installed aforementioned solutions are shown in the following photos:

Photo 7-1: Vierendeel tower

Photo 7-2: Monotower

Photo 7-3: Monopile

Self-installing platforms were investigated in some depth to determine whether they could be applied in the place of a typical steel jacket. Self-installing platforms do not require the large marine spread needed to install a typical piled jacket. Greece is relatively remote from offshore support infrastructure and mobilizing specialist barges from the North Sea or Persian Gulf represented a large cost and increased environmental impacts (emissions due to consumption of fuel during transportation and installation). The following two-competing designs were selected and addressed during FEED. One was considered the best buoyant sub-design and the other the best non-buoyant design:

- Buoyant Tower or Self – Installing Floating Tower (BT/SIFT)
- Self Installing Platform 2 (SIP2)

More specifically:

The Buoyant Tower (BT) concept was developed to install a platform in a seismically active offshore location in Peru. It was enhanced and modified for application in the North Sea and renamed the SIFT. The BT is buoyant before, during and after installation. It “floats” in the seabed

allowing it to withstand severe earthquakes. The SIFT is buoyant before installation but is upended and sunk to the seabed during installation. Post installation it functions as a traditional gravity based structure.

The design incorporates a combination of existing and proven technologies from deep-water Spars and compliant structures, together with shallow foundations, to provide a cost effective alternative to conventional fixed steel platforms.

Installation can be effected without the use of a derrick crane vessel and negates the need for heavy duty piling and grouting of the foundations. In addition, the simple design and fabrication principles optimize opportunities for regional fabrication and construction.

The SIFT, examined for the new fields, consisted of four cellular legs with each leg comprised of tank compartments whose design would account for hydrostatic pressure and axial load, free flooding and ballast tanks. The four cellular legs were structurally connected through horizontal tubular frames.

The SIFT is grounded by suction piles, which protrude from the bottom of each cellular leg and penetrates into the seafloor.

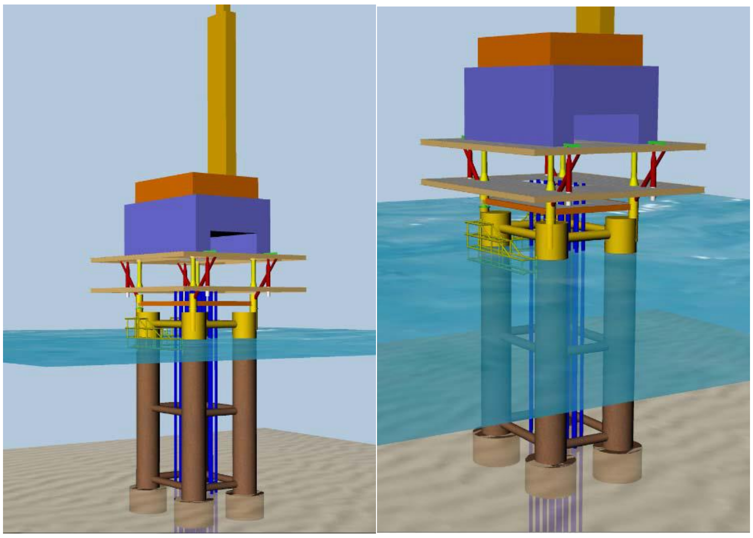


Figure 17: General view of the assessed BT/SIFT platform as alternative platform

The Self Installing Platform 2 (SIP2) chosen for the development of Epsilon and the Prinos North area fields is fully described in section 5 of the ESIA.

7.5.2 Evaluation of Alternative Platform types

The solution of monopole / monotower was rejected for technical reasons. More specifically:

- Monopile: Single legged jackets can only accommodate a limited number of wells that would be drilled from a jack-up rig. In a monopole the column is used to contain the pile and hence wells have to be positioned externally. A maximum of 2 wells can normally be accommodated. Risers are exposed. Use of a driven pile was not seen as desirable

due to the need to mobilise specialized equipment.

- Monotower: Soil conditions were idea for a suction pile, however a one-legged platform was not large enough to accommodate the planned number of well slots. Wells are normally drilled through the central column. A SIP2 is effectively 4 mono-towers linked by the topsides.
- Vierendeel Tower: This platform type is not strong enough to support a platform based drilling rig.

For the selection between the SIFT and SIP2 concepts the environmental and technical/economical parameters considered were:

- Environmental:
  - ⇨ Minimum scale structure
  - ⇨ Quick and small scale construction
  - ⇨ Minimal risk
- Technological: / economical:
  - ⇨ Flexibility
  - ⇨ Ease of maintenance
  - ⇨ Costs

Table 7-3: Evaluation of BT/SIFT and SIP2

Criteria	BT/SIFT	SIP2
Environmental	• Mobilization of a small fleet (2-3 barges, 1 supporting ship). • Some external resources, ie. extended spreads might be required. • Operational risks requires an offshore float-over that increases installation risk and hence impact on environment. • Environmental footprint from operation: Irrelevant to type of platform.	• Mobilisation of a small fleet of tugs plus a transportation barge. • No need for external resources, such as crane barges, piling spreads etc. This option has a minimum risk to environment. • Operational risks: identical for any type of self-installing platform. • Environmental footprint from operation: Irrelevant to type of platform.
Technical / economical	• Installed in approximately a week. • Minimal external resources are required. • Flexibility: can be moved to another location although would need to topsides to be removed. • Maintenance: Irrelevant to type of platform	• Installed in a few days, rather than a few weeks • No need for external resources, such as crane barges, piling spreads etc. • Requires rental of strand jacks • Flexibility: the structure can very be transferred to another location • Maintenance: Irrelevant to type of

Criteria	BT/SIFT	SIP2
	• Costs: Similar.	platform • Costs: Similar.

The SIFT and SIP2 technologies are both similar as can be seen from the above analysis. The SIP2 sub-structure was finally chosen as it was perceived to offer less installation risk due to the avoidance of an offshore float over. Whilst both approaches use similar quantities of steel the SIP2 leg fabrication is slightly simpler offering minor cost advantages.

7.6 TOPSIDE FACILITIES

7.6.1 Alternative options

With processing capacity for oil, produced water, gas and water injection available on Delta it was clear that the topsides of Lamda and Omicron should be designed with minimal facilities. There were therefore few topsides alternatives to be investigated. The only decision to be made was whether to invest in equipment that would minimize manned operations at the new facilities. As this was a way to minimize risk levels to staff it was decided to link the new platforms to Delta with an umbilical cable. This would avoid the need for power generation on the satellites (hence emissions and maintenance), provide remote control via fibre optics (avoid the need for a local control room) and to store, bunker and pump chemicals locally (reduced chance of spillage, lower manpower, lower emissions).

The topside design described in section 5 was developed based upon this philosophy of minimizing manned interventions. Energean has completed all design and safety studied for the topside facilities. The design follows standards, regulations and good industry design practices. It has been designed to reduce the inherent risk to staff of managing hydrocarbons with significant toxic potential. ALARP techniques were used at the start of concept design to achieve the lowest possible risk levels. Hazards were identified by using well-known techniques, such as HAZID and HAZOP. It must be mentioned, that part of the ESIA was the QRA for the topside facilities.

7.6.2 Evaluation of Alternative Topside Facilities

No viable alternatives to the chosen concept could be identified without increasing risk levels to staff.

7.7 PIPELINES

7.7.1 Alternative options

The routing and mechanical aspects of the required pipelines were determined according to the field development option and platform type selected.

The alternative options investigated were:

- Buried or unburied pipelines
- Installation by towing or by S-Lay.

7.7.2 Evaluation of Pipelines

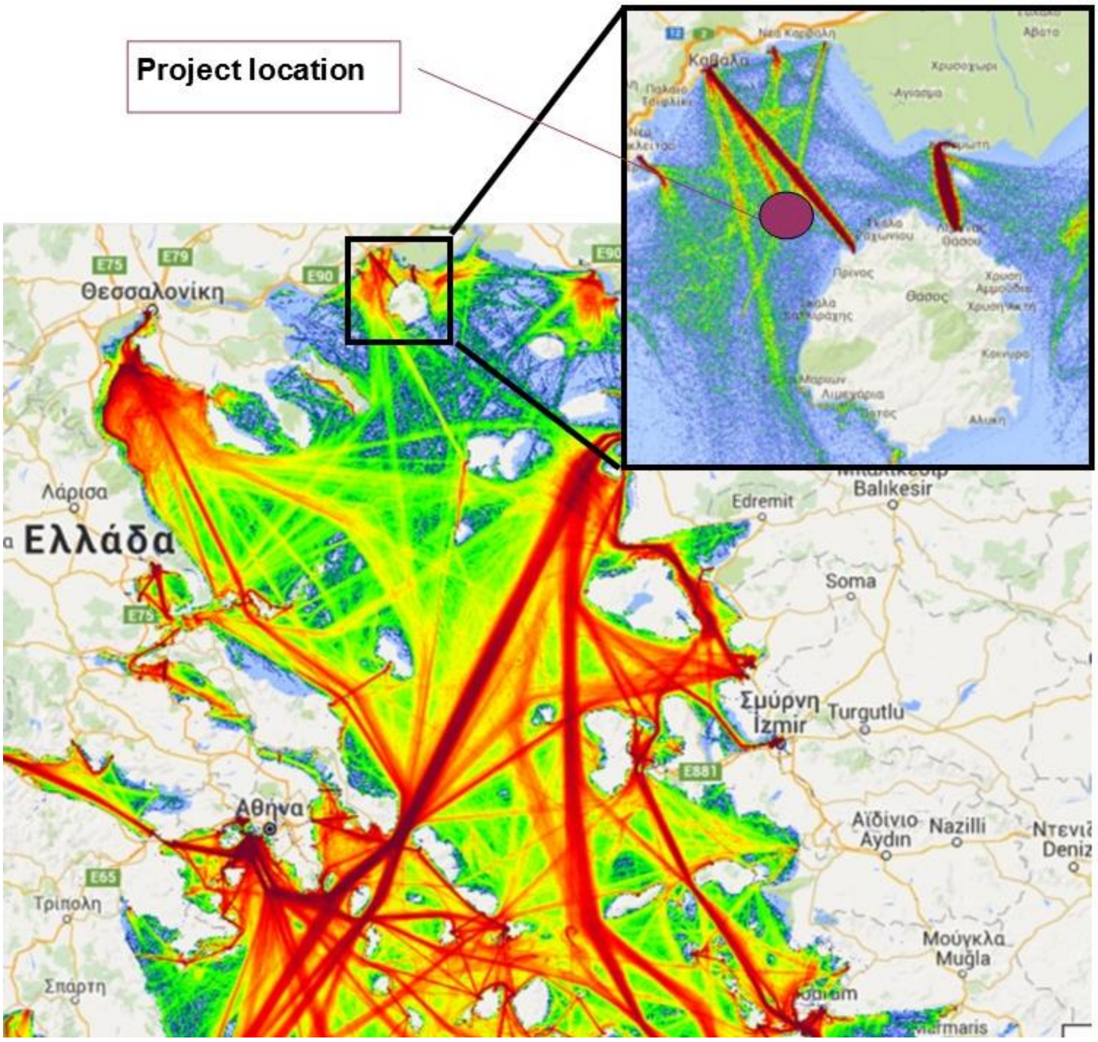
The evaluation of pipelines was based on environmental and safety parameters / criteria. Energean has elaborated detailed studies for:

- The best solution for protection by navigation and fishing gear;
- The construction option provided the highest on-bottom stability

More specifically:

Criterion 1 – protection by navigation and fishing gear:

Mediterranean region is well known by high marine traffic. The shipping traffic in Aegean Sea is presented in the following figure:



Map 7-1: Recorded marine traffic in Aegean Sea (source: www.marinetraffic.com)

As shown in the figure, there are several shipping lanes falls next to Prinos field (north Aegean Sea). The concern is that statistically, around 50% of ships travelling under a “flag of convenience” and do not stick to designated shipping lanes.

But, the most critical issue is the intense fishing activities around the project area. Special protection measures have to be taken against fishing gear interaction. The best solution is all pipelines to be trenched for permanent protection from fishing gear (and navigation).

<u>Criterion 2 – on-bottom stability:</u>

Pipelines were checked for on-bottom stability based on available metocean data. The analysis considered the installation sequence lay the pipeline flooded on seabed and then trench it. The design cases considered relying on mechanical and natural backfill. Minimum pipeline wall thicknesses (for production and gas lift pipelines) were considered in this analysis. The following table summarizes the analysis results:

Table 7-4: On-bottom Stability Analysis Results

Location	Design Case	Duration	Current Return Period	Waves Return Period	Pipeline: Production Pipeline 10inch ×15.88mm	Pipeline: Water Injection 6inch ×11mm	Pipeline: Gas Lift 6inch ×9.5mm
Lamda	Flooded on Seabed	≤3 days	1 year	1 year	Stable	Stable	Stable
Delta					Stable	Stable with CWC or Mattresses (250m @ Delta)	Stable with CWC or Mattresses (500m @ Delta)
Lamda	Flooded on Seabed	1 month	1 year	10 year	Stable	Stable with CWC or Mattresses	Stable with CWC or Mattresses
Delta					Stable with CWC or Mattresses (750m @ Delta)	Stable with CWC or Mattresses	Stable with CWC or Mattresses
Lamda	Flooded on Seabed	1 month	100 year	1 year	Stable	Stable	Stable
Delta					Stable	Stable with CWC or Mattresses (250m @ Delta)	Stable with CWC or Mattresses (750m @ Delta)
Lamda	Operating in open trench	12 months	1 year	10 year	Stable	Stable	Stable
Delta					Stable	Stable	Stable
Lamda	Operating in open trench	12 months	100 year	1 year	Stable	Stable	Stable
Delta					Stable	Stable	Stable
Lamda	Operating in open trench	20 years	100 year	100 year	Stable	Stable	Stable
Delta					Stable in 1.5m trench (without backfill) or in 1m trench (with backfill)	Stable	Stable in 1.25m trench (without backfill) or in 1m trench (with backfill)

The general conclusion is that pipeline is stable in a trench and unstable on seabed in many cases particularly near Delta platform (shallower water depth ~28m).

Pipeline was assessed flooded on seabed, from results above it is expected that operational

condition on seabed will be unstable (due to lower weight and higher loading conditions). Further sensitivities and modifications could enhance the stability of pipe on seabed (actual water depths after tie-in confirmation, more recent survey, final corrosion rate and type, additional metocean data investigation and geotechnical. investigation, increasing the wall thickness, lower safety factor and reduction in wave velocity due to spreading). These parameters could make the pipe stable in many cases.

Apart from stability issue, trenching and backfilling are beneficial for protection and buckling aspects.

The overall conclusion of the evaluation of pipeline connections option is that the buried pipelines are the best solution. The option of unburied pipelines is rejected.

Finally, an installation assessment took place, also, for towing and S-Lay methods. The analysis showed that, although the two methods are technically feasible and have the same environmental footprint, the preferred option is towing, due to lower cost.

8 CURRENT STATE OF THE ENVIRONMENT

The current environmental and social conditions in the Project area set the benchmark against which environmental and social impacts are considered. The collection of baseline environmental and social primary and secondary data is an important task The data collections was based mainly on secondary data (literature, past studies, research outcomes) although a number of field studies were conducted to support the assessment of the current environment (marine ecology, sampling and analysis, analytical surveys in the area of Natura 2000 to cover coastal, marine and avifauna environments).

Prior to the collection of the baseline data, receptor specific study areas were defined. Establishing the coverage of the primary study area is based mainly upon the following factors: physical attributes of the project site, physical and biological characteristics, the nature of receptors and their sensitivity, prevailing meteorological conditions and the area of potential impact. It is requirement of applicable Greek legislation (JMD170225/2014 on the environmental permitting contents) that the primary study area should be at least 1km around the project. For completeness reasons, a wider study area is also described according to desk-based information. The coverage of the primary and wider study area for each environmental and social parameter is summarised below

Table 8-1: Primary and wider study area definition for environmental and social parameters

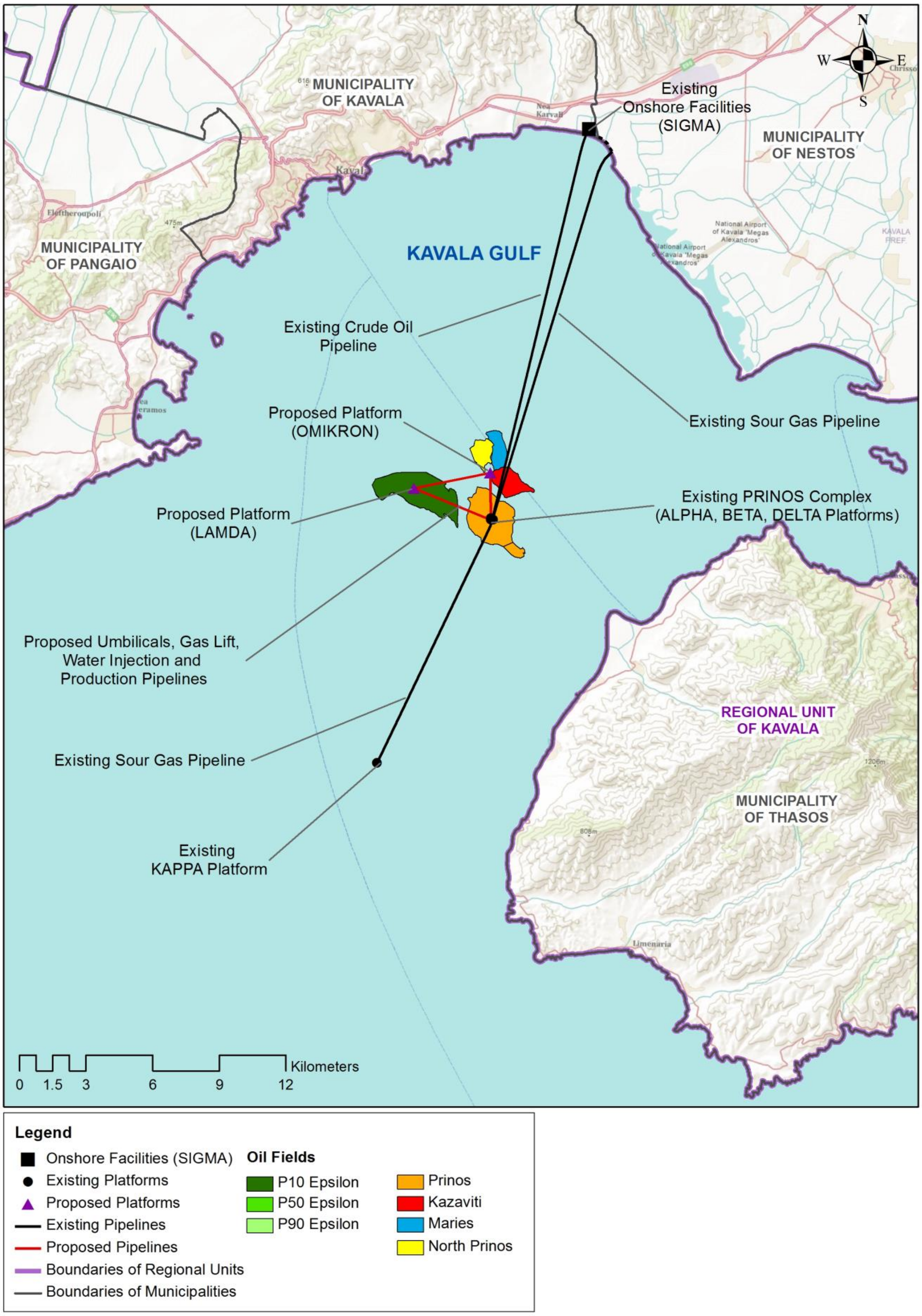
Environmental Parameter	Wider study area	Primary study area
Climate and Bioclimatic characteristics	Coastal Zone of onshore facilities, Kavala Gulf	Existing platforms (Prinos complex and Kappa) and proposed platforms (Lamda and Omicron) locations
Morphological and Topological characteristics	Coastal Zone of onshore facilities, Kavala Gulf	Approximately 1 km around the existing and proposed platforms (Omicron is not included)
Geological and Tectonic characteristics	Coastal Zone of onshore facilities, Kavala Gulf	Approximately 1.5 km around the existing platforms and proposed platforms
Seawater environment	Kavala Gulf	Approximately 1.5 km around the existing platforms and proposed platforms
Air environment	Coastal area of onshore facilities and Kavala Gulf	Onshore facilities and Existing platforms locations
Acoustic environment	Coastal area of onshore facilities and Kavala Gulf	Existing platforms locations
Biotic environment	Thracian Sea and Kavala Gulf	Approximately 1.5 km around the existing platforms (Prinos complex and Kappa) and proposed platforms (Lamda and Omicron)

Environmental Parameter	Wider study area	Primary study area
Manmade environment	RU of Kavala	Municipalities of Kavala and Thassos
Socioeconomic environment	RU of Kavala	Municipalities of Kavala and Thassos
Technical infrastructures	RU of Kavala	Municipalities of Kavala and Thassos
Existing pressures on the human and natural environment	Coastal Zone and Kavala Gulf	Coastal Zone and Kavala Gulf

It should be noted as part of the current operations, there is a prohibition area of 500 m radius over the pipeline routes and the platforms. Additional exclusion zones will be agreed as part of the new project. Therefore, before the construction of the project, a Navigation exclusion zone will be defined in collaboration with the Naval Authorities (Port Authority and the Coast Guard under the supervision of the relevant Ministries).

A current prohibition area of 39.71 km^2. With the addition of planned and potential further developments this is expected (conditional to the naval authorities' decisions) to reach a total area of 46.34 km^2.

Map 8-1: Orientation map (red circle: project area)



Map 8-2: Project area

8.1 CLIMATE AND BIOCLIMATE CHARACTERISTICS

8.1.1 Climate characteristics

At the Kavala Prefecture level, the climate characteristic of the coastal zone is classified as Mediterranean, with warm, dry summers (circulation of subtropical and warm-dry air), cold and wet winters (circulation of relatively cool air from the temperate zone) with rainfall of approximately 300-400 millimetres. The respective continental part of the prefecture tends to be different, showing a respective continental climate, characterized from cool wet winters, dry summers and rainfall of approximately double values than that of coastal zone.

8.1.2 Meteorological and metocean data

Meteorological and metocean data has been acquired from a number of sources utilizing reputable organisations both within and outside Greece, which have gathered statistical data over a period up to 50 years. The main source of metocean data specifically modelled at the existing and new platform locations has been provided by BMT ARGROSS who have used global computer simulation data based on the Climate Forecast System (CFS). CFS is a model representing the global interaction between Earth's oceans, land, and atmosphere. Produced by several dozen scientists under guidance from the NOAA's National Centres for Environmental Prediction (NCEP), the model offers hourly data with a horizontal resolution down to one-half of a degree (approximately 56 km) around Earth for many variables. CFS uses the latest scientific approaches for taking in, or assimilating, observations from data sources including surface observations, upper air balloon observations, aircraft observations, and satellite observations. To complement the CFS global data, data from local weather stations in the Kavala area (Thassos Island, Kavala Airport) and national weather stations have been used to calibrate and benchmark the computer data simulations.

8.1.2.1 Meteorological data

8.1.2.1.1 Temperatures

The data presented in the tables and diagrams in this section summarize the average monthly temperature range over a 52-year period. January is the coldest month, with an average minimum temperature of 1.7°C and average monthly temperature of 5.6°C, while the warmest month is July, with an average maximum temperature of 30.5°C and average monthly temperature of 26°C. In absolute values, for the same period, the maximum recorded temperature is 39°C during July and -8°C during January.

Although the colder months are during the winter (December, January and February), it is noted that the minimum temperature can drop below zero in March and April, due to oncoming cold winds.

The annual fluctuation of the monthly absolute Maximum and Minimum Temperatures are presented in the diagram below:

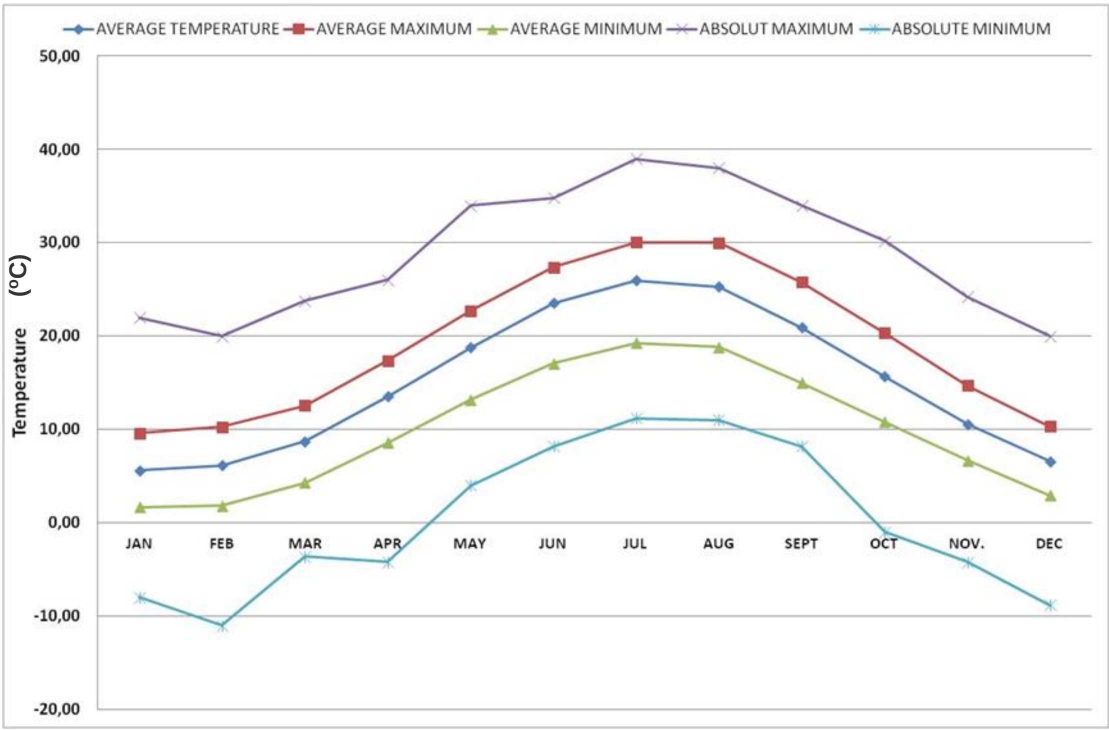


Diagram 8-1: Annual development of the Monthly Mean Maximum, Mean and Mean Minimum Temperature (°C), (*Source: Hellenic National Meteorological Service HNMS)*

Table 8-2: Temperature data of Meteorological Station of Chryssoupolis Kavala for the period 1958-2010

Month	Average Monthly Temperature (°C)	Maximum Monthly Temperature (°C)	Minimum Monthly Temperature (°C)	Absolute Max Temperature (°C)	Absolute Min Temperature (°C)
January	5.6	9.7	1.7	22.0	-8.0
February	6.2	10.3	1.8	20.0	-11.0
March	8.7	12.6	4.3	23.8	-3.6
April	13.5	17.4	8.6	26.0	-4.2
May	18.8	22.7	13.2	34.0	4.0
June	23.6	27.4	17.1	34.8	8.2
July	26.0	30.1	19.3	39.0	11.2
August	25.30	30.02	18.84	38.0	11.0
September	21.0	25.8	15.0	34.0	8.2
October	15.7	20.3	10.8	30.2	-1.0
November	10.6	14.7	6.7	24.2	-4.2
December	6.6	10.3	3.0	20.0	-8.8

Month	Average Monthly Temperature (°C)	Maximum Monthly Temperature (°C)	Minimum Monthly Temperature (°C)	Absolute Max Temperature (°C)	Absolute Min Temperature (°C)
Annual	15.1	19.3	10.0	39.0	-11.0

Source: Hellenic National Meteorological Service HNMS

8.1.2.1.2 Precipitation

The total annual precipitation of the MS of Chryssoupolis is 429.72 mm while the average days of rainfall is 91.1 per year. August is the driest month with 13.86 mm in 5.5 days of rainfall while the wettest month of all is December with 76.05 mm in average 9.3 days of rainfall. More detailed data for the precipitation in the project area are depicted in the table below (Table 8-3). In (Diagram 8-2) below are shown the data of average height of precipitation per month for the period of 1958-2010.

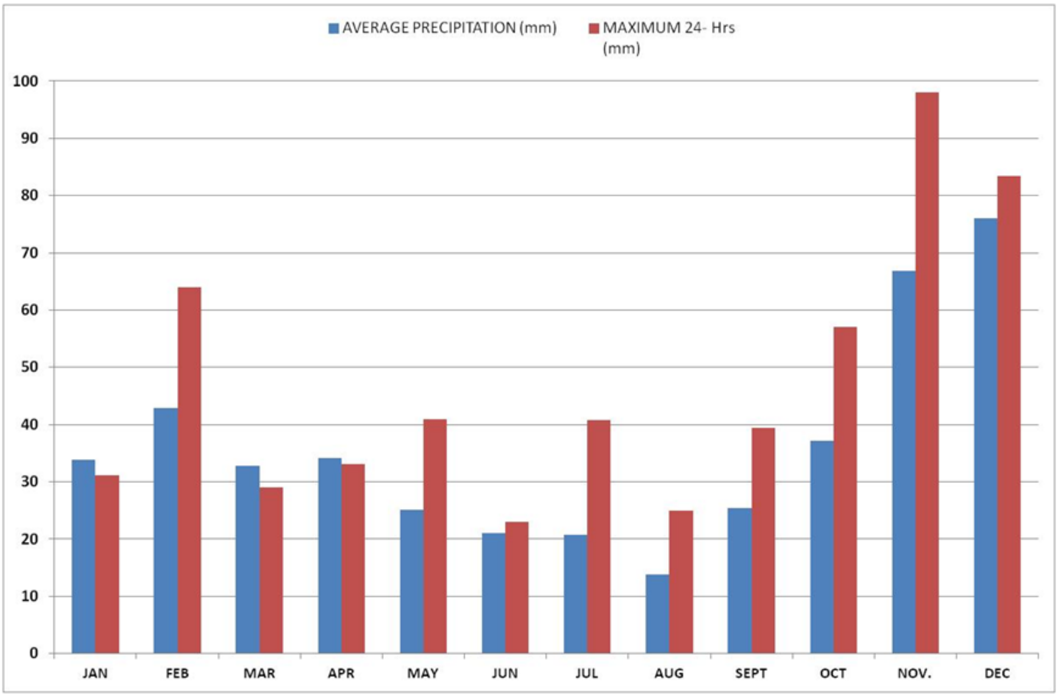


Diagram 8-2: Annual development of the average precipitation (mm) and maximum 24-hrs (Source: Hellenic National Meteorological Service HNMS

Table 8-3: Precipitation Data of MS of Chryssoupolis Kavala for the period 1958-2010

Month	Precipitation	
	Average precipitation (mm)	Maximum 24- Hrs (mm)
January	33.8	31.2
February	42.8	64.0
March	32.8	29.0

Month	Precipitation	
	Average precipitation (mm)	Maximum 24- Hrs (mm)
April	34.2	33.1
May	25.2	41.0
June	21.1	23.0
July	20.7	40.8
August	13.9	25.0
September	25.4	39.4
October	37.1	57.0
November	66.8	98.0
December	76.1	83.4
Annual	429.7	98.0

As presented below, air in the wider area of the RU of Kavala appears to be saturated with vapour of 70-75% during the winter months, when lower temperatures are observed, whereas during the summer and, in particular, during the dry months of July-September, the relevant humidity ranges at lower levels (in average 57-65%). The average monthly humidity and the annual average value are shown in the following table

Table 8-4: Humidity Data of MS of Chryssoupolis Kavala for the period 1958-2010.

Month	Relative humidity (mm)
January	75.05
February	72.54
March	71.98
April	71.86
May	66.88
June	62.46
July	57.91
August	59.53
September	65.44
October	70.54
November	75.54
December	75.56
Annual	68.79

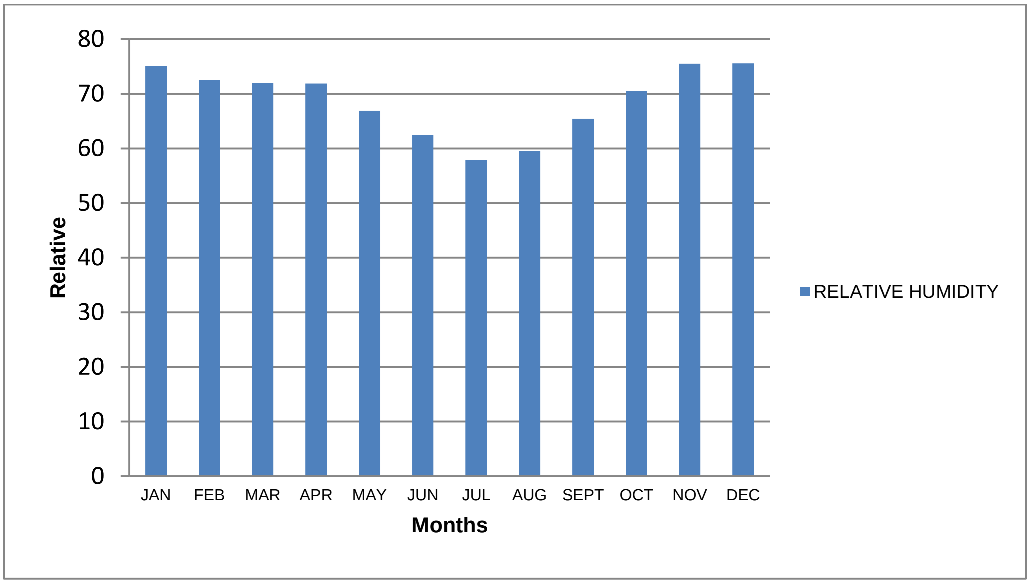


Diagram 8-3: Average monthly relevant humidity range 1984-1981, Source: Hellenic National Meteorological Service HNMS

8.1.2.1.3 Gaussen-Bagnouls climate Graph

In the Gaussen-Bagnouls climate Graph below shows the average monthly values of rainfall, in mm and temperature in Celsius degrees (oC). This graph shows in X axis the months of the year and has two Y axis. In the left side is shown the average monthly rainfall (P) in mm and in the right side the average monthly temperatures (T) in oC in double size climax from the rainfall P=2T. According to Bagnouls & Gaussen (1957) one month is characterized as dry while the total amount of precipitation is equal of lower than the double of the average temperature of the month Pmm ≤ 2T oC. When the rainfall curve is lower than the temperature curve, then there is P<2T, and this period is considered to be dry. The surface, between these two curves, shows the duration and the tension of the dry period. As it is shown in the Diagram 8-4 below, the dry-warm period, for the area of the study, lasts from the end of April until October.

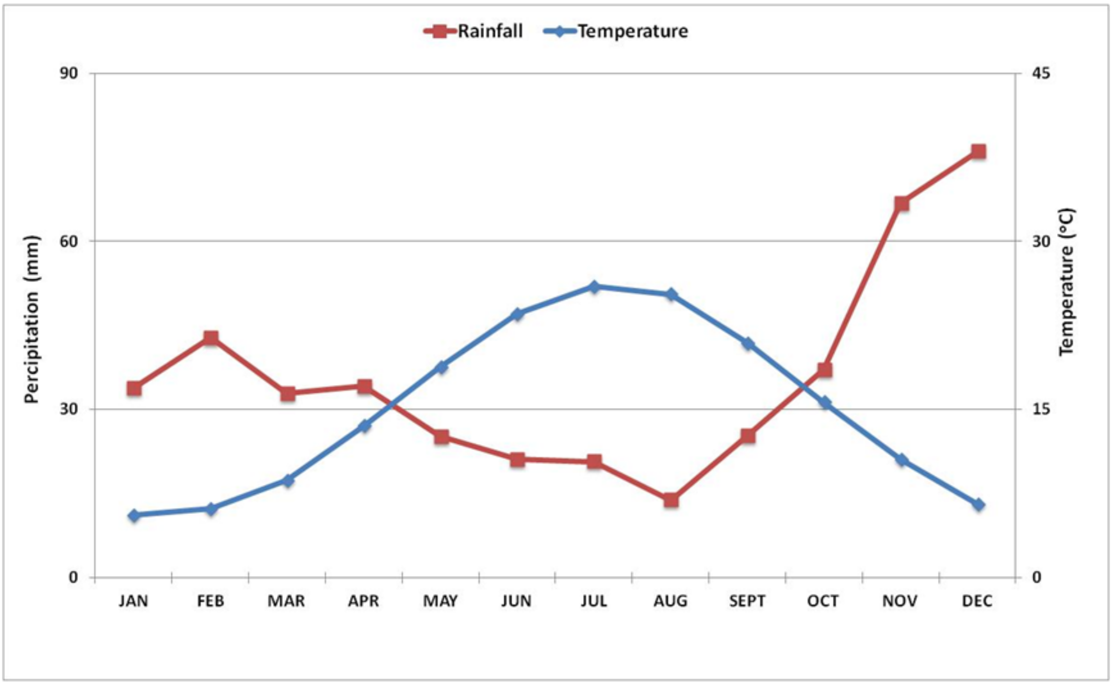


Diagram 8-4: Gaussen-Bagnouls climate Graph of Chryssoupolis

8.1.2.1.4 Winds

The annual frequency of winds at the platforms' location is shown in the table below and is complimented by below diagrams, which illustrates the wind rose % distribution of the winds.

Table 8-5: Annual % frequency and intensity of maximum wind speed per month (Source: BMT ARGROSS Epsilon field metocean report October 2015)

Speed BF	Speed m/s		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All
11	29	30	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	28	29	0	0	0	0	0	0	0	0	0	0	0,018	0	**0,002**
10	27	28	0,018	0	0	0	0	0	0	0	0	0	0	0	**0,002**
	26	27	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	25	26	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	24	25	0	0	0,018	0	0	0	0	0	0	0	0,018	0	**0,003**
9	23	24	0	0,077	0	0	0	0	0	0	0	0,018	0	0	**0,007**
	22	23	0,018	0,039	0	0	0	0	0	0	0	0	0,018	0,035	**0,009**
	21	22	0,035	0,058	0,018	0	0	0	0	0	0	0,035	0,036	0,053	**0,019**
	20	21	0,070	0,077	0,035	0	0	0	0	0	0	0,018	0,036	0,018	**0,021**
8	19	20	0,140	0,077	0,105	0,036	0	0	0	0	0	0,035	0,073	0,175	**0,054**
	18	19	0,193	0,231	0,245	0,036	0,018	0	0	0,018	0	0,035	0,181	0,193	**0,095**
	17	18	0,351	0,173	0,386	0,018	0	0	0	0	0	0,193	0,217	0,281	**0,135**
7	16	17	0,456	0,269	0,298	0,054	0,018	0	0	0	0,018	0,158	0,254	0,684	**0,185**
	15	16	0,684	0,673	0,579	0,109	0,053	0	0	0	0	0,263	0,471	0,947	**0,314**
	14	15	1,157	0,865	0,579	0,163	0,053	0	0,018	0	0,163	0,403	0,652	1,368	**0,451**
6	13	14	1,192	1,519	0,947	0,236	0,140	0,036	0,123	0,018	0,236	0,561	0,707	1,666	**0,612**
	12	13	1,736	2,192	1,262	0,670	0,456	0,127	0,123	0,158	0,598	1,280	1,721	2,139	**1,033**
	11	12	2,332	2,558	1,841	1,069	0,754	0,127	0,210	0,421	0,978	2,367	2,681	2,753	**1,503**
5	10	11	3,471	3,385	3,103	1,540	1,069	0,417	0,544	0,912	1,775	3,471	3,333	3,138	**2,175**
	9	10	4,453	4,673	3,401	1,938	1,911	1,178	1,280	1,964	2,518	4,453	3,986	5,137	**3,070**
	8	9	6,434	5,673	4,628	3,388	2,980	1,685	2,279	2,770	4,130	5,645	5,036	6,101	**4,226**
4	7	8	7,433	6,500	6,364	4,783	3,594	3,116	5,645	5,242	5,634	6,311	5,797	7,100	**5,629**
	6	7	8,555	7,077	6,452	5,924	5,908	5,580	8,275	8,240	6,902	6,925	7,138	7,749	**7,068**
	5	6	7,714	7,404	7,696	8,116	8,310	8,859	11,799	11,729	9,801	8,012	7,917	8,310	**8,817**
3	4	5	7,889	8,115	9,537	10,815	11,606	13,279	15,305	14,919	12,428	8,994	8,351	8,292	**10,810**
	3	4	9,081	9,135	11,325	13,696	14,008	16,069	15,761	15,077	14,294	10,256	9,746	9,274	**12,321**
2	2	3	9,730	11,865	11,553	14,348	14,884	16,522	14,043	13,517	14,004	12,272	10,996	10,063	**12,811**
1	1	2	11,957	12,154	13,377	14,819	16,567	16,033	12,290	12,062	13,297	12,658	12,663	11,325	**13,265**
	0	1	14,902	15,212	16,252	18,243	17,672	16,975	12,307	12,956	13,225	15,638	17,953	13,201	**15,366**
			100	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	Mean Speed		**5,2**	**5,1**	**4,6**	**3,8**	**3,6**	**3,3**	**3,9**	**3,9**	**4,1**	**4,7**	**4,7**	**5,4**	**4,3**
	Mean Directi		**52,1**	**53,4**	**60,3**	**66,7**	**60,7**	**40,5**	**30,8**	**37,3**	**48,4**	**52,6**	**59,2**	**54,6**	**51,3**

Legend
Common occurrences
red - 12 most common
yellow - next 24 most common
orange - next 24 most common
blue - all remaining

The directional percentages of the winds at the platform location are shown in the following diagram annually as well as for February and June (where the maximum peaks are anticipated).

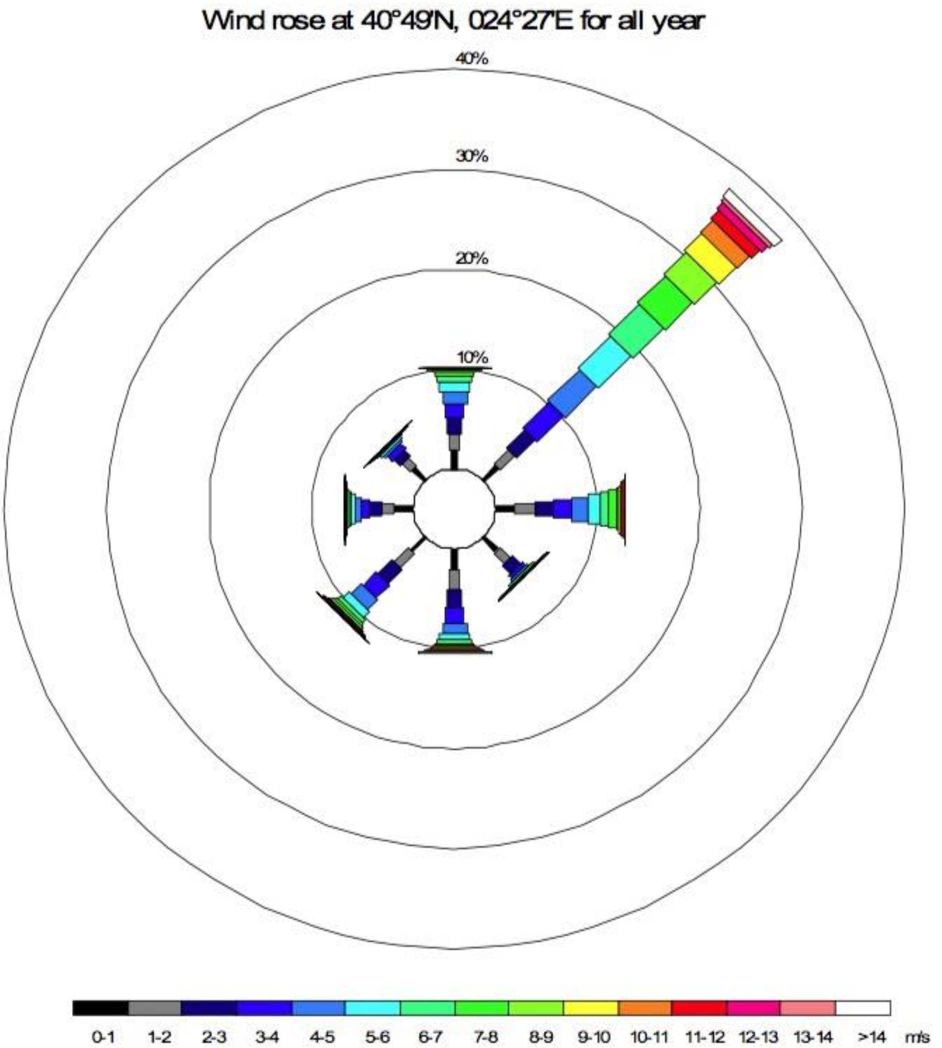


Diagram 8-5: Wind direction frequency chart (Source: BMT ARGROSS Epsilon field metocean report October 2015)

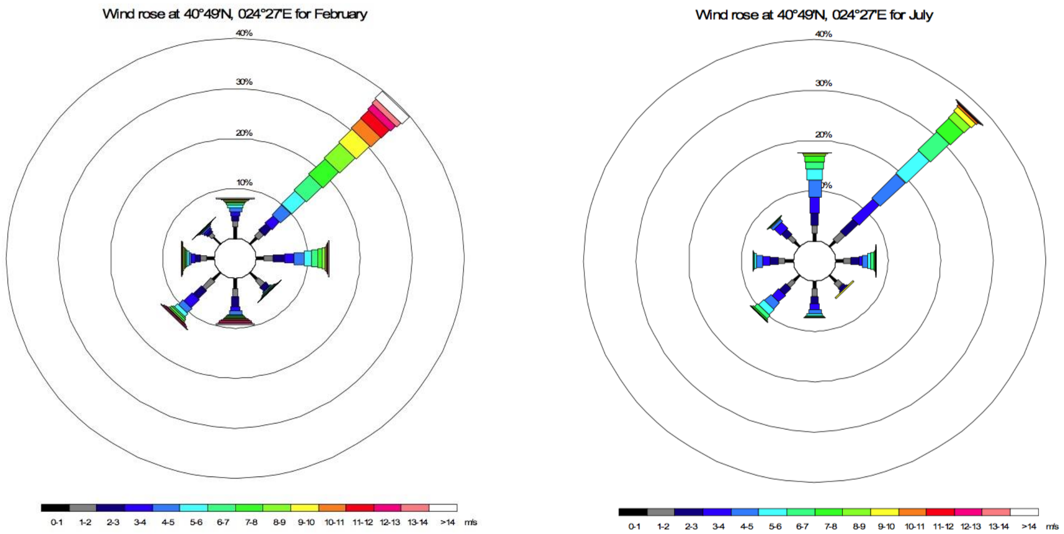


Diagram 8-6: Wind direction frequency chart for February and July (Source: BMT ARGROSS Epsilon field metocean report October 2015)

The prevailing winds through the year are in a north easterly direction and the relative wind speeds are seasonal. In the winter months (October through to April) the average wind speeds range from 3.8m/s to 5.4m/s occurring 60%-70% of the time characterised as ‘gentle breezes’. In the summer months (May through to September) the average wind speeds range from 3.8m/s to 4.1m/s occurring 50-60% of the time, which are characterized as ‘light breezes’.

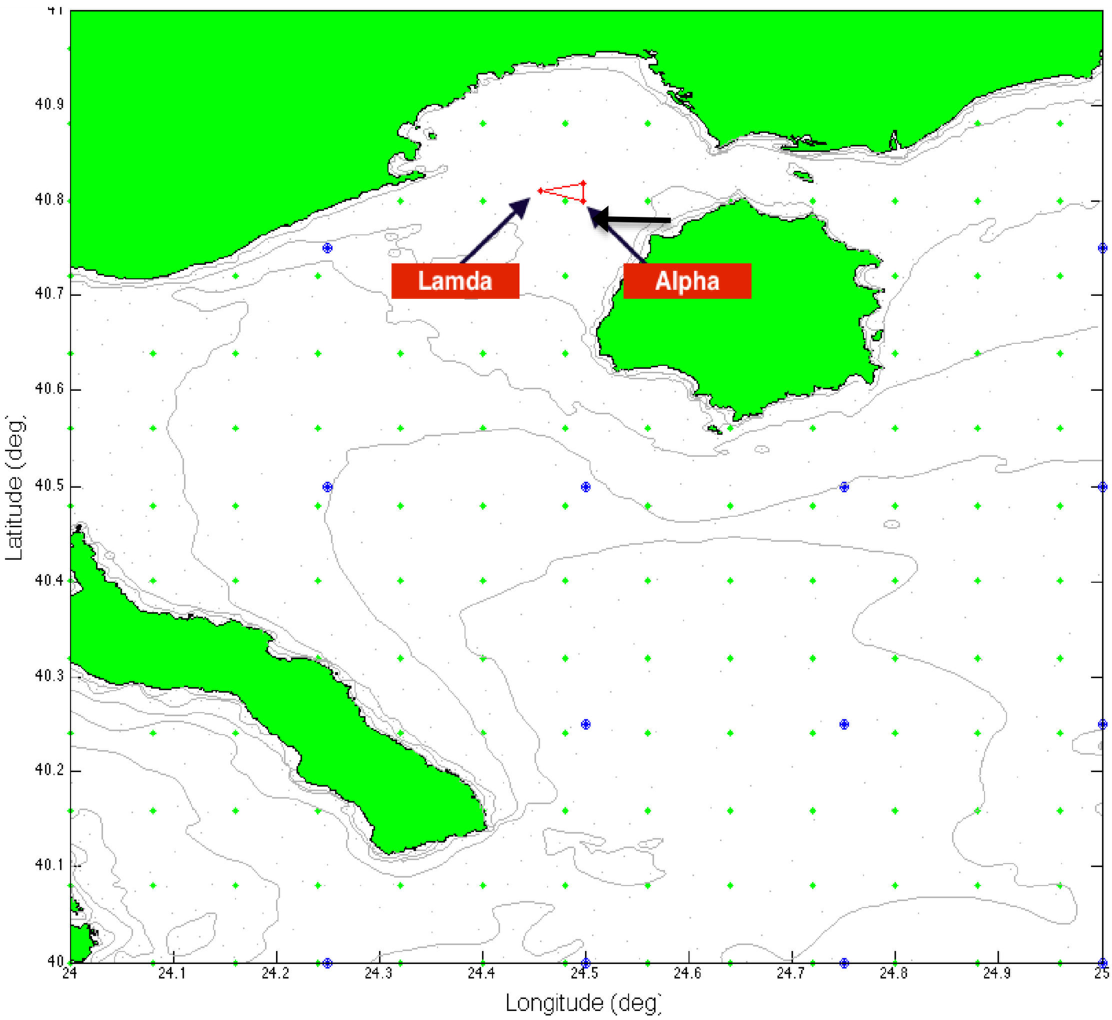
Winter is from October to April and is characterized by stronger winds, predominantly from the NE and E (more than 50% of the time). Winds from the NE dominate – around 40% of the time. The winds from the NE not only dominate but also have the highest wind speeds. Winds above 10 m/s (Bf 5) can be expected for periods of up to 48 hours in a month. Mean speeds are a little higher than in the summer. Winds blowing towards Thasos are weaker in the winter than the summer and slightly less frequent. Even in the winter the most likely circumstance is calm weather. Winds of below 3 m/s (light breeze and below) are seen for about 38% of the time.

Summer is from May to September and is characterized by light winds predominantly from the N, NE and E (50 to 60% of the time). Winds blowing onshore (to the mainland - S and SE - or to Thasos - NW) are of low strength (rarely exceeding 3 to 4 m/s) and infrequent (20 to 30% of the time). In the summer there is no significant wind (below 3 m/s) for around 45% of the time.

Stormy weather (winds above 14 m/s or anything above a strong breeze) occurs for around 1.25% of the time, nearly always in the winter months and entirely from the NE or S.

8.1.2.2 Metocean data

The design of existing facilities was based on oceanographic data based on metocean study performed by A.H. Glenn and Associates in 1974 at single location (about 3.5 km east of Lamda platform and about 0.5 km northeast from Delta. For the new development, Energean contracted BMT ARGROSS UK in October 2015 to perform a metocean study specifically at the locations of the existing platform and the new platform. The BMT AGROSS metocean report contains the necessary statistical data required for the detailed design of the new facilities, ie 1 year, 10 year, 100 year return data with the associated directions and for wind speeds, wave heights/periods, current speeds and tidal variations. In addition the study uses computer modelling to give monthly distributions of sea surface air/seawater temperatures sea water density and salinity. The basic conclusions are presented in the following paragraphs. The map below, presents the areas of interest and the reference locations.



Map 8-3: Locations of interest – Lamda, Alpha and Omicron

Key data sources used were the following:

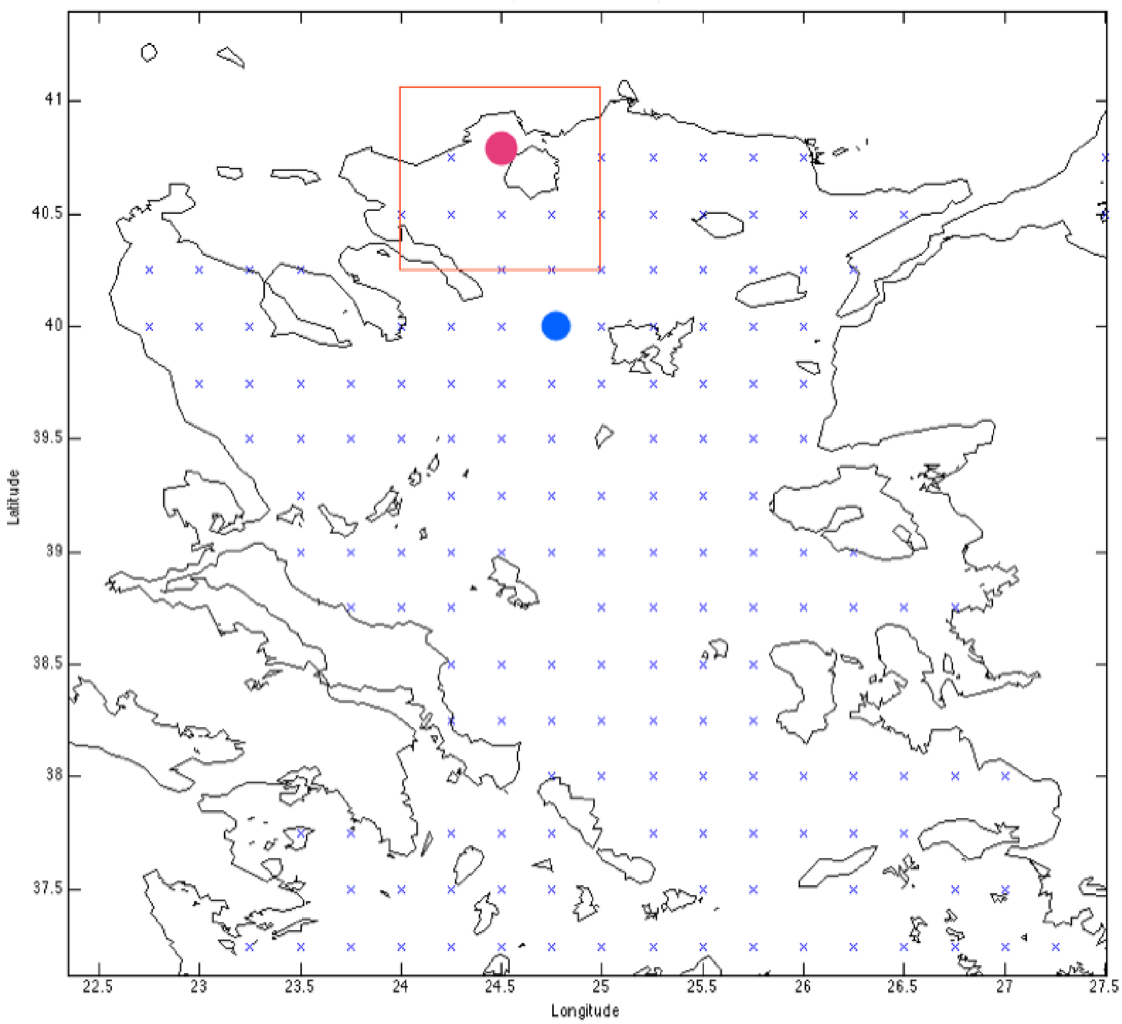
- BMT ARGOSS Hindcat (winds and waves): 3rd generation wave prediction model based on the WaveWatch III (WWIII) code on a global grid and several regional grids, for hindcast and forecast purposes. In this study we have used the Mediterranean grid as a starting point. Data are available between 1992 and 2014.
- BMT ARGOSS Satellite database (winds and waves): satellite database covers a period of about 25 years and all observations are extensively calibrated and validated against wave buoy data; the calibration is re-run each time the database is extended, nominally annually.
- Due to their global coverage and accuracy, the satellite wave/wind data can be used to validate/calibrate hindcast wind/wave data at practically any site in the world, also at sites where no local in-situ wave measurements are available. The systematic quality control applied to the satellite data including their calibration/validation to wave buoy data by BMTA ensures that the satellite data can be used as a reliable source of

reference data worldwide.

- Local weather station data from Thassos Island and KAVALA airport was used to benchmark the satellite wind and wave data.
- BMT ARGOSS Tidal model (tidal currents and levels): BMT tidal model provides the water motions associated with the eight most significant harmonic constituents of tidal oscillation including the principal lunar (M2) and solar (S2) semi-diurnal constituents; another 12 constituents are inferred. The global tidal information is based on the integration of approximately 5000 tidal stations and 15 years of satellite radar altimeter measurements into depth average global and regional tidal models (the 2DH model).
- HYCOM 2.2 model (residual currents, sea temperature and salinity): this is a general circulation model providing wind driven and geostrophic flows with vertical co-ordinates. Residual current data has been extracted from the HYCOM Reanalysis database configured for the global ocean with HYCOM 2.2 as the dynamical model. The bathymetry is derived from the 30-arc second GEBCO dataset. Surface wind forcing is from the NCEP 1-hourly CFSR. Data are available between 1995 and 2012. Besides non-tidal (residual) currents, HYCOM also includes information on sea surface temperature and salinity data through the water column.
- AVHRR Sea surface temperatures: The HYCOM sea surface temperatures have been verified against NOAA's AVHRR's (Advanced Very High Resolution Radiometer) sea surface temperature data. Two high-resolution sea surface temperature (SST) analysis products are available from NOAA's AVHRR satellite sensors.
- NCER CSFR Air temperatures: Air temperatures have been extracted directly from the NCEP CSFR database. Air temperatures correspond to an elevation of 2 m asl

8.1.2.2.1 Waves

Spatial representation of the many small islands in the Aegean Sea is modelled through sub-grid representations within the hindcast model. A wave buoy was identified, to the west of the island of Limnos, at approximately 40.00°N, 24.75°E (blue circle in map below) that provided some verification of the general hindcast performance in the north Aegean Sea. The buoy is part of the Poseidon network of buoys situated around the Greek seas. Basic statistics are available just to the south of the proposed SWRT boundary sites (red square in map below). The satellite calibrated Mediterranean hindcast against these statistics were then compared. Details of the calibrations are contained in the BMT ARGROSS report.



Map 8-4: Aegean Sea and Mediterranean hindcast gridpoints, (Red circle: project areas, blue circle: wave buoy)

The annual frequency of significant wave heights (Hs) at the Lamda platform is given in the table below. The significant wave height is less than 1m. Extreme storms are more frequent in the winter months, dominated by southerly winds.

Table 8-6: annual frequency of significant wave heights (Source: BMT ARGROSS Epsilon field metocean report October 2015)

Wave Height Hs (m)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All
6,5	7,0	0	0	0	0	0	0	0	0	0	0	0	0	0
6,0	6,5	0,018	0	0	0	0	0	0	0	0	0	0	0	0,002
5,5	6,0	0	0,019	0	0	0	0	0	0	0	0	0	0	0,002
5,0	5,5	0	0	0	0	0	0	0	0	0	0	0	0	0
4,5	5,0	0,018	0,019	0	0	0	0	0	0	0	0	0,018	0,018	0,006
4,0	4,5	0	0,058	0,053	0	0	0	0	0	0	0,018	0,054	0,140	0,027
3,5	4,0	0,088	0,154	0,035	0	0	0	0	0	0	0,070	0,018	0,175	0,045
3,0	3,5	0,105	0,250	0,105	0,036	0,018	0	0	0	0	0,175	0,109	0,158	0,079
2,5	3,0	0,245	0,250	0,123	0,073	0,018	0	0	0	0,018	0,070	0,199	0,351	0,112
2,0	2,5	0,666	0,654	0,473	0,073	0,053	0	0	0	0,054	0,123	0,707	0,473	0,271
1,5	2,0	1,718	1,615	1,455	0,580	0,456	0,018	0,018	0,018	0,145	0,491	2,065	2,016	0,879
1,0	1,5	7,398	7,039	5,891	3,931	2,104	0,453	0,579	0,403	1,359	3,576	5,851	9,607	4,006
0,5	1,0	32,241	30,423	29,383	23,696	18,496	13,533	17,111	17,865	22,246	29,453	27,319	32,837	24,537
0,0	0,5	57,504	59,519	62,483	71,612	78,857	85,996	82,293	81,715	76,178	66,024	63,659	54,225	70,036
		100	100	100	100	100	100	100	100	100	100	100	100	100

Legend
Common occurrences
red - 12 most common
yellow - next 24 most common
orange - next 21 most common
blue - all remaining

The maximum wave heights for the respective extreme return conditions are given in following table. The maximum significant wave height predicted is 6.7m from a southerly direction. The highest waves during the year are from the south despite the predominant wind direction being the north-easterly direction. The waves from the south are swell driven and have time to develop within the Aegean, whereas waves driven by the North easterly winds are smaller as the location is very close to the coastline, and swell development is limited.

It should be noted that Thassos Island provides shelter from the southerly waves, to a greater extent for the existing platform, and this is reflected in the higher wave heights reported for the new platform location.

Table 8-7: Maximum wave heights (in m) for respective extreme return conditions (Source: BMT Hindcast)

Directions from	Return period (years)			
	1	10	50	100
Storm duration (hrs)	4.8	3.3	2.5	2.2
North	1.0	1.6	2.1	2.3
Northeast	1.7	2.4	2.8	3.0
East	1.6	2.2	2.7	2.9
Southeast	1.2	2.0	2.6	2.8
South	3.7	5.3	6.3	6.7
Southwest	1.8	2.4	2.8	3.0
West	0.6	1.3	1.8	2.0
Northwest	0.3	0.8	1.3	1.5

Directions from	Return period (years)			
	1	10	50	100
Omnidirectional	3.7	5.3	6.3	6.7

8.1.2.3 Tidal data

The tidal ranges (based on data extracted between January 1992 and December 2014) at the study site are relatively small.

Table 8-8: Tidal water level components

Tidal definition		Level (rel. MSL)	Level (rel. LAT)
Highest astronomical tide	HAT	0.23	0.46
Mean high water spring (mean of high high-waters only)	MHWS (high)*	0.19	0.42
Mean high water spring (mean of low and high high-waters)	MHWS (mixed)	0.17	0.40
Mean high high-water (mean of all the high high-waters)	MHHW	0.13	0.35
Mean low high water (mean of all the low high-waters)	MLHW	0.09	0.32
Mean high water neap	MHWN***	0.02	0.25
Mean sea level	MSL	0.00	0.23
Mean low water neap	MLWN***	-0.02	0.20
Mean high low-water (mean of all the high low-waters)	MHLW	-0.09	0.14
Mean low water spring (mean of all the low low-waters)	MLLW	-0.13	0.10
Mean low water spring (mean of low and high low-waters)	MLWS (mixed)***	-0.17	0.06
Mean low water spring (mean of low low-waters)	MLWS (low)	-0.19	0.04
Lowest astronomical tide	LAT	-0.23	0.00

** Actual definition of MHWS but in some mixed semi-diurnal tidal regimes this can be lower than MHHW which is not as expected.*

*** Actual definition of MLWS but in some mixed semi-diurnal tidal regimes this can be higher than MLLW which is not as expected.*

**** No need to split Neap Tides, as the constants are very similar.*

8.1.2.4 Currents

Only the residual component of current flow has been subjected to the extreme value analyses. Tidal currents are assumed essentially independent of return period and are usually added subsequently. However, at these study sites the tidal currents are negligible and have been omitted from further analyses. The residual flow extremes may therefore be considered to represent the total current flow.

Traditional methods of deriving extreme current speeds through the water column involve simply treating each depth measurement separately. This method is perfectly adequate in relatively shallow water depths with fixed type structures, where the wave forces may be more important than currents. However, in deep-water situations it cannot take account of the possibility of strong vertical coherence (e.g. the strongest seabed currents may occur at different times to those near the surface; they may even move in opposite directions).

At the locations of interest the water depth is shallow enough and the current flow is orientated in the same directions for the majority of the vertical profile (small changes are observed in the bottom flow but at these depths the current magnitudes are minor) to allow extreme value analyses at each depth interval to be treated independently. The resultant extremes are then combined to form extreme profiles by direction.

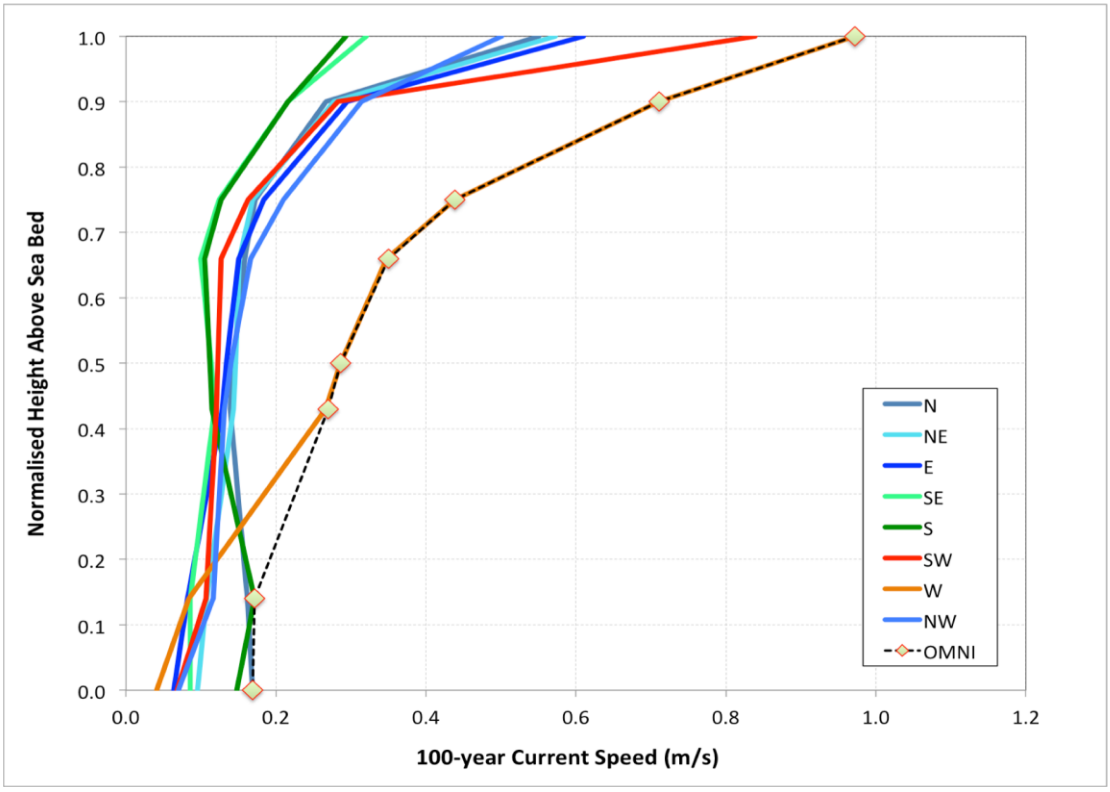


Diagram 8-7: Vertical current profiles by direction

Above Diagram 8-7 emphasises the dominance of the background flow towards the west (at the surface only the south-westerly flow is almost as great). This westerly flow is equal to the omnidirectional flow in all of the upper 75% of the water column. At depth (lower 25% of water column) the current changes to a north/south orientation but by this stage the flow is much reduced.

8.1.2.5 Seawater properties

Sea temperature and salinity data have been extracted directly from the HYCOM hindcast. Sea surface temperatures have been validated against the satellite derived AVHRR data (and found to be in good agreement.

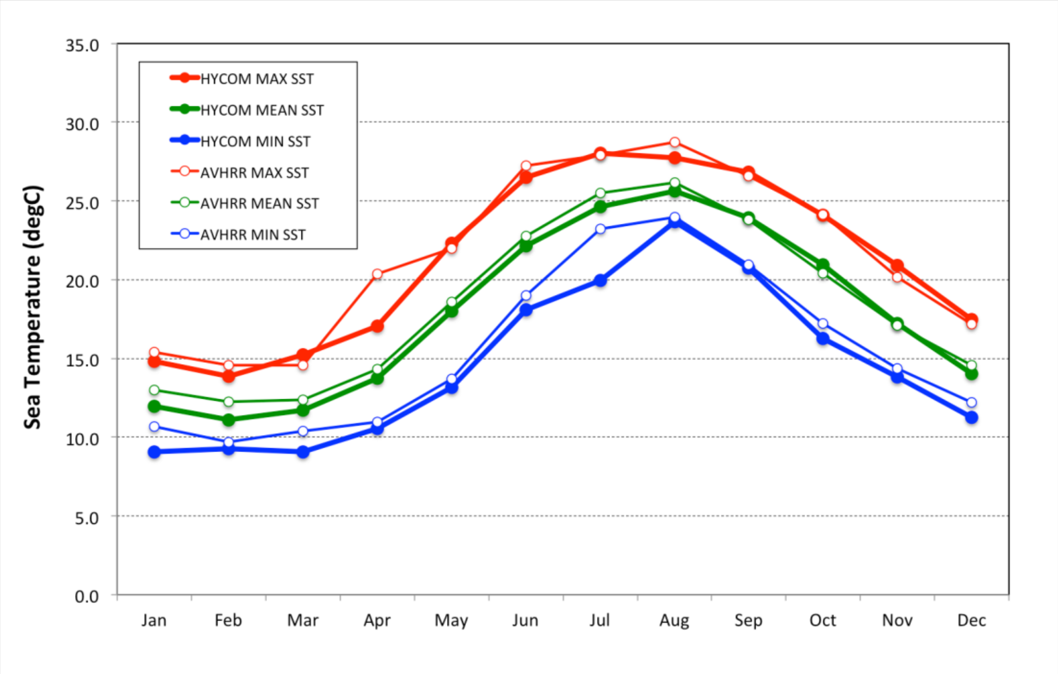


Diagram 8-8: HYCOM vs AVHRR Sea surface temperature check

Seawater density has been calculated using algorithms obtained through the Gibbs Seawater (GSW) Oceanographic Toolbox11. However, one should note that minimum and maximum temperature and salinity values presented may not occur simultaneously and therefore parameter values derived from simply the minima and maxima of each independent variable as presented in the statistical tables may not be representative. Instead we derive seawater density for each timestamp in the HYCOM series (i.e. taking associated values of temperature and salinity together) and calculate density statistics from those. Therefore the temperature, salinity, density tables may appear as inconsistent in the statistical tables.

8.1.3 Bioclimatic characteristics

With regard to climate conditions of Mediterranean areas, usually the Emberger index is used, according to the synthetic formula thereof, the rainfall, the average temperature and the average minimum temperature of the warmest and coldest months of the year are taken into account. Thus, the Mediterranean areas are divided in various bioclimatic levels.

This index is calculated as follows:

Q = 2.000 x P / (M^2 – m^2), where:

- P = average annual rainfall (mm)

- M = average value of maximum temperatures of the warmest month*
- m = average value of minimum temperatures of the coldest month*

**The figures M and m are expressed in absolute temperature grades, with 273°K corresponding to 0°C*

The quotient Q is used as an ordinate at a coordinates' axis, the abscissa of which is the m index, expressed this time in Celsius grades (°C). The foregoing values are placed on axes of a diagram prepared in advance, which distinguishes between bioclimatic levels.

Based on the Emberger formula, for the period 1984-1999 (based on the data from the Kavala M.S.) the index Q is calculated as follows:

Q = $2{,}000 \times 403.2 / (273+29.7)^2 - (273+3.0)^2$ **= 52.19**

By placing the value of the index on the Emberger[10] climate diagram, we can observe that the RU of Kavala belongs to the semi-dry bioclimatic level, characterized by cold winters.

More specifically, the climate characteristic of the coastal zone of the area is characterized by warm, dry summers (circulation of subtropical and warm-dry air), cold and wet winters (circulation of relatively cool air from the temperate zone) as well as rainfall of approximately 300-400 mm. The respective continental part of the RU tends to be different and is characterized by cool wet winters, dry summers and rainfall of approximately double values than the coastal zone.

[10]Bioclimatic levels, "The bio climate of Greece, relationship between climate and natural vegetation, bioclimatic maps, forest survey", Volume 1, 1980, Mavromatis G.

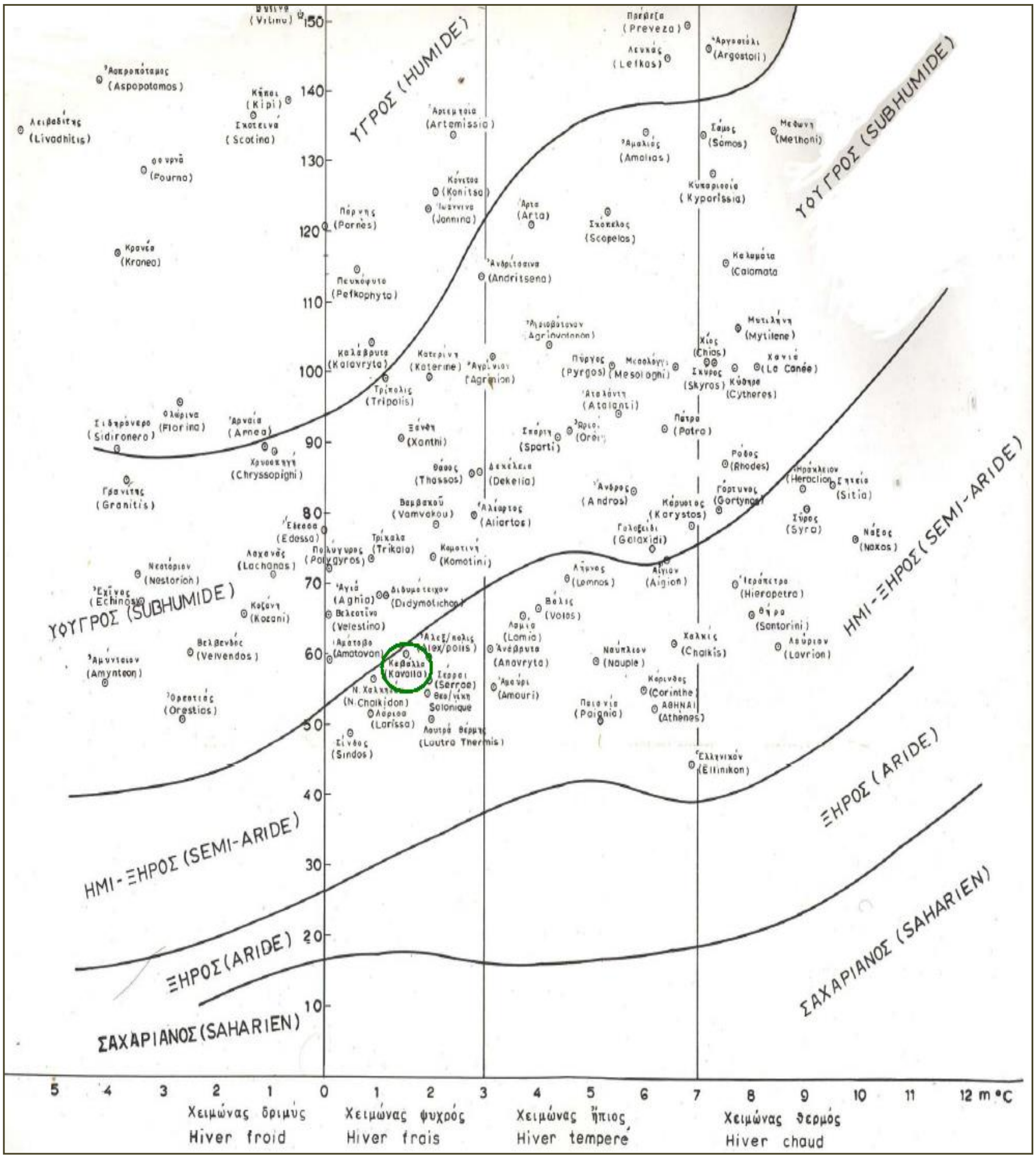


Diagram 8-9: Abstract from bioclimatic levels of Emberger diagram

It is noted that changes to climate and bioclimatic characteristics of the wider area have not been observed and so it can be concluded that the existing offshore and onshore project has no effect on these environmental parameters, which is also expected given the nature and the size of the installations.

8.2 MORPHOLOGICAL AND TOPOLOGICAL CHARACTERISTICS

The topological and morphological characteristics of the area under assessment are divided (for the purposes of better description thereof) in:

- Land morphological and landscape characteristics;
- Marine morphological and landscape characteristics.

It is noted that the concept of morphological characteristics in the sea and at a large distance from the shore, can only be understood as seabed morphology (described in the following paragraph), whereas any topological elations are due to floating fixed installations, such as the existing platforms/platforms for the extraction and processing of the extracted hydrocarbons.

8.2.1 Morphological and topological characteristics in the land environment

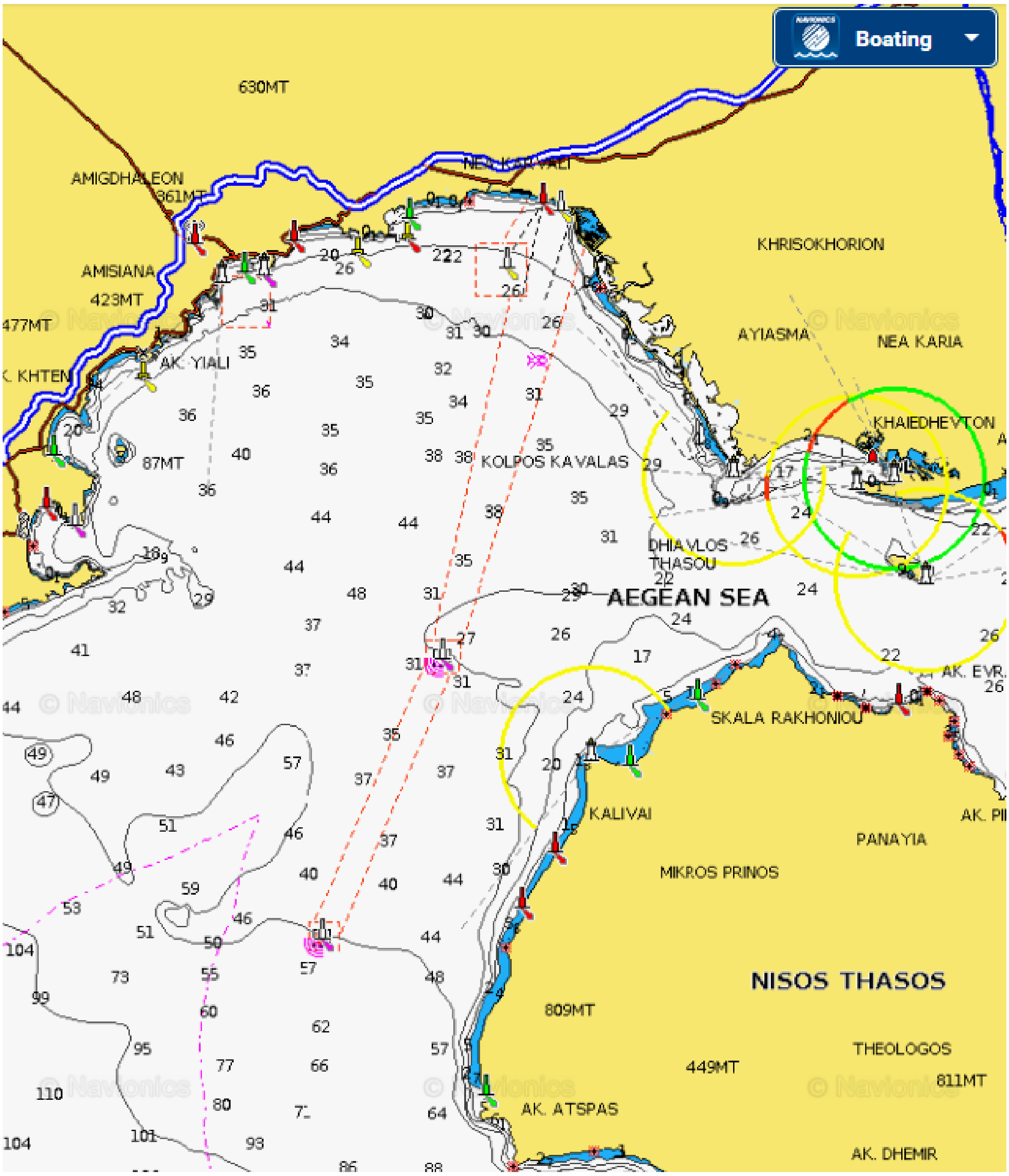
The morphology of the coastal zone can be characterised by extensive sand beaches with lakes, lagoons and land strips. The river Nestos delta is dominant in terms of morphology and topology. The lagoons closest to the project under assessment are Erateino and Vassova. Rainwater forms numerous torrents towards the plain. The water from these torrents, which in the past used to form marshes at the low locations of the plain, now reaches the sea through drainage channels. The plain, to a large part, consists of light, sandy soil with low water retention capability. As regards human intervention in the topological and morphological characteristics of the wider area, it must be noted that the projects with the most significant impact is the Kavala airport, to the east of the land facilities, and the road projects (Egnatia Odos and the highway N.R. Kavala – Xanthi), the routing of which is located to the north of the facilities.

The offshore platforms are installed at a distance more than 10km from residential areas and historical monuments and at a maximum height of 25 m above sea level, and for that reason there is not significant visual disturbance to the receptors (residents, tourists etc). The platforms are clearly visible only by vessels sailing in the area.

8.2.2 Morphological and topological characteristics in the marine environment

8.2.2.1 Bathymetry in the Kavala Gulf

The bathymetry in the Kavala Gulf and in the project area is given in the following map.



Map 8-5: Bathymetry in the Kavala Gulf

Source: https://webapp.navionics.com/#@11&key={xvvEmabyC

8.2.2.2 Geophysical characteristics in the project area

According to the JMD 170225/2014 on the environmental permitting procedure, the preparation of Geophysical and Geotechnical surveys is obligatory for such projects. The geophysical survey provides the overall mapping of the seabed surface and subsurface (up to 100 m).

The Preliminary study of the seabed of Kavala Gulf has been assigned to the Laboratory of Marine Geology and Physical Oceanography of the Geology Department of the University of Patras, in collaboration with GEODOMIKI. The main objective of the work is the seafloor

mapping and shallow seabed stratigraphy analysis through processing and interpretation of multi-platform geophysical datasets collected from the Delta-Epsilon/Lamda-Omikron complex in the PRINOS Field at the Kavala Gulf.

This chapter briefly presents the results of the Geophysical and Geotechnical Survey related to the morphology of the seabed. The full report is given in Annex 03.

The content of the survey related to the seabed morphology include:

- A detailed bathymetric survey;
- A detailed mapping of the seabed morphological features;
- A detailed study of the shallow seabed seismic stratigraphy;
- The detection of magnetic field anomalies indicating major metallic objects lying or being buried on the seafloor;
- The detection and mapping of existing pipelines and cables within the Base Case area; and
- The detection and the identification of ancient, historical and modern wrecks lying on the seabed.

The major field activities related to the seabed morphology are:

- Detailed Bathymetry Survey (Multibeam and Single beam echo sounders) to establish water depth and seabed contours
- Side scan sonar survey (detailed seabed surface imagery for the detection of objects/obstacles/gas pock marks in the platform and pipeline locations)

The area of geophysical survey (base case area) is shown in the following figure.

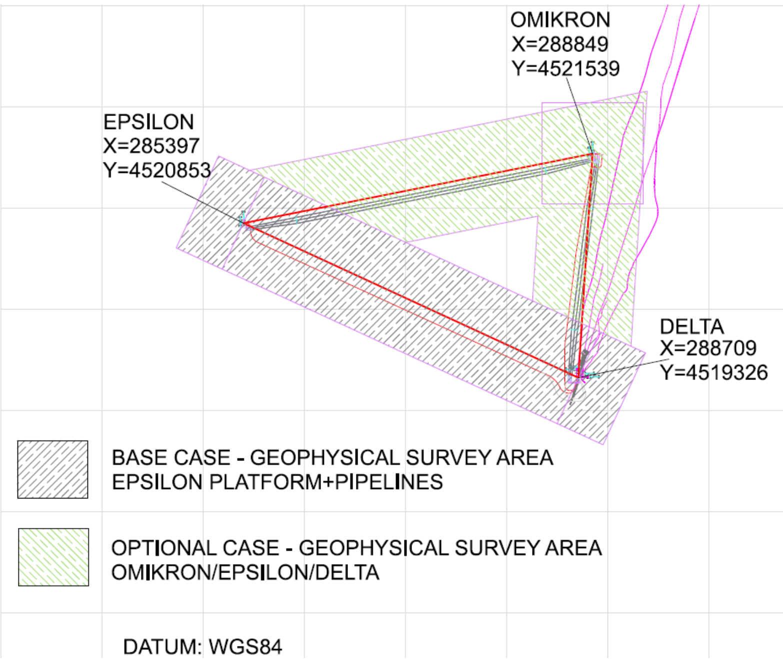


Figure 8-1: Area of Geophysical Survey

Detailed Bathymetry Survey

The depth of water in the area of the geophysical survey (see figure above) ranges between 30 m and 52 m. The area can be separated in three parts based on the bathymetry. The eastern part (-the area between Delta complex and the central part of Base Case area-) constitutes a bathymetric high plateau and is characterized by a smooth seafloor, deepening gently from 30m water depth at Delta complex to 34m water depth at the central part of the Base case (slope <1°). The western part (including Epsilon/Lamda platform area) also constitutes a bathymetric high plateau (37-41m water depth), which is deepening gently to the east and north (slope ≈1°). The two bathymetric high plateaus are separated by a deep part (50-52m water depth), which forms a channel, running almost north-south. In the area between the channel and the western plateau, the seafloor is deepening with a low slope to the west (2 ° - 4 °) and a medium slope to the north (3° - 9°). The seafloor between the eastern part and the channel is characterized by low slopes towards the south and by medium to high slopes (up to 13°) towards north.

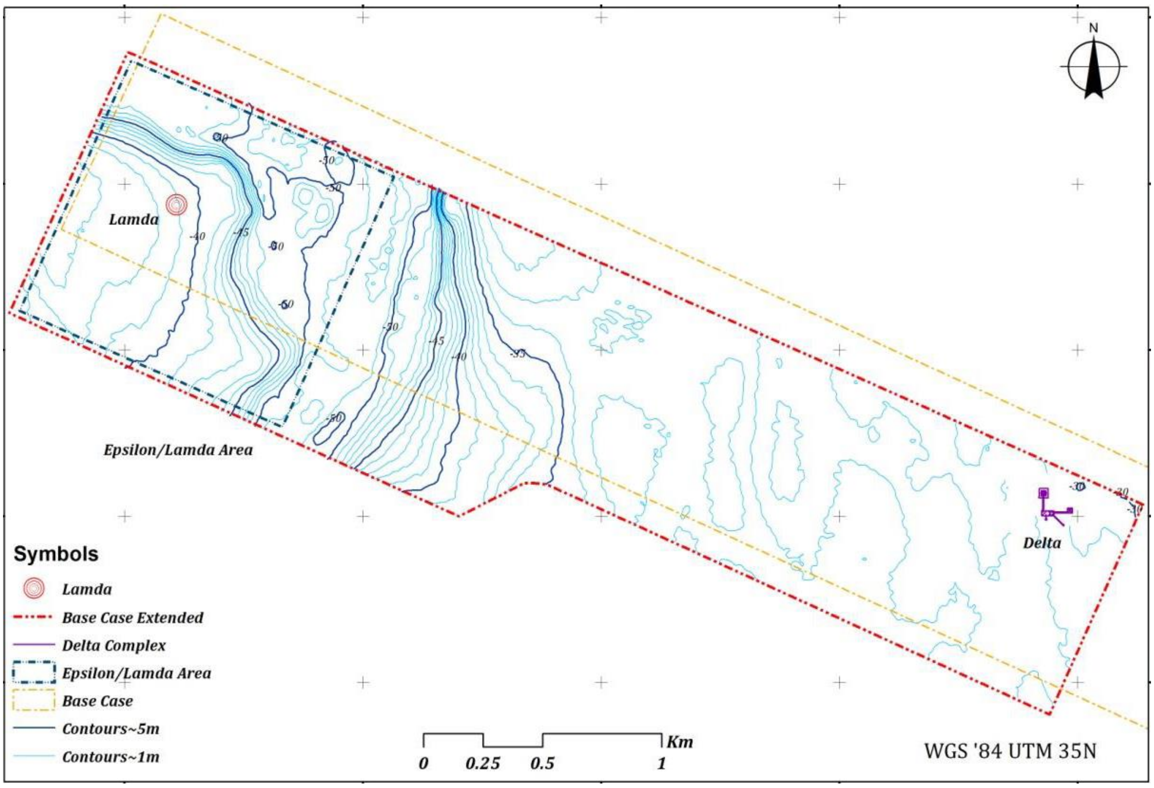


Figure 8-2: Bathymetric Map of the Base Case Area

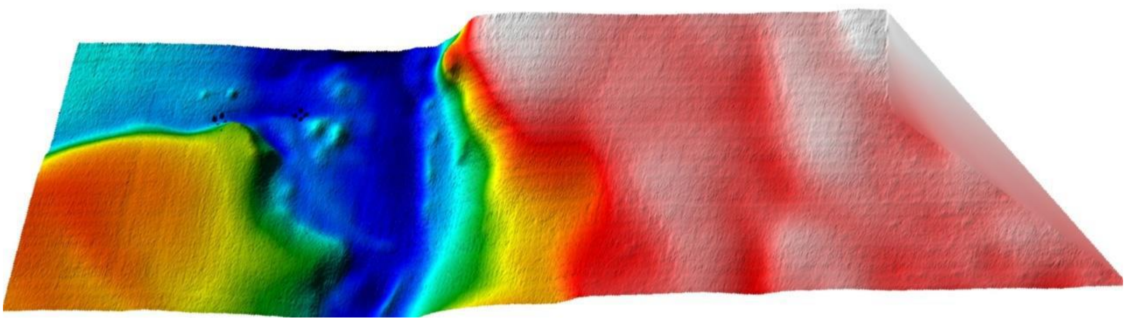


Figure 8-3: 3D Representation of the Base Case Area (Delta Complex area has been excluded)

The bathymetry of the Epsilon/Lamda platform area is characterized by a plateau at the western part, as described above, with water depth ranging from 37 to 41m and a channel (deeper part) at the eastern and northern part of the area. The slope between these two morphological units is low to medium at the southern part and medium at the northern part. At the northern part of the area, within the deeper part, eight small scale, circular deepening's about 25 m in diameter and 1.5 m deep were recorded. The location of the deepening's form two rectangles. Most probably these deepening's have been formed by the weight of the legs of two old well platforms. The identification of the drill rig footprints, gives a good indication that seabed movement is minimal in the area.

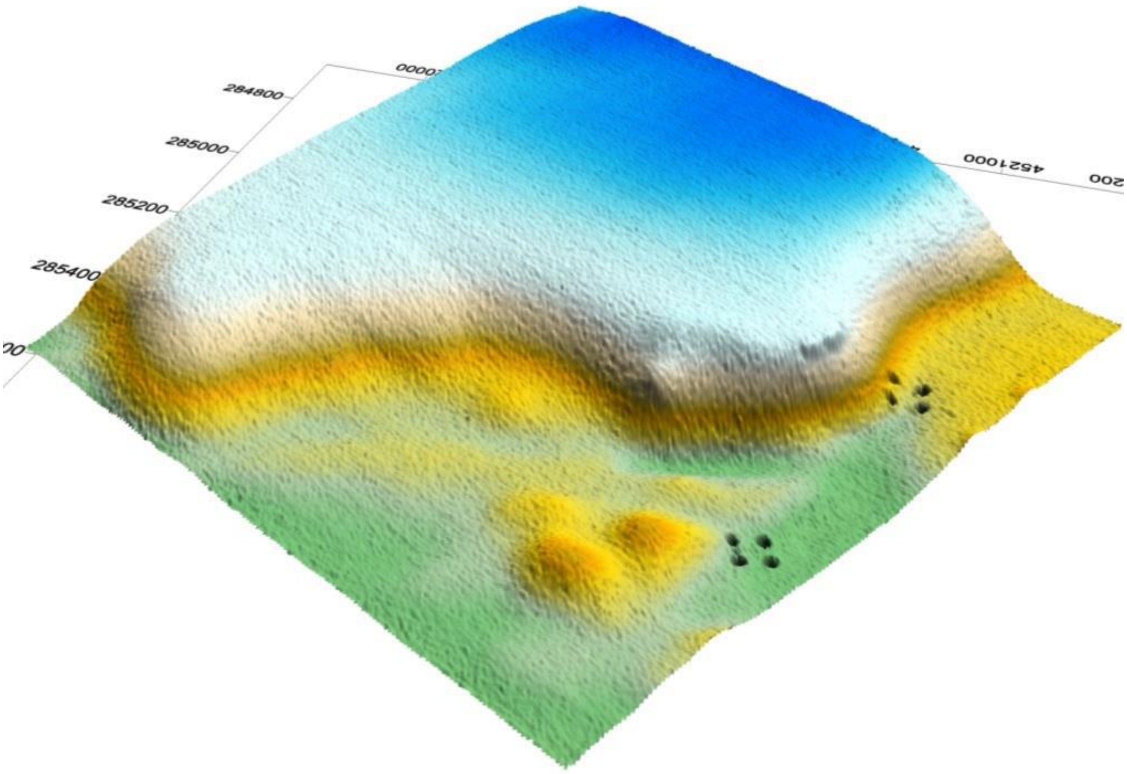


Figure 8-4: 3-D representation of Epsilon/Lamda platform Area. The deepening's that have been formed by the weight of two old well platforms are also shown.

Side Scan Sonar Survey

Side scan sonar imagery indicates no major seabed features or anomalies along the pipeline route and new platform location. There is also no evidence of gas pock marks or craters on the seabed. As expected, a narrow man made rock berm covering the existing pipeline from Delta to Kappa was identified running North/South from the south side of the DELTA platform, see below.

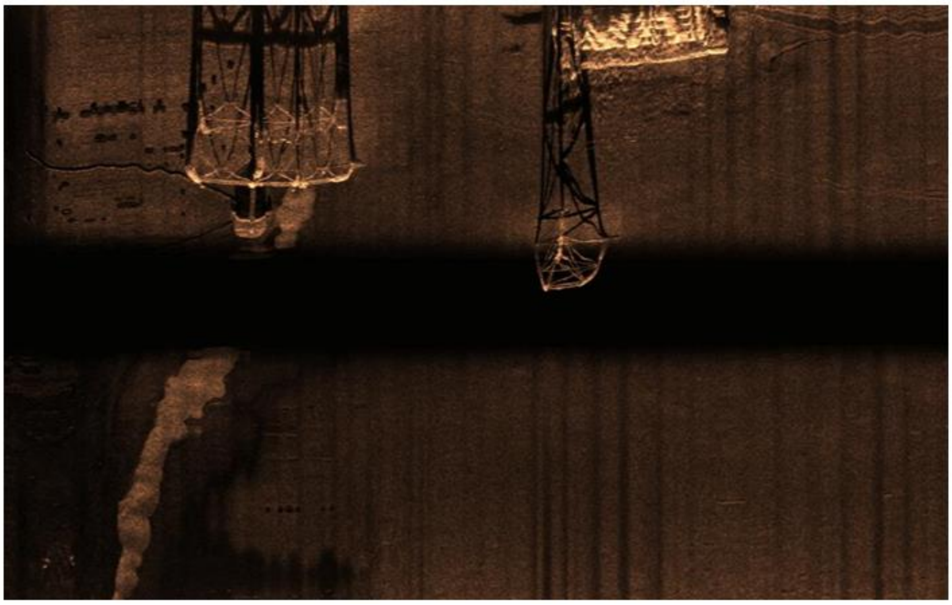


Photo 8-1: Seabed soils in Kavala Gulf

The side scan sonar identified the location of the previous drill rig footprints (E1 and E2) described in section above. This gives a good indication that seabed movement is minimal in the area; given that the drill rig was present in this location nearly 15 years ago, see photo below.

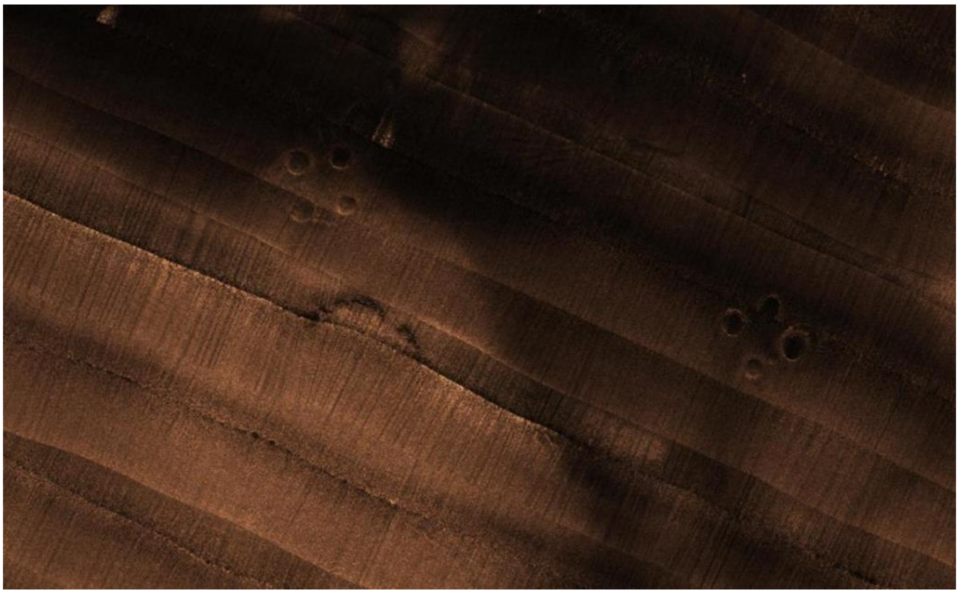


Photo 8-2: Seabed in Kavala Gulf

8.3 GEOLOGICAL AND TECTONIC CHARACTERISTICS

The geological and tectonic characteristics are divided into:

- Land geological characteristics;
- Marine geological characteristics;

- Tectonic characteristics

8.3.1 Geological characteristics in the land environment

Geological characteristics in the land environment are examined in brief for completeness reasons. The RU of Kavala is located on the geotectonic zone of Rodopi and constitutes part of the tertiary tectonic depressions of Nestos and Visthonidas.

Concerning the sedimentary rocks – meaning the series of sediments, it must be noted that the stratigraphic classification thereof (which composes the whole wider area to the south of the mountainous zone, at a great depth) from the surface of the background of the basins until the current surface, is as follows:

Paleogene Sediments: They constitute the majority of the west and southwest hill ranges of the Visthonida basin, constituting also the watershed of the adjacent basin of Nestos. At the same time, they can also be found in the surface of this eastern area, to the southwest of the city of Komotini. At the base of this system breccia and gravel can be found, while, subsequently sits a discontinuous (in the form of lenticular intercalations) nummulitid limestone. The series of Palaeogene sediments follows, which, usually appears as layers of conglomerates, sandstone, marlstone and clay slate. These formations, in terms of spring waters, are of very limited interest.

Neogene sediments: This system is the first series of sediments for the largest part of the Nestos basin. In many locations these Neogene sediments cannot be distinguished from the paleoquaternary ones, due to same origin (fluviotorrential) and the same characters. A characteristic of the sediments of Neogene is the lack of development of clear and normal horizons, but the existence of one characteristic primary heterogeneity with lateral transitions and slippings.

Quaternary sediments (recent and modern silting): The quaternary sediments and the paleoquaternary surface ones occupy a small area, while they are located at a depth below the newer quaternary silting. They originate from the lateral scree and the materials deposited by the small torrents with a mouth exactly at the fringes. They consist of coarse material, breccia, gravel, pebbles of various sizes – the composition of which are mainly gneiss, amphibolite's and marbles, as well as fine materials, mainly from clay silt and/or sand materials.

Specifically, Nestos plain may be considered as consisting of soils that show common characteristics, such as:

- Common bedrock, in the sense of quaternary deposits - alluvial from small torrents that result from the various rocks of the basin and comprise a complex material, however mainly a coarse one, and rarely medium grain or fine grain;
- Low soil development and lack of horizons, due to the short-term impact of soil generation factors (namely, young age);
- Common bedrock from water-bearing sand, with a depth of 0 to 4 m and a thickness up to 5m, most of the time;

- Small relevant thicknesses, with a surface layer from 0 to 2 m, many times less than 0.7 m;
- Rare occurrence of calcium carbonate;
- Excellent pH reaction from 6.3 to 7.6
- Relief with moderate to gentle slope;
- Low content of Ca, N, P and organic substances and sufficient K content;
- Moderate to rapid initial invasiveness and very slow to rapid final one.

8.3.2 Geological characteristics in the marine environment

8.3.2.1 Geological characteristic on Kavala Gulf

On a general level, the Aegean Sea is characterized from a multitude of sedimentary basins of the Tertiary, some of which were developed due to volcanic activities. At the beginning of the Eocene, faults were formed, which resulted in the fragmentation of the area. Pieces were lifted, whereas other sunk. Consequently the sea entered the lower areas. Moreover, the development of Miocene molasse sediments in closed tectonic basins resulted in evaporites, under which hydrocarbon deposits were located inside Messinian sandstone formations. At the same time, around the end of the Oligocene and at the beginning of the Miocene the last alpine folds are formed, resulting in the folding of the formations of the Eocene - Oligocene. The breaking of old faults, rising and sinking of pieces, creation of seas and lakes follow, while in the Thracian Sea a closed sea was formed, which created all the prospects for trapping hydrocarbons.

The granulometric analysis of the sediments of the gulf (Lykousis 1984) shows that the largest part thereof is covered by fine sediments with mud-clay percentages between 85 and 95%. Increased sand and mud percentages, with high content of mica and silica are found in the south-eastern part and along the north-eastern and eastern shores of the gulf. It is considered that the major source of fine materials is the river Nestos. The distribution of these fine materials is basically attributed to the general cyclonic-anticyclonic movement of waters (tide, wind-currents), the relatively small speeds of bottom currents and the slope of the bed. Finally, biogenic sand (pieces of echinoderms, molluscs) can be found in the central and southwestern part of the gulf.

8.3.2.2 Geological characteristics in the project area

As already mentioned in the chapter 8.2.2, the preparation of Geophysical and Geotechnical surveys is obligatory for such projects. The geotechnical survey provides the physical soil parameters for the pipeline and platform foundation design based on actual borehole data. The Preliminary study of the seabed of Kavala Gulf has been assigned to the Laboratory of Marine Geology and Physical Oceanography of the Geology Department of the University of Patras, in collaboration with GEODOMIKI. The main objective of the work is the seafloor mapping and shallow seabed stratigraphy analysis through processing and interpretation of multi-platform geophysical datasets collected from the Delta-Epsilon/Lamda-Omikron complex in the PRINOS

Field at the Kavala Gulf.

This chapter briefly presents the results of the Geophysical and Geotechnical Survey related to the seabed geology of the seabed. The full report is given in Annex 03. The content of the survey related to the seabed geology include a ground-truthing survey consisting of visual inspection and sediment sampling based on the geophysical seabed mapping results.

The major field activities related to the seabed geology are consist of

- Magnetometer Survey;
- Sub bottom profile Survey (Chirp and Sparker to determine soil profiles below seabed and indications of shallow gas);
- Seabed surface grab sample acquisition at strategic points along the survey route.

The area of geophysical survey (base case area) is shown in the following figure.

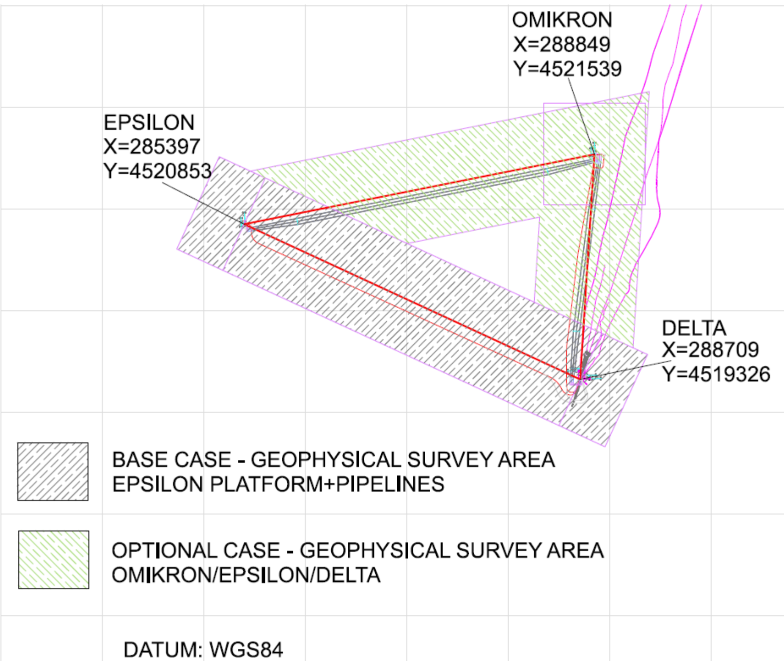


Figure 8-5: Area of Geophysical Survey

Magnetometer Survey

The map of the magnetic field deviation exhibits correlations both to geologic components of the seafloor as well as to metallic objects lying on it. The geologic components are expressed as low range (-5 - 5nT) deviations, while metallic objects as major magnetic anomalies (12 - 180nT). All major magnetic anomalies match very well to known man-made objects, which are four wells and a pipeline, having magnetic signatures of about 180 and 12nT, respectively.

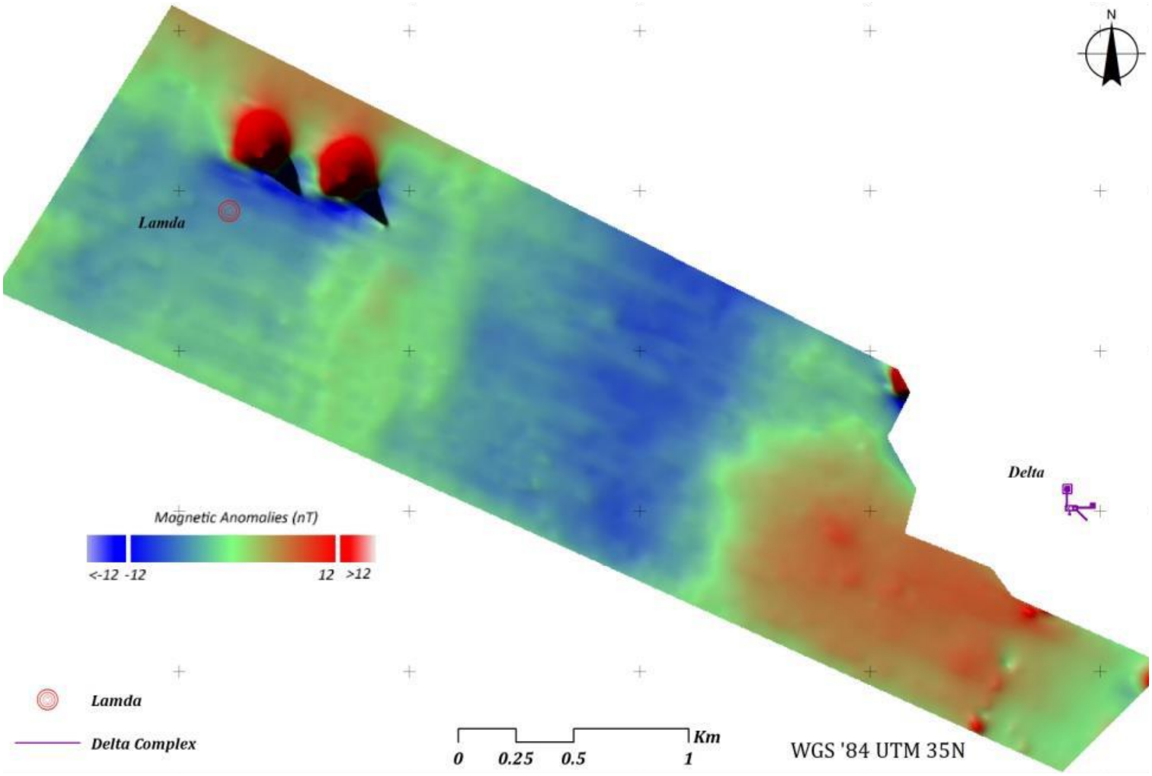


Figure 8-6: Magnetic Map showing the magnetic field deviation

Sub Bottom Profile Survey

Sub bottom profiles were generated on all lines, by a chirp and sparker, with results up to 100m below the seabed. In general the sediment profiles are consistent with very little sub layering up to depths of 30m. In general the material encountered from the reflectivity was shown to be silty sand, which is also consistent with the side scan sonar data and the ground trothing soil samples taken.

Seabed Sampling – Ground Truthing

Surface soil samples were recovered by a simple grab bucket at strategic locations within the survey area. The summary of the locations and representative samples are depicted in Figure 8-7. It is clear that the sediments recovered are mostly coarse grained silty sands, which is substantiated by core samples taken by previous surveys and the reflection indications from the side scan sonar and sub bottom profile data.

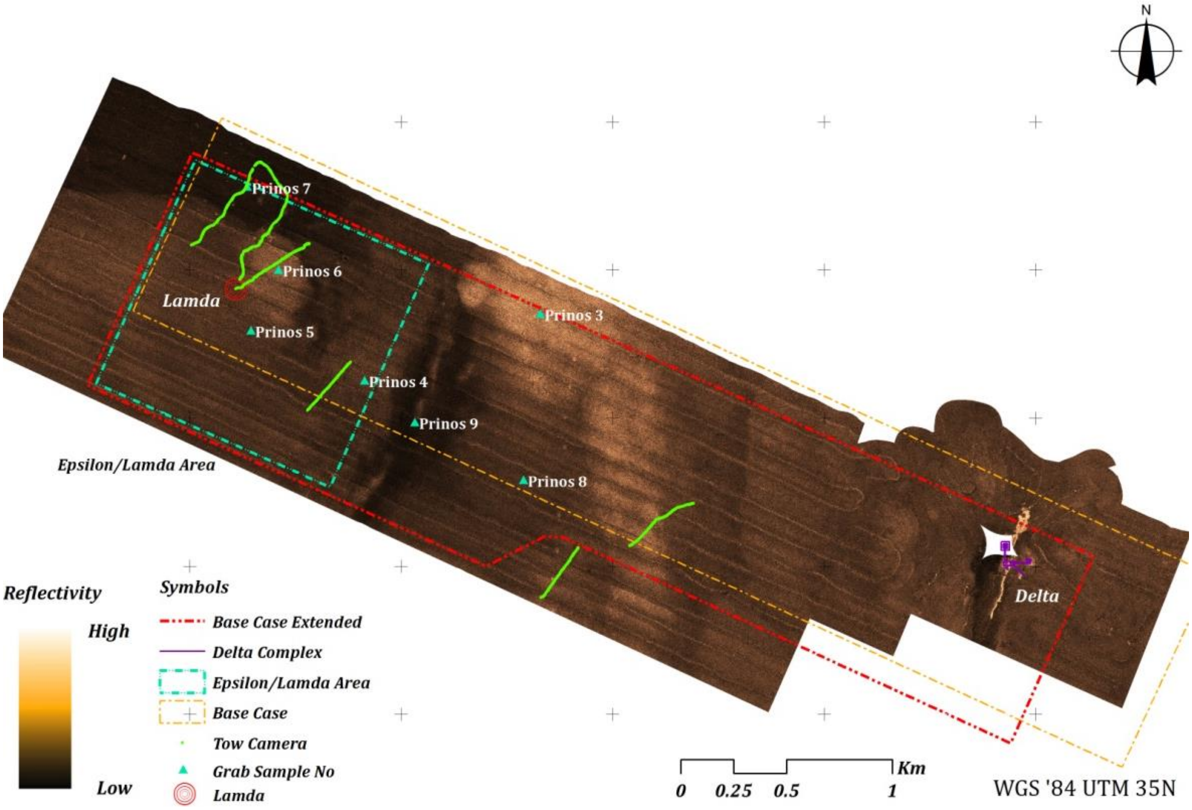


Figure 8-7: Sample locations and tow camera tracklines carried out at the Base Case Area, Lamda Platform.

In the following table, it is presented the information about the collected sediment samples, concerning: (1) location, (2) depth, (3) sample code, (4) indicative photos and (5) macroscopic/qualitative description.

Table 8-9: Information about the sediment samples collected during the ground-truth survey. Colour coding was held according to the ''Munsell Soil Colour Chart''

Location (1)		Depth (m) (2)	Sample code (3)	Indicative Photo (4)	Macroscopic description (5)
X	Y				
286657	4520588	28.3	PRINOS_3		Top Layer: Maerl (thickness >5 cm) Base Layer: Light brownish grey (2.5Y 6/2) silty sand with high presence of biogenic fragments
285826	4520273	50.3	PRINOS_4		Greyish brown (2.5Y 5/2) silty sand with high presence of biogenic fragments, gastropods and bivalve shells

Location (1)		Depth (m) (2)	Sample code (3)	Indicative Photo (4)	Macroscopic description (5)
X	Y				
285289	4520508	39.6	PRINOS_5		Dark greyish brown (2.5Y 4/2) silty sand with presence of biogenic fragments and plant residues
285419	4520795	40.6	PRINOS_6		Top Layer: Maerl (thickness >5 cm) and bivalve shells Base Layer: Greyish brown (2.5Y 5/2) sandy silt
285272	4521187	47.7	PRINOS_7		Gray (2.5Y 5/1) silt with low presence of biogenic fragments and gastropods. It is covered by a thin veneer of brown (10YR 4/3) watery, clayey layer
286577	4519802	37.7	PRINOS_8		Greyish brown (2.5Y 5/2) silty sand with presence of biogenic fragments and gastropods
286064	4520076	50.4	PRINOS_9		Greyish brown (2.5Y 5/2) sandy silt with presence of biogenic fragments

Sediment Quality

With regards to the sediment quality in the area of existing and proposed platforms, a survey of “Trace Metal determination and pollution assessment” and a survey of “Polycyclic Aromatic Hydrocarbons” have been carried out by the National Technical University of Athens. The main findings related to the sediment quality are presented below in brief while the full reports are included in Annex 06. Surface sediments were collected from thirteen (13) stations and were analyzed for metal and PAHs concentrations.

Map 8-6: Sampling points of sediments

The metal concentration in sediment is given in the following table. All values are expressed in mg/kg of dry sample with the exception of iron Fe in sediments, which is expressed in % w/w. Minimum, maximum and median values determined in the sediments are also reported.

Table 8-10: Metal concentration in sediments

Sampling point	% w/w	μg/g									
	Fe	As	Pb	Cr	Cu	Mn	Ni	Co	Zn	Cd	Mo
Sampling point 1	1.22	5.1	12.1	8.7	3.8	154.9	5.0	4.7	24.5	0.6	<0.5
Sampling point 3	4.69	12.2	41.6	59.8	24.6	310.3	34.5	11.2	106.4	1.8	<0.5
Sampling point 4	1.82	6.1	22.1	24.9	9.1	226.5	14.8	7.0	51.2	1.1	<0.5
Sampling point 5	1.16	7.1	23.1	17.8	8.1	190.1	9.8	4.4	39.3	0.7	<0.5
Sampling point 6	1.40	6.9	19.7	13.5	4.6	156.5	7.0	4.3	37.2	0.7	<0.5
Sampling point 7	2.85	9.7	34.9	52.5	21.1	283.6	30.3	9.3	89.0	1.4	<0.5
Sampling point 8	1.06	4.3	24.4	16.7	8.0	146.7	9.9	4.0	48.4	0.7	<0.5

Sampling point 10	0.92	7.5	25.7	14.0	6.5	127.1	7.6	3.6	35.4	0.6	<0.5
Sampling point 11	0.61	4.4	31.2	13.6	6.8	97.0	5.8	2.8	33.7	0.4	<0.5
Sampling point 12	0.60	5.8	16.3	9.6	3.7	80.4	5.5	2.6	22.8	0.4	<0.5
Sampling point 13	0.90	3.3	18.8	12.7	5.6	166.4	7.8	3.8	31.6	0.6	<0.5
Sampling point 1E	0.61	7.85	16.13	9.97	25.9	222.2	5.7	4.6	23.5	1.81	<0.5
Sampling point 2E	0.77	6.10	11.46	7.41	30.8	238.3	4.6	2.7	26.8	1.71	<0.5
maximum	4.69	12.2	41.6	59.8	24.6	310.3	34.5	11.2	106.4	1.8	n/a
minimum	0.60	3.3	12.1	8.7	3.7	80.4	5.0	2.6	22.8	0.4	n/a
median	1.16	6.1	23.1	14.0	6.8	156.5	7.8	4.3	37.2	0.7	n/a
STDEV	1.21	2.6	8.5	17.4	7.0	72.1	10.2	2.8	26.7	0.4	n/a

The strong correlation (Pearson correlation coefficient) of most elements reveals a common origin of the examined samples. All elements except copper (Cu) and cadmium (Cd) show strong correlation with iron (Fe), suggesting common lithogenic origin. Cd and Cu on the other hand, show strong correlation between them but not with the rest of the elements thus suggesting a common, most probably, anthropogenic origin. Estimation of the element distribution among the sampling sites is depicted in the following figures revealing peak values for all the examined elements at the sampling sites 3 and 7, although As, Pb and Mn show a broader distribution.

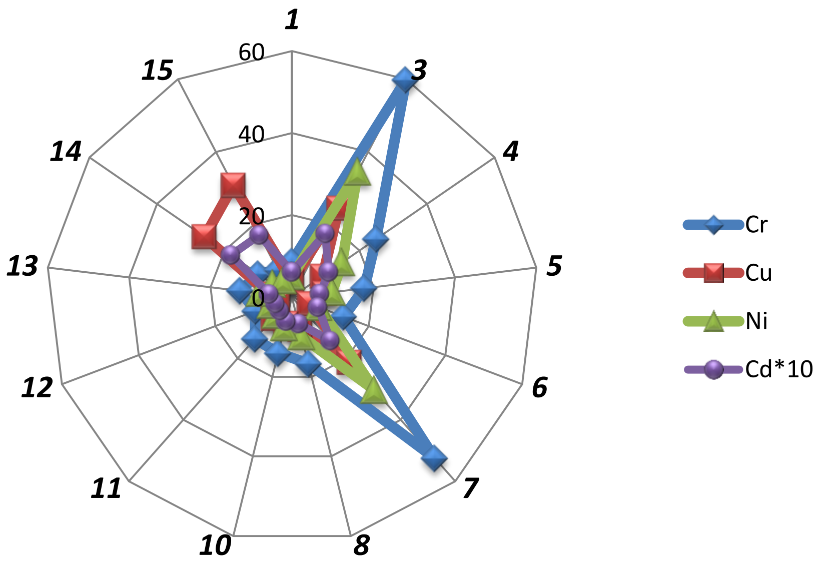


Figure 8-8: Distribution of Cr, Cu, Ni and Cd in the sampling sites (Cd is plotted as ten times the actual concentration for scale reasons)

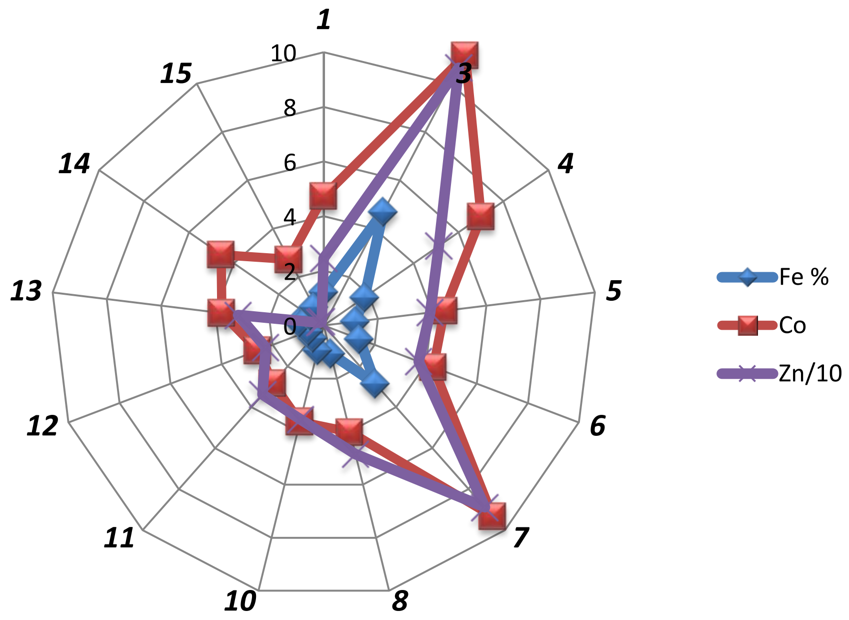


Figure 8-9: Distribution of Co, Zn and Fe in the sampling sites (Zinc is plotted as 1/10 of the actual concentration for scale reasons)

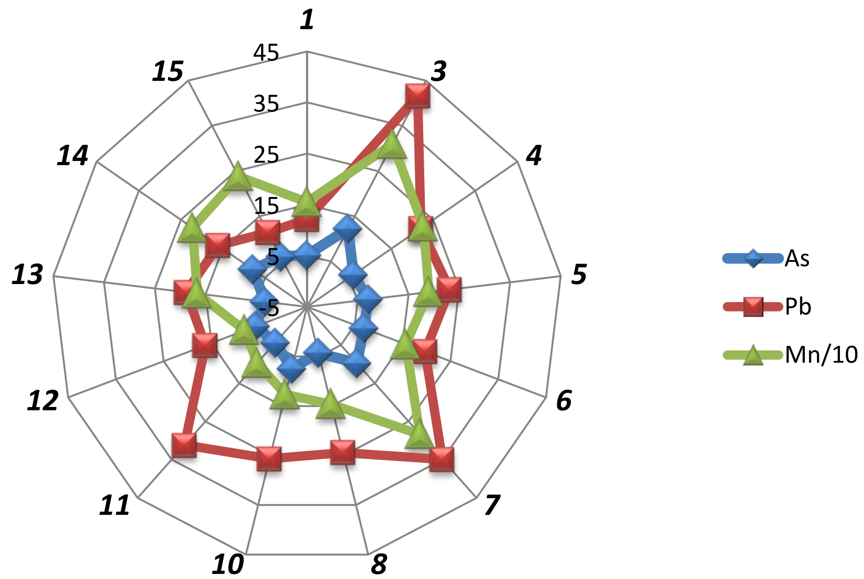


Figure 8-10: Distribution of Pb, As and Mn in the sampling sites (Manganese is plotted as 1/10 of the actual concentration for scale reasons)

The results of PAHs analysis are presented in the following table.

Table 8-11: PAHs in sediments (μg/L)

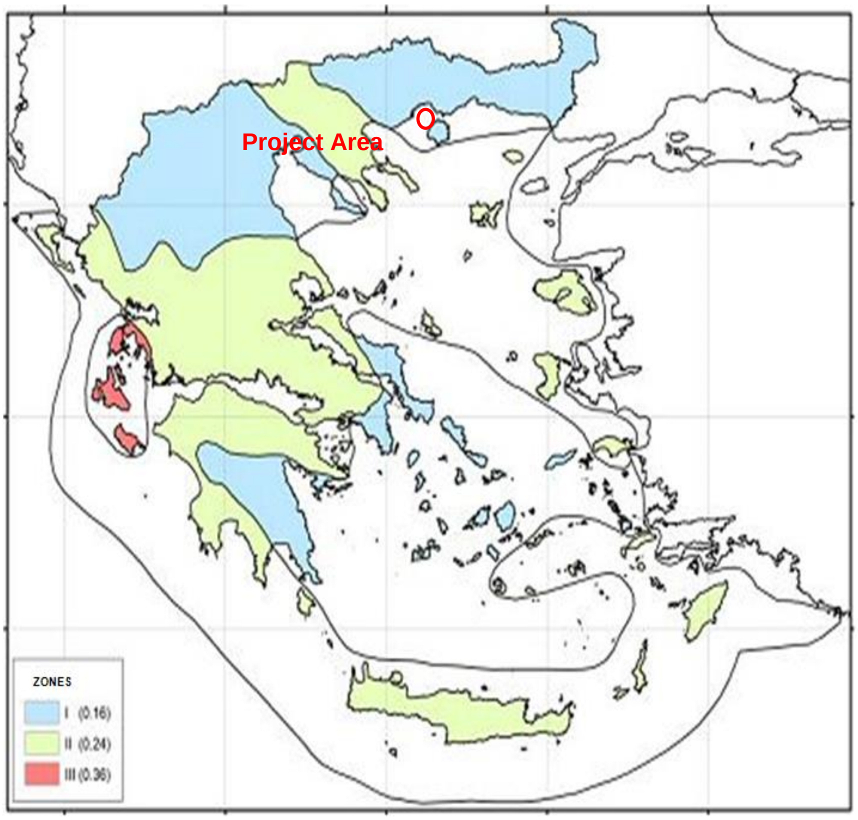
Sampling point	NAPH	ANTH	FLUO	B[b]F	B[k]F	B[a]P	B[ghi]P	IP
Sampling point 1	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Sampling point 3	N.D	<LOQ	N.D	0.005	<LOQ	<LOQ	<LOQ	N.D
Sampling point 4	N.D	N.D	N.D	<LOQ	N.D	N.D	N.D	N.D
Sampling point 6	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Sampling point 7	N.D	<LOQ	N.D	0.004	<LOQ	<LOQ	<LOQ	N.D
Sampling point 8	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Sampling point 10	N.D	N.D	N.D	<LOQ	N.D	N.D	<LOQ	N.D
Sampling point 11	N.D	<LOQ	<LOQ	0.008	0.004	0.006	0.005	<LOQ
Sampling point 12	N.D	N.D	N.D	<LOQ	N.D	N.D	<LOQ	N.D
Sampling point 13	N.D	N.D	N.D	<LOQ	N.D	N.D	N.D	N.D
Sampling point 1E	N.D	N.D	N.D	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
Sampling point 2E	N.D	N.D	N.D	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ

N.D.: Not detected
LOQ: Level Of Quantification

Conclusively and according to the outcomes presented above, the study area shows minor metal enrichment except cadmium (Cd). Despite this observed anomaly, the quality of the sediments is below baseline metal pollution with the exception of sites 3 and 7 which show increasing pollution levels The conclusion is drawn based on the average earth crust as reference environment and is considered to be representative of the present situation. The results of the determination of the main PAHs in sediments indicate the non-existence of pollution problems concerning this type of pollutant neither in the area of the existing facilities, nor in the area of the planned installations. The concentrations are below the EU thresholds for Good Environmental Status of marine environment.

8.3.3 Tectonic characteristics

With regards to the seismicity of the area, the onshore and offshore project area is classified in the seismic risk zone I, namely in the lower category (see map below) in accordance with the "Amendment to the Provisions of the Greek Seismic Code GSC 2000 due to Revision to the Seismic Risk Map GG 1154/B/12.08.2003".



Map 8-7: Seismic risk zone map of Greece11

8.4 WATER ENVIRONMENT

This chapter presents the quantity and quality status of surface and groundwater bodies in the study area according to the National River Basin Management Plans (RBMPs) which were prepared in accordance with the Water Framework Directive 2000/60 and carried out under the responsibility of Special Secretariat for Water of the Ministry of Environment. Moreover, it presents in brief the main findings of the “Polycyclic Aromatic Hydrocarbons” survey and “Trace Metal determination and pollution assessment” survey (carried out by the National Technical University of Athens) related to the seawater quality in the area of existing and proposed platforms. The full report is included in Annex 06.

This chapter also presents the quality of bathing waters according to the “Monitoring Program of bathing water quality on the coast Greece in accordance to the specification set out in the Directive 2006/7/EC”, carried out under the responsibility of Special Secretariat for Water of the Ministry of Environment.

[11] *Seismic risk zones of Greek territory, Earthquake Planning and Protection Organization (EPPO), available at the link: http://www.oasp.gr/ (last visited on 5/05/2015).*

8.4.1 Surface Water

The project area belongs to the 11th and 12th Water Districts. More specifically, the onshore facilities belong to the river basin of Nestos. Moreover, close to the offshore facilities (SIGMA), at the west, there is a stream named Kotsas stream. The ecological and chemical status of Kotsas stream is characterized as unknown.

With regards to the Coastal Water Bodies (CWB,) the project area belongs to GR1106C0004N "Gulf of Kavala West" and GR1207C0001N "Gulf of Kavala East" and is close to the CWB GR242C0012N "Thasos coast". The ecological status of the CWB GR1106C0004N is characterized as "medium" and the chemical status as "unknown". The ecological status of the CWB GR1207C0001N is characterized as medium and the chemical status as "failing to achieve good". Finally, the ecological status of the CWB GR242C0012N is characterized as "high" and the chemical status as "good".

As already mentioned, a survey of "Trace Metal determination and pollution assessment" and a survey of "Polycyclic Aromatic Hydrocarbons" have been carried out by the National Technical University of Athens (see Annex 06). The seawater samples were collected from four sampling points and analyzed for metal and PAHs concentrations. The results of metal (Fe, As, Pb, Cr, Cu, Mn, Ni, Co, Zn, Cd) concentrations were below the quantification limits. The results of PAHs analysis are presented in the following table.

Map 8-8: Seawater sampling points

Table 8-12: PAHs in seawater (μg/L)

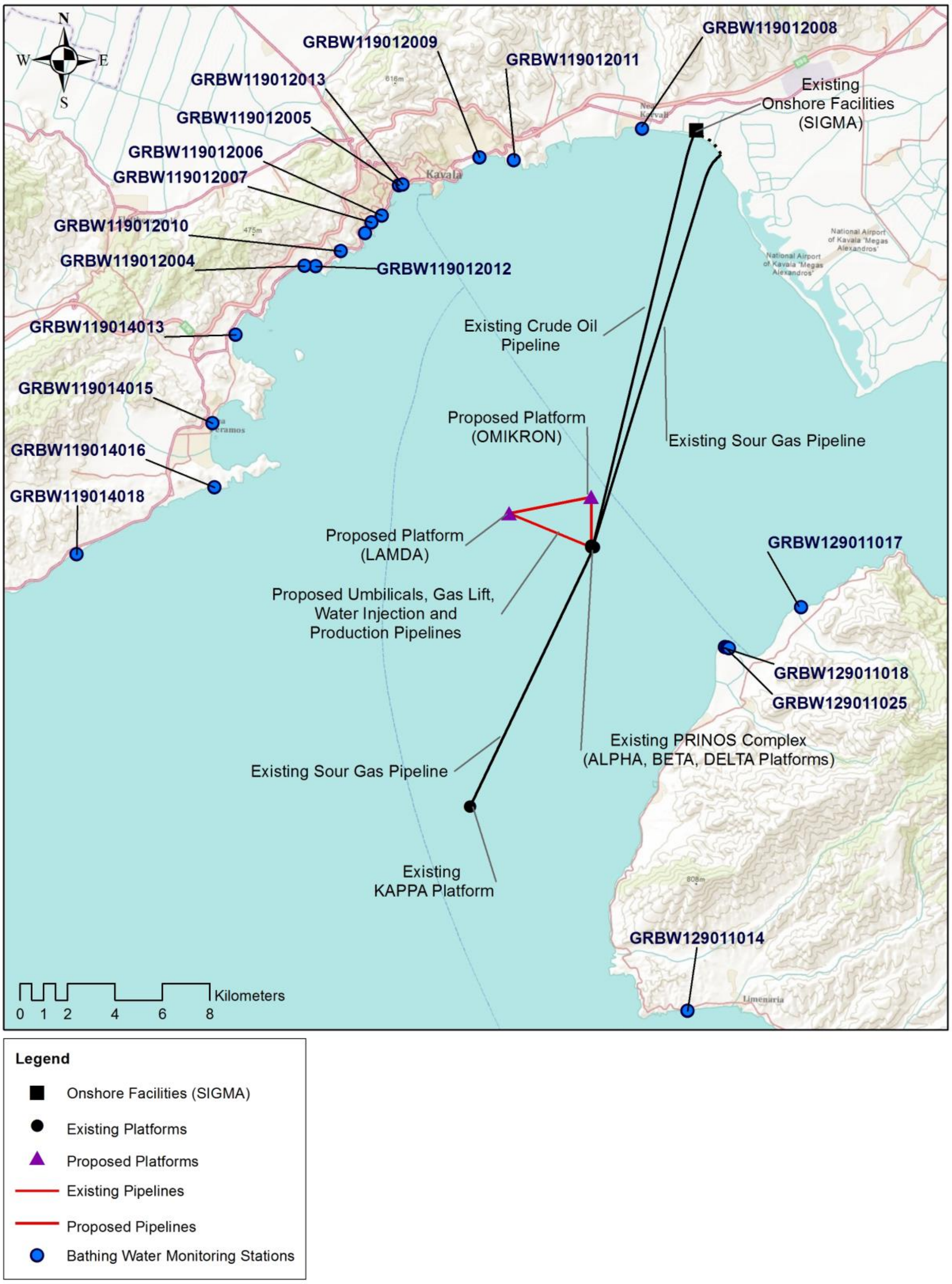
Sampling point	NAPH	ANTH	FLUO	B[b]F	B[k]F	B[a]P	B[ghi]P	IP
Sampling point 11	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Sampling point 13	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Sampling point 1E	<LOQ	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Sampling point 2E	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D

N.D.: Not detected
LOQ: Level Of Quantification

The results of the determination of the main PAHs in seawater indicate the non-existence of pollution problems concerning this type of pollution. All metal and PAHs values were below detection or quantification limit and below the EU thresholds for Good Environmental Status of marine environment.

8.4.2 Bathing waters

The quality of bathing water is monitored under "Monitoring Program of bathing water quality on the coast Greece in accordance to the specification set out in the Directive 2006/7/EC", carried out under the responsibility of Special Secretariat for Water of the Ministry of Environment. The monitoring stations of the wider project area are shown in the following map. The quality of the bathing water per each station are given in the below tables.



Map 8-9: Bathing Water Monitoring Stations in the wider study area

Table 8-13: Quality of bathing waters from 2011 till 2014 in the wider study area

Code of Monitoring Station	Name of Monitoring Station	Results 2011	Results 2012	Results 2013	Results 2014
GRBW129011017	Rachoniou Lake	High	High	High	High
GRBW129011018	Thasos Dasyllio 1	High	High	High	High
GRBW129011025	Thasos Dasyllio 1	High	High	High	High

Code of Monitoring Station	Name of Monitoring Station	Results 2011	Results 2012	Results 2013	Results 2014
GRBW129011014	Limenaria	High	High	High	High
GRBW119012008	Nea Karvali	High	High	High	High
GRBW119012011	Aspri Ammos	High	High	High	High
GRBW119012009	Perigiali	High	High	High	High
GRBW119012013	Rapsani 2	High	Good	Sufficient	Good
GRBW119012005	Rapsani 1	High	Good	Good	Good
GRBW119012006	Kalamitsa	High	High	High	High
GRBW119012007	Mpatis	High	High	High	High
GRBW119012010	Toska	High	High	High	High
GRBW119012004	Palio	High	High	High	High
GRBW119014013	Nea Iraklitsa	High	High	High	High
GRBW119014015	Nea Peramos	High	High	High	High
GRBW119014016	Ammolofoi	High	High	High	High
GRBW119014018	Ocean View	High	High	High	High

8.4.3 Terrestrial Groundwater Bodies

The onshore facilities (SIGMA) belong to the Groundwater Body (GWB) GR1100130 “System of Symvolou – Kavala” which is a fractured aquifer system. With regards to the qualitative status of this GWB, small point pollution sources from livestock activities are observed. However, overruns of water quality have not been detected and also pollution trend in the concentrations of qualitative parameters of the system have not been not diagnosed. The qualitative (chemical) status is characterized as “good”. With regards to the quantitative status of this GWB, there is no available information concerning the piezometer of the aquifer. In this GWB system, 36 wells and 20 springs have been identified. The wells’ supply is ranging from 10 to 50 m^3/h and is utilized to cover water supply and irrigation needs. According to the hydrogeological conditions and the registration of the wells, no indication of overpumping is observed and the quantitative status is characterized “good”.

The onshore facilities borders with the GWB GR1200060 “Nestos Delta System” which is an alluvial aquifer system. The system has hydraulic communication with the river Nestos from which it receives strong water supply. In this GWB, it has been observed seawater intrusion in the eastern part and high concentration of EC and Cl due to the overpumping of the aquifer for irrigation needs. The number of wells in this aquifer is 510. The quality status of this GWB is degraded due to industrial pollution from food, agricultural and ceramics industries, urban pollution from wastewater discharges and presence of underground geothermal fluids. The qualitative (chemical) status is characterized as “bad”. The quantitative status of this GWB is characterized as “good” because the estimated amount of total abstractions are less than the annual renewable water reserves. However and as mentioned above, overpumping is observed

in the waster eastern part during the irrigation period and the water balance is deficit.

8.5 AIR ENVIRONMENT - AIR QUALITY

The probable degradation of air quality may occur from the various industries in the wider project area:

- Industrial activity of Energean (Sigma onshore and offshore facilities)
- Greek Fertilizers and Chemical ELFE SA
- Activity in port Philippos B' as well as Kavala and Keramoti ports
- Road Traffic (Egnatia motorway, side roads connections and urban Kavala network)

Energean (previously Kavala Oil) operates continuously since 1979 an air quality monitoring station located within 500 meters of shore-based installations "Sigma" fully equipped with all necessary equipment for continuous monitoring of air quality:

- Concentration of hydrogen sulphide (H_2S).
- Concentration of sulphur dioxide (SO_2).
- Concentration of total hydrocarbons (HCT).
- Concentration of methane (CH_4)
- Concentration of non-methane hydrocarbons (NMHC).
- Measurements of meteorological parameters (wind direction and speed, ambient temperature, relative humidity).

In the region of Thasos and Kavala are established 12 monitoring stations of total sulphation of the atmosphere on a monthly basis.

According to the recent annual report 2014 of the onshore and offshore facilities of Energean for 2014, the measurements of the sulphur dioxide (SO_2) and hydrogen sulphide (H_2S) analysers of the Environmental Stations and the results from the 12 air sulfation monitoring stations in the surrounding of area of Kavala and Thasos were all within the permissible limits as shown in the following diagrams.

The annual GHG emission of onshore & offshore facilities according to the TUV Austria Hellas verification statement of 2014 is 34,100 tn CO2. The verification statement is sufficient and has been conducted according to the 600/2012/EU and 601/2012/EU Regulations and there are no important inaccuracies.

The annual inventory of European Pollutant Release and Transfer Register has been submitted until the year 2014 to the Division EARTH of the Ministry of Environment, Energy and Climate Change (YPEKA, currently YPEN).

The sulphur oxides (SO_x/SO_2) and nitrous oxide (NOx) emission of the offshore facilities during 2014 is 1,517 tn and 1.075 tn respectively.

The GHG emissions of the offshore facilities during 2014 were 1,684 tn CO_2.

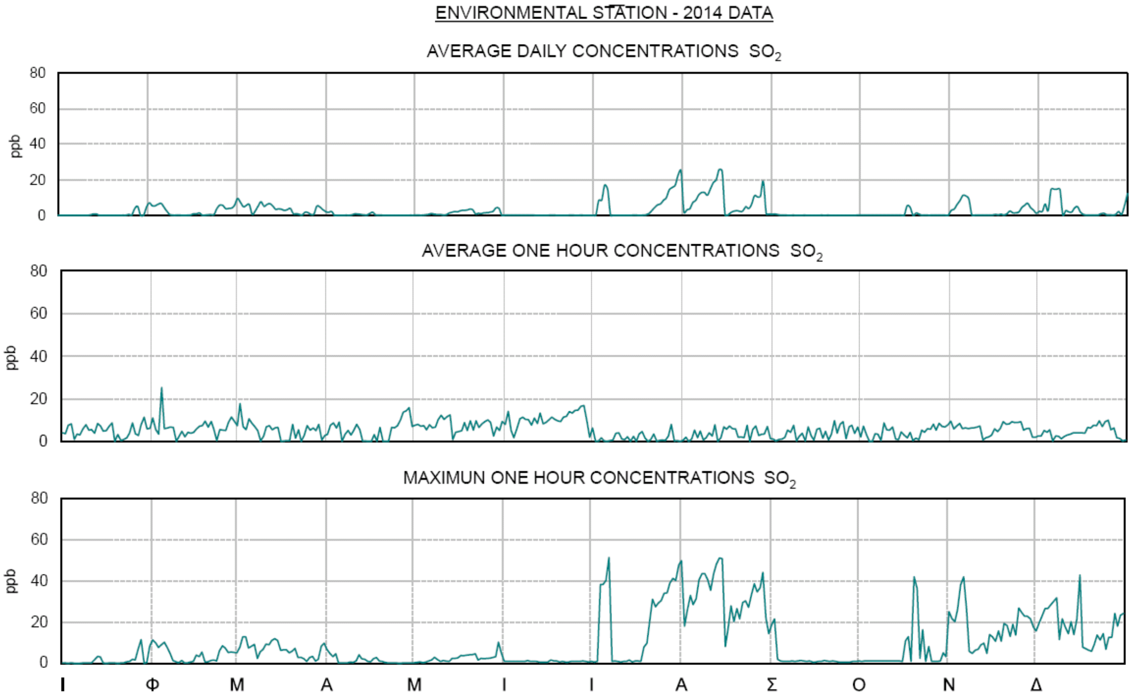


Diagram 8-10: Average SO2 concentrations in ppb.

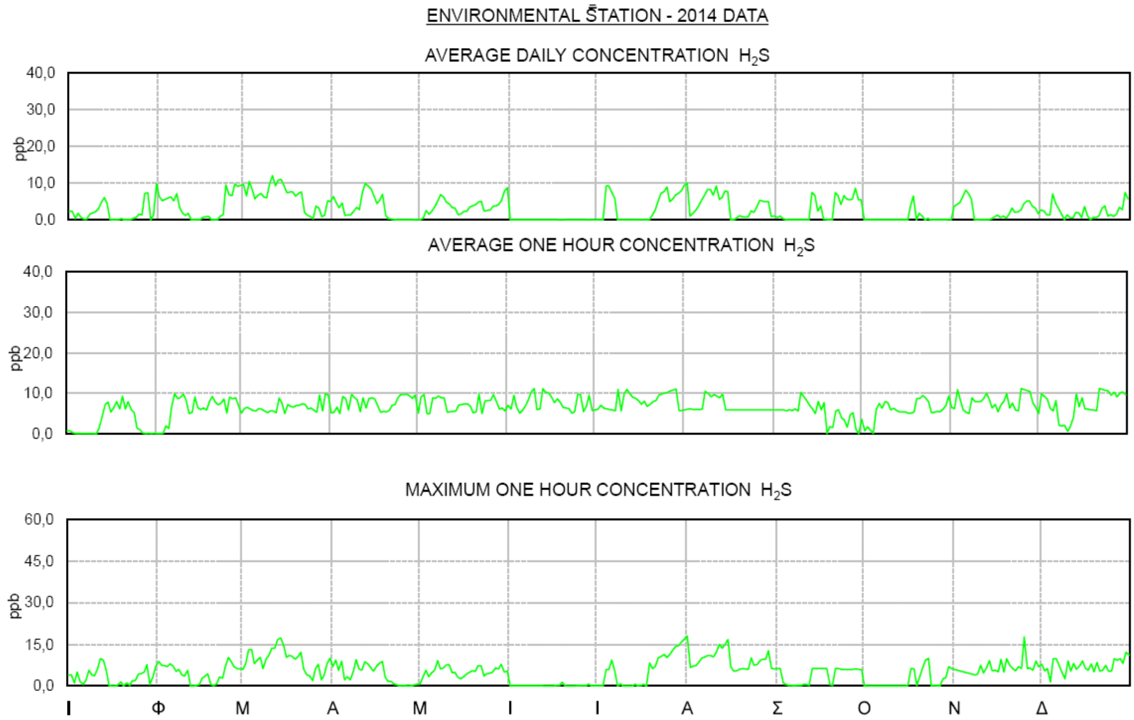


Diagram 8-11: Average H2S concentrations in ppb

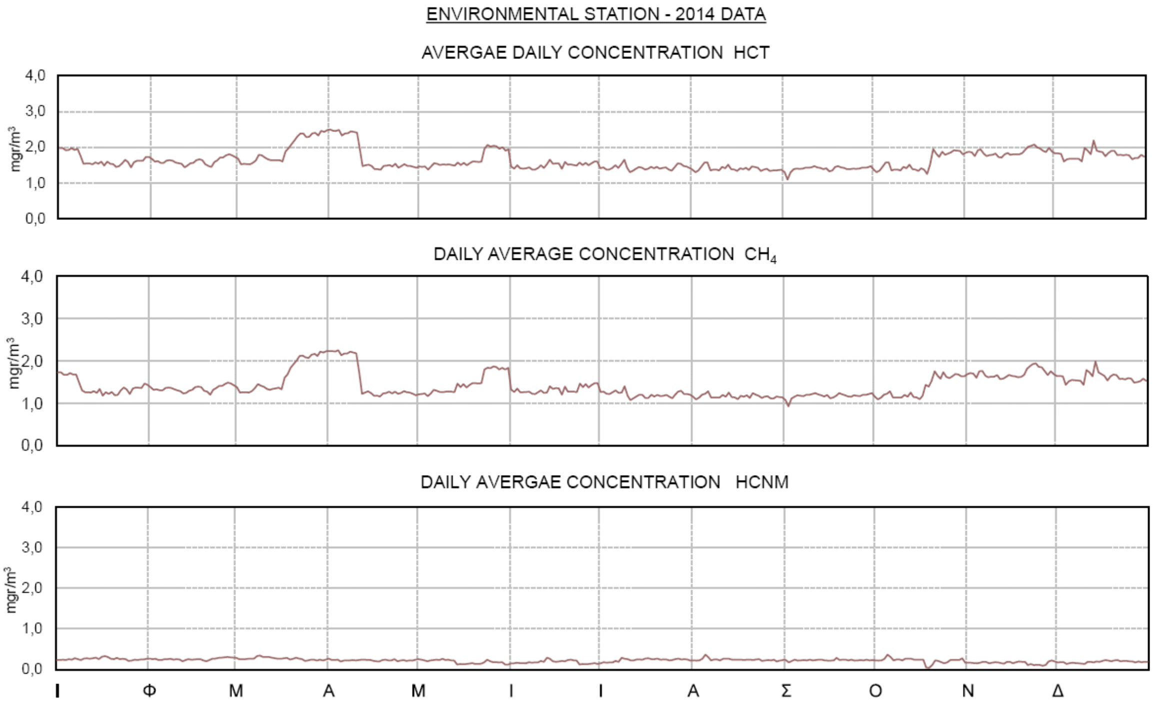


Diagram 8-12: Average Total Hydrocarbon- HCT concentrations in mg/m3

The air pollution waste of offshore facilities originates from the use of natural gas fuel and diesel. The points where natural gas fuel gas is consumed are:

- Torch chimney, FS-165 of Delta Rig
- Pilots and purge of the complex flare
- The glycol reboiler for the dehydration of sour natural gas, E-102, on Delta Rig.

In addition, the atmospheric flash gases of the produced water are sent continuously to flare. These are calculated at 420 Nm^3/h, with a hydrogen sulphide content of 40% by volume.

Smoke from the glycol furnace does not exceed level 1 of the Ringelman scale. Moreover, neither burning chamber nor any point of the production process releases dust to the ambient environment of the installation.

Diesel is consumed by the motors of the platforms cranes, the backup firefighting pump, the emergency generator on Delta and the generators on Kappa. Any impact from their operation is minimal because the measured pollutants are within the accepted limits/thresholds. The overall processes are fully monitored by the existing Environmental Monitoring Plan, currently providing annual Environmental Reports to the Ministry's agencies.

8.6 ACOUSTIC ENVIRONMENT

The major sources of impacts on acoustic environment in the wider area are:

- Industrial noise from facilities operating in the region (Energean Oil and Gas, Greek Fertilizers and Chemical ELFE SA , quarries);

- Noise from the activity in the commercial port of Philippos II;
- The movement of vehicles on roads in the region, including heavy vehicles, due to industrial activity;
- Noise from the marine traffic;
- Typical urban activities in settlements of the region.

The operation of the offshore facilities is continuous and, therefore, there are not significant fluctuations in the level of noise. It must also be noted that, there is a 500m exclusion zone around the offshore facilities, thus there is not an effect of noise to the passing fishing vessels and ships. The offshore facilities do not constitute a source of noise for the surrounding area due to the limitation of 65db that is enforced at the border of the facility.

8.7 BIOTIC ENVIRONMENT

8.7.1 Plankton

According to the available desk based information, the Aegean Sea, like the rest of the eastern Mediterranean Sea, is an area of low nutrient concentration, plankton biomass and production. The water-column structure of the N. Aegean is influenced by the input of brackish waters from the Black Sea through the Dardanelles generating strong salinity stratification in the upper layers during both seasons. Furthermore, the Black Sea waters being significantly colder in spring produced in the N. Aegean a 20 m thick surface layer cooler than the subsurface waters at that season. The North Aegean, which is influenced by Black Sea waters (BSW), is relatively more productive than the highly oligotrophic southern part. The main zooplanktophagus fish in the area is the European anchovy (*Engraulis encrasicolus*). The main zooplankton groups are Holoplankton (Chaetognaths, Cladocerans, Appendicularians, Copepods, Doliolids, Euphausiids, Medusae, Ostracods, Pteropods, Siphonophores) and Meroplankton (Gastropod larvae, Lamellibranchia larvae). In the surface level (0-50 m), copepods, cladocerans and appendicularians showed highest abundance in coastal areas, whereas chaetognaths and doliolids in pelagic areas. Below the surface layer, copepods constituted the bulk of zooplankton and chaetognaths became more important than in the surface. The abundance of the main groups showed a strong decrease with depth with the exception of ostracods, which showed an increasing trend. The larval fishes that were identified in the North Aegean area are: *Sardinia aurita, Engraulis encrasicolus, Cyclothone braueri, Vinciguerria soo., Ceratoscopelus maderensis, Hygophum benoti, Lampanyctus crocodiles, Lobianchia dofleini, Myctophum punctatum, Lestidiops jayakari, Callanthias ruber, Serranus hepatus, Serranus cabrilla, Capola rubescens, Trachurus meditteraneus, Mullus spp., Chromis chromis, Coris julis, Labridae I, Labridae II, Auxis rochei, Scomber japonicas, Callionymus maculatus, Callionymus risso, Arnoglossus laterna, Arnoglossus thori, Buglossidium luteum, Maurolicus muelleri, Bentosema glaciale, Lampanyctus crocodiles*.

According to the available desk based information and with regards to the phytoplankton, picoplankton dominates and contributes more in total chlorophyll a (chla) and total primary production in the North and South Aegean Sea. Microplankton is next in abundance proportions of total chla and total primary production and ultraplankton has the lowest contribution. It is noted that no specific surveys have been carried out in the project area and so no location specific information is available.

Source: Laboratory of Zoology, Department of Biology, University of Patra, 2005, Mesozooplankton distribution in relation to hydrology of the Northeastern Aegean Sea, Eastern Mediterranean

Institute of Biology of the National Research Centre Democritos, Institute of Marine Biology of Crete, Institute of Oceanography, National Centre for Marine Research, 2001, Phytoplankton size-based dynamics in the Aegean Sea (Eastern Mediterranean)

Institute of Marine Biology of Crete, 1996, Distribution and abundance of larval fish in the northern Aegean Sea – Eastern Mediterranean – in relation to early summer oceanographic conditions

8.7.2 Benthic Communities and Habitats

In order to assess the marine ecology of the area, a field survey was undertaken in order to collect benthic samples, which were processed for lab analysis and identification. The "Study of the benthic communities in Prinos area, Kavala Bay" as well as the analytic laboratory methods and conclusions are found in Annex 05. The legislation that has been enforced for the assessment of the Environmental Status of the marine waters of Kavala gulf is the "Marine Strategy Framework Directive (MSFD)" (EC, 2013). The MSFD directive has set the criteria to achieve good environment status of marine waters. It is noted that the statistical package PRIMER was used for the statistical treatment of data, while the Ecological Quality was assessed using the index BENTIX (Simboura & Zenetos, 2002) recommended for the Eastern Mediterranean.

The report of the Marine ecology of the area in scope examines a number of environmental parameters. The parameters that have been examined in the study are:

- The ecological indicators (number of species and number of individuals) per platform and per station,
- The diversity of community characteristics (number of species and individuals and diversity per station and platform),
- The Good Environmental Status according to Marine Directive.

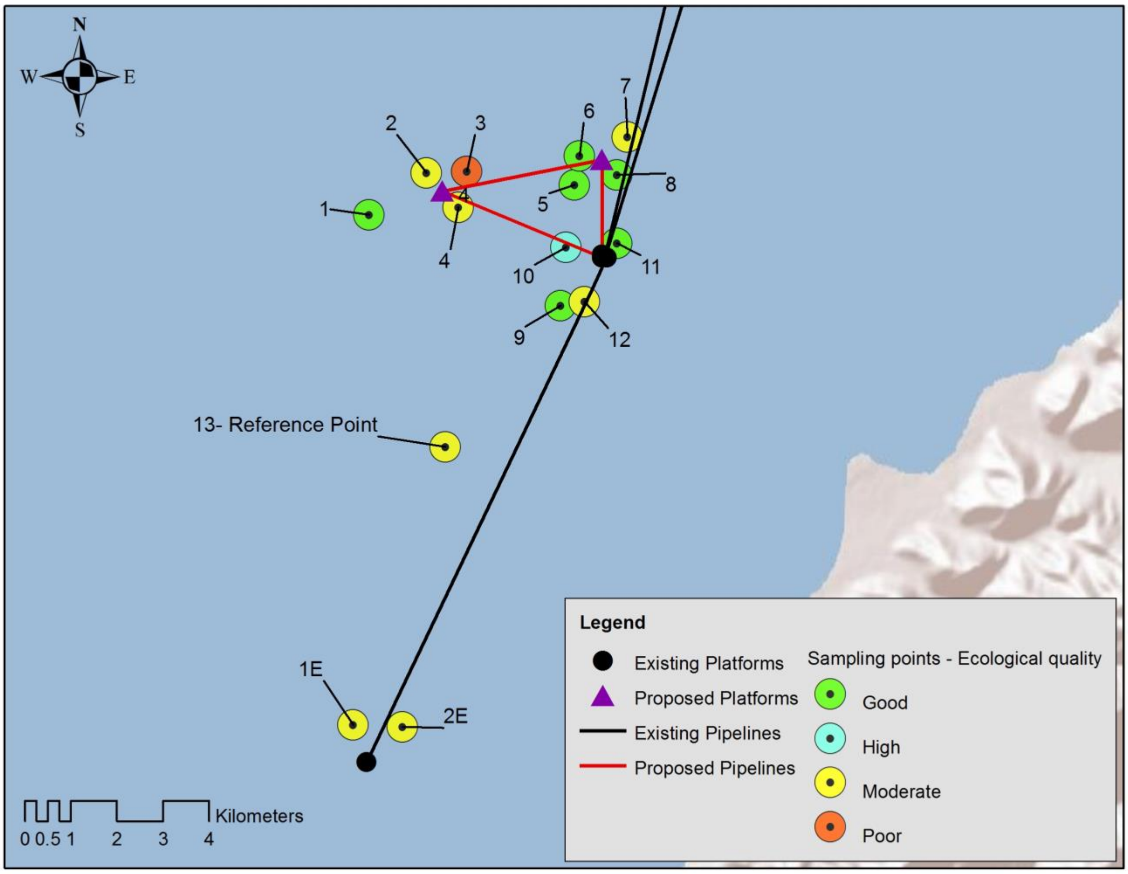
The quantitative results of the Marine ecology study are shown in the following table and while the study is given in Annex 05.

Table 8-14: Values of BENTIX and ecological quality of sampling stations

St.	PL[12]	Diversity H'	Classif. H'	Richness S	Classif. S	Bentix	Classif. MSFD	Class. WFD
1	L	3.22		31	GEnS	3.53	GEnS	GOOD

[12] *PL: Platform; L: Lamda; O: Omicron; D: Delta; R: Reference point; K: Kappa*

St.	PL[12]	Diversity H'	Classif. H'	Richness S	Classif. S	Bentix	Classif. MSFD	Class. WFD
2	L	1.42		5		2.8		MODERATE
3	L	1.78		10		2.2		POOR
4	L	3.02		27	GEnS	3.22		MODERATE
5	O	3.35		38	GEnS	4.24	GEnS	GOOD
6	O	3.16		31	GEnS	3.63	GEnS	GOOD
7	O	2.43		13		3		MODERATE
8	O	3.29		34	GEnS	3.56	GEnS	GOOD
9	D	3.03		34	GEnS	4.09	GEnS	GOOD
10	D	3.04		36	GEnS	4.87	GEnS	HIGH
11	D	2.97		31	GEnS	4.45	GEnS	GOOD
12	D	3.22		49	GEnS	3.46		MODERATE
13	R	2.24		13		2.89		MODERATE
1E	K	3.18		36	GEnS	3.1		MODERATE
2E	K	3.62		55	GEnS	3.34		MODERATE



Map 8-10: Graphical representation of the ecological quality of the sampling stations. Colour symbolism as in the Water Framework Directive

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Concerning community structure, the species found in the "Study of the benthic communities in Prinos area, Kavala Bay (Annex 05)" are either characteristic or abundant in benthic

communities of the Circalittoral Zone of the Mediterranean, as described by the classic work of Peres and Picard (Peres 1967). Thus, there were species belonging to the Coastal Terrigenous Mud (VTC), such as the polychaetes Sternaspis scutata Laonice cirrata and Goniada sp., the bivalve Abra alba and the crab Goneplax rhomboides. There were also species belonging to the Coastal Detritic (DC) community, such as the polychaetes Glycera rouxi and Terebellides stroemi the bivalves Corbula gibba and Tellina serrata, the crab Ebalia and the echinoderms Amphipholis squamata and Amphiura chiajei. The biogenic detritus originate from inorganic parts of benthic organisms and they are often covered by layers of calcareous algae. Such detritus were quite abundant in the study area. It is worth noticing that a lot of the common or abundant species found in this study have also been mentioned by previous studies in the Bay of Kavala at similar depths by Zarkanellas (1977) and Papazaharias et al (1998). The benthic communities in the study area are typical of the Mediterranean in the given depthsand similar to those described for the area in the past. Moreover, there is an increased number of species and individuals in the area of the installations, which is due to the exclusion of the area of other activities and the resulting protection of the sea bottom. With regards to the marine habitats and according to the field survey of marine ecology, the habitat in the area of proposed and new platforms can be characterized as “Mediterranean communities of muddy detritic bottoms” in accordance to the EUNIS Habitat classification. The description of this habitat is “This biocenosis develops in areas where a detritus bottom is covered with mud formed by terrigenous deposits from rivers. The sediment is a very muddy sand or sandy mud, or even a rather compacted mud, rich in shell debris or volcanic fragments (scoriae); sedimentation is slow enough to allow the development of sessile epifauna. Gravel, sand and mud are mixed in varying quantities, but mud always predominates”. This habitat type is not characterized as “priority” habitat and is not included in the Annex I of the Habitats Directive 92/43/EEC. Annex I contains the types of habitats whose conservation requires the designation of special areas of conservation and some of them are defined as "priority" habitats (in danger of disappearing).

8.7.3 Fish Species

According to the available desk based information, the Aegean Sea is separated into two sub-areas in respect of the distribution of fish fauna: (i) the northern Aegean Sea, roughly a rectangular basin, separated from the South Aegean by the archipelago of the Kyklades islands, characterized by cold water fauna, and (ii) the southern Aegean Sea characterized by more thermophilic species, as well as Lessepsian immigrants from the Red Sea. The dominant fish species in the Thracian Sea based on abundance rank for different depth groups identified by cluster analysis are shown in the following table.

Table 8-15: Dominant fish species and protection status in the Thracian Sea based on abundance rank for various depth groups identified by cluster analysis.

Fish species in depth 16-28 m average similarity: 67.8 SD: 4.9	Protection status Bern Convention	Protection status 2009/147/EC Habitat Directive
Arnoglossus laterna	Not included	Not included
Serranus hepatus	Not included	Not included
Diplodus annularis	Not included	Not included
Gobius niger	Not included	Not included
Mullus barbatus	Not included	Not included
Trisopterus minutus capelanus	Not included	Not included
Spicara flexuosa	Not included	Not included
Trigla lucerna	Not included	Not included
Merlangius merlangus euxinus	Not included	Not included
Scorpaena notata	Not included	Not included
Merluccius merluccius	Not included	Not included
Gobius paganellus	Not included	Not included
Solea vulgaris	Not included	Not included
Cepola rubescens	Not included	Not included

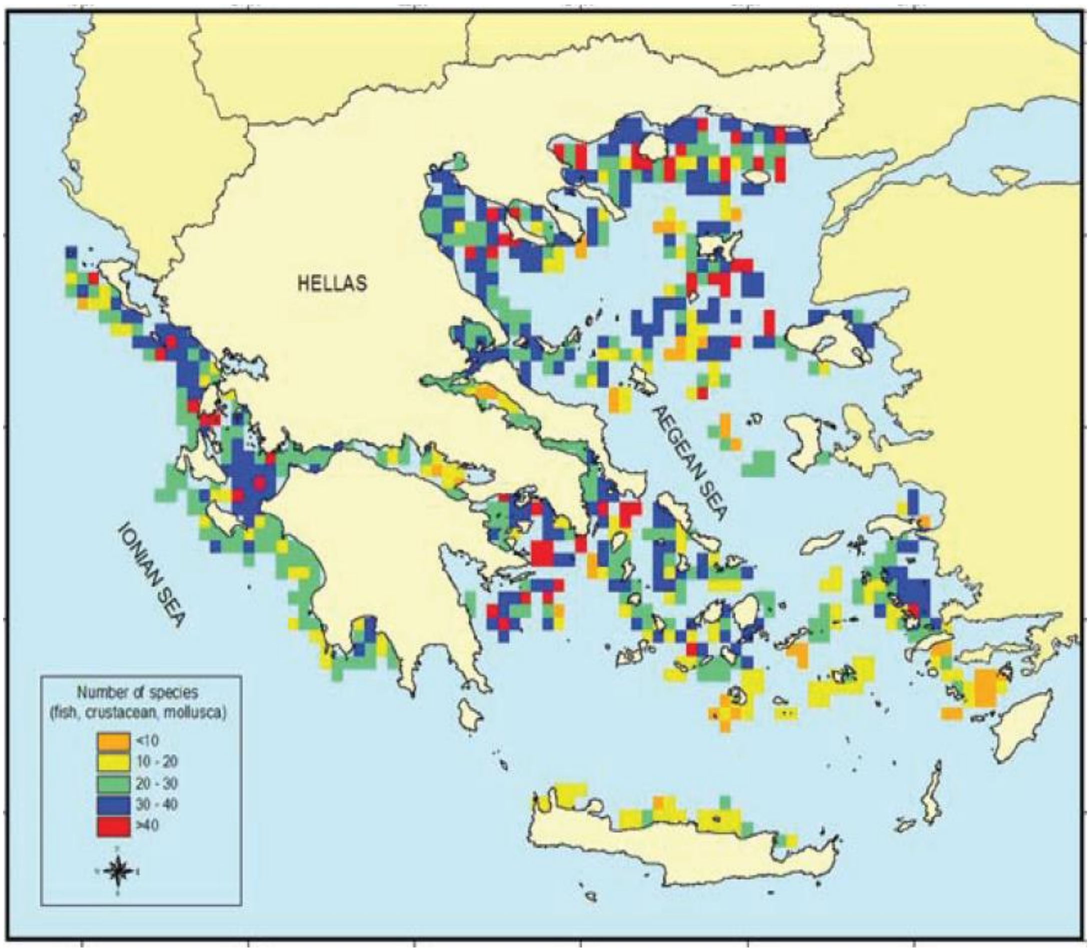
Fish species in depth30-90 m average similarity: 73.8 SD: 7.1	Protection status Bern Convention	Protection status 2009/147/EC Habitat Directive
Serranus hepatus	Not included	Not included
Trisopterus minutus capelanus	Not included	Not included
Mullus barbatus	Not included	Not included
Arnoglossus laterna	Not included	Not included
Merluccius merluccius	Not included	Not included
Spicara flexuosa	Not included	Not included
Lepidotrigla cavillone	Not included	Not included
Cepola rubescens	Not included	Not included
Deltentosteus quadrimaculatus	Not included	Not included
Callionymus maculatus	Not included	Not included
Scyliorhinus canicula	Not included	Not included
Citharus linguatula	Not included	Not included
Lophius budegassa	Not included	Not included
Serranus cabrilla	Not included	Not included
Symphurus ligulatus	Not included	Not included
Gaidropsarus sp.	Not included	Not included
Raja clavata	Not included	Not included
Arnoglossus thori	Not included	Not included

Fish species in depth 100-190 m average similarity: 73.6 SD=4.4	Protection status Bern Convention	Protection status 2009/147/EC Habitat Directive
Trisopterus minutus capelanus	Not included	Not included
Merluccius merluccius	Not included	Not included
Argentina sphyraena	Not included	Not included
Lophius budegassa	Not included	Not included
Lepidorhombus boscii	Not included	Not included
Arnoglossus laterna	Not included	Not included
Scyliorhinus canicula	Not included	Not included

Fish species in depth 100-190 m average similarity: 73.6 SD=4.4	**Protection status Bern Convention**	**Protection status 2009/147/EC Habitat Directive**
Lepidotrigla cavillone	Not included	Not included
Callionymus maculatus	Not included	Not included
Cepola rubescens	Not included	Not included
Serranus hepatus	Not included	Not included
Capros aper	Not included	Not included
Phycis blennoides	Not included	Not included
Aspitrigla cuculus	Not included	Not included
Trigla lyra	Not included	Not included
Mullus barbatus	Not included	Not included

Fish species in depth 200-500 m average similarity: 72.3 SD: 7.8	**Protection status Bern Convention**	**Protection status 2009/147/EC Habitat Directive**
Hymenocephalus italicus	Not included	Not included
Gadiculus argenteus argenteus	Not included	Not included
Lepidorhombus boscii	Not included	Not included
Micromesistius poutassou	Not included	Not included
Coelorhynchus coelorhynchus	Not included	Not included
Phycis blennoides	Not included	Not included
Lophius budegassa	Not included	Not included
Argentina sphyraena	Not included	Not included
Merluccius merluccius	Not included	Not included
Galeus melastomus	Not included	Not included
Trigla lyra	Not included	Not included
Capros aper	Not included	Not included

According to the information presented in the above table, protected fish species are not expected in the wider project area. The distribution of selected species of interest to commercial and recreational fisheries (crustacean, shell fish, squid and octopuses, sharks, rays and bony fish) based on various survey data is shown in the following map.



Map 8-11: Distribution of selected species of interest to fisheries (crustacean, shell fish, squid and octopuses, sharks, rays and bony fish) based on various survey data. The number of species refers to the estimated mean per sampling operation.

As already mentioned, a survey of “Trace Metal determination and pollution assessment” and a survey of “Polycyclic Aromatic Hydrocarbons” have been carried out by the National Technical University of Athens (see Annex 06).

In total 4 bottom fish samples were obtained, weighting approximately 400 grams each. Two of the fishes were acquired in the waters of Delta platform, while the other two were fished in the area of Lamda platform. An approximate total of 19 bivalve molluscs were obtained, solely found in Delta platform. The encountered species regarded mussels, attached in the metallic “legs” of the platform. Direct retrieval of the mussels from the metallic structures can theoretically result in elevated traces of Fe and other metals within the bivalve tissues, however, the existing intermediate layer of marine growth (biofouling) between the metal and the mussels can also act as an isolating barrier.

The metal concentration in fishes and mussel samples is given in the following table.

Table 8-16: Metal concentration in sediments, fish and mussels sampled in Kavala Gulf

Organisms	µg/g									
Sample name	**Fe**	**As**	**Pb**	**Cr**	**Cu**	**Mn**	**Ni**	**Co**	**Zn**	**Cd**	**Mo**
Mussels MNTUA	69.1	5.8	1.7	<0.5	2.3	4.7	1.4	1.1	52.7	0.5	<0.5
Mussels MUOA	81.1	7.1	2.1	<0.5	3.3	3.8	1.7	1.1	74.7	0.6	<0.5
Fish F3+F4	26.5	<0.5	1.2	<0.5	1.4	2.1	0.9	0.7	32.8	0.2	<0.5
Fish F2	35.0	0.3	1.6	<0.5	2.3	1.7	0.9	0.7	26.8	0.1	<0.5

The correlation (Pearson correlation coefficient) of most elements is strong, verifying the common origin of the trace elements but it must be underlined that the results should be considered with caution due to the limited number of samples.

The results of PAHs analysis are shown in the following table.

Table 8-17: PAHs in fishes and mussels (mg/L)

		NAPH	ANTH	FLUO	B[b]F	B[k]F	B[a]P	B[ghi]P	IP
1	FISH1/EPA 368	18.32	0.69	<LOQ	N.D	N.D	N.D	N.D	N.D
2	FISH2/EPA 369	27.45	1.03	0.98	N.D	N.D	N.D	2.04	N.D
3	FISHES 3+4/EPA 370	17.66	0.65	1.13	N.D	<LOQ	N.D	0.93	N.D
4	MUSSELS/EPA 371	4.17	<LOQ	<LOQ	N.D	N.D	N.D	0.35	N.D

ND: not detected, LOQ: level of quantification

The PAHs values on fishes presented in the above table are lower from the upper limits both for human consumption and for Good Environmental Status.

8.7.4 Marine Mammals

8.7.4.1 International, EU and National Protection Regime of Marine Mammals

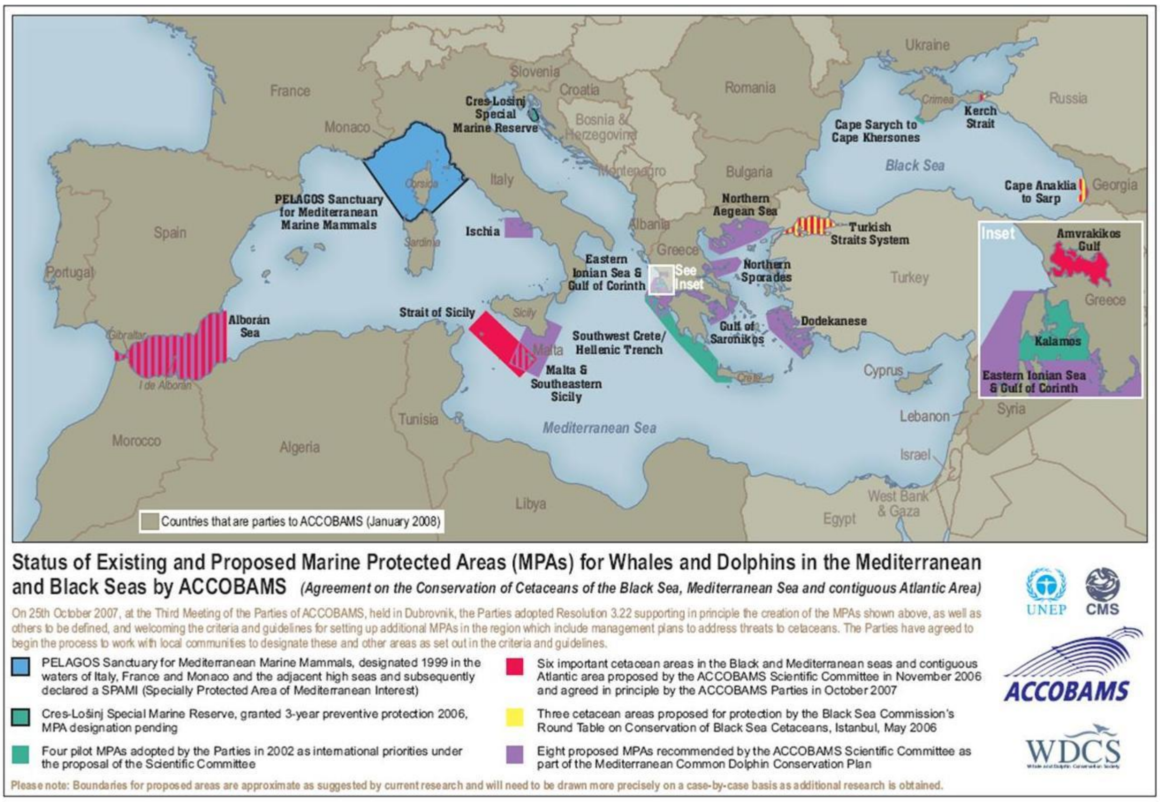
Marine mammals are protected by a series of international, EU and national legislative acts. The legislative acts concerning directly the protection of marine mammals are:

International legislation

- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, Washington Convention), (1973)
- The Convention for Protection of the Mediterranean Sea against Pollution (Barcelona Convention) (1976)
- The Convention on the Conservation of Migratory Species of Wild Animal ls (CMS or Bonn Convention) (1979)

- The Bern Convention on the Conservation of European Wildlife and Natural Habitats (Berne Convention or Bern Convention) (1979)
- The Rio Convention on Biodiversity (1992).
- Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) (1996)

ACCOBAMS has proposed to declare the entire Thracian Sea, Greece, which includes the Project area, as a Marine Protected Area MPA already back in 2007, aiming at the protection of various cetacean populations, but more importantly for the protection of the short-beaked common dolphin population (see map below). Furthermore, the presence of the recently identified sub-species of the harbour porpoise (Phocaea phocoena relicta) in the Thracian Sea is unique for the Mediterranean Sea with additional populations in the Sea of Marmara, and in the Black Sea.



Map 8-12: Status of existing and proposed Marine Protected Areas (MPAs) for Whales and Dolphins in the Mediterranean and Black Seas by ACCOBAMS.
ACCOBAMS (2007): already existing and proposed future Marine Protection Areas for cetaceans in the Mediterranean and the Black Seas. The 8 proposed future MPAs, aiming at the protection of the short-beaked common dolphin are highlighted in purple colour. One of those 8 future MPA's is the Thracian Sea, with its south-most boundary being the island of Limnos, Aegean Sea, and including the marine area adjacent to the peninsula of Chalkidiki, Region of Central Macedonia.

It is noted that up today there is no time schedule from the Greek State for establishment of the abovementioned MAP. Certain obligations, such as specific management measures, monitoring, zoning, research activities etc. will arise from the future establishment of the MPA. The potential future implications, to the Project and to future activities, by this fact will be faced by:

- Defining the mitigation measures for cetaceans – in this ESIA - according to ACCOBAMS Guidelines.
- Taking into account ACCOBAMS Guidelines in the design of all future activities.
- The participation of Energean, as a stakeholder, in the consultation for the MPA establishment - when put in place sometime in the future.

EU Legislation

The main legal tools of the EU with respect to the protection of marine mammals are the following:

- Council Directive 92/43/EEC of 21 May 1992 “On the conservation of natural habitats and of wild fauna and flora”, or "Habitats Directive", and its Annexes (Official Journal L 206, 22.07.1992).
- Marine Strategy Framework Directive 2008/56/EC (MSFD) of the European Parliament and of the Council, adopted on 17-06-2008
- Directive 2014/89/EE of the European Parliament and the Council of 23 July 2014 “establishing a framework for maritime spatial planning

Additional to the above-mentioned legislation, there are also a number of other EU legislation acts indirectly involving the conservation of cetaceans, primarily through the conservation of their habitats and the populations of their prey species. Two examples are mentioned here:

- Council Regulation (EC) No 1967/2006 of 21 December 2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea amending Regulation (EEC) No 2847/93 and repealing Regulation (EC) No 1626/94 (Mediterranean Fisheries Regulation), aiming at sustainable practices in fisheries, the conservation of the fragile marine environment and the restoration of the fishery resources. The Regulation also sets a series of legislative and policy measures to help eliminate overfishing and illegal fishing.
- Directive 2013/30/EU of the European Parliament and of the Council of 12.06.2013 on safety of offshore oil and gas operations and amending Directive 2004/35/EC which makes a reference to the safety levels and to the required safety measures for offshore oil and gas operations facilities and works.

National legislation

The national legislation, in addition to international conventions and EU regulations and Directives ratified by Greece, also provides the following legal tools that clearly and directly protect the marine mammals in general:

- Presidential Decree (P.D.) 67/1981 "For the Protection of the Wildlife and Native Flora": It lists the species threatened with extinction for the first time.
- Framework Law 1650/1986 constitutes the main legal tool and, since its issue, it has been supplemented with additional Joint Ministerial Decisions and Presidential Decrees. It lays down the fundamental rules and establishes and provides the necessary legal mechanisms required for the conservation of the environment (the establishment of

protection zones, for instance, etc.).

- Biodiversity Law 3937/2011: in accordance with the provisions of the specific Law, the state is obliged to develop and implement action plans for all marine mammals that are part of international conventions and in the EU legislation.
- Joint Ministerial Decision 69269/5387/1990 sets the criteria for the classification of various works and activities into categories and defining the contents of Environmental Impact Assessments (EIA).

8.7.4.2 Protection Regime for the Mediterranean monk seal

The Mediterranean monk seal is a species protected under the Greek legislation by Presidential Decree 67/1981, as well as by the Habitats Directive 92/43/EEC, Annex II (priority species), and Annex IV. In addition, Regulation 1626/94/EU has listed the Mediterranean monk seal under Annex I. The Mediterranean monk seal is also included in the following international Conventions: the Washington Convention; the Barcelona Convention; the Bonn Convention, Annexes I and II; the Bern Convention, Annex II; Protocol on Special Protected Areas and Biodiversity.

Finally, the Mediterranean monk seal was classified as a critically endangered species in the relevant IUCN lists between 1966 and 2015. In 2015 the monk seal was re-classified as endangered (criterion - C2a(i)). According to IUCN (www.iucnredlist.org) it is now thought that the previous assessment (critically endangered A2abc) was an overestimate of the scale of decline in the global population over the previous 33 years. However, in Greece, the Mediterranean monk seal is still considered as critically endangered in the “Red Data Book of the threatened vertebrates of Greece” (Hellenic Zoological Society 2009) and is protected by law, according to the Presidential Decree 67/1981.

8.7.4.3 Protection Regime for Cetaceans

Cetaceans also benefit from a series of international, EU and national legislation acts currently in power. The Red Data Book of Endangered Animals of Greece (Legakis & Marangou 2009) lists a total of 8 cetacean species regularly recorded in the Greek seas, out of which 5 have been classified in one of the three IUCN categories under threat (Critically Endangered, Endangered, Vulnerable). The remaining 3 species, the populations of which are not known at a satisfactory level, are listed in the category “Data Deficient”. None of the cetacean species of Greece has been filed under the categories “Near Threatened”, “Least Concern” or “Not Evaluated”, neither any of them has been filed under the categories “Extinct”, “Regionally Extinct”, and “Extinct in the Wild.

Cetacean species with no regular presence in Greek waters, as is the case with the false killer whale and the humpback whale, which are visitor species in the entire Mediterranean Basin, are not included in the Red Data Book of Endangered Animals of Greece (Frantzis 2009).

At the international level, the situation is sometimes different with respect to the classification of

the 8 cetacean species with regular presence in Greek waters. Certain populations might count satisfactory numbers of individuals on a global scale, as is the case of some species of dolphins. Therefore, they are classified under the "Least Concern" category at the global level. However, their Mediterranean populations are isolated from those in the Atlantic and they constitute genetically different and evolutionary important sub-populations that are highly vulnerable with respect to epidemics or to human-induced pressure, etc.

8.7.4.4 Noise and Marine Mammals

Noise and Marine Mammals

Many marine organisms, including most marine mammals (whales, dolphins, porpoises and pinnipeds) use sound for a variety of purposes, for example in communication, to locate mates, to search for prey, to avoid predators and hazards, and for short / long-range navigation. Depending on the intensity (sound pressure level) at the source, the pitch (frequency) and the distance between source and receiver, sound can potentially affect marine organisms in various ways. The auditory bandwidth of cetaceans can be roughly divided into three functional groups, low, medium and high as outlined in the table below.

Table 8-18: Functional hearing groups for cetaneans

Functional Hearing Group	Estimated Auditory Bandwidth
Low-frequency cetaceans	7 Hz to 22kHz
Mid-frequency cetaceans	150Hz to 160Hz
High-frequency cetaceans	200Hz to 180kHz
Pinniped in water	75Hz to 75kHz
Pinniped in air	75 Hz to 30kHz
Low-frequency cetaceans	7 Hz to 22kHz

Categories after Southall et al 2007

8.7.4.5 Marine Mammals in the study and wider project area

Seismic survey

The section below provides an overview of the key species identified during a 1 month seismic survey in the project area in 2015. Two ships, *MV Polar Marquis* and *MV Artemis Arctic*, with 3 chase boats for support (*MV Moonrise*, *MV EDT Niovi* and *MV Aegean*) were in charge of the seismic surveys. The project covered an area of approximately 385 km^2 located in the marine area west of the island of Thassos, Bay of Kavala, in water depths ranging from 17 to 116 metres with an average depth of 42 metres along 82 sailing lines (orientation: northeast - southwest). In total, there were 246 hours and 32 minutes of total airgun operation.

During the survey, dedicated Marine Mammal Observers (MMO) and a Passive Acoustic Monitoring Operator (PAM) were employed by Geo-Marine Consultants in order to mitigate the

impacts of acoustic disturbance to marine mammal species (4 cetacean species and the Mediterranean monk seal, *Monachus monachus*) living in these waters. Two MMOs on board the *RV Polar Marquis* and another two on *MV Artemis Arctic* conducted the visual observations. Additionally, hydrophones were used to acoustically detect cetaceans. Both survey methods MMOs and PAM covered 24 hr. On 23.06.2015, the *MV Artemis Arctic* completed its part of the survey and left the area and the two MMOs were transferred to the chase boat *MV Moonrise*, from where they continued the marine mammal observation, supporting the *Polar Marquis* MMO team. Weather conditions, sea state and visibility were generally favourable for the entire period of the survey, allowing observation during almost the entire period of the seismic survey.

A total of 21 sightings of cetaceans were registered in a total of 10 days out of the 24 days of the seismic survey (41,7% of the total number of days). Four species of cetaceans were identified: the common bottlenose dolphin *Tursiops truncatus* (10 sightings) the short beaked common dolphin *Delphinus delphis* (1 sighting) the striped dolphin *Stenella coeruloalba* (3 sightings) and the sperm whale, *Physeter macrocephalus* (1 sighting). The rest of sightings concerned unidentified delphinid species (4 sightings) and unidentified cetacean species (2 sightings).

As mentioned above, almost half of the sightings with identified species (10 sightings or 66,7% of the 15 sightings) concerned the common bottlenose dolphin. The species appeared always in groups of 3 to 7-9 animals together. The 4 sightings of the striped dolphin (26,7%) concerned 3-4 or possibly 5-6 animals together. The sighting of the short beaked common dolphin concerned 4 animals together. These three delphinids are known to permanently exist in the Thracian Sea. Generally, the short beaked common dolphin is found in the coastal waters of Northern Aegean and striped dolphin has as main habitat the pelagic waters after the continental shelf, though it can be found and in shallower waters. The single sighting of sperm whales concerned 2-3 animals together at a distance of 8,000 metres from the ongoing operation. It is unknown if the sperm whale permanently exists in this area; however, the deep basin between the N. Sporades islands and the peninsula of Chalkidiki is known to be frequented by sperm whales. As mentioned above, this species prefers deep waters.

The table below provides a summary of information on the marine mammals likely to be found within the Kavala Gulf and Aegean Sea generally according to the seismic survey and the literature review.

Table 8-19: Cetaneans species likely to be found within the Kavala Gulf

Species	Mediterranean Sub-population (MS) or Sub-species (SSP)	Red Book of Endangered Species of Greece (2009)	IUCN Threat status		Recorded During Seismic Survey	Geographic Distribution	Functional Hearing Group (after Southall et al 2007)	Habitat			Main threats
			Mediterranean	International				Type	Depth	Distance from coasts	
Fin whale	MS	Data Deficient	Data Deficient	Endangered		Present in N Ionian Sea and especially from NW of Lefkada Island north up to N Corfu; at least occasionally in Saronikos	Low-frequency cetacean	Pelagic, occasionally coastal	81 m (coastal) 670 m (50-1337 m)	2.9 km (coastal) 14.7 km (0.1-22.8 km)	Ship strikes in the western Mediterranean
Sperm whale	MS	Endangered	Endangered	Vulnerable	Y	Mainly along the Hellenic Trench from Kefallonia to E Rodos, also in deep basins/trenches of the Aegean Sea (Myrtoon, Cretan, N Ikarion, NW Aegean Sea)	Mid-frequency cetacean	Slope, secondarily pelagic	1235 m (510-2933 m)	8.1 km (1.6-25.2 km)	Ship strikes Noise Plastic debris
Cuvier's beaked whale	MS	Data Deficient	Data Deficient	Vulnerable		Present and locally (S Crete, W Lefkada) common all along the Hellenic Trench; present or common over steep depressions of the Aegean (e.g. N. Sporades)	Mid-frequency cetacean	Slope, probably pelagic as well	1066 m (491-2279 m)	8.6 km (2.1-26.5 km)	Sonar Noise Plastic debris
Risso's dolphin	MS	Vulnerable	Data Deficient	Least Concern		Common in Myrtoon Sea south to NW Crete, present or common in N. Sporades and Chalkidiki, present or rare or seasonal in all other Aegean and Ionian Seas	Mid-frequency cetacean	Slope, probably over its shallower part	737 m (165-1717 m)	8.2 km (0.3-28.3 km)	Bycatch in long-lines Plastic debris
Common bottlenose dolphin	MS	Vulnerable	Vulnerable	Vulnerable	Y	Present in all coastal areas, straits, gulfs, and also between islands in the Ionian, Aegean and Cretan Seas with no exceptions.	Mid-frequency cetacean	Typically coastal, also over shallow waters "offshore"	121 m (1-1504 m)	3.0 km (0.0-26.0 km)	Prey depletion Direct killing Bycatch in artisanal fishery Noise
Striped dolphin	MS	Vulnerable	Vulnerable	Least Concern	Y	Common in all areas over depths >500 m (present in >200 m) including Gulf of Corinth. Absent/vagrant in depths	Mid-frequency cetacean	Typically pelagic and slope	1024 m (75-2920 m)	8.7 km (0.6-37.1 km)	Chem. pollution Direct killing Bycatch in driftnets

Species	Mediterranean Sub-population (MS) or Sub-species (SSP)	Red Book of Endangered Species of Greece (2009)	IUCN Threat status		Recorded During Seismic Survey	Geographic Distribution	Functional Hearing Group (after Southall et al 2007)	Habitat			Main threats
			Mediterranean	International				Type	Depth	Distance from coasts	
Short-beaked common dolphin	MS	Endangered	Endangered	Least Concern	Y	Thracian Sea, Thermaikos Gulf, Northern Sporades, Pagasitikos Gulf, NE Aegean Sea, Cyclades; S Evvoikos Gulf, Dodecanese; Gulf of Corinth, Inner Ionian Sea, recorded in N Evvoikos Gulf	Mid-frequency cetacean	Coastal and shallow	86 m (11-274 m) Gulf of Corinth: 713 m (275-935)	4.3 km (0.2-20.8 km) Gulf of Corinth: 5.9 km (1.2-10.4)	Prey depletion Direct killing Bycatch in artisanal fishery
Harbour porpoise, Black Sea Sub-species	SSP	Endangered	Endangered	Least Concern		Thracian Sea, possibly present in Thermaikos Gulf and Chalkidiki peninsula. Only vagrant further to the south.	High-frequency cetacean	Probably coastal and shallow	-	-	Climate change Bycatch in artisanal fishery Prey depletion
Mediterranean Monk Seal	MS	Critically Endangered	Endangered	Endangered		Widely distributed throughout the entire coastline of the country and show a strong preference for isolated and inaccessible islands, islets or parts of the coastline on the mainland. The largest and most closely monitored populations are those at the Northern Sporades Islands and at the Kimolos – Polyaigos island complex.	Pinniped	Coastal and shallow	-	-	Deliberate killing, Drowning from accidental entanglement in fishing gear, Overfishing, Habitat degradation and destruction

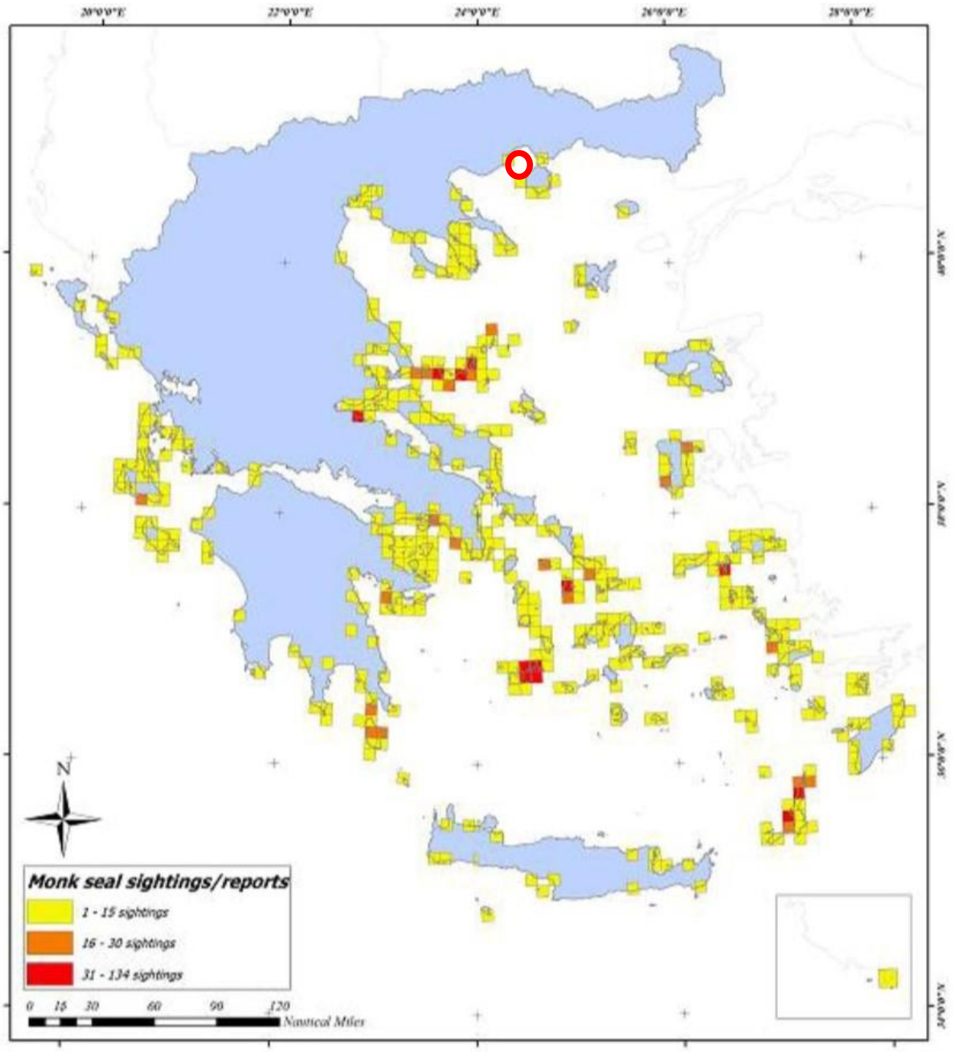
Source: Frantzis A. 2009. Cetaceans in Greece: Present status of knowledge. Initiative for the Conservation of Cetaceans in Greece, Athens, Greece, 94 pp and MOm/ The Hellenic Society for the Study and Protection of the Monk seal - Greek non–governmental environmental organization with the legal status of a Non–profit association

Mediterranean monk seal

Only few data exist about the monk seals in the study area. Since 1976, when biologist Th. Schultze-Westrum first started actions for the preservation of the Mediterranean monk seal in the area of the N. Sporades, most of the effort was placed to the establishment and the operation of the Alonnissos - Northern Sporades National Marine Park as also in the areas of Milos, Kimolos, Polyaigos islands, Cyclades, of Carpathos and Saria islands, Dodekanese, and in the Ionian islands of Kefalonia, Ithaca, Lefkada and Zakynthos. Similar systematic effort is also being invested recently in the island of Yiaros, Cyclades (Dendrinos *et al*. 2008). Below, all data in the last decade available from the area of study are presented, starting from the most recent data:

2009 – 2010 (Kapiris *et al*. 2010). According to the data on stranding's of dead or injured marine mammals in Greece collected by the local port police authorities and forwarded to and processed by the Hellenic Centre for Marine Research, for the period of January to May 2009, only one case of a monk seal -found on Thassos- was registered, whereas no case was registered for the same period in 2010. The Thassos case constitutes 14,3% of a total of 7 reports of monk seals found at various locations in the country for the year 2009, whereas for 2010 a total of 11 cases were reported. The majority of cases concerning monk seals were reported from the Cyclades: 43% of the total number at national level for the year 2009 and 55% for 2010.

1996 – 2009 The following map displays the areas from which monk seal sightings were reported during the period 1996 – 2009 to the so-called "Rescue and Information Network" (RINT) run by the NGO Mom/Hellenic Society for the Study and Protection of the Monk Seal. The yellow colour represents the areas from which 1–15 sightings were reported; the brown colour represents the areas from which 16– 30 sightings were reported and the red colour represents the areas from which 31–134 sightings were reported (Kotomatas 2009). Areas marked with yellow colour (1 – 15 sightings) exist practically throughout the NW Aegean Sea, including Thassos, Limnos, Agios Efstratios and Samothraki islands.

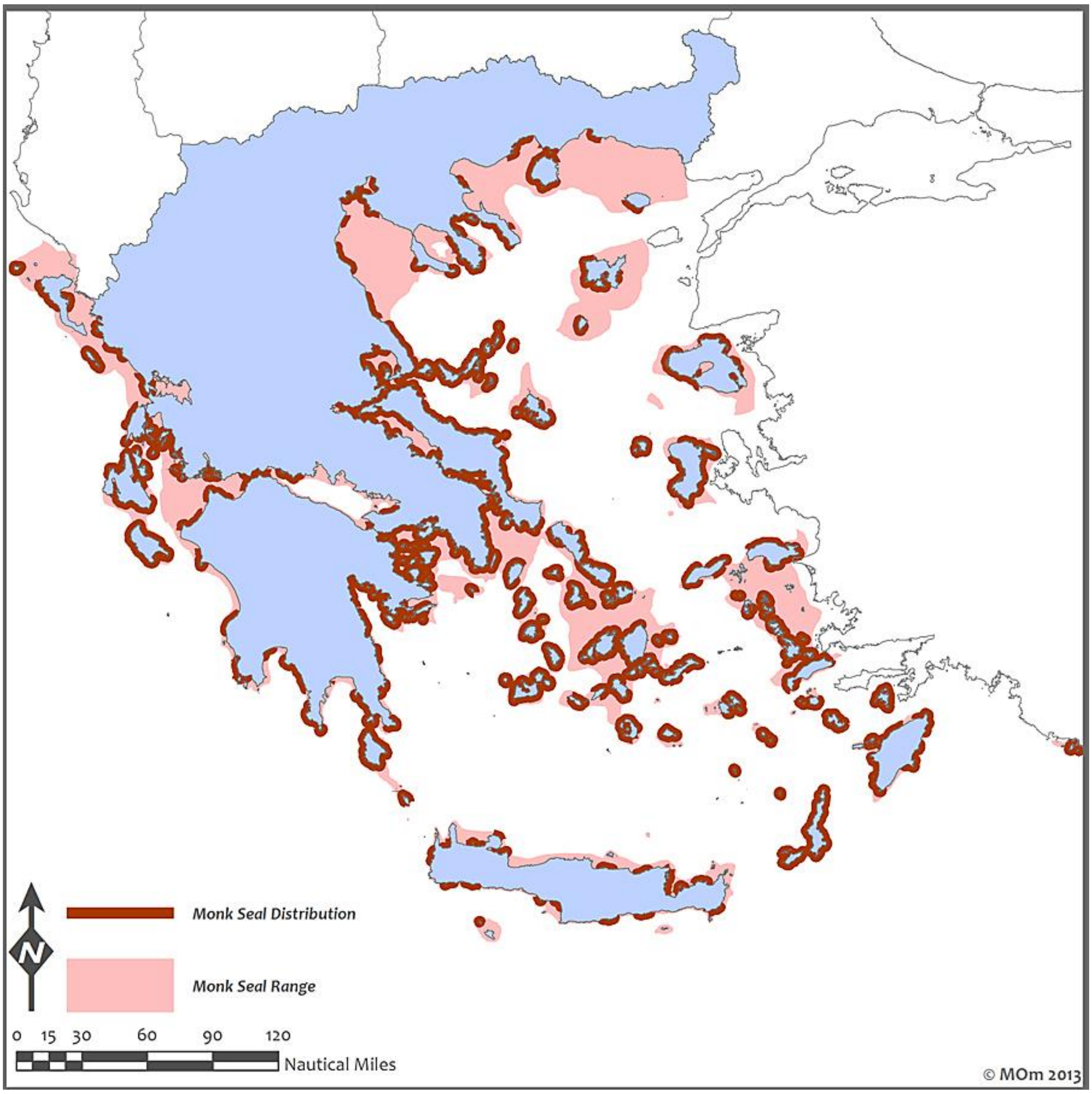


Map 8-13: Appearance of monk seal in Greece during the period 1996 – 2009 - red circle: project area (source: Kotomatas, 2009)

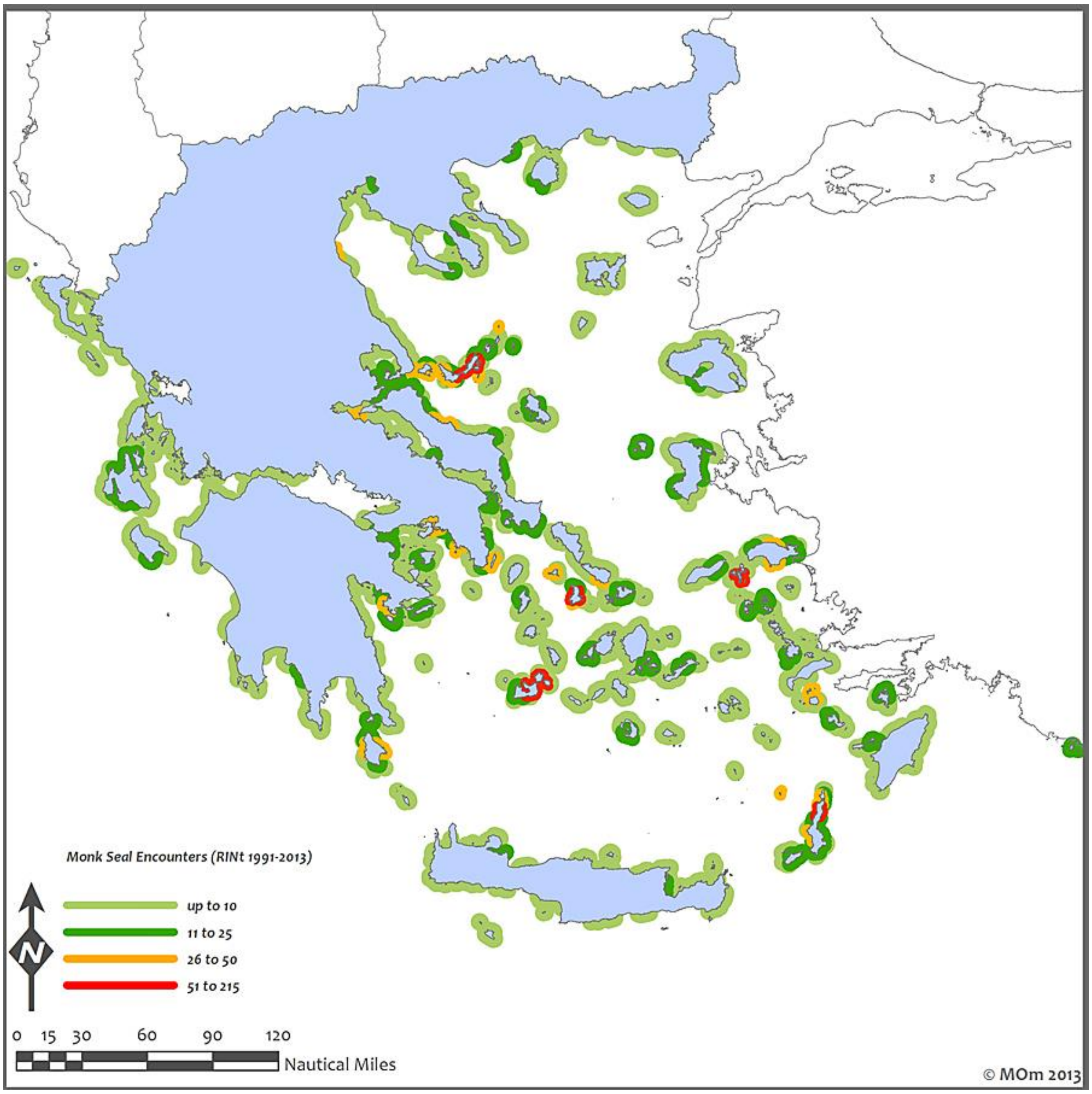
Conservation of the Mediterranean monk seal in Greece: achievements, drawbacks and potential of an MPA network. Proceedings of the 1st International Conference Marine Mammal Protected Areas. Maui, Hawai'i, USA, 30 March - 3 April 2009. Mom / Hellenic Society for the Study and Protection of the Mediterranean Monk Seal Athens.

The breeding period of monk seal is, mainly, between August – December. Although, the species in the past used open beaches, the last decades, due to tourism growth and intense expansion of residential uses in the coastline, the monk seals are using underwater caves. These habitats are very far from the study area, thus the sensitivity of the species in respect to nuisance from Project activities are negligible.

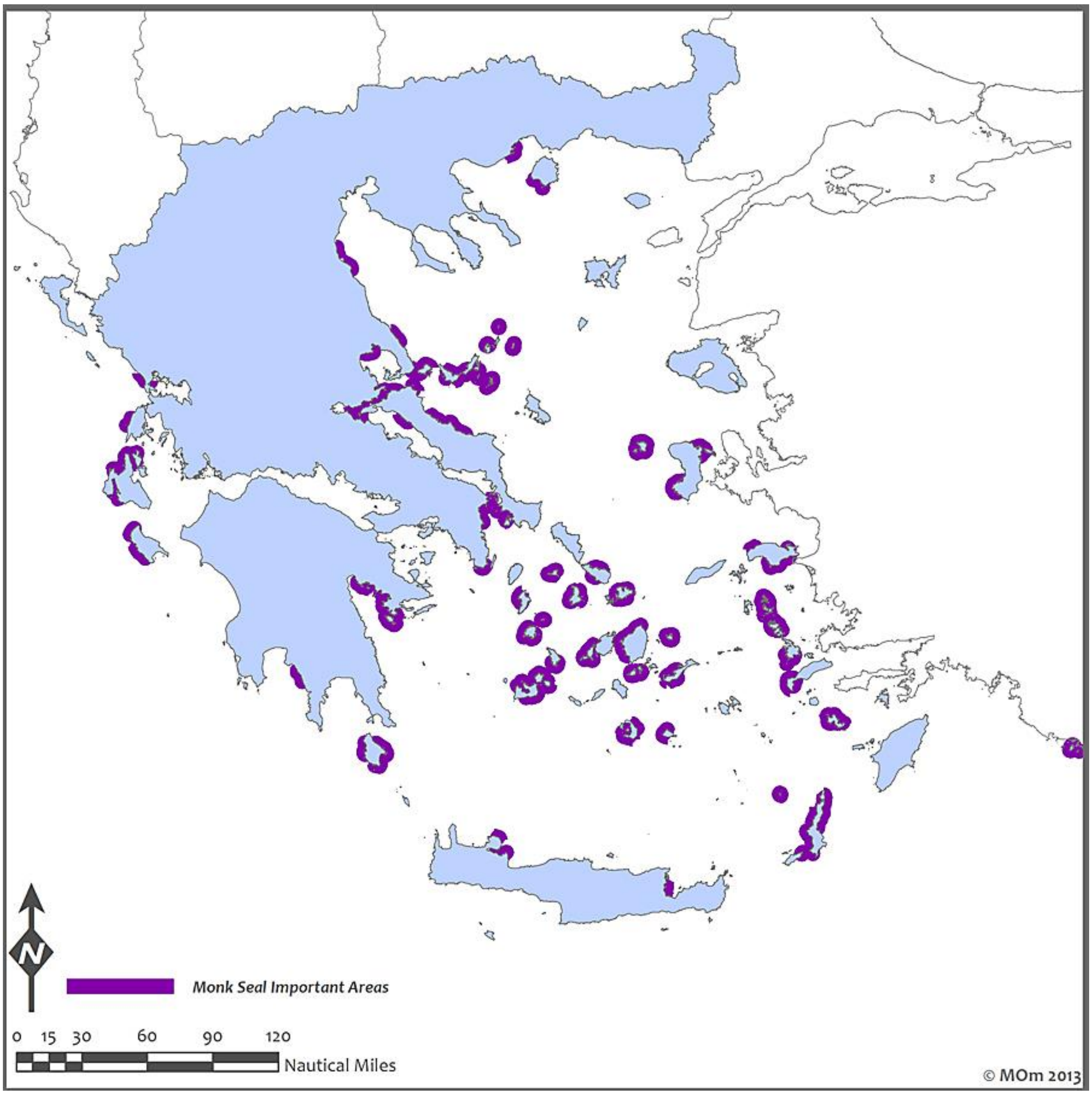
The monk seal distribution, encounters and important areas in the wider project area are shown in the following maps. Not official information on the location of caves is available.



Map 8-14: Monk seal distribution in Greece (MOm 2013)



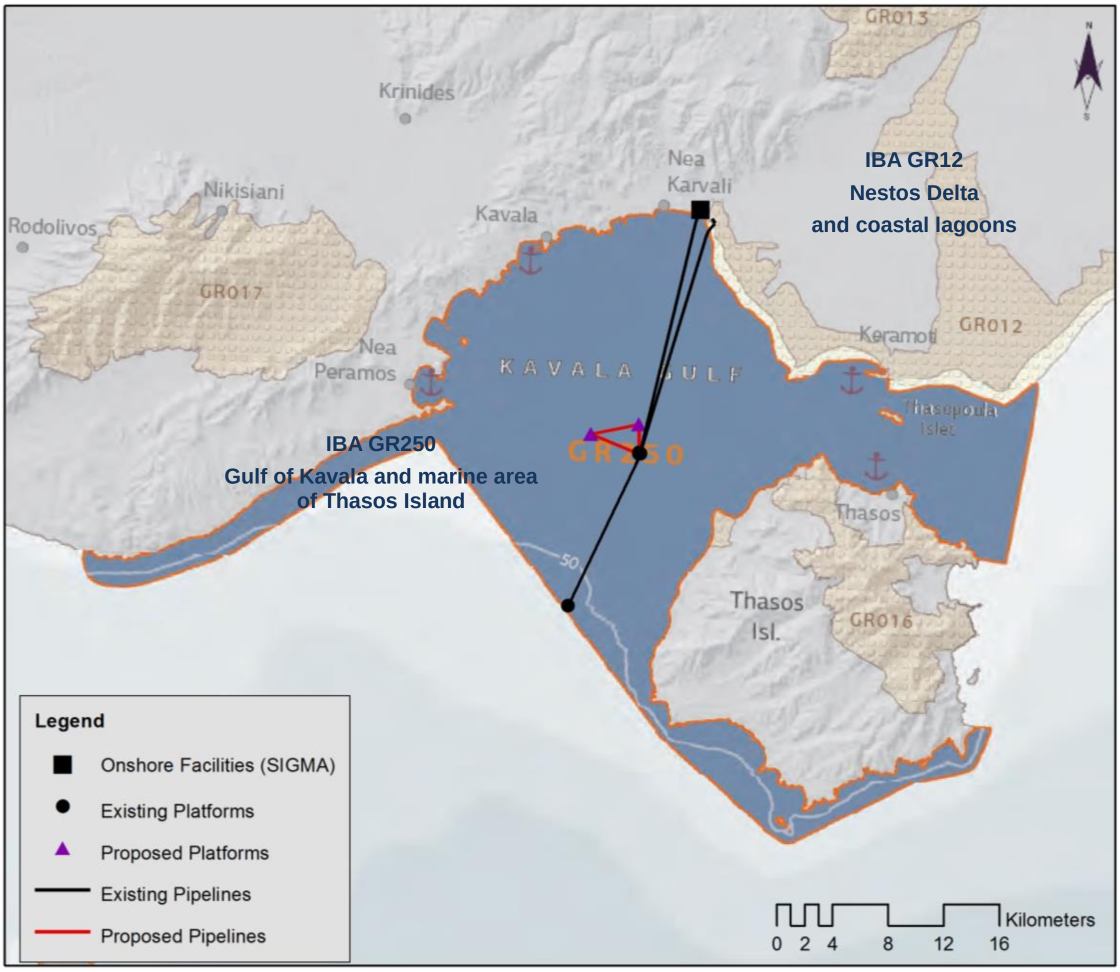
Map 8-15: Monk seal encounters in Greece (MOM 2013)



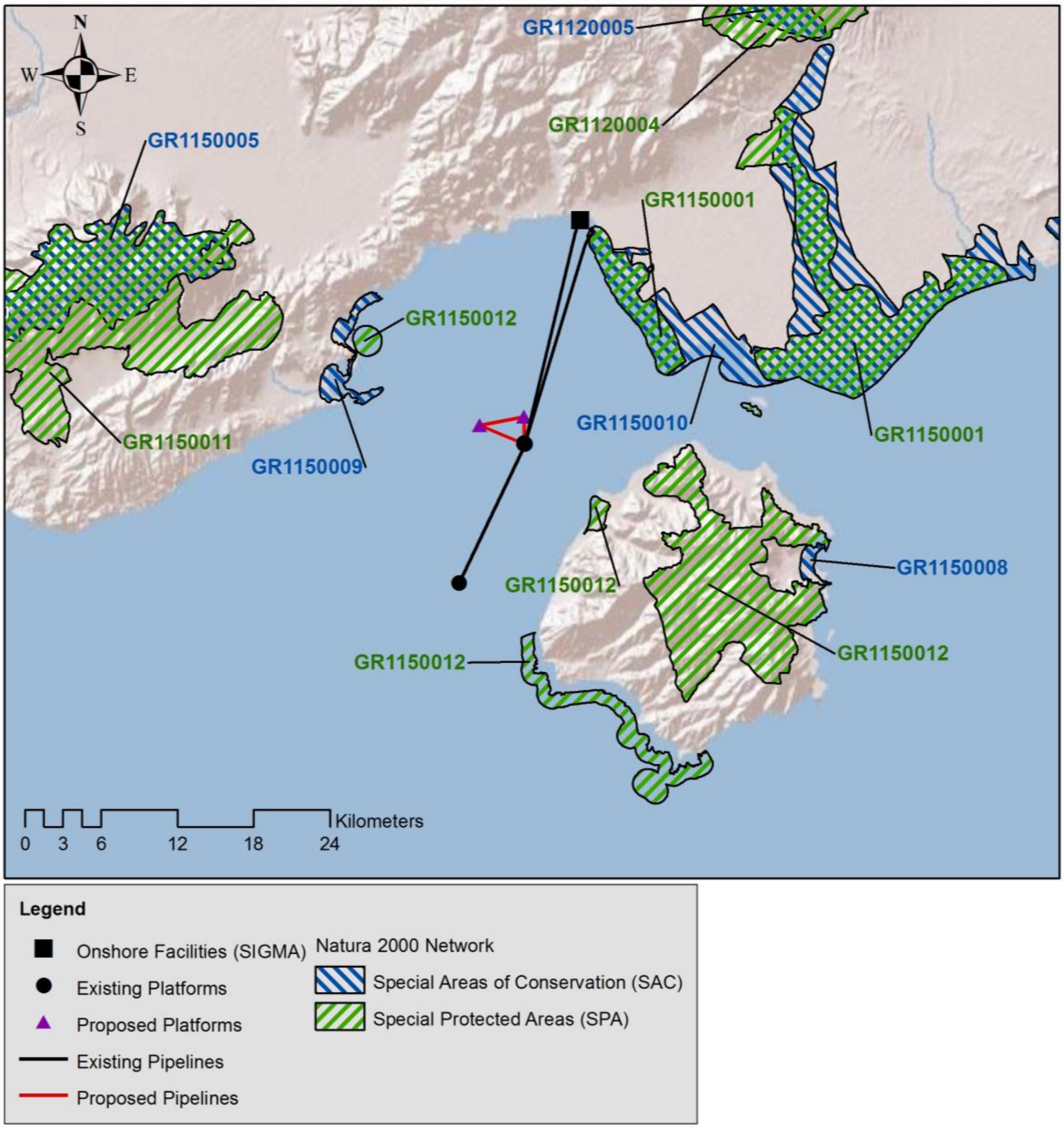
Map 8-16: Monk seal important areas

8.7.5 Avifauna

The international importance of the area is further supported by its inclusion in the network of Important Bird Areas (IBAs) identified by the BirdLife International i.e. the study area is part of the IBAs GR12 "Nestos Delta and coastal lagoons" and GR 250 "Gulf of Kavala and marine area of Thasos Island". Based on the decision of the European Court of Justice the IBAs constitute baseline reference information of the determination of SPAs therefore the marine areas covered by the IBA GR250 (part of it or as a whole), currently not included in the Natura 2000 network, could be included in the future in the Natura 2000 network. The marine part of the Study Area overlaps with the Marine IBA GR250 and IBA GR12 as shown in the following figure.



Map 8-17: Important Bird Areas (IBAs) in the Project area (adopted from BirdLife International, Important Bird and Biodiversity Areas (IBAs) http://www.birdlife.org/datazone/site)



Map 8-18: NATURA 2000 Areas within the broader Project area (existing and proposed platforms - red circle)

According to the report "Important Areas for Seabirds in Greece, LIFE07 NAT/GR/000285 – Hellenic Ornithological Society (HOS / BirdLife Greece, 2012), the qualifying species for the IBA250 GR250 "Gulf of Kavala and marine area of Thasos Island" include *Phalacrocorax aristotelis* and *Puffinus yelkouan*. This Marine IBA includes the entire Gulf of Kavala, the Straits of Thassos, coastal waters along southern Thasos Island and along the mainland up till Drakopetra in the west. This IBA has been designated for its importance for the Mediterranean Shag (*Phalacrocorax aristotelis desmarestii*) and for the Yelkouan Shearwater (*Puffinus yelkouan*). More specifically, the area includes the foraging and maintenance marine areas of the largest breeding population of the Mediterranean Shag in Greece which breeds in the Natura SPAs GR1150001 "Delta Nestou kai limno thalasses Keramotis kai nisos Thasopolula" and

Natura GR1150012 "Thasos (Oros Ypsario kai parakatia zoni)" and consists 10% of the national breeding population of the species. After the end of the breeding season, Mediterranean Shags from other areas migrate to the area, due to abundant food sources present in the area, resulting in the 17% of the national wintering population of the species spending its post-breeding period in the area. Due to shallow waters (<50m) of the Gulf of Kavala, the Mediterranean Shags use the entire area of the Gulf for foraging. Additionally, the area also host large foraging concentrations (up to 2000 individuals) of the Yelkouan Shearwater (*Puffinus yelkouan*), which regularly feed in the area in both coastal and pelagic waters (Fric et al. 2012), south and eastwards beyond the boundaries of the IBA250.

Table 8-20: Main phenology variables of the 2 main seabirds in the Kavala Gulf

Species	Arrival to breeding sites	Colonies	Clutch size (eggs)	Egg-laying period	Incubation period (days)	Chick stage (days)	Fledging period
Yelkouan Shearwater	March	Mono-specific or mixed	1	End of April to beginning of May (March till May)	48-52	60-68	July
Mediterranean Shag	December - January	Mono-specific	1-6	End of January, peaking in mid-February	30	53	End of May

The IBA12 qualifying species which are included in the Annex I (species being a subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution) of the Birds Directive 2009/147/EC (JMD 37338/1807/01.09.2012) are the followings: *Anser erythropus, Branta ruficollis, Aythya nyroca, Puffinus yelkouan, Ixobrychus minutus, Ciconia ciconia, Casmerodius albus, Pelecanus crispus, Phalacrocorax pygmeus, Phalacrocorax carbo, Phalacrocorax aristotelis, Falco naumanni, Accipiter brevipes, Aquila clanga, Burhinus oedicnemus, Vanellus spinosus, Charadrius alexandrinus, Numenius tenuirostris, Glareola pratincola, Larus melanocephalus, Sterna albifrons, Dendrocopos syriacus, Lanius minor, Lanius nubicus* and *Calandrella brachydactyla*.

Table 8-21: Species of conservation concern recorded or expected to be present in the wider area including qualifying species for IBAs and Natura, species included in Annex I of the Birds Directive

Code	Species	Conservation status[1]	Population in Natura 2000 sites[2]			
			Resident	Migratory		
				Breed	Stage	Winter
A293	*Acrocephalus melanopogon*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; RDB-Greece: VU IUCN: LC			P	
A402	*Accipiter brevipes*	2009/147/EC: Annex I; IUCN: LC		P		

Code	Species	Conservation status[1]	Population in Natura 2000 sites[2]			
			Resident	Migratory		
				Breed	Stage	Winter
A042	*Anser erythropus*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix I IUCN: Vulnerable				26-26i
A060	*Aythya nyroca*	2009/147/EC: Annex I; Bonn Convention: Appendix I IUCN: Near threatened			P	P
A229	*Alcedo atthis*	2009/147/EC: Annex I; Bern Convention Appendix II; RDB-Greece: DD IUCN: LC		P		P
A090	*Aquila clanga*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix I, II; International Species Action Plan RDB-Greece: EN IUCN: VU				1-5i
A396	*Branta ruficollis*	2009/147/EC: Annex I; Bern Convention :Appendix II; Bonn Convention: Appendix I IUCN: Endangered				R
A133	*Burhinus oedicnemus*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; RDB-Greece: NT IUCN: LC		P		
A243	*Calandrella brachydactyla*	2009/147/EC: Annex I; Bern Convention Appendix II; IUCN: LC		P		P
A027	*Casmerodius albus*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; AEWA RDB-Greece: VU IUCN: LC				51-100i
A138	*Charadrius alexandrinus*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; AEWA RDB-Greece: LC IUCN: LC		P		P
A081	*Circus aeruginosus*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; CITES II/A RDB-Greece: LC IUCN: LC		P		
A031	*Ciconia ciconia*	2009/147/EC: Annex I; Bonn Convention : Appendix II UCN: LC		P		
A429	*Dendrocopos syriacus*	2009/147/EC: Annex I; IUCN: LC	P			

Code	Species	Conservation status[1]	Population in Natura 2000 sites[2]			
			Resident	Migratory		
				Breed	Stage	Winter
A026	*Egretta garzetta*	2009/147/EC: Annex I; Bern Convention Appendix II; AEWA RDB-Greece: LC IUCN: LC		101-250i		11-50i
A095	*Falco naumanni*	2009/147/EC: Annex I; Bonn Convention : Appendix II; IUCN: LC			P	
A135	*Glareola pratincola*	2009/147/EC: Annex I; Bern Convention: Appendix II; Bonn Convention : Appendix II; AEWA RDB-Greece: VU IUCN: LC		20-20i		
A022	*Ixobrychus minutus*	2009/147/EC: Annex I; Bern Convention: Appendix II; Bonn Convention :Appendix II; IUCN: LC		15-15i		
A131	*Himantopus himantopus*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; AEWA RDB-Greece: LC IUCN: LC			P	
A176	*Larus melanocephalus*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; AEWA RDB-Greece: EN IUCN: LC			P	P
A339	*Lanius minor*	2009/147/EC: Annex I; IUCN: LC		6-10i		
A433	*Lanius nubicus*	2009/147/EC: Annex I; IUCN: LC		6-10i		
A159	*Numenius tenuirostris*	2009/147/EC: Annex I; Bonn Convention Appendix I; IUCN: Critically endangered			V	
A020	*Pelecanus crispus*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix I, II; CITES I/A; AEWA; International Species Action Plan; RDB-Greece: VU IUCN: VU				6-10i
A392	*Phalacrocorax aristotelis*	2009/147/EC: Annex I; Bern Convention Appendix II; International Species Action Plan RDB-Greece: NT IUCN: LC	P			
A391	*Phalacrocorax carbo*	Bern Convention Appendix III; AEWA RDB-Greece: NE IUCN: LC				101-250i

Code	Species	Conservation status[1]	Population in Natura 2000 sites[2]			
			Resident	Migratory		
				Breed	Stage	Winter
A393	*Phalacrocorax pygmeus*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; AEWA RDB-Greece: LC IUCN: LC				51-100i
A035	*Phoenicopterus roseus*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; CITES II/A; AEWA RDB-Greece: LC IUCN: LC				51-100i
A034	*Platalea leucorodia*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; CITES II/A; AEWA RDB-Greece: VU IUCN: LC			P	
A013	*Puffinus yelkouan*	2009/147/EC: Annex I; Bern Convention Appendix II; RDB-Greece: NT IUCN: VU			V	
A132	*Recurvirostra avosetta*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; AEWA RDB-Greece: VU IUCN: LC			P	
A195	*Sterna albifrons*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; AEWA RDB-Greece: NT IUCN: LC		51-100i		
A193	*Sterna hirundo*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; AEWA RDB-Greece: LC IUCN: LC		P		
A418	*Vanellus spinosus*	2009/147/EC: Annex I; Bern Convention Appendix II; Bonn Convention Appendix II; AEWA RDB-Greece: VU IUCN: LC		35-35i		

Code: *Natura 2000 species code*
Species: *Scientific species name*
[1]***Conservation Status:***
Birds directive: *Directive 2009/147/EC of the European Parliament and the Council on the conservation of wild birds (http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm):*
Annex I: Species being a subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution
Annex II/A: Species that may be hunted in the geographical sea and land area where the Directive applies
Annex II/B: Species that may be hunted only in the Member States in respect of which they are indicated
Bern Convention: *Convention on the Conservation of European Wildlife and Natural Habitats (http://www.coe.int/web/bern-convention/home):*
Appendix II: Strictly protected fauna species
Appendix III: Protected fauna species
Bonn Convention: *CMS Convention on the Conservation of Migratory Species of Wild Animals (http://www.cms.int/)*
Appendix I: Endanger Migratory Species
Appendix II: Migratory Species in unfavourable conservation status to be the Subject of Agreements where these should benefit the species and should give priority to those species in an unfavourable conservation status
AEWA: *Agreement on the Conservation of African-Eurasian Migratory Waterbirds (http://www.unep-aewa.org/en/legalinstrument/aewa)*
CITES: *Hellenic Wild Fauna Species and Native Flora of CITES Convention*

(http://www.ypeka.gr/Default.aspx?tabid=596&language=el-GR)
***RDB-Greece**: Red Data Book of the Threatened Animals of Greece (2009)*
(http://www.ypeka.gr/LinkClick.aspx?fileticket=TPsw%2b3PNVX8%3d&tabid=518&language=el-GR)
*Categories: **CR**: Critically Endangered; **EN**: Endangered; **VU**: Vulnerable; **NT**: Near Threatened; **LC**: Least Concern; **DD**: Data deficient; **NE**: Not Evaluated*
IUCN: IUCN Red List of Threatened Species (http://www.iucnredlist.org/)
*Categories: **CR**: Critically Endangered; **EN**: Endangered; **VU**: Vulnerable; **NT**: Near Threatened; **LC**: Least Concern; **DD**: Data deficient; **NE**: Not Evaluated*
[2]***Population in Natura 2000 sites:** Population and presence data based on the GR1150001 and GR1150010 Standard Data Forms (SDF).*

According to the report "Important Areas for Seabirds in Greece, LIFE07 NAT/GR/000285 – Hellenic Ornithological Society (HOS / BirdLife Greece, 2012), the main threat for the Mediterranean Shag is disturbance at colony sites and in surrounding marine areas mainly relating to tourists and fishermen, particularly amateur fishermen. Disturbance in the past years has been intense leading to negative impacts on the breeding success of the species. During recent years amateur fishermen regularly stay overnight on those islets hosting the largest Mediterranean Shag colonies. The species' breeding performance is also affected by introduced rats and overabundant Yellow-legged Gulls which prey on eggs and chicks. Threats for Yelkouan Shearwaters and Mediterranean Shags include reduced fish-stocks and disturbance during the breeding season arising from intensive trawler operations, as well as illegal fishing practices which are frequently reported. Accidental trapping in nets and longlines also presents a significant threat for both species. In 2012, more than 70 Yelkouan Shearwaters were found entangled in one single net, although such mass incidents are rare. There are numerous aquaculture units in the area, mainly mussel and fish farms, primarily located within the Strait of Thasos. The intensity of commercial and passenger shipping traffic, fishing and recreational activities exhibits large spatial and temporal variations, however in general is considered high. It is noted that an extensive algal bloom event in winter and spring 2009-10 caused almost complete failure of the Mediterranean Shag breeding performance during 2010 and 2011 in the entire area. The national importance of the area for the Mediterranean Shag led to the systematic monitoring of its colonies carried out since 2007 by HOS in collaboration with the University of Patras. Additionally, during the period 2010-12, rat eradication and Yellow-legged Gull population control actions have been implemented to improve the breeding success of the Mediterranean Shag.

8.7.6 Environmental Protected and Sensitive Areas

8.7.6.1 Natura 2000 Network

At a European level, the Natura 2000 network is a European Environmental Network of areas hosting natural types of habitats as well as species habitats, which are considered of high ecological importance. It comprises two types of areas:

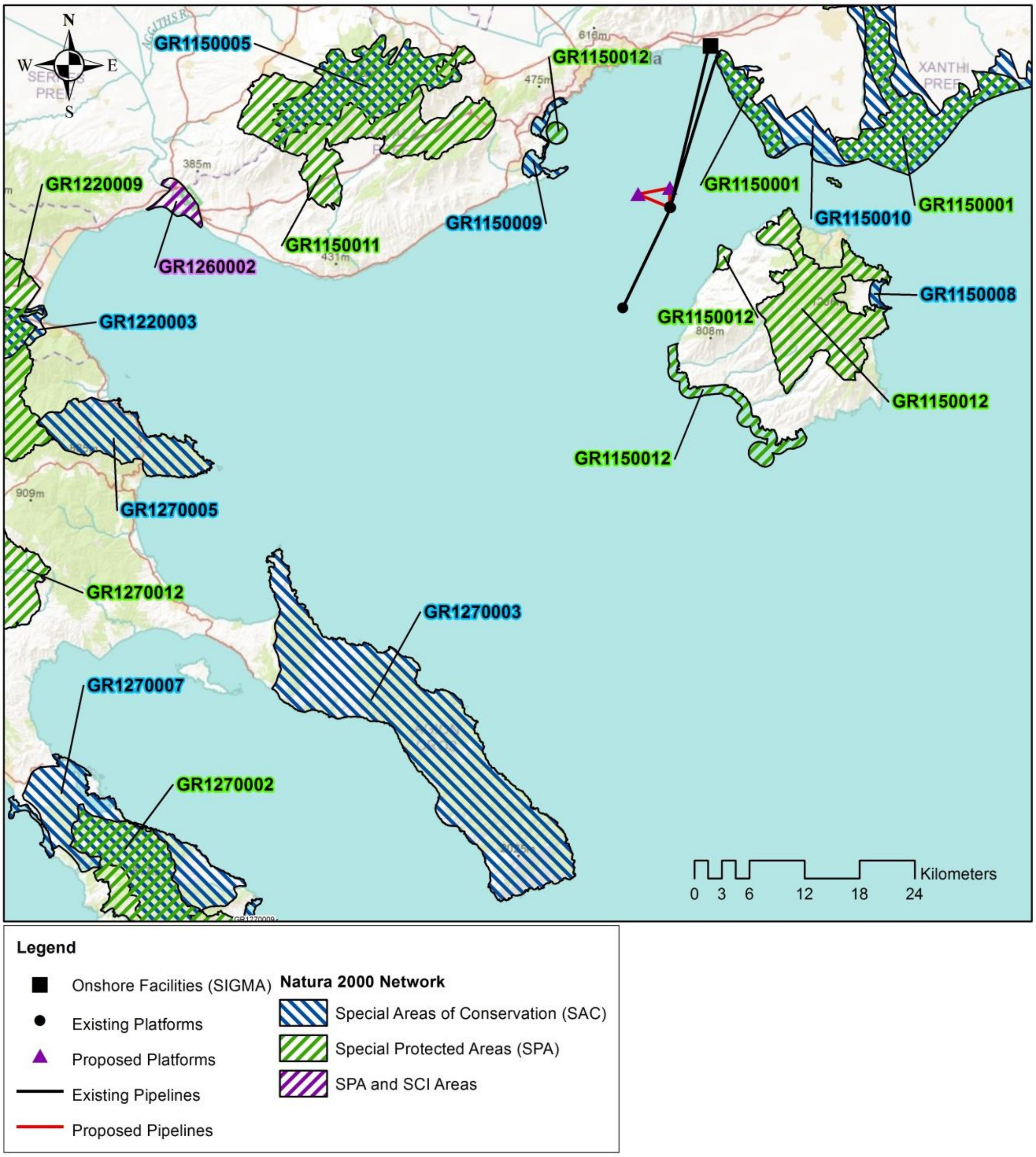
- The "Special Protection Areas – SPA" (SPA), for the protection of bird fauna, as defined in Directive 79/409/EC on the conservation of the wild birds, which was transposed into the Greek domestic legislation with JMDs 414985/29.11.1985 (GG 757/B/18.12.1985), 366599/16.12.1996 (GG 1188/B/31.12.1996), and 294283/23.12.1997 (GG

68/B/4.02.1998). Marine and/or land areas are selected as SPA, which are considered as appropriate for the conservation of the birds under Annex I (195 species and subspecies) of 79/409/EC. Usually, selection is made among the Important Bird Areas (IBA), which arises out of the Global Species Programme of Birdlife International, the aspiration of which is to ensure appropriate areas for the reproduction, wintering or the layover of migratory birds along the migration routes. Henceforth, the Greek S.P.A. amount to 196.

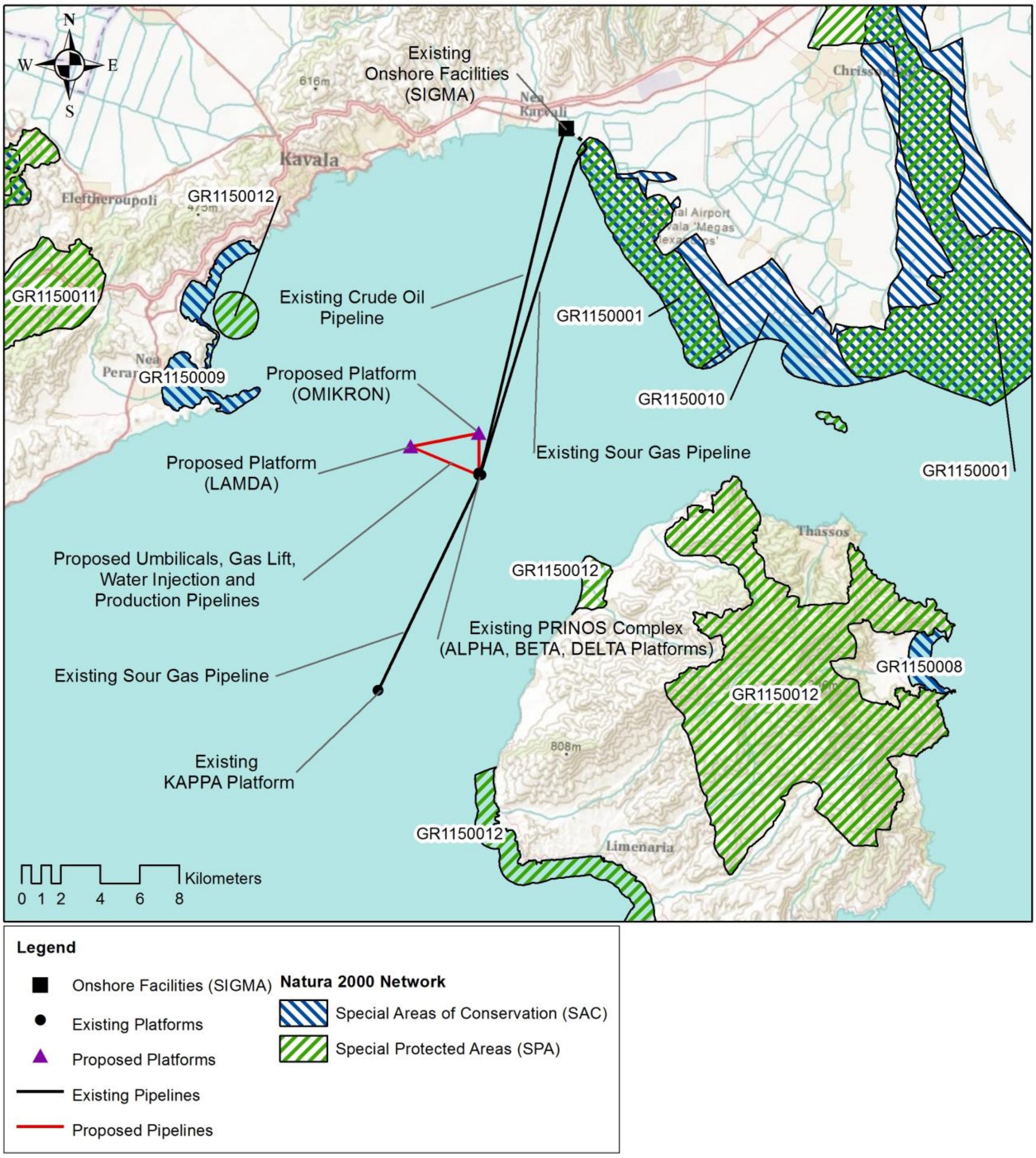
- The "Sites of Community Importance – SCI", as defined in Directive 92/43/EEC, transposed into Greek legislation with the JMD 33318/3028/11.12.1998 (GG 1289/B/28.12.1998). Particularly, the designation of SCI takes place in accordance with the habitats types referred to in Annex I to Directive 92/43/EEC, as well as the species of Annex II, pursuant to the criteria described in Annex III thereto. In particular, there are 231 natural habitats that can be classified as follows, taking into account four digit codes:
  - ⇨ Coastal and halophytic habitats
  - ⇨ Coastal sand dunes and continental dunes
  - ⇨ Freshwater habitats
  - ⇨ Temperate heath and scrub
  - ⇨ Sclerophyllous scrub
  - ⇨ Natural and semi-natural grassland formations
  - ⇨ Raised bogs and mires and fens
  - ⇨ Rocky habitats and caves
  - ⇨ Forests

At a national level, the Natura 2000 network currently comprises 241 SCI and 202 SPA. The list of SPA was published in Annexes B and C to the JMD 37338/1807/1.09.2010 (GG 1495/6.09.2010), in accordance with the transposition of Directive 79/409/EEC (which was codified by Directive 2009/147/EC – L20). By means of the additional finalization of the list of SCI – that is included in Annex I to Decision 2006/613/EC of the Commission (L 259), member-states were obliged to designate all these areas as "*Special Areas of Conservation – SAC*", in order to determine the priorities for the conservation of the types of habitats and species of community interest that can be found within such boundaries at a satisfactory condition. In Greece, the designation of the SAC was effected by Law 3937/2011 on Biological Diversity (GG 60/A/31.03.2011).

The following maps, present the Natura areas (SPA, SAC) is in the Kavala Gulf and in the broader area of significance (Northwest Aegean sea).



Map 8-19: General map of NATURA 2000 Areas in the Northwest Aegean Sea



Map 8-20: NATURA 2000 Areas within the Kavala Gulf

Due to the fact that a part of the existing sour gas pipeline (approximately 550 m offshore and 350 m onshore) is located within Natura areas and in regards to the environmental licensing of the project, the submission of a Special Ecological Assessment study is obligatory according to the Law 4014/2011 (see Annex 04).

Law 4014/2011 on the environmental licensing of works and activities establishes the Special Ecological Assessment (SpEA) study, which follows the Environmental Impact Assessment (EIA) study. SpEA is based primarily on the examination of the "appropriate assessment" of the impact of a project in an area of the Natura 2000 network (Article 6 of Directive 92/43/EEC). Specifically, it takes into account the conservation objectives of the protected area, focuses on the consequences of the project under licensing in the area, and examines whether the integrity

of this region is compromised. The requirements and the contents of the SpEA study are set out in the Joint Ministerial Decision (JMD) 170225/2014.

8.7.6.1.1 GR 1150001, DELTA NESTOU KAI LIMNOTHALASSES KERAMOTIS KAI NISOS THASOPOULA

It is the most important wetland because of the big area that occupies and because of its rich habitat-types. Nowadays, it still is a valuable part of a wetland chain included between Axios river and Delta of Evros of north Greece. Ornithologically is still important breeding site for spur-winged plover (*Hoplopterus spinosus*) (largest breeding population in Europe), purple heron, (*Ardea purpurea*) etc. It is also important for migratory waterfowl and Lesser spotted Eagles which winter. However, its importance has declined due to the lack of protection. From ichtyological point of view especially the wider part of the river mouth is important spawning and nursery ground for several commercially, intensively used species (Seabream, Seabass, Mullet, Eel, etc.). The reference on *Leuciscus cephalus* is about the subspecies macedonicus. Concerning the fauna the quality of the site is indicated by the occurrence of the invertebrate *Araschnia levana* which is the southern edge of extension, the invertebrate *Maculinea alcon* which is referred to IUCN Conservation Monitoring Centre 1988. 1988 IUCN Red List of Threatened Animals and the invertebrate *Lycaeides argyrognomon* which is referred to Koomen P., van Helsdingen P.J. 1993. Listing of biotopes in Europe according to their significance for invertebrates. Council of Europe.In the present site *Salvinia natans*, a plant species included in WCMC, as well as *Pancratium maritimum*, a plant seriously endangered by the human activities on the coast are growing wild. Keramotis lagoons are an important site from ornithological and ichthyological point of view. Some heronries are also found here. An important site for breeding, passage and wintering waterbirds, raptors and passerines associated with reedbeds. Species of concern include: *Puffinus yelkouan, Phalacrocorax aristotelis, Phalacrocorax pygmeus, Pelecanus crispus, Ixobrychus minutus, Egretta alba, Ciconia ciconia, Cygnus olor, Anser erythropus, Branta ruficollis, Aythya nyroca, Haliaeetus albicilla, Accipiter brevipes, Aquila clanga, Aquila heliaca, Falco naumanni, Burhinus oedicnemus, Glareola pratincola, Hoplopterus spinosus, Gallinago media, Numenius tenuirostris, Larus melanocephalus, Sterna albifrons, Dendrocopos syriacus, Calandrella brachydactyla and Lanius minor*. In the present site *Leymus racemosus ssp. sabulosus*, a plant taxon which reaches its extreme distribution limit in Northern Greece is growing wild.

8.7.6.1.2 GR 1150010, DELTA NESTOU KAI LIMNOTHALASSES KERAMOTIS - EVRYTERI PERIOCHI KAI PARAKTIA ZONI

The wetland is important from ornithological point of view because of the big expanse it occupies and because of its rich habitat types. Moreover, it is a valuable part of a wetland chain included between Axios river and Delta Evrou in northern Greece. The riparian forest and the coastal area are important for breeding, the lagoons for migrating and the river for the wintering of many species as grebes, ducks, herons, cormorants, pygnies, raptors, geese, flamingos, waterfowl

and others. The reference on *Leuciscus cephalus* is about the subspecies macedonicus. Concerning the fauna the quality of the site is indicated by the invertebrate Araschnia levana which is the southern edge of extension, the invertebrate Lycaeides argyrignomon which is referred to Koomen P., van Helsdingen P.J. 199, Listing of biotopes in Europe according to their significance for invertebrates, Council of Europe and the invertebrate Maculinea alcon which is referred to IUCN Conservation Monitoring Centre 1988, IUCN Red List of Threatened Animals. In the present site *Salvinia natans*, a plant species included in WCMC as well as *Leymus racemosus ssp. sabulosus*, a plant taxon which reaches its extreme distribution limit in Northern Greece, are growing wild.

8.7.6.1.3 GR 1150008, ORMOS POTAMIAS - AKR. PYRGOS EOS N. GRAMVOUSSA

The area is characterized by its rich flora and vegetation. The beds of Posidonia are in very good condition and cover a substantial part of the sea bed in the bay. Additionally, the area is free of major point pollution source and presents a typical biotope with a great species diversity. Motivation D *Posidonia oceanica*: the seagrass is at risk in the Mediterranean (WCMC 1993), *Paracentrotus lividus*: a threatened species (IUCN 1988).

8.7.6.1.4 GR 1150009, KOLPOS PALAIOU - ORMOS ELEFTHERON

The bays of Paleon and Heraklitsa are characterized by rich marine flora and vegetation. In these marine areas *Cystoseira* (motivation D) and *Phaeophyceae* communities play an important role. Limited changes in community structure and composition during the last few years may be due to anthropogenic activities (building, tourism). Posidonia beds have shown a tendency to move in greater depth, mainly in Eleftheron bay. The presence of *Paracentotus lividus* is characteristic in the area. Its coexistence with Cystoseira and Posidonia is typical for unpolluted areas. In Eleftheron bay limited species diversity was observed. Some species of gastropods live in the Posidonia leaves (Koutsoubas 1992) and other species in the algal associations. In the area were found "fruits" of Posidonia, is a fact that indicate the great vitality of the meadows. Motivation D *Posidonia oceanica*: threatened species (WCMC, 1993) *Pinna nobilis*: is protected by Greek legislation (Presidential Decree 67/1981).

8.7.6.1.5 GR 1150012, THASOS (OROS YPSARIO KAI PARAKTIA ZONI) KAI NISIDES KOINYRA, XIRONISI

Thasos Island is one of the most important nesting sites, on a European Level, for the Shag (*Phalacrocorax aristoteli*) and the Lanner Falcon (*Falco biarmicus*). Furthermore, it holds significant numbers of birds of prey such as the Golden Eagle (*Aquila chrysaetos*), the Peregrine Falcon (*Falco peregrinus*) and the Short-toed Eagle (*Circaetus gallicus*). In the past, Griffon Vultures used to nest, but now they are only visitors to the area. With appropriate conservation measures, they could re-use the area for nesting.

8.7.6.2 Ramsar Site

The Convention on Wetlands of International Importance, especially as Waterfowl Habitat, also known as "Ramsar Convention" – named after the Persian city of the same name, where it was signed in 1971, provides for the protection of wetland ecosystems.

Pursuant to Article 1 of the Convention, wetlands means: "(...) *areas of marsh, fen, peatland or water, whether natural or artificial. These areas are permanently covered 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. The wetlands may include riparian or coastal zones, adjacent to the wetlands or islands or sea ponds that are deeper than six meters at low tide* (...)".

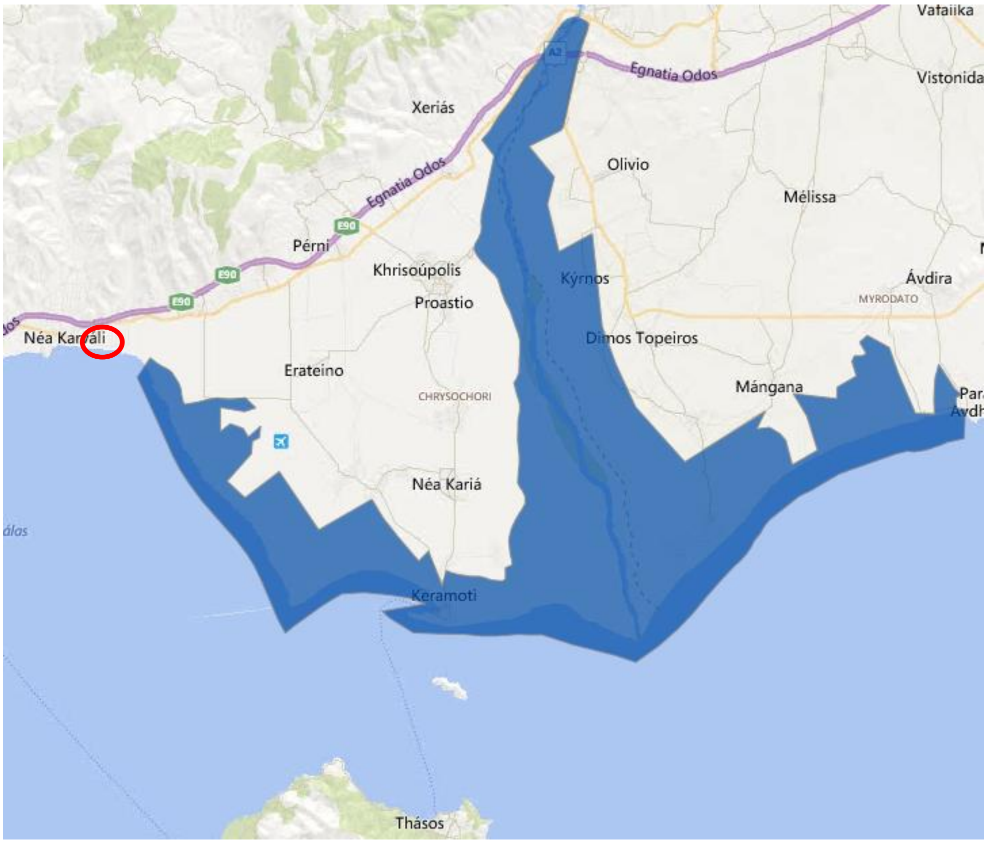
Every state party to the Convention must designate at least one wetland of international importance, whereas in accordance with the most recent survey, the 158 states that have ratified the Convention have designated 1,828 wetlands of international importance.

The Convention was ratified by Greece by means of the Legislative Decree 191/1974 (GG 350/A/20.11.1974), which was subsequently amended by Law 1751/1988 (GG 26/A/9.02.1988) and Law 1950/1991 (GG 84/A/31.05.1991) "On the Ratification of the Amendments to the Ramsar Convention". The Greek wetlands that have been designated since 21 August 1975 as wetlands of international importance (Ramsar Wetlands) are 10 and cover an area of 1,635,010, sq. meters. It must be noted that Greece, by signing and ratifying the Ramsar Convention has undertaken to conserve and properly use all wetlands of the country, through local, regional, international activities and cooperation.

The Montreux Catalog is an abstract of the Ramsar Wetlands list, which was established during the 4th Conference of Contracting Parties – COP, which was held between 27.06 and 4.07-1990 (Recommendation 4.8, Ramsar Convention). The purpose of the catalog was the registration of all Ramsar Wetlands, which are in risk of changes to their ecological character, with a corollary obligation of the contracting parties to take drastic measures for the prevention or reversal of such changes.

Upon the original establishment of the Montreux Catalog, all 10 Greek wetlands were included therein, however, in 1999 three – Small Prespa Lake, Kerkini Lake and Evros Delta, were removed therefrom. Currently, 7 out of the 10 Greek wetlands are included in the Montreux Catalog.

In the vicinity in the project development area, within the limits of the Municipality of Nestos lies one (1) Ramsar Wetland, which, in addition, is included in the Montreux Catalog (see Figure below).



Map 8-21: Area of the Ramsar Site "Nestos Delta and Adjoining Lagoons" in relation to the Onshore Facilities - SIGMA (red circle)

8.7.6.3 National Park of East Macedonia and Thrace

The National Park of East Macedonia and Thrace, as defined in 2008 by the Common Ministerial Decision (CMD) 44549/2008 (Government Gazette 497 / D / 17-10-2008), includes the protected areas of the wetland Delta Nestos, lakes Vistonida, Ismarida and the region, with the total land and water area of 930,000 acres.

The institutionalized management of the National Park of Eastern Macedonia and Thrace is the Management Body Nestos Delta Vistonidas- Ismarida which is a private legal entity, non-profit and was founded in April 2003 by the Ministry of Environment and Energy. The management of the National Park should be compatible with the requirement of the relevant Management Plan.

The wetland complex of the National Park is one of the most important in Greece, due to the large surface area and high biological, aesthetic, scientific, educational and geomorphological value. The purpose of the National Park is the effective protection of habitats and rare species of flora and fauna that inhabit and breed in the area. In the National Park, more than 326 bird species have been observed nesting, overwintering or simply passing through the area. Moreover there is a great variety of, fish, amphibian and reptilian species. The wetland also provides an important habitat to otters, wolves, roe deer and many other mammals. The main habitats are as follows:

- Sandy areas: only plants adapted to the harsh conditions live here such as the sea

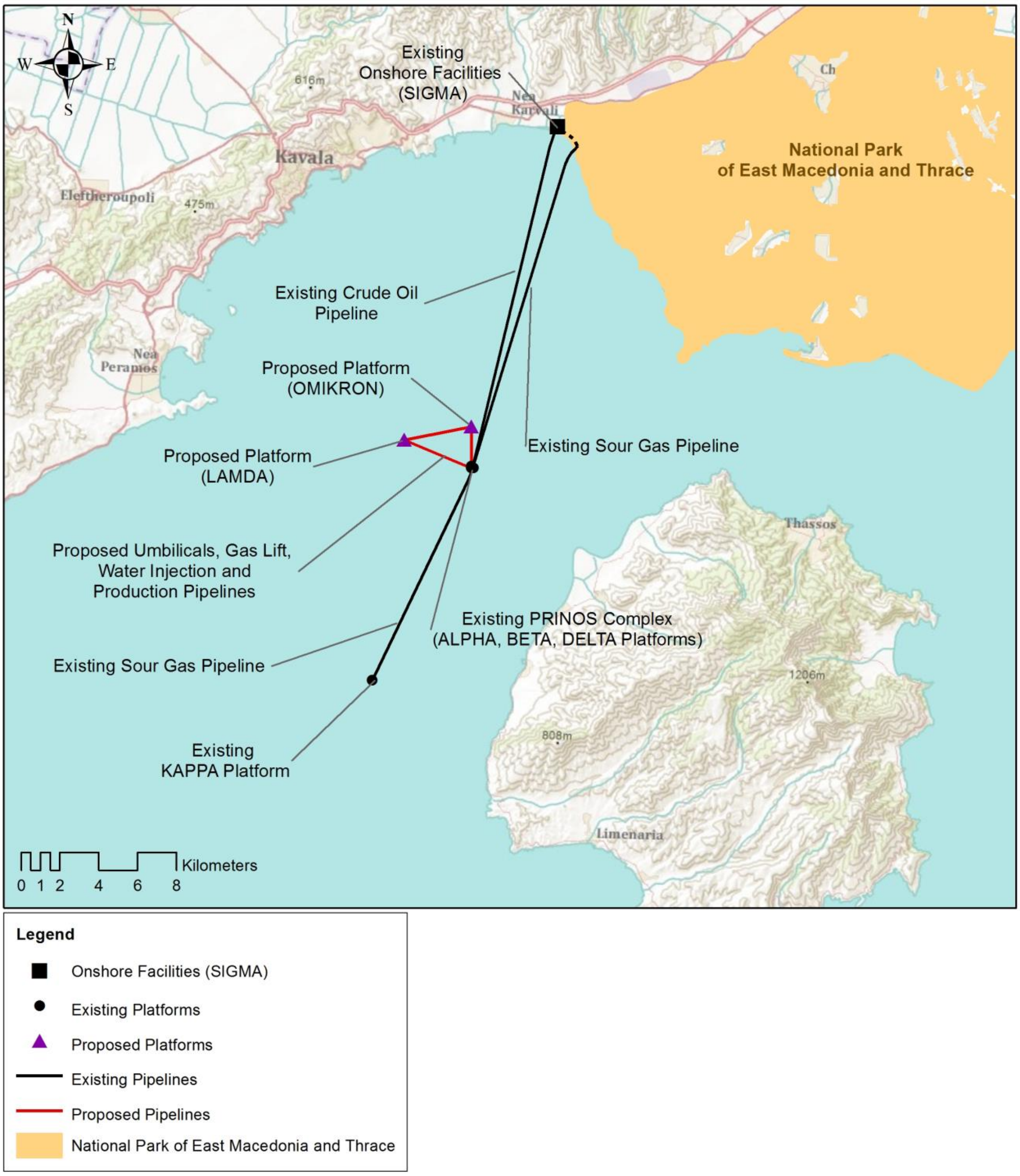
daffodil, in addition to birds which prefer sandy barren sites.

- Salt marshes and salt pans: These areas are periodically flooded by brackish or salt water. Salt tolerant plants can be found here as well as animals adapted to this unfavourable environment.
- Meadows with rushes: these are important feeding grounds for storks, birds of prey and many other bird species.
- Reeds: Reed stands are ideal nesting sites for a remarkable number and variety of bird species.
- Tamarisk shrubs hills, riverine forests: protected areas in the forests provide ideal conditions in which many birds of prey can breed and find sufficient food.

Within the area of the National Park, specific Protected Zones are specified and their boundaries follow the physical characteristics or artificial elements of the area. In these Protected Zones, specific uses and activities are allowed which are defined in CMD 44549/2008. During the Environmental Permit Procedure of new or existing projects within the National Park, consultation with the Management Body Nestos Delta Vistonidas- Ismarida is necessary.

The Protected Zones in order of decreasing severity of uses and activities are the following.

- Zone A: Nature Reserve Zone
- Zone B: Protected Landscapes
- Zone Γ: Eco development Zone
- Zone Δ: National Park Peripherial Zone



Map 8-22: National Park of East Macedonia and Thrace

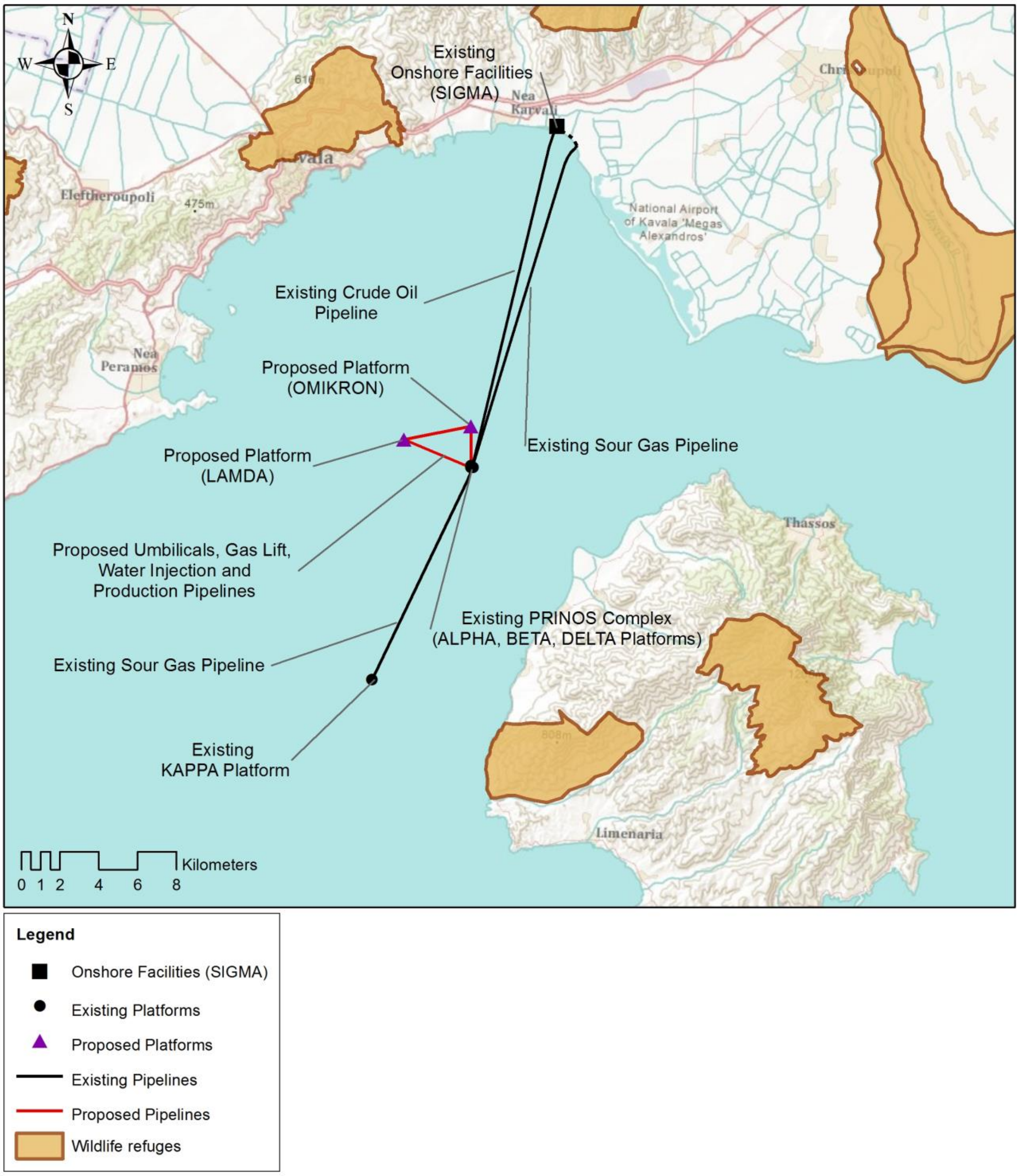
8.7.6.4 Wildlife Refuges (WR)

The establishment of the first permanent Game Refuges, within the administrative boundaries of the Thasos Forest Authority, resulting in the permanent prohibition of hunting, was effected by means of the Ministerial Decision 38098/1976 (GG 744/B/4.06.1976), while the Game Refuges were subsequently renamed to Wildlife Refuges (W.R.), as they are currently known, was effected by means of Article 57 of Law 2637/1998 (GG 200/A/27.08.1998).

The currently in force Law 3937/2011 (GG 60/A/31.03.2011) defines the WR (Wildlife Refuges)

in para. 4.3 of Article 5, as “(...) *natural areas (land, wetlands or marine) of significant importance as significant areas for the development of wild flora or as habitats for the reproduction, feeding, and wintering of wild fauna species or fish reproduction areas and spawn concentration areas or, finally, as significant marine habitats* (...)”. Moreover, it provides that ecological corridors between certain categories of protected areas may also be designated as W.R.

In the project development area lies no designated WR (para. 3 of Article 6 of Law. 3937/2011). The WR within the broader Project area are shown in the following figure.



Map 8-23: Wildlife Refuges within the broader Project area

8.8 MANMADE ENVIRONMENT

8.8.1 Physical planning and land uses

Kavala city is the most developed urban centre of Eastern Macedonia and Thrace, is located exactly on tip of the road axis between Thessaloniki and the Turkish border, while its geo-strategic picture is complemented by the 2nd largest commercial port of Egnatia Odos, to the east of the city of Kavala. With one large port and one equally large marina downtown, in combination with the Nea Peramos port and the Nea Irakleitsa marina, Kavala, among others, is one of the most significant fisheries centres in Greece. One of the largest fish markets of the Mediterranean operates in the city, where goods are traded for domestic and international markets. The development of fisheries rendered it necessary to establish in Kavala one of the three Fisheries Research Institutes (FIREI) that operate in Greece.

As a commercial and industrial centre, it is ranked second in N. Greece, behind Thessaloniki. In addition to tobacco processing industries and tobacco warehouses, food and salted foodstuff factories, as well as roller mills and rice mills operate in the city, while the tobacco of Macedonia and Thrace is exported from its port.

The vast majority of residential and production zones of the secondary and tertiary sector (industrial and commercial zones) are concentrated in the coastal zone, which is located, most of the time, along the main road and developmental axis of Drama-Kavala-Xanthi.

The same applies for the basic transport facilities, as well as for arable agricultural land, permanent crops and meadows. The percentage of irrigated land is larger than the one of arable land, a fact that is related to the irrigation channels from Nestos at the Kavala plain, also located in the eastern wetland of the RU of Kavala. The land uses in the RU of Kavala based on the Corine Land Cover register are presented in the following table.

Table 8-22: Land distribution in the RU of Kavala13

RU of Kavala		
Coverage category	**Surface Area (thousands of sq. meters)**	**Percentage (%)**
Urban fabric	35,655	1.68
Production activities and other artificial surfaces	24,700	1.17
Irrigated agricultural land	246,922	11.65
Arable land	173,310	8.18

[13] *Corine Land Cover 2000, European Environmental Agency (EEA), Copenhagen, available at the link: http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2000-clc2000-seamless-vector-database (last visited 20/04/2015).*

RU of Kavala		
Coverage category	**Surface Area (thousands of sq. meters)**	**Percentage (%)**
Arboraceous cultivations	74,775	3.53
Heterogeneous agricultural areas	228,813	10.80
Coniferous forests	228,813	10.80
Broadleaved forests and mixed forests	321,578	15.17
Forest and bush areas	655,466	30.93
Natural pastures - meadows	180,632	8.52
Areas with sparse vegetation	36,744	1.73
Burnt areas	8.431	0.40
Wetlands	25,960	1.22
Water surfaces	18.702	0.88
Total	**2,119,203**	**100**

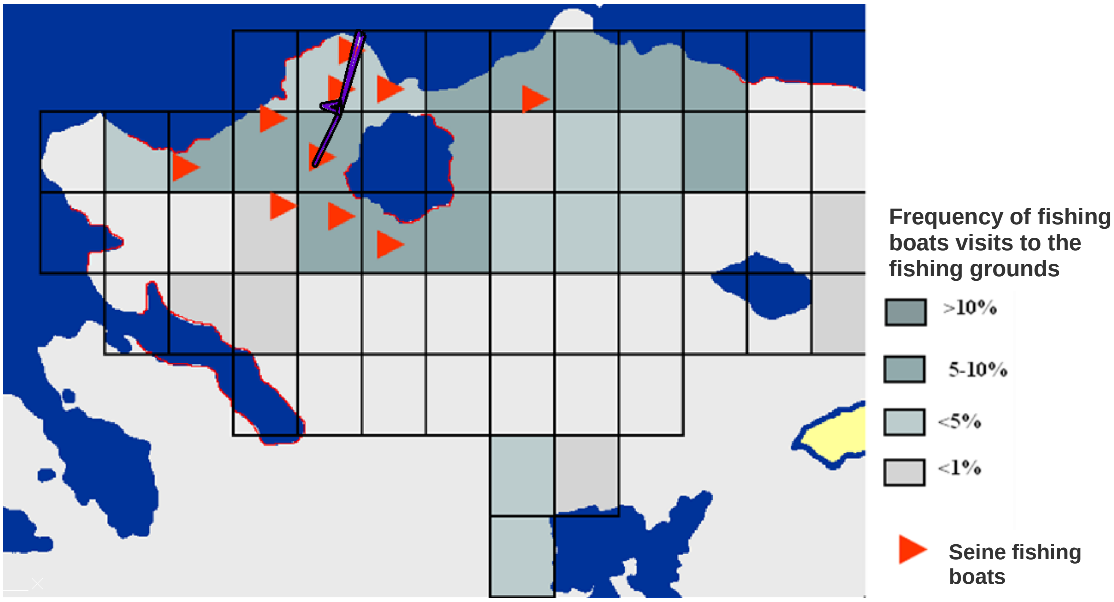
The existing offshore and onshore facilities compatible to the directions and the specifications set out by the Regional Framework of Physical Planning and Sustainable Development (RFPPSD) of the Region of East Macedonia and Thrace

8.8.2 Fisheries and aquacultures

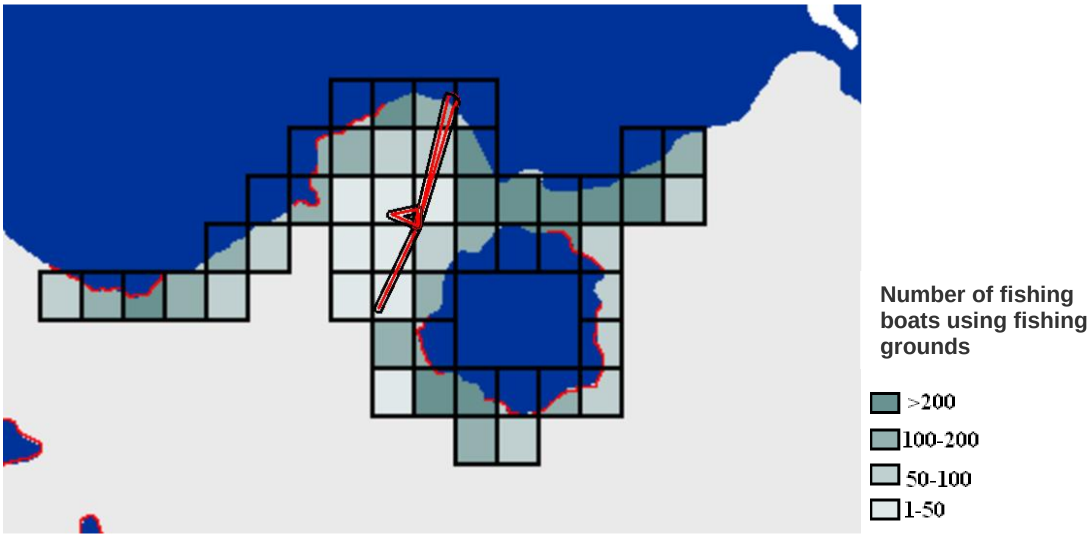
Fisheries

According to the available desk based information, the whole area of the Kavala Gulf is considered a fishing ground, especially for species such as European anchovy and sardine. Particularly abundant quantities of bivalve molluscs (mussels, oysters), crustaceans (shrimps, prawns, crabs) and pelagic fishes (sardine, European anchovy, bluefish, bonito, tuna).

The main fishing grounds of the trawlers fleet expand to a depth between 20 and 300 m, at a medium distance from the shore, which ranges from a few miles from the shore, within the territorial waters, until the limit of 450 m of depth, far away from the territorial waters of Greece. Topographically, the main grounds are located along the shores of Thrace, with the exception of the winter period, when some vessels fish at the western side of the Kavala Gulf. The main catches are red mullet, cod, octopus, prawn, shrimp and crayfish.



Map 8-24: Fishing grounds of trawlers in the RU of Kavala – red arrows show the main grounds of the seine-fishing vessels



Map 8-25: Coastal fishing grounds along the coasts of the RU of Kavala

In accordance with the recent data from the Directorate of Rural Economy & Veterinary Medicine of the RU of Kavala (Fisheries Department), approximately 250 coastal vessels (boats) have been recorded, with a length between 3 and 15 meters, 38 vessels of medium distance fishing (trawlers and seine fishing vessels), with a length between 15 and 30 m. Moreover, people, directly or indirectly, connected to the fisheries sector are estimated at 2,000 - 2,500. The catch of the Kavala fleet end up in the Kavala Fish Market in order to be auctioned. There, approximately 8,000 to 10,000 tn of fisheries are traded annually, the larger part thereof comprising small pelagic fishes (sardine and European anchovy), which constitute raw materials for processing activities. A percentage of the total catch – equal to 35%, comprises the catch unloaded by trawlers, approximately 40-50% from seine-fishing vessels and a percentage of 15-20% by the coastal vessels.

The following table shows the main catches of the trawlers fleet, as they are recorded in the Kavala Fish Market bulletin. The table shows that the main catch is cod, which provides 5.2% of income, mullet, with 5.6% of the income and octopus, which is the characteristic species of the Thracian sea, since it is massively caught with many fishing tools.

Table 8-23: Main catches of the Kavala Fish Market Trawlers

Main species	Common Name	Quantity (tn)	Percentage (%)	Euro (thousands)	Percentage (%)
Fishes					
Merluccius merluccius	Cod	92.44	1.51	1,676	5.29
Rajidae	Raja	61.4	1.02	137	0.65
Labridae	Wrasse	63	1.03	1,026	0.51
Gobiidae	Rock goby	14.3	0.23	196	0.11
Mullus barbatus	Red mullet	80.6	1.32	1,131	5.64
Pagellus erythrinus	Red snapper	15.49	0.25	119	0.58
Lophius sp.	Toadfish	70.48	1.15	196	1.37
Trachurus trachurus	Horse mackerel	110.3	1.8	256	1.72
Diplodus sp.	Seabream-type (seabream, sargo, blacktail bream)	23.5	0.38	7	0.17
Mollusks					
Illex sp.	European flying squid	18.6	0.3	101	0.48
Octopus sp.	Octopus	197.6	3.23	1,166	8.49
Eledone sp.	Horned and musky octopuses	63.7	1.04	218	0.75
Crustaceans					
Parapeneus longirostris	Prawns	160.7	2.36	741	3.45
Peneaus sp.	Shrimps	17.58	0.28	176	2.23

Fishing Prohibitions

For navigation and project safety, fishing and movement of respective vessels is prohibited in a radius of 500 m around the platforms (IOR No. 3 of 1980, Article 10– GG 63/B/24.01.1980), while the Kavala Port Authority is the competent authority for organizing, ensuring, and monitoring the safe navigation terms in the area of the facilities.

More generally and according to the Directorate of Fisheries Monitoring, in the wider area of Kavala, the following are prohibited:

- Fishing at a distance of 300m from the shore, between 15 June and 15 September each year (Decision of Kavala Central Port Authority 2134.1/09 /11/14.10.2011).
- Fishing in the safety maritime zone around the platforms and at a radius of 500 m throughout the year (Article 10 I.O.R. 03/1980 – GG 63/B/1980).
- Fishing (trawlers and seine-fishing vessels) over beds with marine vegetation, in particular *Posidonia oceanica* or other marine phanerogams (REG. EC 1967/2006, MD 167378/2007 – GG 241/Δ/2007, as subsequently corrected by GG 392/Δ/2007).
- The day seine-fishing vessels during the months of July and August and between 15 December and end of February (PD/1993 – GG 9/A/5.02.1993).
- The day-night seine-fishing vessels, at a distance of less than 100 m from the shore (R.D./1953 – ΦΕΚ 81/A/8.04.1953).
- The use of day seine or day-night seine at a distance within 300 m from the shore or at a depth less than 50 m, if this depth is located at a shorter distance from the shore. Seine-fishing vessels may not fish at depths smaller than 70% of their total vertical height – maximum 120 m (REG. EC 1967/2006).
- Fishing with bottom trawler at a distance of 2 nautical miles from the shores of Thrace until the shores of eastern Macedonia (from the mouth of Nestos until the Ierissos Gulf) between the months of March and November each year (Article 5 of RD 917 – GG 248/A/12.10.1966) (Map 8-26)).
- The use of trawling nets within 3 nautical miles from the shore or at a depth of less than 50 m (if this depth is located at a shorter distance from the shore) and, in any event, within 1.5 nautical miles from the shore, regardless of depth. (REG. EC 1967/2006).
- Fishing with trawlers in the Kavala Gulf (within the line Vrasidas cape - Eleftheres Gulf – Pachi, Thasos, as well as within the line cape Kalogeros, Thasos and mouth of river Nestos) between the months April and October each year (Article 10 of RD 917 – ΦΕΚ 248/A/12.10.1966).
- The use of trawling fishing permit in international waters, with the “bottom trawler” fishing tool in the geographical sub-area (GSA) 20, 22, 23 of GFCM as follows: (a) between 24 May and 15 July, in all sub-areas and (b) between 16 July and 1 October and to the west of the 25th meridian of the sub-area 22 (Decision by the Minister for Rural Development & Food No. 4023/64557 – GG 1307/B/22.05.2014) (Map 8-27).

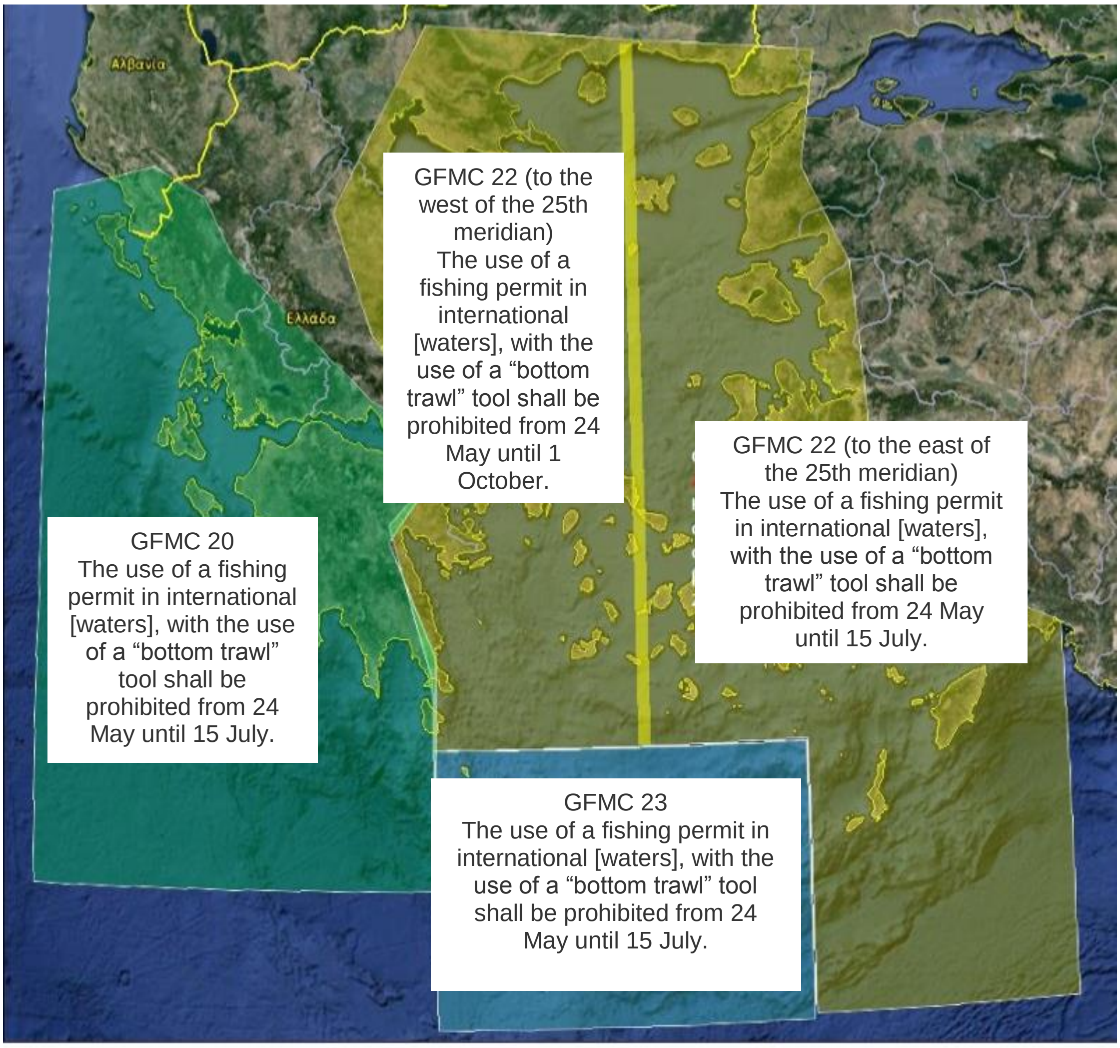
Safety zones of 500 m surrounding the existing platforms where no unauthorised vessels are permitted are designated, whereas for the existing pipelines a safety zone 200 m is also designated on each side where no anchoring and no trawling is permitted.

These zones around existing structures in Kavala Gulf cause restrictions on ship traffic, which are regulated by Kavala Port Authority. However those zones are distant from the usual ferry crossings and naval zones used by the ships approaching Kavala area ports. The irregular routes (fishing boats, leisure boats etc) are not interfering with the existing facilities as those are away of any relevant destinations and pose only a small fraction in comparison of the available

marine area of the Kavala Gulf.

Map 8-26: Fisheries prohibition with trawling net in accordance with the RD 917/1966[14]

[14] Fisheries Prohibitions, Hellenic Coast Guard – Directorate of Fisheries Monitoring, April 2015, available at the link: http://www.hcg.gr/alieia/etisies/GREECE/ier_thasos/1.php (last visited at 20/04/2015).



Map 8-27: Fisheries prohibitions for trawlers in accordance with Decision by the M.R.D&F. No. 4023/64557/2014

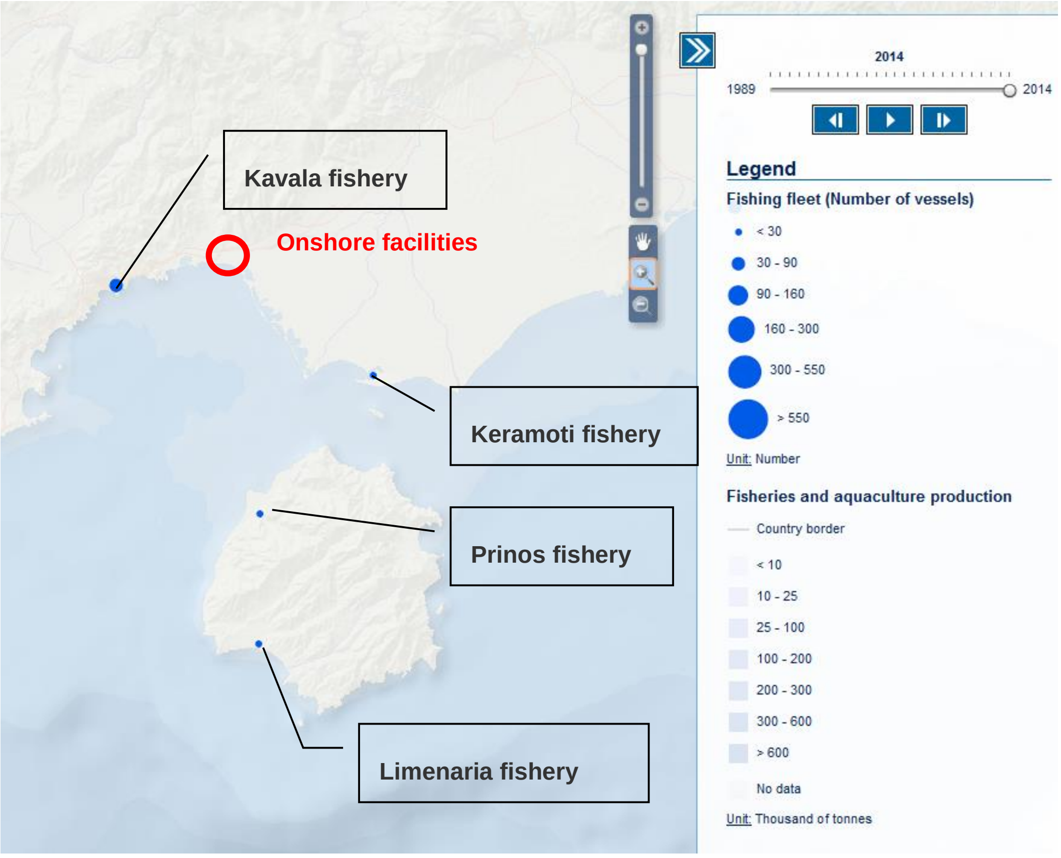
The foregoing shows that the fishing period with trawlers begins on 1st October and ends on 31st May. Fishing within the Kavala Gulf is allowed between 1st and 30 November.

In Greece, since the 1970s, fishing with bottom trawlers between July and September each year is prohibited. During years that bottom trawling fishing is productive even during May, the performance of the vessels reduces gradually, in order to cease at the end of May. Vessels with dual permits continue to fish even during this month with bottom trawlers, however, if the quantities of demersal organisms are reduced or if the demand for European anchovy is high, then the said vessels gradually change their tools and start fishing with seine. In this manner, the number of vessels unloading catches in Kavala is not stable, but it is gradually reduced around the end of May.

Normally, the seine-fishing vessels stop fishing, in accordance with a relevant provision, during the period between 15 December and 15 February. However, every year the factors that determine the alternative fishing are two: a) the quantities of demersal organisms caught and b) the price of small pelagic fish and particularly the European anchovy.

Aquaculture

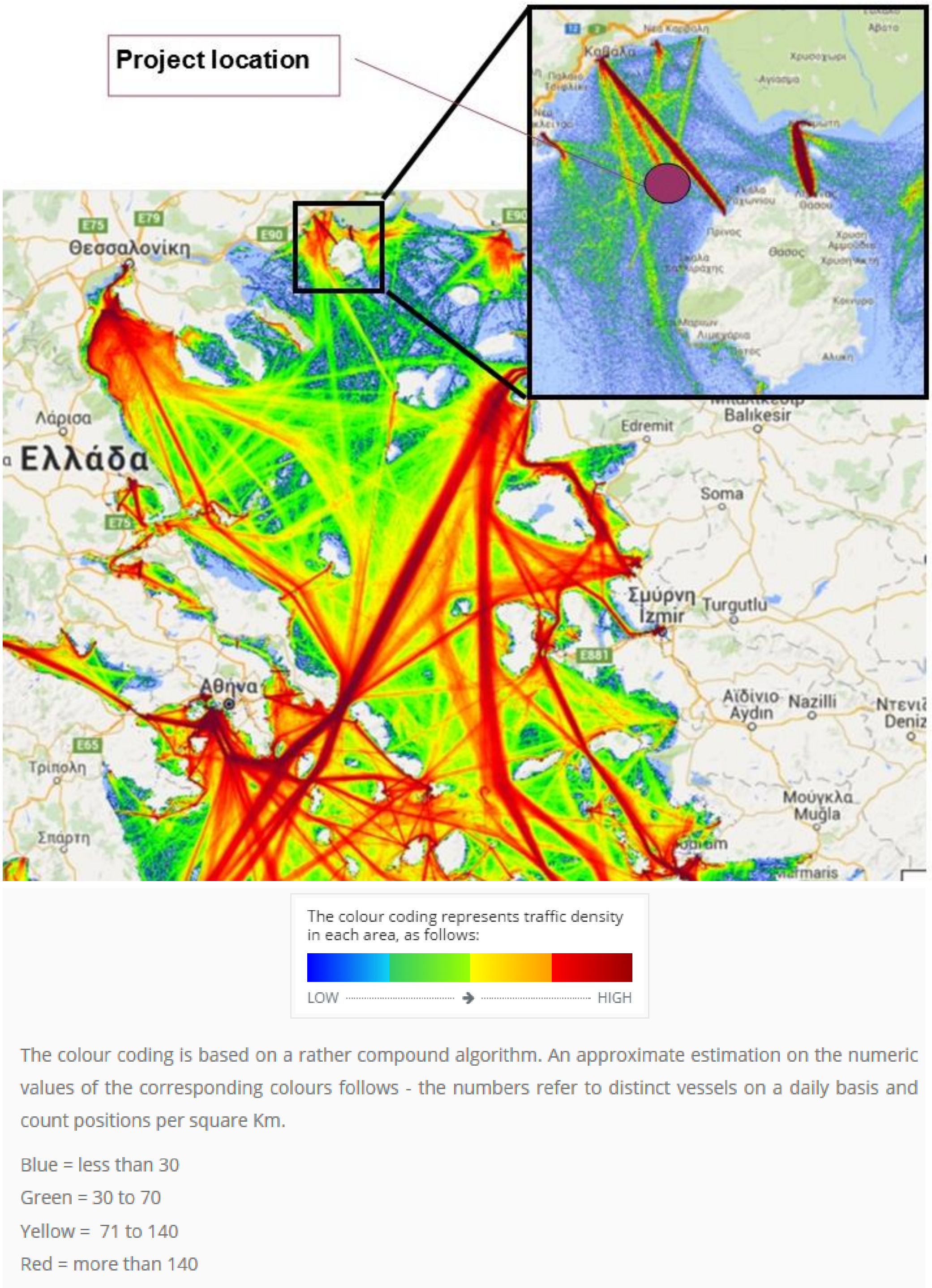
There are four aquacultures in the locations shown in the following figure.



Map 8-28: Aquaculture in the Kavala Gulf

8.8.3 Navigation

Based on the available data of the Kavala Port Authority (KPA), from the central port of Kavala there are 5 weekly routes to the S. Aegean. From Kavala, at the Prinos Ferry, three trips per day take place, whereas from Keramoti to the Thasos port approximately twelve trips per day. Currently, access to North Aegean is served by two companies and respectively, three for Thasos. As regards cruises, the number of cruisers that visited in 2013 the passenger terminal of the port of Kavala amounts to fifteen (15), in 2014 twenty six (26), whereas for 2015 the figure may reach nineteen (19).



Map 8-29: Density of marine traffic in the Aegean Sea and the Kavala Gulf (source: www.marinetraffic.com)

From the above map it can be clearly seen that the existing facilities are in between the main marine traffic areas of the Kavala Gulf. However, the routine navigation routes used by the commercial ferries presented by high frequency traffic are passing away from the existing offshore facilities and the exclusion zones defined in the naval charts, so by no means create any possible interference. The routes presented to be pointing from Kavala port to the centre of the existing facilities, actually represent the daily marine traffic carried out in the framework of

the existing operations (i.e. loading of supplies, personnel and equipment on and off the existing platforms), and therefore do not consist of any interference with the overall gulf marine traffic.

Occasional marine traffic, like recreational and commercial, also do not interfere with the existing facilities as those take up only a small fraction of the overall marine area available for navigation.

8.8.4 Tourism

In accordance with data from Hellenic Statistical Authority (ELSTAT, 2011), the RU of Kavala, shows greater specialization in tourism, absorbing 54% of all tourists staying in the region. The island Thasos is the main tourist attraction, located in the Kavala Gulf, at the northern part of Aegean Sea.

The area between the river mouth of Strymonas and Nea Peramos (western shores of Kavala), showed during the last decade a significant increase of construction activities with regard to holiday houses. The next coastal area between Nea Peramos and Kavala constitutes a tourist attraction since a long time ago, resulting in the development of a tourism activities zone, with hotels, holiday and permanent residences, as well as restaurants. The shores of the area between Kavala and Nea Karvali consist of a series of bays with sand beaches, which are formed from low hills, with steep slopes towards the sea.

The shores of the plain of Chrysoupoli, between Nea Karvali and Nestos Delta, consist of a continuous zone of sand beaches behind of which lie lakes and lagoons of various sizes, which are protected under the Ramsar Convention. The Keramoti shore can also be found in this area, with its natural port, which, however, has impacts on the marine area, since it is intensely used for fishing and for maritime commercial and passenger transports, to and from Thasos. Moreover, around the settlement of Keramoti, unlicensed buildings can be found and unregulated development of leisure facilities. Finally, the existence of the airport in Chrysoupoli contributes to the tourist development of the aforementioned areas.

The accessibility rate of the tourist resources of the regional unit, with regard to road, train, sea and air access, is considered as having improved during the last decade. Nevertheless, it is considered that further improvement is required, in order to be able to attract visitors from other places in Greece and abroad.

Table 8-24: Hotels of all types in the continental part of the RU of Kavala and the island of Thasos until 24.6.2015 (Hellenic Chamber of Hotels)

	No. of Units	No. of Rooms	No. of Beds
Continental part of the RU of Kavala	50	1,625	3,091
Thasos	206	5,144	10,267
Sum	256	6,769	13,358

Table 8-25: Rooms & apartments to let, and self-serviced accommodations in the continental part of the RU of Kavala and Thasos Island (Hellenic Chamber of Hotels)

	No. of Units	No. of Rooms	No. of Beds
Continental part of the RU of Kavala	87	531	1,444
Thasos	896	5,203	12,290
Sum	983	5,734	13,719

The spatial distribution expands to 19 areas (8 in Thasos and 11 in the continental part of the RU of Kavala). The island of Thasos concentrates 89% of the units. The most touristic areas of Thasos Island are the Port, Potos, Potamia, Limenaria, Panagia and Rachoni. The most touristic areas of Kavala are Peramos and Irakleitsa.

As regards organized camping grounds, for the year 2015 the RU of Kavala concentrated 9 (of which 4 on the island of Thasos) with a total number of spaces for tents and trailers amounting to 1226. In 2011, 25 units within the RU of Kavala ceased operations, 17 of which are located on the island of Thasos.

Moreover, in accordance with the following table, the total stays in hotel accommodations between the years 2005-2007 shows a greater increase by 11.46%, which continues with a slower rate (7%) during the subsequent year. Subsequently, between 2009 and 2010, there is a decrease by the rate of -10.39% in order to return to an increase by 6.44% in 2011.

Table 8-26: Percentages of stays in hotel accommodations in the RU of Kavala[15]

Regional Unit	2005/2004	2006/2005	2007/2005	2008/2007	2009/2008	2010/2009	2011/2010
Kavala	2.07 %	-0.76%	11.46	7.09%	-1.93%	-10.39%	6.44%
REMTH	1.40%	1.28%	8.32%	7.03%	-1.13%	-9.66%	1.03%

Taking into account table below, the number of stays by foreign tourists in the Region shows a significant decrease, that can be observed in 2004 (-12.4%) and, obviously, is related to the attractiveness of Athens at that period, as the host of the Olympic Games, however during a small decrease of stays in the whole country at the same period. The small decrease in the years 2009 and 2010 is probably related to the effects of the crisis in the overall image of the country. On the contrary, in 2011 there is a significant increase of foreign tourists, by 17.73%, which is larger than the respective increase for the country.

Table 8-27: Percentages of total stays of foreign tourists in hotel accommodations3 in the RU of Kavala

Unit	2005/2004	2006/2005	2007/2005	2008/2007	2009/2008	2010/2009	2011/2010
RU Kavala	3.61%	3.54%	13.90%	12.28%	-2.66%	-5.14%	16.82%
REMTH	3.03%	8.51%	8.88%	11.47%	-1.87%	-2.84%	17.73%
Country total	4.61%	5.95%	11.66%	-0.37%	-2.77%	5.05%	11.45%

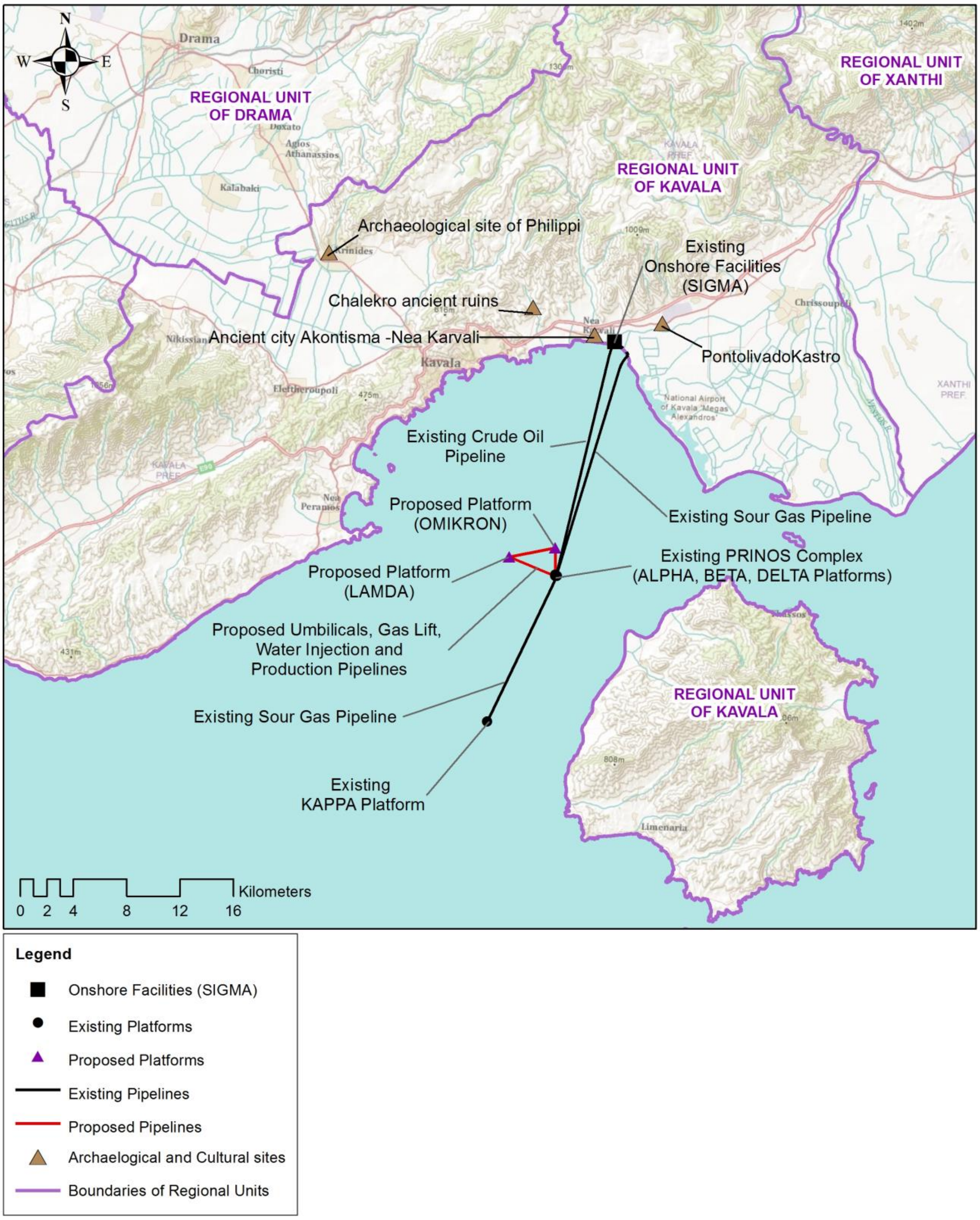
[15] *Sum of stays in hotel accommodations per RU, ELSTAT, 2011*

8.8.5 Cultural Heritage

The marine area of the Gulf of Kavala, where all offshore facilities (existing and new) are located, is well investigated and there are no signs of archaeological findings that could be of any interests. The shallow waters as well the type of the seabed do not enable the preservation of any possible ruins, through the ages.

The main archaeological and cultural sites in the Regional Unit of Kavala are briefly described below:

- Philippoi – the most important archaeological site of eastern Macedonia, 17 km to the NW of Kavala, with monuments characteristics of the Hellenistic, roman and early Christian eras. It includes the ancient city of Philippoi (GG 35/B/2.02.1962) and the monument – outside the wall of Philippoi, Basilica C (GG 36/B/3.02.1962), under the competence of the 18th Ephorate of Prehistoric and Classic Antiquities.
- The archaeological site “Remnants of the ancient city Akontisma in Nea Karvali” (MD 21220/10-8-1967 GG 527/B/24-8-1967). During the cleaning process (2005-2007) in the newer fortifications on the hill top fort in the eastern boundaries of Nea Karvali and Kavala, an ancient fortified settlement was discovered
- The archaeological site Chalkero (MD 54780/3306/10.17.2001, GG 1464/B/26-10-2001). This is the hill north of the National Road Kavala - Xanthi before crossing to Chalkero, within the limits of Kavala Municipality. It consists of visible on soil surface ancient ruins, buildings and retaining walls, attributed to what is known in the area to be the Temple of Zeus and ancient quarries.
- The site Pontolivado (YA YPPE/ARCH/A1/F18/68159/3413/12.04.1979 - GG 93/B/1.31.1980) is located 3 km east of the settlement and consists of enclosure walls, residential complex and findings of classical and Hellenistic periods (ancient Pistiros).



Map 8-30: Archaeological and cultural sites in the RU of Kavala

The Museums of Kavala are:

- The Archaeological Museum, containing findings from the Neolithic period, findings of the Dikili Tash settlement, from the Bronze Age, findings of Neapolis, the ancient Amphipolis and of the region of Thrace.
- The Tobacco Museum of Kavala Municipality is the only theme Tobacco Museum across Europe. It is a modern industrial and experiential museum with many exhibits and archives.

- The Municipal Folklore Museum of Kavala opened in 1988. Its department are Archives, Ethnographic Collection, Art Collection, Natural History, Library, and Museum Education.
- In Nea Karvali is located the Historical and Ethnological Museum of Greek Cappadocian with costumes, carpets, paintings, jewellery, embroidery etc.

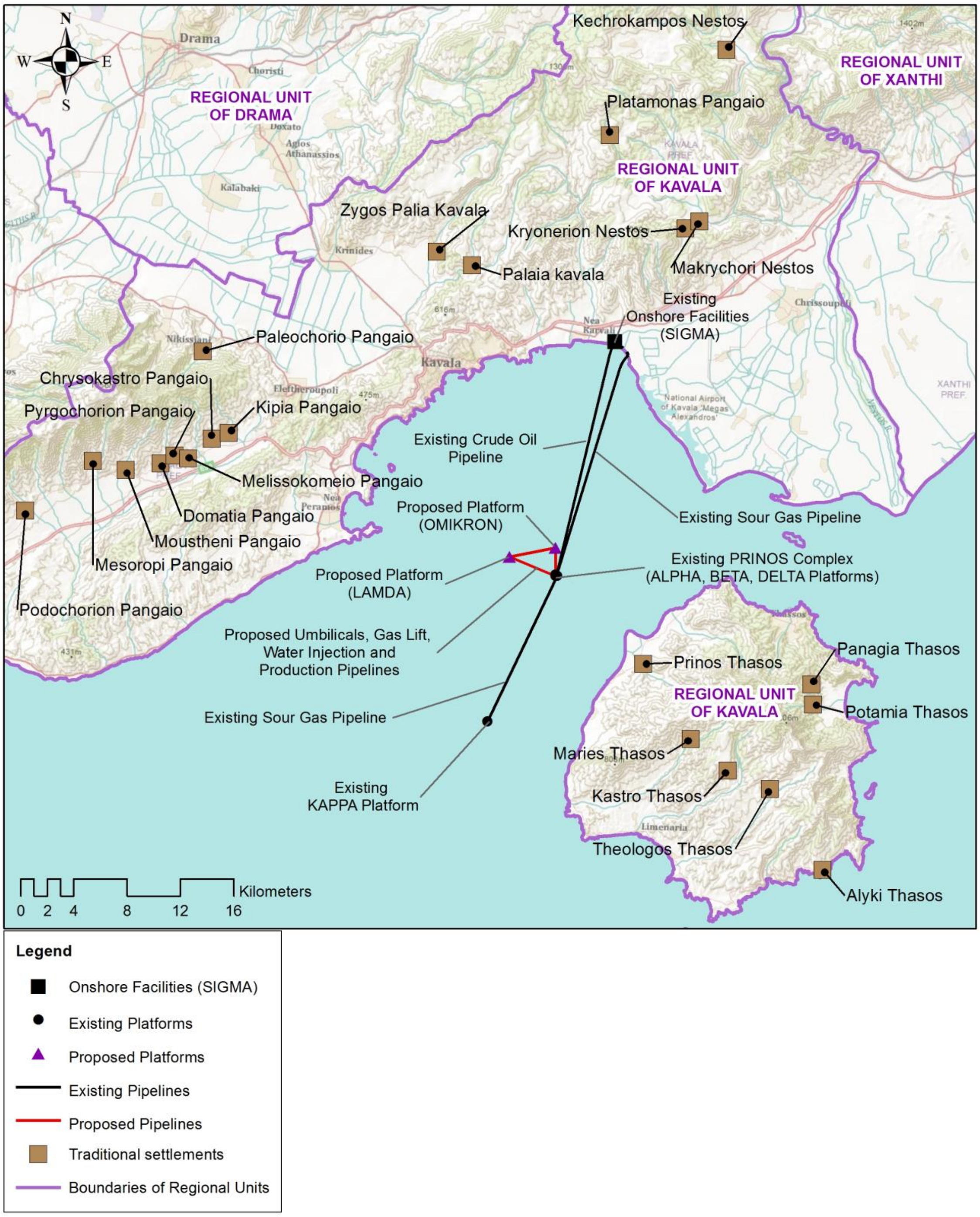
As regards cultural events taking place every year, these are:

- The Eleftheria – taking place the second semester of June in Kavala.
- The maritime week in Kavala.
- The grape festival during the months of August and September in the village of Elaiochori.
- The folk festival in Chrysoupoli.
- The potato festival in Lekani.
- The Kavazitiana, in September, at Ano Prinos, Thasos.
- The Klydona in Kavala.

The most traditional settlements in the Regional Unit of Kavala have been designated by the PD of 1978 (GG 594/Δ/13.11.1978) "*On the designation of some settlements of the country as traditional ones and determination of the terms and restriction in buildings in the plots thereof*", which are referred to in the following table:

Table 8-28: Traditional settlements in RU of Kavala)

Municipality	Traditional Settlement
Thasos	Alyki
	Theologos
	Kastro
	Mariai
	Palaiochorion
	Panagia (Anastasion)
	Potamia
	Prinos
Kavala	Zygos
	Palaia Kavala
Nestos	Kechrokampos
	Kryonerion (Karga)
	Makrychorion
	Platamon
	Stenopos
Pangaio	Domatia (Samakovo)
	Kipia
	Melissokomeion
	Mesoropi
	Moustheni
	Palaiochorion
	Podochorion
	Pyrgochorion
	Chrysokastron



Map 8-31: Traditional settlements in RU of Kavala

At a different time period, the above settlements as well as parts thereof have been designated as historical sites and Landscapes of Outstanding Natural Beauty (LONB). These are referred below, along with the respective Government Gazette issues designating them:

- Chersonisos, neighbourhood known as Panagia. It is a historical site and a LONB (GG 822/B/22.08.1974).
- Nea Peramos, beach It is a LONB (GG 363/B/11.04.1980).
- Agios Ioannis It is a LONB (MD Γ/1224/21-8-82).

- Part of the town of Eleftheroupoli. It is a historical site and a LONB (GG 128/B/28.03.1983).
- Ancient port of Thasos Port. It is a marine protected area (GG 74/B/5.02.1987).
- Alyki in Thasos. It is an archaeological site and a LONB (GG 166/B/3.03.1977).
- Astris in Thasos. It is an archaeological site and a LONB (GG 166/B/3.03.1977).
- Theologos in Thasos It is an archaeological site and a LONB (GG 166/B/3.03.1977).
- Kinyra in Thasos. It is an archaeological site and a LONB (GG 166/B/3.03.1977).
- Panagia in Thasos It is a historical site (GG 875/B/23.10.1972).

The area south of the wall of ancient Thasos, at a radius of 1,000 meters around it, is a LONB (GG 1501/B/14.12.1976).

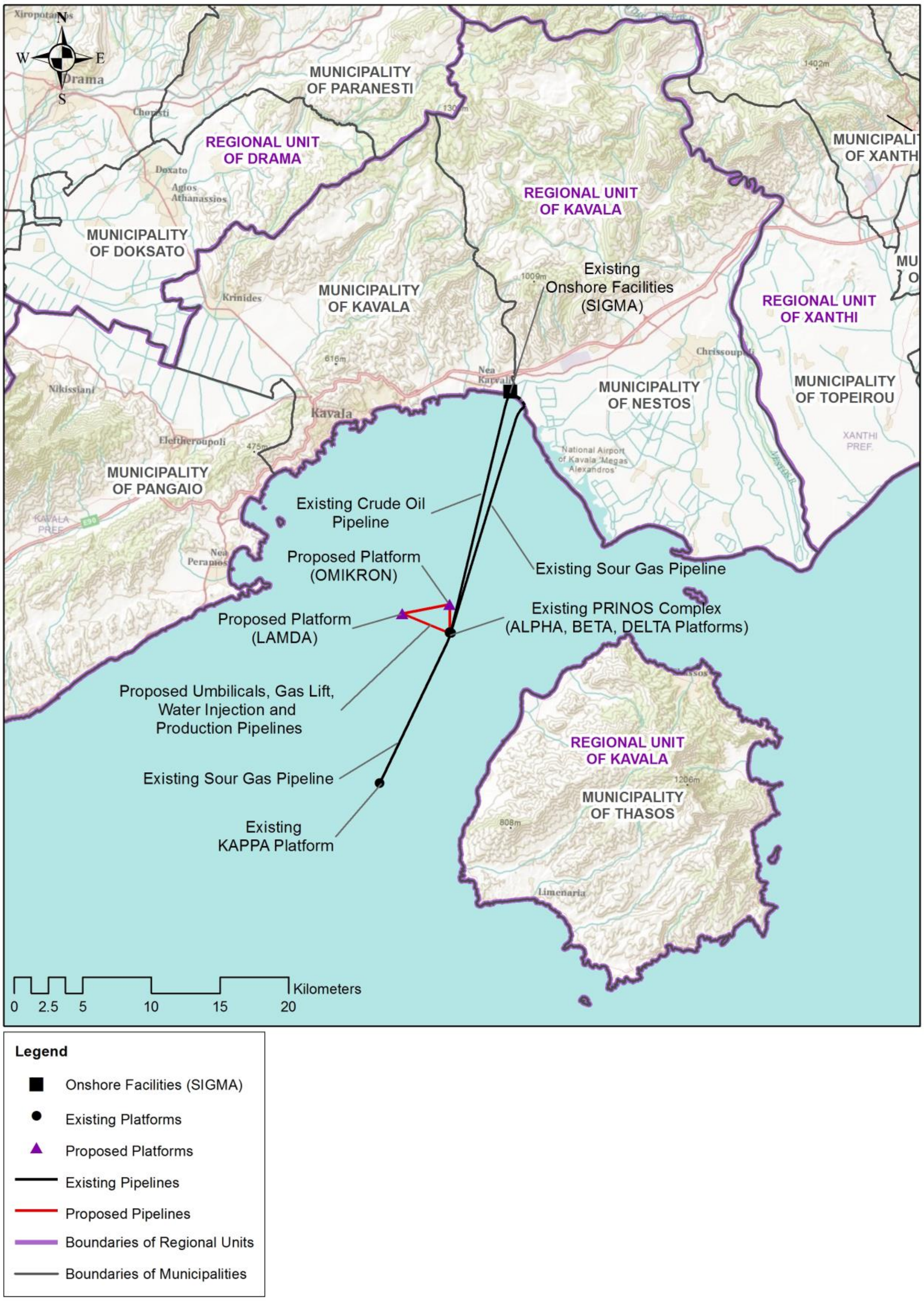
Summarizing, archaeological finding are not observed in the area of existing and proposed platforms and pipelines based on the results of the geophysical surveys. Moreover, during the environmental permitting procedure and the operation of the existing onshore and offshore facilities, there are not any negative opinions or specific suggestions from the competent archaeological department.

8.9 SOCIO-ECONOMIC ENVIRONMENT

The aim of this section – based on Greek environmental law specifications (MD 170225/14) – is to provide an overview of the socioeconomic conditions in Kavala area (Kavala Regional Unit, Kavala city, Thasos Island) in terms of demography, local GDP, employment and income sources. The information, which presented in this chapter, is based on material from secondary sources and especially from the Greek Statistic Authority or other official databases.

8.9.1 Demography

The municipalities of the Regional Unit of Kavala are Thasos, Kavala, Pangaio and Nestos as shown in the map below. The municipalities of RU of Kavala have a coastline and the main settlements are next or near the sea. The seats and the area of the above mentioned municipalities are given in the following table.



Map 8-32: Administrative divisions in the RU of Kavala

Table 8-29: Inventory of municipalities in the RU of Kavala

Regional Unit	Municipality	Seat	Area (m^2)
Kavala	Thasos	Thasos	380,097

Regional Unit	Municipality	Seat	Area (m^2)
	Kavala	Kavala	351,350
	Pangaio	Eleftheroupoli	701,427
	Nestos	Chrysoupoli	678,831

The permanent population of the RU of Kavala, according to the results of the 2011 census, amounts to 608,182 residents, covering, thus, 5.62% of the total population of the country. Out of all residents, 49.3% (299,643 residents) are male and 50.7% (308,539 residents) are female. 59.1% of the total population is classified as urban population, with an increase trend, whereas 40.9% of the population as rural population, with a decrease trend.

The following municipalities belong to the Regional Unit of Kavala (former Kavala Prefecture), based in Kavala:

- Municipality of Kavala based in Kavala
- Municipality of Nestos based in Chrysoupoli
- Municipality of Pangaio based in Eleftheroupoli
- Municipality of Thassos based in Thasos

The table below shows changes in resident population per municipality for the period 1991 - 2001 - 2011.

Table 8-30: Change in resident population in the Regional Unit of Kavala by Municipality, 1991 - 2001 - 2011.

AREA	1991	2001	2011	Change 1991 - 2001	Change 2001 - 2011
Regional Unit of Kavala	120,992	128,051	124,917	5.8%	-2.4%
Municipality of Kavala	60,784	63,572	58,790	4.6%	-7.5%
Municipality of Nestos	21,444	22,218	22,331	3.6%	0.5%
Municipality of Pangaio	29,523	31,644	32,085	7.2%	1.4%
Municipality of Thasos	13,315	13,451	13,770	1.0%	2.4%

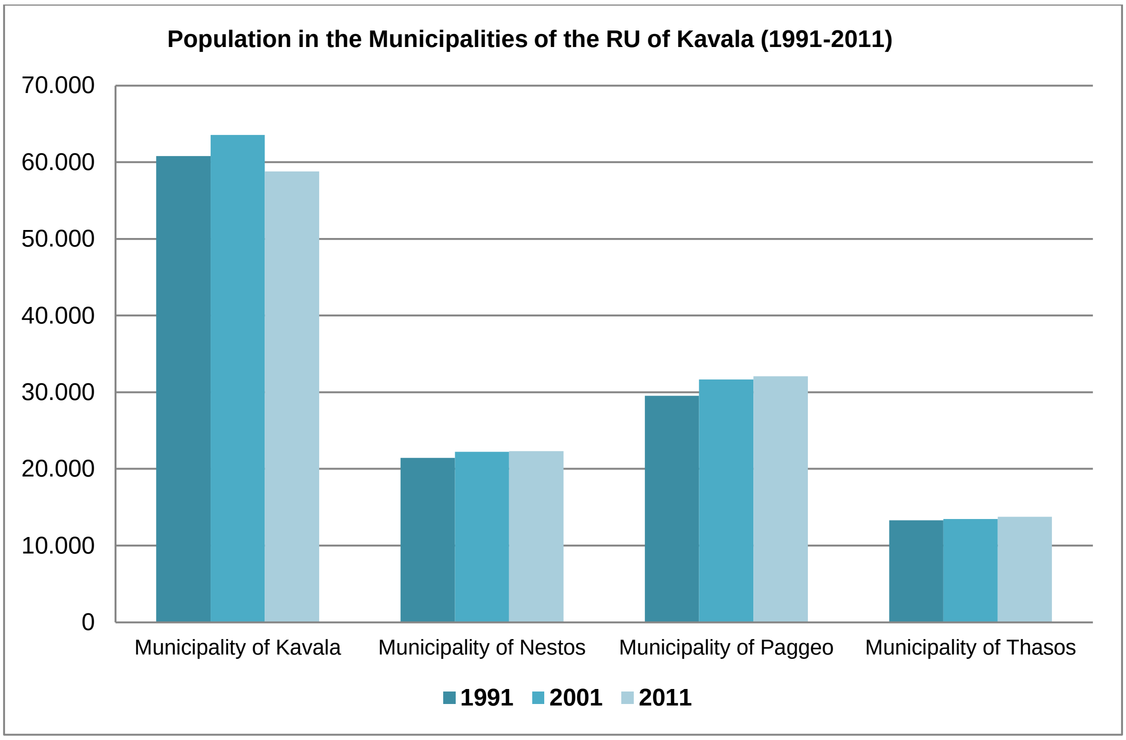


Diagram 8-13: Population in the municipalities of the RU of Kavala (1991-2011)

The quality of life is related to factors such as public and environmental health. Any potential impact, to the project's area health and safety quality, mainly relates to emissions from the release of hydrogen sulphide. The air emissions are below the permissible levels, to ensure the protection of public health and safety. Energean implements the necessary protection/prevention measures, to ensure the protection of public health, according to Protection Plans (especially, in case of hydrogen sulphide release).

The facilities are located in the offshore area of Kavala Gulf (while the onshore facilities are in an industrial area outside of the city), thus there is no interference of the operating activities in everyday life of Kavala and therefore there are not noticed any negative impacts.

Furthermore, based on the results of the measured pollutants of the sediments samples taken from the marine environment of the project area, are within the accepted limits/thresholds (Heavy Metals and PAHs), thus the impacts to environmental health are considered negligible.

Additionally, Energean has developed its own medical facilities, in order not to burden local health services. Overall the Company has been operating in the area for a very long period, without major incidents.

Under normal operating conditions there will be no impacts on public health and safety of wider Kavala area.

Taking into consideration the Safety, Prevention measures as well as the Preparedness and Emergency Response Plans of the company, in case of emergency, company's activities are and will continue to be conducted taking foremost account of the health and safety of employees, subcontractors, related personnel and the community while paying major attention to the

environment. In conclusion, under normal operating conditions, there is not any impact in the public health and public health facilities of the wider project area and especially the municipality of Kavala.

8.9.2 Refugees

It is noted that since mid 2015, Kavala port, has been used as an intermediate transport hub for refugees. The phenomenon of refugees transport through the Turkish coastline to the Eastern Greek islands of Aegean (like Chios, Lesvos, Kos and a number of smaller ones), has been largely increasing during 2015, as part of the serious deteriorating war situation in the middle east and in particular in Syria, Iraq but also in a number of African and Asian countries (Erythrea, Somalia, Pakistan, etc).

As part of the immediate strategy to cope of the situation by both the Greek government and the EU, ferry lines have been leased in order to transport the registered refugees from the islands of arrival (entry points) to various mainland locations (Athens – Piraeus, Thessaloniki and Kavala) and from these points to be then eased to be transported mainly to the northern Greek borders (mainly with FYRoM) as a gateway to Northern EU countries.

As stated above, Kavala port has been used as a transit point. The usual practice has been that those people have been spending only a few hours or so, before they get onto buses to continue their journey and therefore they are not really interfering with the local community apart form a small (possibly) commercial interaction on their way.

Generally the Region, has been in the crossroad of the different continents (Europe and Asia) and a number of countries (Greece, Turkey, Bulgaria), and all areas have the influence of the long history and exchange of habits through the ages. Also following a number of wars, a number of population changes and movements that have been taking place, a number of small ethnic and religion groups and minorities that are still apparent in most of the region's areas. However, it is safe to say that most of those communities have by now been integrated into the backbone of the Greek society with their own specific cultural, religious and in some occasion linguistic characteristics.

8.9.3 Productive structure of the local economy

The primary sector constitutes the main production activity of the RU of Kavala, both in terms of production contribution to the GDP of the REMTH and in terms of the number of persons occupied therein. Agriculture, animal farming, fishing, aquaculture (in sea and fresh water) and beekeeping are developing throughout the area and contribute significantly to its financial figures. Particular attention must be given to the problems relating to the ageing active agricultural population, the reduction of the income of the persons occupied therein, as well as the improvement of quality and promotion of the produced agricultural products, and they have to be dealt with.

The secondary sector includes, on the one hand, the businesses processing the primary sector, such as the natural and mineral wealth (oil and marble extraction), and on the other hand the businesses processing other raw materials. The RU of Kavala has a rich natural environment and climate conditions that favour the exploitation of renewable energy sources, with emphasis on the exploitation of geothermic, sunshine and wind potential. Wind farms already operate in the RU of Kavala, as well as a natural gas power plant, whereas the further utilization of these capabilities is of significant financial, social, environmental and geostrategic importance.

In addition to the growth potential offered by the primary and secondary sector, the tertiary sector is an important parameter for the RU of Kavala, mainly tourism, which is based – primarily, to summer tourism, which is focused on the island of Thasos and the coastal zone of the RU of Kavala. However, it is possible to prolong the tourist period and develop alternative forms of tourism (mountainous, religious, cultural, etc.).

As it is shown in the following tables and figures fishing activities, plus aquaculture and fisheries process units, provide income to many residents of Kavala and Thasos Island. Furthermore, tourism (hotels and restaurants) in Kavala and Thasos Island, as part of tertiary sector, contributes significantly to local GDP and employment.

The following table shows in detail the financial and production activities in the RU of Kavala (including the island of Thasos).

Table 8-31: Financial and production activities in the RU of Kavala16

AGRICULTURAL ACTIVITIES (agricultural land of 545,751,000 sq. meters)	
Businesses processing agricultural products	
19	Olive oil mills
12	Edible olive processing plants
6	Almond crushers
13	Grapes packaging plants
11	Kiwi packaging plants
11	Asparagus packaging plants
1	Cherry packaging plants
2	Ginning mills
8	Corn dryer plants
20	Wineries
1	Rice husking plants
1	Pickles manufacturing plants
ANIMAL FARMING ACTIVITIES (number)	
174	Dairy cattle
245	Beef cattle

[16] Financial & production activities in the RU of Kavala, Directorate of Rural Economy, (data retrieved on 22/04/2015)

222	Mixed cattle
1	Exotic ruminants species
650	Sheep (pure farms)
485	Goats (pure farms)
494	Sheep and goats (mixed farms)
120	Equines
32	Pigs
1	Chickens for meat production
1	Turkeys
1	Ducks
10	Geese
5	Rabbits
1	Ostriches
285	Bees
Animal farming activities (animal population)	
1,277	Dairy cattle
6,410	Beef cattle
1,554	Mixed cattle
4	Exotic ruminants species
165,086	Sheep (pure farms)
133,212	Goats (pure farms)
0	Sheep and goats (mixed farms)
179	Equines
4,014	Pigs
200,000	Chickens for meat production
300	Turkeys
200	Ducks
200	Geese
570	Rabbits
60	Ostriches
29,500	Bees (hives)
Businesses processing animal farming products	
3	Slaughterhouses
5	Meat processing
11	Dairy
6 (15 tn / day)	Fisheries
1 (110 tn / year)	Honey standardization
FISHERIES - AQUACULTURE	

Fishing boats (occupied personnel 975)	
36	Medium-distance fishing
275	Coastal fishing
Aquaculture farms	
18	Aquaculture farms
17	Mussel farms
Businesses processing fisheries products	
6 (5,470 tn)	Businesses processing fisheries products
TOURISM – SERVICES	
4	5***** Hotels
11	4**** Hotels
41	3*** Hotels
140	2** Hotels
62	1* Hotels
8	Auxiliary accommodations with 4 keys
112	Auxiliary accommodations with 3 keys
464	Auxiliary accommodations with 2 keys
221	Auxiliary accommodations with 1 key
8	Tourist camping
3615	Commercial enterprises
4359	Service provision businesses (except hotels, accommodations, tourist camping)
1	Spa tourism facilities - thermal springs (number)
ENERGY PRODUCTION	
Heat produced	
2 / 22.349 MW	Power greater than 0.5MW (number)
Hydroelectric generation	
1 / 0.94 MW	Power less than 10MW (number)
Solar generation	
63 units / 0.503 MW	Power less than 1 MWp (number)
1 unit /2 MW	Power greater than 1 MWp (number)
64 units / 2.503 MW	Total (number)
INDUSTRIAL UNITS	
1	Petrochemical plants (number)

The GDP per sector in the RU of Kavala and generally in the REMTH is given in the table below. It is noted that the local community of Kavala has received substantial economic benefits over

the last seven years through exploitation of the Prinos deposits by Energean and not least the preceding 28 years of oil and gas extraction in the RU of Kavala prior to Energean's involvement. Over the last seven years Energean has contributed over 40 mil. Euros in Greek government, through the payment of taxes, royalties and VAT, and through the contributions to employee Social Security Funds (healthcare, pension, etc). A percentage of these contributions are retroceded to the RU of Kavala. The Company has also contributed more than 90 million euros to the local economy in Kavala through:

- Salary payments to staff members;
- Employment of local contractors;
- Procurement of goods through local suppliers; and
- Use of local hotel, conferencing and restaurant facilities.

The Company employees 355 people in REMTH as well as 50 people in Athens. In addition, the Company recruits contractors on both a regular and ad hoc basis. The Company is seen as a key employer in the wider area with Company employee salaries supporting their wider families, etc. With households' sizes ranging from 3-4 people, this implies that the employee salaries support or contribute to the support in excess of 1,000 people.

Table 8-32: GDP per sector in the RU of Kavala (€ millions)

	2001				2009				AARC* 01/2009	AARC* 05/2009			
	Total	Primary	Secondary	Tertiary	Total	Primary	Secondary	Tertiary	Total	Total	Primary	Secondary	Tertiary
REMTH	5,237	709	1,386	3,142	8 264	462	1,840	5,962	6%	4%	-9%	5 %	6%
REMTH/Greece	4.1%	8.6%	5.0%	3.4%	4.0%	7.2%	4.6%	3.7%	0%	0%	-3%	2%	0%
RU of Kavala	1263	129	281	853	2227	95	506	1626	7%	5 %	-8%	11%	4%

*Average annual rate of change (AARC)

8.9.4 Employment per production sector and trends

The contribution of employment of RU Kavala per sector and per respective municipality is presented in the following table and diagram.

Table 8-33: Contribution of employment of RU Kavala per production sector, 2001

Municipality	Primary sector	Secondary Sector	Tertiary sector	Total
RU Kavala	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Thasos	9.6%	8.6%	7.5%	8.2%
Kavala	14.1%	52.6%	65.4%	51.7%
Pangaio	44.2%	22.6%	15.4%	23.3%
Nestos	32.1%	16.2%	11.7%	16.8%

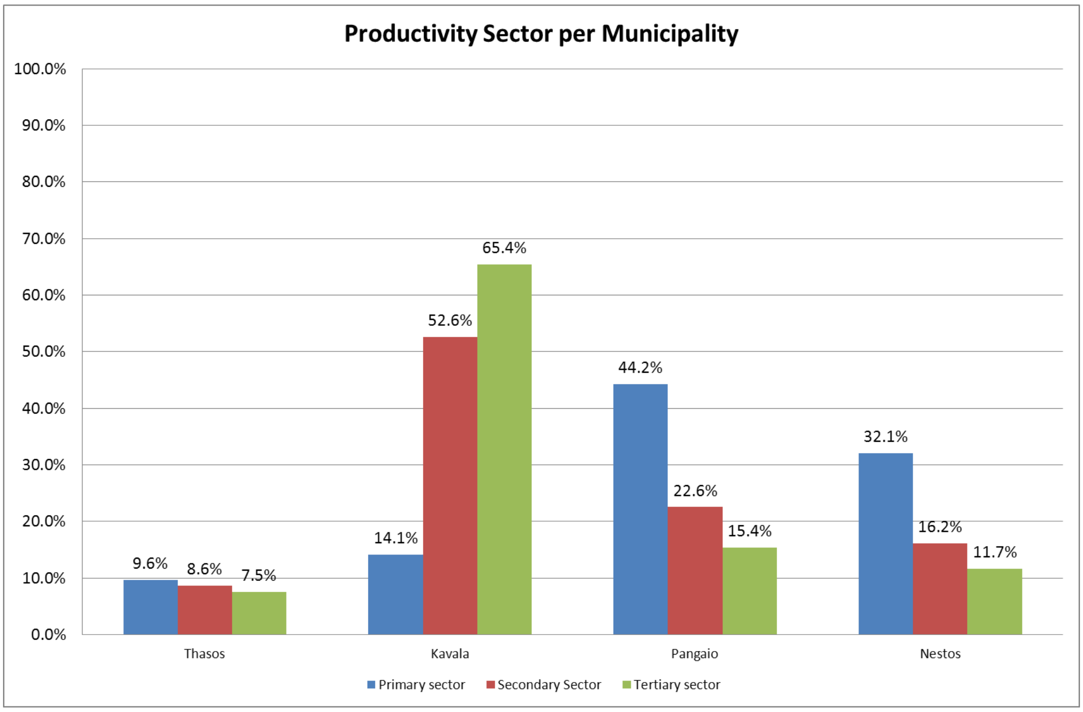


Diagram 8-14: Productivity Sector in the Regional Unit of Kavala by Municipality.

Overall the aforementioned four municipalities that constitute the RU of Kavala contribute by 23.2% in total in the productivity of the region (REMTH) and in particular 15.5% in the primary sector, 26.7% in the secondary and 26.6% in the tertiary sector as presented in the following table.

Table 8-34: Contribution of employment of RU of Kavala in the total REMTH, per production sector and per Municipality, 2001

Municipality	Primary sector	Secondary Sector	Tertiary sector	Total
RU Kavala	**15.5%**	**26.7%**	**26.6%**	**23.2%**
Thasos	1.5%	2.3%	2.0%	1.9%
Kavala	2.2%	14.0%	17.4%	12.0%
Pangaio	6.9%	6.0%	4.1%	5.4%
Nestos	5.0%	4.3%	3.1%	3.9%

Energean currently employs 355 persons either directly or indirectly from the region as well as about 50 more in various locations of Athens. The company has ensured positions of employment at sea rigs of Prinos, on the terrestrial (onshore) facilities of Nea Karvali and Athens offices, and proved that oil production could be fully compatible with the highest environmental responsibility, the health and safety conditions for personnel and the tourism activity, which is particularly popular destinations such as Thasos.

The relevant direct or indirect influence to the employment of the wider area of Kavala as well as the RU of Kavala has positive contribution the secondary production sector as well as to the local economy of the RU of Kavala.

8.9.5 Unemployment

The employment conditions in the RU of Kavala are shown in the following table.

Table 8-35: Employment conditions per municipality of the RU of Kavala

Municipality	Employees	Unemployed	Pupils/Students	Pensioners	Housewives	Others
Thasos	4,478	990	1,765	3,918	1,613	1,006
Kavala	22,033	5,987	12,282	17,449	7,702	5,048
Pangaio	9,849	2,241	4,455	9,222	3,670	2,648
Nestos	7,060	1,612	2,920	6,360	2,534	1,845

In the following diagrams is depicted the percentages of the population conditions per municipality of the Regional Unit of Kavala.

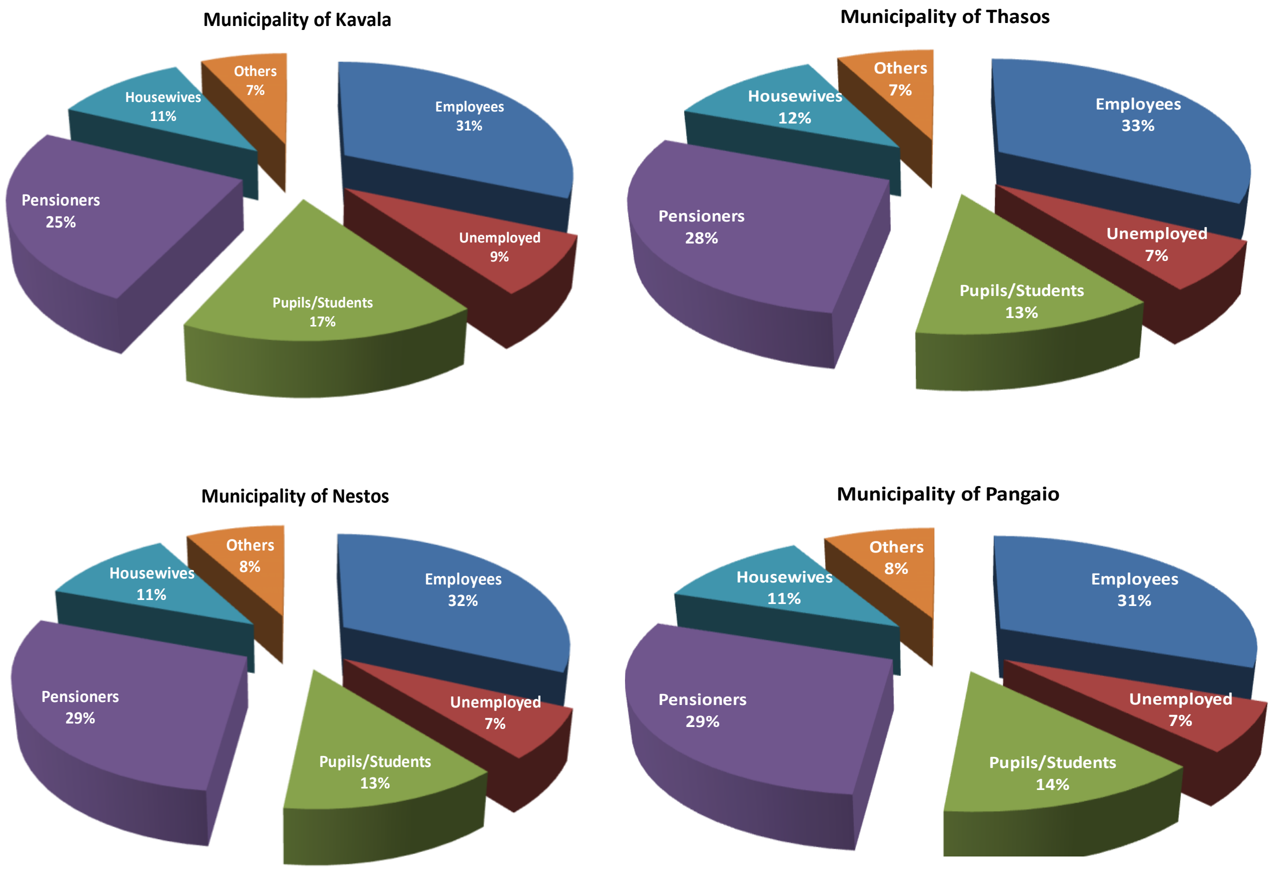


Figure 8-11: Population conditions in RU of Kavala

The employment in the Regional Unit of Kavala ranges between 31-33%, while the unemployment between 7-9%.

8.10 TECHNICAL INFRASTRUCTURES

8.10.1 Transport infrastructure

The transport infrastructure in the wider project area (road network, railway, airports and ports) is shown in the following map and is described in brief in the following paragraphs.

Map 8-33: Transport infrastructures

8.10.1.1 Road network

The road network infrastructures of RU of Kavala consist of the axes of Egnatia Odos (completed or otherwise), the national roads network (classified as primary, secondary and tertiary), as well as established and main district roads. The network is sufficiently dense, in good condition and allows smooth access. The coastal areas are connected to each other through the district roads. The Thassos road network includes a paved peripheral road, through which pass roads that lead to the most popular coastal areas.

8.10.1.2 Railway Line

The existing railway line connects Thessaloniki with Ormenio, Evros, and subsequently with the Greco-Bulgarian border, passing through all urban centres, with the exception of Kavala.

8.10.1.3 Ports

The central port of Kavala serves i) the fishing fleet, ii) tourism, iii) the passengers from and to Thassos, Limnos, Mitilini and Samothrace, iv) water sports. The Nea Karvali port named "Philippos II" is used for commercial reasons. The ports of Keramoti (Keramoti – Thassos ferry) and the central port of Thassos are also considered as significant for passenger use and fishing fleet. The ports of Prinos and Limenaria of the RU of Thasos, as well as the port of Nea Peramos mainly serve local passenger traffic. The latter also serves the transport of employees to the oil extraction facilities.

The tourism and yacht ports consist of zones in existing ports, harbours and fishing refuges. No connections between them have been planned, whereas the exclusive yacht port (marina) in Limenaria, Thasos – with a capacity of 70 yachts (against 230 yachts that were foreseen in the R.F.S.P.S.S.) has been included in the sectoral project of Competitiveness and Shipping on 26/09/2011 and it is expected that its construction will begin shortly.

The tables below show the number of passengers arriving at the ports of Kavala and Keramoti.

Table 8-36: Passenger traffic of "Kavala-Prinos" ferry line (Source: Kavala port Authority)

	Passengers							
Month	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
January	12,967	9,208	7,986	3,958	7,285	6,587	7,308	8,973
February	11,928	8,175	6,956	3,879	6,471	5,631	6,517	7,960
March	14,748	12.856	8,845	7,108	7,906	10,045	9,031	9.562
April	18,952	14,648	11,125	9,296	14,004	15,711	14.077	16,023
May	23,760	17,243	17,969	13,789	19,435	19,624	21,283	22,829
June	28,849	28,884	25,419	17,142	27,429	28,243	30,133	29,360
July	50,174	43,336	45,203	41,064	52,970	50,673	52,275	52,188
August	61,963	58,448	60,561	53,119	66,976	64,700	65,823	64,386
September	28,886	23,224	23,319	16,858	24,494	29,065	30,692	30,008
October	13,398	12,249	11,398	7,221	11,588	16,914	16,589	17,426
November	10,688	7,904	7,242	9,711	11,472	10,728	12,248	10,498
December	9,755	5,571	6,430	9,365	8,742	8,320	8,726	9,014
Total	**286,068**	**241,746**	**232,453**	**192,510**	**258,772**	**266,241**	**274,702**	**278,227**

Table 8-37: Passenger traffic of "Keramoti - Thassos Port" ferry line (Source: Kavala port Authority)

	Passengers							
Month	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
January	32,562	38,006	36,624	35,803	33,937	32,139	28,153	31,294
February	33,645	35,966	36,682	37,017	31,405	26,912	27,146	30,414
March	50,095	57,724	48,469	48,645	44,391	38,244	37,660	39,911
April	79,038	87,405	76,150	74,730	69,306	63,335	63,070	63,158
May	113,027	134,339	109,610	113,170	102,923	91,420	100,154	101,218
June	151,822	190,371	181,632	142,452	157,889	148,826	173,713	177,135
July	248,460	259,340	272,047	248,196	261,370	253,156	259,625	301,446
August	287,882	326,556	329,260	304,866	325,196	309,364	321,981	372,384
September	144,037	159,812	152,260	139,450	165,211	158,647	173,369	190,108
October	67,731	71,259	66,043	56,324	48,212	54,935	59,705	56,457
November	43,294	48,023	49,696	44,913	39,425	35,744	35,021	37,530
December	41,645	42,791	43,858	38,221	38,676	33,393	33,749	33,692
Total	**1,293,238**	**1,451,592**	**1,402,331**	**1,283,787**	**1,317,941**	**1,246,115**	**1,313,346**	**1,434,747**

Table 8-38: Passenger traffic of “Kavala-Samothraki” ferry line (Source: Kavala port Authority)

	Passengers		
Month	**2007**	**2008**	**2009**
January	203	112	1,096
February	217	50	101
March	75	56	-
April	155	150	-
May	190	220	-
June	281	293	-
July	1,118	986	-
August	3,222	2,061	-
September	487	572	-
October	116	107	-
November	82	78	-
December	76	44	-
Total	**6,222**	**4,729**	**1,197**

The above tables, show that the largest passenger traffic can be found in the “Keramoti - Thasos Port” ferry line, which increases every year, reaching, in 2014, 1,434,747 passengers. The line “Kavala-Prinos” follows, which, however, shows a small decline in passenger numbers The above tables, show that the largest passenger traffic can be found in the “Keramoti - Thasos Port” ferry line, which increases every year, reaching, in 2014, 1,434,747 passengers. The line “Kavala-Prinos”, however, shows a small decline in passenger numbers in 2007, but significant increase between 2008 and 2014. Subsequently, with regard to the line “Kavala - Samothraki” it must be noted that 2014 shows a significant increase over 2013.

In addition, a table concerning cruises passenger traffic at the port of Kavala is shown, which has increased compared to 2012.

Table 8-39: Passenger traffic of cruises (Source: Kavala port Authority)

	2009	2010	2011	2012	2013
Number of ships	25	11	10	10	15
Passengers	7,325	4,233	2,708	4,323	7,099

8.10.1.4 Air transport

In the RU of Kavala one national-civil airport operates, which covers air travel to the area. The “Megas Alexandros” airport is located at Chrysoupoli, and, essentially, is the main point of entry of foreign tourists to the region and, in particular, to Thasos. It was constructed in the late 1970s and, initially, served only chartered flights.

The regular flights are flights to and from Athens, with a fixed number of 36 weekly flights (18 “Kavala-Athens” flights and 18 “Athens-Kavala” flights), as well as international chartered flights during the summer. The following table shows the arrivals of foreigners at the Chrysoupoli airport in the years 2012 and 2013.

Table 8-40: International tourist arrivals at the Chrysoupoli airport (Source: Business Plan of the RU of Kavala)

Passengers		
Month	**2012**	**2013**
January	0	0
February	0	0
March	145	592
April	1,719	1,188
May	8,165	8,268
June	12,024	13,921
July	18,127	17,245
August	15,720	16,435
September	9,843	11,760
October	1,952	2,894
November	95	178
December	143	176
Total	**67,933**	**72,657**

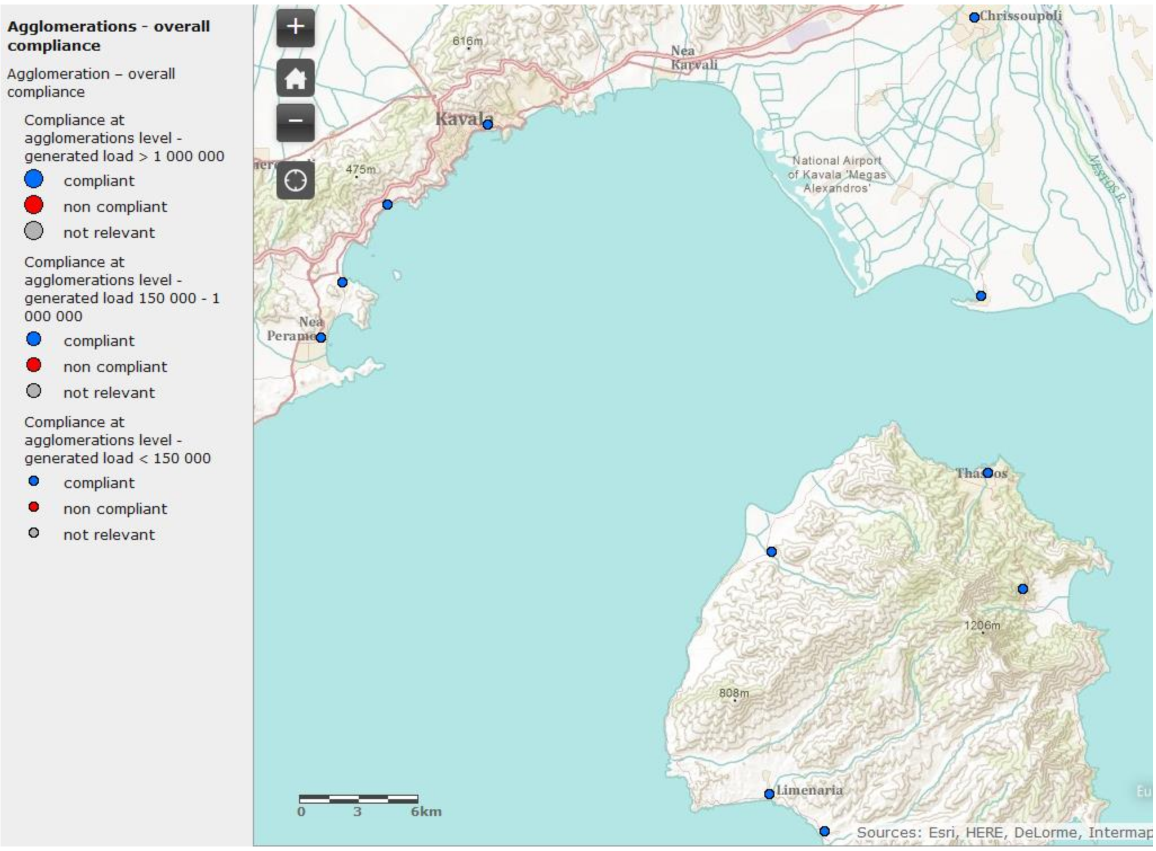
The table above shows that the arrivals of foreigners at the airport of Chrysoupoli has increased by 6.95%

During the operation of the existing onshore and offshore facility there will be no extensive use of the regional public utilities and as a result the technical infrastructure is not affected.

8.10.2 Water supply / sewerage / urban wastewater

Wastewater treatment plants

The Wastewater treatment plants in the wider area are shown in the following map.



Map 8-34: Wastewater treatment plants

Solid waste / garbage management

In Kavala operates the landfill with the same name, which is located at the Eski Kapou location, at the boundaries of the Municipality of Kavala and the municipal unit of Philippoi. The landfill serves the aforementioned areas, whereas the location of a Material Recycling Facility (MRF) is under study for the wider area of the RU of Kavala.

Electricity production

In the RU of Kavala, two private power plants are in operation (thermoelectric, combined circle, etc.).

Table 8-41: Private Power Plants

Regional Unit	Municipality	Settlement	Location	Capacity MW
Kavala	Kavala	N. Karvali	Kavala CCGT Power Plant	440
	Pangaio	Karyani	Pidima Papakosta	0.32
Thasos	Thasos	Potamia	Potamia Quarry	0.51

Renewable Energy Sources

- Wind farms: Currently one wind farm undergoing licensing procedure can be found at the location Soumadotopoi, on the island of Thasos with installed capacity of 72 MW.
- Solar parks: In the RU of Kavala, at the location Kokkinochori, there is a solar park with an installed capacity of 2 MW. Three more parks are in the licensing phase, two of which within the IZ of Kavala, with installed capacity of 3.8 and 5 MW, respectively, whereas the third on is at the location Vounochori of the Municipality of Kavala, with a capacity of 28 MW.
- Geothermal field: Two geothermal fields can be found – one located in the Municipality of Nestos, Erateino settlement (currently in the stage of signing the contract) and the other at the Akropotamos settlement.
- Small hydroelectric plants: There are two small H/P (Hydroelectric Plants) at the location Nestos and Paradeisos, with installed capacity of 0.94 and 0.75 MW, respectively.

During the operation of the existing onshore and offshore facility there will be no extensive use of the environmental infrastructure systems such water supply system, electrical energy transmission, and telecommunication network and as a result the technical infrastructure is not affected.

8.10.3 Electricity, natural gas and telecommunications networks

Power transmission network

The power transmission network to the east of Thessaloniki consists mainly of TL (Transmission Lines) of 150 kV, as well as three TL of 400 kV. More specifically:

- The single circuit TL with triplet conduit (B΄B΄B΄/400 kV) Thessaloniki HVC (High Voltage Center) – Philippoi HVC;
- The dual circuit TL with triplet conduit (B΄B΄B΄/400 kV) Philippoi HVC – N. Santas HVC;
- The single circuit TL with triplet conduit (B΄B΄B΄/400 kV) N. Santas HVC – Turkish border.

The power grid of the area under assessment consists of the TL Kavala - Philippoi HVC In order to improve the power transmission capacity to and from the REMTH, the upgrade of the line from E/150 to 2B/150 (code. ΓΜ150.Σ.41, ΑΝ150.Σ.23) is planned. Upon completion of the upgrade, the TL B/150 Kavala – Philippoi HVC and Kavala - Xanthi will be disconnected from the Kavala S/T and will be connected to each other, at the open ends, overriding the Kavala S/S. The project will also contribute to the improvement of the reliability of the power supply to the phosphate fertilizers factory.

Natural gas network

In the area under assessment the Kavala high-pressure branch (80 bar) can be found, which is

part of the national natural gas network. However, a medium and low-pressure network has yet to be implemented, in order to supply the area of Kavala and the island of Thasos. Additional provisions related to the new interstate "Trans Adriatic Pipeline", with the purpose of transporting natural gas to Italy and Europe, through Albania. Part of the routing is located in the northern part of the R.U of Kavala

Submarine pipelines and submarine cables Hellenic Electricity Distribution Network Operator S.A

According to Kavala HEDNO S.A. (Hellenic Electricity Distribution Network Operator SA), there is a submarine cable in the area of Port of Thasos - Keramoti, installed outside the area of interest. No submarine pipeline can be found in the area under assessment.

8.10.4 Health services

The Health Unit of Kavala has the following infrastructure:

- Kavala Hospital: This is the general hospital of the area. Services include surgery, internal medicine, paediatrics etc.
- Health Centres: These are primary care facilities with the ability to stabilize and transport patients and perform basic diagnostic tests. In the area there are three Health Centres at Chrisoupoli, Eleftheroupoli and Prinos (Thasos Island).

Patients or injured are transferred to health care facilities by the National Centre for Immediate Response (EKAB), which is actually the first responder. EKAB belongs to the National Health System. In the event of emergencies, accidents or casualty incidents the health care facilities act provides the first health services until casualties can access more specialised care from general hospitals or in larger centres, if required (ie. Thessaloniki).

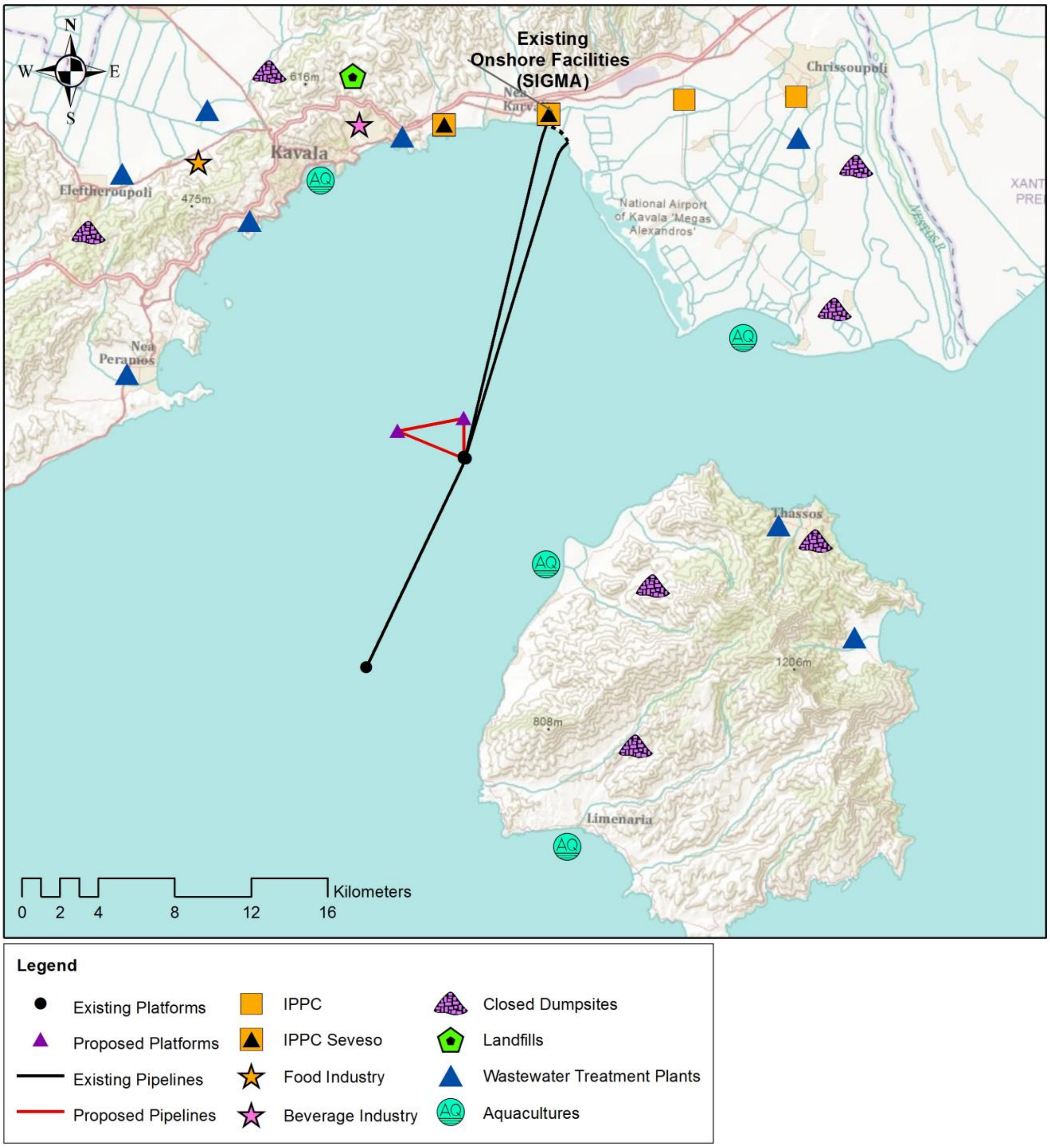
8.11 EXISTING PRESSURES ON THE HUMAN AND NATURAL ENVIRONMENT

The potential anthropogenic pressures on the environment of the wider study area (RU of Kavala) are:

- Overexploitation of the land, unregulated use of the groundwater for irrigation, over – disposal of the wastes in the aquifer;
- Contamination from the fertilizers and the pesticides;
- Wastewater treatment plants;
- Landfills and dumpsites;
- Industries in the vicinity of the project area;
- Marine traffic;
- Fishing activities and aquacultures;

- Tourism;
- Mines and quarries;
- Livestock's.

The following map shows the location of industries, aquacultures, wastewater treatment plants and landfills in the wider project area.



Map 8-35: Location of industries, aquacultures, wastewater treatment plants and landfills in the wider project area

9 ENVIRONMENTAL AND SOCIAL SCOPING

9.1 INTRODUCTION

The overall objective of carrying out the scoping exercise is to determine the key parameters, which may require additional attention during the preparation of the ESIA. The purposes include

- To identify the key environmental issues and potential impacts associated with each of the project phases;
- To share this information along with project specifics, with the relevant identified stakeholders, in order to make sure the identified issues are reflecting the true nature of issues on the ground and in case there are any further to be included in the assessment conducted in the framework of the ESIA.

While carrying out scoping for the ESIA is not obligatory in the Greek legislative system, nothing precludes this step being undertaken (as it has in this assessment).

The current Greek legislative framework prescribes analytical both the screening process and the scoping stages by:

- Classifying all projects and activities as per the type / capacity / population served / etc (screening process), with MD 1958/2012 and
- Setting out analytical specifications for all categories / classes of projects and activities, with MD 170225/2014.
- Specialising particular requirements in the cases that project falls within protected areas or fall within particular Directives (IPPC, Offshore Directive, etc) and defining the baseline studies required to be performed within the framework of the ESIA.

It is noted, that the Greek legislative framework, is fully harmonised with all relevant EU Directives and therefore the provisions set out by the aforementioned legislative acts, are fully in line with the EU policies. In particular, with regards to the provisions of Article 5(2) of Directive 97/11/EC, which requires the Member State (MS) to implement a procedure whereby, at a minimum, developers can ask competent authorities for advice on the information to be submitted under the EIA procedure. This procedure has been defined by Article 2 of L.4014/2011, where the scoping report (in particular Preliminary Determination of Environmental Requirements), is foreseen as part of a **voluntary procedure**. Moreover the specifications of the scoping report, of have been defined in Annex 1 of the MD 170225/2014 for the cases that the project developer, wishes to follow this.

Although, the voluntary procedure of the scoping stage was chosen not to be followed, Energean has decided to perform a scoping exercise in order to

- Be in line with international best practices and EBRD's PRs;
- Identify environmental and social impacts potentially associated with the Project which should be considered in the ESIA,
- Inform and consult with stakeholders discuss with them:
  - ⇨ The baseline information (including the existing facilities environmental and social issues) and the story of the company in the area over the last three decades;
  - ⇨ The company plans for further development;
  - ⇨ The relevant legislative requirements as those arise from national, EU and EBRD standards;
  - ⇨ The methodology of the ESIA assessment;
  - ⇨ The specialist studies to be conducted in the framework of the ESIA as well as the overall designing of the new planned developments

Scoping activities involved meetings key institutional stakeholders identified during the development of the Stakeholder Engagement Plan (SEP) and are described in more detail in the SEP.

In the following chapters, the main environmental and social impacts are considered in terms of their significance and mitigation measures required to avoid, reduce, offset or compensate the impacts

9.2 IDENTIFICATION OF KEY ENVIRONMENTAL AND SOCIAL IMPACTS

In the following chapter, a primary environmental scoping exercise was done, for both routine and unplanned events.

The methodology used, included the following steps:

- Identification of the distinct project activities, for each phase of the project, that could potentially cause an interaction with the physical, biological or social environment;
- Identification of the potential receptors types present in the project area. Receptors were identified for the physical, biological, and social environment, considering both marine and terrestrial receptor types.
- The preparation of a matrix, which lists the project activities against the potential affected receptor types;
- A workshop with the ESIA team and Energean where each project activity was systematically evaluated for potential interactions with receptors. Any potential interactions were classified as 'positive', 'scoped out' or 'Scoped in'.
- For those interactions that were 'scoped out' from further assessment, the supporting rationale is provided in this Chapter.
- For any positive impacts or 'scoped in' interactions, a detailed assessment of potential impacts is provided in Chapter 11.

- Discussion of a similar (simplified) matrix with stakeholders to make sure they are also involved in the process (as further described in the SEP, Annex 11).

The developed matrix is presented in the following tables, whereas the justification of the scoping out of particular activities is further given below as per environmental parameter.

Table 9-1: Scoping – interaction table during construction phase

Activity		Marine											Terrestrial								Social								
		Physical				Biological							Physical					Biological											
Construction phase																													
		Water quality	Sediment quality	Seabed features	Underwater noise	Benthic habitats	Coastal marine habitat	Plankton	Fish ecology	Marine mammals	Sea-coastal birds	Protected areas	Soils & landscape	Surface & groundwater	Air quality	Global climate	Airborne noise	Flora species	Fauna species	Protected areas	Fisheries (commercial / subsistence)	Tourism	Other livelihoods	Marine traffic	Cultural heritage	Workforce	Community health & safety	Infrastructure & services	Community cohesion
Routine activities	Transport of components and final SIP assembly at a deep-water quay																												
	Onshore fabrication of pipeline (including possible changes to breakwater, levelling and bringing to sea																												
	Transport SIP to site																												
	Installation of permanent mooring																												
	Leg lowering and suction anchor installation																												
	Topside jack-up																												
	Installation of pipelines and umbillicals																												
	Burial of pipelines and umbilicals																												
	Operation of support vessels																												
	Establishment and enforcement of safety exclusion zone including the placement of marker buoys																												
	Maintenance of an offshore workforce																												
	Modification to Delta (new risers / J-tubes)																												

Activity		Marine											Terrestrial							Social									
		Physical				Biological							Physical					Biological											
Construction phase																													
		Water quality	Sediment quality	Seabed features	Underwater noise	Benthic habitats	Coastal marine habitat	Plankton	Fish ecology	Marine mammals	Sea-coastal birds	Protected areas	Soils & landscape	Surface & groundwater	Air quality	Global climate	Airborne noise	Flora species	Fauna species	Protected areas	Fisheries (commercial / subsistence)	Tourism	Other livelihoods	Marine traffic	Cultural heritage	Workforce	Community health & safety	Infrastructure & services	Community cohesion
Unplanned	Worst case unplanned event (damage to Delta platform leading to large oil spill)																												

LEGEND:

No interaction	
Scoped out – possible low level interaction	
Scoped in – definite interaction, potentially significant	
Positive interaction	

Table 9-2: Scoping – interaction table during operation phase

Activity		Marine											Terrestrial								Social								
		Physical				Biological							Physical					Biological											
Operation phase																													
		Water quality	Sediment quality	Seabed features	Underwater noise	Benthic habitats	Coastal marine habitat	Plankton	Fish ecology	Marine mammals	Sea-coastal birds	Protected areas	Soils & landscape	Surface & groundwater	Air quality	Global climate	Airborne noise	Flora species	Fauna species	Protected areas	Fisheries (commercial / subsistence)	Tourism	Other livelihoods	Marine traffic	Cultural heritage	Workforce	Community health & safety	Infrastructure & services	Community cohesion
Routine activities	Maintenance of exclusion zones																												
	Mooring of Energean Force																												
	Installation of conductors (new wells only)																												
	Spuding and drilling of wells, including cementing of initial casings																												
	Seabed cuttings disposal (0-400m)																												
	Cuttings treatment and disposal (400-3,150m)																												
	Construction of flow lines																												
	Water injection																												
	Gas lift																												
	Injection of chemicals																												
	Use and handling of hazardous materials																												
	Maintenance flaring																												
	Disposal of produced water to sea at Delta																												
	Stormwater discharge to sea																												
	Natural resource usage (indirect form grid use)																												

Activity		Marine											Terrestrial								Social								
		Physical				Biological							Physical					Biological											
Operation phase																													
		Water quality	Sediment quality	Seabed features	Underwater noise	Benthic habitats	Coastal marine habitat	Plankton	Fish ecology	Marine mammals	Sea-coastal birds	Protected areas	Soils & landscape	Surface & groundwater	Air quality	Global climate	Airborne noise	Flora species	Fauna species	Protected areas	Fisheries (commercial / subsistence)	Tourism	Other livelihoods	Marine traffic	Cultural heritage	Workforce	Community health & safety	Infrastructure & services	Community cohesion
	Any ballasting / deballasting																												
	Maintenance of an offshore workforce																												
	Operation of Energean Force																												
	Operation of support vessels																												
Unplanned	Worst case unplanned event (loss of well control with large oil spill, leak from pipeline or spill from loading point)																												

LEGEND:

No interaction	
Scoped out – possible low level interaction	
Scoped in – definite interaction, potentially significant	
Positive interaction	

Table 9-3: Scoping – interaction table during abandonment phase

Activity		Marine											Terrestrial								Social								
		Physical				Biological							Physical					Biological											
Abandonment phase																													
		Water quality	Sediment quality	Seabed features	Underwater noise	Benthic habitats	Coastal marine habitat	Plankton	Fish ecology	Marine mammals	Sea-coastal birds	Protected areas	Soils & landscape	Surface & groundwater	Air quality	Global climate	Airborne noise	Flora species	Fauna species	Protected areas	Fisheries (commercial / subsistence)	Tourism	Other livelihoods	Marine traffic	Cultural heritage	Workforce	Community health & safety	Infrastructure & services	Community cohesion
Routine activities	Mobilize light work over rig to sites																												
	Plug wells																												
	Sever conductors																												
	Operation of support vessels																												
	Maintenance of an offshore workforce																												
	Clean and leave pipelines in situ																												
	Disposal of pipeline rinse water to sea at Delta																												
	Anchoring of support vessels / barge																												
	Existing platforms																												
	Dispersal of drill cuttings from piles																												
	Removal of topside																												
	Cut piles																												
	Remove jacket																												
	Onshore deconstruction																												
	New platforms																												
	Removal of SIP																												
	Reuse																												

Activity		Marine											Terrestrial								Social								
		Physical				Biological							Physical					Biological											
Abandonment phase																													
		Water quality	Sediment quality	Seabed features	Underwater noise	Benthic habitats	Coastal marine habitat	Plankton	Fish ecology	Marine mammals	Sea-coastal birds	Protected areas	Soils & landscape	Surface & groundwater	Air quality	Global climate	Airborne noise	Flora species	Fauna species	Protected areas	Fisheries (commercial / subsistence)	Tourism	Other livelihoods	Marine traffic	Cultural heritage	Workforce	Community health & safety	Infrastructure & services	Community cohesion
Unplanned	Worst unplanned event (localised spill)																												

LEGEND:

No interaction	
Scoped out – possible low level interaction	
Scoped in – definite interaction, potentially significant	
Positive interaction	

9.2.1 Routine activities

9.2.1.1 Climate & bioclimate characteristics

Following the aforementioned scoping exercise, it was identified that no interaction or serious concern has been identified from the activities that could potentially adversely impact the climatic and bioclmatic characteristics.

The justification of the scoping in / out is provided below per project phase.

Construction phase

- Transport of components and final SIP assembly at a deep-water quay was scoped out since although emissions of GHGs will be generated from vessel operation, it is expected that those will be small and thus will not significantly contribute to any climate change. GHG emissions from the project have been quantified for all phases of the project to support this.
- Onshore fabrication of pipelines (including possible changes to breakwater, levelling and bringing to sea) was scoped out since although some combustion emissions (e.g. CO_2) from equipment and vehicles are expected to be produced during this activity, they are expected to be rather small and dispersion will be localized. Given the limited duration, extent and scale, potential impacts to climate change are considered negligible
- Operation of support vessels was also scoped out since although emissions of GHGs will be generated from vessel operation, it is expected that those will be small and thus will not significantly contribute to any climate change. GHG emissions from the project have been quantified for all phases of the project to support this.

Operation phase

- Activities including the operation of Energean Force are scoped out since the rig is not self-propelled and therefore does not emit combustion emissions.
- Operation of support vessels was also scoped out since although emissions of GHGs will be generated from vessel operation, it is expected that those will be small and thus will not significantly contribute to any climate change. GHG emissions from the project have been quantified for all phases of the project to support this.

Abandonment phase

- Activities to mobilise work over rig to sites were scoped out since although emissions of GHGs will be generated from vessel operation, it is expected that those will be small and thus will not significantly contribute to any climate change. GHG emissions from the project have been quantified for all phases of the project to support this.
- Operation of support vessels was also scoped out since although emissions of GHGs will be generated from vessel operation, it is expected that those will be small and thus will not significantly contribute to any climate change. GHG emissions from the project have been quantified for all phases of the project to support this.

9.2.1.2 Morphological and topological characteristics

Following the aforementioned scoping exercise, it was identified that no interaction or serious concern has been identified from the activities that could potentially adversely impact the morphological and topological characteristics.

Construction phase

- Activities related the onshore fabrication of pipeline (including possible changes to breakwater, levelling and bringing to sea), were scoped out since the levelling activities are expected to be small scale and not significantly altering the landscape.

Operation phase

- Installation of conductors (for new wells only), was scoped out since although the activity is expected to change seabed features in the area immediately surrounding the conductors, the extend will be very localized and thus this is not considered to be a significant impact.

Abandonment phase

- Sever conductors, was scoped out since although the activity is expected to change seabed features in the area immediately surrounding the conductors, the extend will be very localized and thus this is not considered to be a significant impact.
- Anchoring of support vessels / barge was scoped out since although the activity is expected to change seabed features in the area where anchors will be dropped, the extend will be very localized and thus this is not considered to be a significant impact.
- Cutting piles on the existing platforms was scoped out since although the activity is expected to change seabed features in the area surrounding the piles, the extend will be very localized and thus this is not considered to be a significant impact.

9.2.1.3 Geological, tectonic and pedological characteristics

Following the aforementioned scoping exercise, it was identified that no interaction or serious concern has been identified from the activities that could potentially adversely impact the geological, tectonic and pedological characteristics.

The justification of the scoping in / out is provided below per project phase.

Construction phase

- Leg lowering and suction anchor installation was scoped out, since although it is expected to cause temporary disruption to the seabed/sediment in the vicinity of the platform through mixing with the water column, in practice the overall nature of the sediment is not expected to change and no impacts are therefore predicted to sediment quality.
- Installation of pipelines and umbillicals were scoped out since although it they are expected to cause temporary disruption to the seabed/sediment in the vicinity of the pipeline and umbilicals through localized mixing with the water column, the overall nature of the sediment is not expected to change and no impacts are therefore predicted

to sediment quality.

- Burial of pipelines and umbillicals was scoped out since although it is expected to cause temporary disruption to the seabed/sediment in the vicinity of the pipeline and umbilicals through localized mixing with the water column, overall nature of the sediment is not expected to change and no impacts are therefore predicted to sediment quality.
- Modifications activities to Delta (new rises / J-tube) were scoped out, since although they are expected to cause temporary disruption to the seabed/sediment in the vicinity of the platform through localized mixing with the water column, the overall nature of the sediment is not expected to change and no impacts are therefore predicted to sediment quality.

Operation phase

- Activities related to the installation of conductors (new wells only) were scoped out, since although they are expected to cause temporary disruption to the seabed/sediment in the vicinity of the platform(s) through localized mixing with the water column, the overall nature of the sediment is not expected to and no impacts are therefore predicted to sediment quality.

Abandonment phase

- Activities relating to plugging wells were scoped out, since although they are expected to cause temporary disruption to the seabed/sediment in the immediate vicinity of the wells through the introduction of cement at the well, the only sediment affected by this activity will be that in the immediate vicinity of the well. Given this very limited extent, the physical change in sediment quality at the wells sites is not considered to be a significant impact.
- Sever conductors was scoped out, since although it is expected to cause temporary disruption to the seabed/sediment in the vicinity of the platform(s) through localized mixing with the water column, the overall nature of the sediment will not be changed and no impacts are therefore predicted to sediment quality.
- Disposal of pipeline rinse water to sea at Delta was scoped out, since this will be routed to the existing treatment system at Delta platform. Following treatment, water will be discharged at the seabed near Delta platform. Because the existing treatment system is monitored prior to any discharge to meet Greek water quality standards (as per current environmental Permit), and because this additional volume of water for treatment is within the existing treatment systems' design capacity, this discharge is assumed to not contain pollutants in quantities enough to significantly impact sediment quality.
- Anchoring of support vessel/barge is scoped out. It is anticipated that by lowering the anchor to the seabed, some sediment may temporarily be disturbed in the vicinity of the anchor. However, the overall nature of the sediment will not be changed by this activity and no impacts are therefore predicted to sediment quality.
- Dispersal of drill cuttings from piles is scoped out. By dispersing drill cutting piles from existing platforms, some sediment may temporarily be disturbed in the vicinity of the platform. However, because these cuttings will have become part of the seabed over

time, dispersing this material will not change the overall nature of the sediment and no impacts are therefore predicted to sediment quality.

- Cutting piles from existing platforms is scoped out since although it is expected to cause temporary disruption to the seabed/sediment in the vicinity of the platform(s) through mixing with the water column, the overall nature of the sediment will not change by this activity and no impacts are therefore predicted to sediment quality.
- Removal of SIPs (new platforms) is scoped out since although it is expected to cause temporary disruption to the seabed/sediment in the vicinity of the platform(s) through mixing with the water column, the overall nature of the sediment will not change by this activity and no impacts are therefore predicted to sediment quality.

9.2.1.4 Water environment

Following the aforementioned scoping exercise, it was identified that no interaction or serious concern has been identified from the activities that could potentially adversely impact the water environment.

Construction phase

- Activities associated with the onshore fabrication of pipelines (including changes to breakwater, leveling and bringing to sea) were scoped out. In particular in order to support moving the fabricated pipes from onshore location to the sea, some minor reconstruction may be required of the breakwater in the existing port. This activity may result in extremely localised increases in turbidity near the breakwater, however given the limited extent and the low sensitivity of the area, due to its existing industrial nature, this activity is assumed to result in no significant impacts.
- Installation of permanent mooring was scoped out. By lowering the mooring to the seabed, some sediment may temporarily be disturbed causing increased turbidity in the immediate vicinity of the mooring; however, given the limited extent and the short duration of any such disturbance, no significant impacts on water quality are anticipated
- Operation of support vessels in the project area was scoped out. This may result in small-scale discharges to the sea (e.g. stormwater runoff); however all vessels operated for the Project will be compliant with MARPOL requirements governing discharges to the sea. For this reason, no significant impacts are predicted.

Operation phase

- Installation of conductors (new wells only) was scoped out. The installation of the conductors into the seabed will cause some sediment to temporarily be disturbed causing increased turbidity in the immediate vicinity of the conductors; however, given the limited extent and the short duration of any such disturbance, no significant impacts on water quality are anticipated.
- Disposal of produced water to sea at Delta. All produced water will be routed to the existing treatment system at Delta platform. Following treatment, water will be discharged at the seabed near Delta platform. Because the existing treatment system is

monitored prior to any discharge to meet Greek water quality standards, and because this additional volume of water for treatment is within the existing treatment systems' design capacity, no significant impacts to water quality are anticipated from this activity.

- Stormwater from areas of the platform where oil/hazardous chemicals are not present is discharged directly to the sea. For areas where oil or hazardous chemicals are present, a closed drain system collects and routines any stormwater to the water treatment system at Delta platform. As the stormwater discharged directly to sea is not expected to have any contaminants in it, no significant impacts to water quality are expected.
- Activity of operation of the Energean Force. Operating the Energean Force in the project area may result in small-scale discharges to the sea (e.g. stormwater runoff); however the vessel is compliant with MARPOL requirements governing discharges to the sea. For this reason, no significant impacts are predicted.
- Support vessels operating in the project area may result in small-scale discharges to the sea (e.g. stormwater runoff); however the vessel will be compliant with MARPOL requirements governing discharges to the sea. For this reason, no significant impacts are predicted.

Abandonment phase

- Activity of mobilize light work over rig to sites was scoped out. Operating the light work over rig vessel may result in small-scale discharges to the sea (e.g. stormwater runoff); however all vessels operated for the Project will be compliant with MARPOL requirements governing discharges to the sea. For this reason, no significant impacts are predicted.
- Plugging wells by pouring cement into the wells. This may result in a small amount of cement mixing with the water column in the immediate vicinity of the sea; however, as the cement will contain no hazardous compounds, no impacts to water quality are anticipated from this activity.
- Sever conductors. Severing the conductors at the seabed will cause some sediment to temporarily be disturbed causing increased turbidity in the immediate vicinity of the conductors; however, given the limited extent and the short duration of any such disturbance, no significant impacts on water quality are anticipated.
- Support vessels operating in the project area may result in small-scale discharges to the sea (e.g. stormwater runoff); however all vessels operated for the Project will be compliant with MARPOL requirements governing discharges to the sea. For this reason, no significant impacts are predicted.
- Activity of disposal of pipeline rinse water to sea at Delta. The pipeline rinse water will be routed to the existing treatment system at Delta platform. Following treatment, water will be discharged at the seabed near Delta platform. Because the existing treatment system is monitored prior to any discharge to meet Greek water quality standards, and because this additional volume of water for treatment is within the existing treatment systems' design capacity, no significant impacts to water quality are anticipated from

this activity.

- Anchoring of support vessels / barge was scoped out. By lowering the anchor to the seabed, some sediment may temporarily be disturbed causing increased turbidity in the vicinity of the anchor; however, given the limited extent and the short duration of any such disturbance, no significant impacts on water quality are anticipated.

9.2.1.5 Air quality

Following the aforementioned scoping exercise, it was identified that no interaction or serious concern has been identified from the activities that could potentially adversely impact the air quality.

Construction phase

- Activities relating with the transport of components and final SIP assembly at a deep-water quay were scoped out from further assessment. Emissions to air are expected to be generated from vessel operation; however, these emissions will be temporary in nature and no sensitive receptors (i.e. human populations or terrestrial ecology) are expected to be present in the immediate vicinity of the vessel. All vessels will be operated to meet MARPOL requirements pertaining to emissions to air.
- Activities including the onshore fabrication of pipeline (including possible changes to breakwater, levelling and bringing to sea). Some dust emissions, and combustion emissions from equipment and vehicles will be produced during this activity; however, these emissions will be relatively small and dispersion will be localized. Given the limited duration, extent and scale, potential impacts to air quality are considered negligible.
- Operation of support vessels is expected to generate emissions to air; however, these emissions will be temporary in nature and no sensitive receptors (i.e. human populations or terrestrial ecology) are expected to be present in the immediate vicinity of the vessel. All vessels will be operated to meet MARPOL requirements pertaining to emissions to air.

Operation phase

- Activity of maintenance flaring was scoped out, since no flaring will occur for the new platforms.
- Activity of operation of the Energean Force was scoped out, since Energean Force rig is not self-propelled and therefore does not emit combustion emissions.
- Activity of operation of support vessels was scoped out. Although emissions to air are expected from vessel operation these emissions will be temporary in nature and no sensitive receptors (i.e. human populations or terrestrial ecology) are expected to be present in the immediate vicinity of the vessel. All vessels will be operated to meet MARPOL requirements pertaining to emissions to air.

Abandonment phase

- Activity to mobilize light work over rig to sites. Emissions to air will be generated from vessel operation; however, these emissions will be temporary in nature and no sensitive

receptors (i.e. human populations or terrestrial ecology) are expected to be present in the immediate vicinity of the vessel. All vessels will be operated to meet MARPOL requirements pertaining to emissions to air.

- Activity of operation of support vessels. Emissions to air will be generated from vessel operation; however, these emissions will be temporary in nature and no sensitive receptors (i.e. human populations or terrestrial ecology) are expected to be present in the immediate vicinity of the vessel. All vessels will be operated to meet MARPOL requirements pertaining to emissions to air.

9.2.1.6 Acoustic environment

Following the aforementioned scoping exercise, it was identified that no interaction or serious concern has been identified from the activities that could potentially adversely impact the acoustic (airborne – underwater) environment.

9.2.1.6.1 Airborne noise

Construction phase

- Activities of transport of components and final SIP and assembly at a deep-water quay are expected to generate airborne emissions, however since there are no sensitive receptors in the vicinity, this activity is scoped out from further assessment.
- Activities in relation with the onshore fabrication of pipeline (including possible changes to breakwater, levelling and bringing to sea) is expected to generate some very localized airborne noise emissions associated with operation of construction equipment; however, given the short duration of activities and expected noise levels, any impacts to surrounding communities are expected to be negligible.
- Operation of support vessels is expected to generate airborne noise emissions, however since there are no sensitive receptors in the vicinity, this activity is scoped out.

Operation phase

- The operation of the Energean Force is expected to generate airborne noise emissions, however since there are no sensitive receptors in the vicinity, this activity is scoped out.
- The operation of support vessels is expected to generate airborne noise emissions, however since there are no sensitive receptors in the vicinity, this activity is scoped out.

Abandonment phase

- The activity including the mobilization of light work over rig to sites is expected to generate airborne noise emissions, however since there are no sensitive receptors in the vicinity, this activity is scoped out.
- The activity of operation of support vessels is expected to generate airborne noise emissions, however since there are no sensitive receptors in the vicinity, this activity is scoped out.

9.2.1.6.2 Underwater noise

All underwater noise related impacts have been assessed in terms of their interactions against specific receptors (i.e. fish species, marine mammals). The activities that were assessed and assessed as been scoped out are the following:

Construction phase

- Transport of components and final SIP assembly at a deep-water quay
- Transport SIP to site
- Installation of pipelines and umbillicals
- Operation of support vessels
- Modification activities to Delta (new risers/J tubes)

Operation phase

- Operation of the Energean Force
- Operation of support vessels

Abandonment phase

- Activity to mobilize light work over rig to sites
- Plugging wells
- Operation of support vessels

9.2.1.7 Biotic environment

Following the aforementioned scoping exercise, it was identified that no interaction or serious concern has been identified from the activities that could potentially adversely impact the biotic environment.

This is broken down to the types of biotic assessed, i.e. plankton, benthic communities, fish species, marine mammals, avifauna

9.2.1.7.1 Plankton

Construction phase

- Transport of components and final SIP assembly at a deep-water quay causing physical disturbance to plankton is assumed to be negligible given that an existing commercial port will be used, which would mean the project's activities will not significantly alter the physical environment of the port and therefore this is scoped out.
- Activities related to onshore fabrication of pipeline (including possible changes to breakwater, levelling and bringing to sea). To support moving the fabricated pipes from onshore location to the sea, some minor reconstruction may be required of the breakwater in the existing port. This activity may result in extremely localised increases in turbidity near the breakwater which could impact existing plankton present, however given the limited extent and the low sensitivity of the area, due to its existing industrial nature, this activity is assumed to result in no significant impacts.
- Transport SIP to site. Vessel propulsion results in interaction with plankton in the project

area; however, this interaction is expected to be very localized (i.e. the direct route followed by vessels) and will not result in any adverse effects.

- Leg lowering and suction anchor installation. Leg lowering and the use of suction anchoring will temporarily disturb the water column. Any plankton present at this time would be disturbed; however, this would be temporary and no lasting harm to plankton should occur.
- Installation of pipelines and umbillicals is expected to temporarily disturb the water column. Any plankton present at this time would be disturbed. Any disturbance would be temporary and no lasting harm to plankton should occur.
- Operation of support vessels. Vessel propulsion is likely to result in an interaction with plankton in the project area; however, this interaction will be very localized (i.e. the direct route followed by vessels) and will not result in any adverse effects.
- Modifications activities to Delta (new risers/J tubes) are expected to temporarily disturb the water column. Any plankton present at this time would be disturbed. Any disturbance would be temporary and no lasting harm to plankton is expected occur.

Operation phase

- Installation of conductors (new wells only) is expected to temporarily disturb the water column. Any plankton present at this time would be disturbed. Any disturbance would be temporary and no lasting harm to plankton should occur.
- Spudding and drilling of wells, including cementing of initial casings is expected to temporarily disturb the water column. Any plankton present at this time would be disturbed. Any disturbance would be temporary and no lasting harm to plankton should occur.
- Disposal of produced water to sea at Delta. The produced water will be routed to the existing treatment system at Delta platform. Following treatment, water will be discharged at the seabed near Delta platform. Because the existing treatment system is monitored prior to any discharge to meet Greek water quality standards (as per the environmental permit), and because this additional volume of water for treatment is within the existing treatment systems' design capacity, no significant impacts to water quality, or dependent receptors such as plankton, are anticipated from this activity.
- Stormwater from of the platform where oil/hazardous chemicals are not present areas is discharge directly to sea. For areas where oil or hazardous chemicals are present, a closed drain system collects and routines any stormwater to the water treatment system at Delta platform. As the stormwater discharged directly to sea is not expected to have any contaminants in it, no significant impacts to water quality, or dependent receptors such as plankton, are expected.
- Operation of support vessels. Vessel propulsion is expected to result in an interaction with plankton in the project area; however, this interaction will be very localized (i.e. the direct route followed by vessels) and will not result in any adverse effects.

Abandonment phase

- Sever conductors at the seabed is expected to cause some sediment to temporarily be

disturbed causing increased turbidity in the immediate vicinity of the conductors; however, given the limited extent and the short duration of any such disturbance, no significant impacts on water quality, nor dependent receptors such as plankton, are anticipated.

- Disposal of pipeline rinse water to sea at Delta. This will be routed to the existing treatment system at Delta platform. Following treatment, water will be discharged at the seabed near Delta platform. Because the existing treatment system is monitored prior to any discharge to meet Greek water quality standards (and as per current environmental permit), and because this additional volume of water for treatment is within the existing treatment systems' design capacity, no significant impacts to water quality, or dependent receptors such as plankton, are anticipated from this activity.
- Anchoring of support vessels/barge. By lowering the anchor to the seabed, some sediment may temporarily be disturbed causing increased turbidity in the vicinity of the anchor; however, given the limited extent and the short duration of any such disturbance, no significant impacts on water quality, or dependent receptor such as plankton, are anticipated.
- Activities relating to the dispersal of drill cuttings from piles at the existing platforms are expected to temporarily disturb the water column. Any plankton present at this time would be disturbed. Any disturbance would be temporary and no lasting harm to plankton should occur.
- Cutting piles at existing platforms is expected to temporarily disturb the water column. Any plankton present at this time would be disturbed. Any disturbance would be temporary and no lasting harm to plankton should occur.

9.2.1.7.2 Benthic communities and habitats

Construction phase

- Installation of conductors (new wells only) is expected to only affect a very small area of the seabed (conductor area). Based on this limited area affected, any impacts on the benthic community are assumed to be negligible.

Operation phase

- Disposal of produced water to sea at Delta. The produced water will be routed to the existing treatment system at Delta platform. Following treatment, water will be discharged at the seabed near Delta platform. Because the existing treatment system is monitored prior to any discharge to meet Greek water quality standards (as the facilities' environmental permit), and because this additional volume of water for treatment is within the existing treatment systems' design capacity, no significant impacts to water quality, or dependent receptors such as the benthic community, are anticipated from this activity.
- Activity of stormwater from areas of the platform where oil/hazardous chemicals are not

present is discharged directly to the sea. For areas where oil or hazardous chemicals are present, a closed drain system collects and routines any stormwater to the water treatment system at Delta platform. As the stormwater discharged directly to sea is not expected to have any contaminants in it, no significant impacts to water quality, or dependent receptors such as the benthic community, are expected.

Abandonment phase

- Sever conductors is expected to affect a very small area of the seabed (immediately near conductors). Based on this limited area affected, any impacts on the benthic community are assumed to be negligible.
- Disposal of pipeline rinse water to sea at Delta. The pipeline rinse water will be routed to the existing treatment system at Delta platform. Following treatment, water will be discharged at the seabed near Delta platform. Because the existing treatment system is monitored prior to any discharge to meet Greek water quality standards (as per the facilities' environmental permit), and because this additional volume of water for treatment is within the existing treatment systems' design capacity, no significant impacts to water quality, or dependent receptors such as the benthic community, are anticipated from this activity.
- Anchoring of support vessels/barge is expected to affect a very small area of the seabed (direct anchor site(s)). Based on this limited area affected, any impacts on the benthic community are assumed to be negligible.

9.2.1.7.3 Coastal marine habitat

Construction phase

- Onshore fabrication of pipeline (including possible changes to breakwater, levelling and bringing to the sea. While this activity will interact with the coast (i.e. bringing the pipes from onshore to offshore), the sites being considered are not located in areas with sensitive coastal marine environments.

9.2.1.7.4 Fish species

Construction phase

- Transport of components and final SIP assembly at a deep-water quay. Some noise will be generated from vessel operation; however this will be within an existing port and therefore represents negligible change in baseline conditions. Physical disturbance to fish from this activity is also assumed to be negligible given that an existing commercial port will be used, which would mean the project's activities will not significantly alter the physical environment of the port.
- Onshore fabrication of pipeline (including possible changes to breakwater, levelling and bringing to sea). To support moving the fabricated pipes from onshore location to the sea, some minor reconstruction may be required of the breakwater in the existing port. This activity may result in extremely localised increases in turbidity near the breakwater

which could impact existing fish present, however given the limited extent and the low sensitivity of the area, due to its existing industrial nature, this activity is assumed to result in no significant impacts.

- Transport SIP to site is expected to generate some noise from vessel operation; however, this will be constant low-level noise to which fish are not particularly sensitive.
- Leg lowering and suction anchor installation is expected to temporarily disturb the water column. Any fish present at this time would be disturbed; however, this would be temporary and no lasting harm to fish should occur.
- Installation of pipelines and umbillicals is expected to temporarily disturb the water column. Any fish present at this time would be disturbed; however, it is expected that fish would demonstrate avoidance behaviour. Any disturbance would be temporary and no lasting harm to fish should occur.
- Operation of support vessels is likely to generate some noise; however, this will be constant low-level noise to which fish are not particularly sensitive.
- Modifications to Delta (new risers/J tubes) are expected to temporarily disturb the water column. Any fish present at this time would be disturbed; however, it is expected that fish would demonstrate avoidance behaviour. Any disturbance would be temporary and no lasting harm to fish should occur.

Operation phase

- Disposal of produced water to sea at Delta. The produced water will be routed to the existing treatment system at Delta platform. Following treatment, water will be discharged at the seabed near Delta platform. Because the existing treatment system is monitored prior to any discharge to meet Greek water quality standards (as per the facilities' environmental permit), and because this additional volume of water for treatment is within the existing treatment systems' design capacity, no significant impacts to water quality, or dependent receptors such as fish, are anticipated from this activity.
- Stormwater from areas of the platform where oil/hazardous chemicals are not present is discharged directly to the sea. For areas where oil or hazardous chemicals are present, a closed drain system collects and routines any stormwater to the water treatment system at Delta platform. As the stormwater discharged directly to sea is not expected to have any contaminants in it, no significant impacts to water quality, or dependent receptors such as s fish, are expected.
- Operation of support vessels is expected to generate some noise; however, this will be constant low-level noise to which fish are not particularly sensitive.

Abandonment phase

- Operation of support vessels is expected to generate some noise; however, this will be constant low-level noise to which fish are not particularly sensitive.
- Disposal of pipeline rinse water to sea at Delta routed to the existing treatment system following treatment, water will be discharged at the seabed near Delta platform. Because the existing treatment system is monitored prior to any discharge to meet

Greek water quality standards (as per the facilities' environmental permit), and because this additional volume of water for treatment is within the existing treatment systems' design capacity, no significant impacts to water quality, or dependent receptors such as fish, are anticipated from this activity.

- Dispersal of drill cuttings from piles at the existing platforms is expected to temporarily disturb the water column. Any fish present at this time would be disturbed; however, it is expected that fish would demonstrate avoidance behaviour. Any disturbance would be temporary and no lasting harm to fish should occur.

9.2.1.7.5 Marine mammals

Construction phase

- Activities of transport of components and final SIP assembly at a deep-water quay are expected to generate some noise from associated vessel operation; however this will be within an existing port and therefore represents negligible change in baseline conditions. Physical disturbance to fish from this activity is also assumed to be negligible given that an existing commercial port will be used, which would mean the project's activities will not significantly alter the physical environment of the port.
- Transport SIP to site is likely to generate some from associated vessel operation; however, this will be a single trip and will be at constant low-level noise to which marine mammals are not particularly sensitive.
- Leg lowering and the use of suction anchoring are expected to temporarily disturb the water column. Any marine mammals present at this time would be disturbed; however, this would be temporary and no lasting harm to marine mammals should occur.
- Installation of pipelines and umbilicals will temporarily disturb the water column near the seabed. It is unlikely that many marine mammals would be present in the area affected; however, it is expected that any marine mammals present would demonstrate avoidance behaviour. Any disturbance would be temporary and no lasting harm to marine mammals should occur.
- Modifications activities to Delta (new risers/J tubes) are expected to temporarily disturb the water column near the seabed. It is unlikely that many marine mammals would be present in the area affected; however, it is expected that any marine mammals present would demonstrate avoidance behaviour. Any disturbance would be temporary and no lasting harm to marine mammals should occur.

Operation phase

- Disposal of produced water to sea at Delta. The produced water will be routed to the existing treatment system at Delta platform. Following treatment, water will be discharged at the seabed near Delta platform. Because the existing treatment system is monitored prior to any discharge to meet Greek water quality standards (as per the facilities' environmental permit), and because this additional volume of water for treatment is within the existing treatment systems' design capacity, no significant impacts to water quality, or dependent receptors such as marine mammals, are

anticipated from this activity.

- Stormwater from areas of the platform where oil/hazardous chemicals are not present is discharged directly to the sea. For areas where oil or hazardous chemicals are present, a closed drain system collects and routines any stormwater to the water treatment system at Delta platform. As the stormwater discharged directly to sea is not expected to have any contaminants in it, no significant impacts to water quality, or dependent receptors such as marine mammals, are expected in Abandonment phase.
- Mobilize light work over rig to sites is expected to generate some noise from associated vessel operation; however, this will be a single trip and will be at constant low-level noise to which marine mammals are not particularly sensitive.
- Plug wells by pouring cement into the wells may result in a small amount of cement mixing with the water column in the immediate vicinity of the sea; however, as the cement will contain no hazardous compounds, no impacts to water quality, or dependent receptors such as marine mammals, are anticipated from this activity.
- Disposal of produced water to sea at Delta. The produced water will be routed to the existing treatment system at Delta platform. Following treatment, water will be discharged at the seabed near Delta platform. Because the existing treatment system is monitored prior to any discharge to meet Greek water quality standards (as per the facilities' environmental permit), and because this additional volume of water for treatment is within the existing treatment systems' design capacity, no significant impacts to water quality, or dependent receptors such as marine mammals, are anticipated from this activity.
- Dispersal of drill cuttings from piles activities at the existing platforms is expected to temporarily disturb the water column. Any marine mammals present at this time would be disturbed; however, it is expected that marine mammals would demonstrate avoidance behaviour. Any disturbance would be temporary and no lasting harm to marine mammals should occur.

9.2.1.7.6 Avifauna

Birds are potentially affected by a number of activities through their reliance on fish as a food source. As impacts on fish have been scoped out, so are impacts on birds.

The activities that were assessed to be of relevance are the following:

Operation phase

- Disposal of produced water to sea at Delta. Birds are potentially affected by this activity through their reliance on fish as a food source. As impacts on fish have been scoped out, so are impacts on birds.
- Stormwater discharge to sea

Abandonment phase

- Disposal of pipeline rinse water to sea at Delta

9.2.1.8 Manmade environment

Following the aforementioned scoping exercise, it was identified that no interaction or serious concern has been identified from the activities that could potentially adversely impact the manmade environment.

9.2.1.8.1 Community cohesion

Construction phase

- Maintenance of an offshore workforce. Interactions between a project's workforce and community members can lead to conflict; however, in this case, the construction workforce will be the workforce already employed for existing operations, plus supplemental local support. Given the low percentage of expat/non-local workers, it has been assumed that the project's workforce will not be significantly different from the surrounding area, and as such, the risk of reduced social cohesion and increased conflict is low.

Operation phase

- Maintenance of an offshore workforce. Interactions between a project's workforce and community members can lead to conflict; however, in this case, the operations workforce will be the workforce already employed for existing operations. Given the low percentage of expat/non-local workers, it has been assumed that the project's workforce will not be significantly different from the surrounding area, and as such, the risk of reduced social cohesion and increased conflict is low.

Abandonment phase

- Maintenance of an offshore workforce. Interactions between a project's workforce and community members can lead to conflict; however, in this case, the abandonment workforce will be the workforce already employed for existing operations, plus supplemental local support. Given the low percentage of expat/non-local workers, it has been assumed that the project's workforce will not be significantly different from the surrounding area, and as such, the risk of reduced social cohesion and increased conflict is low.

9.2.1.8.2 Community health & safety

As any community health and safety impacts from routine operations would be related to emissions to air, because air quality impacts have been scoped out for this activity, impacts to community health and safety are also considered to be negligible. The following activities present the activities which could potential interact with the community H&S parameter.

Construction phase

- Transport of components and final SIP assembly at a deep-water quay
- Onshore fabrication of pipeline (including possible changes to breakwater, levelling and bringing to sea)

- Operation of support vessels

Operation phase

- Maintenance Flaring
- Operation of the Energean Force
- Operation of support vessels

Abandonment phase

- Mobilize light work over rig to sites
- Operation of support vessels

9.2.1.8.3 Marine traffic

Construction phase

- Transport of components and final SIP assembly at a deep-water quay. An existing quay is planned to be used within a commercial port. As this will not constitute a change in use from existing conditions, no significant impacts to marine traffic are assumed.
- Transport SIP to site. This will be a single event, that will occur for a short duration (<1 day). Based on this, minimal interaction with exiting marine traffic is expected.
- Establishment and enforcement of safety exclusion zone including placement of marker buoys. Marker buoys will be placed around the exclusion one to clearly demark the area so that any other marine traffic will be aware of the restrictions. The location of the exclusion zones does not overlap with any existing navigation channels used for ferries, and avoiding the exclusion zones should not add any significant hardship to marine traffic given the availability of alternative routing.

Operation phase

- Maintenance of exclusion zones. The location of the exclusion zones does not overlap with any existing navigation channels used for ferries, and avoiding the exclusion zones should not add any significant hardship to marine traffic given the availability of alternative routing.
- Operation of support vessels. Limited vessel movements will occur during operation. These movements will not significantly change the number or composition of marine traffic in the region.

Abandonment phase

- Operation of support vessels. Limited vessel movements will occur during operation. These movements will not significantly change the number or composition of marine traffic in the region.

9.2.1.9 Socioeconomic environment

Following the aforementioned scoping exercise, it was identified that no interaction or serious concern has been identified from the activities that could potentially adversely impact the socioeconomic environment.

9.2.1.9.1 Fisheries

Any impacts to fisheries from this activity would be related to the broader impacts on fish. As impacts to fish have been scoped out, impacts to fishing have also been scoped out. Moreover, a further interaction relates with the activity of setting and maintaining an exclusion zone during the operation phase.

Construction phase

- Transport of components and final SIP assembly at a deep-water quay
- Transport SIP to site
- Installation of pipelines and umbillicals
- Operation of support vessels
- Establishment and enforcement of safety exclusion zone including placement of marker buoys

Operation phase

- Maintenance of exclusion zones. An exclusion zone of 500 m around each of the new platforms will be maintained (subject to designation by the naval authorities). While this will reduce the area that can be fished by 157 hectares, this is a small portion of the overall area of the sea that is fished. Moreover, the positive benefit to fish by creating a marine habitat where fishing is not present may increase local fish populations (as has been seen at the existing platforms), thereby increasing the fish stocks in the sea. In consideration of these two factors, any negative impacts to fishing from maintenance of the exclusion zones are considered negligible.
- Operation of support vessels

Abandonment phase

- Operation of support vessels

9.2.1.9.2 Tourism

Operation phase

- Maintenance of exclusion zones. An exclusion zone of 500 m around each of the new platforms will be maintained (subject to designation by the naval authorities). While this will reduce the area that can be used for tourism by 157 hectares, this is a small portion of the overall area of the sea and an area that is not current used for tourism activities (e.g. diving). Based on this, negligible adverse impacts are predicted to tourism from this limitation of access.

9.2.1.10 Technical infrastructure

Following the aforementioned scoping exercise, it was identified that no interaction or serious concern has been identified from the activities that could potentially adversely impact the technical infrastructure of the broader area. Some small-scale wastes will be generated by these

activities that may be disposed of at existing waste facilities in Greece. Given the small volumes to be generated, these waste streams are not expected to significantly contribute to any strain on capacity of existing waste sites.

The activities that are expected to interact with those are the following:

Construction phase

- Transport of components and final SIP assembly at a deep-water quay
- Onshore fabrication of pipeline (including possible changes to breakwater, levelling and bringing to sea)
- Operation of support vessels

Operation phase

- Operation of the Energean Force
- Operation of support vessels

Abandonment phase

- Mobilize light work over rig to sites
- Operation of support vessels

9.2.2 Unplanned events

Because of the extent and potential magnitude of any unplanned oil spill, numerous receptor types have the potential to be significantly affected in the event of such a release. Additionally, due to the scale, any interactions are considered to be potentially significant. For this reason all potentially affected receptors will be evaluated in the detailed assessment of impacts from an unplanned oil spill.

However, it is important to note that as presented in the scoping tables the main interactions are with the marine and coastal environment and not with the terrestrial environmental (both in terms of biotic and abiotic).

Also in order to capture the most severe cases, the impacts are considered for the cases of reaching the coasts and not necessarily within the timeframes of the already existing and in place emergency response plans. So, the scenarios modelled to show the time the spill within the first 3 hrs have in essence been scoped out not because they are insignificant but because they are not the worst cases and the assume that the emergency response will contain the spill within this timeframe.

10 EMERGENCIES AND RISKS TO THE ENVIRONMENT AND PEOPLE – QUANTITATIVE RISK ASSESSMENT (QRA)

10.1 PURPOSE, SCOPE AND OBJECTIVES OF THE RISK ASSESSMENT

This section of the Environmental and Social Impact Assessment (ESIA) describes the Quantitative Risk Assessment (QRA) studies performed to date in order to determine the level of risk (to groups of individuals) associated with the existing and proposed new facilities.

Whilst the current QRA work was undertaken to demonstrate that individual and total facility risk levels have been managed to ALARP as part of Energean's work to prepare a Safety Case for the new and existing facilities (in line with European and Greek legislation) it has also been employed to define a number of oil spill scenarios that have subsequently been modelled deterministically to assess potential environmental impacts. This work is described in further detail below (see section 10.8.2 Oil Spill Dispersion Modelling) and the full Oil Spill Modelling report is included as Annex 08. For completeness, calculated IRPA levels for worker groups are presented and discussed in this report even though they have no direct relationship to the potential environmental impact of the described facilities. The safety of Energean staff working offshore clearly influences the socio-economic wellbeing of the wider project area.

The purpose of the QRA is to provide a numerical estimate of the level of risk to people, associated with identified and defined Major Accidents. Risk is normally presented as IRPA (Individual Risk Per Annum – the chance each worker has of suffering a fatal accident per year of work) and PLL (Potential Loss of Life: the number of staff that might be killed in a defined period). QRA provides a means to compare the derived risk levels against industry accepted tolerability criteria and also provides a baseline against which potential risk reduction measures can be assessed. For new facilities potential design modifications can be implemented to allow risk levels to be reduced to a level that is demonstrated to be ALARP. For facilities already in operation (such as the Prinos complex which this ESIA also covers), it is clearly more difficult to implement design changes. However risk levels can be reduced, principally by introducing enhancements to the way the facility is operated and/or the response measures to prevent failures from escalating.

The scope of the QRA was to provide an integrated risk profile, which considers the level of risk

associated with the existing Prinos production facilities and the new Self Installing Platforms (SIPs). Drilling and workover/intervention, using the 'Energean Force' Tender Assist Drilling (TAD) facility is also considered within the QRA. However, the Major Accidents that are associated with the Energean Force itself (e.g. loss of stability) are not considered in the scope of the risk assessment. The risks associated with the Kappa platform, located at the South Kavala field and its associated pipeline, have not been formally assessed. The future of this field is currently uncertain. It is currently operated for approximately a week every month, with crew in attendance for just a few hours at the start and end of a production cycle. The platform processes sweet gas at very low pressures (maximum of 12 bar) with little liquid inventory and so the risk levels will be orders of magnitude lower that those associated with sour crude production at Prinos and Epsilon (both to the workers and to the environment).

No QRA work was completed for the onshore facilities as part of this scope. QRA analyses for onshore facilities are not currently required under applicable legislation (Serveso). Historically risks and controls applicable to onshore facilities including oil loading facilities have been determined Qualitatively based upon a comprehensive HAZID exercise.

Whilst the primary objective of the QRA is to assess the level of risk to personnel; it also allows the scenarios, which could adversely impact the environment to be defined in a systematic and auditable manner. Clearly one of the key risks that staff working on an offshore oil and gas installation are exposed to, is the unplanned and uncontrolled release of hydrocarbons, particularly if those hydrocarbons either contain poisonous components such as hydrogen sulphide or if the released hydrocarbon stream is subsequently ignited causing fires and explosions. Clearly the uncontrolled release of a hydrocarbon stream has the potential to not only affect the safety of the staff on the facility but also the environment in which the facility is located. Unignited oil spills clearly present the most significant hazard to the environment of any upstream oil and gas operation. To define risk to humans the size and frequency of potential hydrocarbon leaks has to be calculated. This data can then be used to define the key threats to the environment.

10.2 DEFINITION OF A MAJOR ACCIDENT

The QRA is focused on deriving an estimate of the numerical level of risk associated with the major accidents. According to article 2 of EU Directive 2013/30 on the Safety of Offshore Oil and Gas Operations (currently being transposed into Member State legislation), Major Accidents are defined as:

f. *an incident involving an explosion, fire, loss of well control, or release of oil, gas or dangerous substances involving, or with a significant potential to cause, fatalities or serious personal injury;*

g. *an incident leading to serious damage to the installation or connected infrastructure involving, or with a significant potential to cause, fatalities or serious personal injury;*

h. *any other incident leading to fatalities or serious injury to five or more persons who are on the offshore installation where the source of danger occurs or who are engaged in an offshore oil and gas operation in connection with the installation or connected infrastructure; or*

i. any major environmental incident resulting from incidents referred to in points (a), (b) and (c).

j. for the purposes of determining whether an incident constitutes a major accident under points (a), (b) or (d), an installation that is normally unattended shall be considered attended.

10.3 FACILITY AND OPERATIONS OVERVIEW

The current and planned hydrocarbon production infrastructure in the Prinos offshore area has been fully described in the previous sections. For the Prinos complex itself the QRA model was based upon the situation following the tie back of the Lamda and Omicron platforms, i.e. all planned modifications including new pipework, risers, flanges, storage tanks etc. were included in the model. The composition of fluids in the defined surface and sub-sea pipework network changes with time as new wells and fields are brought on stream and gas lift rates are increased or decreased. The scenario which models the early period of production from Epsilon was used as this combined a high net production rate with a low gas lift rate and thus results in hydrogen sulphide concentrations that are considered on the "high" side of average. As will be demonstrated hydrogen sulphide levels are the key contributors to personnel risk (IRPA) whilst net oil production rates (and associated pressures) are the largest contributor to environmental risk.

The new facilities were modelled "as currently designed". By necessity this EIS is prepared early in the detailed design phase and hence the risks calculated will be higher than the final risk levels obtained. The opportunity to implement further risk reduction measures will be taken over the course of detailed design and in doing so ALARP demonstrated before construction contracts are awarded. Some of these potential risk reduction measures are discussed.

10.4 THE RISK ASSESSMENT PROCESS

The risk assessment process is summarised in diagram below and consists of the following key stage activities:

- Systematic and structured identification and definition of the scenarios giving rise to the Major Accidents
- Assessment of the likelihood or frequency of the defined scenarios

- Assessment of the consequences, to people, associated with the defined scenarios
- Combining the frequency and consequences to derive estimates of the numerical levels of risk
- Comparison of the estimates of risk against risk tolerability criteria.

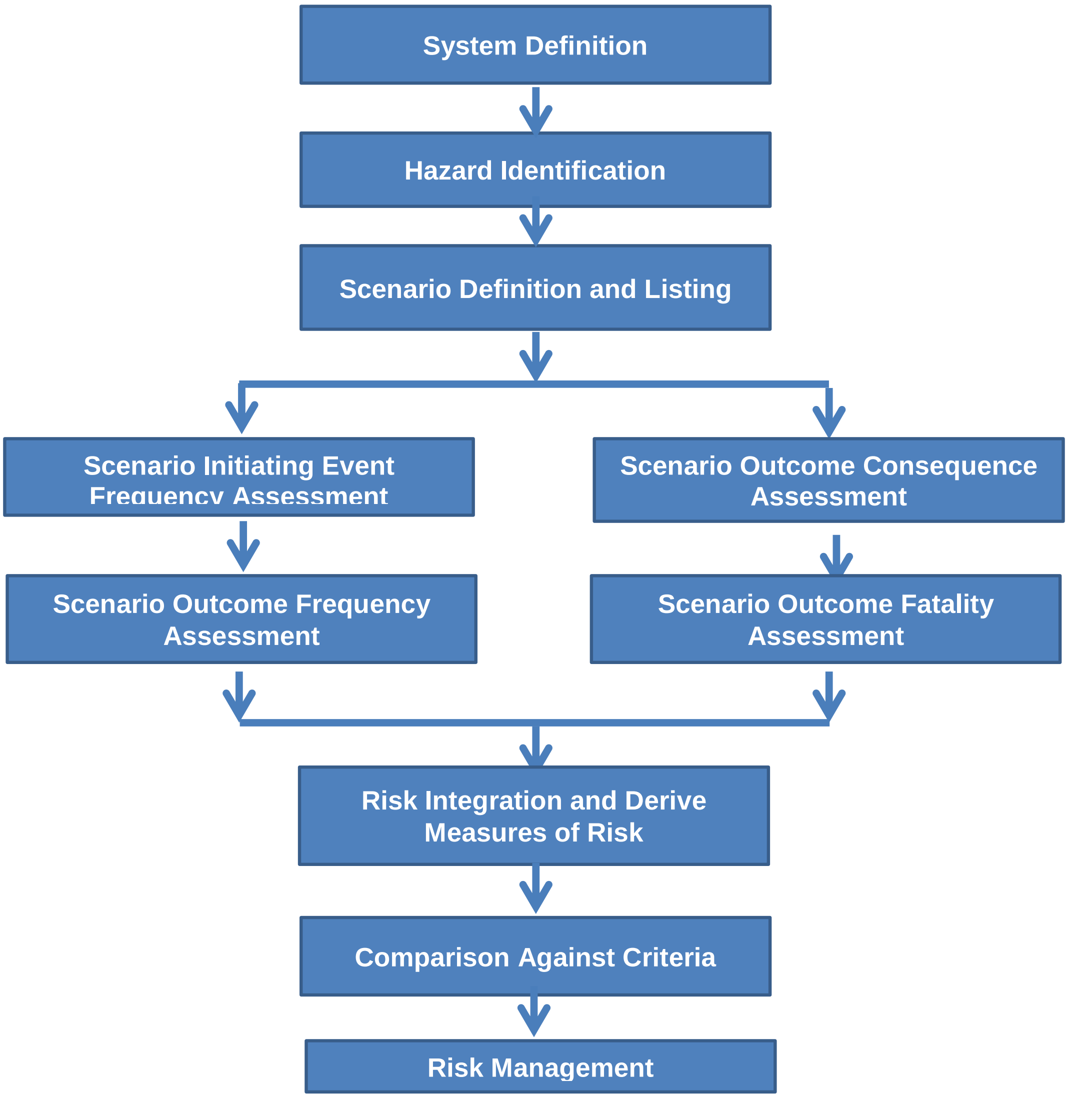


Diagram 10-1: Risk assessment process

10.5 IDENTIFICATION OF MAJOR ACCIDENT SCENARIOS

The Major Accidents for the Prinos QRA were derived based on a review of existing Hazard Identification (HAZID) and risk assessment studies and by review of the processes and activities. The Major Accidents associated with the new SIP facilities are based upon the safety studies

performed during the engineering phase. The diagram below summarizes the approach adopted for the identification of the major accidents.

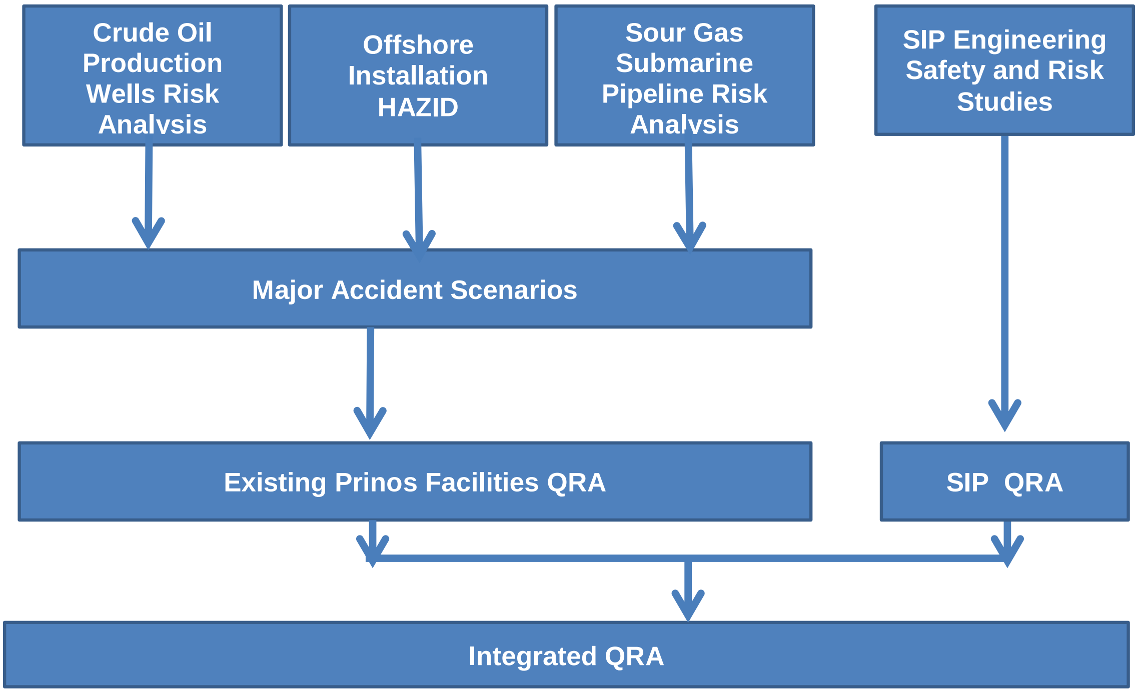


Diagram 10-2: Identification of major accidents scenarios

10.6 MAJOR ACCIDENT SCENARIOS

The Major Accident scenarios considered for the Prinos and Lamda/Omicron QRA can be broadly summarised as follows:

- Release of well fluids, from the wells, during drilling, workover/intervention, production activities. Sources include Alpha, Beta, Lamda, and Omicron platforms. These have the potential to result in fire/explosion/toxic gas effects and/or environmental impact due to oil spillage.
- Release of well fluids, sour gas, sour liquid or sweet gas from the production, export and gas lift subsea pipeline infrastructure. Such releases could result in fire/toxic gas/explosion effects (depending on the location of the release and proximity to platforms). Pipelines containing liquid hydrocarbons have the potential to result in environmental impact.
- Structural failure/collapse, which in addition to the immediate injury/fatality effects, could also result in loss of hydrocarbon containment and hence environmental impacts.
- Ship collision. Impact from attendant or passing vessels have potential to cause immediate injury/fatality effects and also result in loss of hydrocarbon containment

- Loss of control during crew boat operations. A major loss of control (e.g. capsize could result in injury/fatalities. It is noted that personnel logistics activities are conducted by a crew boat, helicopters are not used to support the offshore operations.

Table below, summarizes the major accidents associated with Prinos offshore activities.

Table 10-1: Major accidents summary

Location	Hazard Source	Prinos Major Accidents		
		Ref	Event	Potential Consequences
Wellhead Platforms	Alpha / Beta Platforms	AB-01	Loss of Containment: Well Fluids	• Injury/fatality due to fire/explosion/toxic gas effects • Oil spill/environmental impact
		AB-02	Loss of Containment: Sweet Gas (Gas Lift)	• Injury/fatality due to fire/explosion effects
		AB-03	Blowout: Well Fluids (Drilling/Intervention)	• Injury/fatality due to fire/explosion/toxic gas effects • Oil spill/environmental impact
		AB-04	Structural Failure	• Injury/fatality due to structural collapse effects • Injury/fatality due to fire/explosion/toxic gas effects (in the event if subsequent loss of containment) • Oil spill/environmental impact
		AB-05	Ship Impact	• Injury/fatality due to structural collapse effects • Injury/fatality due to fire/explosion/toxic gas effects (in the event if subsequent loss of containment) • Oil spill/environmental impact
	SIPs (Lamda / Omicron)	LO-01	Loss of Containment: Well Fluids	• Injury/fatality due to fire/explosion/toxic gas effects • Oil spill/environmental impact
		LO-02	Loss of Containment: Sweet Gas	• Injury/fatality due to fire/explosion effect

Location	Hazard Source	Prinos Major Accidents		
		Ref	Event	Potential Consequences
			(Gas Lift)	
		LO-03	Blowout: Well Fluids (Drilling/Intervention)	• Injury/fatality due to fire/explosion/toxic gas effects • Oil spill/environmental impact
		LO-04	Structural Failure	• Injury/fatality due to structural collapse effects • Injury/fatality due to fire/explosion/toxic gas effects (in the event if subsequent loss of containment) • Oil spill/environmental impact
		LO-05	Ship Impact	• Injury/fatality due to structural collapse effects • Injury/fatality due to fire/explosion/toxic gas effects (in the event if subsequent loss of containment) • Oil spill/environmental impact
Production Platform	Delta Production Platform	D-01	Loss of Containment: Sour Crude	• Injury/fatality due to fire/toxic effects • Oil spill/environmental impact
		D-02	Loss of Containment: Sour Gas	• Injury/fatality due to fire/explosion/toxic gas effects
		D-03	Loss of Containment: Sweet Gas	• Injury/fatality due to fire/explosion effects
		D-04	Structural Failure	• Injury/fatality due to structural collapse effects • Injury/fatality due to fire/explosion/toxic gas effects (in the event if subsequent loss of containment)

Location	Hazard Source	Prinos Major Accidents		
		Ref	Event	Potential Consequences
				• Oil spill/environmental impact
		D-05	Ship Impact	• Injury/fatality due to structural collapse effects • Injury/fatality due to fire/explosion/toxic gas effects (in the event if subsequent loss of containment) • Oil spill/environmental impact
Pipelines	12 ins Wellfluids from Alpha, Beta to Delta	PL-01	Loss of Containment: Wellfluids	• Injury/fatality due to fire/explosion/toxic gas effects • Oil spill/environmental impact
	10 ins Wellfluids from Lamda, Omicron to Delta	PL-02	Loss of Containment: Wellfluids	• Injury/fatality due to fire/explosion/toxic gas effects (in the event subsea release effects are able to impact Delta, SIP platform/manned areas) • Oil spill/environmental impact
	6 ins Gas Lift from Delta to Alpha, Beta	PL-03	Loss of Containment: Sweet Gas	• Injury/fatality due to fire/explosion effects (in the event subsea release effects are able to impact Delta, SIP platform/manned areas)
	6 ins Gas Lift from Delta to Lamda, Omicron	PL-04	Loss of Containment: Sweet Gas	• Injury/fatality due to fire/explosion effects (in the event subsea release effects are able to impact Delta, SIP platform/manned areas)
	8 ins Sour Crude to Shore	PL-05	Loss of Containment: Sour Crude	• Injury/fatality due to fire (sea surface pool fire) /toxic effects • Oil spill/environmental impact

Location	Hazard Source	Prinos Major Accidents		
		Ref	Event	Potential Consequences
	12 ins Sour Gas to Shore	PL-06	Loss of Containment: Sour Gas	• Injury/fatality due to fire/explosion/toxic gas effects (in the event subsea release effects are able to impact Delta, platform/manned areas)
	5.3 ins Sweet Gas Recycle From Shore	PL-07	Loss of Containment: Sweet Gas	• Injury/fatality due to fire/explosion effects (in the event subsea release effects are able to impact Delta, platform/manned areas)
Prinos Field	Logistics Activities	CB-01	Loss of Control (Crew Boat)	• Injury/fatality due to loss of control of the crew boat (e.g. capsize)

10.7 NATURE OF CONSEQUENCES

In general, major accidents are associated with loss of containment from the primary hydrocarbon systems. Release of pressurised hydrocarbon fluids can result in a range of physical effects (consequences) that can affect personnel. Table below summarizes the nature of the consequences that are associated with the major accidents.

Table 10-2: Major accidents consequences

Consequence	Summary	Potential Impacts on People
Jet Fire	Upon release, the gas can form momentum driven jets several tens of meters in length. Should ignition occur, high heat levels could be experienced at some distance away from source. Sustained jet fire impingement can result in structural failure and escalation.	Injury/fatality due to exposure to high heat radiation levels.
Pool Fire	Ignition of large quantities of released flammable liquids can form a pool fire. Equipment and structures exposed to the effects of pool fires can subsequently fail, resulting in escalation.	Injury/fatality due to exposure to high heat radiation levels.
Flash Fire	Flash fires generally occur as a result of delayed ignition of flammable gas clouds. Ignition of the cloud results in “burn back” to source and subsequent fire.	Injury/fatality due to being engulfed in a flammable gas cloud.
Explosion	Typically there is potential for explosions in those areas of plant where there is a high degree of congestion and confinement. Increased levels of congestion and confinement serve to both reduce ventilation rates, and hence provide conditions conducive to the accumulation of flammable mixtures. The congestion and confinement also services to increase the level of overpressure associated with the rapid combustion of the flammable gas cloud.	Explosions can result in injury/fatality via the following mechanisms: • Direct physical effects of the overpressure • Overpressure physically moving a person • Overpressure causing missiles/ structural collapse
Hydrogen	There are a number of areas of the process	Fatality due to the

Consequence	Summary	Potential Impacts on People
Sulphide (H_2S)	where H_2S is present in the hydrocarbon stream. Loss of containment from the hydrocarbon envelope can result on the formation and dispersion of a toxic plume.	exposure to the toxic effects of H_2S

10.8 OIL SPILL SCENARIOS

10.8.1 Scenarios identifications & description

In addition to the potential impacts on personnel, which as explained above, are the primary focus of the QRA, the major accidents can also affect the environment via the release of quantities of liquid hydrocarbons to sea. The QRA process served to inform a range of credible oil spill cases for which trajectory modelling and impact assessment has been performed (Paragraph 10.8.2).

Table below summarises the oil spill scenarios. They cover all relevant parts of the production infrastructure, i.e.:

- Well head platforms (new and existing) and release of well fluids;
- Release of well fluids during drilling and workover/intervention activities;
- Release from liquid topsides processes; and
- Releases from the pipeline systems.

Estimates of credible oil spill sizes have been derived within the Prinos Complex oil spill contingency plan and these have been adopted and supplemented with spill size estimates for the new planned facilities.

Oil spill modelling has been performed on the spill scenarios considered to be the most threatening to the marine and coastal environments. This work and the results and implications are discussed below. The full oil spill modelling report is attached as Annex 08.

Table 10-3: Oil spill scenarios

Ref	Scenario	Release Size	Release Locations	Sub Scenario	Notes/Justification
P1	Blowout	475 m^3 (largest credible blowout)	1. Prinos Complex 2. Lamda 3. Omicron	Blowout- Alpha, Beta during drilling, workover using Energean Force. Release of well fluids	The Prinos Oil Spill Contingency Plan proposes 120m^3 as a representative oil spill size for the wells associated with the Prinos reservoir. The Prinos reservoir is highly depleted and the wells will not self-flow, in addition the reservoir fluids have a high water cut. The oil spill contingency plan suggests a 24 hr response time, this is assumed to be representative of the time take to initially respond, access the well head, kill the well and initiate oil spill response. During this period it is assumed the volume spilled is as per the oil spill contingency plan scenario (i.e, 120 m^3). The 24 hr duration is of the order of blowout durations experienced historically. The impact assessment prepared for the new EU Offshore Safety Directive, which is based on historic blowout data, suggested 56% likelihood that a blowout would persist for < 2 days before being controlled/naturally bridging. This assessment suggested only small proportion of blowouts result in major spills (e.g. 15% likelihood of blowout lasting > 2 weeks).
L1				Blowout- Lamda during drilling, workover using Energean Force. Release of well fluids	The wells to be drilled and completed from the Lamda platform serve to develop the Epsilon reservoir. The pressure of the Epsilon field well fluids is approximately 2,000 to 3,000 psi higher than for Prinos/Prinos North reservoir. The water cut is also very low. It is assumed that the 24 hr response time (refer to the above discussion) is representative of the time taken to secure a well. The Basis of Design (Rev B) states the maximum production rate is 3,000 bbls/day. Hence the spill

Ref	Scenario	Release Size	Release Locations	Sub Scenario	Notes/Justification
					scenario is 3,000 bbl (approximately 475m^3)
O1				Blowout- Omicron during drilling, workover using Energean Force. Release of well fluids	The wells to be drilled and completed from the Omicron platform serve to develop the Prinos North reservoir, which has similar characteristic s to the Prinos reservoir, hence (as per Prinos) 120m^3 is adopted for the representative oil spill scenario.
P2	Topside Leak	150m^3 (worst case topside leak)	1. Prinos Complex 2. Lamda 3. Omicron	Process release – release of liquid hydrocarbons from topsides hydrocarbon envelope	From Oil Spill Contingency Plan – Estimate of maximum credible topside spill size. This scenario is assumed to represent/bound Prinos topsides process release scenarios
L2				Process release – release of liquid hydrocarbons from topsides hydrocarbon envelope	Full bore release from production header considered (production riser release covered in LO1 case below). Max anticipated HC liquid flowrate is 90m^3/hr. Detection / Isolation assumed to occur within 60 seconds. Inventory size for production header is estimated to be about 3 m^3.
O2				Process release – release of liquid hydrocarbons from topsides hydrocarbon envelope	Assume topsides production system inventory is identical to Lamda
LO1	Release from Productio	205 m^3	Vicinity of the subsea tie-in	Release of well fluids from production pipelines –	Estimate based on pipeline volume plus maximum production rate (12,150 stdbpd, based on SIP basis of design) assumed to continue for 30 minutes prior to shut down.

Ref	Scenario	Release Size	Release Locations	Sub Scenario	Notes/Justification
	n Pipeline			Lamda/Omicron to Delta	Assuming: • 12,150 stdbpd (SIP Basis of Design, Rev B) • Approx. 80m^3/hr throughput • Assume 30 mins to shutdown = 40 m^3 released, in addition volume released by reverse flow/draining from Delta end of the pipeline is assume to be 40 m^3, hence released amount prior to shutdown is 80 m^3 • Inventory of the pipeline approximately 250 m^3 (assume 5 km of pipeline) • Assume 50% of the pipeline inventory is released = 125 m^3 • Assumed total volume released is therefore 125 m^3 + 80 m^3 = 205 m^3
PL1	Release from Export Pipeline	410m^3	Vicinity of Prinos, Mid-point between Prinos and Sigma Onshore, Near Sigma Onshore	Release of sour crude from export pipeline Delta to Sigma	Assuming: Pipeline volume is 580 m^3 Assume 50% of pipeline inventory is released = 290 m^3 Assume 30 mins to shutdown, yields an additional 60 m^3 (throughput assumed as 17,000 bopd). In addition, volume released by reverse flow/draining from sigma end of the pipeline prior to shutdown is assumed to be 60m^3, hence total release prior to shutdown is 120 m^3. Assumed total volume released is 290 m^3 + 120 m^3 = 410 m^3 *This includes estimated future output including Lamda and Omicron Platforms.*

10.8.2 Oil Spill Dispersion Modelling

10.8.2.1 Introduction

The offshore oil and gas facilities covered by the current ESIA (both existing as well as the planned and potential new facilities) are located in close proximity to the coast lines of the Greek mainland and the Greek island of Thasos. Hydrocarbons are currently produced from 3 drilling locations (Alpha, Beta and Kappa) that contain 26 wells between them. These fluids are initially treated at the Delta platform. From here partially stabilised oil at approximately 1% BS&W and dry sour-gas are sent by two independent pipelines to the onshore facilities (Sigma). Fully treated crude oil is stored at Sigma and periodically loaded in 250,000 bbl parcels to crude tankers through a loading buoy located 3 km from the shore. The planned and potential extension projects will add two further drilling centres (Lamda and Omicron) that will each hold up to a maximum of 15 wells. These new facilities will be tied back to the existing facilities by short-length, small-bore, multiphase pipelines.

Leaks of oil from this offshore infrastructure (including the marine loading buoy) clearly present a significant hazard to the immediate environmental and socioeconomic wellbeing of the area surrounding it. Oil entering the sea from loss of integrity of the existing or extended facilities will form a slick on the surface which will then be moved by the wind, waves and current until it is either:

- Recovered by Energean using its oil spill response facilities,
- Washes up onto the coastline or
- Dissipates due to the combined effects of evaporation and biodegradation.

In this section, the modelling work commissioned by Energean to calculate risks to the most vulnerable receptors on the surrounding coastlines is discussed.

10.8.2.2 Definition of leak sources and leak scenarios

A QRA investigation has been undertaken that allowed potential, non-routine (failure), events to be modelled. This work was described above. Based upon this analysis three worst case scenarios were defined and from these corresponding oil spill modelling scenarios developed and then used as inputs to the oil spill modelling work described in this section.

The three worse case leaks considered were:

- **A blow out from one of the new wells being drilled on the Lamda platform:** analysis indicated that a blowout would create a larger potential release than any other scenario that could take place on the existing or new facilities. Whilst a blowout releases crude from only one well (rather than other topside scenarios that could release production from all wells simultaneously) it takes longer to recover from such an incident. Simulation work indicated that unconstrained flow for a period of 24 hours at a rate of up to 3,000 bbl/day could occur. The Lamda platform was selected as the blowout location. A blowout whilst drilling into a virgin reservoir has a higher likelihood (and also a more

significant consequence) than when sidetracking an existing well in a depleted field. Lamda was selected rather than Omicon as the Epsilon field has the highest bottom-hole reservoir pressure and it is fractionally closer to the island of Thasos from this location.

- **A leak from the main oil line transporting semi stabilised crude from Delta to Sigma:** a leak in this existing line can generate a larger spill due to its long length and higher throughput than either of the new multiphase lines installed in the extension projects. The new lines have a low potential for failure as they will be buried over their whole length (protecting them from external damage) and will be designed for full wellhead shut-in pressures (giving them a very large corrosion allowance compared with normally rated lines). The main export line runs on the sea bed for the first 4.2 nautical miles (approximately 7km) after it leaves Delta. Although fishing is prohibited over the line, pipeline inspections have shown that trawling does occur. In the unburied sections damage from trawl boards has been noted to the external concrete coating. In the buried sections seabed scour from trawl boards has been noted – but never to a depth where the pipeline is impacted. Leaks in the buried section are more likely from internal corrosion than external impacts. Internal events normally result in pin-hole leaks that lead to a sheen developing on the sea surface above or close to the pipeline routing. Sheens are easy to spot in the Kavala Gulf as for 40 to 50% of the year the water surface is calm. Energean also has its divers' swim the pipeline routes regularly looking to see if any oil seeps can be seen from the sea bed. Seeps of this kind have little potential for environmental damage. A major leak can only be caused by an external impact and hence in an unprotected section of the line. Hence the second leak scenario takes the modelled leak on the export pipeline (410 m3 released over an 8.5 hour period) and positions it at the point where the pipeline first becomes buried, i.e. places it as close as feasible to shore.
- **A leak whilst loading processed crude to an oil tanker:** leaks in this system were not considered during the QRA as the onshore facilities were not included in this review. The onshore facilities are not modified by the planned or potential expansions and are already covered by valid environmental permits. However as loading operations represent the closest location to shore where a large leak could potentially occur it appeared prudent to model the worse possible leak in this location. Oil is loaded to tankers at approximately 12,000 bbls/hr. All subsea connections are checked by divers prior to loading commencing and every 4 hours after loading starts and hence these is little to no chance of a full bore rupture subsea. Loading is not undertaken in high wind conditions where the tanker could move. Three anchor points are used in any case to prevent movement during loader. The only feasible (but unlikely) event is that the hose is not properly fixed to the hard piped system on the tanker and suddenly breaks loose. At all times there are 2 tanker staff observing this point. They are in permanent radio communication with the Sigma control room, from where the loading operation can be remotely stopped. A rupture at this point would not be detected by the low-pressure trip system installed, as the pressure close to the ships tanks is very low anyway under

normal conditions. This incident is a scenario used when response systems are tested. It normally takes 2 minutes for the shipping pumps to be stopped and the pressure energy in the loading line to be dissipated. In this period 400 bbls would be spilt. Hence a spill of 400 bbls over 2 minutes, period 3km from shore is assumed for this scenario.

Using these leak scenarios for a range of oil spill scenarios were developed as described below.

10.8.2.3 Development of oil spill modelling scenarios

10.8.2.3.1 Introduction

The quantity of oil released to the sea and the time in which the releases take place are two critical parameters for defining oil spill scenarios that can be used within a simulation model representing the Gulf of Kavala. Oil spill modelling can be undertaken on either a deterministic basis of stochastic (probabilistic) basis. Clearly the final location of a spill of oil and the time it takes to arrive at that location depends on factors such as wind direction, wind strength, wave height, current strength and direction, water and air temperature, type of crude spilled etc. These parameters vary minute by minute, day by day, month by month etc. In stochastic modelling the probability of a defined amount of oil reaching the shore is calculated based upon knowledge of how these properties change with time. Commonly 100 runs for each spill will be undertaken and from this mean, minimum and maximum data generated. Stochastic modelling can simulate events on a particular day, for a particular month or for the average properties over a particular year. This type of modelling gives a good picture of where oil might occur and how its likelihood of appearing at a particular defined location changes with month, season etc. It does not however allow specific worst case (or best case scenarios) to be studied and hence the effectiveness of planned response measures to such worst cases to be determined.

Deterministic modelling is used where specific combinations, normally the “worst” case, or the “most likely” case are to be investigated. At the request of EBRD Energean has developed a series of deterministic scenarios rather than running a stochastic analysis. These have been used to predict how quickly winds blowing in a specific direction, at a certain speed, would carry oil to the most vulnerable sections of shoreline at different times of a typical year. The basis of the data used in these scenarios is outlined below.

10.8.2.3.2 Selection of sensitive receptors

When performing deterministic modelling not all onshore locations can be studied in the same amount of detail. To keep the number of scenarios to a manageable level the areas of particular sensitivity need to be identified and scenarios that look at how these areas could be impacted defined. For the sake of the current work the following locations have been defined:

- **<u>The coast between the Kavala and Nea Karvali</u>** – this coast line contains the historic port of Kavala, a number of tourist beaches (to the west and east of Kavala), the commercial port at Fillipos, small industrial based marine facilities (Fertiliser plant, Sigma water intake and loading buoys, Refined product intake buoys). Oil spills in this area would have an impact on the tourist industry – particularly in the summer months

and on a number of significant socio-economic activities (fishing, car ferry to Thasos, commercial port activities, etc.) year round. Winds from the south would carry spilled oil towards this coastline from all three leak points defined.

- **The coast between the Sigma plant and the mouth of the delta of the Nestos river** – this coast falls under numerous protection provisions (part of Natura 2000, SPA, National park, Ramsar wetlands, IBA). Moreover, it holds a number of small-scale fish farming enterprises. The impact on this coastline would be most significant from the late spring through to the end of summer. Tourism would be disrupted particularly in the summer whilst fauna would be impacted from late spring. Fish farming would be disrupted year round. Winds blowing from the southwest would bring oil towards this stretch of coast from leak points 1 and 2. Clearly leak point 2 is closer to this coastline than leak point 1. Spills from leak point 1 have more chance of being blown to the north of Thasos.
- **The north and North West coast of the island of Thasos** – Thasos is a major tourist destination. Whilst many of the main beaches are on the east and south of the island there are a number of popular tourist locations on the coast immediately adjacent to Energean's offshore facilities (Rachoni, Prinos, Kalarachi etc.). Clearly oil spills during the summer would be of greater significance than those in the winter due to the impact on the dominant tourist industry. Oil would be blown to this coast from spills at locations 1 and 2. Location 1 is clearly closer than location 2

10.8.2.3.3 Metocean data

Energean has collected detailed met-ocean data for the Kavala Gulf area to allow it to design the new facilities. This data has been described in Chapter 8. The same data has been used to define a range of appropriate deterministic oil spill modelling scenarios. Oil spill movement in shallow water environments is largely driven by wind direction. In deep water environments leaks originating below the sea surface can move for considerable distance dictated by current before they surface. In shallow waters such as the Gulf of Kavala this is not an issue. Oil from the main oil line leak reaches the surface less than 20 minutes after the leak occurs whilst for the other two events the oil is spilt from above the sea into it. Understanding wind direction and strength is therefore the most critical parameter when defining deterministic scenarios.

As can be seen from the annual wind data tabulated below, conditions in the Gulf of Kavala can be split into two main seasons, i.e. summer (running from May through to September) and winter (running from October to April). Wind strengths are relatively low throughout the year. The most likely weather condition in winter is a dead calm, with wind speeds being "gentle breeze" or below for around 60% of the time. In summer there are less dead calm days but on average winds are classified as a gentle breeze or lower for around 72% of the time. Hence for the majority of the

time spills in the Gulf of Kavala would move relatively slowly from their starting points.

Legend

Common occurrences

red - 12 most common
yellow - next 24 most common
orange - next 24 most common
blue - all remaining

Diagram 10-3: Wind speed distribution over a typical year

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All
29	**30**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
28	**29**	0	0	0	0	0	0	0	0	0	0	0,018	0	**0,002**
27	**28**	0,018	0	0	0	0	0	0	0	0	0	0	0	**0,002**
26	**27**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
25	**26**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
24	**25**	0	0	0,018	0	0	0	0	0	0	0	0,018	0	**0,003**
23	**24**	0	0,077	0	0	0	0	0	0	0	0,018	0	0	**0,007**
22	**23**	0,018	0,039	0	0	0	0	0	0	0	0	0,018	0,035	**0,009**
21	**22**	0,035	0,058	0,018	0	0	0	0	0	0	0,035	0,036	0,053	**0,019**
20	**21**	0,070	0,077	0,035	0	0	0	0	0	0	0,018	0,036	0,018	**0,021**
19	**20**	0,140	0,077	0,105	0,036	0	0	0	0	0	0,035	0,073	0,175	**0,054**
18	**19**	0,193	0,231	0,245	0,036	0,018	0	0	0,018	0	0,035	0,181	0,193	**0,095**
17	**18**	0,351	0,173	0,386	0,018	0	0	0	0	0	0,193	0,217	0,281	**0,135**
16	**17**	0,456	0,269	0,298	0,054	0,018	0	0	0	0,018	0,158	0,254	0,684	**0,185**
15	**16**	0,684	0,673	0,579	0,109	0,053	0	0	0	0	0,263	0,471	0,947	**0,314**
14	**15**	1,157	0,865	0,579	0,163	0,053	0	0,018	0	0,163	0,403	0,652	1,368	**0,451**
13	**14**	1,192	1,519	0,947	0,236	0,140	0,036	0,123	0,018	0,236	0,561	0,707	1,666	**0,612**
12	**13**	1,736	2,192	1,262	0,670	0,456	0,127	0,123	0,158	0,598	1,280	1,721	2,139	**1,033**
11	**12**	2,332	2,558	1,841	1,069	0,754	0,127	0,210	0,421	0,978	2,367	2,681	2,753	**1,503**
10	**11**	3,471	3,385	3,103	1,540	1,069	0,417	0,544	0,912	1,775	3,471	3,333	3,138	**2,175**
9	**10**	4,453	4,673	3,401	1,938	1,911	1,178	1,280	1,964	2,518	4,453	3,986	5,137	**3,070**
8	**9**	6,434	5,673	4,628	3,388	2,980	1,685	2,279	2,770	4,130	5,645	5,036	6,101	**4,226**
7	**8**	7,433	6,500	6,364	4,783	3,594	3,116	5,645	5,242	5,634	6,311	5,797	7,100	**5,629**
6	**7**	8,555	7,077	6,452	5,924	5,908	5,580	8,275	8,240	6,902	6,925	7,138	7,749	**7,068**
5	**6**	7,714	7,404	7,696	8,116	8,310	8,859	11,799	11,729	9,801	8,012	7,917	8,310	**8,817**
4	**5**	7,889	8,115	9,537	10,815	11,606	13,279	15,305	14,919	12,428	8,994	8,351	8,292	**10,810**
3	**4**	9,081	9,135	11,325	13,696	14,008	16,069	15,761	15,077	14,294	10,256	9,746	9,274	**12,321**
2	**3**	9,730	11,865	11,553	14,348	14,884	16,522	14,043	13,517	14,004	12,272	10,996	10,063	**12,811**
1	**2**	11,957	12,154	13,377	14,819	16,567	16,033	12,290	12,062	13,297	12,658	12,663	11,325	**13,265**
0	**1**	14,902	15,212	16,252	18,243	17,672	16,975	12,307	12,956	13,225	15,638	17,953	13,201	**15,366**
		100	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

The following "wind rose" shows wind speed by direction and strength over an entire year. As can be seen the predominant wind direction is from the northeast. These winds prevail for almost 40% of the time. Wind roses showing monthly variations are available. These show northeasterly winds predominate in all months. Together with winds from the east and north, winds that would generally blow oil slicks away from the critical coastlines identified, dominate for more than 60% of the year. Spills would therefore normally slowly drift out to sea towards the Kappa platform and then into open sea beyond.

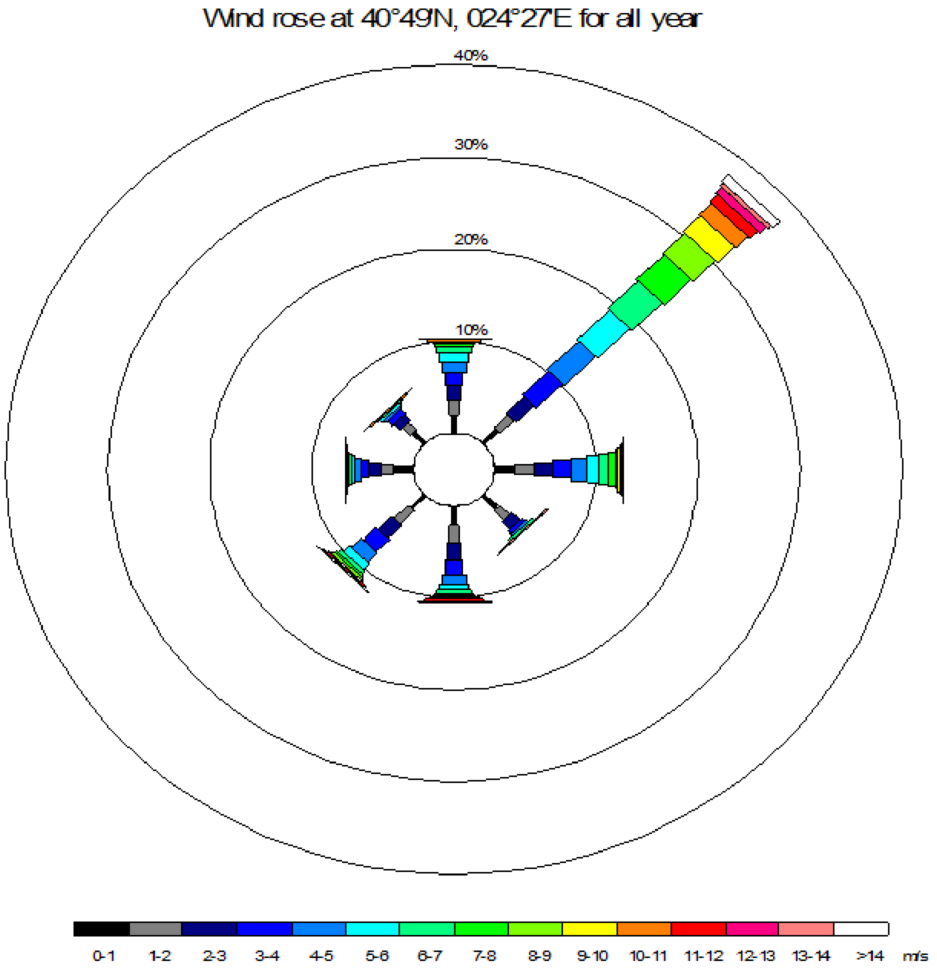


Diagram 10-4: Wind rose showing predominant wind directions

Winds blow about 10% of the time from the south. These winds can be relatively strong in the winter but are infrequent and generally short lived. Winds classified as a strong breeze or above occur for about 7 hours a month in the winter and don't occur in the summer. These short lived southerly storms therefore represent the worst-case scenario for bringing oil onto the coastline between Kavala and Nea Karvali.

Winds blow from the southwest, potentially blowing crude into the Nestos delta wetlands around 12% of the year. Strong winds blow for a maximum of 3 hours per month in the winter and not at all in the summer.

Winds from the North West, which would take spilled crude towards the Thasos island coast are the least frequent occurring only 5% of the time and never at strong conditions. The mean wind speed in this direction in the winter is 2.1 m/s (a light breeze) and in the summer they are slightly fresher at 2.4 m/s. High winds virtually never occur.

Wave heights in the Gulf of Kavala are below 1m height for 95% of the year. The only circumstances where significant waves cab be generated is where winds are from the south (from the open sea) when heights of up to 6m can be very rarely reached. Almost 50% of waves greater than 1m are associated with southerly winds. As a result of the low wave activity, spills

are not dispersed over wide areas as they are blown by the wind. Waves also do not hamper oil spill recovery efforts. Energean's boats are capable of responding for more than 99% of the year. Clearly when responding to spills blown by strong southerly winds towards the Kavala coast line oil response activities could be hindered, but spills tend to be broken up rapidly by these significant waves. This has greatest significance for leaks from location 3 (loading point) which is just 3km from shore. Loading operations are not attempted during periods of strong winds from the south as divers cannot function in this weather to perform required safety checks. These winds are so infrequent and last for such a short time that this is not a significant issue. As a result the coincident leak at location 3 with a major southerly storm is not considered a valid scenario.

		337,5	22,5	67,5	112,5	157,5	202,5	247,5	292,5	Total
		22,5	67,5	112,5	157,5	202,5	247,5	292,5	337,5	
6,5	7,0	0	0	0	0	0	0	0	0	0
6,0	6,5	0	0	0	0	0,001	0	0	0	0,001
5,5	6,0	0	0	0	0	0,001	0	0	0	0,001
5,0	5,5	0	0	0	0	0	0	0	0	0
4,5	5,0	0	0	0	0	0,006	0	0	0	0,006
4,0	4,5	0	0	0,001	0	0,025	0	0	0	0,027
3,5	4,0	0	0	0,001	0	0,043	0	0	0	0,045
3,0	3,5	0	0	0	0	0,079	0	0	0	0,079
2,5	3,0	0	0	0,001	0	0,104	0,006	0	0	0,112
2,0	2,5	0	0,010	0,010	0,003	0,222	0,025	0	0	0,271
1,5	2,0	0	0,164	0,065	0,016	0,475	0,158	0,001	0	0,879
1,0	1,5	0,077	1,890	0,382	0,109	1,085	0,439	0,024	0	4,005
0,5	1,0	0,894	13,574	3,108	0,394	4,310	1,806	0,354	0,095	24,537
0,0	0,5	5,032	15,891	17,746	3,397	18,940	4,440	2,467	2,123	70,036
Total		6,004	31,529	21,317	3,919	25,292	6,874	2,846	2,218	100,000

Legend
Common occurrences
red - 12 most common
yellow - next 24 most common
orange - next 24 most common
blue - all remaining

Diagram 10-5: Wave heights and distribution by direction

10.8.2.3.4 Physical property data

As discussed above, oil spill scenarios have been developed for a typical winter month (February) and a typical summer month (July). HYSIS has been used to determine the physical properties of the spilled crude. Crude properties at leak point 1 are based upon Epsilon PVT Data. Crude properties for leak points 2 and 3 represent a point where equal volumes pf crude are being produced from Prinos and Epsilon.

Water and air temperature data have been obtained from the same source as the wind and wave speed data for the area:

- Crude properties: Epsilon
  - ⇨ Oil viscosity 9 cp
  - ⇨ Oil gravity 36 API
  - ⇨ Oil wax content 3.9%

- ⇨ Oil pour point: -36'C
- Crude properties: Mixed blend
  - ⇨ Oil viscosity: 8 cP
  - ⇨ Oil gravity: 34.5 API
  - ⇨ Oil wax content: 1.7%
  - ⇨ Oil pour point: -24'C
- Summer properties
  - ⇨ Air temperature: 25.2'C
  - ⇨ Water temperature: 24.0'C
- Winter properties
  - ⇨ Air temperature: 7.5'C
  - ⇨ Water temperature: 12.0'C

10.8.2.3.5 Oil spill scenarios

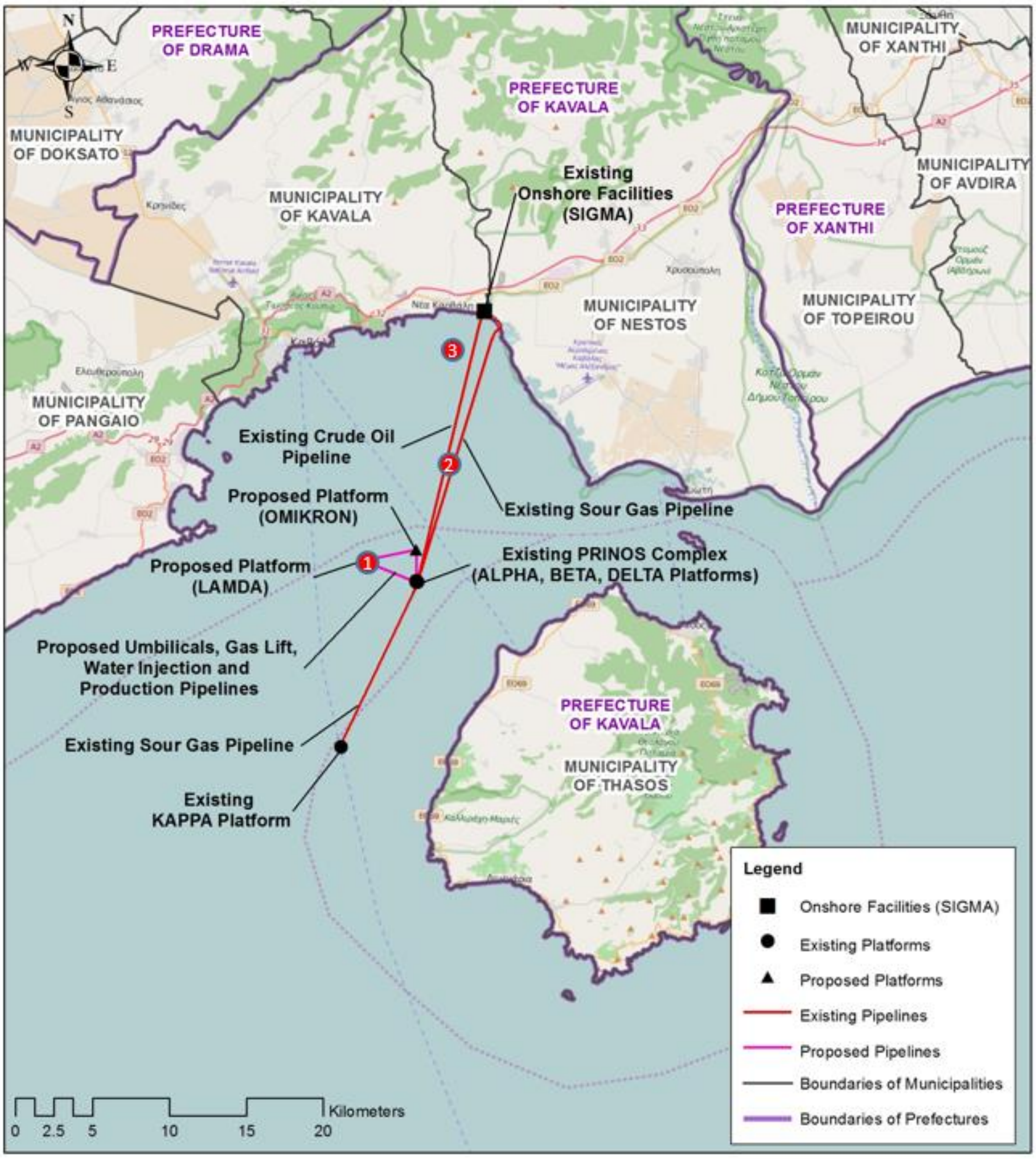
Based upon the above analysis the following scenarios have been defined.

- **Winter – based upon February as a typical month**
  - ⇨ **1A:** Wind from the S at a mean speed of 3.95 m/s. This represents 8.3% of potential outcomes in a typical winter month. This takes oil towards Kavala/Nea Karvali
  - ⇨ **1B:** Wind from the S at 10 m/s for 7.5 hrs, followed by 3.95 m/s after this. This represents 1.0% of potential outcomes in a typical winter month. Simulates the worst case of a single continuous storm blowing directly towards Kavala/Nea Karvali. It is expected that for leaks at location 1 and 2 this will potentially represent the "worst case" scenario.
  - ⇨ **1C:** Wind from the SW at a mean speed of 3.38 m/s. This represents 12.2% of potential outcomes in a typical winter month. This takes oil towards the protected wet lands east of Nea Karvali
  - ⇨ **1D:** Wind from the SW at 10 m/s for 3.5 hours followed by 3.38 m/s after this. Simulates a worst case storm at the same time the leak starts. This represents 0.5% of potential outcomes in a typical winter month. It sends oil towards the protected wetlands east of Nea Karvali. It is possible that for leak point 2 this would represent the "worst case" scenario.
  - ⇨ **1E:** Wind from the NW at a mean speed of 2.1 m/s. There is no storm conditions recorded with wind from this direction. This represents 6.3% of potential outcomes for a typical winter month. This would take oil towards the island of Thasos.
  - ⇨ **1F:** Wind from the NE at a mean speed of 7.5 m/s. This represents 33.1% of potential outcomes in a typical winter month. This is the predominant wind direction taking oil generally offshore. This and the subsequent scenario represent the "most likely outcome" when applied to all leaks.
  - ⇨ **1G:** Wind from the NE at a speed of 13 m/s for 48 hours followed by 7.52 m/s after this. This simulates a typical storm with winds from the predominant direction. This represents 6.6% of potential outcomes. It would take oil generally offshore

- **Summer – based upon July as a typical month**
  - ⇨ **2A**: Wind from the S at a mean speed of 2.7 m/s. This represents 7.3% of outcomes. There are no winds greater than strong breeze and hence no storm scenario in the summer. This takes oil towards Kavala/Nea Karvali. When applied to leak point 3, this would be the likely "worst case".
  - ⇨ **2B**: Wind from the SW at a mean speed of 3.4 m/s. This represents 10.9% of the potential outcomes during a typical summer month. There are no winds greater than strong breeze in the summer in this direction and hence no storm scenario. This takes oil towards the protected wet lands east of Nea Karvali
  - ⇨ **2C**: Wind from the NW at a mean speed of 2.4 m/s. This represents 6.8% of potential outcomes in a typical summer month. Again there are no storms in this direction in summer. This takes oil towards Thasos. It is likely that this scenario represents the "worst case" for oil spills reaching Thasos when applied to leaks in position1.
  - ⇨ **2D**: Wind from the NE at a mean speed of 5.0 m/s. This represents 37% of the potential outcomes in the summer months. This is the predominant wind direction that takes oil generally offshore. This combined with the storm scenario below, represent the "most likely" outcome
  - ⇨ **2E**: Wind from the NE at 10 m/s for 7 hours followed by 5.0 m/s. This simulates a typical summer storm from the predominant wind direction. It occurs around 2% of the time.

All of the twelve above scenarios will be applied to each of the leak points 1 and leak points 2. Scenario 2A will also be applied to leak point 3. There is no merit in simulating this leak point for other wind directions or in the winter. As discussed above loadings are not undertaken in the winter when winds are blowing from the south as the concurrent high waves disrupt safety procedures. Average winds in the summer and winter (if storms are ignored) are similar. As this point is so close to the shore the impact of winds from the southwest are very similar to those from the south.

The leak points are shown on the following map for clarity.



Map 10-1: Potential leak points

10.8.2.4 Modelling

Energean contracted BMT Cordah (Aberdeen, UK) to develop an oil spill model for the Kavala Gulf and to use this to simulate the 25 deterministic runs defined above. BMT Cordah has performed many similar studies for operators and fields located in the UK North Sea as well as elsewhere in the world. It uses OSIS modelling software. OSIS can simulate the fate and dispersion of surface oil slicks in 2D. 3D modelling was not considered necessary due to the low water depths and small waves sizes prevailing in this area. OSIS was jointly developed by BMT and AEA Technology plc and is a particle-tracking model that represents an oil slick as a collection of free moving particles that simulate the spreading slick. The weathering model and associated algorithms within OSIS have been validated against controlled actual spills at sea and real spill events, supported with laboratory calibration. The model combines:

- Weathering algorithms that determine physical change to the slick as it spreads;
- Transport processes acting on the oil due to the current, wind, waves, diffusion and buoyancy in the ocean surface layer; and
- Change due to evaporation, emulsification and natural dispersion; and prediction of physical properties (density, viscosity and flash point changes)

Hydrodynamic and bathymetric data are available in the OSIS package for most locations in the world, including the North Aegean. These standard inputs have been checked for validity and retained. BMT separately has prepared met-ocean (wind and wave data) for the project and these surveys have been used within the oil spill modelling work. Hence met-ocean data used across the whole project is consistent.

As in all deterministic modelling the outcomes are relatively simplistic. Oil generally moves in straight lines (in the direction of the modelled winds). Only where currents are strong do trajectories change from the wind direction. Lateral spread of oil is similarly limited. To better replicate lateral spreading time series data can be used. In these models wind speeds are varied around a defined mean based upon actual weather data measured. Whilst this type of model provides more realism it can make the results harder to interpret than a more simplistic deterministic approach. In a deterministic model OSIS tends to give more weight to the wind than the current conditions. Results vary from the geographic location on the globe and are a function of the current data available in the area of interest. OSIS has been found generally in trials to slightly over estimate the volume of oil that beaches. In this way it gives a worst-case volume of oil beached under specific and fixed wind conditions.

For each scenario defined above BMT Cordah has run the corresponding model until no significant amount of oil remains on the sea surface (significant in this context means that 99% of the spilled oil has either arrived at a coast line, or has been removed by weathering effects – evaporation and/or biodegradation). As output they have provided image files that show:

- The size and orientation of the oil slick approximately 3 hours after the spill occurs. In around 99% of wind and weather conditions Energean will be able to have its oil spill response facilities mobilised to site and booms deployed at this point. Having an estimate of spill size at this point provides a check that the length of booms currently available are sufficient to contain the predicted slick.
- The size and orientation of the slick at the point in time when oil first arrives at a coastal location. In the model it is assumed that no oil is removed by the emergency response system mobilised, i.e. the system is either 100% ineffective, or it is not actually mobilized.

In addition to these figurative outputs the OSIS model also generates the following data:

- The time taken from the spill occurring until the first droplet of oil arrives at the coast;
- The coordinates of the predicted beaching location assuming the deterministic parameters applied;
- The time at which no significant amount of the slick remains on the sea surface;
- The volume of oil that has reached the coast between these two times.

As the models are deterministic, there is no output that identifies the likelihood of this event from

occurring. Wind and wave data used is summarised by compass point direction (i.e. North, North East etc.) representing angles O', 45' etc. from north. Each data point represents data gathered in a range of -22.5' to +22.5' from the selected compass point. Hence when a specific coastal coordinate is defined (e.g. from a wind blowing directly from the south) the actual extent of the coast potentially contacted could be anywhere on a bearing of -22.5' to +22.5' from the modelled point. Deterministic modelling does not attempt to predict actual landing points based upon real data, but simulates the time in which response measures need to be deployed given an assumed fixed weather direction. As discussed above this type of model tends to somewhat overestimate the amount of oil beached and underestimate the amount of time to the beaching incident (in reality the spill would meander to the coast rather than travel there directly).

10.8.2.5 Modelling results

The results of the oil spill modelling work as undertaken by BMT Cordah are summarised in the table below. To the data generated by the deterministic modelling has been added the likelihood of the defined case representing the prevailing weather conditions when the spill occurs. As can be seen for leak points 1 and 2, approximately 67% of potential weather events have been modelled (with winds orientated from 4 of a potential 8 compass directions). With weather from the non-modelled directions the tendency would be for slicks to move away from the coast (i.e. act like the scenarios that model weather from the predominant North Easterly direction).

For leak point 3, only 7.3% of potential outcomes have been modelled. As discussed previously only winds from the southerly direction have been considered for this leak point, considering is relative closeness to shore. Wind in all other directions would result in significantly longer durations before a beaching event occurs.

The data representing the "worst case" scenarios for each of the three defined sensitive coasts are highlighted. For these scenarios (case 1B for the coastline between Kavala and nea Karvali) case 1D (for the coast along the Nestos Delta wetlands) and case 2C (for the north western coast of Thasos island) the illustrations showing positions of the slick after 3 hours and the shape and orientation of the slick when beaching first occurs have been included. Data for the prevailing wind condition is also presented and discussed.

The worst case scenarios seem to be:

- **Coast between Kavala and Nea Karvali:** Case 1B, oil is forecasted to beach after 7 hours
- **Coast between Nea Karvali and the mouth of the Nestos River:** Case 1D, oil is forecast to beach after 9 hours
- **North West Coast of Thasos Island:** Case 2C, oil is forecast to beach after 48 hours

The worst case scenarios for the mainland areas are those simulating the winter months when short lived storms can occur. They also are both associated with a leak from the main oil export pipeline. Although this leak is smaller than the modelled blow out scenario, the fact that the leak point is closer to shore gives a higher probability for significant volumes of oil arriving at the shore.

The worst case scenario for Thasos is the summer scenario following a blow-out from Lamda. Storm force winds do not blow towards Thasos in the winter and summer winds are slightly fresher.

The three identified worst case scenarios are discussed in further detail below. Clearly scenario 1B applied to the pipeline leak is the most critical. The single scenario applied to the loading line leak is similarly discussed. Under the modest winds of the Kavala Gulf, oil beaches after this incident after approximately 10 hours.

10.8.2.5.1 Worst Case Scenario for the Kavala-Nea Karvali shoreline

As simulated, oil beaches after a major leak from the oil export pipeline on the shore somewhere between Kavala and the Sigma Plant after approximately 7 hours. All released oil has come ashore after 30 hours. The time to reach shore is short relative to other scenarios because 1B assumes that a storm commences at exactly the same time as the leak occurs and blows at a constant 13 m/s from the south for 7.5 hours before then subsiding to average winter wind conditions. These high southerly winds carry the oil slick rapidly to the coast. Southerly winds also bring with them high waves. These high waves are significant. Firstly they break up the oil spill creating an emulsion. Hence the volume of “emulsified oil” arriving at the shore is greater than the volume of “oil” released (1,042 m^3 compared with 410 m^3). Secondly, the high waves would prevent Energean from deploying its oil spill rescue system. Normally this system takes a maximum of 3 hours to deploy and can prevent the slick moving to the coast whilst the oil is skimmed from the surface.

Whilst the potential impact of scenario 1B is significant, largely because existing oil spill response measures cannot prevent such a leak escalating into a coastal pollution event, the likelihood of it occurring is very remote. Southerly storms such as that modelled occur for just 0.6% of the year. Scenario 1B assumes that all winds over 10 m/s in a winter month occur as a single storm of 7.5 hour duration. Frequently high winds blow multiple times in a month for a shorter duration. Any storm of 5 hours or less would have significantly less impact as after it passes wave levels quickly dissipate and oil spill equipment would be mobilised prior to the oil reaching shore. No statistical data is available to determine how frequent a “maximum” storm occurs, but from local experience it is probably the case twice per winter. This would reduce the probability of this scenario to 0.2% (i.e. by a factor 3).

The other aspect to consider when judging significance is the likelihood of the leak occurring at the same time a major storm occurs. Clearly if the modelled failure was caused by high winds or waves then the probability of the two events cannot be multiplied as there would be a degree of dependency. As it is, in this instance, there is a significant degree of independence; that is, during a storm such a failure is less likely to occur than at any other time of the year. As discussed above, a major failure of the export pipeline is likely caused by the impact of the trawl board of a fishing boat. Southerly storms of this magnitude are forecast accurately a number of days in advance. During this weather the small fishing boats that make their living in the Gulf of Kavala are not fishing. Hence the chance of such a leak occurring during a storm is considerably lower than in calm weather.

If we take the chance of such a major leak occurring in the first place as a relatively probable event, say 1 x 10^{-2} (once per hundred years) and then multiply this by the probability of scenario 1B occurring (2 x 10^{-3}) and reduce the probability that both events occur simultaneously by a modest factor 10, then this gives a likelihood of an oil spill reaching this shore, in the magnitude calculated, as 2 x 10^{-6}. This clearly is a very low incident frequency. Whilst the existing response measures do not allow this level to be reduced further the fact that the likelihood is so low anyway would likely not warrant further mitigation measures from being considered. As oil skimming operations cannot be made effective in high seas the only alternative to further reduce risk levels would be to reduce the size and probability of a failure. This could be achieved by burying the sections of the pipeline that are currently exposed.

10.8.2.5.2 Worst case scenario for the coast line between Nea Karvali and the Nestos river Delta

Scenario 1D represents the worst case scenario for an oil spill arriving at this vulnerable stretch of coastline. Under modelled winter storm conditions it takes 9 hours for oil from a spill in the oil export line to reach the shore. Whilst this is only 2 hours longer than the worst case scenario for the northern coast (discussed above), the potential severities of these two incidents are very different.

Available data clearly shows that high winds from the southwest are less common than those from the south, and they are not accompanied by significant waves. Although the modelled pipeline leak is closer to this shore than the northerly shore it takes 2 hours longer to travel this shorter distance because storm force winds last only for 3 to 4 hours maximum per winter month. As high waves are not associated with winds from this direction the oil response vessel owned by Energean can be deployed with no issue and have booms deployed and skimming operations underway at least 6 hours before any oil reaches the shore. Whilst such operations are not 100% effective they would dramatically reduce the calculated volume of “emulsified oil” (567 m^3) reaching the shore. These operations would also slow the passage of oil to shore further. Southwesterly winds are uncommon and short lived. If the passage of an oil slick can be slowed it gives time for the wind to swing back to the predominant north westerly direction, which would blow the slick back out to sea, or for the wind to fall to calm conditions which is the most common situation in winter.

Met-ocean data shows that storms from the southwest occur for about 0.3% of the year. If again we assume that the pipeline failure frequency from ship impact is 1 x 10^{-2}, the frequency of a spill reaching the shore can be calculated. In this case it is possible that a storm from the south west of this length and magnitude could occur each month, hence the probability is not reduced as in scenario 1B. Also in this case it is less certain that fishing would cease, hence the frequency is reduced by 2 rather than 10 as was previously the case. As wave conditions allow for effective use of oil spill rescue equipment 99% of the year in the Gulf of Kavala then there is only a 1% or 1 x 10^{-2} chance they fail to contain the spill. Hence the probability of a spill of the calculated magnitude reaching the coast is 1.5 x 10^{-7}. This is a lower probability than for scenario 1B because in this case there is time and capacity to implement design oil spill response measures.

10.8.2.5.3 Worst case scenario for oil arriving on the north western coast of Thasos Island

As storm winds never blow from the North West towards the coast of Thasos and wave heights are always modest, oil spills floating in this direction move slowly. The worst case modelled (scenario 2C) predicts that oil from a blowout at Lamda takes approximately 48 hours to arrive at the coast. In an average month winds blow in this direction for just 36 hours in total. The probability that they blow continuously for 48 to 81 consecutive hours (as simulated) in this direction is therefore highly improbable. In reality the slick is likely to move part of the way towards the coast before being either becalmed or blown from the northeast towards open sea (see section 10.8.2.5.5 below for a description of the impact of winds from the north east). A deterministic model cannot simulate this type of behaviour. Clearly where travel times are longer than a few hours the chances are that weather conditions will shift to predominant strengths (i.e. calm) and direction (northeasterly).

According to North Sea OGP data the probability of a blowout occurring whilst drilling a normally pressured development well is 4.8 x 10^{-5}/well. A side track would have a lower probability. However if all 17 wells are assumed to have this probability then the chance of a blowout happening during the planned extension project is 8 x 10^{-4}. The probability of the modelled worst case scenario is 2.8% or 2.8 x 10^{-2}. There is no dependency or independency between the event and the weather assumed in the scenario. Weather conditions are ideal for oil recovery operations using booms and spills. Although waves from this direction are minimal it will be assumed that response efforts fail 1 in 100. Hence the probability of a slick of the calculated magnitude calculated arriving on Thasos is 2.3 x 10^{-7}.

10.8.2.5.4 Oil spill from the loading buoy

As discussed earlier in this section, loading operations cannot take place during storm conditions. If a storm is forecast it is allowed to blow through before loading commences. If a storm develops unexpectedly loading ceases. Hence the worst case for a spill from the loading system is normal average winds from the south. Whilst these wind speeds are modest (3 m/s) a spill reaches the shore approximately 10 hours after it occurs. All oil has beached after 11 hours. Although there is sufficient time for the Energean oil spill response system to be mobilised in this period, operational requirements are for a boom to be deployed around the front of the vessel prior to loading commencing. If a leak occurs oil is captured by the boom and prevented from passing to shore. This is effective as inshore wave sizes are even smaller than the already small wave sizes seen more generally and the maximum volume of such a leak is relatively small. Because such a leak could have major consequences the integrity of the system is checked before each operation and monitored during the entire operation. Clearly if oil is seen passing the fixed boom the oil spill response vessel would be mobilised. It would be mobilised in any regard to skim collected oil from the surface.

10.8.2.5.5 Impact of winds blowing from the predominant northeastery direction

As discussed above, winds blow predominantly from the northeast. Winds from this direction have been modelled even though they would not constitute a worst case for any of the identified sensitive coastal areas in the Gulf of Kavala. Considering the relatively long durations it takes for an oil slick to reach shore (in all but two of the modelled cases the time is above 10 hours), it is reasonable to conclude that nearly all oil spilled in the Gulf of Kavala would end up being blown eventually in the direction of this predominant wind.

Hence analysis of these cases (1F, 1G, 2D and 2E for either leak point) is important. As can be seen from the attached drawings oil blown in this direction would eventually beach, if not removed using the oil spill response facilities, in Iersissos Bay, Akti peninsular, Halkidiki. This stretch of coast has similar features and sensitivity to the North West coast of Thassos. It contains stretches of rocky cliffs and sandy beaches with many tourist resorts.

The minimum time for oil to reach this coast would be following a blowout in the winter. The time period would be between 34 and 71 hours, the shorter time being if the blowout occurred during the early part of a major winter storm. Whilst a storm from the south brings high winds and high waves a storm from the northeast only brings high winds. Waves do not develop because of the very limited fetch area. Energean's oil spill response vessel can operate easily in these conditions and hence with such long transit times most oil could be removed from the sea before reaching the coast. In summer conditions transit times are more than 4 days to this location. The potential for a significant spill would be greater than on Thasos because for a large part of the year slicks would move in this direction.

Table 10-4: Modelling outcomes for the three leak cases

Leak Point	Scena-rio #	Wind Directi on (from)	Storm (yes/no)	Impact Location (place)	Time to Coast (hrs)	Time to End slick (hrs)	Volume Beached (m^3)	Annual Likelihood (%)
1	1A	S	No	Kavala	32	63	319	4.8
1	1B	S	Yes	Kavala	16	64	546	0.6
1	1C	SW	No	Protected area	36	65	228	7.1
1	1D	SW	Yes	Protected area	28	66	322	0.3
1	1E	SE	No	Thasos	53	83	214	3.7
1	1F	NE	No	Open Sea	71	129	469	19.3
1	1G	NE	Yes	Open Sea	34	106	809	4.4
1	2A	S	No	Kavala	56	85	128	3.0
1	2B	SW	No	Protected area	36	66	237	4.5
1	2C	NW	No	Thasos	48	81	215	2.8

Leak Point	Scena-rio #	Wind Direction (from)	Storm (yes/no)	Impact Location (place)	Time to Coast (hrs)	Time to End slick (hrs)	Volume Beached (m^3)	Annual Likelihood (%)
1	2D	NE	No	Open Sea	111	183	503	15.4
1	2E	NE	Yes	Open Sea	99	184	540	0.8
Total deterministic scenarios for leak point 1 (Lamda blow out)								**66.7 %**
2	1A	S	No	Kavala	22	30	291	4.8
2	1B	S	Yes	Kavala	7	30	1,042	0.6
2	1C	SW	No	Protected area	17	25	257	7.1
2	1D	SW	Yes	Protected area	9	25	567	0.3
2	1E	SE	No	Thasos	59	67	185	3.7
2	1F	NE	No	Open Sea	81	89	498	19.3
2	1G	NE	Yes	Open Sea	38	46	812	4.4
2	2A	S	No	Kavala	38	46	162	3.0
2	2B	SW	No	Protected area	17	26	246	4.5
2	2C	NW	No	Thasos	57	65	193	2.8
2	2D	NE	No	Open Sea	126	134	488	15.4
2	2E	NE	Yes	Open Sea	114	134	562	0.8
Total deterministic scenarios for leak point 2 (main pipeline)								**66.7 %**
3	2A	S	No	Kavala	10	11	36	7.3
Total deterministic scenarios for leak point 3 (Tanker loading point)								**7.3 %**

Selected results are graphically presented in the below figures. The full Oil Spill Modelling Report is presented as an annex:

Figure 10-1: Pipeline 1B scenario. Deterministic results 3 hrs after release (max response time); 7 hrs after release (min arrival time until beaching) and 30 hrs after release (end of simulation)

Key: Red cross for the release point, track and beaching locations (red); final particle positions (black)

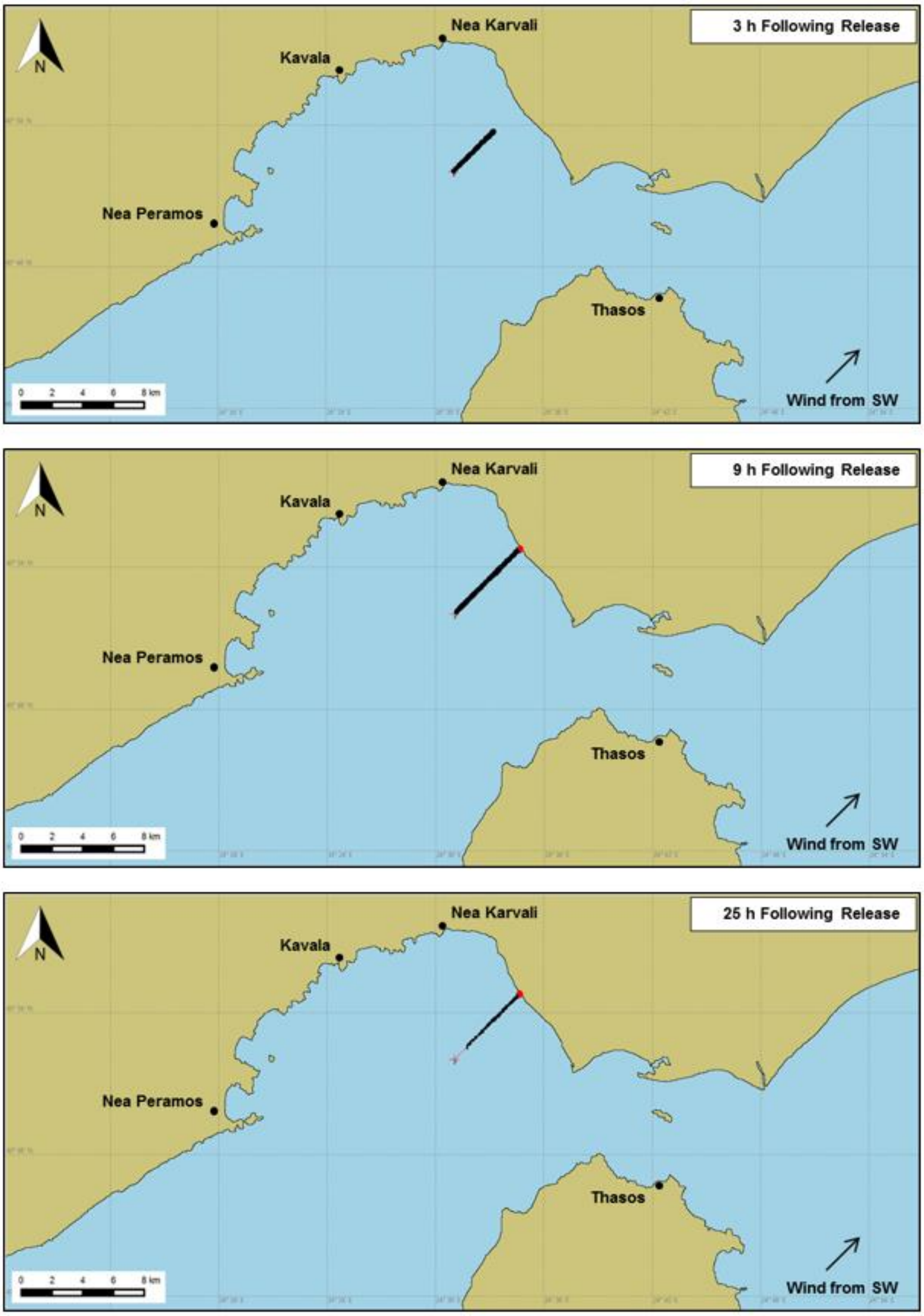


Figure 10-2: Pipeline 1D scenario. Deterministic results 3 hrs after release (max response time); 9 hrs after release (min arrival time until beaching) and 25 hrs after release (end of simulation)

Key: Red cross for the release point, track and beaching locations (red); final particle positions (black)

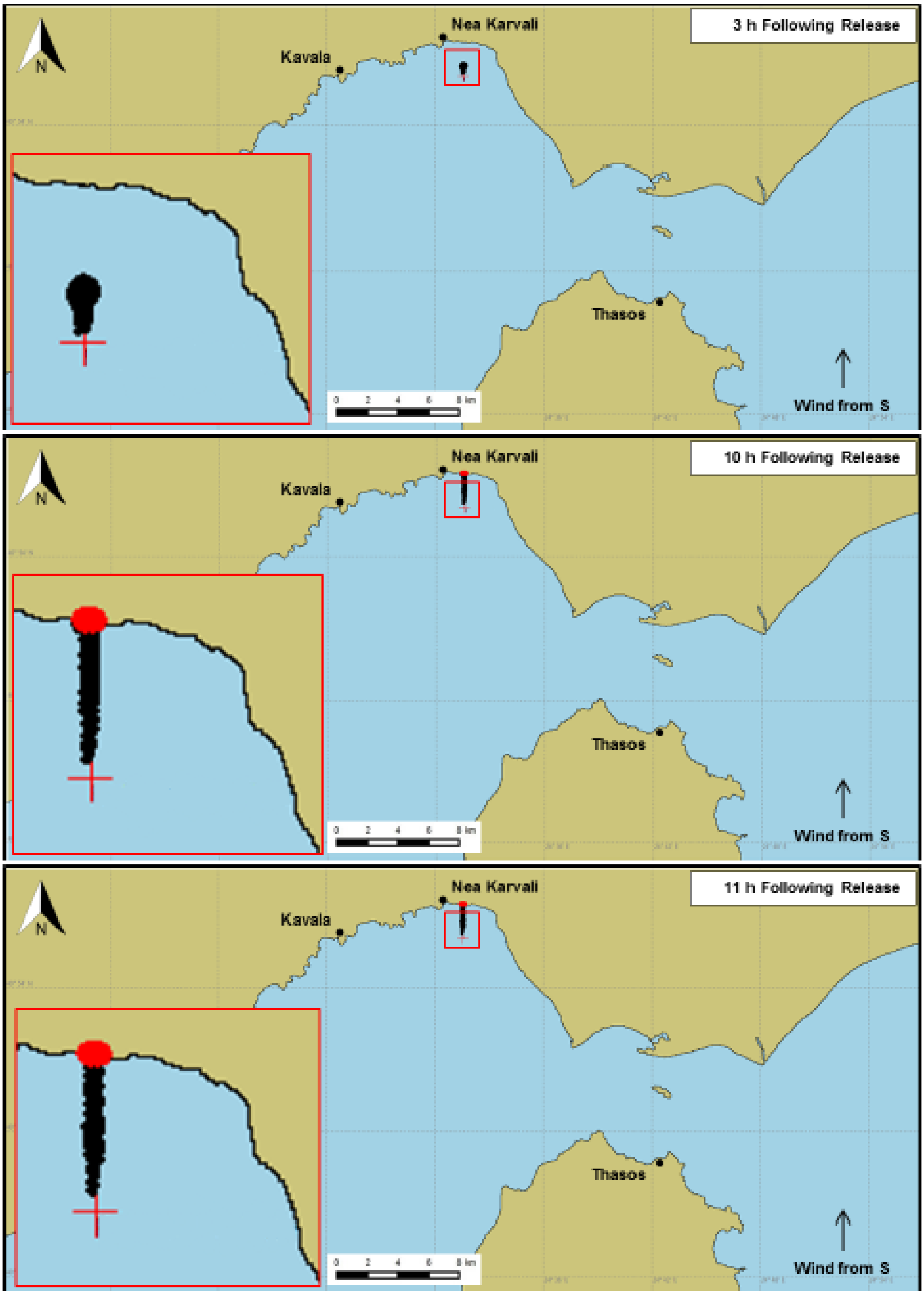


Figure 10-3: Loading buoy scenario. Deterministic results 3 hrs after release (max response time); 10 hrs after release (min arrival time until beaching) and 11 hrs after release (end of simulation)

Key: Red cross for the release point, red square: zoom; track and beaching locations (red); final particle positions (black)

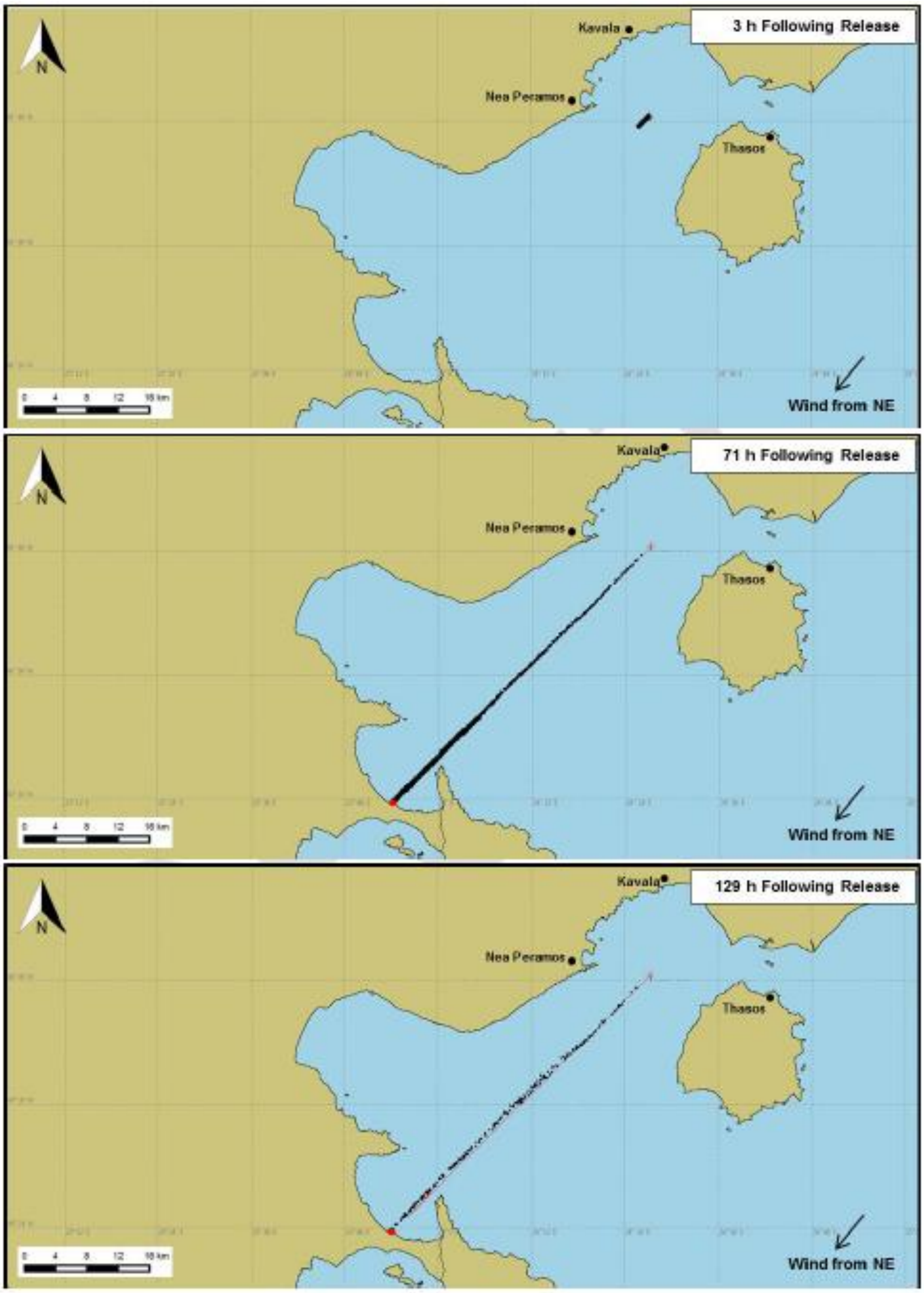


Figure 10-4: Well blow-out 1F scenario. Deterministic results 3 hrs after realease (max response time); 71 hrs after release (min arrival time until beaching) and 129 hrs after release (end of simulation)

Key: Red cross for the release point, track and beaching locations (red); final particle positions (black)

10.8.2.6 Conclusion and discussion

10.8.2.6.1 Introduction

A deterministic analysis of the potential impacts of worst-case oil spills from the existing and future offshore oil facilities operated by Energean in the Gulf of Kavala has been undertaken. These scenarios modelled a spill of 475 m^3 over a 24 hour period originating from a well blow-out on the planned new Lamda platform, a spill of 410 m^3 over an 8.5 hour period originating due to the impact of a trawling board striking and rupturing the main export line at the point just before the line becomes buried and a spill of 64 m^3 over a 2 minute period due to a failure of the hose connection to a tanker being loaded with crude at the tanker loading point.

The deterministic scenarios developed were used to model wind directions in the summer and winter months, under normal (mean) and maximum (storm) conditions, that would push the surface slick towards the most sensitive coastlines in the study area (the commercially sensitive coast line between Kavala and Nea Karvali, the environmentally sensitive coastline of the Nestos river delta wetlands and the tourist sensitive coastline of north western Thasos).

Metocean data has been prepared and analysed to assess the likelihood of the modelled weather directions being dominant when a leak occurs.

Deterministic modelling tends to overestimate the amount of oil arriving at the coast as it is assumed that the spilled oil moves uniformly in the chosen weather direction. In realty oil would spend more time drifting in multiple directions before reaching the coast. In the Gulf of Kavala where wind speeds are generally low or zero and dominated by stronger winds that blow to offshore, it is probable that winds taking crude onshore never blow for long enough to actually satisfy the time predicted in the deterministic models.

10.8.2.6.2 Detailed discussion

The worst case scenario is a result of a winter storm bringing oil to the shore between the Sigma plant and the port of Kavala following a major rupture of the main oil export line. Under such circumstances oil would arrive at the coast about 7 hours after release and continue for a further 23 hours. Weather from the south produces significant waves. These would prevent the immediate deployment of Energean's oil spill response vessel. Before it could be at site first oil would have reached the coast. As a result of the high waves the leaked oil is emulsified. The volume of emulsified oil arriving at the coast is almost three times the volume of oil spilled.

Whilst such a scenario would have a significant impact to the commercial and tourist activities of the area the chance of such an event occurring is remote. Assuming that oil spill response vessels are not mobilised at all the calculated probability of such a severe event is calculated as 2×10^{-6} (i.e. twice per million years). In the 20 year life span of the described project the probability would be 4×10^{-5}. In reality the volume of oil would never reach the level calculated. Although the oil spill response system could not prevent some oil reaching the shore it should be in place 4 hours after the beaching commences. Hence if oil arrives at a uniform rate around 83% of the spilled volume should be recovered. It is also highly unlikely that southerly winds would blow continuously for 30 hours. On average southerly winds occur for about 10% of the time on average, with the worst month being April (20%). Thus 40% of southerly winds would

have to blow in one continuous period for all oil to be beached. In reality during this period either calm weather or winds from the northeast would occur.

In all other cases there is sufficient time to allow oil spill response vessels to be mobilised. The Kavala Gulf is characterised by low waves heights (for 95% of the time wave heights are less than 1m) and hence skimming operations are very effective. Taking into account the availability of this system the chance of oil arriving on the other two sensitive coasts examined is an order of magnitude lower.

It is therefore concluded that the prolongation of oil production from the existing and planned oil infrastructure does not present significant risk with regards to unplanned/failure events.

10.8.2.6.3 Existing mitigation measures applied

As discussed above there is a relatively low chance of oil spilt to the sea from Energean's facilities reaching the coastline of the Kavala Gulf. The location that has the highest likelihood of seeing spilled oil is Ierissos Bay on the Akti peninsula. Predominant winds would likely carry most slicks formed towards this coastline, unless the spill occurred during heavy southerly winds that blow for limited duration in the Winter months.

The likelihood (probabilities) calculated assumes that:

- A leak actually occurs and
- No response measures are taken to remove the pool of oil before it reaches the shore.

In reality Energean has developed structured controls that create "barriers" to both prevent incidents such as these from occurring and if such incidents do occur, preventing them from escalating to a point where significant damage occurs. Clearly oil spills need to be avoided, but if they do occur, their consequence is relatively limited if the spilt oil is contained offshore and recovered prior to drifting to coast.

The following "barriers" have been defined by Energean and effectively implemented over the last 35 years of operation. The additional facilities to be installed do not significantly change the size and complexity of the offshore assets or increase the likelihood of a spill from occurring or the potential size of such spills. The biggest consequence is on oil loading operations as the frequency of these events will increase with growing production.

Barriers to prevent spills occurring:

Blow out prevention – As the consequence of a well blowout is significant strict controls are applied during the drilling process to ensure such an event occurs very infrequently. Like all oil and gas operators Energean has a suite of well design and well operations manuals that dictate the precautions to be taken to avoid loss of well control. These are built on available international standards and embrace good oilfield practice. At all times multiple barriers between the live reservoir and the atmosphere are maintained. These barriers change as a drilling operation progresses and comprise elements such as: drilling "mud" and "brine" to provide hydrostatic pressures greater than reservoir pressures, cement, plugs and of course a blow-out preventer mounted at surface. This critical device is subject to detailed certification on a 5-yearly basis and is function and pressure tested every 28 days. Data collected by OGP for normally pressured oil

development wells drilled to North Sea standards indicates the chance of an accidental well release is 3.9 x 10^{-4}/well drilled. Such a release would necessitate use of a well control device. Such events result in a blow-out 4.8 x 10^{-5}/well drilled. Hence the chance of a blowout occurring whilst Energean drills and side-tracks the 17 firm wells covered by this project is 8x10^{-4}. This is well within the ALARP region.

Pipeline integrity management – Precautions to ensure oil pipelines do not leak commence with the selection of the correct materials so as to avoid excessive corrosion, in the design phase. The line that represents the largest risk is one that was designed more than 35 years ago and which inspection has shown over the intervening period has not suffered excessive corrosion. Internal inspection using intelligent pigs is the key method of ascertaining pipeline condition and verifying integrity. Corrosion rates are not expected to increase due to the implementation of the planned field extension. Crude properties will not change and the main oil line will remain essentially free of water. Hence the chance of internal damage leading to a significant leak will remain low. External impacts do have the potential to cause failures. This is why the lines are protected with a concrete coating and largely buried. Fishing activities are banned over the pipeline corridors. External corrosion is avoided by using cathodic protection systems. The only area of potential exposure is in the part of the main oil export line that is not buried if fishing vessel activities are not adequately controlled. Consideration will be given to burying this line when the new pipelines are buried. This will have a short-term localised negative impact to the environment (disruption of the sea bed) but would further reduce the probability of a large pipeline leak.

Loading Operations – specific precautions are taken when tanker loading operations are undertaken. The tanker loading system comprises a fixed pipeline approximately 3km long (buried) connected to 200m of flexible heavy-duty hose. This hose is picked up by a crude tanker. A blind flange removed and then connected to the inlet manifold of the vessel. Prior to each loading all sub-sea components are inspected by Energean's divers. The divers stay on location and re-inspect the hose every 4 hours. Small leaks would therefore be identified rapidly. The hose itself is replaced completely every 5 years. At surface 2 staff are deployed to monitor the connection between the hose and ship at all times. These staff can radio the Sigma control room and request pumping to stop. Loading does not take place in the winter months when high winds are blowing from the south bringing significant waves to shore.

Recovery measures – as described elsewhere in the ESIA Energean has developed an oil spill response system comprising booms and skimmers for containing surface slicks and recovering them to a dedicated barge. This system can be mobilised offshore day and night in a maximum of 3 hours. Deployment is regularly practised. Sea states are conducive to immediate mobilisation for 99% of the year. When storm force winds are blowing from the south deployment could be delayed by up to 7 hours. The results of the oil spill modelling work undertaken in support of the ESIA would indicate that the size and deployment time achievable are suitable. When loading tankers a boom is installed at all times around the loading point. With a location so close to shore 3 hours is considered too long to be able to mobilise a boom following a spill.

10.9 MAJOR ACCIDENT FREQUENCY ASSESSMENT

10.9.1 Hydrocarbon release scenarios

The frequency assessment part of the QRA serves to estimate, numerically, the likelihood of the defined major accident occurring in the first instance (e.g. a release of hydrocarbons) and the outcome frequency (e.g. jet fire). The hydrocarbon release frequency assessment consists of two key components:

- Derivation of the initiating event frequency; and
- Derivation of the outcome frequency.

The initiating event frequency is derived by combining a “parts count” with generic, industry recognised, equipment leak data. This approach yields a statistical leak frequency for defined isolatable sections of the process. These leak frequencies are further modified by applying a hole size distribution to generate the frequencies of “small”, “medium” and “large” releases.

To model the development of the scenario after release, event trees are prepared for each isolatable section and for each hole size. The event tree provides a framework for the frequencies of the possible outcomes associated with the release of hydrocarbons (e.g. jet fire, pool fire, flash fire, explosion, unignited toxic release). The nodes on the event tree consider factors such as:

- Does the release ignite immediately?
- Does the release ignite after a delay?
- Is detection and isolation effective?
- Are active and passive mitigation measures effective?

The success or failure of these factors dictates the outcomes.

The frequency assessment part of the QRA relies on the use of a range of datasources, databases and assumptions. These are further detailed in the QRA Reports (Annex 07). Table below provides a summary of the main frequency assessment data sources.

Table 10-5: Hydrocarbon Release Scenarios: Frequency Data Sources Summary

Aspect	Description	Data Source
Equipment Leak / Release Frequencies	The generic release frequencies for equipment items such as pumps, valves, flanges, vessels etc.	OGP, based on UK Hydrocarbon Release Database.
Pipeline Release Frequencies	The generic release frequencies for pipelines and risers.	OGP, based on “PARLOC”
Blowout / Well Release Frequencies	The generic frequency of blowout/well releases during drilling or workover/intervention activities.	OGP, based on “SINTEF”
Hole / Release Size Probabilities	The hole size distribution, probability of “small”, “medium”, “large”, “full bore”	OGP based on UK Hydrocarbon

Aspect	Description	Data Source
	releases.	Release Database.
Ignition Probabilities	The probability that the release ignites at an early stage (yielding jet or pool fire) or delayed (resulting in flash fire/explosion).	OGP, based on Energy Institute Review
Detection / Isolation / Shutdown Probabilities	The probability that the release is detected and isolated	CMPT

10.9.2 Non-hydrocarbons release scenarios

In addition to assessing the risk to people associated with the hydrocarbon release major accidents, the QRA also considers the levels of risk due to non-hydrocarbon release major accident Scenarios.

Typically for offshore installations, non-hydrocarbon release major accidents include:

- Loss of control during personnel marine or aviation logistics transfer (helicopters are not used to support Prinos operations, personnel transfer is via crew boat);
- Structural failure;
- Loss of stability (not relevant for the Prinos complex as the platforms are fixed jacket/tower design) nor for the proposed satellites;
- Loss of station keeping/position
- Ship impact (impact by attendant or errant passing vessel)

The frequency assessment for the Prinos and Lamda non-hydrocarbon release major accidents also uses industry data sources as a basis for estimating frequency of occurrence.

Table 10-6: Non-Hydrocarbon Release Scenarios: Frequency Data Sources Summary

Aspect	Description	Data Source
Crew Boat Loss of Control Frequency	The frequency of a Major Accident associated with marine logistics / personnel transfer by crew-boat.	OGP, based on global data
Ship Impact Frequency	The frequency associated with a vessel impacting the offshore structures	OGP
Structural Failure Frequency	The frequency of severe structural failure.	OGP

10.10 MAJOR ACCIDENT CONSEQUENCE ASSESSMENT

10.10.1 Overview

The consequence assessment process of the QRA serves to assess the magnitude of the physical effects associated with the major accidents (e.g. hazard ranges due to jet fires, toxic gas plume dispersion). Subsequent to determining the levels of physical effects, the vulnerability assessment is performed to translate levels of harm, to people, into probabilities of fatality.

10.10.2 Physical effects assessment

The physical effects assessment serves to estimate parameters such as:

- Initial release rates, for the defined hole sizes;
- Heat radiation and profiles associated with jet fires and pool fires;
- Overpressures associated with explosions;
- Extent of flammable and toxic gas dispersion hazard ranges.

A number of software packages (described below) have been used for this assessment.

In particular subsea releases have been modelled using guidance outlined by the CMPT [1999]. The guidance in CMPT [1999] indicates that subsea releases can be modelled as a bubbling cone reaching the surface, as illustrated below.

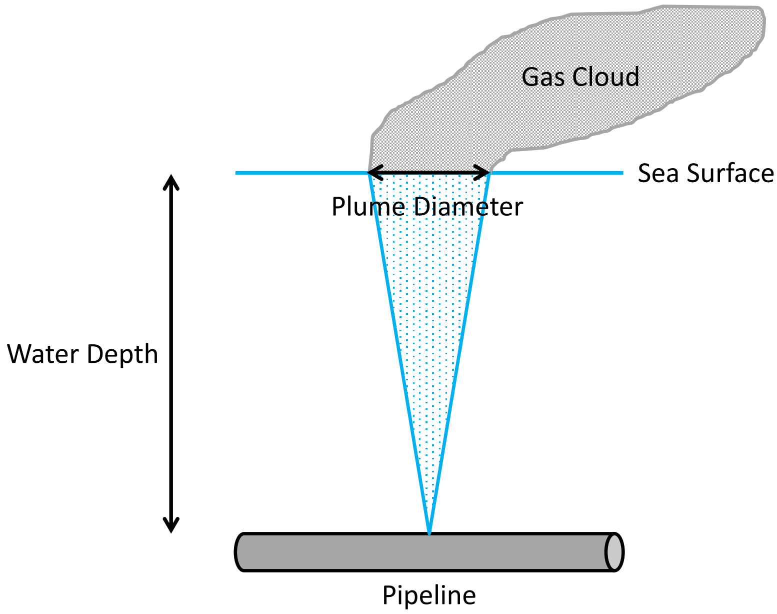


Figure 10-5: Illustration of subsea release (bubbling cone)

CMPT [1999] outlines an industry standard assumption that the diameter of the plume at the

surface can be approximated as 20% of the depth to the release point, regardless of the rate of material being released. The average sea depth at Prinos is around 40 m; as such a plume surface diameter of 8 m was used for modelling subsea releases. Pipelines going to shore have also been modelled at 20 m depth and at sea surface to account for variations in water depth in the route of these pipelines.

The consequence modelling has been carried out using DNV Phast (an industry leading consequence modelling software package).

Release rate analysis was carried out using DNV Phast. Multiphase streams use a representative material to approximate the mass release rate based on the molecular weight of the mixture. This is to account for errors that can arise when modelling multiphase fluids due to the simplification of mixtures modelled by DNV Phast. However for gas streams, pure methane or a representative mixture was used.

The gas fraction of the stream was calculated based on the Heat and Material Balance sheets. The calculated release rate was factored according to the gas mass fraction. It has been assumed the gas would reach the surface uniformly and form a 'pool' with the gas composition at the surface taken as the same as in the pipeline (i.e. no benefit was taken to account for gas absorption into the sea whilst bubbling up to the surface).

Preliminary modelling indicated that the worst-case consequence results were found using the average gas release rate over the 2 first minutes of discharge; as such this was used as the basis of the analysis.

Flammable results are given for the LFL and half LFL, which is respectively 44,000 ppm and 22,000 ppm for methane. Toxic results are given according to the UK HSE SLOT (Specified Level of Toxicity) and SLOD (Significant Likelihood of Death) for a 10 minutes exposure, i.e. at 669 and 1,107 ppm. The concentrations are in line with the analysis carried out for the QRA.

10.10.3 Vulnerability assessment

To translate the physical effects into a numerical estimate of harm to people, vulnerability assessment is performed. There are a number of industry recognised data sources and approaches available for translating varying levels of fire, explosion and toxic gas consequences into the estimates of probability of fatalities that are required for the QRA.

Table below summarises the harm criteria adopted for the QRA.

Table 10-7: Harm Criteria

Consequence	Criteria – Level of harm to people	Reference
Jet Fire	100% fatality – 35 kW/m^2 70% fatality – 12.5 kW/m^2 Escape route impeded – 6 kW/m^2 Muster Area inaccessible - 4 kW/m^2	OGP
Pool Fire	Escape route impeded – 6 kW/m^2	

Consequence	Criteria – Level of harm to people	Reference
	Muster Area inaccessible - 4 kW/m^2	
Flash Fire	100% fatality – within the gas cloud Lower Flammable Limit (LFL) envelope	OGP
Explosion	100% fatality - 0.3 bar	OGP
Hydrogen Sulphide (H_2S)	100% fatality – 1107 ppm 50% fatality – 669 ppm	HSE Assessment of Dangerous Toxic Load (DTL)

10.11 RISK INTEGRATION AND MEASURES OF RISK

The frequency, consequence and vulnerability data, for each scenario, are combined to generate the numerical measures of risk, which can then be compared against the appropriate risk tolerability criteria. Table below summarises the measures of risk derived by the QRA.

Table 10-8: Measures of risk

Measure of Risk	Description	Presentation
Location Specific Individual Risk (LSIR)	The risk at a particular location for a hypothetical individual who is positioned there for 24 hours per day, 365 days per year.	For offshore the LSIR essentially represents the zones of risk, it can be represented in tabular format.
Individual Risk Per Annum (IRPA)	The level of risk (of death) experienced by an individual person. This measure of risk takes into account the amount of time a person is exposed to the major hazards. The individual risk therefore includes both the proportion of time onsite and also the proportion of time in specific locations on the facility where they may be exposed to the effects of potential hazards. IRPA is independent of the number of people exposed.	Typically presented in tabular format, which presents IRPA for a range of worker groups. This allows distinction to be made between the most exposed (e.g. operators, maintenance) and least exposed (e.g. accommodation) personnel. For Prinos the IRPA will consider proportion of time individual spends in various platform areas and the time they spend offshore.
Potential Loss of Life (PLL)	The level of risk (of death) experienced by the whole group of people exposed to the major accidents. Since this measure of risk is related	Generally tabular format summarising the PLL for each worker group. The total PLL is also derived, which is useful since it presents a

Measure of Risk	Description	Presentation
	to the total exposed group, it is therefore dependent on the total number of people onsite and in each worker group.	single "rolled up" measure of risk. For this reason PLLs are used as a basis for Cost Benefit Analysis (CBA).

10.12 RISK TOLERABILITY CRITERIA

The offshore oil and gas sector and Major Hazard industries in general have tended to adopt the risk tolerability framework proposed by the United Kingdom Health and Safety Executive (UK HSE). This framework is presented in the below figure and uses the IPRA as the prime measure of risk.

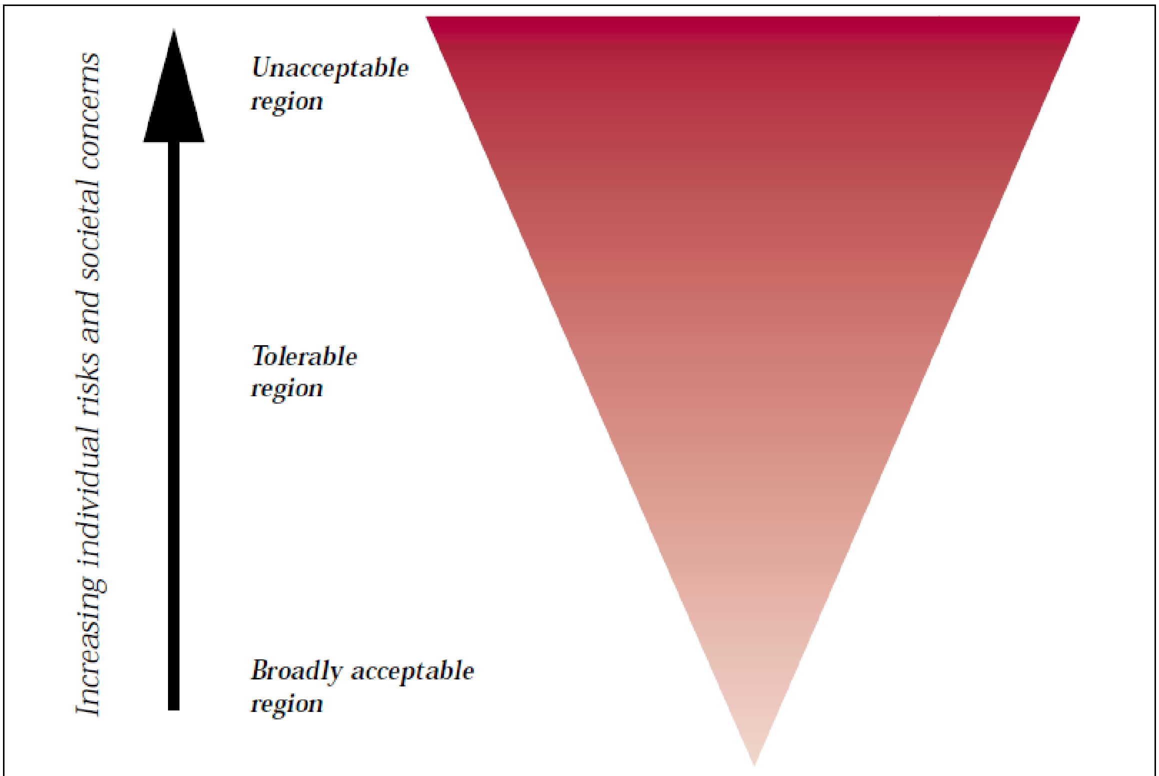


Figure 10-6: Risk tolerability criteria (UK HSE)

The risk tolerability criteria adopted for the QRA aligns with and is based up the UK HSE criteria (refer to table below).

Table 10-9: Individual risk tolerability criteria

IRPA (/yr)	Description	Expectation
$>1 \times 10^{-3}$	Intolerable	Fundamental improvements needed to reduce risk

IRPA (/yr)	Description	Expectation
1×10^{-4}	Target for Worker	Energean "target" for a worker. Aim to reduce risks to this level,
1×10^{-6} to 1×10^{-3}	ALARP Region	Look for opportunities to reduce risk to As Low AS Reasonably Practicable (ALARP)

Note that there are no tolerability criteria for Potential Loss of Life (PLL), since the PLL is related to the total number of exposed personnel. A platform with a high number of Persons on Board (POB) will have a higher PLL than a platform with a lower PLL hence numerical PLL tolerability criteria cannot be established. PLL is a useful, rolled up measure of the level of group risk and aids in the understanding of risk contributors and assists risk based Cost Benefit Assessment (CBA).

There is no measure equivalent to IRPA or PLL to represent the potential for damage to the environment due to the failure of an oil and gas installation. Hence no tolerability criteria have been defined and therefore an exercise equivalent to ALARP cannot not be performed for environmental risks as it can for personnel safety risks.

10.13 RISK ASSESSMENT RESULTS

10.13.1 Individual risk per annum (IRPA)

The Individual Risk Per Annum for installation workers is presented in the following table.

The worker groups listed are those defined for the existing Prinos complex. Separate worker groups were defined for the Lamda platform and IRPA levels for these groups calculated. Energean does not however intend to employ dedicated Lamda staff. Lamda staff will be drawn from the existing Prinos crew and hence whilst on Lamda they will not attract risk on Prinos.

The Prinos staff that will be exposed to risks at Lamda are:

1. Alpha Operator
2. Beta Operator
3. Safety representative
4. Maintenance lower deck (crane operator)
5. Maintenance Instrumentation and
6. Maintenance Electrical

The Alpha or Beta operator will visit Lamda every month to launch a pig to Delta. He will be accompanied by the crane driver and an electrical and instrument technician who will undertake any routine maintenance activities required. Every two weeks the Alpha and Beta operator together will visit for a process walk round. During Coiled Tubing interventions an Operator will be in attendance with routine visits of the crane operator and safety officer.

LSIR levels for Lamda (based on full year occupancy) are lower than either Alpha or Beta

platforms. However staff assigned to Lamda sees a small increase in their IRPA as when on the satellite they spend all of their time on the process deck, i.e. the Alpha operator attracts less risk whilst on Lamda than Alpha but because he spends none of this time in the Delta restroom or control room his risk level rises slightly. His risk level remains below $1x10^{-3}$.

The values shown for Prinos/Lamda workers are for a representative year of normal operations, the values for a year of simultaneous operations during a drilling campaign are also shown to ensure the worst case operating conditions are considered.

Table 10-10: Individual risk per annum

Worker Group	IRPA per year (normal operations)	IRPA per year (drilling campaign)
Instrumentation	4.49E-04	4.72E-04
Control Room Operator	2.29E-04	2.49E-04
/ Safety Representative	5.48E-04	5.74E-04
Alpha Operator	5.73E-04	6.29E-04
Beta Operator	5.40E-04	5.96E-04
Upper Deck Operator	8.02E-04	8.13E-04
Lower Deck Operator	5.51E-04	5.62E-04
Maintenance Upper Deck	6.95E-04	7.06E-04
Maintenance Lower Deck	4.73E-04	4.84E-04
Maintenance Electrical	2.73E-04	2.87E-04
Maintenance Instrumentation	3.99E-04	4.18E-04

10.13.2 Potential loss of life (PLL)

The total potential loss of life for Prinos is $4.86x10^{-2}$ per year the contribution from various hazard types is shown in the following diagram. This level of risk means that statistically there should be 1 fatality every 20 years on the Prinos complex. Introduction of the Lamda satellite makes no material change to PLL as no additional workers will be introduced.

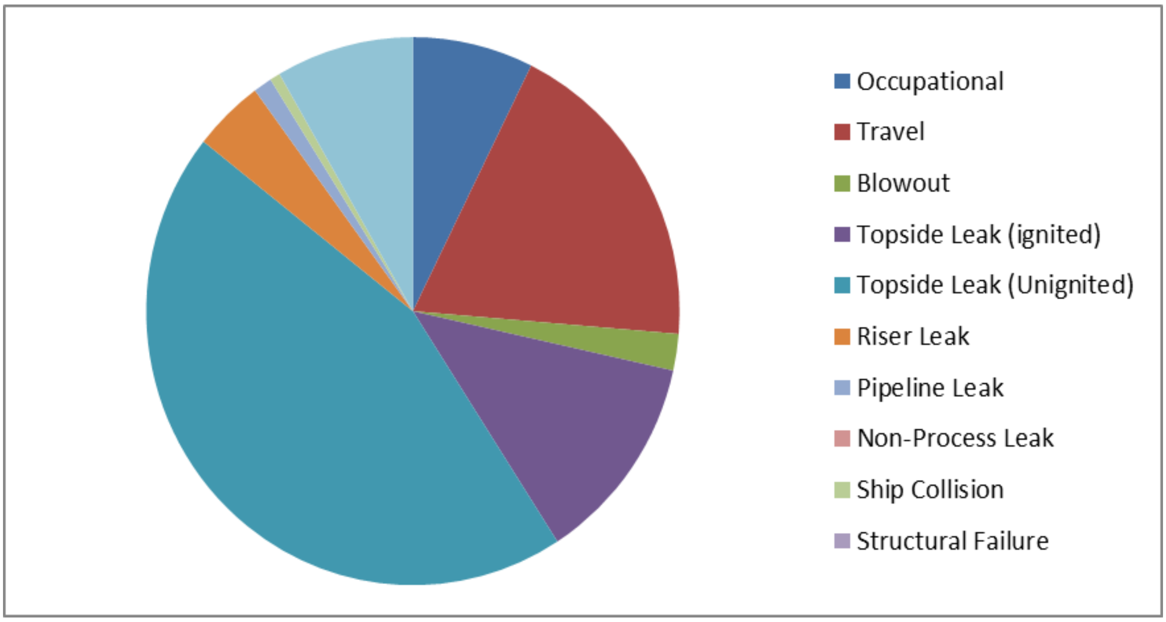


Diagram 10-6: Breakdwon of risk contributirs on Prinos and Lamda platforms

10.14 DISCUSSION

10.14.1 Comparison against risk tolerability criteria

The Individual Risk Per Annum (IRPA), for the existing facilities can be seen to reside within the "Tolerable if ALARP" region of the risk management framework. The risk levels are predominantly driven by the sour/toxic nature of the well fluids and hence the process streams present widely over the complex. The main Delta process platform is of an older type of design and layout, with less segregation between the higher and lower risk areas, than would be found on a more modern processing facility.

This lack of segregation tends to result in personnel being exposed to the risks associated with sour/toxic gas whenever they are offshore unless they are in enclosed locations with a pressurised atmosphere. Energean largely mitigates the toxic hazards associated with high H_2S levels by proactive use of procedural controls, particularly the installed breathing air system that can be accessed at all positions on the platform. Without the use of this system risk levels for individuals would be intolerable.

In contrast to the risk associated with toxic gas the calculated risks associated with fire and explosions are in line with or lower than levels for comparable installations. Whilst the design of the existing facilities is somewhat outdated, the small size of the facility, the low operating pressures coupled with the high water content of most streams, minimises the contribution of fire and explosions to IRPA. Effectively the relative probability of a substantial leak is low because of the small size of the complex and the consequences are limited because of the low pressures and high water content. Toxic hazards are in contrast substantial because although

leaks are predicted to occur with a low frequency the presence of very high H_2S levels means substantial areas of the platform are impacted when even moderate leaks occur.

Whilst overall IRPA levels are below that considered intolerable they remain high and actions to identify options to reduce individual risk are in the process of being identified. Clearly these actions will focus on the hazards that have the largest contribution to risk, i.e. unignited toxic gas releases. As leak frequencies are low focus will clearly have to be on identifying additional barriers to prevent released toxic gasses harming the offshore work force.

It is recognised that significant risk reduction has already been achieved by not using helicopters for personnel transfer, helicopter transportation is typically one of the main contributors to a platforms risk profile. In addition, personnel do not reside on the platform/in the field (there is no accommodation module on Delta), instead they day trip to the offshore location from Kavala.

Although IRPA does not equate directly to environmental risk understanding the source of risk to humans can also be used to assess the potential threat to the environment. As has been illustrated and discussed the underlying frequency of leaks that have the potential to impact the environment is low. Risk reduction measures will focus on reduction of the consequences of toxic gas releases rather than oil spills as oil spills current are seen to contribute negligibly to worker risk. Risk reduction activities are therefore unlikely to significantly change environmental risk levels.

10.14.2 QRA reviews and risk reduction

Given the risk levels estimated by the QRA, a process of risk reduction reviews has been initiated. The risk reduction review process consisted of the following elements:

- Determination and understanding of the key contributors to the risk profile
- Detailed review of the QRA assumptions, rule sets and inputs to confirm these aspects are representative and not overly conservative
- Identification of possible risk reduction strategies that can be passed forward for more detailed evaluation and feasibility assessment as part of the ENERGEAN risk reduction forward plan.

Following this process, the QRA was revised to ensure it was representative of actual operational arrangements in a number of key areas including:

- Shift patterns, area manning and occupancies: this data was developed and reviewed in conjunction with operations.
- Appropriately reflecting how the risks of sour/toxic gas are managed on a day to day basis via strategies such as:
  - ⇨ All personnel being provided with escape Breathing Air (BA) sets and receiving the required training.
  - ⇨ Maintenance work, e.g. breaking into the hydrocarbon envelope, being performed with all personnel under air and all non - essential personnel being made aware and kept away from such work areas.

- Appropriately reflecting the level of protection afforded to occupants of the control room.
- Appropriately reflecting the composition and nature of process streams, in particular those with high sour/toxic gas content.

10.14.3 Risk reduction strategies – existing facilities

The QRA review and risk reduction process served to identify a number of additional potential risk reduction strategies that will be passed forward for more detailed evaluation, these include:

- Upgrading the upper deck restroom/toilet/change room block area. It is proposed that this area and structures be upgraded such that occupants are protected from the effects of fire, smoke, toxic gas, explosion overpressure, for sufficient time to plan and make their escape to place of safety. The risk benefits of implementing this risk reduction are shown in Table below. This project already been accepted by management and included in the 2016 budget.
- Reviewing the control room upgrade project to determine whether there are opportunities that could reduce the amount of time personnel spend in the process areas. For example could information be relayed to control room panels, thereby removing the requirement for gauges, readings to be taken locally, in the process areas. This project was already scheduled for implementation in 2016. The scope is being revisited to ensure maximum benefits to IRPA levels are achieved.
- Upgrading the main escape route from the upper deck restroom area to the Delta boat landing or lifeboats so that staff is protected whilst evacuating from an escalating emergency. This opportunity has yet to be quantified to determine whether on a cost to avert a fatality basis it can be justified.

Table 10-11: Risk benefit to worker groups from protecting the upper desk restroom

Worker Group	IRPA per year (Upper deck restroom protected)	Risk Reduction
Instrumentation	3.59E-04	9.05E-05
Control Room Operator	2.29E-04	Negligible
Shift Supervisor / Safety Representative	4.35E-04	1.14E-04
Alpha Operator	4.56E-04	1.18E-04
Beta Operator	4.23E-04	1.18E-04
Upper Deck Operator	6.79E-04	1.23E-04
Lower Deck Operator	4.28E-04	1.23E-04
Maintenance Upper Deck	6.17E-04	7.76E-05
Maintenance Lower Deck	3.96E-04	7.69E-05
Maintenance Electrical	2.25E-04	4.79E-05
Maintenance Instrumentation	3.27E-04	7.18E-05

10.14.4 Risk reduction strategies – new facilities

An integrated risk based design process will be followed to prioritise inherently safe design principles. This includes risk reduction workshops that will be carried out to identify measures to further reduce the risk to personnel. Current measures being considered include:

- The reduction of leak sources (which is investigated as a sensitivity case of the QRA, where manual valves on headers containing toxic fluids would be welded). The risk benefits of implementing this risk reduction are shown in table below.
- Full process shutdown during maintenance and inspection campaign – already confirmed as being accepted.
- Protection of escape routes.

Table 10-12: Risk benefit to worker groups from welding manual valves on headers containing toxic material

Worker Group	IRPA per year (Upper deck restroom protected)	Risk Reduction
Instrumentation	4.49E-04	Negligible
Control Room Operator	2.29E-04	Negligible
Shift Supervisor / Safety Representative	5.48E-04	3.80E-10
Alpha Operator	5.70E-04	3.61E-06
Beta Operator	5.37E-04	3.61E-06
Upper Deck Operator	8.02E-04	Negligible
Lower Deck Operator	5.51E-04	Negligible
Maintenance Upper Deck	6.95E-04	5.68E-10
Maintenance Lower Deck	4.73E-04	2.43E-09
Maintenance Electrical	2.71E-04	1.74E-06
Maintenance Instrumentation	3.98E-04	1.74E-06

11 ASSESSMENT AND EVALUATION OF THE ENVIRONMENTAL AND SOCIAL IMPACTS

11.1 METHODOLOGICAL REQUIREMENTS

The assessment of the potential impacts of the construction, operational and abandonment phases of the project is based on a number of criteria, which are used to determine the **significance** of potential **positive and negative** effects of the project. Impacts are assessed taking into account the **identified receptors and resources** according to defined assessment criteria.

There is a number of ways, in which impacts may be described and quantified. An impact is essentially any change (whether positive or negative) to a resource or receptor brought about by the presence of the project component or by the execution of a project related activity.

The impact assessment terminology that will be used in the study is given as below:

The nature of the impact is primarily defined as positive or negative and then is categorized as direct, indirect and cumulative.

The assessment of the potential impacts is made on the construction, operational and abandonment phase.

Table 11-1: Impact nature assessment (STEP 1)

Term	Definition
	Impact Nature
Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct impact	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (e.g. between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).
Indirect impact	Impacts that result from other activities that are encouraged to happen as a consequence of the Project (e.g. in-migration for employment placing a demand on resources).
Cumulative impact	Impacts that act together with other impacts (including those from concurrent or future third party activities) to affect the same resources and/or receptors as the Project.

Once **nature of impact** has been identified, significance will be determined for potential negative or positive impacts. For this assessment **impact significance** is determined by considering both the impact magnitude and the likelihood of the impact occurring (note this is not the likelihood of the activity itself occurring). Impact magnitude is considered to be a function of impact extent, duration and intensity. The criteria used by the consultant to determine significance are summarised in the table below.

Table 11-2: Considerations for magnitude and likelihood (STEP 2)

Criteria	Description
	Impact magnitude
Extent	**On-site –** impacts that are limited to the boundaries of the project. **Local –** impacts that affect an area around the project route. **Regional –** impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystem. **National –** impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences.
Duration	**Temporary –** impacts are predicted to be of short duration and intermittent/occasional. **Short-term –** impacts that are predicted to last only for the duration of the construction period. **Long-term –** impacts that will continue for the life of the Project, but cease when the Project stops operating. **Permanent –** impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) and that endure substantially beyond the project lifetime.
Intensity	**BIOPHYSICAL ENVIRONMENT:** Intensity can be considered in terms of the sensitivity of the biodiversity receptor (i.e. habitats, species or communities). **Negligible –** the impact on the environment is not detectable. **Low –** the impact affects the environment in such a way that natural functions and processes are not negatively affected, or these natural functions are enhanced to a small degree. **Medium –** where the affected environment is altered but natural functions and processes continue, albeit in a modified way, or are considerably improved. **High –** where natural functions or processes are altered to the extent that it will temporarily or permanently cease; or in the case of a positive impact, will be restored to close to its natural state in terms of functions and processes. Where appropriate, national and/or international standards are to be used as a measure of the impact. Specialist studies should attempt to quantify the magnitude of impacts and outline the rationale used. **SOCIO-ECONOMIC ENVIRONMENT:** Intensity can be considered in terms of the ability of project affected people/communities to cope with or adapt to negative changes brought about by the Project, the degree to which their quality of life/ well-being will be enhanced as a result of the socio-economic benefits. **Negligible –** there is no perceptible change to people's quality of life. **Low -** People/ communities are able to cope with/ adapt to negative impacts with relative ease and maintain pre-impact quality of life/ well-being. People would marginally benefit from the proposed activity and would experience a relatively small improvement in quality of life/ well being. **Medium -** Able to cope with/ adapt to negative impacts with some difficulty and maintain

Criteria	Description
	pre-impact livelihoods but only with a degree of mitigation support. People's quality of life/ well being are considerably improved as a result of benefits. **High -** Those affected will not be able to cope with/ adapt to negative changes and continue to maintain-pre impact quality of life/ well-being. People will have their quality of life/ well being significantly improved.
Impact likelihood (Probability)	
Negligible	The impact will not occur.
Low	Impact may possibly occur i.e. occurs infrequently.
Medium	Impact is highly likely to occur i.e. occurs under most conditions.
Definite	Impact will definitely occur.

Once a rating is determined for magnitude and likelihood, the following matrices are used to determine the **impact significance** (depending on whether positive or negative).

Table 11-3: Impact significance assessment – Negative impacts (STEP 3)

Significance Rating					
Likelihood		Negligible	Low	Medium	High
Magnitude	*Negligible*	Negligible	Negligible	Negligible	Negligible
	Minor	Negligible	Negligible	Minor	Minor
	Medium	Negligible	Minor	Moderate	Moderate
	High	Minor	Moderate	Major	Major

Significance definitions:

- ***Negligible impact:*** Negligible impact (or insignificant impact) is where a resource or receptor (including people) will not be affected in any way by a particular activity, or the predicted effect is deemed to be 'negligible' or 'imperceptible' or is indistinguishable from natural background variations.
- ***Minor impact:*** An impact of minor significance is one where an effect will be experienced, but the impact magnitude is small (with and without mitigation) and, for negative impacts, well within accepted standards, and/or the receptor is of low sensitivity/value.
- ***Moderate impact****:* An impact of moderate significance is one within accepted limits and standards. The emphasis for moderate impacts is on demonstrating that the negative impact has been reduced to a level that is as low, or positive impact enhanced as far as reasonably practicable (ALARP). This does not necessarily mean that 'moderate' negative impacts have to be reduced to 'minor' impacts, but that moderate impacts are being managed effectively and efficiently. In the same way, moderate positive impacts may not be able to be enhanced to have major positive impact.
- ***Major impact:*** An impact of major significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/ sensitive resource/ receptors. A goal of the EIA process is to get to a position where the Project does not have any major residual negative impacts and major positive impacts are enhanced as far as possible. For some aspects, however, there may be major residual negative impacts after all practicable mitigation options have been exhausted.

Since mitigation measures are normally designed to address a project's **negative** impacts, a third parameter is deemed as essential to determine a negative impact's true significance. This factor is **reversibility** and it regards the ability of an ecosystem or receptor a) to reverse into a pre-impact state by using its own resilience mechanisms, or b) maintain its biological integrity, meaning its pristine state even though an impact has occurred. This process is presented in the table below.

Table 11-4: Consideration of reversibility (STEP 4)

Negative Impact Assessment					
Impact's Reversibility		High Reversibility	Medium Reversibility	Low Reversibility	Irreversible
Impact Significance	*Negligible*	Negligible	Negligible	Negligible	Negligible
	Low	Negligible	Negligible	Minor	Moderate
	Moderate	Minor	Minor	Moderate	Major
	High	Minor	Moderate	Major	Critical Impact

Table 11-5: Explanation of impact assessment

Negative Impact Assessment				
Negligible	Minor	Moderate	Major	Critical Impact
Magnitude of change comparable to natural variation	Detectable but non-significant	Significant; Amenable to mitigation; Should be mitigated where practicable	Significant; Amenable to mitigation; Must be mitigated	Intolerable; Corresponds to a major impact, but not amenable to mitigation; Alternatives must be identified – **Project Stopper**

The final impact assessment will depend not only in the impact's significance, but also on the impact's reversibility, a strong factor to determine whether the impact will need to be mitigated and also in which extend. If reversibility is high (**"high reversibility"**), then the overall impact can be assessed as **minor** even if major in its significance. If on the other hand, reversibility is low (**"low reversibility"**) then the final assessment can also reach a **major** scoring, with the critical point (**"CRITICAL IMPACT"** – project stopper) being reached in case that no reversibility whatsoever will be plausible in the future.

11.2 IMPACT ASSESSMENT FROM ROUTINE ACTIVITIES

11.2.1 Impact on the climate and bioclimate characteristics

As provided in Chapter 09, no significant impacts to climate and bioclimate characteristics have

been predicted for this project. The rationale for excluding these parameters from further assessment is provided in Chapter 09.

11.2.2 Impact on the morphological and topological characteristics

11.2.2.1 Construction Phase

The impacts on the morphological characteristics of the seabed are expected by the activities of:

- Installation of permanent mooring;
- Leg lowering and suction anchor activities;
- Burial of the pipelines and umbilical's; and
- Modifications to Delta platform including new risers and j-tubes.

The aforementioned activities will cause local change in the morphological characteristics of the seabed. The impact significance is assessed as minor to moderate. Due to the high reversibility, the impact significance is finally assessed as negligible or minor.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Installation of permanent mooring	Seabed	Negative	Local	Short	Low	High	Minor	High	Negligible
Leg lowering and suction anchor activities	Seabed	Negative	On site	Short	Low	High	Minor	High	Negligible
Burial of the pipelines and umbilical's	Seabed	Negative	Local	Short	Medium	High	Moderate	High	Minor
Modifications to Delta platform including new rised and j-tubes.	Seabed	Negative	On site	Short	Low	High	Minor	High	Negligible

Mitigation measures to address the minor impacts expected from the activity of burial of the pipelines and umbilicals are presented in Chapter 12.4.2.

11.2.2.2 Operational Phase

The project activity that has the potential to interact with seabed conditions is the seabed cuttings disposal (0-400 m). The potential impact from this activity is localized changes in seabed features in an area of 600 m^2. The morphology of the seabed will change but it is expected to gradually return in the previous condition in the next 5-10 years. Based on the above, the likelihood of the negative impact is assessed as high; the impact intensity as medium and

therefore the impact significance is characterized moderate. Due to the fact that the reversibility is high, the impact significance is assessed as minor.

Activity	Secondary receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Seabed cuttings (0-400m)	Benthic communities	Negative	Local	Long	Medium	High	Moderate	High	Minor

Mitigation measures to address the minor impacts expected from the activity of seabed cuttings disposal are presented in Chapter 12.4.2.

11.2.2.3 Abandonment Phase

Potential impacts on the morphological and topological characteristics of the seabed features during abandonment phase are expected from the following project activities:

- Dispersal of seabed cuttings from piles (from existing platforms); and
- Removal of SIPs (planned and potentially planned platforms).

The aforementioned activities will cause local change in the morphological characteristics of the seabed. The impact significance is assessed as moderate. Due to the high reversibility, the impact significance is finally assessed as minor.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Existing platforms: dispersal of seabed cuttings from piles	Seabed	Negative	Local	Long	Medium	High	Moderate	High	Minor
New platforms: removal of SIPs	Seabed	Negative	Local	Long	Medium	High	Moderate	High	Minor

Mitigation measures to the seabed morphology from the activities of existing and new platforms removal during abandonment phase are presented in chapter 12.4.2.

11.2.3 Impact on the geological and tectonic characteristics

11.2.3.1 Construction Phase

It is anticipated that the only activity that may cause an impact during construction phase is the installation of permanent mooring of Energean Force Rig as well as the SIP2 platform installation and suction anchoring to penetrate in the seabed. Smothering of a portion of the seabed, leading to localised decrease in sediment’s nutrient content

As described in Chapter 06, the tug boats, supply vessels and fast rescue vessel will not anchor. The impact is localized by modification of the seabed through creation of pock marks and scarring of the substrate. Furthermore, the currents will smooth over the pock marks with time. The physical alteration of the seabed sediments due to the creation of depressions from anchor handling will have a localised extent and will be reversible, because sediments will be redistributed. Some further indirect impacts are that suspended sediments are causing increased levels of turbidity that could potentially affect the benthic communities.

The overall impact, by the installation of the drilling barge to the future platforms, extended locally (0.9 ha/platform), its duration is short, it has a medium impact magnitude and quite likely to happen. So although it is assessed as moderate, taking into account the high reversibility nature, it is considered as minor.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Installation of permanent mooring	Geological characteristics	Negative	Local	Long	Medium	High	Moderate	High	Minor

Mitigation measures to address the minor impacts expected from the activity of installation of permanent mooring are presented in Chapter 12.4.3.

11.2.3.2 Operational Phase

The project activity that has the potential to interact with seabed conditions is the seabed cuttings disposal (0-400 m). The potential impact from this activity is localized changes extended over an area of 600 m^2 nearby the well sites and will last during the execution of the drilling. Duration of the impact is expected to be long but it is expected to gradually return to its previous condition in the next 5-10 years. Impact intensity is low and likelihood of impact is high. Based on the above considerations the impact significance is minor. Taking into account the high reversibility nature, it is finally considered as negligible.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Seabed cutting disposal (0-400m)	Geological characteristics	Negative	Local	Long	Low	High	Minor	High	Negligible

11.2.3.3 Abandonment Phase

As provided in Chapter 09, no significant impacts on geologic and tectonic characteristics have been predicted for this project during the abandonment phase. The rationale for excluding these parameters from further assessment is provided in Chapter 09.

11.2.4 Impact on water environment

11.2.4.1 Construction Phase

The impacts on water environment result from the following activities:

- Leg lowering and suction anchor installation of the new SIPs;
- Installation of pipelines and umbilical's;
- Burial of pipelines and umbilical's; and
- Modifications to Delta (new risers/J tubes).

The impact from the above mentioned activities on water quality is increased turbidity. The sediment pollution levels are negligible, so there will be no dispersion of pollution in the water column, nor in the seabed. Based on experience from other oil and gas projects, it is estimated that the suspended sediment will settle within a few hundred meters of the disturbed area.

The proposed development will not affect the inland surface waters and groundwater of the area and therefore will not significantly affect the water resources. The marine part of the project is not constructed near natural water resources or other water streams. The impact significance is assessed as minor to moderate. Due to the moderate - high reversibility the impacts are finally characterized as negligible and minor.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Leg lowering and suction anchor installation	Water environment	Negative	Primary impact Area	Short	Low	High	Minor	Moderate High	Negligible
Installation of pipelines and umbilical's	Water environment	Negative	Primary impact Area	Short	Low	High	Minor	Moderate High	Negligible
Burial of pipelines and umbilical's	Water environment	Negative	Primary impact Area	Short	Medium	High	Moderate	Moderate High	Minor
Modifications to Delta (new risers/J tubes)	Water environment	Negative	Primary impact Area	Short	Low	High	Minor	Moderate High	Negligible

Possible mitigation measures to address the minor impacts expected from the activity of burial of the pipelines and umbilicals to the water environment are presented in Chapter 12.4.4

11.2.4.2 Operational Phase

Potential impacts on the water environment are expected from the seabed cuttings disposal (0-400m). This activity will cause increased turbidity. However, it is noted that the sediments are clean with no hydrocarbon content and low heavy and trace metal concentrations. Any existing contaminants will disperse over a wide area but are unlikely to be noticeable against background levels due to the already low (below any thresholds) levels of concentration. Moreover, the amount of seabed cuttings (400MT) is not considered to be significant. Based on the above considerations the significance of the impacts is assessed as moderate. Taking into account the

high reversibility nature, it is finally considered as minor.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Seabed cuttings (0-400m)	Water environment	Negative	Local	Short	Low	High	Moderate	High	Minor

Possible mitigation measures to address the minor impacts expected from the activity of seabed cutting disposal are presented in Chapter 12.4.4

11.2.4.3 Abandonment Phase

The potential impact to the water from the decommissioning works originate from the

- Dispersal of drill cutting from piles of the existing platforms
- Drilling Cuttings from the piles of the existing drilling platforms (Alpha and Beta)
- Removal of SIP of the new platforms (Lamda & Omicron)

The potential impact on the water environment is increased turbidity leading to adverse effects to water quality. The project abandonment will deteriorate the water quality and the status of the environment as long as the decommissioning phase lasts. With the completion/decommissioning of the project and the removal of the effect the natural mechanisms will restore the physical, marine environment and the water quality will be improved in short period of time. The impact significance is assessed as minor and due to the high to moderate reversibility; the impact is finally characterized as minor or negligible.

As far as the technology of decommissioning method concern, the new platforms are better decommissioned in a more environmental friendly method. The SIP may be relocated to another similar location by towing in the upright position. An alternative decommissioning solution is the disposal of the platforms in deep-water. The exact deep-water disposal technique applied will be a result of extensive environmental, legal, social and technical studies. The decommissioning design method will be done when the time is closing by, in order to make use of the best available techniques, methods and international experience available at the time.

Activity	Secondary receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Existing platforms: Dispersal of seabed cuttings from piles	Water environment	Negative	Local (1200m^2)	Short	Low	High	Minor	Moderate	Minor
Existing platforms: Cut piles	Water environment	Negative	Local	Short	Low	High	Minor	High	Negligible

Activity	Secondary receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
New platforms: Removal of SIP	Water environment	Negative	Local	Short	Low	High	Minor	High	Negligible

The mitigation measures to the water environment from the activity of seabed cuttings dispersion from the existing platform abandonment phase are presented in chapter 12.4.4

11.2.5 Impact on air environment

As provided in Chapter 09, no significant impacts to air quality have been predicted for this project. The rationale for excluding this parameter from further assessment is provided in Chapter 09.

11.2.6 Impact on acoustic environment

As provided in Chapter 09, no significant impacts to the acoustic environment for airborne have been predicted for this project. The rationale for excluding this parameter from further assessment is provided in Chapter 09.

The Project will conduct several activities during construction that will generate underwater noise. This noise may cause adverse impacts on sensitive species (i.e. marine mammals) in the area. Further detailed assessment of the impacts on the underwater environment is presented in 11.2.7.

11.2.7 Impact on biotic environment

The impacts on biotic environment concern the benthic communities, plankton, fish ecology and marine mammals. Note that impacts to other species (e.g. sea and coast birds and terrestrial ecology) have been scoped out as detailed in Chapter 09.

11.2.7.1 Construction phase

11.2.7.1.1 Plankton

As provided in Chapter 09, no significant impacts to plankton have been predicted for this project during routine construction phase activities. The rationale for excluding this parameter from further assessment is provided in Chapter 09.

11.2.7.1.2 Benthic communities

The project activities that have the potential to interact with benthic communities are the following:

- Installation of permanent mooring;
- Installation of pipelines and umbilical's;
- Leg lowering and suction anchor installation;
- Burial of pipelines and umbilical's; and
- Modifications to Delta platform (new risers/J tubes).

The potential impact on benthic communities is disturbance and in cases relocation due to the increased water turbidity and/or smothering of a portion of seabed, which in addition to the direct impacts on benthic species, can also result in reduced sediment nutrient quality. . It is noted that the benthic communities in the study area are typical of the Kavala Gulf Mediterranean as presented by the outcomes of the marine ecology study, (Chapter 8.7.2). No rare or protected species were identified.

Installation of permanent mooring and installation of pipelines and umbilical's

The duration of the activities is short but the duration of the impact is considered long as these project elements will remain permanently in place. The potential extent of the impact is local with the occupational zone of pipelines and umbilical's to be more extent comparing with the occupational zones of platforms (0.9ha/platform). The impact intensity is characterized as medium, the likelihood as high and therefore the significance is characterized as moderate. As the new platform will form a new place for benthic colonisation, the impact reversibility is characterized as high and the final impact significance as minor.

Leg lowering and suction anchor installation and modification to Delta platform

The duration of these activities and their impacts is short. The occupational zones of these activities are small and therefore there is a small change / disturbance of the seabed and the benthic communities. The potential extent of the impact is on site. Based on these, the impact intensity is characterized as low, the likelihood as high and therefore the significance is characterized as minor. As the new platform will form a new place for benthic colonisation, the impact reversibility is characterized as high and the final impact significance as negligible.

Burial of pipelines and umbilical's

The duration of activity and impacts is short and the potential extent of the impact is local. The impact intensity is characterized as medium, the likelihood as high and therefore the significance is characterized as moderate. As the new platform will form a new place for benthic colonisation, the impact reversibility is characterized as high and the final impact significance as minor.

Activity	Receptor	Type	Extent	Impact Duration	Intensity	Likelihood	Initial Significance	Reversibility	Final assessment
Installation of permanent mooring	Benthic species	Negative	Local (0.9ha/ platform)	Long	Medium	High	Moderate	High	Minor

Activity	Receptor	Type	Extent	Impact Duration	Intensity	Likelihood	Initial Significance	Reversibility	Final assessment
Installation of pipelines and umbilical's	Benthic species	Negative	Local	Long	Medium	High	Moderate	High	Minor
Leg lowering and suction anchor installation	Benthic species	Negative	On site	Short	Low	High	Minor	High	Negligible
Burial of pipelines and umbilical's	Benthic species	Negative	Local	Short	Medium	High	Moderate	High	Minor
Modifications to Delta (new risers/J tubes)	Benthic species	Negative	On site	Short	Low	High	Minor	High	Negligible

Mitigation measures to address the minor impacts to the benthic community expected from the activities of installation of permanent mooring, installation and burial of pipelines and umbilicals are presented in Chapter 12.4.7

11.2.7.1.3 Fish ecology

As provided in Chapter 09, no significant impacts to fish ecology have been predicted for this project during routine construction phase activities. The rationale for excluding this parameter from further assessment is provided in Chapter 09.

11.2.7.1.4 Marine mammals

The project construction activities that have the potential to interact with marine mammals are the following:

- Suction anchoring;
- Operation of support vessels; and
- Modifications to Delta platform (new risers / J tubes).

Suction anchors

Suction pumps will operate for around 12 hours overall (short period) with 40 dB noise emissions. The necessary dumb cargo barges and two tugs noise emission is considered to be 1% of the total noise level of a typical installation.

Naturally occurring noise levels in the ocean as a result of wind and wave action, may range from 90 dBA re 1μPa under very calm, low wind conditions to 110 dB re 1μPa under windy conditions.

Underwater noise may cause marine animals to alter their behavior (such as diving, surfacing, vocalizing, feeding, and/or mating), move away from the area of noise, prevent marine animals from hearing important sounds (masking), cause hearing loss (temporary or permanent), or

damage tissue. Behavioral responses depend on a number of factors, including an individual animal's hearing sensitivity, tolerance to noise, exposure to the same noise in the past, behavior at the time of exposure, age, group composition. The degree of masking is influenced by the level, frequency band, and the duration of the noise in comparison to the sound of interest. Hearing loss depends on the hearing sensitivity of the animal in comparison to the intensity of the sound, the frequency of the sound, and the duration of exposure to the sound. The functional hearing group of marine mammals likely to be found in the Kavala Gulf is presented in the chapter 8.7.4 of the current study. The marine mammals recorded in the project area during the seismic survey are sperm whale, common bottlenose dolphin, striped dolphin and short-beaked common dolphin (see chapter 8.7.4.5). It is noted that none of the marine mammals species present are known to be breeding within the project area. They use a wide area for feeding and as such a very small area of increased noise over a small period of time will not lead to a significant impact.

The intensity of the underwater noise caused by this activity is expected to be low and within the range of existing noise given existing baseline conditions in the area (fishing boats and gear, boats, ferries etc). The duration of the activity is short (12 hours), the impact intensity is assessed as negligible and for that reason the significance is also characterised as negligible

Operation of support vessels

The potential impact on marine mammals from the operation of vessels is noise disturbance and risk of collision. Underwater noise from vessels may cause marine animals to alter their behaviour, move away from the area of noise and prevent marine animals from hearing important sounds (masking),. The duration of the activity is medium and the potential extent of the impact is local. The impact intensity is characterized as low because visits will occur at most every two weeks using existing vessels that move staff between shore and Prinos or Prinos and South Kavala. As it is described in the chapter 8.8.3, the traffic density in the Kavala Gulf is high and the number of distinct vessels on a daily basis is estimated more than 140. Therefore, the impact likelihood from this activity is low. However the impact intensity is high and for that reason the impact significance is moderate. Due to the fact that in case of a collision the impact reversibility is low, the final impact significance is assessed as moderate.

Modifications to Delta platform (new risers/J tubes)

This activity will generate underwater noise of low intensity and the duration of activity and impact will be short. Based on these, the impact intensity is low. However, the impact significance is high and so the significance is moderate. Due to the high reversibility, the final assessment of impact is minor.

Activity	Receptor	Type	Extent	Impact Duration	Intensity	Likelihood	Significance	Reversibility	Final assessment
Suction anchoring	Marine mammals	Negative	Local	Short	Negligible	High	Negligible	High	Negligible
Operation of support vessels	Marine mammals	Negative	Local	Medium	High	Low	Moderate	Low	Moderate
Modifications to Delta (new risers/J tubes)	Marine mammals	Negative	On site	Medium	Low	High	Moderate	High	Minor

Mitigation measures to address the moderate and minor impacts to the marine mammals expected from the activities of support vessels operation and modifications to Delta platform are presented in Chapter 12.4.7.

11.2.7.2 Operational phase

11.2.7.2.1 Plankton

As provided in Chapter 09, no significant impacts to plankton have been predicted for this project during routine operation phase activities. The rationale for excluding this parameter from further assessment is provided in Chapter 09.

11.2.7.2.2 Benthic communities

The operation activities that have the potential to affect benthic communities are:

- Maintenance of exclusion zones; and
- Seabed cuttings disposal (0-400 m)

Maintenance of exclusion zones

By preventing fishing in the exclusion zones, the benthic habitat will be impacted positively.

Seabed cuttings disposal (0-400m)

The seabed cuttings will not contain any oil or hazardous chemicals, but will represent a physical change to the local seabed topography. The potential impact from this activity is localized to within an area of 600 m^2. An indirect impact from this activity is expected on the benthic communities in the vicinity of the platforms. As presented in Chapter 8, these communities are considered to be of low sensitivity. Based on the above considerations, the likelihood of the negative impact is assessed as high; the impact intensity as medium and therefore the impact significance is characterized moderate. Due to the fact that the reversibility is expected to be high, the impact significance is assessed as minor.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Maintenance of exclusion zones	Benthic communities	Positive	Local	Long	Medium	High	Positive		Positive
Seabed cuttings (0-400m)	Benthic communities	Negative	Local ($600m^2$)	Long	Medium	High	Moderate	High	Minor

Mitigation measures to address the minor impacts to the benthic community expected from the activity of seabed cuttings disposal are presented in Chapter 12.4.7.

11.2.7.2.3 Fish ecology

The operation activities that have the potential to affect fish ecology are:

- The installation of conductors (new wells) planned; and
- The spudding and drilling of wells, including cementing of initial casings.

Those activities are expected to generate noise, which could be of nuisance to particular species. However, fish species in the area of study, are not under any protection status and they are in good populations as presented in Chapter 8. Therefore the receptor's sensitivity is considered low. Moreover, the duration of the activity and therefore of any potential impact is low.

Based on the above considerations, the likelihood of the negative impact is assessed as high; the impact magnitude low and therefore the impact significance is characterized minor. Due to the fact that the reversibility is expected to be high, the overall impact significance is assessed as negligible.

Activity	Receptor	Type	Extent	Impact Duration	Intensity	Likelihood	Significance	Reversibility	Final assessment
Installation of conductors (new wells)	Fish ecology	Negative	Local	Short	Low	High	Minor	High	Negligible
Spudding and drilling of wells, including cementing initial casings	Fish ecology	Negative	Local	Short	Low	High	Minor	High	Negligible

11.2.7.2.4 Marine mammals

The operation activities that have the potential to affect marine mammals are:

- Maintenance of exclusion zones;
- Installation of conductors (new wells only);
- Spudding and drilling of wells, including cementing of initial casings;
- Operation of support vessels.

Maintenance of exclusion zones

By maintaining the operation of exclusion zones, fishing activities are prevented within those areas, something that is expected to cause increases in fish populations, which in turn are the predominant food supply of marine mammals.

Installation of conductors (new wells only) - Spudding and drilling of wells, including cementing of initial casings – Operation of support vessels

These activities are expected to generate noise and collision risk is increased due to the support vessels traffic.

Naturally occurring noise levels in the ocean as a result of wind and wave action, may range from 90 dBA re 1μPa under very calm, low wind conditions to 110 dB re 1μPa under windy conditions.

As described previously in this chapter, underwater noise may cause impact marine mammals in various ways from forcing them to move away from the area of noise to extreme cases of hearing loss and tissue damage. The magnitude of the impact depends on the intensity of the sound, the frequency of the sound, the duration of exposure to the sound and the sensitivity of the animal to such noise. The functional hearing group of marine mammals likely to be found in the Kavala Gulf is presented in the chapter 8.7.4 of the current study. The marine mammals recorded in the project area during the seismic survey are sperm whale, common bottlenose dolphin, striped dolphin and short-beaked common dolphin (see chapter 8.7.4.5). It is noted that none of the marine mammals species present are known to be breeding within the project area. They use a wide area for feeding and as such a very small area of increased noise over a small period of time will not lead to a significant impact.

With regards to the conductors, they are traditionally hammered into the seabed to a distance of 40 to 50 m to support the wells drilled from a platform. These are large diameter (30”) tubes through which the well is drilled. When hammer driving conductors, sound levels up to 180 dB can be generated. It is noted that the sound levels generated by the typical marine craft that service platforms is approximately 120 dB.

The hearing of mammals can be damaged at the sound levels up to 180 dB produced by the conductors, in a range of 3 to 10m (depending on noise frequency) with behavioural modifications noted out to 200 m. It is noted that, five (5) conductors will be driven initially. This will take approximately 5 days to complete, although noise would only be generated for about a third of this period. Impacts such as hearing loss and behavioural changes may only result if marine mammals are present in close proximity to the conductor driving location. Conductor driving, however, will only take place if marine mammals are not within 500m of the conductor drilling area to avoid noise related impacts. The Company will also consider alternatives to hamering such as virbopile to reduce noise levels.

With regards to the spudding and drilling of wells, the estimated noise levels are expected to be lower but may still result in significant impacts. Similarly the Company will ensure that marine mammals are not present within 500m of the drilling site before commencing drilling activities.

Operation of support vessels

The potential impact on marine mammals from the operation of vessels is noise disturbance and risk of collision. Underwater noise from vessels may cause marine animals to alter their behaviour, move away from the area of noise and prevent marine animals from hearing important sounds (masking),. The duration of the activity is medium and the potential extent of the impact is local. The impact intensity is characterized as low because visits will occur at most every two weeks using existing vessels that move staff between shore and Prinos or Prinos and South Kavala. As it is described in the chapter 8.8.3, the traffic density in the Kavala Gulf is high and the number of distinct vessels on a daily basis is estimated more than 140. Therefore, the impact likelihood from this activity is low. However the impact intensity is high and for that reason the impact significance is moderate. Due to the fact that in case of a collision the impact reversibility is low, the final impact significance is assessed as moderate.

Activity	Recep	Type	Ext	Imp	Inte	Like	Sign	Reve	Final
Maintenance of exclusion zones	Marine mammals	Positive	Local	Long	Medium	High	Positive	-	Positive
Installation of conductors (new wells)	Marine mammals	Negative	On site	Short	Medium	Medium	Moderate	High	Minor
Spudding and drilling of wells, including cementing initial casings	Marine mammals	Negative	On site	Short	Medium	Medium	Moderate	High	Minor
Operation of support vessels	Marine mammals	Negative	Local	Short	High	Low	Moderate	Low	Moderate

Mitigation measures to address the minor and moderate impacts to the marine mammals expected from the activities of installation of conductors, drilling wells and operation of support vessels are presented in Chapter 12.4.7.

11.2.7.3 Abandonment phase

11.2.7.3.1 Plankton

As provided in Chapter 09, no significant impacts to plankton have been predicted for this project during routine abandonment phase activities. The rationale for excluding this parameter from further assessment is provided in Chapter 09.

11.2.7.3.2 Benthic communities

The abandonment activities that have the potential to benthic communities are:

- Dispersal of historic drill cuttings on seabed (from existing platforms); and
- Removal of SIPs (planned and potentially planned platforms)

The impact from the decommissioning of the facilities will have a limited duration (recovery time), while it will be withdrawn completely after the end of the decommissioning period, and it will be localized. The impacts will arise from the removal of the existing and new (currently planned) platforms. The historic drill cuttings on the seabed near the platforms will be pneumatically dispersed, which may cause disturbance to benthic communities on and around them (from direct physical disruption and increased turbidity). Drill cutting materials will disperse over a wide area and are unlikely to be noticeable against background levels. The amount of seabed cuttings is considered to be small. The seabed will be reformed in the next 5-10 years and the seabed quality will improve.

Following the removal of the platforms it is assumed that either onshore deconstruction or recycling of the material or deep-water disposal will be the preferred disposal route. It should be noted that the decommissioning method has not been chosen.

As far as the technology of decommissioning method concern, the new platforms are better decommissioned in a more environmental friendly method. The SIP may be relocated to another similar location by towing in the upright position. An alternative decommissioning solution is the disposal of the platforms in deep-water. The exact deep-water disposal technique applied will be a result of extensive environmental, legal, social and technical studies.

The decommissioning design method will be done when the time is closing by, in order to make use of the best available techniques, methods and international experience available at the time.

The project offshore area will be maintained in a clean condition throughout the duration of the decommissioning phase. Upon completion of the project, each temporary facility, waste, tools, equipment, materials, machinery installations, will be removed and parts of the site that may have been damaged will be repaired and rehabilitated.

The final impact to seabed features is assessed to be of small intensity, local extent and of long-term duration. All necessary measures will be taken for remediation and restoration of operating spaces in a satisfactory condition. With the completion of the project and the removal of the effect the natural mechanisms will restore the physical, marine environment. The impact to seabed features after the implementation of the proposed remediation measures will be minor.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Existing platforms: dispersal of seabed cuttings from piles	Benthic communities	Negative	Local	Long	Medium	High	Moderate	High	Minor
New platforms: removal of SIPs	Benthic communities	Negative	Local	Long	Medium	High	Moderate	High	Minor

Mitigation measures to address the minor impacts expected from the activities of decommissioning of existing and new platforms to the benthic community are presented in

Chapter 12.4.7.

11.2.7.3.3 Fish ecology

The operation activities that have the potential to affect fish ecology are:

- Sever conductors;
- Existing platforms: cut piles;
- Existing platforms: remove jacket; and
- New platforms: removal of SIP.

The activities of sever conductors and cut piles of existing platforms will generate underwater noise that may result in disturbance and / or harm of fish. The activities of removal of the jacket of the existing platforms and new the SIP of the new platforms will result in the destruction of this man-made habitat which is (will be) used by various marine species including fish. However, the activities will take place for a short period of time in a local extent and also the fish in the study area is not considered sensitive. Based on the above considerations, the likelihood of the negative impact is assessed as high; the impact magnitude low and therefore the impact significance is characterized minor. Due to the fact that the reversibility is expected to be high, the overall impact significance is assessed as negligible.

Activity	Receptor	Type	Extent	Impact Duration	Intensity	Likelihood	Significance	Reversibility	Final assessment
Sever conductors	Fish ecology	Negative	Local	Short	Low	High	Minor	High	Negligible
Existing platforms: cut piles	Fish ecology	Negative	Local	Short	Low	High	Minor	High	Negligible
Existing platforms: remove jacket	Fish ecology	Negative	Local	Short	Low	High	Minor	High	Negligible
New platforms: removal of SIP	Fish ecology	Negative	Local	Short	Low	High	Minor	High	Negligible

11.2.7.3.4 Marine mammals

The project abandonment activities that have the potential to interact with marine mammals are the following:

- Sever conductors;
- Operation of support vessels;
- Existing platforms: cut piles;
- Existing platforms: Remove jacket; and

- New platforms: removal of SIP

Sever conductors

The potential impacts on marine mammals from the sever conductors are noise disturbance and risk of collision.

Potential impacts to marine mammals due to underwater noise are described elsewhere in this chapter.

The noise associated with severing the conductors may result in some impacts to marine mammals, No permanent hearing damage is anticipated however behaviour responses to the noise are possible. The likelihood and the intensity of the impacts are assessed as medium and therefore the significance is characterized as moderate. Due to the fact that the reversibility is expected to be medium, the overall impact significance is assessed as moderate. Measures will be implemented to minimise noise levels associated with this activity and further avoid potential noise related impacts.

Operation of support vessels

The potential impacts on marine mammals from the operation of support vessels are noise disturbance and risk of collision. However, the Kavala Gulf already supports a significant number of marine traffic (regular ferry lines, commercial, and leisure). As it is described in the chapter 8.8.3, the traffic density in the Kavala Gulf is high and the number of distinct vessels on a daily basis is estimated more than 140. Therefore, the impact likelihood for this activity is low. However the impact intensity is high and for that reason the impact significance is moderate. Due to the fact that in case of a collision the impact reversibility is low, the final impact significance is assessed as moderate. Moreover, it could be considered that mammals are already accustomed to the noise from existing marine traffic in the area.

Existing platforms: cut piles

The potential impact on marine mammals from cut piles is noise disturbance and / or harm. The noise levels and the impacts expected will depend on the exact method to be decided. Explosives are considered as a worst case scenario in which the impact intensity is assessed as high, the likelihood as medium and therefore the significance is characterized major.

Existing platforms: remove jacket and New platforms: removal of SIP

Removal of the jacket of the existing platforms and the SIP of the new platforms will result in the destruction of this man-made habitat and potentially reduces the quality / abundance of the food supply for marine mammals. However, the impact intensity is low since the mammals have numerous areas of habitats in the region. The impact significance is characterized as minor. As the impact reversibility is medium, the final impact assessment is minor.

Activity	Receptor	Type	Extent	Impact Duration	Intensity	Likelihood	Significance	Reversibility	Final assessment
Sever conductors	Marine mammals	Negative	On site	Short	Medium	Medium	Moderate	Medium	Moderate
Operation of support vessels	Marine mammals	Negative	Local	Short	High	Low	Moderate	Low	Moderate
Existing platforms: cut piles	Marine mammals	Negative	Local	Short	High	Medium	Major	Medium	Major
Existing platforms: remove jacket	Marine mammals	Negative	Local	Long	Low	High	Minor	Medium	Minor
New platforms: removal of SIP	Marine mammals	Negative	Local	Long	High	High	Minor	Medium	Minor

Mitigation measures to address the impacts expected from sever conductors, jacket removal, existing and new platforms removal and operation of support vessels are investigated in Chapter 12.3.7.

11.2.8 Impact on manmade environment

The Project will conduct several activities during construction, operation and abandonment phase that will generate pressures to the fisheries and aquacultures, marine traffic and tourism. As provided in Chapter 09, no significant impacts to the manmade environment have been predicted for this project. The rationale for excluding this parameter from further assessment is provided in Chapter 09.

11.2.9 Socioeconomic impact

11.2.9.1 Construction Phase

Employment will increase during the construction phase of the project. Local contractors will be employed to assist in construction activities, thus supporting the local economy. The impact on the socioeconomic environment during construction is assessed to be positive. The duration of the activity is considered to be medium and the impact intensity to the socioeconomic structure of the area in scope is medium.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
All	Socioeconomic environment	Positive	Regional	Medium	Medium	High	Positive		Positive

11.2.9.2 Operational Phase

The employment indicators will not change during the operational phase. While no new jobs will be created as part of the expansion, these activities will improve the life of the fields, thereby allowing the company to retain the existing employment levels (355 jobs, of which 308 are locally resourced). The impact on the socioeconomic environment, during operation is assessed to be positive. The duration of the activity and the impact to the region of Kavala is medium.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
All	Socioeconomic environment	Positive	Regional	Long	Medium	High	Positive		Positive

11.2.9.3 Abandonment Phase

Following abandonment of all platforms (existing and new), the existing workforce will need to find alternative employment. The impact significance is assessed as moderate.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
All	Socioeconomic environment	Negative	Regional	Long	Medium	High	Moderate	High	Minor

Mitigation measures to address the minor impacts to the socioeconomic environment during the abandonment phase are presented in Chapter 12.4.9.

11.2.10 Impact on technical infrastructures

11.2.10.1 Construction Phase

As provided in Chapter 09, no significant impacts on technical infrastructures i.e. transport infrastructures; telecommunication, health services and urban waste water have been predicted for this project during construction phase. The rationale for excluding this parameter from further assessment is provided in Chapter 09.

11.2.10.2 Operational Phase

The project activity that has the potential to interact with social infrastructure is the treatment and disposal of drilling cuttings (from 400 – 3,150 m). These drill cuttings will contain oil-based muds and will be disposed at an existing waste facility onshore. Depending on the capacity and existing use of this facility, this waste stream could adversely affect the site's overall capacity for other users. The potential impact from this activity is regional due to the large amount of drilling cuttings

that will be treated. Energean will audit the waste facility to make sure it has capacity before it sends the waste for further treatment. Based on the above, the likelihood of the negative impact is assessed as high; the impact intensity as medium and therefore the impact significance is characterized moderate. Due to the fact that the reversibility is medium (since Energean will also look for alternatives in case the aforementioned audit prove that this is required), the final impact significance is assessed as minor.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Cuttings treatment and disposal (400 - 3150 m)	Social infrastructure (waste)	Negative	Regional / national	Long	Medium	High	Moderate	Medium	Minor

Mitigation measures to address the minor impacts expected from the activity of cuttings treatment and disposal are presented in Chapter 12.4.10

11.2.10.3 Abandonment Phase

During the decommissioning phase of the platforms wastes associated with abandonment, including waste metal, will be disposed at an existing waste facility(s) onshore. Depending on the capacity and existing use, this waste could adversely affect the site(s)'s overall capacity for other users. Based on the above, the likelihood of the negative impact is assessed as high; the impact intensity as medium and therefore the impact significance is characterized moderate. Due to the fact that the reversibility is medium (since a number of alternative facilities could be potentially used), the final impact significance is assessed as minor.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Existing platforms	Social infrastructure (waste)	Negative	Regional / national	Long	Medium	High	Moderate	Medium	Minor

Mitigation measures to address the minor impacts expected from the activity of existing platforms decommissioning are presented in Chapter 12.3.10.

11.3 IMPACT ASSESSMENT FROM UNPLANNED EVENTS

11.3.1 Impact on climate and bioclimate characteristics

As provided in Chapter 09, no interaction with climate and bioclimate characteristics has been predicted for this project during construction, operation and abandonment phases. The rationale for excluding these parameters from further assessment is provided in Chapter 09.

11.3.2 Impact on morphological and topological characteristics

As provided in Chapter 09, no interaction with seabed has been predicted for this project during construction, operation and abandonment phases. The rationale for excluding this parameter from further assessment is provided in Chapter 09.

11.3.3 Impact on geological and tectonic characteristics

As described in Chapter 10, a spill of hydrocarbons is unlikely and a significant spill would only occur due to incidents. Marine diesel will disperse naturally, evaporating quickly on release, and any components that settle to the seabed will be naturally biodegraded by microbes within one to two months. Oil will not pool on the seabed. However, elevated concentrations of hydrocarbons may be noticeable in sediments close to the discharge point after a large spill, which in turn could be toxic to benthic species. Given the rarity of such an event and based on the fact that the oil floats on the water surface, the impact significance on the geological characteristics is assessed as minor.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Operational oil spill unplanned event	Seabed	Negative	Local	Short	Medium	Low	Minor	Low	Minor

Mitigation measures to address the minor impact expected from the activity of operational oil spill and unplanned event to the geological characteristics of the project area are presented in Chapter 12.2 and in Annex 13 (Contingency plan)

11.3.4 Impact on water environment

The accidental spill of hydrocarbons could cause localized and significant effects on the water quality. The water environment constitutes the pathway to the secondary biotic receptors such as plankton, fish ecology, marine mammals and seabirds. (see chapter 11.3.7 biotic environment). Based on the above considerations and given the fact that the likelihood of the impact is moderate; the impact significance is assessed as minor. The worst case scenarios of the potential leak points, the sensitive locations affected and the released quantities by an oil spill unplanned event have been described in chapter 10.8.2. The mitigation measures in case

of an emergency are described in chapter 12.2 and in Annex 13 (Contingency plan).

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Operational oil spill unplanned event	Water environment	Negative	Local	Short	High	Low	Moderate	Moderate	Minor

11.3.5 Impact on air environment

As provided in Chapter 09, no interaction with air quality has been predicted for this project during construction, operation and abandonment phases. The rationale for excluding this parameter from further assessment is provided in Chapter 09.

11.3.6 Impact on acoustic environment

As provided in Chapter 09, no interaction with underwater noise has been predicted for this project during construction, operation and abandonment phases. The rationale for excluding this parameter from further assessment is provided in Chapter 09.

11.3.7 Impact on biotic environment

Plankton and Fish ecology

An accidental spill of diesel or hydrocarbons may affect the plankton and fish ecology of the study area. The likelihood of such an event occurring has been assessed in Chapter 10 and is minimized through mitigation measures required by the governing legislation and supported by industry best practices.

In fish life cycles the egg and juvenile stages are the most vulnerable to toxicity in the water column, as adult fish are highly mobile and generally able to avoid polluted areas. Fish and shellfish will be vulnerable to toxic effects from oil spill in the water. Localised fatalities would occur in the immediate vicinity of the spill, but fish are likely to avoid the area if the situation persists, and any effects are unlikely to be felt on a population level. A major spill has therefore been assessed as having the potential for an impact of moderate significance.

Benthic communities

Elevated concentrations of hydrocarbons may be noticeable in sediments close to the discharge point after a large spill, which in turn could be toxic to benthic species. Benthic community recovery after an impact of this kind is expected within three months to two years. Based on the above considerations, the impact significance is assessed as low.

Marine mammals

There is the potential that marine mammals could be significantly affected if a large hydrocarbon spill was to occur, the likelihood of which is extremely low (see Chapter 10).

An oil spill may affect marine mammals through inhalation, ingestion, and dermal pathways. Each pathway could cause a suite of physiological responses that could compromise health as well as long-term survival and reproduction. With regards the monk seal, the most serious health threats from oil are (i) hypothermia; (ii) respiratory system damage from inhalation of the volatile and highly toxic aromatic components of oil; (iii) gastrointestinal damage from ingestion of oil through grooming or consumption of contaminated prey; and (iv) eye, skin, and mucus membrane damage from oil and excessive grooming. For most cetaceans, the greatest threat is likely to be acute respiratory injury if they encounter fresh oil. For those species that primarily live or feed nearshore, incidental ingestion of oil and chronic respiratory exposure may be the most damaging over the long term. In addition, any marine mammal population could be indirectly impacted by an oil spill that reduces prey populations locally or over a broad area. The marine mammals recorded in the project area during the seismic survey are sperm whale, common bottlenose dolphin, striped dolphin and short-beaked common dolphin although in low numbers (see chapter 8.7.4.5). The impact intensity is assessed high but the likelihood of the impact (the oil spill) occurring is very low and therefore the impact significance is assessed as moderate.

Avifauna

There is the potential that birds and especially the seabirds could be affected negatively if a large spill of hydrocarbons occurred. As is mentioned in the Chapter 8.7.5, the study area overlaps with the Marine Important Bird Areas IBA GR250 and IBA GR12. The main seabirds are the Yelkouan Shearwater (*Puffinus yelkouan*) and the Mediterranean Shag (*Phalacrocorax aristotelis desmarestii*). It is noted that the Yelkouan Shearwater arrival to breeding sites occurs in March, the egg laying period is from March to May and the fledging period is at July. The Mediterranean Shag arrival to breeding sites occurs between December and January, the egg laying period is at the end of January (peaking in mid-February) and the fledging period is at the end of May. The highest species richness is recorded in the Vasova Lagoon in the Natura GR1150001, while the largest congregations were recorded in the coastal waters eastnorth of the Study Area.

The main breeding sites of avifauna species are located in the Natura areas SPAs GR1150001 "Delta Nestou kai limno thalasses Keramotis kai nisos Thasopolula" and Natura GR1150012 "Thasos (Oros Ypsario kai parakatia zoni)" which are northeast and east of the project (see chapter 8.7.6). Natura area GR1150001 is also important for mating, foraging, roosting, maintenance (e.g. moulting) and wintering (see chapters 8.7.5 and 8.7.6).

Oils spill could lead to the degradation of marine fauna and flora, which would result in the limited food availability. It would also temporarily reduce the foraging habitats at sea, as well as roosting and maintenance sites along the coast. However unlikely but potential oil spill could have negative impact on habitats and individuals and lead to the loss of some individuals and habitats. Individuals might be lost either due to mortality or temporary displacement to other areas. Crude

oil is toxic to fauna and may lead severe damage to internal organs and mortality. Additionally, bird contact with oil causes feather oiling. If oil sticks to bird's feathers it caused them to mat and compromised waterproofing leading to exposure of skin to surrounding temperature and hypothermia. Feather oiling may lead to loss of buoyancy and ability to flight. All bird species could potentially be at risk of poisonous impacts gas leak, while primarily seabirds and pelicans are expected to be most vulnerable to oil spills.

Given the likelihood of the impact is very low, and the importance of the area with regards to avifauna, it is assessed that the impact on seabirds would be of moderate significance. The impact significance is expected to be lower in the period from August until December which is the post breeding period. However, it is noted that resident seabirds and herons, migratory passerines, as well as post-breeding concentrations of particular species e.g. Mediterranean Shag (*Phalacrocorax aristotelis*) and Dalmatian Pelican (*Pelecanus crispus*) are disperse after the breeding season.

Environmental Protected Areas

As it is discussed in the Chapter 8.7.6, the importance of the area has been recognized on the (I) global level, by inclusion as a Ramsar Site "Nestos Delta and Adjoining Lagoons" (designated in 1975), (II) EU level by inclusion in the network of Natura 2000 sites, as an SPA GR1150001 and SAC GR1150010, and (III) national level by inclusion in the National Park of Eastern Macedonia and Thrace with the Management Body of Nestos Delta - Vistonis and Ismaris. The complex of wetlands, including lakes and lagoon consisting the National Park of Eastern Macedonia and Thrace is considered to be one of the most important in Europe. Moreover, the international importance of the area is further supported by its inclusion in the network of Important Bird Areas (IBAs) identified by the BirdLife International i.e. the study area is part of the IBAs GR12 "Nestos Delta and coastal lagoons" and GR 250 "Gulf of Kavala and marine area of Thasos Island". The most vulnerable components of the protected ecosystems to oil spills in offshore and coastal environments are seabirds and marine mammals, due to their close association with the sea surface. It is noted that the closest marine part of Natura 2000 site (GR1150010) is at a distance of 12 km from the project area. In case that an oil spill reaches the coast, it will significantly affect the integrity of coastal protected areas. The features for designation may also be adversely affected. However, the likelihood of this event is very low.

The worst case scenarios of the potential leak points, the sensitive locations affected and the released quantities by an oil spill unplanned event have been described in chapter 10.8.2. The mitigation measures in case of an emergency are presented 2 in chapter 12.2 and in the relevant Annex 13 (Contingency Plan).

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Operational oil spill unplanned	Marine mammals	Negative	Regional	Long	High	Low	Moderate	Low	Moderate

event	Plankton and Fish ecology Avifauna								
Operational oil spill unplanned event	Benthic communities	Negative	Regional	Long	Medium	Low	Minor	Low	Minor

11.3.8 Impact on manmade environment

Fishing activities

Fishing vessels may be excluded from the affected area of oil spill unplanned event, although for short periods of time the fishing industry can generally relocate to other grounds without any detrimental impacts to catch. If fish stocks are contaminated there could be a loss of market confidence as people may be unwilling to buy fish caught in a contaminated area. Given the fact that the Kavala Gulf is an important fishing ground, the significance of the impact is assessed as moderate.

Marine traffic

A spill event could lead to the shipping lanes in the region being closed to facilitate emergency response operations to be implemented. Similarly, it is possible that shipping lanes could be routed around the affected area. There is the risk of economic impacts on shipping associated with longer routes and delays. Given the small area likely to be directly impacted and the rarity of such an event, a hydrocarbon spill has been assessed as having a low impact on the shipping activities. Details of the potential leak points, the amount of released oil and the duration that it will take to reach the shore are given in chapter 10.8.2.

Tourism and livelihood

An oil spill event would significantly affect, directly and indirectly, the tourism and the livelihood of the wider area of Kavala Gulf. A potential oil spill event would affect the coast quality, leisure activities, small businesses such as restaurants, hotels, seafood industry, gift shops etc. The oil spill accident would have a long term impact to the wider touristic area of Kavala gulf due to the negative visitors' perception. However, given the fact that the likelihood of the impact is low, the impact significance is assessed as moderate. Details on the released oil quantity and time that the spill will reach the shoreline, in case of an accident, has been given in chapter 10.8.2.

Cultural heritage

As provided in Chapter 09, no interaction with cultural heritage has been predicted for this project during construction, operation and abandonment phases. The rationale for excluding this parameter from further assessment is provided in Chapter 09.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment

Operational oil spill unplanned event	Tourism and livelihood, Fishing activities	Negative	Regional	Long	High	Low	Moderate	Low	Moderate
Operational oil spill unplanned event	Marine traffic	Negative	Regional	Short	Medium	Low	Minor	Low	Minor

The mitigation measures in case of an emergency are presented in chapter 12.2 and in Annex 13 (Contingency plan).

11.3.9 Impact on socioeconomic environment

The oil spill unplanned event may affect the socioeconomic environment due to the negative economic impacts on the tourism industry and other livelihoods, fishing activities and shipping (see section 11.3.8). The impact significance is assessed as moderate. The potential source of leakage as well as the quantity of a potential oil spill is described in chapter 10.8.2.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Operational oil spill unplanned event	Socioeconomic environment	Negative	Regional	Long	High	Low	Moderate	Low	Moderate

The mitigation measures in case of an emergency are presented in chapter 12.2 and in the relevant Annex 13 (Contingency plan).

11.3.10 Impact on technical infrastructures

The oil spill unplanned event may affect the marine traffic as well as the technical infrastructures. This impact is described in the section 11.3.8. The technical infrastructures that might be affected are the authorised waste treatment sites, the emergency response infrastructure for support such as boats and tug vessels and the public authorities that will participate in the restoration of the oil spill. However, given the fact that the likelihood of the impact is low, the impact significance is assessed as minor.

Activity	Receptor	Type	Extent	Duration	Magnitude	Likelihood	Significance	Reversibility	Final assessment
Operational oil spill unplanned event	Technical infrastructures	Negative	Regional	Short	Medium	Low	Minor	Low	Minor

The mitigation measures in case of an emergency are presented in chapter 12.2 and in Annex

13 (Contingency plan).

12 MANAGING ENVIRONMENTAL AND SOCIAL IMPACTS

12.1 INTRODUCTION

The existing offshore facilities in the Gulf of Kavala have been in operation for more than 35 years. During this period Energean has developed and implemented appropriate management systems to ensure that routine and unplanned impacts to the environment are mitigated to a level that is as low as reasonably practicable (ALARP).

Routine impacts are subject to an Environmental Management Plan that forms part of the existing Environmental Impact Assessment approved by the Greek government. The effectiveness of these systems and procedures are routinely audited by local and state authorities.

As discussed in preceeding sections, unplanned events, particularly the accidental release of oil to the sea, have significantly more potential for impacting the environment than routine emissions and discharges. These events can occur due to a failure in the hydrocarbon containment envelope (loss of Technical Integrity) or a failure of the established preventative systems (fixed/equipment related and/or procedural). Technical Integrity of the existing facilities, including pipelines, is checked and verified by Det Norske Veritas (DNV) every 5 years. DNV renews the Company's Operating Certificate based upon a successful audit and issues this to the Greek authorities. Any deficiencies are noted and a remedial action plan agreed. This includes target dates for rectification of any significant issues. On a 2-yearly basis DNV performs a separate audit of safety equipment. Whilst the primary focus of safety equipment is protection of staff, clearly they are also critical with regard to prevention of failures escalating so that they could also have a major impact on the environment.

When planning the development of the described new facilities (the new satellite platforms and interconnecting submarine pipelines) Energean's intent was to embed safety and environmental risk mitigation measures in the design wherever possible. Clearly risk is better mitigated by removing hazards via appropriate conceptual design work than attempting to mitigate identified hazards by controls or barriers in the construction, operational or abandonment phases.

All hazards cannot of course be completely removed. Oil and gas are in their essence hazardous materials and their production, and the development of the facilities to allow them to be produced, entails a degree of residual risk no matter what design approach is adopted. In preparing this Environmental and Social Impact Assessment (ESIA) Energean has examined

whether the existing mitigation measures applied to its new facilities can be expanded to effectively mitigate residual risks associated with the introduction of the new facilities. In general it has concluded that these existing measures are appropriate. The new facilities add little complexity and introduce no new risks, hence in general existing mitigations are appropriate. A number of new activities (largely related to construction work) are introduced. In these cases Energean considers it prudent to introduce a number of new mitigation measures. These will be added to its existing management system as described below.

In the following sub-sections mitigation measures will be presented in the order described below, namely:

- Current mitigation measures in place for the existing facilities as included in:
  - ⇨ Environmental and Operational permits;
  - ⇨ Operational and Maintenance Procedures;
  - ⇨ Safety, pollution prevention and emergency response plans;
  - ⇨ Environmental management plans; and
  - ⇨ Environmental monitoring procedures
- Mitigation measures embedded in the design of the planned (and potential) new facilities and the modifications to be applied to the existing facilities where necessary
- Additional mitigation measures proposed as a result of the assessment of environmental and social impacts as described in the previous chapter.

Energean's overarching approach to environment, social and health and safety impact and risk management is described in detail the overarching Environmental and Social Management and Monitoring Plan (ESMMP) following up in Chapter 13. Mitigation and management controls as well as monitoring provisions are expanded upon in a series of issue specific management plans that are attached to this ESIA. These management plans are framework plans, fall below the ESMMP, and will be developed into full plans and integrated into the existing environmental and health and safety management system prior to construction works and operations where relevant. Many of these plans draw on existing robust mitigation and management measures that have already been implemented by Energean and will be applied to the Project, will limited revision where necessary.

12.2 CURRENT MITIGATION MEASURES IN PLACE

Environmental and social impacts associated with the existing facilities have been managed successfully over the last 35 years through a system of controls that the company implements.

This system is in line with:

- The environmental permit that the offshore facilities currently have (80994/7.2.2002 Ministry of Environment, Spatial Planning and Public works), which was recently renewed (46781/1283/12.8.2013 Ministry of Environment, Energy and Climate Change);
- The operation permit for the offshore and onshore facilities (26556/F6.5/19.8.1985

Ministry of Industry, Energy and Technology) which was renewed in 2003 (D3/B/11591/15.9.2003 Ministry of Development);

- Pollution prevention certificate, renewed on 18.06.2015 by the Ministry of Marine, according to Marpol 73/78;
- The permit for the Greenhouse Gases emissions (135368/28.12.2004 Ministry of Environment, Spatial Planning and Public works) which was renewed in 2012 (214104/31.12.2012 Ministry of Environment, Energy and Climate Change)
- The Common Ministerial Decision 13588/725/2006 regarding waste management and annual reporting;
- The Directive 166/2006/EC regarding the European Pollutant Release and Transfer Registry annual reporting on CO_2, NO_X and SO_2 emissions;
- The Presidential Decree No. 546 regarding the code for life saving and fire fighting appliances and training practices on units for the exploration or exploitation of hydrocarbons, issued on 31.10.1985 by the Ministry of Merchant Navy;
- The rules of DNV-GL that certifies the safe operation of all offshore and onshore installations.

In Chapter 8, an assessment of the current environmental baseline (physical and social) was made. Links between the current environmental conditions and the operation of the existing facilities were made, where applicable. No significant negative impacts were identified. This would imply that the current environmental management and monitoring systems applied to routine discharges and emissions have been largely effective. Key controls are:

- Produced water, deck-washing and rain-water treatment systems at the Prinos complex and Kappa platforms in accordance with the provisions of L.1269/1982 (Government Gazette 89/A721.7.82) "International Convention for the Prevention of Pollution from Ships (MARPOL)" and PD 479/84 (GG 169 A71.11.84).
- Management of the flare system to minimize routine fugitive emissions and avoid release of liquid hydrocarbons via this open system
- Maintenance of a regularly tested Oil Spill Response system and associated Oil Spill Response Plan to eliminate or minimize the adverse effects of unexpected sea and coast oil pollution incidents, so as to:
  - ⇨ Protect the environment;
  - ⇨ Protect the interests of the local community;
  - ⇨ Enhance employees' safety;
  - ⇨ Accelerate return to normal operation of the facilities;

  These goals are met by:

  - ⇨ Minimizing the spread of the oil spill by having sufficient booms to contain the largest spill 3 hours after its formation;
  - ⇨ Recovering oil from the sea into a barge with capacity for the largest spill possible;
  - ⇨ Protecting the most critical coastlines by deployment of additional booms/dispersants as appropriate;
  - ⇨ Decontamination of the shoreline of any residual oil not removed whilst the spill is

offshore;

The operational readiness of the oil spill response mechanism is ensured by the training of personnel, the use of special equipment and the means to combat pollution and is maintained through regular exercises in readiness based on hypothetical accident scenarios.

The Plan is authorized by decision of the Kavala Harbour Master and then is communicated to all recipients of the Facilities' Contingency Plan.

- Maintenance of installed Fire & Gas (F&G) detection systems consisting of detectors, to identify and alarm in the case of hydrocarbon leaks (including hydrogen sulphide) and subsequent fire (if the release is ignited). Emergency Shut Down systems are activated by the fixed F&G systems to prevent escalation.
- Provision of appropriate lifesaving and firefighting equipment at the Prinos complex and the Kappa satellite platform
- Implementation of a rigorous and structured Health, Safety and Environment (HSE) management system that defines the HSE policies, standards and procedures to be applied by all employees to all current and future facilities and activities.
- Execution, and regular updates, of an HSE plan that provides a schedule for implementing the HSE management system including all necessary guidelines to employees, HSE targets, responsibilities and effective regulations, standards and rules, training schedules and emergency drills to ensure personnel effective response in case of emergency.
- Execution, and regular updates, of a Risk Management Plan (RMP) as part of an ongoing process that continues through the life of a project and defines daily operations. It includes processes for hazards identification, analysis, risk management planning, monitoring, control and reporting. Many of these processes are updated throughout the project life cycle as new risks can be identified at any time. It's the objective of risk management to decrease the probability and impact of events adverse to the project. On the other hand, any event that could have a positive impact is exploited.

  Hazards are identified using various techniques; HAZID (Hazard Identification), HAZOP (Hazard and Operability Study), TRA (Toolbox Risk Assessments) and related risk is continuously assessed and evaluated leading to mitigation measures for either eliminating hazards or substituting with different, less hazardous approaches. Barriers forming functional grouping of safeguards and controls selected to prevent the realization of a hazard are identified to reduce the risk to ALARP (As Low As Reasonably Practicable). Hard controls are engineered solutions or physical barriers. Soft controls are procedures and work instructions. The effectiveness of all controls depends on the actions of personnel. Residual risks caused by potential failure of these controls are managed by identification of a set of HSE critical activities. These activities mainly describe the verification actions required to ensure that controls are maintained and identify the SPR (Single Point Responsible) person for the activity.

  As project activities are conducted and completed, risk factors and events are monitored

to determine if in fact trigger events have occurred that would indicate the risk is now a reality. Based on these trigger events that have been documented during the risk analysis and mitigation processes, the operations / project team or operations / project managers have the authority to enact contingency plans as deemed appropriate.

- Implementation, and regular updates, of an Emergency Response Plan (ERP). Energean's ERP covers the organization and actions to be taken during emergencies at the facilities. Emergencies are defined as:
  - ⇨ Injuries or more serious incidents;
  - ⇨ Pollution or;
  - ⇨ Damage to facilities.

  It is the responsibility of the company to do everything possible to provide a safe working environment for its employees and minimize the possibility of causing damage or injuries to third parties. It is also the responsibility of every employee of the company to perform his / her assigned duties so as not to expose himself, other persons, or the property of the company or others to potential danger.

  Despite this, it is recognized that the possibility of unplanned incidents exists and the company has developed a series of action plans to handle and control contingencies within its sphere of operations.

  The ERP outlines a course of actions for the mobilization of personnel and equipment that may be required to handle a serious emergency. The system may result in some cases in over reaction, but this must be accepted.

  Energean's ERP is regularly discussed with the Oil and Gas Division in the Ministry of Environment & Energy (YPEN). This is critical as during major emergencies collaboration with regional and national authorities could be required. The Ministry is responsible for ensuring Regional authorities are familiar with the Plan and are supplied with equipment and competent staff to support Energean's own staff.

- Implementation, and regular updates, of an H_2S emergency response plan. H_2S is a major hazard during drilling and production and a special H_2S plan is designed and implemented to avoid abnormal H_2S conditions. The plan covers all necessary general procedures and working guidelines and communications that will lead to a safe response. Furthermore, it describes alarm conditions and appropriate actions for essential and non-essential personnel. Specific H_2S procedures are applied during drilling operations, while tripping and during well control operations. These procedures define safe drilling activities and the evacuation provisions by the stand-by vessel.
- Implementation, and regular updates, of Well Management and Well Control plans. Energean uses established Good Oil Field Practice as the basis of its drilling and well management systems. The drilling of new wells is one of the most hazardous activities undertaken in the oil industry and as such a significant number of controls are required. These include:
  - ⇨ Mandatory use of API standards during drilling especially while isolating potential flow zones;

- ⇨ Selection of the casing and the cement design appropriate to expected wellbore conditions;
- ⇨ Provision of a specific number of barriers between the reservoir and surface and the regular testing of these;
- ⇨ Provision of a blowout prevention system (BOP) and the regular testing of its functionality. Provision of redundancy in the BOP system such as two sets of independent blind sheer rams;
- ⇨ Making sure all rig personnel are trained, familiar with all well equipment employed as well as practices to be followed. Demonstration of this via a formal Competence Assessment and Assurance system;
- ⇨ By implementing an effective communication system on the drilling rig unit and between drilling rig and coastal based staff;
- ⇨ By employing quality contractors and requiring these contractors to have the same level of attention to HSE management as the Company.

Whilst preparing the ESIA these existing control systems have been assessed to determine whether they are sufficient to manage the increased complexity as well as any new hazards introduced by the planned and potential extensions. Due to the relative simplicity of the new facilities compared with the existing facilities and the fact that no new hazards are introduced, it has been determined that the existing mitigation and management measures are sufficient to manage risks during the operational phase of the project at a level considered to be ALARP. This has been formerly demonstrated for health and safety risks (via QRA studies) and for environmental and social impacts (through the ESIA). The complexity of the new facilities was deliberately minimised by careful design selection as discussed in Chapter 7 and summarised below. The existing operational systems, plans and procedures will be updated to reflect the new offshore facilities.

12.3 MITIGATION MEASURES EBMEDDED IN PROJECT DESIGN OF THE PLANNED FACILITIES

Energean has consciously built into the design of the planned facilities specific features that minimise complexity and help mitigate risks across the full life cycle of the project. These are further detailed below for construction, operation and abandonment phases. It is noted that since the exact method of abandonment for the existing facilities is not yet decided, further mitigation measures may be added in the future to the outlined methodology. For the planned facilities abandonment impacts was a key consideration when selecting the chosen design.

- The following measures have been embedded in the design to minimize environmental and social impacts during the construction phase
  - ⇨ A novel sub-structure design has been adopted. This allows the total platform to be assembled onshore in a location designed for such industrial activities. As a result

the installation time offshore is reduced from 6 - 8 weeks to a matter of days.

- ⇨ The size of the installation fleet is similarly reduced. The need for permanent offshore manning is avoided. Environmental and social risk during construction is partly driven by the extent of the marine fleet required.
- ⇨ Another benefit of the selected design is the significant reduction in offshore noise. Energean has selected to use suction piles rather than conventionally driven piles to hold the new structure in place. This avoids weeks of pile driving activities and the associated underwater noise.

- The following measures have been embedded in the design to minimize impacts during the operational phase.
  - ⇨ The topside facilities and sub-marine pipelines have all been designed to withstand the maximum closed in pressure of the wells. This means that when operating at normal conditions the corrosion allowance available is significantly increased. This reduces the calculated frequency of losses of integrity and hence introduction of hydrocarbons into the environment.
  - ⇨ In addition this conservative approach has also removed the need for a permanently lit flare on the new platforms. Flares clearly introduce significant environmental impacts. They are a source of continuous emissions and light pollution. They also represent a significant leak path to introduce liquid hydrocarbons into the environment if process systems fail. The planned and potential new facilities do not need a flare due to the conservative approach taken to rating of process pipework and the avoidance of vessels.
  - ⇨ Energean has also elected to link the new facilities to the Delta complex by submarine power cables rather than equip them with diesel-powered generators. The selected approach increases initial capex but reduces emissions by allowing efficiently generated power from the national network to be employed rather than lower efficiency locally generated electricity. This approach also reduces noise and local emissions and avoids the need to transfer diesel onto the satellites.
  - ⇨ The new facilities have been designed to be unmanned, with control achieved from Delta. Visits will be limited to 2 per week, rather than 3 per day as at the existing facilities. This reduces marine traffic and hence associated environmental impacts as well as occupational health and safety (OHS) risks.

The analysis performed in the ESIA has demonstrated that the routine risks associated with the new facilities can be managed at a level that is as low as reasonably practical (ALARP). The most significant risk associated with the new facilities is that associated with potential accidental releases.

- The following measures are embedded in the design with the objective of minimising the likelihood of unplanned (failure) events. The only credible source of a significant spill associated with the new facilities is from a blowout when the new wells are being constructed. The frequency or consequence of other typical leak types has been mitigated, for example:

- ⇨ Carry over from the flare knock-out drum: no flare is required by design
- ⇨ Rupture of topside equipment/vessels or mal operation: no vessels are included in the main process system; topside hydrocarbon inventory is limited to 6 m^3 by design. All surface equipment is rated to 235 bar – 215 bar higher than normal operational pressures
- ⇨ Rupture of the multiphase export lines from Lamda and Omicron to Delta: line is rated to 235 bar and buried to avoid external impacts; system has been designed to allow internal inspection; liquid volume in export line limited to approximately 50 m^3 by use of small diameter and by multiphasing with produced gas

- The following measures have been embedded in the design to minimize environmental impacts during the abandonment phase:
  - ⇨ The new satellite facilities have been designed so that they can be re-floated and used elsewhere. This requires only a modest fleet of vessels to implement and hence generates a much lower impact due to noise and seabed disturbance.
  - ⇨ All pipelines are piggable to ensure effective removal of contaminants prior to abandonment.

12.4 ADDITIONAL MITIGATION MEASURES PROPOSED

Apart from the existing mitigation measures and controls in place as well as the mitigations embedded in the project’s design, the impact assessment has identified the need to have a number of additional mitigation measures that are further detailed in the paragraphs below.

In the previous chapters 09 and 11, the project activities that could potentially lead to an adverse impact, were investigated in terms of their interaction to a number of environmental and social parameters. In Chapter 09, the ones that show little or non-significant interaction were scoped out from further assessment, whereas the remaining were further assessed in Chapter 11.

Further below, the mitigation measures are provided for the assessed impacts that were found to be minor, moderate or high as applicable. Impacts assessed as negligible were not included for additional mitigation measures.

12.4.1 Climate and bioclimate characteristics

As presented in Chapters 9.2.1.1 and 11.2.1 the Project impacts on the climate and bioclimate characteristics in the project area have been scoped out of the ESIA, since they have been assessed to be insignificant and no additional mitigation is required.

12.4.2 Morphological and topological characteristics

In Chapter 9.2.1.2 some project effects on the morphological and topological characteristics of

the project area have been scoped out of the ESIA, since they have been assessed to be insignificant and no additional mitigation is required.

Some project impacts, however, were assessed in Chapter 11.2.2 to be either negligible or minor. In particular during construction phase, the activity of burial of the pipelines and umbillicals was found to have a minor impact to the seabed. During the operation phase, the activity of the seabed cuttings (0-400m) is expected to have a minor impact to the benthic communities. Finally in the abandonment phase, the activities of the dispersal of seabed cutting from piles (from existing platforms) and the removal of SIPs (new platforms), is expected to also have a minor impact.

A key mitigation measure to further reduce these already minor impacts is to minimise the project footprint on the seabed as much as possible through design. This can be applied specifically to the pipelines.

Mitigation measure: The technical feasibility of bundling the three pipelines (so that they are installed together) will be investigated by Energean since through this method, the area of the seabed impacted will be smaller.

12.4.3 Geological and tectonic characteristics

During construction phase, the installation of permanent mooring was found to have a minor impact on seabed conditions. This footprint has been minimised as much as possible through design.

During drilling of the initial sections of each weel, the Project will deposit uncontaminated drill cuttings on the seabed. This will be minimised through the use of conductors to limit the volume of cuttings and impact area.

Mitigation measure: During drilling and with respect to seabed cuttings, conductor of 30” will be used instead of 36” in order to minimize volume of cuttings.

12.4.4 Water environment

A number of project impacts on the water column were assessed in Chapter 11.2.4 to be either negligible or minor. In particular during construction phase, the activity of burial of the pipelines and umbillicals, was found to have a minor impact on the water column through a temporary increase in turbidity.

In the abandonment phase, the activities of the dispersal of seabed cutting from piles (from existing platforms) and the removal of SIPs (new platforms), is expected to also have a minor impact on the water column through a temporary increase in turbidity

Mitigation measures: All burial techniques will impact the seabed to some degree and cause sediment to be disturbed and enter the water column. Jetting has been selected as it is less disruptive than trenching and back filling. In case that the pipelines are bundled

together, this will further reduce the impact as only one pass with the jetter is required. Hence less area is disrupted and less sand enters the water column. The only way to totally remove the impact is to leave them unburried but this would present a risk of external damage.

During abandonment and the resulting dispersion of cuttings from jacket before piles are cut and jacket removed, the feasibility of trial lifting the cuttings to surface will be investigated. This will minimize the cuttings that are disposed on the seabed and that may cause increases in turbidity in the water column.

Accidental spills will be avoided through the use of good practice codes, collision avoidance and fuel handling and transfer procedures. Management controls will be in place to avoid and minimise accidental events. In addition all staff and contractors will be required to undertake training and maintain good housekeeping standards.

12.4.5 Air environment

As presented in Chapters 9.2.1.5 and 11.2.5 all project impacts on air quality in the project area have been scoped out, since they have been assessed as insignificant following the Project design.

12.4.6 Acoustic environment

As presented in Chapters 9.2.1.6 and 11.2.6 most noise related impacts have been scoped out of the ESIA as they have been assessed as insignificant. However, specific measures are required to minimise noise related impacts to marine receptors such as fish and marine mammals. These are presented under 12.4.7.

12.4.7 Biotic environment

12.4.7.1 Plankton

As presented in Chapters 9.2.1.7.1 and 11.2.7.1 impacts on plankton have been assessed as insignificant and no further mitigation is required other than what forms part of the existing design.

12.4.7.2 Benthic communities and habitats

During the construction phase, the following activities were found to have a minor impact to the benthic communities:

- Installation of permanent mooring;
- Installation of pipelines and umbilicals; and
- Burial of pipelines and umbilicals.

During operation phase, the activity of seabed cuttings (0-400m) has a minor impact to the benthic communities.

Finally in the abandonment phase, the activities of the dispersal of seabed cutting from piles (from existing platforms) and the removal of SIPs (new platforms), is expected to also have a minor impact to the benthic communities and habitats.

Mitigation measures: Measures outlined in Sections 12.3.2 and 12.3.4 will be adopted to reduce and/or eliminate the impacts on water quality and the footprint of the development on the seabed will also mitigate the potential impacts on the benthic community. These are not repeated here but are listed in the previous sections.

12.4.7.3 Coastal marine habitats

As presented in Chapter 9.2.1.7.3 impacts on coastal marine habitats have been assessed to be low and insignificant even in the event of an unplanned spil due to the design measures in place and the Company's existing oil spill response and emergency response measures.

12.4.7.4 Fish ecology

During the operational and abandonment phases, the impacts significance on the fish ecology is assessed as minor. However, because the reversibility is high, the final impact significance is negligible. It is noted that reversibility refers to the ability of an ecosystem or receptor a) to reverse into a pre-impact state by using its own resilience mechanisms, or b) maintain its biological integrity even if an impact has occurred. Based on the above, no specific mitigation measures for fish ecology are presented other that built into the project design such as no piling activities.

12.4.7.5 Marine mammals

During the construction phase, the following activities were found to have a minor and moderate potential impact to the marine mammals:

- Operation of support vessels (moderate);
- Modifications to Delta (new risers / J-tubes) (minor)

Collisions of marine mammals with vessels usually occur at speeds exceeding 20 knots. Therefore a speed limitation of 20 knots will be defined in all boat movements under the responsibility of Energean and, thus, the possibility of a collision with a marine mammal is rather

minimal.

Construction project activities with the potential to generate significant noise are quite limited and short in duration (for instance installation of mooring bays). In terms of the additional marine traffic this is against baseline conditions with the study area around subject to a moderate level of marine traffic. Marine currently using the study area will have habituated against the background and it is probable that the marginal increase in traffic will have no impact.

During operation phase the following activities were found to have a positive and minor impact:

- Maintenance of exclusion zones (positive);
- Installation of conductors (new wells) (minor);
- Spudding and drilling of wells, including cementing initial casings (minor);
- Operation of support vessels (moderate).

During abandonment phase, sever conductors activity is likely to have a moderate impact to marine mammals, cutting piles from existing platforms, a major impact whereas removing existing platforms jackets and removal SIPs (new platforms) is expected to have minor impacts to marine mammals. Finally operation of support vessels is also expected to have a moderate impact.

Mitigation measures: Energean will examine the possibility to install conductors with vibropile equipment rather than hammers (to be determined through a soil sample analysis). Vibropile equipment produces low noise levels.

Use cold cutting equipment during abandonment rather than explosives for removal of platforms as this method produces low noise levels.

Collisions of marine mammals with vessels usually occur at speeds exceeding 20 knots. Therefore a speed limitation of 20 knots will be defined in all boat movements under the responsibility of Energean and, thus, the possibility of a collision with a marine mammal is rather minimal.

Support vessel will have at least one experienced marine mammal observer (MMO) onboard and will have two if 24 hour operations are expected. Construction will not commence during periods of darkness or poor visibility (such as fog) unless MMOs are equipped with night vision binoculars. A pre-construction search will be conducted by the MMO. Construction (including conductor driving) will not commence if marine mammals detected within 500m of the activity or until 20 minutes after the last visual detection.

12.4.7.6 Avifauna

As presented in Chapters 9.2.1.7.6, project impacts on avifauna have been assessed as insignificant. Impacts may occur during a spill but existing design and oil spill response equipment reduces the likelihood of such event occurring and the impact area. Flaring is limited and the proposed structures would complement the existing offshore facilities.

12.4.8 Manmade environment

As presented in Chapters 9.2.1.8 and 11.2.8 significant impacts on the manmade environment were not identified. No additional mitigation other than existing controls is required.

12.4.9 Socio-economic environment

Implementation of the newly developed Stakeholder Engagement Plan is a key mitigation measure aimed at managing the relationships with potentially impacted and interested stakeholders. This will help manage actual and/or perceived environmental *and* social impacts, especially if any unplanned events occur.

The Company will ensure that good and services are procured locally where possible

12.4.10 Technical infrastructures

During the operation phase, treatment and disposal of drilling cuttings (from 400 – 3,150 m) is expected to add additional burden to the region's waste management infrastructure, which has been assessed in Chapter 11.2.10.2 as minor impact.

As mentioned in the above chapter, Energean will audit the waste facility to make sure it has the required capacity before it sends the waste for further management / treatment.

During the abandonment phase a number of waste streams in various quantities are expected, which again will need to be managed by licenced contractors / facilities, adding an additional burden to their operations. Since there are a number of alternative facilities to receive, the impact is minor and there is no need to specific mitigation measures.

13 ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN (ESMMP)

13.1 INTRODUCTION

The purpose of the Environmental and Social Management & Monitoring Plan (ESMMP) is to:

- Present an overview of the E&S Management System that is being implemented and will accordingly adjusted to continue in the upcoming project phases, to ensure systematic and effective execution of the environmental and social (E&S) commitments relevant to the construction phase of the Project, future operations, potential future developments as well as to the final decommissioning / abandonment phases, presented in Chapter 12;
- Provide a summary of the relative role and responsibilities of Energean, the EPC and other contractors throughout the phases.

It therefore provides assurance that E&S mitigation and management measures are fully accounted for, and will be implemented in line with the commitments made to date.

With this purpose, the remaining sections:

- Identify and communicate relevant legal requirements and good practice that have been adopted as Project Standards for the Project, to govern E&S management;
- Demonstrate how those Project Standards have been taken into account to date, while updating the currently in place HSE Management System (MS);
- Provide an overview of the current status of the HSE MS that Energean operates, with signposting to the existing E&S documentation where relevant; and
- Describe how the HSE MS will continue to develop, to ensure effective and sustainable management of E&S aspects, as the Company progresses towards Project operation.

This document is a “live” document – Energean’s E&S Programme will continue to develop and evolve further in response to the different stages of project development and the outcomes of ongoing stakeholder engagement. This document will be reviewed regularly to ensure the approach to E&S management remains fit-for-purpose and continues to align with relevant good practice.

The ESMMP is supported by the following topic specific Management and Monitoring Plans (MMP). As for the ESMMP these plans are ‘live’ documents and will be updated prior to construction:

The following topic specific Management and Monitoring Plans (MMP) are part of the ESMMP are:

- Chemical use plan
- Waste management plan
- Stakeholder engagement plan (SEP)
- Chance finds procedure for cultural heritage
- Contingency Plan
- Health, safety and environment (HSE) management plan
- Traffic management plan
- General construction management plan (for your onshore works in pipeline assembly)
- Biodiversity and Wildlife management plan
- Pollution Prevention Management Plan

The Management Plans are provided as Annexes.

13.2 SCOPE

The scope of this document comprises the activities to be undertaken as part of the construction phase but also for current and future operations, and demonstrates how design-based risk assessment and ESIA activities are to be considered and implemented during the construction phase.

The organisational structure of Energean and the main contractor parties is likely to evolve and change over the course of the construction period. While developing this document, Energean has therefore endeavoured to develop an approach that responds to the need for some flexibility regarding future roles, and responsibilities for implementation of various compliance tasks during the construction and operational phase of the Project.

The requirements and commitments set out in this document are directly applicable to all Project personnel, including employees (full-time, part-time, temporary and seconded staff etc.). The EPC, and other contractors and suppliers are required to implement management systems complying with the minimum standards set out by the Energean HSE Management System, as communicated in this document.

Energean's HSE Management System is being updated to address all aspects of "sustainability", as addressed in the EBRD Performance Requirements. As such, it encompasses consideration of environment, social, occupational health and safety and labour and working conditions. For the sake of simplicity, the acronym E&S is used throughout this document, but this acronym should be interpreted as including community relations, community health safety and security, labour and working conditions and other ERBD sustainability aspects.

13.3 MANAGEMENT OF CHANGE

Effective Management of Change underpins every element of the Project Management System and therefore is addressed in multiple sections of the ESMP. The ESMMP is a living document and will be updated for the following reasons:

- Before the tender for the Contractor;
- Periodically update, regarding the results of monitoring programs during operation (every 3 years);
- Update due to environmental and social emerging issues;
- Incorporation of new legislative and regulative provisions;
- Update due to chance.

13.4 PROJECT STANDARDS

The Project Standards governing the development of the Project E&S Management System are summarised in the following sections.

The following Project Standards have been adopted and the ESMMP has been developed according to the:

- Energean's HSE Policy;
- National Legislation (L.4014/2011 and all relevant regulation governing the national permitting and broaded environmental protection framework);
- European Legislation (EIA and Offshore directives as well as all relevant environmental and safety framework Directives);
- International Conventions:
  - ⇨ International Convection for the Prevention of Pollution from Ships (MARPOL)
  - ⇨ International convention on Oil Pollution Preparedness, Response and Cooperation (OPRC)
  - ⇨ Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic Sea (ACCOBAMS)
  - ⇨ United Nations Convention on the Law of the Sea (UNCLOS)
  - ⇨ International convention on the establishment of an international fund for compensation for oil pollution damage (FUND)
  - ⇨ Stockholm Convention on Persistent Organic Pollutants (POPs)
  - ⇨ Aarhus Convention
- Good Oilfield Practices and Good International Industry Practice (GIIP):
  - ⇨ Energean is committed to follow 'Good Oilfield Practices' and 'Good International Industry Practice' throughout day to day activities, whether they be the drilling of new wells, the installation of new facilities or the management of existing facilities
- EBRD Standards:

- PR1 – Assessment and management of environmental and social impacts and issues: This project is categorised as A under PR1 and is thus subject to a comprehensive ESIA.
- PR2 – Labor and Working Conditions: The implementation of the actions necessary to meet the requirements of this PR will be managed under the Company's Environmental and Social Management System and Human Resources System.
- PR3 - Resource efficiency and pollution prevention and control: The implementation of the actions necessary to meet the requirements of this PR will be managed under the Company's ESMS and is incorporated in the project design.
- PR4 – Health and Safety: While the PR is acknowledging the role of relevant authorities in protecting and promoting the health and safety of the public, the Company has the duty to identify, avoid, minimize or mitigate the risks and adverse impacts health and safety of the affected communities that may arise from the project.
- PR5 – Land acquisition, involuntary resettlement and economic displacement: Certain requirements have to be addressed during the environmental and social assessment process and generally during the project's lifetime.
- PR6 - Biodiversity conservation and sustainable management of living natural resources: The implementation of the actions necessary to meet the requirements of this PR will be managed under the Company's Environmental and Social Management System (ESMS).
- PR7 - Indigenous peoples: There are no indigenous peoples in Greece as per the definition presented in PR7 and therefore this PR does not apply to the Project.
- PR8 - Cultural heritage: Certain requirements have to be addressed during the environmental and social assessment process and generally during the project's life.
- PR9 – Financial intermediaries: This PR does not apply to this Project.
- PR10 - Information disclosure and stakeholder engagement: This PR identifies the stakeholder engagement and information disclosure as an ongoing process and should be read in conjunction with PR1.

13.5 OBJECTIVES AND TARGET SETTING

The main objective is to provision of a framework for the implementation of the measures identified in the impact assessment analyzed in the ESIA, in order to avoid, mitigate or offset adverse environmental and social impacts and to minimise and manage risks on the environment, project personnel and local communities.

Each topic specific Management and Monitoring Plans (MMP) set its own objectives and targets. More specifically these:

- Outlining how Energean will monitor and review Contractor's performance

- Defining Contractor's roles and responsibilities
- Ensuring environmental protection of the highest achievable level
- Ensuring a high standard in work conditions
- Assisting the Contractor:
    - ⇨ in identifying the possible hazards that relate to the work process and to assume appropriate measures for the reduction of risks
    - ⇨ in preventing possible environmental damages or damages to third parties properties
    - ⇨ in anticipating and preventing possible damage of property belonging to third parties, caused by construction procedures and / or operations.
    - ⇨ in ensuring environmental protection of the highest achievable level
    - ⇨ in implementing the mitigation measures
    - ⇨ in ensuring that all works complies with the Energean HSE Policy, national legislations, best international practice and all relevant EBRD PRs, in order to avoid all potential damages

The topic specific Management Plans are provided as Annexes.

13.6 ENERGEAN's HEALTH, SAFETY AND ENVIRONMENTAL MANAGEMENT SYSTEM (HSE MS) OVERVIEW

13.6.1 Overview

Energean is responsible for the environmental and social management of the construction and operation activities, to ensure that project commitments are implemented, and conforms to applicable environmental and social legal, regulatory and corporate requirements.

Energean's current Health, Safety and Environmental (HSE) Management System defines the principles to be followed by all employees and contractors associated with O&G fields exploitation business in Prinos and South Kavala fields and relating facilities and future developments. This system will be adapted to cover the proposed new planned infrastructure / operations.

Energean's system is based on internationally recognized best practices in managing HSE risks in exploration & production (E&P) industry, structured around a classical PLAN – DO – ASSESS – ADJUST cycle.

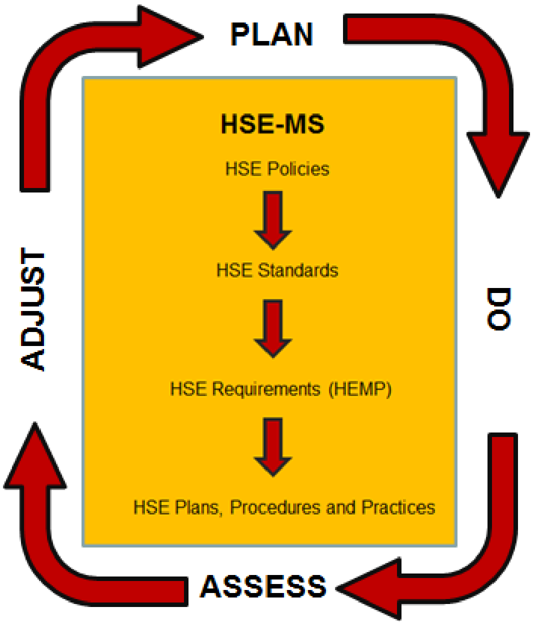


Figure 13-1: HSE system

By managing risks in this manner:

- All Hazards associated with the company's operations are well understood;
- Necessary activities are performed to manage these hazards and bring risks to a level as low as reasonably practical;
- The effectiveness of the performance is assessed through measurement, monitoring, reviews, audits and investigations;
- Plans and procedures are adjusted based upon these assessments

All staff is included and is participating at all levels in this continuous cycle.

13.6.2 Risk assessment – hazard / aspect identification and risk management

The ESIA and various other E&S studies have identified key E&S aspects, risks and potential impacts requiring mitigation and control. Identification and assessment of impacts has been undertaken through a process comprising consultation, modelling, on-site observations, literature review and expert opinion based on experience of other similar projects. These modelling and assessment results have been reviewed and verified. Energean is committed to the Mitigation Hierarchy (for Health and Safety), and the Mitigation Hierarchy (for Environmental and Social Risks) presented respectively in the following figures. This hierarchy will be adhered to when devising appropriate mitigation and management strategies and measures.

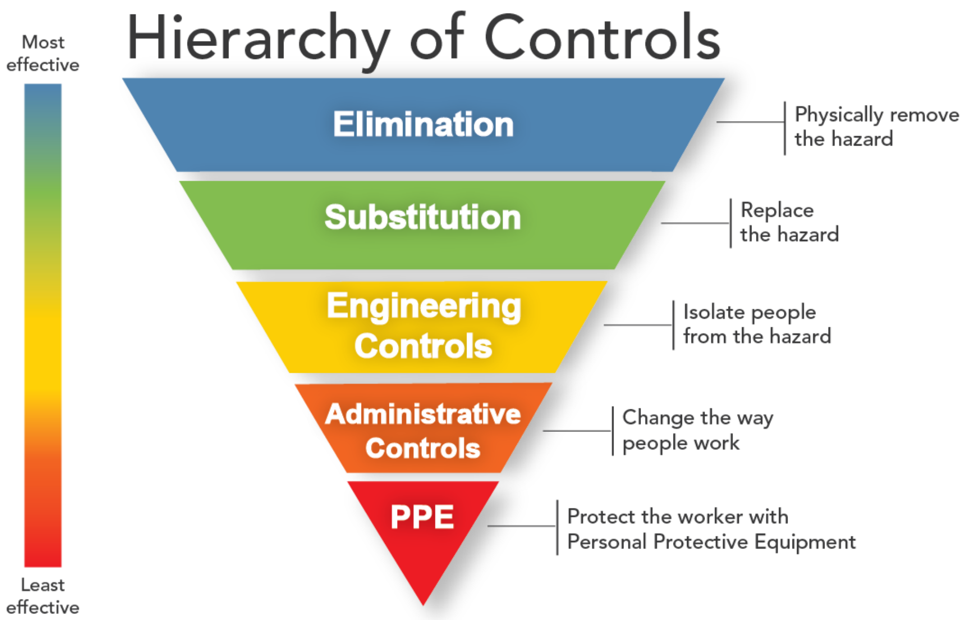


Figure 13-2: Mitigation hierarchy of controls for Occupational Health and Safety (OHS) risks

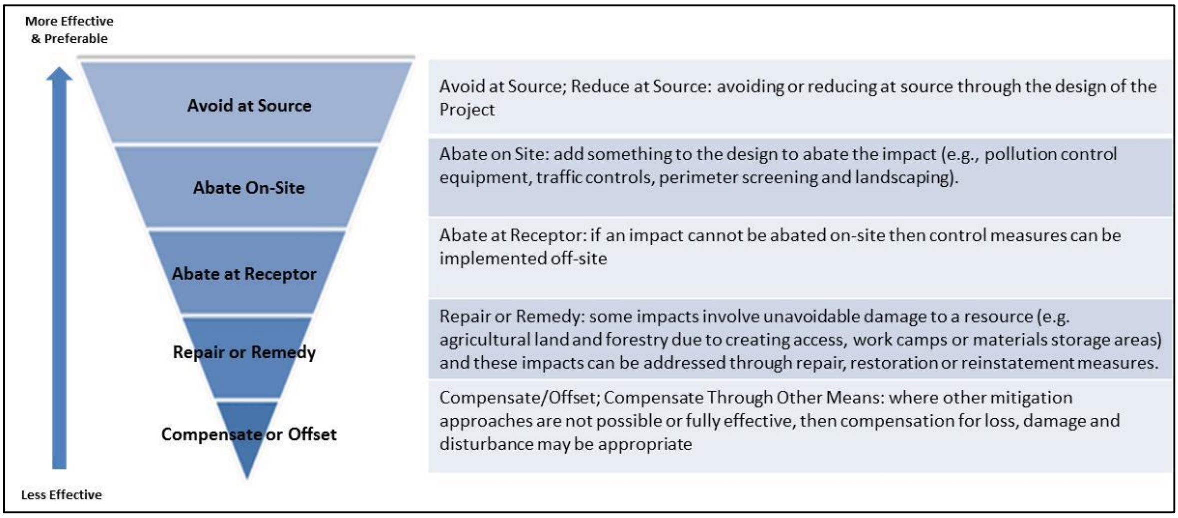


Figure 13-3: Mitigation hierarchy of control for environmental and social risks

To ensure ongoing risk management on the Project, during the construction phase, the EPC will develop and maintain a risk register for the Project. This risk register will develop to reflect the findings of the ESIA study and other E&S studies relating to the construction phase. As part of compiling the risk register for the Project, the EPC team will ensure EHS and social risks are proactively and systematically identified, assessed, evaluated and controlled.

The methodologies used to, identify, assess and analyse risks shall be defined with respect to their scope, nature and timing to ensure methods are proactive rather than reactive; and provide for the identification, prioritization and documentation of risks, and the application of controls. The methodologies that are used will align with international good practice. The EPC will adhere

to the Hierarchy of Control and ALARP when devising risk control measures.

The EPC will ensure personnel working for or on behalf of the Project are aware of the key EHS and Social risks identified as part of that risk assessment process and the measures that they are required to implement. The risk register, risk management procedures, and risk assessments will be available to Energean for review at all reasonable times. Risk information shall be shared between the various project parties as shown in Figure below. As shown in the figure, a minimum of once every two months, the Energean will review the top risks relevant to the Project and associated mitigation and management measures. Pertinent information will be included in the quarterly reports to the lenders, where relevant.

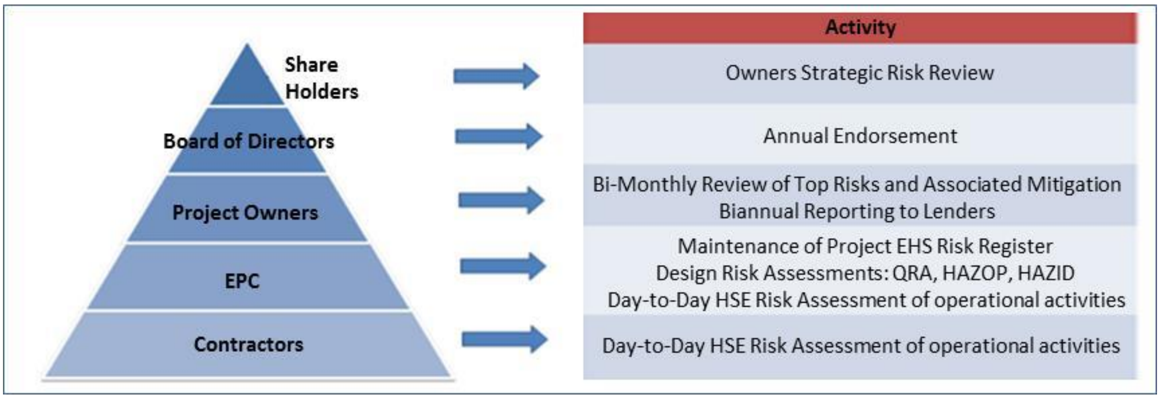


Figure 13-4: Hierarchy of responsibility for risk management

13.6.3 Legal and other requirements

The compliance framework for the Project (i.e. the Project Standards) is summarized above in Chapter 13.4 of the present ESIA, whereas further detailed information is provided in Chapter 05 of the present ESIA, which included an in-depth analysis of relevant legislation, national policy and development plans; and lender requirements and related guidance.

Compliance with all relevant legislation is a core company commitment of Energean and has been communicated externally as part of the Environmental and Social Policy.

Energean requires the EPC to establish processes to proactively identify legislation and other standards relevant to E&S management of their activities, and put measures in place to ensure Project personnel are aware of all relevant legal requirements and adhere to them. A register of Legal and Other Requirements shall be compiled by the EPC in consideration of the Project Standards, shall be kept up to date and shall be communicated to Project personnel where relevant.

13.7 THE ESMMP AS PART OF ENERGEAN’s

MANAGEMENT SYSTEM

To support the ESMMP, framework environmental and social management plans have been developed by Energean to manage and mitigate the E&S issues associated with the Prinos Development Project. The table below lists this management. The Prinos Development Project environmental and social management plans will be developed into full plans prior to mobilization of the main construction and installation contractors, and regularly reviewed as construction work proceeds.

Table 13-1: Environmental and Social Management Plans

Title of Plan	Issues Covered
Chemical use plan	• Regulatory framework; • Chemicals registry; • Usage and quantities
Waste management plan	• Waste management principles & legislation; • Management procedures for non-hazardous waste; • Management procedures for hazardous waste; • Management procedures for liquid waste; • Wastewater receptors; • Monitoring, reporting and auditing
Stakeholder engagement plan (SEP) and Grievance mechanism	• Community liaison training; • Grievance mechanism; • Nuisances management and monitoring (i.e. construction noise, artificial light from work areas, odors, pests and vermin); • Community interaction (i.e. prior notification of noisy activities, road congestion associated with the transport of oversize and heavy loads); • Monitoring and reporting
Chance of find procedure for cultural heritage	• Cultural heritage training; • Archaeological chance finds procedure; • Monitoring and reporting
Contingency plan	• Spill prevention; • Spill response training; • Spill response management

Title of Plan	Issues Covered
	• Monitoring and reporting
Pollution Prevention Plan	• Pollution prevention training • Energy efficiency (vehicle, vessel and equipment selection, maintenance) • Emissions and dust management (i.e. vehicle, equipment and generator emissions, dust management) • Wastewater management • Sewage treatment and disposal • Chemical selection and management, and hazardous materials management • Noise and vibration management and maximum permissible levels • Treatment of contaminated soil • Monitoring and reporting
Health, safety/social and environment (HSE) plan	• Responsibilities; • Regulations, standards, rules & procedures in force • Access to drilling locations; • Training; • Emergency drills; • Safety audits; • Monitoring & reporting; • Environmental policy; • Personnel protective equipment • Personal health; • Medical evaluation
Traffic management plan	• Driver and captain management training • Onsite vehicle and vessels movements • Offsite vehicle movements and the prohibition on off-road driving • Risk assessment for the transport of oversized and heavy loads • Monitoring and reporting
Construction management plan	• Project management – engineering and procedures; • Roles & responsibilities;

Title of Plan	Issues Covered
	• Project standards; • Implementation schedule; • Mitigation & management controls; • Monitoring; • Training; • Auditing & reporting
Biodiversity wildlife management plan	• Ecology and wildlife training • Protocols for offshore works including mitigation related to marine mammals • Pre-construction ecological surveys and wildlife inspections • Habitat and species protection during construction (i.e. traffic restrictions, code of conduct) • Monitoring and reporting

Energean will manage the construction phase of the Project, monitoring and auditing the technical, environmental and social performance of its contractors throughout the construction phase through application of the topic management plans and the existing HSE Management System. The contractors will be responsible for the management of their staff (to the extent that reflects staffing at the site) and ensuring compliance with Energean's HSE management system, management plans and requirements at all times.

Energean will operate the Project, and existing facilities, using the established an Operations Phase HSE MS and again based on the "plan-do-assess-adjust" cycle. Commitments from the ESIA and the ESIA management plans will be integrated into the HSE management system. In addition, the MS will be adapted to include the Project.

13.8 OTHER HSE MS RELATED

The 'Energean Force' Rig already used to drill existing wells is managed by a rig management team who has its own independent HSE MS already in place. Alignment of the plans, procedures and reporting requirements of the rig and Energean HSE MS has been achieved through the development of an HSE MS Bridging Document. The document defines clearly how all activities will be managed to ensure compliance with Energean overachiing requirements.

The HSE MS Bridging Document is a live document and will be reviewed at least annually. Both the Energean HSE MS and the rig management HSE MS monitor the same targets and objectives, which are separately audited as part of their internal review process. Communications lines are in place to ensure the effective sharing of the findings and action lists.

Drilling monitoring and reporting on the Energean Force will be undertaken in accordance with Energean policy and procedures and is set out within the rig Environmental Operating Procedure which details the method and frequency of reporting for the following categories:

- Deck drainage and wash water, garbage disposal unit effluent and grey water treatment effluent, oily water, fuel usage records;
- Volume of drilling fluids and cuttings discharged and Water Based Muds (WBM) fluid properties;
- Wastes sent to shore;
- Drilling/ workover/cementing/ testing chemicals;
- Mud sampling and labelling;
- Rig chemicals reporting;
- Any environmental accidents, incidents, oil, base fluid and chemical spill reporting; and
- End of well environmental report.

Auditing and checking are the key elements of the both HSE MSs. Individuals from each company are tasked with the responsibility of sharing the audit findings. Where necessary, additional audits and reviews may be undertaken to address identified areas of concern. Joint audits are undertaken to ensure that procedures are being followed appropriately. Both have systems in place to control communication, tracking and follow up of audit and review recommendations.

13.9 ROLES AND RESPONSIBILITIES

13.9.1 Construction phase

Energean is responsible for the detailed design, procurement, construction and operation of the Prinos Development Project. Energean has appointed design contractors to undertake the detailed design of the project and a drilling contractor to manage the 'Energean Force' Drilling Rig that will drill the wells. In due course, Energean will issue technical invitation to bid documents for the various elements of the construction work scope.

As Project Owner, Energean will have the ultimate responsibility for implementing the ESMMP, which will include:

- On-going management of environmental and social issues as detailed design proceeds
- Monitoring and auditing of the Contractor's' HSE (including labour and working conditions) performance
- Assisting the Contractor in implementing the ESMMP and topic special management plans
- Acting as a point of contact for consultation with Authorities and stakeholders

- Environmental and social compliance monitoring and reporting.
- Activities that ensure that Contractors will be deployed in accordance with Project standards and regulations.
- Recording of compliance and non-compliance with the provisions of the ESMMP.

The main construction and installation contractors for the jacket, topside and subsea facilities construction will be expected to conform fully to the relevant aspects of the Energean's existing HSE MS which will be updated accordingly and for which they are responsible.

The main construction and installation contractors will be required to develop and implement their own Construction Phase management plans for the Prinos Development Project, which will meet or exceed the requirement of Energean's HSE MS.

Energean's existing and updated HSE MS will form the framework for managing social and environmental issues throughout construction, prior to the operation of the new facilities.

The aforementioned HSE MS will be used to deliver the Project ESIA commitments and coordinate and review the environmental and social performance of the Project at the construction stage. Special consideration will be given to the following:

- Practical training and raising the environmental and social awareness of personnel;
- Supervision and monitoring of environmental and social issues in the field; and
- Continuous improvement of environmental and social performance throughout the Project.

The Contractor will be responsible for:

- Comply with all national laws, rules and regulations concerning environmental protection and with all permitting terms;
- Demonstrating how requirements will be implemented during the construction;
- Demonstrating commitment to Energean's ESMMP, topic specific management plans and HSE MS at all levels, including subcontractors;
- Produce a Contractor's ESMP in accordance to Energean's ESMP and HSE MS;
- Follow up of legislative and regulative frame development and comply with them;
- Update his ESMP, if required.

As part of Energean responsibilities, the company's Environmental Officer will be required to conduct weekly inspections of all work places.

Any other construction areas for which the contractor is responsible at each of the aforementioned sites, the Contractor Environmental Officer will be required on a daily basis to check as per the following table where relevant.

Table 13-2: Daily worksites checks

By observation
Litter

By observation
Separation of solid waste as per system (general, hazardous, recycling, scrap)
Hydrocarbon spill
Effectiveness of control measures
Washouts of stormwater / WW drains
Water use
Water pollution incidents
Any activities contravene the ESMMP

The contractor Environmental Officer will be required to conduct monthly inspections of the entire construction site, which may involve subcontractors and may include, but not be limited to the following:

- The entirety of Construction;
- Environmentally sensitive areas that could potentially be affected;
- Liquid and solid waste storage facilities (general, hazardous, recycling, scrap etc);
- Dumping areas;

At each of those the EO will be checking as per the following table.

Table 13-3: Construction site checks

By observation	By document check	By measurements	By monitoring
Litter	All receipts for the collection of general waste and hazardous waste	Amount of water used by contractor(s) and sub- contractor(s)	Effectiveness of control systems
Separation of solid waste as per system (general, hazardous, recycling, scrap)	Correct placement of environmental signage and posters		Effectiveness of pollution control systems
Use of banding, hard standing and other protection measures	Document board listing emergency numbers, hazmat info sheets, etc		
Management means		Amount of waste recycled, sent to scrap yard or disposed to municipal waste	

By observation	By document check	By measurements	By monitoring
		disposal sites	

13.9.2 Operation phase

Energean will operate the Project facilities using the established HSE MS that will be adjusted as described earlier to cover the construction phase. This will be further adjusted prior to commencement of Project's operations and transition plans will be developed to assist with the movement from the construction to existing HSE MS that will be updated accordingly to fit into the operations the new planned and future development facilities.

The updated HSE-MS will be used to operate the Project facilities in accordance with the ESIA commitments and applicable legal and regulatory standards and Energean's policy.

The adjusted HSE-MS will:

- Promote legislative compliance;
- Regularly assess the environmental and social aspects and impacts of its activities;
- Promote the principles of best environmental practice in all general and emergency working procedures;
- Develop objectives and targets to address any significant aspects;
- Define roles and responsibilities (developer, supervising engineer, contractors, operators, other associated parties), and in particular, the environmental and social obligations of the project owner during the construction / installation stage;
- Define legislative requirements, guidelines and best industry practices that apply to the project;
- Ensure that works are carried out in accordance with the legal environmental framework applicable (approval procedures, national and international standards and good practices);
- Provide clear procedures and schedules for management of the environmental impacts, including corrective actions;
- Appropriately resource and train staff; and
- Define a monitoring mechanism and identify monitoring parameters in order to:
    - ⇨ Ensure the complete implementation of all mitigation measures;
    - ⇨ Ensure the effectiveness of the mitigation measures;
    - ⇨ Define requirements for environmental monitoring and auditing;
    - ⇨ Provide a mechanism for taking timely action in the face of unanticipated environmental situations; and
    - ⇨ Identify training requirements at various levels.

This system will be implemented with the aim of ensuring continual improvement in performance. Key components of the HSE MS are the following (as applicable):

- Purpose;
- Project definition and facilities;
- Legislation and guidelines and applicable standards;
- Organizational structure (roles and responsibilities);
- Monitoring / Management plan;
- Environmental monitoring;
- Communication and documentation;
- Change management;
- Competence and training program;
- Waste disposal plan;
- Contractor and supplier management;
- Abandonment, restoration and rehabilitation;
- Traffic Management;
- Nonconformance, incident and action management; and
- Reporting

The operations commitments included within this ESIA will be implemented through the operations phase environmental of environmental management system. The following existing plans will be updated to incorporate the Project or new plans developed as required:

- Emissions management;
- Waste management; and
- Ecological management and monitoring.

In addition, the existing Emergency Response Plan (ERP) will be reviewed and amended to reflect the new Project facilities.

13.10 COMPETANCIES AND TRAINING

13.10.1 Introduction

Environmental training will help to ensure that the requirements of the ESIA and EMMP are clearly understood and followed by all project personnel throughout the project period.

Environmental training will form part of the environmental management system. The training shall be directed towards all personnel for general environmental awareness.

In the framework of the ESMMP there will training programs for the implementation of the

mitigation measure, monitoring programs etc and for enhancing personnel's competencies in respect to the ESMMP.

Training will apply both in construction and operation phase. More specifically:

- Training during construction phase:
  - ⇨ Energean's top management level
  - ⇨ Topic-specific training (as per MMP)
  - ⇨ Worksite management
  - ⇨ Monitoring and auditing
  - ⇨ Records
  - ⇨ Stakeholder engagement and Grievance Mechanism.
- Training during operation phase:
  - ⇨ The training during operation will follow the existing procedures of Energean (HSE management plan, ESMS etc).

13.10.2 Objectives of training programme

The key objective of the training programme is to ensure that the requirements of the ESMMP are clearly understood and followed throughout the project. Staff training will help in communicating environmental related controls specified in the ESIA and ESMMP.

13.10.3 Roles and responsibilities

Energean's Environmental Manager and the contractor's Environmental Officer shall primarily be responsible for providing Environmental or HSE training to all project personnel on potential environmental issues of the project. Contractor shall prepare a project specific training manual for this purpose. Contractors on their part shall be required to provide induction training/ briefing to all their staff before the start of any activity in the project area.

13.10.4 Training log

A training log shall be maintained by Energean and contractor(s), sub-contractor(s). The training log shall include;

- Topic;
- Date, time and location;
- Trainer; and
- Participants

13.10.5 Assessment of training requirements

In addition to the training specified in the training log special/ additional trainings shall be provided during each activity. The criteria to assess the need of training shall be based on the following:

- When a specified percentage of staff is newly inducted in the project;
- When any non-compliance is repeatedly reported, refresher training will be provided regarding that issue;
- When any incident/accident of minor or major nature occurs;
- Arrival of new contractor / sub-contractor; and
- Start of any new process / activity.

13.10.6 Training material

ENERGEAN's Environmental Manager and the contractor's Environmental Officer shall develop and prepare training material regarding Environmental or HSE awareness, ESIA, ESMMP and controls to be followed during the project. Separate training material can be prepared for each topic. A generic scope of the training covering the requirements of the ESIA and the ESMMP is discussed in table below.

Table 13-4: indicative scope of training programme

Staff	Contents	Schedule
Selected management staff and contractor(s) / sub-contractor(s)	• Environmental sensitivity of the project area Key findings of the ESIA • Mitigation measures ESMMP Social and cultural values of the area Leadership dynamics	Prior to the start of project activities
All project personnel	• Environmental sensitivity of the project area • Wildlife and vegetation sensitivity of the project area • Mitigation measures Contingency plan Waste disposal Community issues Social and cultural values • Waste disposal • Nature resource conservation • Housekeeping	Prior to the start of project activities

13.10.7 Training during construction phase

During the construction phase, mainly, the responsible for personnel's training is the Contractor. The Contractor shall ensure that personnel involved directly to the implementation of the ESMMP must have adequate qualification and skills necessary to perform this work.

Prior to the commencement of the construction, the Contractor shall prepare a Training Plan, as defined in every MMP. This Training should include:

- Induction training program to all personnel
- Timely delivery of training courses
- Training procedures
- Information material for the personnel
- Information material or training program for subcontractors
- Means of confirming that the system is effective

Specifications of training, during the construction phase, is provided in every topic specific MMP.

13.10.8 Training during operation phase

The training during operation will follow the existing procedures of Energean (HSE management plan, ESMS etc) and will apply in all levels:

- Top managements
- Drilling personnel
- Barge personnel
- Riggers
- HSE officers and personnel

Part of the training program will be emergency and oil spill response drills.

Specifications of training, during the construction phase, is provided in every topic specific MMP.

13.11 COMMUNICATIONS

13.11.1 Communications during construction phase

Communication between Energean and Contractor

During the construction phase there will be a direct communication line between the Contractor and the Company. The establishment of the communication line is Contractor's responsibility. Other Contractor's communication responsibilities are:

- Keeping the Company informed in advance of the construction schedule, progress and key activities.
- Inform Energean immediately if a regulator or statutory stakeholder proposes to visit the Project
- Inform Energean prior to any visit to Authorities
- Communicate to company any complaint from stakeholders
- Keep contact log
- Communicate with other Contactors, if needed, through Energean communication

procedures

Communication with Authorities

ENERGEAN will be responsible for contacting with Authorities. In case the Contractor wants to have a meeting with Authorities, he must inform Energean prior to any action.

Communication with Stakeholders

The communication with Stakeholders is described in the SEP and in the Grievance Mechanism.

13.11.2 Communications during operations phase

Communications in the operation phase will follow the existing procedures of ENERGEAN.

13.12 MANAGEMENT OF CHANGE

13.12.1 Overview

Although the Project design is in detail level, there are always uncertainties in the Project development (construction and operation phase), which need to be dealt in a structured way. The way in which these changes will be managed with in the period following the submission or after the approval of the ESIA is a matter of the magnitude and nature of change.

The basic legal framework for environmental permitting changes in Greece is the provisions defined in Law 4014/11, as supplemented by relative Joint Ministerial Decisions (JMDs). Energean will follow this regulative frame, but the actions to be taken will be based on the magnitude and nature of change:

- Minor changes, usually, do not require new or advanced environmental studies, but only environmental reports and notifications to competent Authorities. Probably, the alterations in the ESMMP will be minimal.
- Moderate changes, usually, require Reports for Modification of Approved Environmental Terms or even a new ESIA. In such a case, a revision of some sections of the ESMMP is required.
- Major changes, requires a new ESIA and a total revision of the ESMMP.

13.12.2 Emergency preparedness and response

Energean requires all Project personnel, including the EPC and contractors to identify potential and actual emergency situations, and respond to these situations in an appropriate manner, in order to prevent or mitigate potentially adverse E&S impacts.

Energean requires the needs of relevant interested parties will be taken into account (e.g. emergency services, communities, neighbours) as part of this process, and procedures shall be

reviewed, tested and revised periodically, and where required.

For the construction phase, the EPC will develop emergency response procedures. These procedures will be implemented and tested during the first 3 months of the Project, with training initiatives for relevant personnel.

Energean will review and monitor the performance of the EPC's and the related emergency response plans as part of the Project monthly site management meetings, where appropriate.

As the Project transitions to the operational phase, Emergency Preparedness and Response will become the responsibility of Energean. In anticipation of that transition, a Qualitative Risk Assessment (QRA) of the Project design has been completed and an Emergency Response Plan for the Operational Phase is already established (Annex 13 – Contingency Plan).

13.13 CONTRACTOR AND SUPPLIER MANAGEMENT

All Contractors and Suppliers have to follow Energean's HSE Policy, HSE Management Plan and ESMS and to comply with this ESMMP. Contractors have to develop their own ESMMP, according to this one.

The Contractors and Suppliers must know and comply with any duties or responsibilities set by the national, EU and international regulations and EBRD standards with regard to HSE and labour issues.

Energean has the responsibility to provide to Contractors and Suppliers all relevant documents and apply an audit procedure for their compliance.

13.14 MONITORING AND EVALUATION

The monitoring procedures are defined hereby, within the ESMMP. This is an operational document, which provides all the operational background necessary for the efficient implementation of the measures identified in the ESIA. More specifically the objectives of the ESMMP are to:

- Promote legislative compliance;
- Promote the principles of best environmental practice in all general and emergency working procedures;
- Facilitate the implementation of mitigation measures identified in the ESIA;
- Define legislative requirements, guidelines and best industry practices that apply to the project;
- Define the role and responsibilities of the project proponent to ensure environmental

protection; and

- Define a monitoring mechanism and identify monitoring parameters in order to:
  - ⇨ Ensure the complete implementation of all mitigation measures;
  - ⇨ Ensure the effectiveness of the mitigation measures;
  - ⇨ Define requirements for environmental monitoring and auditing;
  - ⇨ Provide a mechanism for taking timely action in the face of unanticipated environmental situations; and
  - ⇨ Identify training requirements at various levels.

The monitoring program ensures that the impact is within the predicted limits and to provide timely information if an unacceptable impact is taking place. For each component of the monitoring program, the following information should be presented:

- Mitigation measures recommended in ESIA
- Responsible person
- Monitoring parameters
- Periodicity of monitoring

Evaluation of the application of the ESMMP shall be carried out to ensure compliance with the requirements of the ESIA. Evaluation is made by:

- Systematically observe the application of measures
- Verification of efficiency of measures
- Maintaining records
- Reporting

13.15 ENVIRONMENTAL AND SOCIAL MONITORING PLAN

13.15.1 Introduction

The purpose of monitoring is to ensure that the impact is within the predicted limits and to provide timely information if an unacceptable impact is taking place. The scope and frequency of the monitoring depends on the residual impacts identified earlier in the present ESIA report. To address the mitigation measures and monitoring requirements identified in ESIA, a management plan will be developed in coordination with the permitting authority and will be part of the environmental permit. This will need to ensure that the project is designed, constructed, maintained and implemented in the manner described in the ESIA.

For each component, the following information should be presented in the plan:

- The required mitigation measures recommended in ESIA;

- The person/organization directly responsible for adhering to or executing the required mitigation measures;
- The person/organization responsible for ensuring and monitoring adherence to mitigation measures;
- The parameters which will be monitored to ensure compliance with the mitigation measures; and
- A timescale for the implementation of the action to ensure that the objectives of mitigation are fully achieved.

Generally the plan will need to encompass all the monitoring parameters that are currently prescribed by the current permit in power an already monitored by ENERGEAN and in case of any new legal / statutory obligations, this will need to be expanded to cover those on top.

The process and management of the monitoring plan is further described in the paragraphs below.

13.15.2 Environmental monitoring and reporting

The objective of environmental monitoring during the construction/installation activities will be as follows:

13.15.2.1 Compliance monitoring

Compliance monitoring shall be carried out to ensure compliance with the requirements of the ESIA. The objectives of the ESIA compliance monitoring will be to:

- Systematically observe the activities undertaken by the civil work contractors or any other person associated with the project;
- Verify that the activities are undertaken in compliance with the ESIA, the ESMMP, the ESMS and other conditions identified by Energean;
- Document and communicate the observations to the concerned person(s) at Energean so that any corrective measures, if required, can be taken in a timely fashion; and
- Maintain a record of all incidents of environmental significance and related actions and corrective measures.

Compliance monitoring will be the responsibility of all teams involved in the construction i.e. Energean and the contractor(s) / sub-contractor(s) and hence it will be done at two levels.

- Monitoring by Energean Environmental HSE Manager; and
- Monitoring by the contractor(s) / sub-contractor(s) Environmental Engineers(s) as applicable.

The management plan provided in previous tables shall be used as a management and monitoring tool for compliance monitoring. Inspection shall be done using checklists, which will be developed on the basis of the mitigation plan. During compliance monitoring the following parameters would be specifically addressed:

- Visual monitoring of air emissions;
- Recording water consumption for each project activity;
- Disposal of domestic and operations (HZW and nHZW) wastes;
- Recording of noise levels from each project activity; and
- Recording complaints regarding environment in a complaints register (as per established grievance mechanism).

13.15.2.2 Monitoring plan for key environmental and social parameters

Monitoring of all key environmental and social parameters that could potentially lead to an impact will be required to analyse the impacts of construction and operation on the environment. Therefore, self-mentoring and reporting techniques will be adopted to carry out monitoring.

Energean's Environmental Manager shall be responsible for monitoring of residual impacts. The best monitoring techniques will be identified by the department and frequency of selected parameters for monitoring will be followed.

An outline of the monitoring programmes proposed for the construction and operation phases, is presented in the following tables. Monitoring process will enable Energean to understand how environmental performance will change over time and will facilitate improvements to the environmental and social management system.

Table 13-5: Outline of Monitoring Program during the Construction Phase

Receptor	Monitoring Task	Monitoring Parameter	Timing
Marine environment	Marine ecology inspection	Benthic analysis	Monthly
	Monitoring of marine water quality	Turbidity / Suspended solids Oil and grease	Weekly
	Monitoring of sensitive marine fauna	Presence of marine mammals and birds – visual monitoring	Continuous
	Identification and reporting of leakage events	Number of leakage events caused during the construction	Continuous
Noise	Noise monitoring at direct interference (within 500 m)	Day and night noise levels	Weekly
Working conditions, health and safety	Health and Safety (H&S) monitoring and audits. H&S Performance evaluation Personal Protected Equipment monitoring	Total recordable incidents, lost time incidents and other H&S indicators. Records verifying the conditions of Personal Protected Equipment	Weekly

Receptor	Monitoring Task	Monitoring Parameter	Timing
	Maintain grievance mechanism Analyse workers and community grievance trends Maintaining training records	Grievance mechanism records Training records	Monthly

Table 13-6: Outline of Monitoring Program during the Operation Phase

Receptor	Monitoring Task	Monitoring Parameter	Timing
Marine environment	Monitoring of marine water, seabed morphology, integrity of the pipelines and marine ecology at direct interference (within 500 m)	Physicochemical analysis of seawater and benthos. Analysis of benthic communities Visual inspection via ROV or diving survey	Every 12 months for sample analysis Every 3 years for visual inspection
	Identification and reporting of leakage events	Number of leakage events caused by the activity	Continuous
Air quality	Air emissions monitoring through a Continuous Emissions Monitoring (CEM) System	Temperature Pressure drop H_2S Combustible gases	Continuous Continuous detection monitoring Continuous detection monitoring
Noise	Noise monitoring at direct interference (within 500 m)	Day and night noise levels	Every 6 months for the first two years
Working conditions, health and safety	Inspection of the emergency and detection systems	Maintenance check, services and record verifying the condition of the emergency shutdown, fire detection, H_2S detection, combustible gas detection and fire water systems	According to the manufacturer
	Inspection of the Personal Protected Equipment	Visual inspection and records verifying the condition of the	Monthly

Receptor	Monitoring Task	Monitoring Parameter	Timing
	(PPE) and the safety equipment	safety equipment (life rafts, life jackets, flares, smoke canisters)	
	Monitoring of Health and Safety implementation by the workforce		Monthly

Table 13-7: Outline of Monitoring Program during the Decommissioning Phase

Receptor	Monitoring Task	Monitoring Parameter	Timing
Marine environment	Marine ecology inspection	Benthic analysis	Monthly One month after direct interference
	Monitoring of marine water quality	Turbidity / Suspended solids Oil and grease	Weekly One month after direct interference
	Monitoring of sensitive marine fauna	Presence of marine mammals and birds – visual monitoring	Continuous
	Identification and reporting of leakage events	Number of leakage events caused during the construction	Continuous
Noise	Noise monitoring at direct interference (within 500 m)	Day and night noise levels	Weekly
Working conditions, health and safety	Health and Safety (H&S) monitoring and audits. H&S Performance evaluation Personal Protected Equipment monitoring	Total recordable incidents, lost time incidents and other H&S indicators. Records verifying the conditions of Personal Protected Equipment	Weekly
	Maintain grievance mechanism Analyse workers and community grievance trends Maintaining training records	Grievance mechanism records Training records	Monthly

13.15.2.3 Complaints register

The Environmental Officer shall maintain a register of complaints received from local communities and measures taken to mitigate these concerns. All community complaints received shall be sent to the Environmental Manager for further action.

The procedure will be set out as described in the grievance mechanism chapter, under the SEP (Annex 11).

13.15.2.4 Photographic record

Energean shall maintain a photographic record of all areas to be used during the project. As a minimum the photographic record shall include the photographs of project areas prior to and after activities. The photograph record shall also be maintained for any noncompliance observed during the project.

13.15.2.5 Audit reports

Energean shall maintain a record of all audits and inspections commissioned or undertaken by the company to check conformance with the ESMMP.

13.15.2.6 Communication and documentation

An effective mechanism for storing and communicating environmental information during the project is an essential requirement of an ESMMP. The key features of such a mechanism are:

- Precise recording and maintenance of all information generated during the monitoring;
- Communicating the information to a central location;
- Processing the information to produce periodic reports; and
- Providing information and answering queries on monitoring originating from various researchers and stakeholders.

13.15.2.7 Meetings

The following Environmental meetings shall take place during the project:

- Kick-off meeting;
- Daily meetings; and
- Weekly meetings.

The purpose of the kick-off meeting will be to present the environmental management plan to the senior staff of the project team, and contractors to discuss its implementation.

A daily meeting shall be held to discuss the environmental conduct of the operation, non-compliances noted by the Environmental Officer, and their remedial measures. Minutes of the

meeting shall be recorded in the form of action tracking register.

The purpose of the weekly Environmental meeting will be to review the weekly performance of the operation by reviewing the number of non-conformances and the environmental incidents that occurred during the week, progress on daily action items, and to agree on recommendations for additional controls, mitigation measures or monitoring requirements. The meeting shall be recorded in the form of a weekly Environmental Monitoring report.

13.16 NON-CONFORMANCE, INCIDENT AND ACTION MANAGEMENT

13.16.1 Overview

Energean's responsible persons for the ESMMP have to make inspection for non-conformance. Inspections will be made in all working sites and operating areas of the Project. In case of non-conformance a report will be prepared to the HSE Manager. The HSE Manager will decide for the approval of the report. If the report is accepted, then correction actions will take place.

Regarding incidents, there will immediate investigations. All personnel must inform immediately for all incidents and near-miss incidents as per the company's HSE MS and HSE procedures.

13.16.2 Incident / Non conformity reporting and resolution

Incidents and nonconformities relating to construction activities and EHS management will be managed by Energean Group HSE Manager. On-site incidents and nonconformities must be reported, in the first instance, by the EPC to the above. The EPC has established procedures for incident reporting, and investigation, corrective/preventative action and resolution (as set out in the EPC's EHS Manual), and will develop those procedures to include reporting lines to the HSE Manager. Any exceedance of a standard or threshold will be recorded as an incident. Further work will be undertaken to develop a mutually shared understanding of the nature and scope of reporting required by the lenders, for different types of incident, and incidents of varying scale and significance. Similarly, the escalation process to be used by the EPC to ensure all relevant incidents are reporting to Energean will develop to reflect lender and regulatory requirements.

Energean has an established Grievance Mechanism, which is available for review as part of the Stakeholder Engagement Plan. The Grievance Mechanism, establishing how grievances from the community, will be managed. In cases where an incident involves an employee from local communities, Energean envisages that the EPC and Energean Group HSE Director can work together to ensure agreements are upheld and the intent of the Grievance Mechanism is fully considered, where relevant

Incident/nonconformity reporting procedures will be fully communicated as part of Project induction training prior to any individual commencing work for, or on behalf of, the Project.

13.17 REPORTING

Energean shall produce weekly and monthly Environmental Monitoring reports for each activity.

Table 13-8: Periodic reports

Report	Timing	Prepared by	Reviewed by
Weekly	On the first day of the following week	Environmental Engineer (EE)	Energean HSE Manager
Monthly	With 7 days of completion of reporting period	Environmental Engineer (EE)	Energean HSE Manager
Change management	Whenever required	Environmental Engineer (EE)	Energean HSE Manager
Final	Within 30 days of completion of the activity	Environmental Engineer (EE)	Energean HSE Manager
Audit Reports	Whenever required	Environmental Engineer (EE)	Energean HSE Manager

ANNEXES

ANNEX 01: RELEVANT DOCUMENTATION

Offshore Prinos complex environmental permits

Offshore exploration permits

Offshore exploitation permits

Onshore Prinos complex environmental permits

ANNEX 02: MAPS & DRAWINGS- PIPING & INSTRUMENTATION DIAGRAMS (P&IDs)- PROCESS FLOW DIAGRAMS (PFDs)

Maps & Drawings

Piping and Instrumentation diagrams (P&IDs)

Existing facilities

New facilities

Process Flow Diagrams (PFDs)

Existing facilities

New facilities

ANNEX 03: MARINE GEOPHYSICAL SURVEY

ANNEX 04: SPECIAL ECOLOGICAL STUDY (SES)

ANNEX 05: MARINE ECOLOGY STUDY

ANNEX 06: POLLUTION ASSESMENT STUDY

Final Report for Polycyclic Aromatic Hydrocarbons (PAHs)

Chemical Analysis Pollution Assessment Study

ANNEX 07 : OIL SPILL MODELLING

ANNEX 08: CHEMICAL USE PLAN (IN ACCORDANCE WITH OFFSHORE PROTOCOL)

ANNEX 09: WASTE MANAGEMENT PLAN (WMP)

ANNEX 10: NOISE MEASUREMENTS

ANNEX 11: STAKE HOLDER ENGAGEMENT PLAN

ANNEX 12: CHANCE OF FINDS PROCEDURE FOR CULTURAL HERITAGE

ANNEX 13: CONTIGENCY PLAN

ANNEX 14: HSE PLAN

ANNEX 15: TRAFFIC MANAGEMENT PLAN

ANNEX 16: CONSTRUCTION MANAGEMENT PLAN

ANNEX 17: BIODIVERSITY WILDLIFE MANAGEMENT PLAN

ANNEX 18: POLLUTION PREVENTION PLAN