Limited Liability Company
SCIENTIFIC-RESEARCH AND DESIGN-INVESTIGATION INSTITUTE OF CITY ECOLOGY
NIiPI OF CITY ECOLOGY

8, 2nd Brest str., 125047, Moscow, tel: +7 (495) 786-6730, fax: +7 (495) 775-3446
e-mail: INFO@ECOCITY.RU; WWW.ECOCITY.RU

Client: SIBUR OOO

Contract: ref. 189-44/1-07 of 05.03.2007

INVESTMENT SUBSTANTIATION FOR CONSTRUCTION OF 330 thousand t/y NIZHNY NOVGOROD INTEGRATED VINYLS PLANT

VOLUME 7

ENVIRONMENT IMPACT ASSESSMENT

BOOK 5

Moscow – 2007

Limited Liability Company
SCIENTIFIC-RESEARCH AND DESIGN-INVESTIGATION INSTITUTE OF CITY ECOLOGY
NIiPI OF CITY ECOLOGY

8, 2nd Brest str., 125047, Moscow, tel: +7 (495) 786-6730, fax: +7 (495) 775-3446
e-mail: INFO@ECOCITY.RU; WWW.ECOCITY.RU

Client: SIBUR OOO

Contract: ref. 189-44/1-07 of 05.03.2007

INVESTMENT SUBSTANTIATION FOR CONSTRUCTION OF 330 thousand t/y NIZHNY NOVGOROD INTEGRATED VINYLS PLANT

VOLUME 7

ENVIRONMENT IMPACT ASSESSMENT

BOOK 5

SUMMARY EXPLANATORY NOTE

General Manager **A.A.Kurbatov**

Responsible **O.V.Zheleznova**

Moscow – 2007

EIA CONTENT

No of Volume, Book	**Designation of data**
Volume 7	
Book 1	BASELINE CONDITIONS
Section 1	Current Status of Environment
Tom 7	FORCAST OF CHANGES IN ENVIRONMENT
Book 2	COMPONENT
Section 2	Section 2. Characteristic of plant supposed to be constructed and its impact on environment.
Section 3	Section 3. Ecological limitations for development of land for intended economic activity
Section 4	Section 4. Impact on environment from intended economic activity
Volume 7	FORCASTED CHANGES OF ENVIRONMENT
Book 3	COMPONENTS
Section 4	Impact on environment from intended economic activity *Impact on status of atmospheric air*
Volume 7	FORCASTED CHANGES OF ENVIRONMENT
Book 3s	COMPONENT
Section 4	Impact on environment from intended economic activity *Impact on status of atmospheric air. Calculation of pollutant dispersion in atmosphere*
Volume 7	ECOLOGICAL SAFETY MEASURES
Book 4	Section 5. Ecological Safety Measures. List of
Section 5	environmental measures
Section 6	Section 6. Ecological and economic efficiency of
Section 7	investment in environment protection measures Section 7. Proposals on program for production ecological control and monitoring organization. Summary.
Volume 7	Summary Explanatory Note
Book 5	Conclusions and recommendations
Volume 7	Attachments
Book 6	

Corporate authors

No	Position	Name	Signature
1	Head of OGE	Iniakina A.Y.	
2	Chief Specialist	Zheleznova O.V.	
3	Lead Specialist	Miakokin A.V.	
4	Ist category Specialist	Savchenko A.L.	
5	Head of OEA	Abramkina O.G.	
6	Lead Specialist	Bezrazumov D.V.	
7	Head of OARiI	Lubelskij V.V.	
8	Acoustic Engineer	Kosobrodov R.A.	
9	Head of OGI	Nikolaev A.P.	
10	Ist category Hydrogeology Specialist	Mulenkova E.V.	
11	Head of OEAiO	Barkov M.V.	
12	Ecological auditor	Korendiasev E.V.	
13	Ist category Specialist	Eliseeva E.V.	
14	Head of Dendrology and protection of plantation	Askerov D.Y.	
15	Chief Specialist	Akhunova L.A.	
16	Head of OIEI	Reshetina T.V.	
17	Head of Ecological simulation department	Miagkov M.S.	
18	Head of OOiVTD	Pavlov N.V.	
19	Lead Specialist	Kolchaeva O.N.	
20	Ist category Specialist	Kochetkov M.E.	

CONTENT

INTRODUCTION

This Assessment of impact on environment from 330 thousand t/y Nizhny Novgorod Integrated Vinyls (PVC) Plant has been performed as part of Investment Substantiation for construction of the said plant.

The objective of the study is to:

- define ecological and sanitary-hygienic conditions for plant construction site;
- preliminary estimate the types and levels of impact from designed plant on environment and health of population at both construction and operation periods;
- justify the size of actual Sanitary-Protective Zone;
- define the conditions and limitations for taking decision about plant location;
- justify the scope and content of environment protection measure providing the meeting of normative quality indices established for environment.

The basis for performance of Environment Impact Assessment (EIA) was:

- "Declaration of Intent for construction of 330 thousand t/y Nizhny Novgorod Integrated Vinyls (PVC) Plant" approved by "Sibur-Holding" OOO's President, A.V.Diukov, on 30.05.2006;
- Contract between "Sibur" OOO and " NIiPI of City Ecology" OOO, ref. 189-44/1-07 of 05.03.2007.

The characteristic of the plant proposed to be constructed, the technical and economic performances, description of technological processes and equipment specifications (process and treatment) have been defined in accordance with pre-project studies performed by General Designer, TECHNIP CIS.

When performing the study, the current status of environment has been analyzed, the impact from intended economic activity on environment components has been assessed, the sanitary protective zone of Integrated Vinyls Plant has been sized by totality of influencing factors, the list of ecological safety measures has been defined, the ecological and economic efficiency of investment into environment protection measure has been assessed, the proposals for organization of production ecological monitoring program have been provided.

1. CHARACTERISTIC OF INTEGRATED VINYLS PLANT AND ITS IMPACT ON ENVIRONMENT. SATNITARY PROTECTIVE ZONE

In 2006, "SIBUR Holding" JSC submitted to Nizhny Novgorod Region Administration the Declaration of Intent for construction 330 thousand t/y Integrated Vinyls Plant. The intent to invest has been fully supported by the regional authorities.

The advanced technology of PVC production from Solvay company has been selected for performance of pre-project studies. A series of plants constructed by the technology of this company are operating in Western Europe.

PVC (polyvinylchloride) – universal thermoplastic polymer produced by suspension polymerization of vinyl chloride. PVC is very long-lived and sustainable to aggressive environment factors. PVC made items do not sustain combustion. Thermal and acoustic protection factors correspond to highest values. PVC plastics have sufficient mechanical strength, good electro insulating features, good reagent resistance: they are not dissolved in gasoline or kerosene, acid and alkali proof.

The one of most important features of PVC is hygienic safety. PVC is used for manufacturing of wide range of items and materials: films and plates, cable and wire, pipes, containers and packing, construction materials, coating for floor, shoes, items for radio and electronic industries.

Nizhny Novgorod Integrated Vinyls Plant will occupy the area of 59.71 ha.

The considered Integrated Vinyls Plant is dedicated for production of PVC (suspension and emulsion), as well as caustic soda (sodium hydrate).

Table 1. Production capacity of the Plant

No	Designation of product	Quantity, t/year
1	PVC suspension	300000
2	PVC emulsion	30
3	Caustic soda	470000

The ethylene and kitchen salt will be used as main raw of the Plant. The ethylene will be supplied from Petrochemical Plant, Kstovo, the kitchen salt from Astrakhan, Donetsk and Solikamsk region fields.

Table 2. Balance of land of the designed Plant.

No	Designation	Measuring unit	Quantity		
			Total site area	Including:	
				Utility area	Plant area
1	1. Site area, including	ha	59.71	12.58	47.13
2	1.1 Built-up area	ha	11.20	0.96	10.24
3	1.2 Paved area	ha	44.56	8.76	35.79

4	1.3 Green plantation area	ha	3.95	2.86	1.09

In accordance with the General Plot Plan, the process buildings and facilities will include VCM, EDC, kitchen salt and caustic soda storages, chlorine compressor, Electrolysis unit, Cracking unit, Oxychlorination unit, EDC polymerization unit, PVC drying, also a part of site is dedicated for parking of freight vehicles and passenger cars, rain water and process effluent treatment installation (figure 1.1).

In accordance with the General Plot Plan, the Office Building, Mechanical Workshop, Fire Station are planned to be located within Utility Area. The summary description of the said buildings is provided here below.

The pre-project proposal studies provide the arrangement of open parkings for passenger cars of visitors and personnel staff (444 car/places capacity), as well as for freight vehicles servicing the considered PVC Plant. The parkings for freight vehicles delivering the raw, and for staying of empty trucks are provided outside the fence of process area of the Plant (40 vehicle/places). For vehicles exporting final products, the parkings are provided within the fence of Process Area (16 vehicle places).

The total number of personnel staff of the Plant will constitute 675 persons including 190 person – managers and specialists, 30 persons – employees, 455 persons – workers.

The plant proposed to be constructed consists of the following process and utility areas:

1. Main Process Units

Membrane Electrolysis Unit

At this unit, the chlorine is produced by membrane electrolysis of kitchen salt solution.

VCM Unit

VCM is produced by cracking EDC, which in its tern is produced by direct chlorination of ethylene by chlorine. A part of EDC is obtained by oxychlorination of ethylene and chloride hydride recovered at EDC cracking.

The gaseous chlorine and ethylene react in direct chlorination reactor in boiling EDC environment.

The oxychlorination (gaseous ethylene and chlorine hydride reaction) is made in reactor in oxygen presence).

After cooling down and treatment, EDC is transferred to storage tank from which it is sent to cracking.

All gaseous and liquid wastes formed in process are sent to incineration unit.

PVC suspension and emulsion Unit

A) PVC suspension (S)

This process is made in large batch autoclave reactors where the monomer is intensively blended under pressure and given temperature in presence of dispersing agent, initiating agent and additives capable to emulsify the monomer and stabilize the suspension of produced polymer.

B) PVC emulsion (E)

This is also made in large batch autoclave reactors.

After polymerization, the raw latex is unloaded to storage at continuous blending. The conditioned latex is sent to drying in spray drier. The dried product is minced to required size, and then the conditioned product is pneumatically delivered to temporary storage silo, and after laboratory control it is sent to packing or to final product storage silo.

VCM and PVC units are completed with own local treatment installations for effluents.

2. Final Product, kitchen salt and auxiliary material storages

PVC will be stored in paper and polyethylene bags on pallets.

All substances used as auxiliary substances for PVC production are received, stored and off loaded in tight packs.

The caustic soda is by-product of PVC production. The concentrated soda (50%) is stored in two heat insulated heated tanks.

The place of salt storage represent an area with hard pavement and size of 450 190 m. Two front wheel loaders permanently operate on site, they make filling and load it into dump trucks for transportation to salt live storage.

3. Auxiliary facilities

Effluent Treatment Installation

The waste water from VCM and PVC units pass preliminary treatment for removal of contained VCM and PVC. Then, this waste water goes to two stage treatment – physical & chemical and biological. Physical and chemical treatment includes all neutralization, flocculation and treatment procedures. In result of treatment, the caught PVC is thickened; dehydrated and solid residue is obtained which is suitable to external use. The waste water after physical and chemical treatment passes biological treatment.

Utility and Power Station Units (steam generation and distribution, cooling water cycle, nitrogen, oxygen and compressed air generation)

The compressed air will be generated at own compressor unit.

The oxygen and nitrogen will be generated by own air separation unit.

The steam will be generated by own boiler house.

Utility network and systems of the Plant

The source of water supply to the Plant is Cheboksary water basin (Volga river) The fresh water for process needs of the Plant will be supplied from "Ecological investor" OOO network possessing own water-intake facilities. For service and domestic needs the water is supplied from "Kstovo Concrete Item Plant" ZAO networks, the potable water in volume of 36 m3/hour.

For the time being, there are treatment installations in Kstovo, which belong to "Ecological investor" OOO and have free capacity that are planned to be used at operation of designed Integrated Vinyls Plant. Cheboksary water basin (Volga River) is intended to be the receiver of treated waste water from the designed Plant.

The heat for buildings and facilities is planned to be supplied from own designed boiler house.

110 MW power supply of Integrated Vinyls Plant is planned to be made from Novogorkovsk Power Plant.

The natural gas in amount of 8890 nm3/hour is planned to be supplied from high pressure gas pipeline from Mokroye station to brunch pipe towards EP-300, BVK plant.

The environment impact from plant intended to be constructed will consist of:

- withdrawal of land resources;
- change of soil covering features;
- change of atmosphere pollution level by appearing of new emission sources;
- change of acoustic regime of the site
- change of geological and geomorphologic conditions by re-leveling of site, change of nature and intensity of exogenous processes;
- cutting of green plantations;
- change of level and nature of green plantations and land improvement;
- change of level and mode of feeding of underground water by both re-distribution of water gathering areas with different infiltration ratios at disposal of its significant part to rain water network, and also by leakages from water supply networks;
- withdrawal of water resources, disposal of treated waste water;
- introducing of process wastes into environment.

Sanitary Protective Zone

In accordance with p. 4.1.1 of SanPiN 2.2.1/2.1.1.1200-03 "Sanitary Protective Zone and Sanitary Classification of the Plants, Facilities and other Installations", the considered plant is associated with 1 class plants having

normative sanitary protective zone of 1000 m (Electrolytic plants of chlorine production, semi-products and chlorine-based products).

The main factors of plant impact on environment which govern the definition of its sanitary protective zone are: chemical pollution of atmospheric air and acoustic impact on environment.

Figure General Plot Plan of the Plant – Main option.

2. CURRENT STATE OF ENVIRONMENT

When performing the Environment Impact Assessment for Integrated Vinyls Plant, which is planned to be constructed in Nizhny Novgorod region, two alternative sites of the plant were considered. The Site 1 – main site, located in industrial area at 5 km to Sough-West direction from Kstovo. The Site no 2 – alternative site located at 2.25 km from Dzerzhinsk city to North-East direction.

For each site two options were considered – implementation of intended economic activity or renounce of intended activity and maintaining of current mode of use of possible sites – "zero option".

The advisability to construct the Integrated Vinyls Plant on each of considered sites was defined depending on current state of environment components, level of man-caused pollution, presence of valuable natural objects, possible damage to natural communities, forecasted changes of environment components in case of implementation of this investment project.

2.1 Location and current use of site

The location of Integrated Vinyls Plant in Nizhny Novgorod region is foreseen on one of two allotted sites (Kstovo and Dzerzhinsk). The location of sites in Nizhny Novgorod region is shown on figure 2.1.1.

Site No 1 (industrial area of Kstovo)

The Site No 1 with 99.75 ha surface is located in industrial area at 5 km distance to South-West direction from Kstovo.

The adjacent surrounding areas of the considered site are:

- Waste ground from North-East, further Petrochemical and Tire Repair Plant;
- "Norci" Commodity and raw material base and Novogorkovsk Power Plant from South-East;
- Auto road with ground coating, further waste ground and lawn and garden communities "Berezka" and "Otdykh" from Shouth-West.
- Access rail way servicing Kstovo industrial area from North-West, further tillage, which is actually is not used for growing of vegetable plants of food purpose.

The considered area consists of three parts with different functionality: site of BVK Plant (44.22 ha surface), site of FGUP "Logistika" (16.22 ha surface) and reserve site of industrial area free of building (39.31 ha surface).

Actually, BVK plant does not operate, there are 1-4 level industrial buildings and facilities on its territory, some buildings are used as storages by third companies. There are rail ways coming to BVK site (see photo 1).

Photo 1. “Kstovo OPZ BVK” OAO site

The site of FGUP “Logistika” is enclosed by fencing and represents waste ground on which it was previously intended to construct pharmaceutical plant. The site is leveled, filled by sand (photo 2). For the time being, there is unauthorized underground tank bitumen storage on the site, the bitumen is supplied and off loaded by freight road trucks.

Photo 2. FGUP “Logistika” Site

The reserve territory of industrial area represents green territory between above mentioned industrial plants. The power transmission line passes through the site (photo 3). The considered site is full of construction waste (fragments of reinforced concrete plates, scrap metal, asphalt and bitumen pieces).

Photo 3. Waste ground between plant sites of industrial area

In the radius of 1000 m from the limit of the site considered for construction of Integrated Vinyls Plant, there are sites of industrial plants of Kstovo industrial area with access rail ways and roads, tillage on which actually the industrial crops are grown, as well as a part of lawn and garden communities “Berezka” and “Otdykh”.

Site No 2 (Area of Igumnov forestry near Dzerzhinsk city)

The territory of 184 ha surface represents populated area of Igumnov Forestry of Dzerzhinsk district forestry administration with swap here and there, there no capital or temporary buildings (photo 4).

Photo 4. Area of Igumen Forestry near Dzerzhinsk

The green plantation is of artificial origin and mainly represented by pine-tree, less frenquently by birches in lower places.

In the radius of 1000 m from the limit of territory proposed for construction of the plant, besides Igumen forestry, there are different industrial plants of Dzerzhinsk industrial area with infrastructure facilities, auto roads. There is no residential development, lawn and garden and holiday villages founded in the radius of 1000 m from the limit of the site proposed for construction of the plant, the residential development of Dzerzhinsk is located at 2.25 km to South-West direction from the considered site.

2.2 Actual state of the air

The comparative ecological and climatic analysis of the sites in Kstovo and Dzerzhinsk region shown that the weather in Kstovo region is generally more propitious for self-cleaning of the atmosphere with exception of autumn season (by less quantity of precipitations and higher frequency of fogs). However, these differences are quite insignificant from statistic point of view.

For Kstovo it is more typical to have development of air-mass large cumulonimbus clouds followed by higher wind velocities promoting the vertical mixing of surface layer and dispersion of pollutants into atmosphere.

The performed analysis of factors of meteorological conditions of transfer and dispersion of pollutants into atmosphere shown that Kstovo is in lightly more favorable conditions then Dzerzhinsk with regards to more significant parameters

defining pollution potential of the atmosphere. On the whole, the whole region is characterized by moderate potential of atmosphere pollution.

The level of air pollution in populated area of Nizhny Novgorod region corresponds to the average level in the Russia, besides the largest chemical center of the country – Dzerzhinsk, where it is higher than average level in the Russia.

The stationary surveillance of atmospheric pollution state in Nizhny Novgorod region is made by Verkhne-Volzhsky administration of hydro meteorology and monitoring of environment (Verkhne-Volzhsky UGMS) in five industrial city – Nizhny Novgorod, Dzerzhinsk and its Eastern industrial area, Kstovo, Arzamas, Balakhna as well as in holiday village Green city.

The background levels of atmospheric pollution in Dzerzhinsk and Kstovo have been compared by the aspects associated with the evaluation of the existing man-caused load on air and definition of its possible increase by emissions from Vinyls Plant. This comparison used the records from surveillance of main and specific pollutants made by Verkhne-Volzhsky UGMS during five years starting from 2000 till 2004, the data contained in the reports " About state of environment in Nizhny Novgorod region" (table 2.1).

Table 2.1 Background concentrations of pollutants (MAC portions)

Designation of substance	Code	Dzerzhinsk		Kstovo	
		PNZ-3, East industrial area	Calculated by city in whole	PNZ-1 Water treatment station	PNZ-1, garden village Green City
Iron*	0123	0.003	0.002		
Cadmium	0133	0.0003	0.000		
Manganese	0143	0.005	0.003		
Cooper	0146	0.004	0.003		
Nickel	0164	0.004	0.004		
Lead	0184	0.22	0.16		
Chrome	0203	0.003	0.004		
Zinc	0207	0.0002	0.0002		
Cobalt	0260	0.001	0.001		
Nitrogen dioxide	0301	0.65	0.55	0.35	0.2
Ammonia	0303	1.15	1.0		
Nitrogen oxide	0304		0.18		
Hydrogen chloride	0316	1.0	1.0		
Sulphuric acid	0322		0.33		
Sulfur dioxide	0330	0.36	0.032	0.01	0.004
Hydrogen sulphide	0333			0.25	0.125
Carbon monoxide	0337	0.52	0.32	0.48	0.28
Chlorine	0349	0.02			
Benzene	0602		0.63	0.8	
Ethyl benzene	0620		0.5	0.6	

Toluene	0621		0.63	0.77	
Xylene	0639		0.47	0.5	
Benzpyrene	0703			0.63	
Phenol	1071		0.7	0.3	0.2
Cyclohexanol	1077		0.43	0.48	
Formaldehyde	1325	0.29	0.26	0.26	0.114
Cyclohexanone	1411		0.45	0.52	
Suspended matters	2902	0.8	0.6	0.6	0.4
Soluted sulphates			0.03		

* – the substances contained in emissions of designed plant are bold marked

Comparison of atmospheric pollution in Kstovo versus Dzerzhinsk shows that the concentration of sulfurous anhydride is at lower level. The concentration of carbon monoxide and nitrogen dioxide in 2002-2003 were at approximately the same level, but for the time being it is 1.5 times lower approx. The same situation is observed for suspended matters. Nevertheless, similarly to Dzerzhinsk, the additional emissions of main pollutants may require the study of compensating measures for existing sources – heat and power facilities and road transport facilities.

With regards to the specific pollutants, such as formaldehyde, benzpyrene and cyclohexanone, the level of atmospheric background pollution in Kstovo is at the same high level then in Dzerzhinsk, but the concentration of phenol is 2-3 times lower in Kstovo. What about other substances that are typical for emissions of chemical plants, there is no surveillance done for background atmosphere pollution in Kstovo.

Therefore, from man-caused air load point of view, actually the situation in Dzerzhinsk is characterized by more strained situation especially with regards to pollution by substances contained in emissions from chemical plants. Therefore, taking into account the more favorable conditions for dispersion of pollutants from Integrated Vinyls plant, Kstovo site is recommended for construction.

2.3 Geological and Geo-morphological and hydro geological conditions

Site No 1 (Kstovo industrial area)

With regards to geomorphologic aspects, the site represents erosive denudational plain on the right side of Volga River (interfluvial area of Kudma River and its right confluent – Shelokshanka River) with absolute levels of surface 86-95 m.

What about geological structure of the site under investigation, in accordance with the data of operating (up to 60-150 m depth) and survey (up to 407 m depth) wells, there are deposits of coal measures, Permian and Quaternary systems.

Within the site the surface layer is mainly represented by filled-up ground with thickness from 0.5 to 2.6 m. On the BVK site, the depth of filled-up soil is maximum, the section is mainly represented by loamy soil and rarely with clay sand interlayers, of 0.7 m thickness. The penetrated thickness of loamy soil amounts to 6.6 m, the full thickness of similar loamy soils of adjacent areas amounts to 13-14m.

Hydro geological conditions

The areas of considered site correspond to Volga-Sursk artesian basin.

The groundwater is confined to the rocks of large stratigraphic range from Quaternary to Permian deposits which differ not only by different water content but also by groundwater quality.

Within the limits of the site under investigation and its surrounding areas, the following hydro geological subdivisions penetrated by operating wells (starting from 60 years) are distinguished.

1. Low water-bearing locally water-bearing Quaternary-Diluvial alluvial system (*all*Q_{I-II});

2. Low water-bearing locally water-bearing Nizhny Urgum terrigenous system (P_2t *ur*$_1$);

3. Water-bearing Nizhne Kazan calcareous stratum (P_2kz_1).

The vulnerability category of the lower water-bearing stratum is considered as low taking into account its depth of occurrence (approximately 70 meters) and predominant clay deposit layers of water-bearing super stratum.

The penetration of pollution into groundwater is confirmed by chemical analysis of subsoil water samples – it has been discovered that the maximum allowable concentrations (MAC for groundwater) are exceeded for the content of the following elements in water:

4. Manganese (35-73 MAC);

5. Polycyclic aromatic hydrocarbons: benzene (2.86 MAC);

6. Total petroleum hydrocarbons (18.78 MAC).

The alluvial low aquifer system is highly exposed to surface and groundwater pollution. On BVK site, the surface pollution is demonstrated by hydrocarbon content in groundwater, and beyond the site – by higher nitrate and sulfates content in water chemical analysis. The underground pollution has been revealed on separate areas associated with tectonically week (valley) areas, where in result of water flow from Nizhny Urzhum aquifer system to alluvial aquifer system, the water of the latter became unsuitable for service water supply (by analysis and salinity). On separate areas, the temperature pollution of man-caused nature has been noticed.

Site No 2 (area of Igumnov forestry near Dzerzhinsk city)

The area of Dzerzhinsk forest reserves is located within III and IV left side terrace above flood-plains of Oka River with absolute height of 90.0-101.0 m.

The near-surface layer is represented by filled-up sabulous loamy soil of 0.2 to 1.2 m thickness. The filled-up soil is laid on Quaternary deposits.

Quaternary formations are represented by equal age rock system of pervasive alluvial genesis. The Permian system on considered site is represented by Tatar stage (Urzhum series) (P_2t *ur*), Kazan (P_2kz) and Sakmarian (P_1s) stages.

Hydro geological conditions

The territory of considered site corresponds to Volga-Sursk artesian basin.

In accordance with stratigraphical belonging, the following hydro geological subdivisions (similar to area in Kstovo region) are distinguished:

7. Middle Quaternary alluvial aquifer system (*all*Q);
8. Low local water bearing Nizhne Urzhum terrigenous system (P_2t ur_1);
9. Water-bearing Early Kazan carbonate package (P_2kz_1).

The water of phreatic alluvial aquifer are not protected against ingress of pollutants from surface due to the lack of strike persistent superposing impermeable barrier and aeration zone of low thickness composed mainly of sends. On the neighboring areas the abnormally high temperatures of subsoil water have been reported, which is of man-caused pollution nature.

Hazardous geological processes developed in the region of designed Integrated Vinyls Plant are: karst, karst-suffosian process, under flooding by subsoil water, swamping, plain and linear (gully erosion) erosion, landslides, heaving man-caused geological processes, seismicity.

The both areas are associated with 6 points seismic region, but since the soils composing the site correspond to III category by seismic features, the design seismicity shall be equal to 7 points.

The site of Kstovo industrial area corresponds to seasonally under flooded and in certain places – to under flooded territory. The swamping is developed on the site of Dzerzhinsk forest reserves area.

No surface deformations linked with karst-suffosian processes near Kstovo site were recorded. The site is associated with V category of karst hazard by intensity of hole formation. The forecasted hole formation intensity is in the range of 0.001-0.005 holes by each 1 km^2 per year. Dzerzhinsk site is not homogenous by its karst hazard and is complicated by many old karst funnels and hollows. The formation of karst-sliding and karst-suffosian holes formation is possible. The site of forestry is associated with higher hazardous II-V category of karst hazard by intensity of hole formation.

The land-sliding and gullying processes have not been reported directly on the sites of designed construction.

In view of quite significant depth of seasonal frost penetration at conditions of high level groundwater, the heaving process may arise in frozen dispersed soils of the both sites.

The analysis of geological and hydro geological conditions and of hazardous geological processes on the two compared sites determined that the construction of Plant on Kstovo site will have lowest negative impact on the geological environment, because:

- Kstovo site is better protected against surface pollution versus Dzerzhinsk site, since it is lesser under flooded and interlayers of low permeable rocks are encountered in the section of aeration zone.

- Kstovo site is not hazardous from the karst-suffosian processes point of view, while Dzerzhinsk site is not homogenous by its karst hazardous and has pre-conditions for potential formation of karst-sliding and karst-suffosian holes. Moreover, the construction on Dzerzhinsk forest reserves site will require additional anti-karst measures and use of special foundation structures.

2.4 Characteristic of soil covering

Nizhny Novgorod region is conventionally split by Volga river into North and South parts which apparently differ by relief, nature of vegetation, forests and, therefore by soils. The differences in relief and vegetation resulted in formation of mainly grey forest soil in higher South part, while the low-laying and even swamped in places North part is represented by soddy podzolic peaty swampy soil.

Therefore, for the region of considered sites (central part of Nizhny Novgorod region) the zonal soils are grey forest soil (Site No 1) and soddy-podzolic soil (Site No 2).

The soil covering ***of Site No 1 (Kstovo industrial area)*** was formed in result of both natural processes and economic development of the territory. The soil covering within investigated are is transformed on all surface, partly covered by asphalt pavement.

The soil covering of considered site is mainly represented by various antropogenically reworked soils – urbanozem, soils of industrial & municipal zones and soils formed under asphalt pavement.

In October 2006, “ERM Eurasia” company performed engineering and ecological investigation on considered territory of “Kstovo OPZ BVK” OAO plant and FGUP “Federal Center of Logistic”, the level of soil covering pollution has been defined.

The soils of considered site (“Kstovo OPZ BVK” OAO and FGUP “Federal Center of Logistic”) have angropogenous genesis, the concentrations of pollutants (heavy metals, organic pollutants and so on) on the significant part of profile exceed the MACs, and, correspondingly, the soil covering does not represent ecological value by its-self.

When investigating the considered territory near waste ground between existing industrial plants, the antropogenous transformed grey forest soils have been reported.

Generally, it was established that the construction of Integrated Vinyls Plant on the Ksovo industrial area site is possible from the negative impact on soil covering point of view. At the design stage, more detail soil investigation shall be

performed for the total depth of earth works, and if required, soil remediation shall be done. Depending on pollution category as per prescription of Nizhny Novgorod region Sanitary Inspection, it will be necessary to remove the polluted soil from the construction site and transfer it to utilization on the existing Municipal solid waste land fills of Nizhny Novgorod region.

The soils of ***the Site No 2 (Igumonv forestry area near Dzerzhinsk)*** were developed on the bed-rock sand alluvial deposits under effect of mainly natural factors of soil formation and are represented by soddy-podzolic soils of sand mechanical composition, which is typical for this region.

The gluying process is being developed on the swamped areas of the site.

The soils of the considered site are closed to the natural soils of the region, the antropogenous disturbance is minimal, and therefore, these soils represent a significant ecological value. The construction of Integrated Vinyls Plant on Dzerzhinsk site will lead to destruction of soil covering on the site of designed plant and to degradation of soil covering on the adjacent areas due to presence of geochemical association of the soils on considered site and on adjacent areas.

2.5 Hydro geological characteristic

The sites considered for construction of the Integrated Vinyls Plant are located within water catch basin of Volga River, the hydrographic network is represented by its confluents of different order.

With regards to the water conditions, the region under investigation corresponds to East European type, which is characterized by spring flood, which is complicated by rains. The summer-autumn period represents mean water interrupted by floods from thawing. The winter period – is steady mean water, rarely the winters are interrupted by floods from thawing. The maximum flow takes place in April, yearly minimum water flow corresponds mainly to summer mean water, less frequently – to winter one.

Nizhny Novgorod region has sufficient water reserves for construction of designed Integrated Vinyls Plant within its limits.

Site No 1(Kstovo industrial area).

The site for construction of Integrated Vinyls Plant is located in interfluves area of Kudma River and its inflow – Shelokshanka River.

There are no permanent water ponds within the intended construction site. The site of designed plant is located in the industrial area, in dividing part of water catch basin of Kudma River, at 3 km distance from water line. The surface flow conditions of the site and adjacent areas are significantly disturbed versus their natural status due to construction and industry developments, fragmentation of territory and construction of utility lines.

The main waterways located in the area of potential impact from the designed plant are Volga and Kudma rivers which actually are intensively used for domestic and industrial needs.

The water from Cheboksary water basin (Volga River – Kstovo, and Oka River – Dzerzhinsk) and Kudma River (Kstovo) is associated with middle pollution class in yearly perspective. The quality of Kudma river water is impacted by waste water of Bogorodsk and Kudma bird farm which is shown by growth of average yearly content of nitrite nitrogen in monitoring section versus background one in 2.5 times. Maximum concentrations in monitoring section amount to: manganese - 9 MAC, nitrite nitrogen - 8 MAC, copper, total iron and sulphates - 6 MAC, easily oxydable organic substances by BOD5 value and ammonia nitrogen - 4 MAC, zinc, petroleum products, phenols - 1-2 MAC.

Site No 2 (forest reserves area near Dzerzhinsk), the site for construction of Integrated Vinyls Plant is located within III and IV left-side terrace above flood-plain of Oka river with absolute elevations of surface 90.0-101.0 m at 3.6 km distance from water line of Oka river.

Within the site considered for the construction of the plant, there are eleven fully or partly swamped drainless water ponds without name. The total are of their water surface constitutes about 6.5 ha. During the period of higher wetting, the surface of water ponds increases, additional temporary small water ponds are formed in the local lower places.

The water ponds located in the area of potential impact from the designed plant along with mentioned water ponds are Oka river, which actually is intensively used for domestic needs, as well as Volga river (Cheboksary water basin) as possible receiver of treated waste water from the plant.

The priority pollutants from lowers of Oka are copper, which average yearly concentration amounts to 4 MAC, nitrite nitrogen – 2 MAC, total iron, lead, manganese, zinc, sulphates - 1-1.6 MAC. The waste water from Dzerzhinsk plants are disposed at left side, which affect the heterogeneity of pollution in river water area: the water at left side is polluted by nitrite nitrogen at 3 MAC level, while in the central part the same ingredient is of – 0.6 MAC. At left side it was recorded: total iron at 1.6 MAC (in central part – 1.2 MAC), lead – 1.3 MAC (in the central part – 0.7 MAC). The one-time concentration of most part of pollutants and

frequency of exceeding of allowable norms will also increase at left bank from Volosianikha channel inflow side.

The nameless water ponds located on the site of designed plant constitute integral part of developed ecosystems governing the development of various semi-aquatic and hygrophilous vegetation, as well as habitat of water and amphibious fauna representatives (Photo 5).

The construction and further operation of the Integrated Vinyls Plant on the considered site will lead to significant worsening of the nature ecosystem state, significant change of water conditions of the territory, sensible increase of pollutants going to surface water and will threat the existence of water ponds, in particularly the existing biogeocenosis in the whole.

In this way, the construction of Integrated Vinyls Plant on the area of forest reserves near Dzerzhinsk is highly undesirable.

Photo 5. Area considered for construction near Dzerzhinsk

The areas of designed plant intended for development are located beyond water protective zone of surface water ponds which remove the corresponding limitations for their use

2.6 State of vegetation cover

On the territory of Nizhny Novgorod region from the North to the South it is distinguished: forest area with sub-zones of fir-spruce, spruce, spruce-board-leaved

(mixed) forests, board-leaved oak forests and steppe zone represented only by sub-zone of meadow steppe.

Site No 1 (industrial area of Kstovo).

When investigating the territory it was reported that the natural vegetation typical for Nizhny Novgorod is practically not present here. The green plantations are formed under effect of antropogenous industrial landscape. Its nature is governed by the type of industrial area build-up, availability of man-caused facilities (pipelines, rail ways, storage and utilization areas, wide road network and so on).

The plantings in Kstovo industrial area are not homogenous by their locations and breed species. The plantings on territory of FGUP "Logistika" and BVK represent self-seed vegetation of the following breeds – maple ash, balsam poplar, drooping birch, sallow, stag's-head, sea-buckthorn. These plantings do not have neither esthetic nor economic significance. The reserve territory free of buildings may be considered as forest phytocenosis, however, it represents an old deforested area abandoned 25-30 years ago and voluntary overgrown by trees of low-value breeds, moreover, all territory is highly polluted by industrial and domestic wastes.

All vegetation corresponds to low-value group of plantings and is in satisfactory state.

In course of reclamation and land improvement the cutting of this vegetation will contribute to introducing of local more precious plantings typical for Nizhny Novgorod region.

The territory in the radius of 1000 m from the site of Integrated Vinyls Plant represents the fields with rare groups of birches, stag's-heads, sea-buckthorns and garden communities. The state of plantings is satisfactory. The plantings of garden plots mainly include the fruit trees: apple-trees, plum-trees, cherry-trees, fruit bushes.

Site No 2 in Dzerzhinsk area

The site for construction of Integrated Vinyls Plant is located on the territory of forest reserves near Dzerzhinsk in Nizhny Novgorod region.

The site represents a part of Igumnov forestry of Dzerzhinsk forest reserves. The forest growing on the investigated site belongs to 1 group forests (photo 6). Such plantings are dedicated to provide land protection against negative natural, antropogenous and technical effects by using soil protective, water controlling and other features of the forest vegetation.

The part of Igumnov forestry on the investigated area is of artificial origin, the plantings were made in 70 years of last century. The pines prevail in stand of trees (about 70%), birches, willow verdure, separate poplar are encountered.

The birches mainly grow near ponds where they form underwood up to 3-4m in height. In the water, the birches are in depression state and are drying up. On the banks of ponds there is stag's-head and birch verdure of 2-4 m in height, the verdure is tight up to thicket formation.

The density of pine plantations significantly differs, in certain places they are excessively tight, and in other places they are too rare because of fire. Besides the grown-up trees and pine under wood, there are many plantlets – from 1 to 3 years. The plantlets are of 10-12 cm in height, they grow by tight groups, mainly in the places of falling and glades.

The green plantation on Igumnov forestry area is recommended to be kept.

Photo 6

2.7 Characteristic of fauna

Actually in Nizhny Novgorod region, 441 vertebrate species were reported including mammal – 75 species, birds - 293 (among them 209 – build its nest), reptiles - 7, amphibious - 11, fishes - 57, cyclostomes - 2.

The fish fauna of Cheboksary water basin, which in any option of site location will be the source of its water supply and receiver of treated waste water counts 39 fish species, the most numerous are: carp family, perch family and pike family. More 20 species are in fishery business.

Site No 1 (Kstovo industrial area)

This site represents antropogenous ecosystem exposed to high negative impact from surrounding industrial plants. When investigating the territory of Kstovo industrial site, it was reported that the natural vegetation, which is typical to Nizhny Novgorod region is virtually not present here. The green plantings are formed under effect of industrial landscape.

In course of investigation, the following bird species were reported: great tit, white wagtail, hooded crow.

This territory may also be the habitat of various rodent species, and of hedgehog.

The area is characterized by low biodiversity and does not represent significant natural and ecological value.

Site No 2 (Igumnov Forestry area in Dzerzhinsk region)

The considered territory includes azonal for Nizhny Novgorod region ecosystem of pine forest and zonal ecosystem of high bog.

In course of investigation, the following bird species were reported: spotted flycatcher, common redstart, crested tit, wood lark, wood warbler, tree creeper and lesser whitethroat.

Among amphibious, the following was encountered on this territory near swamped area: common newt, common toad, edible frog, among reptiles: common lizard and grass snake.

The ant hills of red forest ants have been recorded at field survey.

This forest-covered area may be habitat for squirrel, fox and European hare and various rodent species.

The alternate site has significant ecological value and is characterized by quite high biodiversity. The construction on this site will lead to removal of habitat of various fauna representatives (including species recorded in the Red Book of Nizhny Novgorod region) and reduction of their food basis.

2.8 Integrated assessment of current environment state in the region of Integrated Vinyls Plant site. Selection of Site for plant construction.

The assessment of current state of environment components (soil covering, geological environment, vegetation covering, atmosphere, surface water ponds and so on) allowed to provide complex assessment of ecological situation in the region of Integrated Vinyls Plant construction site, to take decision about selection of site for the Plant.

The implementation of any option considered for Integrated Vinyls Plant construction site in Nizhny Novgorod region will result in negative impact on environment components. However, the degree of impact will differ depending on natural and ecological conditions of the site.

When implementing the main option of Plan construction site (Kstovo), the land resources will be withdrawn – the lands of industrial area, partly deterioration of low value representatives of vegetation, increase of load on environment, in particular increase of chemical atmospheric pollution, noise pollution.

When implementing the alternate option for location of construction site (Dzerzhinsk), the impact of the Plant proposed to be constructed on the environment will differ from the main option towards worst way by the withdrawal of forestry lands having actually high economic and ecological importance for stable functioning of natural complex of Nizhny Novgorod region, and deterioration of habitat of various representatives of local flora and fauna, including rare species, with simultaneous reduction of their food basis and, correspondingly irreplaceable reduction of biodiversity.

The results of performed integrated assessment of the current state of environment on two optional sites in Kstovo and Dzerzhinsk shown, that from the ecological and economic indicators point of view (state of environment components, availability of precious natural communities, transfer of forestry land into industrial lands, compensation of damage from cutting of precious green plantation and other), the construction of plant in Kstovo area is preferred.

The renunciation of implementation of investment project – “zero option” on Dzerzhinsk site, will allow maintaining the valuable environment ecosystem, preventing withdrawal of forestry lands and cutting of 1st category forest having ecological importance for stable functioning of environment complex of Nizhny Novgorod region and destruction of habitat of various species of local flora and fauna.

3. IMPACT ON ENVIRONMENT FROM INTENDED ECONOMIC ACTIVITY

In the course of EIA, two options of architectural and planning concepts of Integrated Vinyls Plant construction in Kstovo industrial area were considered, they differed by remoteness of main sources of negative impact of the plant from garden communities.

Two options of plant layout differ between them by location of office (offsite) and process (in-site) areas with regards to the nearest normalized buildings of garden communities “Berezka” and “Otdykh”. The main option of plant layout foresees the displacement of process area and, correspondingly, of all its sources of chemical atmospheric pollution and of noise impact towards center of the site, which allows to provide the normative distance (1000 m) up to nearest habitation area – garden community “Berezka”, in accordance with sanitary norms SanPiN 2.2.1/2.1.1.1200-03 “Sanitary protective zones and sanitary classification of plants, installations and other facilities”. Together with such a displacement, the configuration of the buildings and facilities of the process area remained practically unchanged, only layout concepts were modified.

The administrative area was extended by additional areas for parking of personnel and service cars and areas for temporary storage of equipment.

Also, the main option differs from alternate option by change of parameters with regards to sources of pollutant emissions.

The nearest habitation and other normalized buildings to plant site are located:

- in case of main option of plant location – at 1000 m distance to South-West direction from Plant process area limit (garden community “Berezka”);

- in case of alternate option of plant layout – at 850 m distance from Plant process area limit (garden community “Berezka”).

Also, a part of agricultural lands of “Mokrinskoye” agricultural company falls within the limits of normative Sanitary Protective Zone of Integrated Vinyls Plant, at 450 m to West and North-West.

3.1 Impact on atmospheric air

This section provides the assessment of impact on atmospheric air from the designed Integrated Vinyls Plant which will have place in result of pre-project proposals implementation and in course of construction works.

The configuration of the Plant includes the following process areas which functioning is associated with emission of pollutants into atmosphere:

The following is located on the plant site:

Option No 1 of design concepts (alternate case): 106 sources of atmospheric pollution, among them 88 – controlled and 18 – fugitive. 53 pollutants will be emitted into atmospheric air. Maximum one-time emission constitutes 70.1 g/s, gross value — 301.1 t/year;

Option No 2 of design concepts (main case): 109 sources of atmospheric pollution, among them 88 controlled and 21 fugitives. 53 pollutants will be emitted into atmospheric air. Maximum one-time emission constitutes 72.1 g/s, gross value — 316.1 t/year.

The increase of design maximum one time and gross emissions in Option No 2 versus Option No 1 is linked with increase of capacity of open car parking for passenger cars of employees and visitors of designed plant.

The list of emitted pollutants into atmosphere is contained in the Table 3.1.

The calculation took into account the territory of garden community as the territory of the population mass rest with higher requirements to air quality and necessity to meet the maximum surface concentrations for all emitted substances not higher than 0.8 $MAC_{one\ time}$ taking into account the background concentration on the limit of the whole territory.

The results of performed calculations generally shown that in case of Option 1 of pre-project concepts implementation, on the limit of garden community, the maximum surface concentration of dichloroethylene may achieve 0.9-1.0 $MAC_{one-time}$ (maximum allowable one-time concentrations of pollutants for population), which meets the requirements of sanitary norms applicable to the area of population mass rest.

Table 3.1. List of pollutants emitted into atmosphere

Code of substances	Designation of pollutant	Hazard class	MAC, mg/m^3		ОБУВ	Emissions			
			one-time	c.c.	mg/m^3	Maximum one-time (g/s)		Gross concentrations (t/y)	
						Option No 1	Option No 2	Option No 1	Option No 2
0101	Aluminium oxide	2	—	0.01	—	0.00136	0.00136	0.0037	0.0037
0123	Ferric oxide	3	—	0.04	—	0.0125	0.0125	0.0672	0.0672
0143	Manganese and its non-organic compounds	2	0.01	0.001	—	0.00031	0.00031	0.002	0.002
0150	Sodium hydroxide	—	—	—	0.01	0.04541	0.04541	1.786	1.786
0152	Sodium chloride	3	0.5	0.15	—	0.6662	0.6662	9.05	9.05
0154	Sodium hypochlorite	—	—	—	0.1	0.00584	0.00584	0.0007	0.0007
0155	Sodium carbonate	3	0.15	0.05	—	0.0004	0.0004	0.0001	0.0001
0161	Sodium tripolyphosphate	—	—	—	0.5	0.000101	0.000101	0.0003	0.0003
0250	Potassium iodide	—	—	—	0.03	0.00329	0.00329	0.0032	0.0032
0301	Nitrogen dioxide	3	0.2	0.04	—	4.85	3.86	95.98	95.99
0303	Ammonia	4	0.2	0.04	—	0.094	0.094	1.562	1.562
0304	Nitrogen oxide	3	0.4	0.06	—	0.612	0.619	15.46	15.5
0312	Hydrogen peroxide	—	—	—	0.02	0.000205	0.000205	0.0062	0.0062
0316	Hydrochloride	2	0.2	0.1	—	0.53024	0.53024	3.032	3.032
0322	Sulphuric acid	2	0.3	0.1	—	0.00121	0.00121	0.0359	0.0359
0328	Soot	3	0.15	0.05	—	0.02507	0.02638	0.1039	0.1123
0330	Sulphur dioxide	3	0.5	0.05	—	0.07457	0.08108	0.6076	0.6549
0333	Hydrogen sulphide	2	0.008	—	—	0.0001	0.0001	1×10^{-5}	1×10^{-5}
0337	Carbon oxide	4	5.0	3.0	—	9.363	11.186	116.5	129.7
0342	Fluoric gaseous compounds	2	0.02	0.005	—	0.00052	0.00052	0.0014	0.0014

Table 3.2. Maximum design concentration of pollutants into atmosphere from emission sources of the plant

Designation of substances	Code	Maximum design concentration, Par of $MAC_{one\text{-}time}$ at BL						Источники, дающие наибольший вклад (для территории садоводческого товарищества)			
		Industrial area		Garden community		Normative sanitary protective zone		No of source		%	
		Number of Option of project concepts									
		Opt. No 1	Opt. No 2	Opt. No 1	Opt. No 2	Opt. No 1	Opt. No 2	Opt. No 1	Opt. No 2	Opt. No 1	Opt. No 2
Dichoroethylene	0820	2.5	2.0	1.0	0.75	0.75	0.75	22	22	63	62
Nitrogen dioxide	0301	1.0	1.0	0.2	0.17	0.17	0.17	618	618	50	44
Vinyl chloride	0827	0.5	0.4	0.17	0.15	0.15	0.15	15	15	45	62
Chloroform	0898	0.5	0.4	0.17	0.15	0.15	0.15	15	15	41	40
Sodium hydroxide	0150	0.35	0.35	0.05	0.05	0.05	0.05	10	10	17	20
Sodium chloride	0152	0.35	0.35	0.05	0.05	0.05	0.05	85	85	70	62
Carbon oxide	0337	0.2	0.15	less than 0.05	less than 0.05	less than 0.05	less than 0.05	601	602	19	13
Ethylene	0526	0.15	0.15	less than 0.05	less than 0.05	less than 0.05	less than 0.05	15	15	84	92
Nitrogen oxide	0304	0.1	0.1	less than 0.05	less than 0.05	less than 0.05	less than 0.05	618	618	50	44
Other emitted substances	—	0.05-0.2	0.05-0.2	less than 0.05	less than 0.05	less than 0.05	less than 0.05	—	—	—	—

At implementation of project concepts by Option No 2, the maximum design concentration of dichloroethane at limit of garden community amounted to 0.7-0.75 $MAC_{one\text{-}time}$, which fully meets the sanitary norms for this specific substances (substances emitted only by specific plant producing specific certain product range is considered as specific substance). Because of better layout concepts and, accordingly, because of better conditions of pollutant dispersion, the pre-project concepts of Option No 2 also provide the reducing at 5-10% of maximum ground concentrations at limit of garden communities with regards to other emitted specific substances: vinyl chloride, chloroform, chloroprene, dichloroethane, ethylene oxide versus Option No 1 (the emissions of these substances will not create maximum ground concentrations exceeding 0.1-0115 $MAC_{one\text{-}time}$ for vinyl chloride and chloroform, and exceeding 0.05 $MAC_{one\text{-}time}$ for other listed substances at the limit of garden community. The Option No 2 of design concepts also provide the reducing of maximum ground concentrations at the limit of garden community for nitrogen dioxide up to 0.15 $MAC_{one\text{-}time}$ which is at 10% lower than the design concentrations of Option No 1 of design concepts, the reducing is due to the better design concept with regards to layout of large sources of emission of the concerned substance.

For specific pollutants, the background monitoring of which was not performed (dichloroethylene, chloroform, vinyl chloride), the allowable input for the territory of garden community considered as area of population mass rest with higher requirements to the quality of atmospheric air was taken as 0.8 $MAC_{one\text{-}time}$.

Taking into account the background pollution, the allowable input for nitrogen dioxide in ground level of atmosphere in garden community area, will constitute 0.45 $MAC_{one\text{-}time}$, for ammonia - 0.7 $MAC_{one\text{-}time}$, for carbon oxide - 0.32 $MAC_{one\text{-}time}$.

In case the main option of pre-project concepts is implemented, the emissions of pollutants from the sources of the designed plant will not create on the limit of garden community the maximum ground level concentrations exceeding 0.7-0.75 $MAC_{one\text{-}time}$ for dichlorethylene and 0.05-0.15 $MAC_{one\text{-}time}$ for other emitted specific substances, 0.17 $MAC_{one\text{-}time}$ for nitrogen dioxide and 0.05 $MAC_{one\text{-}time}$ for carbon oxide and, consequently, will not create concentrations exceeding hygienic norms by the factor of atmosphere chemical pollution.

The performed calculations shown that the construction of Nizhny Novgorod Integrated Vinyls Plant will not lead to above norm impact on the atmospheric air state by the factor of chemical pollution beyond design sanitary protective zone of the plant.

In general, the implementation of pre-project proposals for construction of Nizhny Novgorod Integrated Vinyls Plant will not lead to above norm impact on the state (chemical pollution) of the atmospheric air beyond the limits of design sanitary protective zone in case the main option of pre-project studies (Option No 2) is implemented provided the gas treatment equipment with treating efficiency not less than indicated in Investment Substantiation is installed.

3.2 Impact on acoustic conditions of the territory

The main sources of acoustic impact on the environment from Integrated Vinyls Plant will be the systems of forced ventilation of the process and offices buildings, the process equipment (compressors, pumps, boilers, drying and crushing equipment, transformers and so on). During construction period, the impact will be also from machines and mechanisms used at performance of construction works.

Acoustic calculations performed for the two options of process area layout show that without additional noise protection measures, the process equipment of Integrated Vinyls Plant will be the source of above norm noise effect for the nearest residential area.

The insignificant difference between the options is mainly due to the different level of noise shielding by the buildings of industrial site, and insignificant change of distances up to protected residential area.

Taking into account the developed noise protective measures, the acoustic load on the territory of garden communities will constitute 30–35 dBA in both cases, while the maximum allowable level is 40 dBA in the night time. Therefore, the negative noise impact on the nearest residential area from the designed plant is excluded.

The performed acoustic calculation shows that the construction of Integrated Vinyls Plant will not be source of noise discomfort for residents of neighboring garden communities provided the construction is performed in day time (from 7 to 23 hours). If it is necessary to continue the works in night time, the operation of noisy machines and mechanisms shall be excluded: pile driver, compressors, truck crane, dump trucks and specialized transport.

3.3 Justification of Sanitary Protective Zone size

With regards to the factor of atmosphere chemical pollution, the size of design Sanitary Protective Zone of the Integrated Vinyls Plant shall be defined on condition that beyond the limits of Sanitary Protective Zone, the maximum design concentrations of the main pollutants will not exceed 0.8 $MAC_{one\text{-}time}$ taking into account the background, and the maximum design concentrations of the specific substances, for which there are no background concentrations, shall not exceed 0.8 $MAC_{one\text{-}time}$.

With regards to the factor of air pollution, the definition of the size of Sanitary Protective Zone is governed by the following substances: dichloroethylene, nitrogen dioxide, carbon oxide.

For definition of Plant Sanitary Protective Zone's size with regards to the factor of acoustic impact, it was assumed that beyond the limits of Sanitary Protective Zone, the noise level in night time shall not exceed 40 dBA.

The integral design Sanitary Protective Zone of the considered Plant is defined as summary limit of zones where allowable impact is exceeded by two leading factors – chemical pollution of atmospheric air and acoustic impact on the territory.

It was established that the size of integral design Sanitary Protective Zone of the Plant constitutes form 850 to 1050 m in different directions for the alternate Option, the garden communities partly fall into the limits of Sanitary Protective Zone.

The size of integral design Sanitary Protective Zone of the plant in main Option constitutes from 320 to 850 m in different direction in the main Option, the existing residential buildings, in particular the garden communities and other facilities with normalized quality of the environment do not fall into the limits of the Sanitary Protective Zone.

Sanitary Protective Zone of the main Option on base map

3.4 Forecast for Soil Cover Modification

The soil cover within the limits of the plant site is transformed; partially covered by asphalt surfacing. The soils lost its natural structure, devastated and trenched in places. In some places the surface is heavily cluttered up with construction and domestic debris.

The soil contamination studies conducted at this phase show that the level of organic and non-organic soil contaminants sometimes exceeds the maximum allowable limit.

Physical damage to soil state of nature is the main impact on earth during construction works. First of all it is attributed to tree and bushes removal from the site, and the site grading. Depending on the level of damage it can be divided into:

- total destruction of vegetable soil at the main allotted site in case of construction of buildings and facilities, road embankments on the area of 44.6 ha;

- fragmental destruction of vegetable soil at the main allotted site on the area of 15.1 ha.

During site preparation for construction development the additional site surveys will be performed, and if necessary the land reclamation.

The probability of soil chemical contamination exists at both operation and operation of the Plant. This may be avoided by observance of environmental standards for construction work and environmental protection measures.

According to pre-project proposal, the landscaping and planting of greenery on the considered territory will be made. Landscaping will include measures for soil cover protection, formation of fertile soil layer by addition of clean soil to root layer.

3.5 Impact on vegetation cover

As a result of Integrated Vinyls Plant construction vegetation cover of local areas of said territory will be damaged.

The construction of Integrated Vinyls Plant implies the cutting of green plantings. This study provides preliminary calculation of approximate compensation cost for cut plantings on the proposed site. The calculation is approximate and based on the estimated price for green plantations in Nizhny Novgorod.

The plant site area makes up 59.7 ha; the vegetation at FGUP ‘Logistika’ and the BVK plant site is represented by low valuable species, which are cut down without any compensation. The vegetation of reserve territory of industrial area is represented by drooping birch and balsam poplar with the average number of plants of approx. 900 plants per 1 ha. Based on the price for hardwood of the second group which is 4’328.54 rubles per one tree, the price for planting during

the cleaning at the Kstovo industrial area will account to approx. 155 827 440 rubles.

At further design stage there will be developed an tree plan and tally sheet for trees and shrubs growing on the expected construction area will be established, and exact number of maintained, cut down or transplanted, will be defined.

After the completion of construction work landscaping and planting will be performed on the total plant area of 3.95 ha, including 1.09 ha of the plant site and 2.85 ha on the off-site plant facilities area. The plant green area coefficient makes up 6.62% of the total area. The green plantations will include grass-plot and flower-bed arrangement, trees and bushes planting.

For the plants with the staff of 300 employees and more, per 1 ha of plant area, the green plantation surface is allowed to be reduced provided that the estimated building density index is secured. The maximum green area size shall not exceed 15% of the plant territory (Construction Standards and Rules II - 89-80* 'Plants Overall Plot Plans', Article 3.73). Thus, the ratio of green area of Integrated Vinyls Plant meets standard requirements.

3.6 Impact on fauna

A number of factors arise from the area economic development and have negative effect on fauna, the factors can be divided into two groups: factors of direct impact and factors of indirect impact.

Direct impact factors include direct extermination of animals as a result of human activities on territory development: physical extermination of animals by road transport and construction machines. Such plant units as foundation pits, roads, power lines, etc. represents potential hazard to animals.

Indirect impact is associated with changes in abiotic and biotic environment which finally also effects organisms distribution, numbers and reproduction conditions. The main types of indirect impact are: animals' habitat withdrawal and transformation, noise impact produced by operated machines, violation of habitual everyday and seasonal animals' migration, human presence itself.

The economic development of area for the Integrated Vinyls Plant will be associated with soil withdrawal, which will heavily influence animals inhabiting the area. The soil cover will be transformed; drastic changes will be suffered by lithogenic soil (due to soil compacting and withdrawal), relief and stream conditions.

The Integrated Vinyls Plant is planned to be located within the Kstvo industrial area. This area represents man-made ecosystem, which is negatively affected by the nearby plants, does not comprise large biodiversity, and which does not constitute significant environmental value.

Along with the designed technical facilities construction within the allotted areas, large contiguous territories are exposed to different influences that transform animal habitats. The damaged areas exceed those designated for one or other

technical facilities. Nature and force of this factor will depend on environmental requirements observance during construction period and environmental actions undertaken later on.

3.7 Impact on surface water. Water consumption and water disposal.

The impact from designed plant on the surface-water bodies takes place when the surface water is withdrawn for domestic and process needs, and also when surface-water bodies of underground water-bearing beds get contaminated during construction and operation periods. The main and the only water body, which may be exposed to the impact of designed Plant, is the Volga River, which is the water supply source and the plant treated waste water receiver.

The major effect is put on aquatic environment *during construction period* due to partial cut down of green plantations, which damages vegetation cover. Changes in landscape structure, in their turn, cause modifications of water resources conditions and regime.

One of the ways to decrease negative consequences of topsoil and vegetation damage is the selection of the right construction season and shortest possible construction schedule for soonest reclamation of the soil.

During the plant operation water consumption and water disposal conditions are set forth in consideration of water resources optimum use and such production processes that provide minimum water consumption.

The water going to the plant after clarification (removal of suspended particles) is sent to demineralization and to other consumers. Besides process needs the water will be used by personnel for sanitary and drinking water consumption, and also as fire-water.

The plant's design raw water consumption makes up 3 841 617 m^3 per year. Annual waste waters flow rate is 1930197 m^3 (including rainwater). Irrecoverable losses, included in the final product, going to gaseous emissions, solid waste and vapors, and also those formed during area watering, amount to 2 418 555 m3 per year. Withdrawal of water resources during the operation of the Integrated Vinyls Plant will not have noticeable effect on the Volga river water content.

In the purpose of implementation of the preventive measures of surface water protection against contamination, the pre-project solutions provide the gathering and disposal of contaminated surface flow from the considered site and its sending to sewerage system covering the whole area of the plant with its further disposal to the treatment installation.

According to formation conditions, the plants' waste waters are split into sanitary, process and rainwater waste waters.

Currently in Kstovo there are water treatment facilities belonging to OOO 'Ekologichesky investor', with available free capacities, which are planned to be used during the operation of the designed Integrated Vinyls Plant. OOO 'Ekologichesky investor' performs waste waters treatment for the majority of plants in the Kstvo industrial area.

Cheboksary water basin (Volga River) is designated to be waste water receiver of the designed plant. The Cheboksary water basin is the fish-culture water body. Due to this circumstance, the water protection laws require that contaminants concentrations in the treated waste waters entering said water body must not exceed maximum allowable concentrations set by fishery organizations.

After treatment, the process and sanitary waste water will be disposed to OOO 'Ekologichesky investor' treatment facilities according to the established technical conditions. In order to comply with to the OOO 'Ekologichesky investor' technical conditions, the plant design provides local treatment facilities for process and rainwater waste water treatment.

The part of surface water flow (after the rain of 20 minutes duration) is forwarded to the TGK-6 storage pond (Novogorkovskaya heat and power plant), and then directed to OOO 'Ekologichesky investor' networks.

OOO 'Ekologichesky investor' treats all waste waters disposed to the Volga River up to the contaminants concentrations which comply with the applicable environment protection laws.

3.8 Impact on geologic environment and groundwater

Contaminants from the surface of the Integrated Vinyls Plant site in the Kstvo industrial area are likely to enter groundwater since the latter are unconfined and are not blocked by effective confining layers. In general the Kstvo industrial area of ground waters are poorly protected, or not protected at all.

The site of the plant under design is underflooded seasonally; in places permanently underflooded. Leakages during plant operation attributed to equipment wearing may induce groundwater level rise by 0.8-0.9 m after 7-9 years from the beginning of operation, and further by 1.6 m. Groundwater level will raise not only at the plant site, but at the adjacent territory as well, which means that they will be underflooded.

Area underflood may be avoided by means of drain system designed with consideration of possible groundwater level rise, control for impervious screens integrity, groundwater level measuring and timely maintenance in order to repair detected leakages.

The main requirements to be observed during the design of different pipelines are: protection of the transporting facility itself, and adopting measures to avoid

erosion, karstic and other damages on the pipeline runs, which deteriorate geologic environment.

At the plant territory there will be located the units representing potential leakage threat, namely: cooling water supply unit, brine preparation unit, VCM unit waste water treatment, PVC unit waste water storage tank, PVC waste water treatment unit, waste water reservoir, water pre-treatment unit, treated water tank, fire-water tank, rainwater reservoir, and water networks.

At the plant area there will be arranged main and intermediate feed storages, main and intermediate product storages, solid waste storing places, acid and fuel storage tanks, etc. These units will represent potential sources of the area chemical contamination.

Groundwater chemical contamination forecast is performed by the example of such model migrant as chloride anion. Migration forecast for the operation periods of 25 and 50 years showed that chlorine ions contamination with concentration exceeding maximum allowable value (for groundwater) within 25 years may extend for 800-900 m from the plant battery limit in the stream direction; and within 50 years it can be spread for approx. 1400 m from the plant battery limit.

Chemical contamination of geologic environment can be avoided by observance of all technical requirements for each facility construction and operation, integrity and leak-proofness control and timely repair of the detected damages.

3.9 Impact of process wastes on natural environment

During the construction of Integrated Vinyls Plant, 15 items of wastes will be formed at the site. The amount of these wastes will make up 119 973.55 ton during the whole construction period (June 2008 - July 2010). The major part of these wastes are of the 4th and 5th class of hazard (119 971.75 ton); and only one type of wastes refers to the 3rd class (1.8 ton).

It is planned that prior to removing to the facilities of final disposal, all wastes will be temporarily placed at the plant area in containers and at the arranged temporary waste storage grounds. These temporary waste storage grounds will be covered with temporary impervious asphalt or concrete pavement.

During the Integrated Vinyls Plant operation, 52 items of the main and auxiliary production waste will be formed in the plant area in the amount of 26 869.081 ton per year, including:

1st hazard class: 1.6 ton per year

2st hazard class: 1.661 ton per year

3st hazard class: 2104.35 ton per year

4st hazard class: 24546.72 ton per year

5st hazard class: 214.75 ton per year

The PVC complex waste will be partly disposed by specialized organizations, partly will be burned in waste incinerator, partly directed to treatment facilities, and partly buried in a landfill at the Municipal solid waste landfill.

Based on the calculation results on a potential waste amount and hazard classes, it can be concluded that the Integrated Vinyls Plant operation will mainly cause formation of low hazard and non-hazardous wastes of the 4th and 5th class (69% of total waste amount). These waste, if stored according to the suggested means of temporary waste storage within the plant site, will not have negative effect on the environment in the area of plant site.

To burry sludge from the electrolysis unit, which accounts for 81% of total wastes from the plant operation, it is suggested to arrange a 'Non-recyclable waste landfill'.

In order to store waste within the period up to waste reuse for the plant operation or economic activity, and also for transferring it to the Municipal solid waste landfill or for recycling at any other plant, there should be arranged temporary waste storages specially equipped for this purpose according to the applicable standards and rules.

Rules observance depends on knowledge of hazardous properties of waste components, readiness to take actions in emergency situations, use of appropriate storage means and conditions.

Process and consumption waste collection and storage procedures must comply with normative standards.

Waste collection conditions and limited amounts of waste collected at the plant site to be determined based on waste classification for components hazard and their physical-chemical properties (aggregative state, volatility, chemical activity, biological effect, etc).

4. MEASURES ON ENVIRONMENTAL SAFETY

The ecological laws of the Russian Federation require that the environment protection system shall:

- meet the maximum allowable norms for chemical, physical, biological and mechanical impacts on environment, personnel and population during plant construction and operation;

- meet the requirements to use of environment components;

- fulfill the requirements to design solutions with regards to mitigation (or prevention) of detrimental impact on environment during construction, including the requirements to production and consumption waste management;

- observe requirements to environmentally hazard substances composition, conditions of use, storage and transportation;

- fulfill the requirements to environmental protection measures, treatment equipment and units;

- comply with standards for labor conditions and sanitary standards;

- fulfill the requirements to plant environmental control and environment quality monitoring;

- observe sanitary norms to equipment, materials, labor conditions.

Measures on atmospheric air protection

Major measures on atmospheric air protection are aimed to ensure atmospheric air quality standards and reduction of pollutants emission to atmosphere from all sources of gaseous emission to standard level at construction phase as well as during operation of the plant.

The Integrated Vinyls Plant design should envisage the following nature-conservation measures:

- installation of gas-cleaning equipment with the efficiency no less than that adopted in the justification of investments for the building construction, namely:

  - gas-cleaning equipment in the chlorine absorption section must have chlorine removal efficiency of no less than 99.9%;
  - liquid and solid waste incineration section must be equipped with gas-cleaning equipment with the chlorine and hydrochloride removal efficiency of no less than 99.999%;
  - in the PVC-E drying unit section there must be installed bag filters with PVC dust removal efficiency of no less than 99.98, 99.99, 99.999, 99.999% respectively;

- bag filter in the section of PVC-E reagents preparation must have efficiency of dust fractions removal of no less than 99.9%;
- gas-cleaning system of the PVC-S drying section must operate with PVC dust removal efficiency of not 99.9%;
- PVC-S dust removal efficiency of PVC-S reagents preparation section filter must be no less than 99.99%;
- gas-cleaning system of the initiator synthesis section must be of ethylchlorine formate removal efficiency of no less than 99.999%;
- unreacted VCM recycle section must be equipped with gas-cleaning system of vinyl chloride monomer efficiency of no less than 99.999%;
- bag filter in the PVC-E and PVC-S drying and crushing section must be of PVC dust removal efficiency of no less than 99%;
- PVC bagging section must be equipped with bag filter with PVC dust removal efficiency of no less than 99%;
- PVC dust removal efficiency of the PVC storage section bag filters must be of no less 99.98%.

- the height of sources of emissions to atmosphere from the sections of EDC purification and oxychlorination is no less than 45 m;

- continuous supervisory control of the min and auxiliary processes.

The main measures on atmospheric air protection during construction are:

- control for toxicity and exhausted opacity of transport and special machines exhausted gases;

- lubricant leakages preventing;

- the use of construction machines with improved environmental performances.

Measures on noise protection

The main noise protection measures to be undertaken during operation are:

- to install noise silencers (plate-type noise silencers with the length – 1 m; plates – 200 mm; distance between plates – 200 mm) on input units B1–B7, B12–B22, B24;

- to install silencers (plate-type noise silencers with the length – 1.5 m; plates – 800 mm; distance between plates – 500 mm) on the crusher exhauster, crusher air filter, dryer blower, dry air exhauster, combustion air fan, and forced fan;

- to install process equipment with high noise emission (compressors, pumps, boilers, dryers and crushers, transformers, etc.) in the inner premises of the building and apply such measures as: fences sound isolation strengthening,

installation of noise silencers on natural ventilation systems in the production areas.

It is necessary to develop additional measures on noise protection of the Integrated Vinyls Plant personnel at the design phase.

Construction works are to be performed mainly in day time (since 7 AM till 11 PM) in order to prevent negative noise effect on gardening associations. If the works are required to be continued in night hours, most nosy machines and mechanisms must not be operated, namely: pile-driving equipment, compressors, truck cranes, dump trucks and special transport. In day time optimally arranged working hours must minimize operation of noisy mechanisms.

For total reduction of noise emissions, the plant design should envisage noise protection screens for most noisy equipment. Additionally noise can be reduced by a solid fence along the perimeter of the construction site, which allows for noise loads decrease on the surrounding areas.

Measures for Protection and Prudent Use of Water Resources

The main measures for protection and prudent use of water resources under the plant operation conditions are as follows:

direct the plant road traffic via hard-surfaced roads;

avoid open storages of wastes and other materials, being potential contaminant sources for surface waters;

ensure regular cleaning of the site with maximum use of mechanical tools;

lay quality turf to ground surface and protection by curbing to prevent soil runoff to roads;

localize areas of most likely feed and commercial products spills and arrange surface water drainage to the plant drainage system for treatment;

polluted surface waters to be collected from the site and discharged to the storm water system for further treatment by "Ecology Investor" (EcoIn);

install local water treatment facilities for pretreatment of industrial, sanitary, storm/snow melt waste water;

treatment of the plant wastewater at EcoIn facilities until the level of contaminants concentration complies with the effective environmental regulations.

To minimize contamination of surface water by construction vehicles outside the battery limit the Construction Organization Plan shall envisage installation of facilities for washing motor vehicles wheels at the site access/exit point.

Measures for Protection of Subsurface and Underground Water

The PVC plant to be constructed is a potential source of chemical pollution for soils and underground water. The measures to prevent contamination of the underground water inside the battery limit are: impermeable surface throughout the site, complete water sealing of all underground structures and networks, collection and discharge of storm water into the storm sewage system, sealing of all underground storages, industrial and storm water drainage pipelines.

Leaks during operation may cause a rise of underground water level. Such rise may occur not only at the site, but also in the adjacent area, which will lead to water-logging.

The water-logging in the area may be avoided by using a drainage system designed with regard for potential rise in the levels of the underground water, monitoring integrity of the vessel impermeable membrane, measuring the underground water levels and timely maintenance with elimination of detected leakages.

Measures for Reducing Impact on Vegetation

At the design development stage it is necessary to develop a plan of trees implantation and a list of plants growing inside the PVC Plant BL and define the quantities of the trees and bushes to be cut down, preserved or replanted.

(If possible) arrange the production buildings and structures in the areas which are free from trees or where felling quantities will be minimum.

Allow for landscaping and planting of greenery, including lawn making and planting trees and bushes. Plants to be selected with regard for composition of the emissions from the proposed and existing plants.

When construction sites are arranged all plants to be preserved shall be protected. The plants that are not to be cut down shall be protected with wooden fencing.

Allow for top soil and vegetation scalping and temporary storage until completion of construction or reuse at other construction sites in the same region..

Construction works and traffic circulation shall be within the allotted territory;

Off-road circulation of traffic is forbidden.

After the end of construction the lawns shall be rehabilitated, including soil cultivation, soil adding and grass sowing.

Measures for Soil Preservation

The nature preservation measures to prevent soil contamination are aimed at maximum treatment of emissions and effluents, as well as collection, storage and transportation of production wastes and consumption residue in full compliance with the waste management regulations.

The design shall allow for control and discharge of the surface waste water away from the site to prevent soil erosion.

A detail soil survey to the full depth of the earthworks shall be carried out at the stage of the design development and, if necessary, soil shall be re-cultivated. In accordance with instructions of the Sanitary Inspection of the Nijni Novgorod region the contaminated soil, depending on the type of contamination, shall be removed from the construction site and disposed of at the Municipal solid waste landfills of the Nijni Novgorod region.

To prevent secondary contamination of the soil the top soil, sand and other soils delivered to the site must have quality certificates and data sheets with radiation, environmental and agrochemical parameters.

The PVC plant design shall allow for the following soil preservation measures:

- Equipment of all areas of temporary waste storage during construction shall be such as is adequate to avoid negative impact on the site –contamination of soil, surface and underground water.

- Construction wastes should not be buried on the site or at adjacent areas, but removed to the Municipal solid waste landfills.

- It's forbidden to set up centralized temporary dumps or areas for burning wastes.

- The areas of temporary waste accumulation shall have impermeable bitumen or concrete surface.

- Construction works shall be carried out within the battery limit of the allotted territory without use of the adjacent plots.

- During demolition of the existing buildings and structures and construction works traffic circulation shall be organized only via the existing or proposed access roads avoiding the existing or proposed landscaped areas.

Environmental Measures for Management of Production Wastes and Consumption Residue

The proposed plant is a source of large volumes of wastes of various hazard categories.

To minimize the negative impact of the plant wastes on the environment and health of the residents the following measures are provided:

The wastes awaiting the reuse for production or for other plant activities, and the transportation to the Municipal solid waste landfills or to another plant for recycling shall be temporarily stored in designated areas equipped for the purpose in accordance with relevant norms and rules.

The interim waste storage areas

- shall have surface impermeable to toxic substances;

- shall have shelters and trays to prevent surface water contamination;

- access roads to interim waste storage areas shall be illuminated at day and night time;

- shall be equipped with fixed of movable on-off-loading mechanisms;

- the interim storage areas shall have a slope towards the storm drains to prevent pollutants spreading over the plant site and to response emergency waste spills.

Collecting and storing of production wastes and consumption residue shall comply with the normative documents.

The manner of interim storage of wastes depends of its class of hazard, namely:

- Class I hazard substances shall be stored in airtight containers (vessels, barrels);

- Class II hazard substances shall be stored in closed containers (closed boxes, plastic bags, sacks)

- Class III hazard substances shall be stored in paper sacks, bags, cotton sacks;

- Class IV hazard substances may be stored openly in bulk, in heap.

In case of temporary storage of toxic wastes at open areas special rules must be adhered to (location on the lee side; indestructible and impregnable to toxic substances surface – expanded clay concrete, organic concrete, tiles; the storage waste water shall not enter the storm water drainage), reliable protection of the waste mass against precipitation and wind.

Toxic industrial wastes should be transported in specially equipped vehicles to avoid accidental loss on the way and environmental pollution and to ensure convenient handling.

The in-house rules of environmental safety during collection, storage and transportation of the plant wastes for the plant personnel shall allow for conditions under which the wastes will not have negative impact on the environment and human health.

All works related to loading, transportation, unloading and burial of wastes shall be mechanized and airtight; wastes should be transported in specially equipped vehicles eliminating accidental loss of wastes on the way and environmental pollution and ensuring convenient handling:

- for transportation solid wastes and dust waste a special device or containers with lifting eyes for unloading by truck-mounted cranes at the landfill;

- when handling dust wastes moisturizing at all stages is recommended: at loading, transporting, unloading and leveling;

- unauthorized persons except for a driver and a shipment attendant shall not be involved in transportation of the industrial wastes.

5. SUGGESTIONS CONCERNING THE PROGRAM OF ENVIRONMENTAL CONTROL AND MONOTORING ORGANIZATION

Efficient environmental monitoring helps to solve the tasks of preservation of natural and man-made ecosystems located in the area of the proposed plant impact, satisfaction of the public interest and formation of an objective public opinion regarding the environmental impact of Nijni Novgorod PVC Plant.

Main phases of the environmental monitoring of the proposed plant impact :

1. Pre-construction phase. General assessment of the ecological status of the area located in the area of the proposed plant impact;

2. Construction phase. Control of compliance with the ecological requirements and recommendations for the proposed plant during construction. Analysis of the environmental dynamics;

3. Operation phase. Analysis of changes in the environment, check of effectiveness of the measures designed to minimize the plant impact on the environment of the monitored area.

For development of the program of industrial environmental monitoring the following tasks shall be implemented within a long-term local monitoring:

1) Investigation of the main features of the environmental background of the surveyed area in the Nizhny Novgorod region;

2) Assessment of the impact of the existing, not related to the plant, sources of air, soil and surface (underground) water contamination within the territory in question;

3) Use of up-to-date methods of environmental survey (sampling - preparation - analysis);

4) Elaboration and implementation of a network and schedule of continuous monitoring;

5) Analysis and extrapolation forecast of environmental changes.

The first two are the most urgent tasks, since the territory has been affected by the enterprises of this industrial zone for many years.

To provide information support of the scheduled nature preservation measures for the plant it is necessary to set up a system of industrial environmental monitoring.

Purposes of the system of industrial environmental monitoring:

• provision of reliable up-to-date environmental data, normative and reference information and model-based forecasts related to current environmental status for

decision-making by the plant environment departments and management, statutory control bodies, organizations and associations of the industry;

• support of substantiated solutions with regard to prudent use of nature, elaboration and implementation of nature preservation measures;

• study of possible environmental consequences of the proposed solutions;

• information support of urgent measures for emergencies and contingencies.

Air Condition Monitoring

The main task of the industrial environmental control performed at the operating plant is to provide control of maintenance and correct use of all production units generating atmospheric emissions.

The control system shall be based on assessment of the quantities of atmospheric emissions and comparing them with maximum allowable emission.

The PVC Plant should have two types of atmospheric emissions control: directly at the source of emission and at the boundary of the applicable sanitary protection zone from the side of the areas with controlled air quality (gardening co-operatives).

The emission control shall include monitoring of the following pollutants' content: dichloroethylene, nitric dioxide, carbon monoxide, vinyl chloride, chloroform, sodium hydroxide, ethylene, chlorine, hydrochloride, PVC dust. For substances showing at the boundary of the area with controlled air quality the maximum content shall be below 0.1 MPC and they shall not be treated (sodium hydroxide, ethylene), control to be repeated every 5 years.

Control of nitric dioxide and carbon monoxide mostly emitted by a number of fugitive sources and sodium hydroxide, which concentration is caused by emissions from a number of minor sources, should be implemented at the border of the sanitary protective zone from the side of the gardening plots.

Control of nitric dioxide and carbon monoxide emissions shall be implemented at major organized sources of these pollutants. Control of the emission rates at the sources of emission should be implemented for the sources of emission from the main equipment and all sources equipped with gas treatment devices for treatable substances. In addition to the above flare emission rates shall be controlled on a quarterly basis.

Acoustic Monitoring

Before commencement of construction background noise measurements shall be taken on site at the limits of the sanitary protective zone and in the residential area.

The measurements shall be taken in compliance with GOST 23337–78. Measuring should be done in warm and cold seasons.

A sound pressure level in the frequencies range from 31.5 Hz .. 8 kHz and a volume level shall be controlled.

Series of measurements shall be taken at day and night time, on week-days and at week-ends.

When determining the measuring points, they should be selected far from the traffic arteries or other sources of noise with the noise level exceeding the background noise level of the adjacent areas.

The obtained results will characterize the actual acoustic status of the territory.

After the plant start-up the acoustic monitoring should be carried out 2 times a year at the same locations and according to the same schedule.

Soil Monitoring

Soil contamination is caused by generation of significant amounts of highly toxic substances in the course of production.

The most hazardous are dioxins, chlorine organic compounds, polycyclic hydrocarbons. They are extremely resilient to exposure, can accumulate in ecosystem elements during migration and transformation.

That is why it is necessary to monitor the soil condition, and mainly, the level of the soil contamination by emissions.

Soil contamination survey shall be conducted according to the Guidelines on Methods of Identification of Degraded and Contaminated Lands adopted by the RF Ministry of Natural Resources, Committees on Lands and Agriculture in 1995.

Since the proposed plant is a point source of contamination, it is assumed that the level of the soil contamination is directly proportional to the distance to the source, and it is recommended to draw soil samples in 6 rhumbs (North, North-East, East, South, South-West and West) at the distances of 0.1; 0.25; 0.6 and 1 km from the battery limit of the proposed plant.

Within the sanitary protective zone the suggested number of samples is 18 (on 6 rhumbs at the distances of 0.1; 0.25; 0.6 km from the plant BL), beyond the sanitary protective zone – at the distance of 1 km from the plant BL the suggested number of samples is 4 (North, North-East, East, South-West).

Depth of sampling is 0.2 m.

Surveys are to be repeated every year.

The major contaminants to be studied are:

- sodium (exchangeable and in water extract),
- chlorides (in water extract),
- benzpyrene
- formaldehyde

- polychlorbiphenyl
- dioxins
- furans
- pH

Surface Water Monitoring

The industrial environmental control requires control of waste water quality by sampling (after water treatment) with further sample analysis in a specialized in-door laboratory.

The waste water monitoring schedule shall envisage:

- quantity and quality monitoring of waste waters at construction phase;
- control of volume and quality of all effluents of the operating plant;

Checked parameters:

- volume of discharged waste waters;
- quality of effluents according to the following parameters:
- pH;
- oil products;
- slurry (including PVC, VCM);
- iron and manganese compounds;
- heavy metals (copper, zinc, lead, chromium, cadmium, nickel);
- full BOD;
- nitrogen compounds;
- phosphorus compounds;
- Synthetic surfactants;
- general mineralization (including NaCl).

The schedule of control of the water resources use and protection shall be elaborated with regard for of the process of waste water formation and disposal.

Underground Water Monitoring

Underground water monitoring includes observation of the level, temperature, chemical composition of the underground water.

Soil investigation for the PVC plant construction substantiation requires a number of boreholes distributed both on the plant site and in the impact area.

The boreholes for monitoring shall be placed so that they control seepage from the plant to the local and regional drains, as well as the underground water flow towards the production facilities.

The monitoring should include regular checking of the level and temperature of the underground water at least 1 time every 10 days, which ensures registeration of extreme (maximal and minimal) values of changes in the geological environment during the period of observation.

Ground water sampling from the observation boreholes should be done at least 4 times a year.

Water samples shall be analyzed at an in-door laboratory having a proper certificate.

Content of the following shall be measured in the samples: ammonia, nitrites, nitrates, hydrogen carbonates, phosphates, calcium, chlorides, iron, sulphates, lithium, COD, BOD, organic carbons, pH, magnesium, cadmium, chromium, cyanides, lead, mercury, arsenic, copper, zinc, cadmium, barium, solid residue, etc.

The list of components to be analyzed should be approved by the regional Consumption Supervision Authorities (RosPotrebNadsor) for Nizhny Novgorod region.

Seismic Monitoring

To obtain reliable information on the structure response to earthquakes and shaking of ground close to buildings and structures the design of unique buildings and structures should provide for stations of seismic engineering observation.

The stations shall be designed according to special technical conditions approved by the GosStroy of the Russian Federation.

Vegetation Monitoring

Monitoring of vegetation in the area of the PVC plant impact should be conducted at sampling points selected by relevant specialists on site.

Regular (annual) geo-botanical surveys at sampling points should provide descriptions of the quality and quantity of trees, bushes, grass, phytopathology examination, chemical composition of greenery and crops growing on the plow lands to the West and South-West of the proposed plant.

Health and Social Monitoring

Health and social monitoring shall include collection and processing of information on the incidence rates among the PVC plant staff and residents of the surrounding areas (gardening co-operatives “Berezka” and “Otdykh”) on the basis of the data obtained from medical institutes and social workers.

6. ECOLOGICAL AND ECONOMIC ASSESSMENT OF EFFECTIVENESS OF ENVIRONMENTAL PROTECTION

One of the objectives of Environmental Impact Assessment (OVOS Study) for Nizhny Novgorod Integrated Vinyls Plant was to assess ecological and economic effectiveness of investment in environmental protection. The basis for assessment of ecological and economic effectiveness of investment in environmental protection is comparing of the cost of the protective measures implementation and the prevented economic damage.

It is specified that if the plant operates with a normal adopted emission (effluent) level and application of environmental protection measures the cost of production will include ecology payments of 3 681 422.79 rubles per year, while in the absence of the environmental protection measures the plant will have to deduct from the profit and pay 54 524 490.77 rubles per year . The possible environmental damage prevented by the protection measures is estimated as 50 843 067.98 rubles.

In case of actual emissions (effluents) exceeding normal adopted values and in the absence of temporary permissions for this business the payment for the excessive pollution is calculated by multiplying relevant rates for the allowable quantities for the excessive quantities of pollutants by 25 times, by the payment indexation ratio and summing up the result of multiplication for each type of pollutant. The due payment may amount to 10 503 870 252.2 rubles per year. Then the prevented environmental damage will amount to 101 705 829.4 rubles.

Paying for the pollution does not relieve the business from carrying out measures of environmental protection, fulfilling inspector prescriptions from supervising authorities and paying penalties and full compensation of damage to environment, health and property of people in accordance with the Russian federation laws. The penalty is limited to 2.3 mln rubles per month or the plant operation can be suspended up to 90 days.

The total investment in the project is € K622 902, including € K 79 944 or 21 868 345 094.4 rubles (13% of the total investment) meant for environmental protection. This figure exceeds the average investment in environmental protection in the Russian Federation which comprises $ K 33 a year, that is $ M 233 or 8% of the total investment in the project.

The investment in environmental protection can be partly compensated by exemptions provided by the state. Plants, companies, organizations and people qualify for tax, credit exemptions and other benefits if they are implementing low waste and energy saving technologies and non-conventional power sources, as well as other efficient means of environmental protection.

CONCLUSIONS

The environmental impact assessment for the PVC plant to be constructed in Nizhny Novgorod region led to the following conclusions.

The complex evaluation of the current environmental condition of two alternative sites proved that ecological and economic parameters (status of environmental elements, valuable native coenosis, transfer of lands from forest category to industrial areas, compensation of valuable plants logging) make plote № 1 in the industrial area of Kstovo a more preferable plant site than plot № 2 in Dzerzhinsk area.

Turning down the option to invest in the Dzerzhinsk "zero variant" allows to save the valuable natural ecosystem, prevents reduction of forest lands and logging of 1 category wood of ecological importance for the nature of Nijni Novgorod region.

For the site in the Kstovo industrial area the envisaged business activity is recommended.

The plot where PVC plant will be constructed is located in the Kstovo industrial area at the distance of more than 1 km from the nearest settlement. The distance from the plant BL to the plots of the gardening co-operative is 1 km.

The integral calculated sanitary protective zone of the plant in different directions extends from 320 to 850 m, but residential areas, gardening co-operatives in particular, and other sites with environmental parameters regulated by the normative requirements are beyond the limits of this zone.

Under the condition that it remains in the range of the allowable environmental impact, operates in compliance with the environmental law requirements to businesses, uses the most optimal environmental solutions, carries out recommended measures of environmental protection, the PVC plant located in Kstovo industrial area can be assessed as having a moderate negative impact.

The ecological hazard at normally operating plant is within acceptable (permissible) values.

The planned business activity will generate more new jobs for the people of the Nijni Novgorod region, will boost economy of Nijni Novgorod by product sales and tax payments and eventually contribute to well-being of the people.

The positive effects of the project realization are: employment opportunities for the people, higher income and resulting improving of demography. Refusal to develop a priority sector of Nijni Novgorod region economy – chemical industry – will mean no tax remittance to the regional budget, no stable investment flow, no growth in existing and emerging industries consumers of products produced by the plant in question.

The business activity in the Kstovo industrial area allows for preservation of environment elements currently affected by the existing enterprises.

The bitumen storage at “FGUP Logistika” and BVK plant practically out of operation and gradually leased out are environmentally hazardous as well.

Thus, a refusal to have the PVC plant means missing the opportunity to have a considerable positive effect of growing Kstovo region industry on economic and social aspects of life.

Realization of intention to invest in deployment of the PVC plant in Kstovo industrial zone will have a significant social and economic effect with minimal environmental disturbance, which is the cause of rejecting the “zero variant” for the site in the Kstovo industrial area.

The project implementation will aim at a maximum reduction of environmental impact, nature preservation and rational use of natural resources by:

- all the Project participants respecting requirements to environment protection and use of natural resources regulated by the international and Russian laws;

- elaboration and implementation of design and process solutions complying with all the relevant laws and regulations in the field of economic and industrial safety and with approvals of environmental protection authorities;

- measures for minimizing of environmental pollution;

- relevant environmental payments including damage compensation, participation in social programs of the region, insurance of environmental risks, etc.;

- measures for prevention of accidents, development and implementation of action plans for emergency situations;

- ecological monitoring and environmental industrial control at all phases of the Project;

- introduction of the system of environmental management at the plant and compliance with the up-to-date requirements to ecology of manufacturing according to GOST R ISO series 14000 and GOST R ISO series 19000;

- providing for the public participation in preparation and discussion of the materials on environmental impact as an integral part of the process of environmental impact assessment.