“APPROVED”
Project Coordinator

_____E.A.Konygin

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UNEP/GEF Project:
“Russian Federation: Support to the National Program of Action for the Protection of the Arctic Marine Environment”
NPO “Polar Foundation”

FINAL REPORT
for CONTRACT No. CS-NPA-Arctic-13/2009 of December 01, 2009
within the framework of pilot project
DEVELOPMENT OF TECHNOLOGY OF CLEAN UP OF THE AREA OF DECOMMISSIONED SITES OF THE RUSSIAN FEDERATION MINISTRY OF DEFENSE IN THE ARCTIC BY THE EXAMPLE OF ALEXANDRA ISLAND OF FRANZ JOSEF LAND ARCHIPELAGO FROM HAZARDOUS WASTE

Moscow, 2010

For Contractor
Executive Director

_____Yu.F. Sychev
“ ” _____ 2010

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Customer:	Institution “National Pollution Abatement Facility Executive Directorate”.
Contractor:	Non-Profit Organization “Foundation of Polar Research “Polar Foundation”.

Moscow, 2010

LIST OF CONTENT

1. INTRODUCTION

This report contains the results of the pilot project "Development of technology of clean up of the area of decommissioned sites of the Russian Federation Ministry of Defense in the Arctic by the example of Alexandra Island of Franz Josef Land Archipelago from hazardous waste".
Work is based on Contract for Consultancy Services No. CS-NPA-Arctic-13/2009 of December 01, 2009 between Non-Profit Organization "Foundation of Polar Research "POLAR FOUNDATION" (NPO "POLAR FOUNDATION") and Institution "National Pollution Abatement Facility Executive Directorate" ("NPAF Executive Directorate"). The contact has been concluded within the framework of the GEF grant "Russian Federation: Support to the National Program of Action for the Protection of the Arctic Marine Environment" of June 18, 2005.
In terms of content the report includes the materials from working papers of all stages completed under the Contract and the most important appendices.
The work was aimed at:

1. Identification and mapping of hazardous pollution sources at the sites of Alexandra Island in order to select the main and alternate sites for implementing the pilot project. In the course of work, it is planned to analyze the data obtained in 2007 and carry out an additionally survey of the level of soil contamination and technical liquids at selected sites.
2. Analysis of the existing domestic and foreign experience in the clean up of the territories of decommissioned military sites from drums with fuel and lubricant and PCB residuals. The determination of innovative technology for removing spent technical liquids and oils containing especially hazardous substances… The development of technological project for a mass disposal of drums containing especially hazardous substances, safe removal of their content, compacting of drums and their transportation to a drop-off station in Arkhangelsk. The development of technological project for handling waste, technological equipment and its parts, containing heavy metals. The development of technological project for disposal of the items containing sovtol and other PCB-containing liquids. Assessment of abilities and methods to dispose PCB-containing equipment from airfield service and air defence facilities at the site.
3. Purchase and testing of the necessary technological equipment.
4. Disposal of 1000 drums with fuel and lubricant residuals of different of different time of production at the selected site including their collection, transportation to clean up point and further treatment, discharge of liquid residuals from drums to special tanks, defrosting the drums if needed using specially developed techniques, clean up of drums fron fuel and lubricant residuals and hazardous pollutants with an obligatory hazardous substance discharge control. Cutting, pressing (palletizing), packaging and safe transportation to a specialized enterprise in Arkhangelsk.
5. Development of an order for prospecting and developing a project for large-scale work to clean up the area of sites of the Russian Federation Ministry of Defense on Alexandra Island of Franz Josef Land Archipelago.

The list of contamination parameters to be monitored was determined based on the requirements for soil and ground quality established by the Russian Federation regulatory docunebts (GOST, SanPiN and RD), as well as the recommendations of the Arctic Monitoring and Assessment Program

(AMAP) and the Arctic Council for the key areas of observation of the level of persistent organic pollutant (POP) content.

Non-Profit Organization Foundation of Polar Research (NGO "Polar Foundation"), is the Contractor, which carries out general administration and coordination of the survey.

State Institution "N.N. Zubov State Oceanographic Institute", LLC "I.K.M. Engineering", Saint-Petersburg, North-West Branch of SPA "Typhoon", Saint-Petersburg, Northern Hydrometerological Service Administration, Arkhangelsk and LLC "Gazoanaliticheskie Sistemy" were involved as Subcontractors.

Field work was carried out in May-June and August-Septembr, 2010 with involvement of the R/V "Mikhail Somov", RF FSS Aviation and 2nd Arkhangelsk United Air Group. The management of the Federal Nature Reserve "Franz Josef Land" was involved to monitor environmental safety as a Supervisor.

Field work and laboratory researches were based on applicable regulatory documents regulating the requirements for observation, sampling, analysis procedure and handling hazardous waste.

2. ADDITIONAL SURVEY FOR SELECTING AN EXPERIMENTAL SITE; ORGANIZATION AND METHODOLOGY OF WORK

2.1 Work program characteristics

Field work and laboratory researches at the pilot project Phase 1 were based on the results of the demonstration project "Environmental Remediation of the Decommissioned Military Base on Alexandra Island of Franz Josef Land Archipelago" in 2008. Work was carried out according to the regulatory document requirements regulating the survey of the areas of technological infrastructure elements, organization and conduction of observations of soil and ground contamination.
The scope of work was as follows:

- additional survey of the infrastructure elements to specify the number and location of the most environmentally hazardous equipment, select the experimental site to be cleaned up and remediated;
- determination of the number and exact location of especially hazardous technological infrastructure elements using the global positioning system (WGS-84 Coordinate System);
- determination of the presence of PCB-containing equipment in the technological infrastructure (transformers, radars, etc.), other equipment that is a source of extremely high contamination with aromatic and aliphatic hydrocarbons and heavy metals as well as storage of PCB-containing technical liquids (hydraulic and transformer oils) and accumulations of drums with spent industrial and motor oils;
- record of labeling of the tanks for technical liquids, oils and potentially PCB-containing equipment (radar assemblies, condensers and transformers of various capacity);
- collection of samples of technical liquids and spent industrial and motor oils (no t less than 30).
- identification of technical liquids and oils to be disposed based on standard specifications for the types of production using laboratory testing methods
- 1:1000 scale map development and plotting of the position of hazardous and other infrastructure elements at surveyed areas;
- soil sampling at the sites under technological facilties, which are sources of extremely high contamination – not less than 25 samples (from 4 to 6 per site);
- chemical analytical study of soil samples collected in the course of field work for oil products (total) PCB (-#28, #31, #52, #99, #101, #105, #118, #128, #138, #153, #156, #170, #180, #183, #187), PAH (naphthalene, benz(a)pyrene, acenaphthylene, acenaphthene, fluoranthene, fluorene, phenanthrene, anthracene, pyrene, benz(a)anthracene, chrysene, benz(b)fluoranthene, benz(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)-pyrene, benz(g,h,i)perylene), VAH(benzene, toluene, orthoxylene, sum of meta- and para- xylenes, ethylbenzene, isopropylbenzene (cumene), 1,2,4-trimethylbenzene) and heavy metals (mercury, lead, cadmium, cobalt, nickel, copper, zinc, manganese, chrome, tin);
- determination of the level of soil pollution at the locations of especially hazardous technological facilities;
- cameral processing of field work materials and results of chemical analytical study of specimens and samples;
- assessment of the level of soil pollution at surveyed technological facilities according to

international and Russian environmental assessment criteria;

- cameral processing of field work materials and results of chemical analytical study of specimens and samples, preparation of the working paper including maps and tables;
- selection of the main and alternate sites for disposal of drums with fuel and lubricant residuals based on the additional survey results.

2.2 Organization of work

Work field in the area under study was carried out in the period agreed on with the Customer – from May 17 to June 8, 2010.

Mobilization measures included preparation and performance check of equipment, manning of field crew with the specialists having necessary skills and admission to perform work according to effective labor safety and accident-prevention rules; purchase of consumables and expeditionary equipment.

The field crew and expeditionary equipment was transported to Arkhangelsk by scheduled aircraft and returned by rail.

Logistic support was provided by LLC Krokus.

The field crew left Arkhangelsk on May 16 and arrived at the settlement of Nagurskoe the same day. The areas of technological facilities were surveyed from May 17 through 27.

The personnel of the frontier post Nagurskaya rendered great assistance that made it possible to reduce the time of preparatory work and deployment of the field camp and fulfill the statement of work requirements in full measure.

The crew was transported across the territory by Ural truck having a crew box for placing equipment and personnel; fixed-route survey was being conducted on foot.

Due to a large number of polar bears in the surveyed areas the crew members were accompanied by armed military men from the frontier post.

The crew left for Arkhangelsk on June 08, 2010.

They came back to Saint Petersburg on June 01, 2010.

The field work schedule is given in Table 2.2.1.

The samples taken were submitted for chemical analytical study g.

Structured field data, results of laboratory study and report sections were submitted to NGO “POLAR FOUNDATION”.

Table 2.2.1 Field work schedule

Date	Action
14-16 May	Manning of field crew, supply of the field crew with necessary expeditionary equipment, special cloths, consumables and foodstuff. Arival at Franz Josef Land Archipelago.
17 May	Living arrangements at the frontier post. Development of working plan and its approval with the frontier post administration. Performance of work in the area of industrial and construction waste dumps near the settlement of Nagurskoe.
18 May	Performance of work in the area of fuel and lubricant storage facility near the Severnaya Bay.
19 May	Reconnaissance survey of the territory of the abandoned polar station near the Severnaya Bay.
20 May	Performance of work in the area of radar station near the abandoned air-defense station.
21 May	Performance of work in the area of the abandoned polar station near the Severnaya Bay.
22 May	Performance of work in the territory of the radar station commandant's office near the abandoned air-defense station.
23 May	Additional reconnaissance survey the territory of the radar station commandant's office.
24 May	Performance of work in the area of radar station near the abandoned air-defense station.
25 May	Additional reconnaissance survey of the territory of the radar station commandant's office near the abandoned air-defense station.
26 May	Additional reconnaissance survey of the area of fuel and lubricant storage facility near the Severnaya Bay.
27 May	Additional reconnaissance survey of a area on west coast of Severnaya Bay.
28-30 May	Packing and conservation of the samples.
01-05 June	Preliminary cameral processing of materials.
06-08 June	Waiting for aircraft and flight to Arkhangelsk.

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Picture 2.2.2 Accumulations of scrap metal in the surveyed area of industrial and construction waste dumps near the settlement of Nagurskoe

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Picture 2.2.14 Oil spill on the landscape in the surveyed area of fuel and lubricant storage facility near the Severnaya Bay

Picture 2.2.15 Oil spill on the landscape in the surveyed area of fuel and lubricant storage facility near the Severnaya Bay

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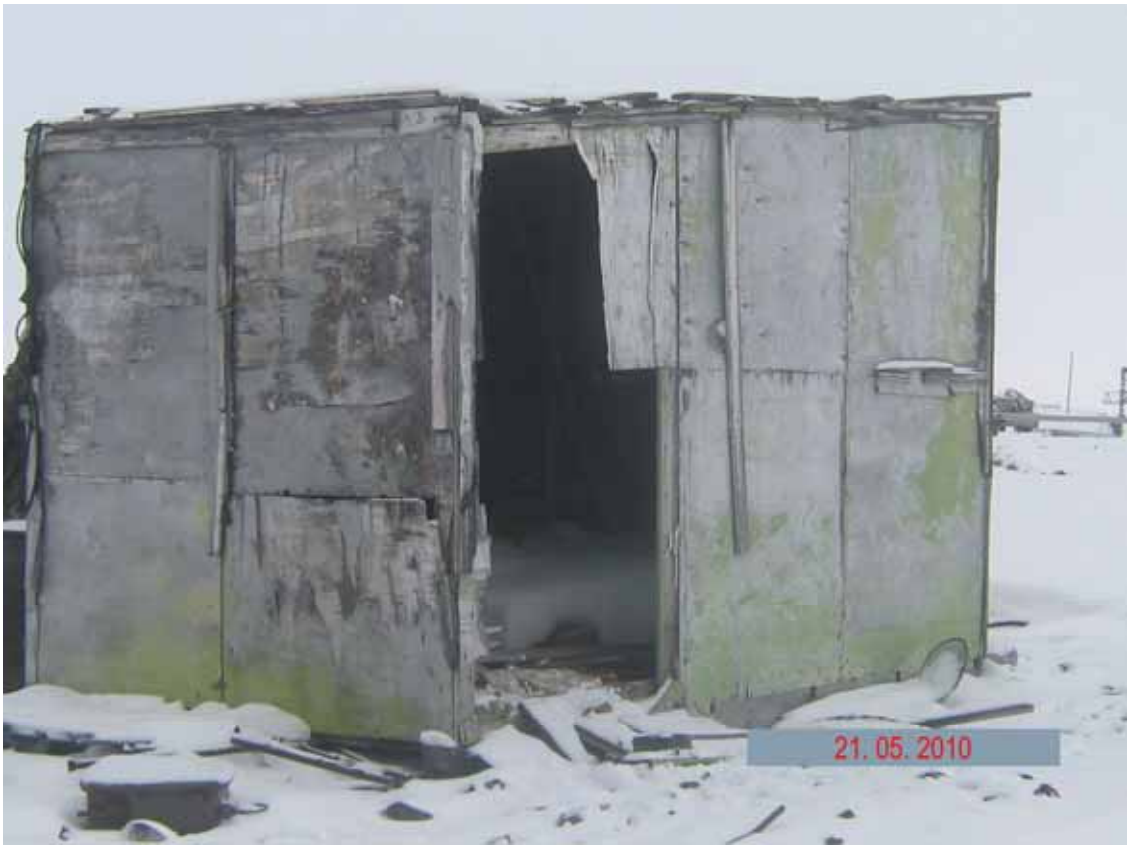
Picture 2.2.17 Diesel generator room (site 280) in the territory of the abandoned polar station

Picture 2.2.18 Room inside the diesel building with chemical agent (site 280) in the territory of the abandoned polar station

Picture 2.2.19 Diesel building (site 280) in the territory of the abandoned polar station



Picture 2.2.20 Chemical agent storage facility (site 279) in the territory of the abandoned polar station

Picture 2.2.21 Accumulation of drums in the territory of the abandoned polar station

Picture 2.2.22 Cistern R-25 in the territory of the abandoned polar station

Picture 2.2.23 Accumulation of drums and construction waste dump in the territory of the radar station commandant's office

Picture 2.2.24 Accumulation of drums and construction waste dump in the territory of the radar station commandant's office

Picture 2.2.25 Radar station commandant's office checkpoint building

Picture 2.2.26 Destroyed building of the radar station commandant's office observation

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Picture 2.2.34 Antenna and radar station building (items No. 169, 170) in the surveyed area of the radar station

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2.3 Field and laboratory examination procedures

2.3.1 Field procedure

During the survey of infrastructure elements aimed at specifying the number and location of the most environmentally hazardous equipment, the territory visual observation was made, the presence, number and location (by determining the geographical coordinates) of permanent and temporary structures, abandoned equipment and devices, other objects is recorded, their designation and type were determined, if possible, pollution of the territory with small and large industrial and domestic waste was described.

When industrial, construction and domestic waste dumps and accumulations of metal scrap and the areas of visible mechanical pollution (degree of pollution) were revealed, their location (distance and azimuth) in relation to nearest buildings and structures was specified, latitudinal and longitudinal orientation (north-south; east-west) and their boundaries were determined and a typical size of contaminated area was measured.

When cisterns, stacks and drums, condensers and transformers accumulations and other similar equipment are revealed, the presence of oil products, technical liquids, leaks and damages in them is identified in addition to the presence of labels and location.

Positioning (determination of the coordinates) of all kinds of technological infrastructure elements, determination of the boundaries of industrial, construction and domestic waste dumps,

accumulations of metal scrap, areas of visible mechanical pollution, technical liquid and soil sampling points was performed using GPSMAP 60Cx/Csx and Garmin II Plus (USA); positional accuracy is 5 m.

The states of surveyed objects, sampling, landscape at sampling points, labeling of the tanks for oil products and potential PCB-containing equipment (radar assemblies, condensers and transformers) were documented using Nicon Coolpix P6000 with the function of determining the geographic coordinates.

Soil and ground samples are collected according GOSTs 17.4.3.01-83, 17.4.402-84 from the surface layer of 0-0.2 m. The sampling points were located close to potentially hazardous objects or in the area of their direct impact (at a distance of up to 30 m). The area with visual pollution was selected for collecting sampling. At the sampling point, ground surface of about 0.5 m^2 was cleaned from snow. The sample was taken from a cleaned up area. Garbage and stones were removed from the samples then the sample was carefully blended and two specimens at least of 0.2 kg were selected by splitting, after which the specimens were placed in sealed polycarbonate containers.

Soil samples were transported and stored in thermally controlled container ISOTERM at a temperature of 4-6^{0}C until their delivery to the laboratory.

Collection of samples for identifying oil products based on the laboratory control of physico-chemical characteristics for the compliance with technical specifications was made with the use of a portable sampler according to GOST 2517-85.

Samples are placed in 1.5 L plastic tanks for packing industrial oils.

The collected samples were labeled. The original sample number included alphabetic codes of the specimen to be studied, number of region, number of sampling point, sample index number.

Collection of samples was documented in appropriate blanks.

2.3.2 Procedures for laboratory examination of samples and specimens

The composition and properties of oil products, transformer and condenser oils was determined according to regulatory documents used for input and acceptance control and also ISO and ASTM.

Content of polychlorinated biphenyls and heavy metals in technical liquids was analyzed according to ASTM D6160-98, IP470/03, ASTM D6160-97 ASTM D3831-98.

Chemical-analytical study of soils was made according to the methodology included in the State register of Quantitative Chemical Analysis Methods (Quantitative Chemical Analysis of Water. Quantitative Chemical Analysis of Soils and Wastes. Quantitative Chemical Analysis of Atmosphere Air and Atmospheric Discharge. Toxicological Control Methods. M. GUAK (State Department for Analytical Control) 1998 with amendments of 1999-2009).

The list of regulatory documents regulating the quantitative chemical analysis is given in Report's Book 1 Appendix 2.

The description of chemical-analytical study, their accuracy characteristics are given in Report's Book 1 Appendix 3.

Report's Book 1 Appendix 4 presents a list of equipment, tools, reference specimens and software used in the performance of work.

3 ADDITIONAL SURVEY FOR SELECTING AN EXPERIMENTAL SITE; SCOPE OF WORK, PROCESSING AND CONSOLIDATION OF INFORMATION

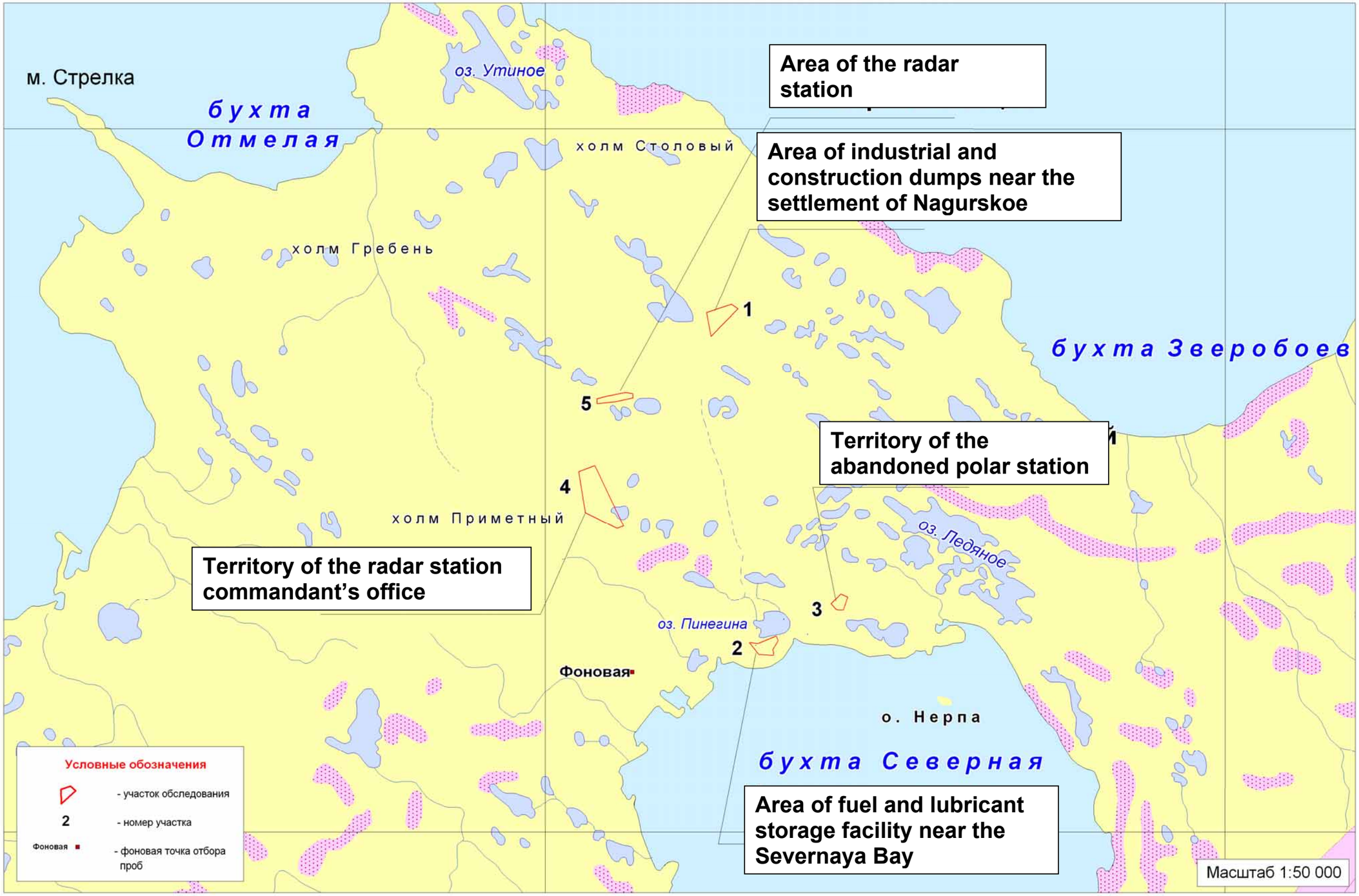
3.1 Scope of work and characteristics of arrays of information

Field work included:

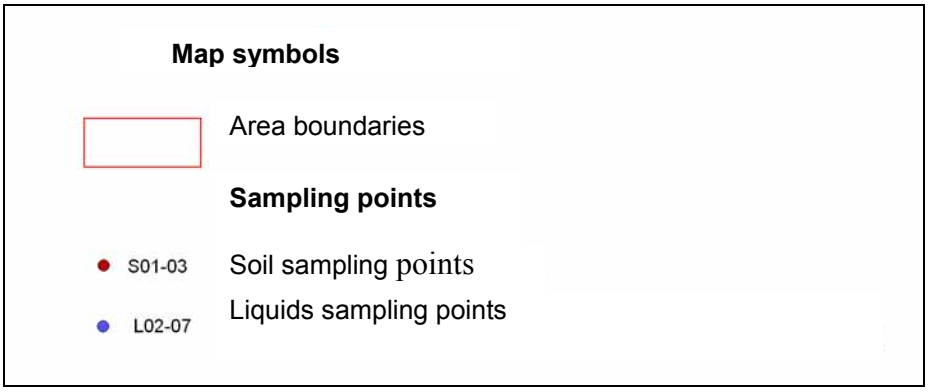
• fixed-route survey and visual inspection of the territory,
• determination of the presence in technological infrastructure of PCB-containing equipment (transformers, radar stations, etc.) other equipment, which is a source of extremely high contamination with toxic and hazardous pollutants;
• revelation of accumulations of drums with spent industrial and motor fuels;
• determination of the boundaries of the areas under study;
• positioning of all types of technological infrastructure elements, stacks and accumulations of drums for oil products;
• determination of the boundaries of industrial, construction and domestic waste dumps and accumulations of metal scrap and the areas of visible mechanical pollution;
• positioning of technical liquid and soil sampling points;
• photodocumenting of field work process, state of the sites under study, collection of samples, and landscape in sampling points;
• photodocumenting of labeling of drums for oil products and potential PCB-containing equipment (radar assemblies, condensers, transformers, etc.);
• collection of technical liquid specimens to determine their physico-chemical characteristics using the laboratory inspection;
• collection of soil and ground samples;
• preparartion, labeling, packing and storage of samples selected for chemical-analytical study in a fixed-site laboratory;
• ensuring of safety and transportation of samples to to LLC I.K.M. “Engineering’s” “Marintest” testing laboratory for chemical-analytical study;
• blank fill.

The additional survey was conductes at five areas of the decommissioned military sites of the RF MD located in 3 regions of north part of Alexandra Island (section: introduction, study area characteristics). The total area of the surveyed territories was 454.2 thousand km^2.

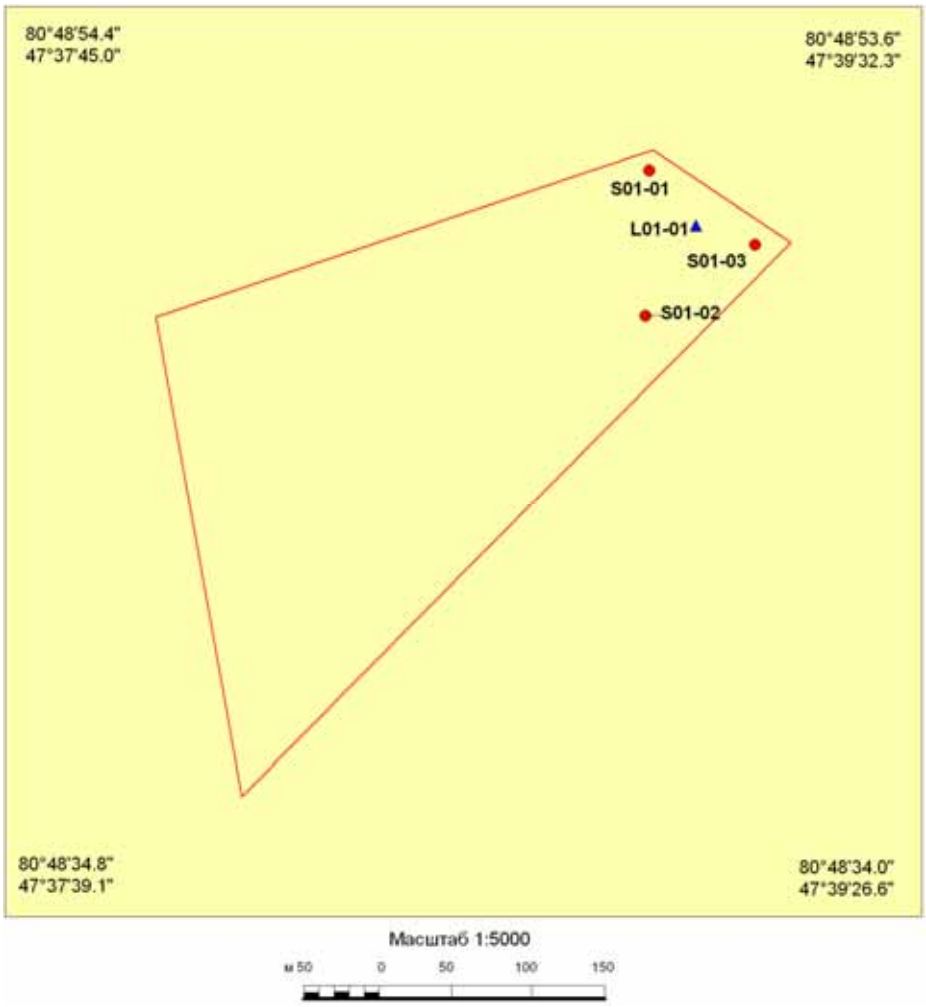
Pictures 3.1.1-3.1.7 show a location plan of the surveyed areas and schematic maps of factual materials. The geographic coordinates of the boundary turning points of the surveyed areas of the decommissioned military sites of the RF MD and location of soil and technical liquid sampling points are given in Tables 3.1.1 and 3.1.2.



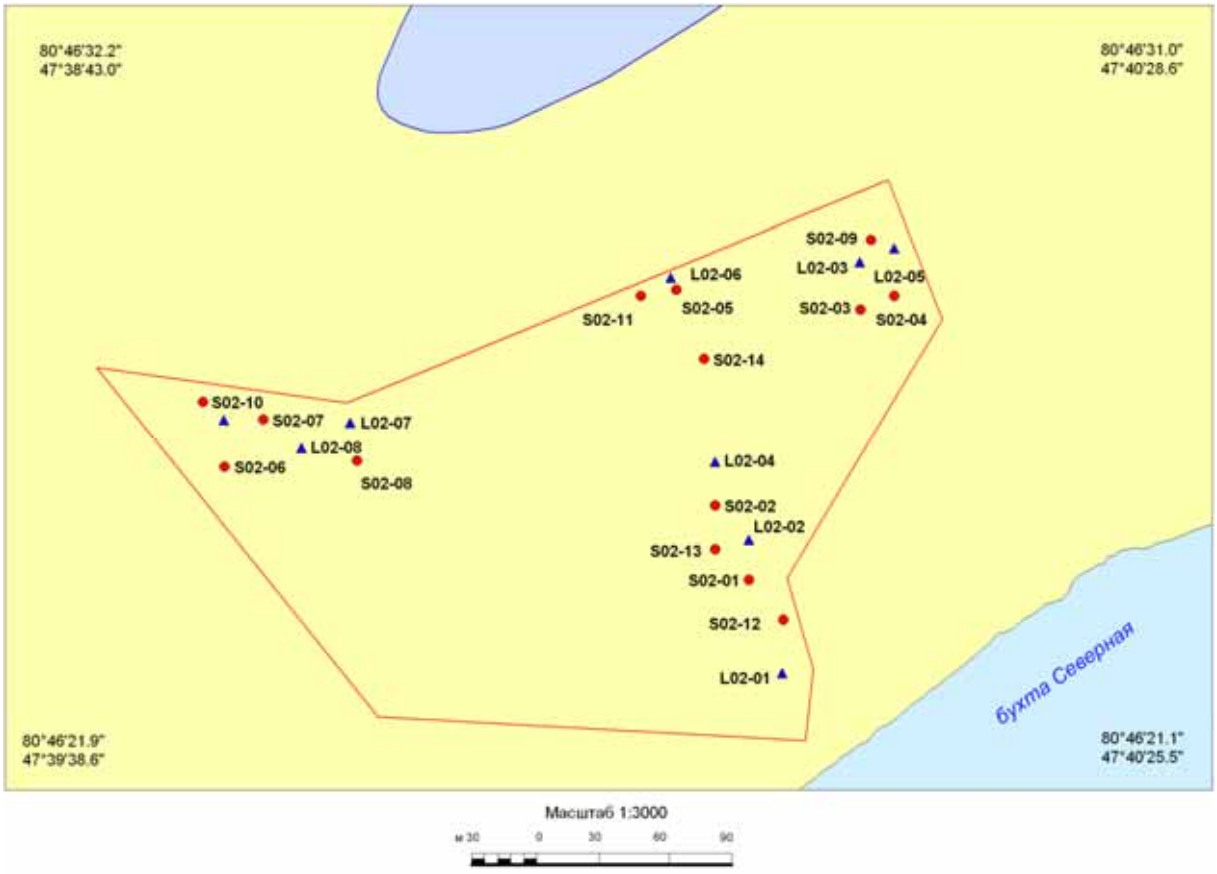
Picture 3.1.1 Location plan of survey areas on Alexandra Island



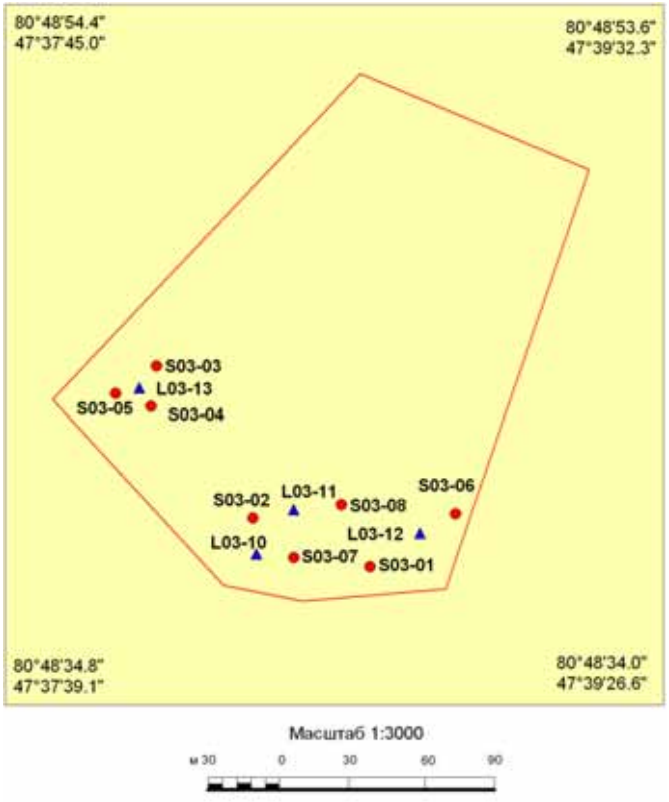
Picture 3.1.2 Map symbols for schematic maps of factual materials (Pictures 3.1.3-3.1.7)



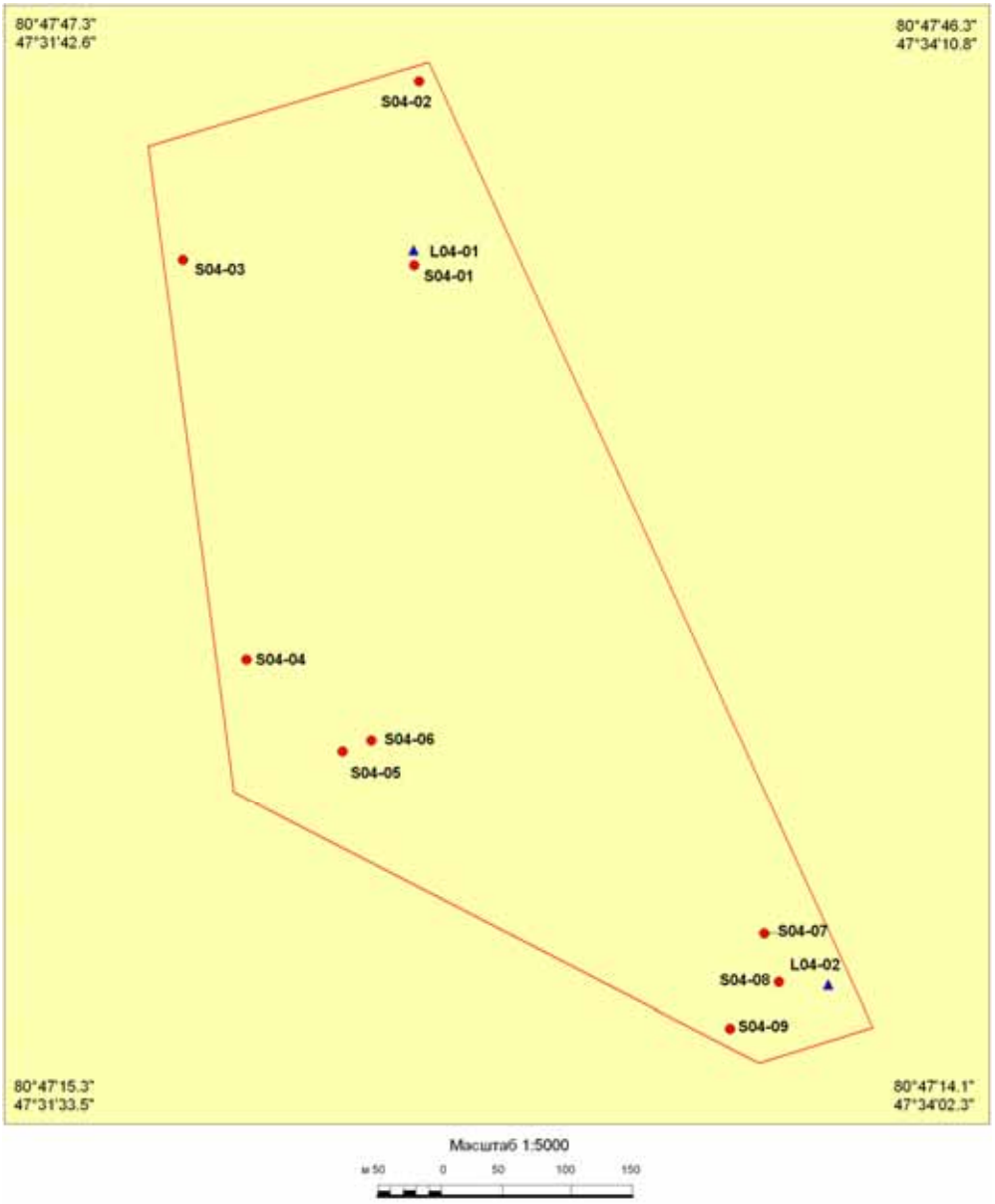
Picture 3.1.3 Schematic map of sampling points in the area of industrial and construction dumps near the settlement of Nagurskoe



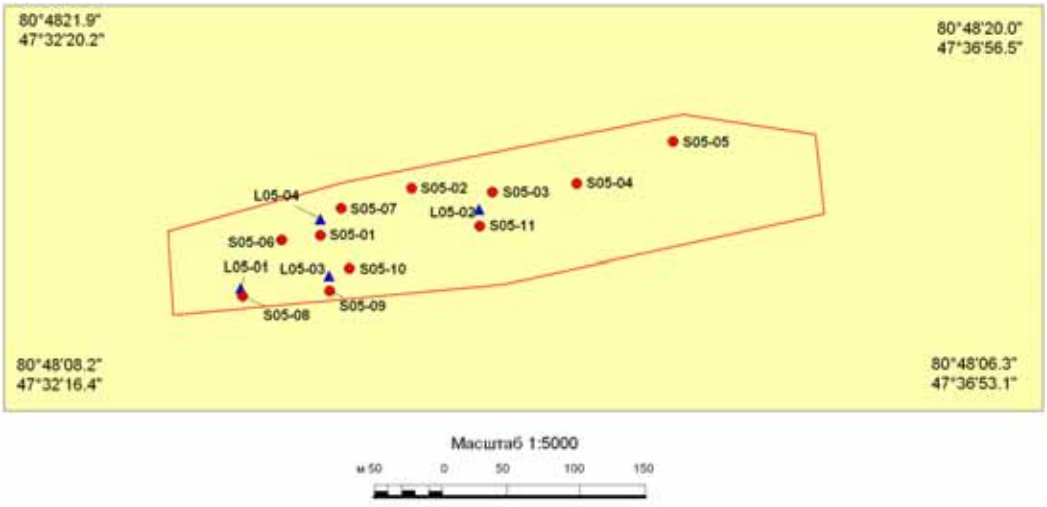
Picture 3.1.4 Schematic map of sampling points in the area of fuel and lubricant storage facility near the Severnaya Bay



Picture 3.1.5 Schematic map of sampling points in the territory of the abandoned polar station



Picture3.1.6 Schematic map of sampling points in the territory of the radar station commandant's office



Picture 3.1.7 Location plan of sampling points in the area of radar station

Table 3.1.1 Geographic coordinates of the boundary turning points of the surveyed areas of the decommissioned military sites of the RF MD on Alexandra Island

Number of Point	WGS-84 Coordinates		Area, thousand km^2
	Latitude	Longitude	
Area of industrial and construction dumps near the settlement of Nagurskoe			
1	80° 48' 51.0"	47° 38' 59.0"	82.3
2	80° 48' 53.1"	47° 38' 41.0"	
3	80° 48' 50.0"	47° 37' 34.0"	
4	80° 48' 39.7"	47° 37' 42.4"	
Area of fuel and lubricant storage facility near the Severnaya Bay			
1	80° 46' 22.1"	47° 39' 11.7"	54.0
2	80° 46' 27.5"	47° 38' 47.3"	
3	80° 46' 26.8"	47° 39' 10.3"	
4	80° 46' 29.7"	47° 40' 01.0"	
5	80° 46' 27.6"	47° 40' 05.4"	
6	80° 46' 25.0"	47° 39' 54.5"	
7	80° 46' 21.5"	47° 39' 51.0"	
Territory of the abandoned polar station			
1	80° 46' 39.8"	47° 42' 45.0"	29.5
2	80° 46' 42.4"	47° 42' 31.4"	
3	80° 46' 46.6"	47° 42' 58.4"	
4	80° 46' 45.2"	47° 43' 17.3"	
5	80° 46' 39.6"	47° 43' 03.6"	
6	80° 46' 39.5"	47° 42' 51.5"	
Territory of the radar station commandant's office			
1	80° 47' 18.9"	47° 33' 07.6"	248
2	80° 47' 19.9"	47° 33' 25.6"	
3	80° 47' 46.3"	47° 32' 15.4"	
4	80° 47' 44.0"	47° 31' 31.0"	
5	80° 47' 26.3"	47° 31' 44.8"	
Area of radar station			
1	80° 48' 14.7"	47° 34' 06.2"	40.4
2	80° 48' 13.3"	47° 33' 18.4"	
3	80° 48' 13.0"	47° 32' 29.4"	
4	80° 48' 14.9"	47° 32' 28.9"	
5	80° 48' 15.9"	47° 32' 55.5"	
6	80° 48' 17.1"	47° 33' 45.9"	
7	80° 48' 16.5"	47° 34' 05.5"	

Table 3.1.2 Location of technical liquid, fuel and lubricant and soil sampling points

Area	Point	WGS-84 Coordinates		Sampling point
		Longitude	Latitude	
1	2	3	4	5
Technical liquid, fuel and lubricant sampling points				
The area of industrial and construction dumps near the settlement of Nagurskoe	L01-01	80° 48' 51.4"	47° 38' 46.4"	400 m north of settlement of Nagurskoe, industrial and construction waste, scrap metal, 200-L drums dump (site 38), separate 200-L drum, ¾ filled (site 327)
Area of fuel and lubricant storage facility in the Severnaya Bay	L02-01	80° 46' 22.5"	47° 39' 49.1"	South part of the surveyed area of fuel and lubricant storage facility, stack of 200-L drums (site 203)
	L02-02	80° 46' 24.5"	47° 39' 46.6"	South-east part of the surveyed area of fuel and lubricant storage facility, stack of 200-L drums (site 248)
	L02-03	80° 46' 28.5"	47° 39' 58.0"	North-west part of the surveyed area of fuel and lubricant storage facility, accumulation of 200-L drums (site 219)
	L02-04	80° 46' 25.7"	47° 39' 43.8"	East part of the surveyed area of fuel and lubricant storage facility, stack of 200-L drums (site 251)
	L02-05	80° 46' 28.7"	47° 40' 01.2"	North-west part of the surveyed area of fuel and lubricant storage facility, accumulation of 200-L drums (site 219)
	L02-06	80° 46' 28.4"	47° 39' 40.5"	North part of the surveyed area of fuel and lubricant storage facility, accumulation of wooden drums with technical liquids (№254)
	L02-07	80° 46' 26.5"	47° 39' 10.4"	West part of the surveyed area of fuel and lubricant storage facility, accumulation of 200-L drums (site 249)
	L02-08	80° 46' 26.1"	47° 39' 05.8"	West part of the surveyed area of fuel and lubricant storage facility, accumulation of 200-L drums (site 250)
	L02-09	80° 46' 26.6"	47° 38' 58.8"	West part of the surveyed area of fuel and lubricant storage facility, accumulation of 200-L drums (site 252)
Territory of the abandoned polar station	L03-10	80° 46' 40.2"	47° 42' 47.9"	South part of the suveyed area of the polar station, Accumulation of drums (site283), 4 m south of Diesel building (site 280)
	L03-11	80° 46' 40.8"	47° 42' 51.2"	South part of the suveyed area of the polar station accumulation of 200-L drums (site 273)
	L03-12	80° 46' 40.4"	47° 43' 01.7"	South part of the suveyed area of the polar station, accumulation of 200-L drums (site 277)
	L03-13	80° 46' 42.5"	47° 42' 38.7"	South-west part of the suveyed area of the polar station, industrial and construction waste dump (site 269)

Continuation of Table 3.1.2

1	2	3	4	5
Area of fuel and lubricant storage facility in the Severnaya Bay	*S02-08*	80° 46' 25.9"	47° 39' 10.9"	West part of the surveyed area of fuel and lubricant storage facility, 15 m south of accumulation of 200-L drums (site 249) and 25 m east of accumulation of 200-L drums (site 250)
	S02-09	80° 46' 28.8"	47° 39' 59.1"	North-west part of the surveyed area of fuel and lubricant storage facility, boundary of accumulation of 200-L drums (site 219)
	S02-10	80° 46' 26.9"	47° 38' 56.9"	West part of the surveyed area of fuel and lubricant storage facility, 10 m north of accumulation of 200-L drums (site 252)
	S02-11	80° 46' 28.2"	47° 39' 37.7"	North part of the surveyed area of fuel and lubricant storage facility, accumulation of 200-L drums (between sites 195—194)
	S02-12	80° 46' 23.3"	47° 39' 49.5"	South-east part of the surveyed area of fuel and lubricant storage facility, south boundary of stack of 200-L drums (site 204)
	S02-13	80° 46' 24.4"	47° 39' 43.5"	South-east part of the surveyed area of fuel and lubricant storage facility, stack of 200-L drums (site 248)
	S02-14	80° 46' 27.2"	47° 39' 43.3"	North part of the surveyed area of fuel and lubricant storage facility 40 m north-east of gantry with cistenr (site196)
Territory of the abandoned polar station	S03-01	80° 46' 39.9"	47° 42' 57.3"	South part of the suveyed area of the polar station, 35 m east of of Diesel building (site 280)
	S03-02	80° 46' 40.7"	47° 42' 47.7"	South part of the suveyed area of the polar station, 10 m north of of Diesel building (site 280)
	S03-03	80° 46' 42.8"	47° 42' 40.3"	West part of the suveyed area of the polar station, industrial and construction waste dump (site 269)
	S03-04	80° 46' 42.2"	47° 42' 39.6"	West part of the suveyed area of the polar station, accumulation of 200-L drums (site 272)
	S03-05	80° 46' 42.5"	47° 42' 36.7"	West part of the suveyed area of the polar station, 17m west of accumulation of 200-L drums (site 272)
	S03-06	80° 46' 40.6"	47° 43' 04.7"	East part of the suveyed area of the polar station, accumulation of 200-L drums (site 277)
	S03-07	80° 46' 40.1"	47° 42' 51.0"	South part of the suveyed area of the polar station, 4 m east of of Diesel building (site 280)
	S03-08	80° 46' 40.8"	47° 42' 55.2"	South part of the suveyed area of the polar station, 8 m south of cistern R-25 (site 274)

Continuation of Table 3.1.2

1	2	3	4	5
Territory of the radar station commandant's office	S04-01	80° 47' 40.7"	47° 32' 13.2"	North part of the territory of the radar station commandant's office, scrap metal and metal drum dump (site 321)
	S04-01	80° 47' 40.7"	47° 32' 13.2"	North part of the territory of the radar station commandant's office, scrap metal and metal drum dump (site 321)
	S04-02	80° 47' 45.8"	47° 32' 14.0"	North part of the territory of the radar station commandant's office, scrap metal and metal drum dump (site)
	S04-03	80° 47' 40.9"	47° 31' 36.7"	East part of the territory of the radar station commandant's office, accumulation of 200-L drums (site297)
	S04-04	80° 47' 29.9"	47° 31' 46.7"	East part of the territory of the radar station commandant's office, 20 m south of destroyed bath-house (site309)
	S04-05	80° 47' 27.4"	47° 32' 01.9"	East part of the territory of the radar station commandant's office, stack of 200-L drums (site313)
	S04-06	80° 47' 27.7"	47° 32' 06.4"	East part of the territory of the radar station commandant's office, scrap metal and metal drum dump (site312)
	S04-07	80° 47' 22.4"	47° 33' 08.5"	South part of the territory of the radar station commandant's office, accumulatorl and metal drum dump (site316)
	S04-08	80° 47' 21.0"	47° 33' 10.8"	South part of the territory of the radar station commandant's office, 25m north of observation post of the radar station commandant's office (site318), scrap metal and drum dump (site 317)
	S04-09	80° 47' 19.8"	47° 33' 03.1"	East part of the territory of the radar station commandant's office, 30m east of observation post of the radar station commandant's office (site318), scrap metal and metal drum dump (site 317)
Area of radar station	S05-01	80° 48' 14.7"	47° 32' 51.6"	West part of the suveyed area of the radar station, 12m north-east of the building (site169)

Continuation of Table 3.1.2

1	2	3	4	5
Area of radar station	S05-02	80° 48' 15.7"	47° 33' 05.3"	Central part of the suveyed area of the radar station, 30 m north-west of the building (site162)
	S05-03	80° 48' 15.5"	47° 33' 17.3"	Central part of the suveyed area of the radar station, 20m north-east of the building (site162)
	S05-04	80° 48' 15.6"	47° 33' 29.8"	Central part of the suveyed area of the radar station, 30m north-west of the building (site145)
	S05-05	80° 48' 16.5"	47° 33' 44.3"	East part of the suveyed area of the radar station, 10 m north-east of industrial and constructional waste dump (site141)
	S05-06	80° 48' 14.6"	47° 32' 45.8"	West part of the suveyed area of the radar station, 5m north-west of the building (site169)
	S05-07	80° 48' 15.3"	47° 32' 54.8"	West part of the suveyed area of the radar station, industrial and construction waste dump (site328)
	S05-08	80° 48' 13.3"	47° 32' 39.6"	West part of the suveyed area of the radar station, Accumulation of drums (site329)
	S05-09	80° 48' 13.3"	47° 32' 52.5"	West part of the suveyed area of the radar station, 20m south-west of the buildingof transformer and condenser storage facility(site164)
	S05-10	80° 48' 13.9"	47° 32' 55.6"	West part of the suveyed area of the radar station, 5m east of destroyed building (site164)
	S05-11	80° 48' 14.7"	47° 33' 15.2"	Central part of the suveyed area of the radar station, 15 m south-east of the building (site162)

Table 3.1.3 gives the number of digital images shot during work. The catalog of digital images is given in Report's Book 1 Appendix 4.

Table 3.1.3 Number of digital images obtained during additional survey of the areas of decommissioned sites of RF MD in 2010

No.	Area	Number of digital images		
		Documenting of progress of work	Documenting of area state	Total
1	Area of industrial and construction dumps	1	67	68
2	Area of fuel and lubricant storage facility	53	66	119
3	Territory of the abandoned polar station	28	45	73
4	Territory of the radar station commandant's office	24	18	42
5	Area of radar station	55	61	116

The total of digital images is 418

Report's Book 1 Appendix 4 selectively presents the images made during documenting of field work process, state of the sites under study, collection of samples, and landscape in sampling points.

Table 3.1.3 gives the number and composition of technical liquid samples and specimens selected for determining their physico-chemical characteristics and the level of soil contamination in the location of especially hazardous technological infrastructure elements using the laboratory inspection.

Table 3.1.4 Type and number of samples taken during survey of the areas of decommissioned sites of RF MD in 2010

No.	Region	Area	Number of samples (specimens)	
			Soils	Technical liquids
1	**Settlement of Nagurskoe**	Area of industrial and construction dumps	3	1
2	**Severnaya Bay**	Area of fuel and lubricant storage facility	14	17
3		Territory of the abandoned polar station	8	6
-		Background sampling point	1	-
4	**Abandoned air-defense station**	Territory of the radar station commandant's office	9	2
5		Area of radar station	11	10
		Total	46	36

After the delivery of speciens and samples to the laboratory, they were accepted, sorted and prepared for laboratory study.

Report's Book 1 Appendix 2 presents the sampling records in the areas under study.

Based on the results of field observation and laboratory study of speciens and samples, an array of information has been obtained on the parameters of composition and properties of technical liquids, soil and ground pollution in the study area.

Characteristics of the array of information for groups of the parameters to be monitored are given in Table 3.1.5

Table 3.1.5 Number of the parameters to be measured at sampling points during survey of the areas of decommissioned sites of RF MD in 2010

Sampling point	Number of parameters					
	Petroleum hydrocarbons	PAH	VAH	PCB	Heavy metals	Physical and chemical parameters
Area of industrial and construction dumps near the settlement of Nagurskoe						
Soils and grounds	3	48	21	48	30	3
Technical liquids	-	-	-	16	9	13
Area of fuel and lubricant storage facility near the Severnaya Bay						
Soils and grounds	14	224	98	224	140	14
Technical liquids	-	-	-	272	153	221
Territory of the abandoned polar station near the Severnaya Bay						
Soils and grounds	8	128	56	128	80	8
Technical liquids	-	-	-	96	54	78

Territory of the radar station commandant's office near the abandoned air-defense station						
Soils and grounds	9	144	63	144	90	9
Technical liquids	-	-	-	32	18	26
Area of radar station near the abandoned air-defense station						
Soils and grounds	11	176	77	176	110	11
Technical liquids	-	-	-	160	90	130
Total	45	720	315	1296	774	513

Total of parameters - 3663

The array of information obtained is sufficient for determining oil products to be disposed and assessing soil and ground pollution in the location of especially hazardous technological infrastructure elements.

Report's Book 1 Appendix 2 presents the test and quantitative chemical analysis records for studied speciens and samples.

The statement of work provided for documenting the labels of drums for oil products and potential PCB-containing equipment (radar assemblies, condensers, transformers, etc.). Most drums had no labels or they were unreadable. The markings revealed are given in Pictures 3.1.1 – 3.1.17.

Picture 3.1.1 Drum with oil product (site 327) in the surveyed area of industrial and construction dumps near the settlement of Nagurskoe

Picture 3.1.2 Radar station high-voltage equipment at the condenser and transformer storage facility (site 164) in the surveyed area of the radar station

Picture 3.1.3 High-voltage condenser at the condenser and transformer storage facility (site 164) in the surveyed area of the radar station

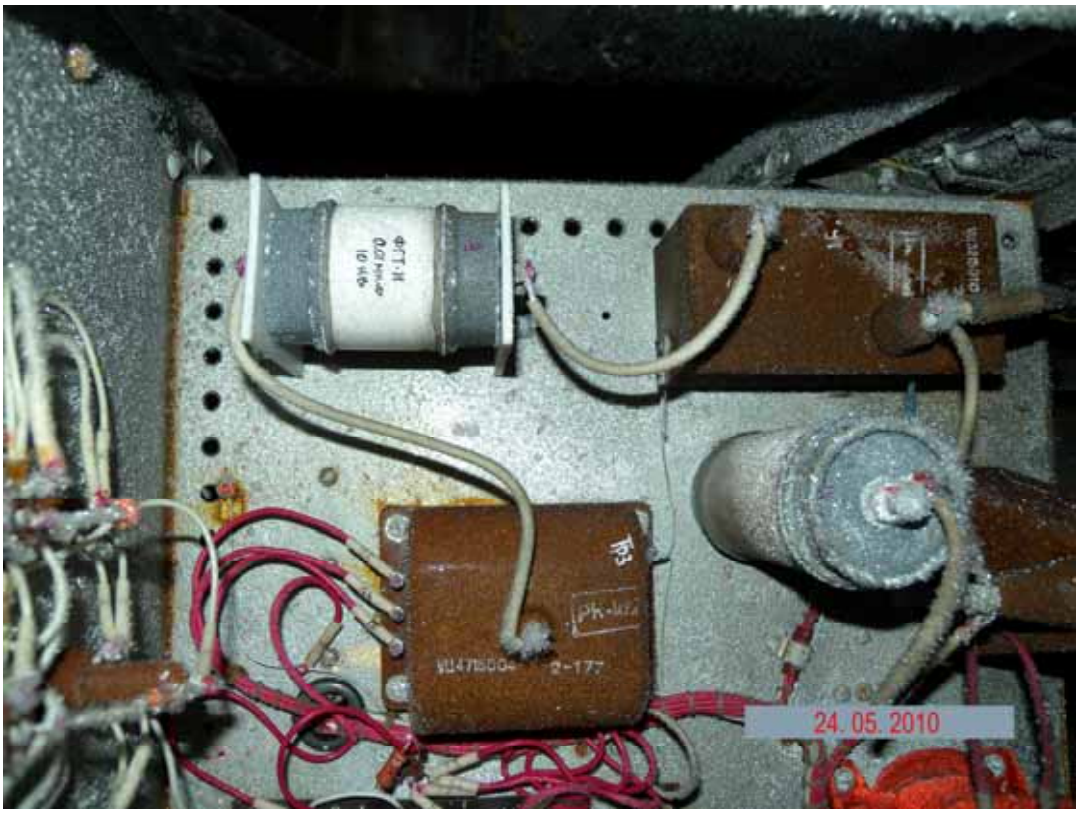
Picture 3.1.4 Accumulation of drums with oil products in the territory of the radar station commandant's office

Picture 3.1.5 Radar station high-voltage equipment at the condenser and transformer storage facility (site 164) in the surveyed area of the radar station

Picture 3.1.6 Radar station high-voltage equipment at the condenser and transformer storage facility (site 164) in the surveyed area of the radar station

Picture 3.1.7 Radar station equipment in the radar station (site 169) in the surveyed area of the radar station

Picture 3.1.8 Radar station equipment in the radar station (site 169) in the surveyed area of the radar station



Picture 3.1.9 Radar station high-voltage equipment in the radar station (site 169) in the surveyed area of the radar station

Picture 3.1.10 Radar station equipment in the radar station (site 169) in the surveyed area of the radar station

Picture 3.1.11 High-voltage current transformer at the transformer dump (site330) in the surveyed area of the radar station

Picture 3.1.12 High-voltage current transformer at the transformer dump (site330) in the surveyed area of the radar station

Picture 3.1.13 High-voltage current transformer at the transformer dump (site330) in the surveyed area of the radar station

Picture 3.1.14 Diesel power station at the radar station equipment dump in the surveyed area of the radar station

Picture 3.1.15 Diesel power station at the radar station equipment dump in the surveyed area of the radar station

Picture 3.1.16 Chemical agent pack at the chemical agent storage facility (site 279) in the territory of the abandoned polar station

Picture 3.1.17 Labeling of the drum in an accumulation of 200-L drums (site 277) in the territory of the abandoned polar station

3.2. Processing and consolidation of information

Information obtained during field observation and laboratory study within the framework of pilot project Phase 1 was consolidated for the surveyed areas of infrastructure elements:

- settlement of Nagurskoe - area of industrial and construction dumps (area 1);
- Severnaya Bay - area of fuel and lubricant storage facility (area 2) and territory of the abandoned polar station (area 3);
- abandoned air-defense station – territory and commandant's office (area 4) and area of the radar station (area 5).

Based on the results of the additional survey with geodetic tie of the elements according to data from the global positioning system (WGS-84 Coordinate System) the element's records and electronic situational maps of the areas were created in 1:1000 scale with indicated sources of hazardous pollution (industrial, construction and domestic waste dumps, accumulations of scrap metal, stacks and accumulations of drums for oil products, PCB-containing equipment, etc.)

Processing of on soil and ground pollution included the determination of extreme and calculation of average values for specific pollution parameters, calculation of total content of compunds belonging to the same group (pollutants). Recalculation of mass concentration of the general quality indicators into MPC, APC, PC and IL (using international criteria of environmental assessment of soil and ground pollution), the calculation of values of complex factors and definition of qualitative characteristics used to assess level (degree) of pollution according to regulatory documents

Statistical processing, analysis of spatial distribution of pollution and mapping of data were carried out using the following software: MS Excel XP, Surface Mapping System 8.0 and GIS MapInfo Professional 8.0.

In preparing the schematic maps of the location of the actual material, electronic blank maps were used as topographic base prepared on the basis of topographic maps of scale 1:50 000 and color synthesized, transformed and linked to reference points of high resolution satellite images (pixel size is 60, WGS-84 Coordinate System). Information bound to coordinates was displayed on a schematic map as a separate vector layers. Editing, final design and printing or maps was made in the GIS package MapInfo Professional 9.0.

Electronic blank maps of Alexandra Island also were a topographic base of situational plans of the surveyed areas. According to the level of revealed sites the following layers were creates on the maps displaying:

- areas littered metal drums (less and more than 10-20 drums per ha);
- littered areas (logs, planks, metal structures).
- buildings and structures of technical and general purposes;
- tanks and cisterns for fuel and lubricant;
- gantries with established cisterns with fuel and lubricant;
- stacks of 200-L drums with fuel and lubricant;
- accumulations of drums;
- radar stations;
- vehicles (tracked, wheeled vehicles, trailers, semitrailers);
- aircrafts,

- wooden gantries;
- power lines;
- heat pipelines;
- Industrial waste and garbage dumps;
- buildings and structures, cisterns for fuel and lubricant on gantries, stacks of 200-L drums

on 1:5000 scale maps are shown as dot signs on 1:1000 ones as areal.

Situational plans of the surveyed areas are presented in printing form on A3 sheets in scales of 1:1000, 1:2000 and 1:2500 in Report's Book 1 Section 4 and included in the electronic appendix in GIS MapInfo in scale of 1:1000.

4. ADDITIONAL SURVEY OF THE AREAS OF INFRASTRUCTURE FACILITIES TO SPECIFY THE NUMBER AND LOCATION OF HAZARDOUS POLLUTION SOURCE

4.1 Area of industrial and construction dumps near the settlement of Nagurskoe

The dumps are located 300 m north west of the settlement of Nagurskoe. The coordinates of the surveyed area boundary turning points in WGS-84 Coordinate System are given in Table 3.1.1. The area of territory is 82.3 thousand square m.

Based on the results of the additional survey with geodetic coupling of the items according to the Global Positioning System is composed situational plan of the area with indicated sources of hazardous pollution in scale of

1:1000 in electronic form in GIS MapInfo format. Situational plans in printing form in scale of 1: 2000 is presented in Figure 4.1.1.

The facility record presented on the situational plan is given in Table 4.1.1. Table contains a unique serial number, name and coordinates in WGS-84 Coordinate System

Total number of the elements in the area - 19.

200-L drums at the dump are empty, the sample was taken from a separate drum (site 327 on situational plan).

The area of the dumps containing PCB in soil in amount multiply exceeding permissible concentrations (PC) according to international standards (report section 5) is 6200 square m

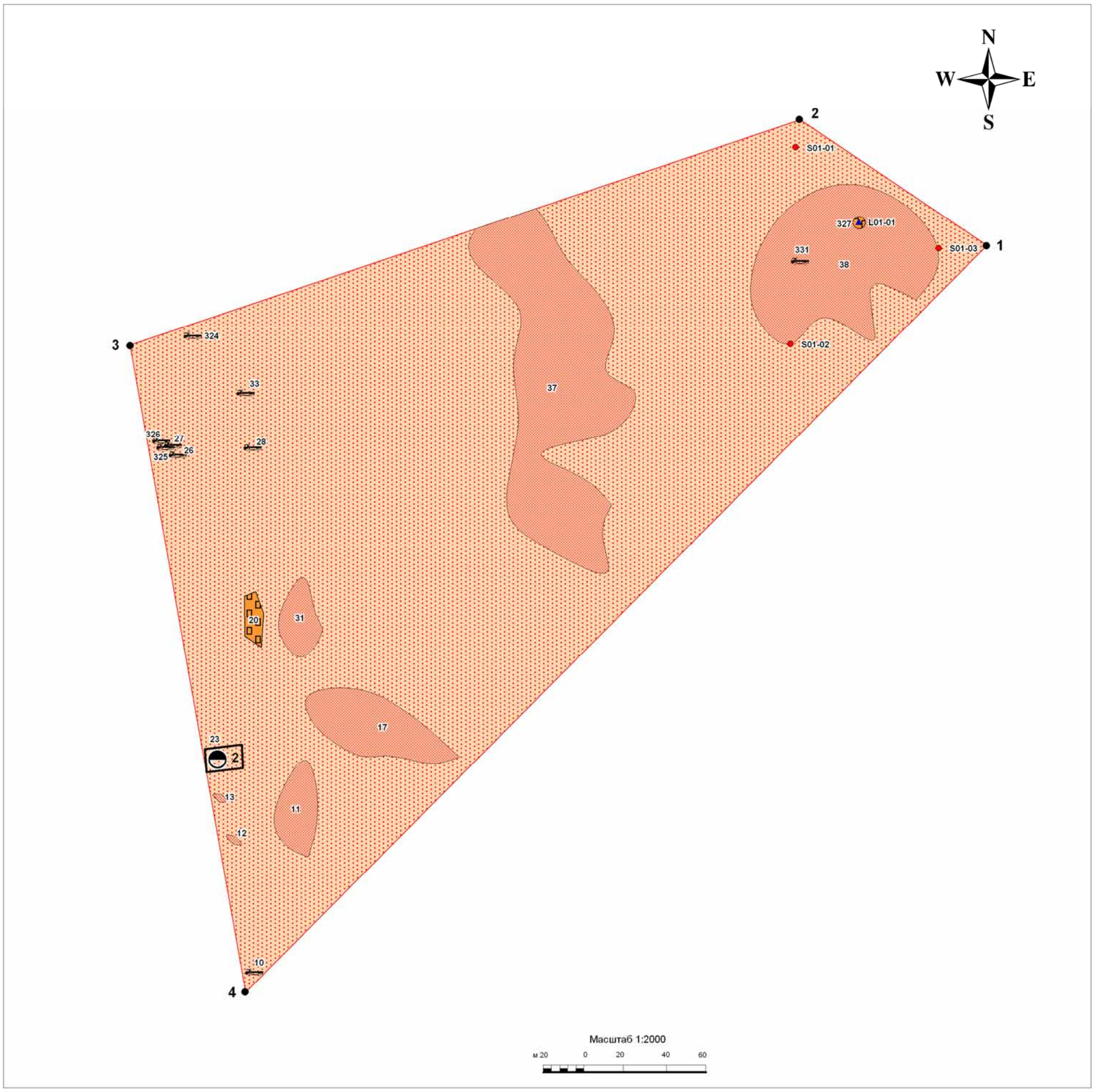


Figure4.1.1 Situational plan of the area of industrial and construction dumps near the settlement of Nagurskoe

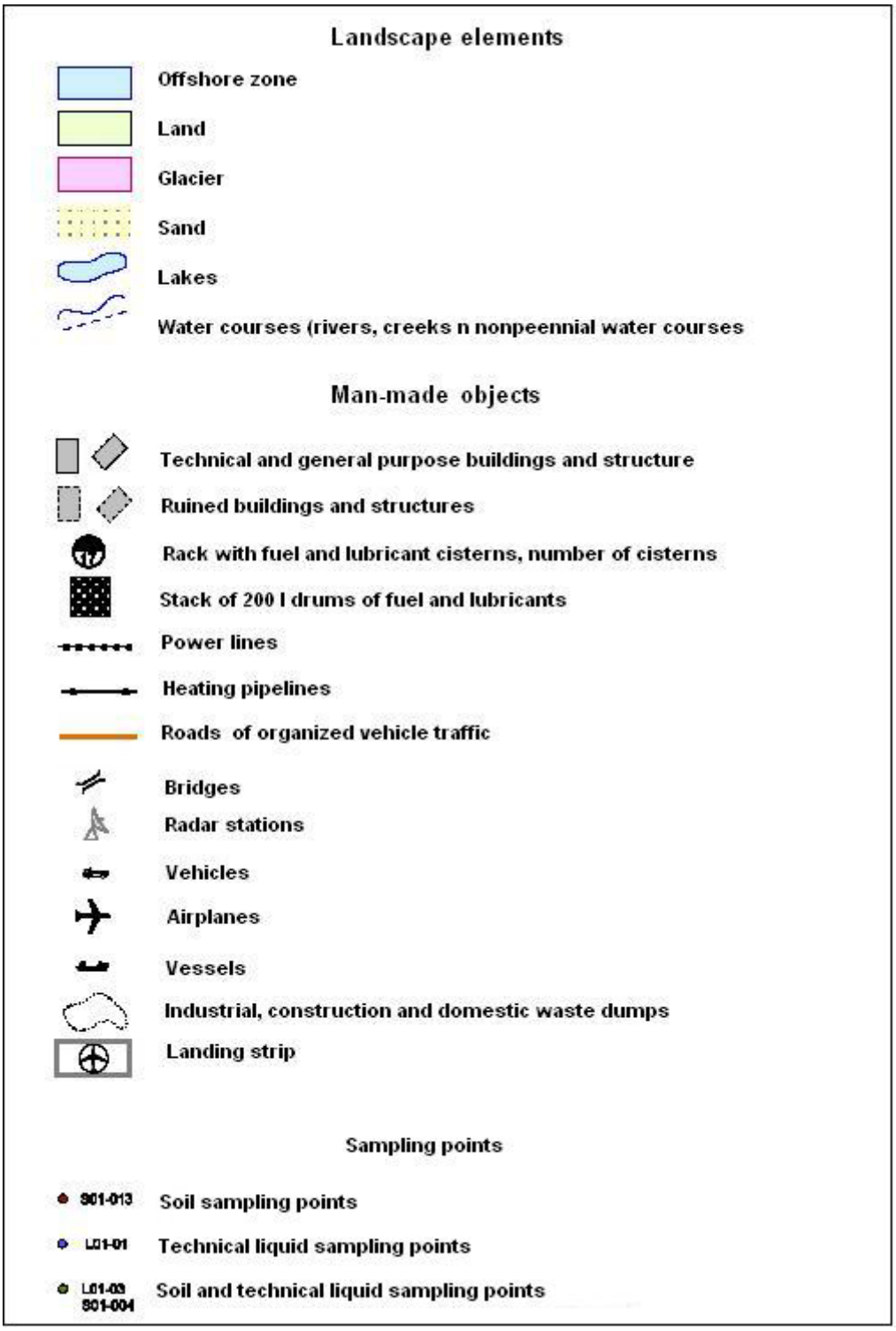


Figure 4.1.2 Legend

Table 4.1.1 Facility record in the area of industrial and construction dumps near the settlement of Nagurskoe

No.	Number of the site on situational plan	Name	Coordinates, WGS-84	
			Latitude	Longitude
1	324	Vehicle (trailer)	80° 48' 50.1"	47° 37' 40.2"
2	33	Vehicle (ZIL truck)	80° 48' 49.2"	47° 37' 45.1"
3	28	Vehicle	80° 48' 48.3"	47° 37' 45.7"
4	326	Vehicle (autocrane on MAZ truck)	80° 48' 48.5"	47° 37' 36.7"
5	325	Vehicle (GAZ truck)	80° 48' 48.4"	47° 37' 37.0"
6	27	Vehicle	80° 48' 48.4"	47° 37' 37.8"
7	26	Vehicle (GAZ truck)	80° 48' 48.3"	47° 37' 38.2"
8	10	Tracked vehicle (tractor)	80° 48' 40.1"	47° 37' 43.6"
9	20	Accumulation of 200-L drums	80° 48' 45.5"	47° 37' 44.9"
10	31	Industrial and construction dump	80° 48' 45.5"	47° 37' 49.5"
11	17	Industrial and construction dump	80° 48' 43.8"	47° 37' 57.1"
12	13	Industrial and construction dump	80° 48' 42.8"	47° 37' 41.1"
13	11	Industrial and construction dump	80° 48' 42.6"	47° 37' 48.3"
14	12	Industrial and construction dump	80° 48' 42.1"	47° 37' 41.9"
15	23	Cistern with fuel and lubricants	80° 48' 43.5"	47° 37' 40.9"
16	37	Industrial and construction dump	80° 48' 49.0"	47° 38' 15.4"
17	327	Separate filled 200-L drum	80° 48' 51.4"	47° 38' 46.4"
18	38	Industrial and construction dump, metal 200-L drums	80° 48' 50.7"	47° 38' 44.8"
19	331	Tracked vehicle	80° 48' 50.9"	47° 38' 40.5"

4.2 Severnaya Bay

4.2.1 Area of fuel and lubricant storage facility near the Severnaya Bay

Fuel and lubricant storage facility is located 4.2 km south of the settlement of Nagurskoe. The coordinates of the surveyed area boundary turning points in WGS-84 Coordinate System are given in Table 3.1.1. The area is 54 thousand square m.

Based on the results of the additional survey with geodetic coupling of the items according to the Global Positioning System is composed situational plan of the area with indicated sources of hazardous pollution in scale of 1:1000 in electronic form in GIS MapInfo format. Situational plan in printing form in scale of 1:1000 is presented in Figure 4.2.1.

The facility record presented on the situational plan is given in Table 4.2.1. Table contains a unique serial number, name and coordinates in WGS-84 Coordinate System WGS-84

Total number of the elements in the area - 41.

Number of 200-L drums in accumulations (items No. 178, 181, 194, 195, 195-1, 219, 217, 186, 199, 198, 249, 250, 251, 252 on situational plan) - 0.3-0.4 thousand pcs. Average percent of drums filled with oil products -10 – 15 %.

Number of 200-L drums in stacks (items No. 179, 180, 187, 208, 209, 207, 184, 185, 202, 204, 201, 216, 205, 206, 183, 197, 203, 182, 248 on situational plan) - 11.2-11.5 thousand pcs. 50-55% of drums are filled with oil products.

Number of wooden drums with semisolid lubricant (site 253) - 50-70, with technical liquids (site255) – 30-50, with industrial waste (site255) – 40-60.

The area of the s containing PCB in soil in amount multiply exceeding permissible concentrations (PC) according to international standards (report section 5) is 10400 square m

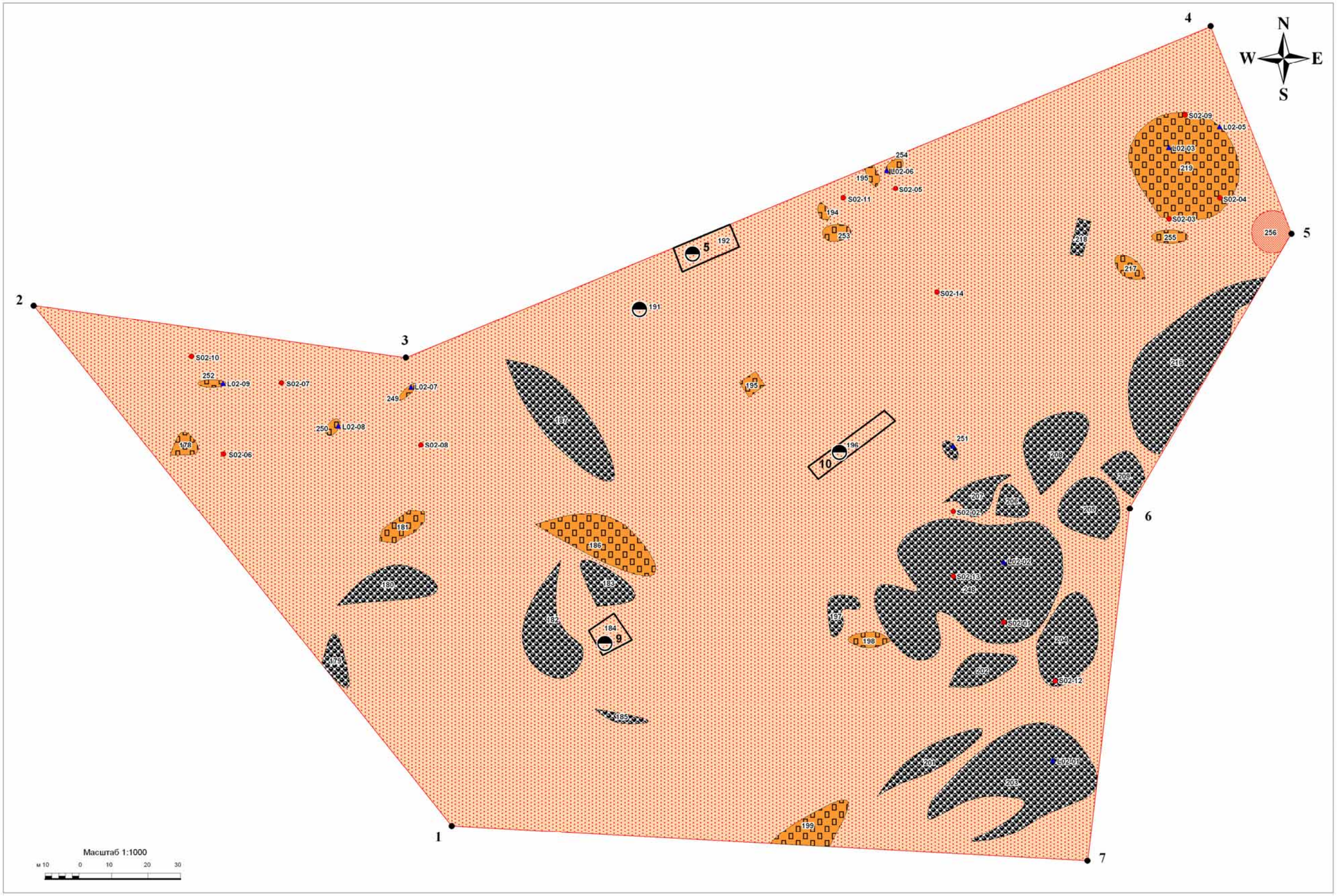


Figure4.2.1 Situational plan of of the area of fuel and lubricant storage facility near the Severnaya Bay

Table 4.2.1 Facility record in the area of fuel and lubricant storage facility near the Severnaya Bay

No.	Number of the site on situational plan	Name	Coordinates, WGS-84	
			Latitude	Longitude
1	178	Accumulation of drums with fuel and lubricant	80° 46' 26.0"	47° 38' 56.1"
2	181	Accumulation of drums with fuel and lubricant	80° 46' 25.1"	47° 39' 09.4"
3	179	Stack of 200-L drums	80° 46' 23.8"	47° 39' 05.0"
4	180	Stack of 200-L drums	80° 46' 24.6"	47° 39' 08.4"
5	187	Stack of 200-L drums	80° 46' 26.1"	47° 39' 19.5"
6	192	Fuel and lubricant cisterns	80° 46' 27.8"	47° 39' 29.1"
7	194	Accumulation of drums with fuel and lubricant	80° 46' 28.1"	47° 39' 36.6"
8	195-1	Accumulation of drums with fuel and lubricant	80° 46' 28.5"	47° 39' 39.5"
9	219	Accumulation of drums with fuel and lubricant	80° 46' 28.3"	47° 39' 58.6"
10	218	Fuel and lubricant cisterns	80° 46' 27.7"	47° 39' 52.4"
11	217	Accumulation of drums with fuel and lubricant	80° 46' 27.4"	47° 39' 55.3"
12	208	Stack of 200-L drums	80° 46' 25.6"	47° 39' 50.1"
13	209	Stack of 200-L drums	80° 46' 25.3"	47° 39' 54.3"
14	207	Stack of 200-L drums	80° 46' 25.2"	47° 39' 45.2"
15	195	Accumulation of drums with fuel and lubricant	80° 46' 26.4"	47° 39' 31.5"
16	196	Fuel and lubricant cisterns	80° 46' 25.7"	47° 39' 37.5"
17	186	Accumulation of drums with fuel and lubricant	80° 46' 24.9"	47° 39' 21.4"
18	184	Fuel and lubricant cisterns	80° 46' 24.0"	47° 39' 22.1"
19	185	Stack of 200-L drums	80° 46' 23.1"	47° 39' 22.5"
20	199	Accumulation of drums with fuel and lubricant	80° 46' 22.0"	47° 39' 33.8"
21	198	Accumulation of drums with fuel and lubricant	80° 46' 23.8"	47° 39' 38.2"
22	202	Stack of 200-L drums	80° 46' 23.4"	47° 39' 45.1"
23	204	Stack of 200-L drums	80° 46' 23.7"	47° 39' 50.0"
24	201	Stack of 200-L drums	80° 46' 22.5"	47° 39' 41.4"
25	216	Stack of 200-L drums	80° 46' 26.4"	47° 40' 00.0"
26	205	Stack of 200-L drums	80° 46' 25.0"	47° 39' 52.0"
27	206	Stack of 200-L drums	80° 46' 25.1"	47° 39' 47.4"
28	183	Stack of 200-L drums	80° 46' 24.5"	47° 39' 22.1"
29	197	Stack of 200-L drums	80° 46' 24.1"	47° 39' 36.0"
30	203	Stack of 200-L drums	80° 46' 22.3"	47° 39' 46.6"
31	182	Stack of 200-L drums	80° 46' 24.1"	47° 39' 18.5"
32	248	Stack of 200-L drums	80° 46' 24.2"	47° 39' 44.4"
33	249	Accumulation of 200-L drums	80° 46' 26.4"	47° 39' 10.7"
34	250	Accumulation of 200-L drums	80° 46' 26.1"	47° 39' 05.0"
35	251	Stack of 200-L drums	80° 46' 25.7"	47° 39' 43.5"
36	252	Accumulation of 200-L drums	80° 46' 26.6"	47° 38' 57.6"
37	253	Accumulation of wooden drums with semisolid lubricant	80° 46' 27.8"	47° 39' 37.7"
38	254	Accumulation of wooden drums with technical liquids	80° 46' 28.6"	47° 39' 43.8"
39	255	Accumulation of wooden drums with industrial waste	80° 46' 27.7"	47° 39' 57.7"
40	256	Iscrap metal dump	80° 46' 27.7"	47° 40' 04.2"
41	191	Fuel and lubricant cisterns	80° 46' 27.2"	47° 39' 24.9"

4.2.2 Territory of the abandoned polar station

The abandoned polar station is located 3.9 km south-south-west of the settlement of Nagurskoe. The coordinates of the surveyed area boundary turning points in WGS-84 Coordinate System are given in Table 3.1.1. The area is 29.3 thousand square m.
Based on the results of the additional survey with geodetic coupling of the items according to the Global Positioning System is composed situational plan of the area with indicated sources of hazardous pollution in scale of 1:1000 in electronic form in GIS MapInfo format. Situational plans in printing form in scale of 1: 1000 is presented in Figure 4.3.1.
The facility record presented on the situational plan is given in Table 4.2.2. Table contains a unique serial number, name and coordinates in WGS-84 Coordinate System WGS-84.
Total number of the elements in the area - 29.
Number of 200-L drums in accumulations (items No. 260, 258, 259, 257, 266, 267, 268, 272, 275, 273, 282, 283, 255, 277, 261 on situational plan) - 0.2-0.3 thousand pcs.
Number of 200-L drums in stack (site 276 on situational plan) - 0,03-0,04 thousand pcs.
There is a chemical agent storage building (site 279).

There were no areas with PCB in soil in amount multiply exceeding permissible concentrations (PC) according to international standards (report section 5).

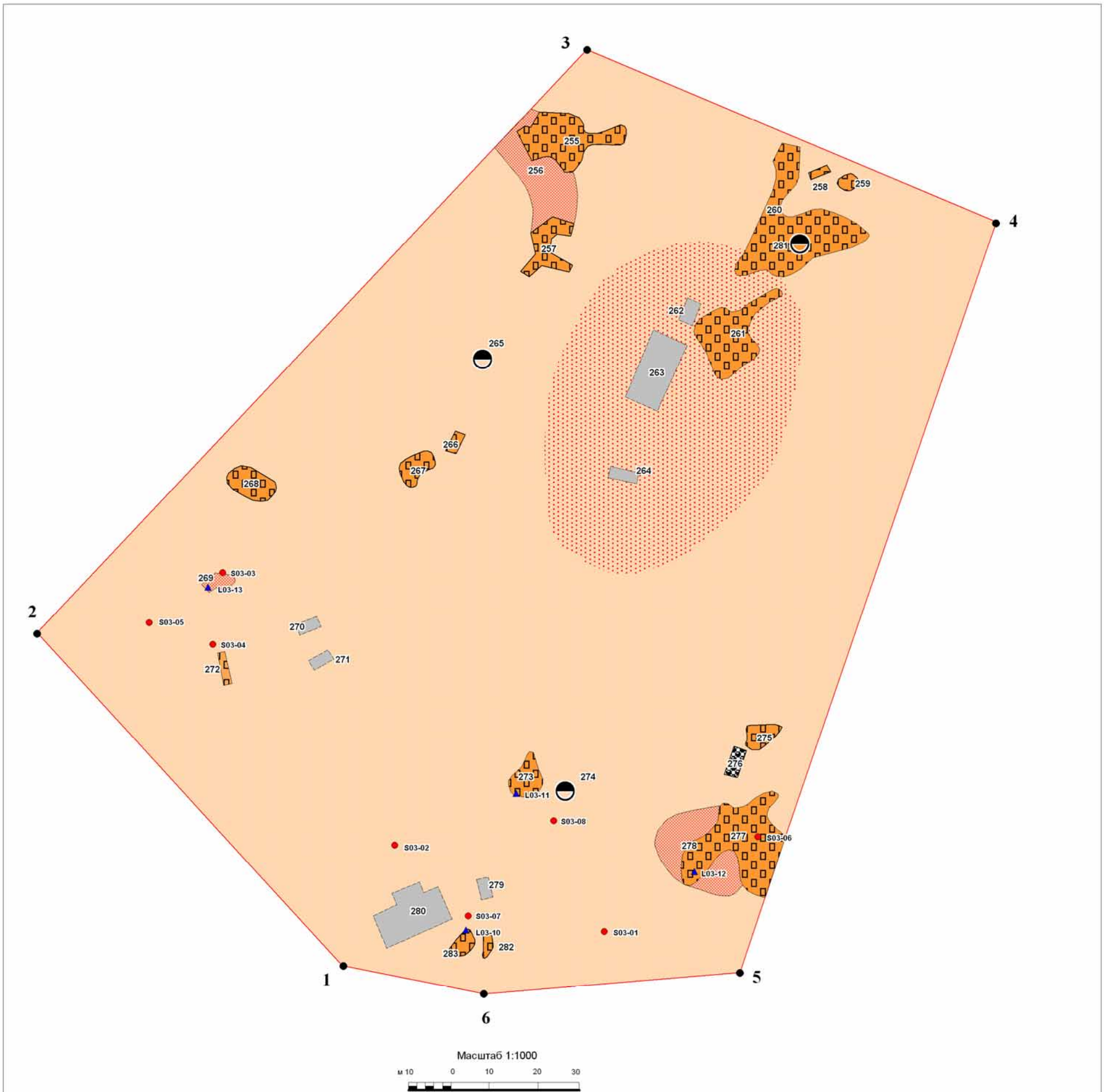


Figure 4.2.2 Situational plan of territory of the abandoned polar station

Table 4.2.2 Facility record in the territory of the abandoned polar station

No.	Number of the site on situational plan	Name	Coordinates, WGS-84	
			Latitude	Longitude
1	265	Cistern with fuel and lubricants	80° 46' 44.4"	47° 42' 53.4"
2	281	Cistern with fuel and lubricants	80° 46' 45.0"	47° 43' 07.0"
3	263	Destroyed 2-floor wooden residence building	80° 46' 44.1"	47° 43' 00.9"
4	260	Accumulation of 200-L drums	80° 46' 45.3"	47° 43' 06.9"
5	258	Accumulation of 200-L drums	80° 46' 45.6"	47° 43' 09.0"
6	259	Accumulation of 200-L drums	80° 46' 45.5"	47° 43' 10.4"
7	257	Accumulation of 200-L drums	80° 46' 45.1"	47° 42' 56.2"
8	262	Destroyed 1-floor wooden building	80° 46' 44.6"	47° 43' 02.7"
9	266	Accumulation of 200-L drums	80° 46' 43.7"	47° 42' 51.1"
10	267	Accumulation of 200-L drums	80° 46' 43.5"	47° 42' 49.6"
11	268	Accumulation of 200-L drums	80° 46' 43.4"	47° 42' 41.8"
12	269	Industrial and construction waste dump	80° 46' 42.7"	47° 42' 40.0"
13	272	Accumulation of 200-L drums	80° 46' 42.1"	47° 42' 40.2"
14	270	Destroyed wooden building	80° 46' 42.3"	47° 42' 44.1"
15	271	Destroyed wooden building	80° 46' 42.1"	47° 42' 44.6"
16	280	Wooden building - Diesel	80° 46' 40.2"	47° 42' 48.5"
17	279	Wooden building - chemical agent storage	80° 46' 40.3"	47° 42' 51.7"
18	276	Stack of drums	80° 46' 41.2"	47° 43' 03.9"
19	275	Accumulation of 200-L drums	80° 46' 41.3"	47° 43' 05.2"
20	273	Accumulation of 200-L drums	80° 46' 41.1"	47° 42' 53.8"
21	274	Cistern with fuel and lubricants R-25	80° 46' 41.1"	47° 42' 55.0"
22	264	Destroyed wooden building	80° 46' 43.4"	47° 42' 59.3"
23	282	Accumulation of 200-L drums	80° 46' 39.9"	47° 42' 51.8"
24	283	Accumulation of 200-L drums	80° 46' 39.9"	47° 42' 50.7"
25	255	Accumulation of 200-L drums	80° 46' 45.9"	47° 42' 57.6"
26	256	Industrial and construction dump	80° 46' 45.7"	47° 42' 55.7"
27	277	Accumulation of 200-L drums	80° 46' 40.5"	47° 43' 03.7"
28	261	Accumulation of 200-L drums	80° 46' 44.4"	47° 43' 04.8"
29	278	Industrial and construction dump	80° 46' 40.6"	47° 43' 01.5"

4.3 Area of the abandoned air-defense station

4.3.1 Territory of the radar station commandant's office

The radar station commandant's office is located 2.8 km south-west of the settlement of Nagurskoe. The coordinates of the surveyed area boundary turning points in WGS-84 Coordinate System are given in Table 3.1.1. The area is 248 thousand square m.

Based on the results of the additional survey with geodetic coupling of the items according to the Global Positioning System is composed situational plan of the area with indicated sources of hazardous pollution in scale of 1:1000 in electronic form in GIS MapInfo format. Situational plans in printing form in scale of 1: 2500 is presented in Figure 4.3.1.

The facility record presented on the situational plan is given in Table 4.3.1. Table contains a unique serial number, name and coordinates in WGS-84 Coordinate System WGS-84.

Total number of the elements in the area - 40.

Number of 200-L drums in accumulations (items No. 294, 293, 296, 297, 323, 322, 287, 288, 290, 291, 292, 311 on situational plan) is 1,1-1,2 thousand pcs. The drums in accumulations are mainly empty.

The area with PCB in soil in amount multiply exceeding permissible concentrations (PC) according to international standards (report section 5) is 4900 square m

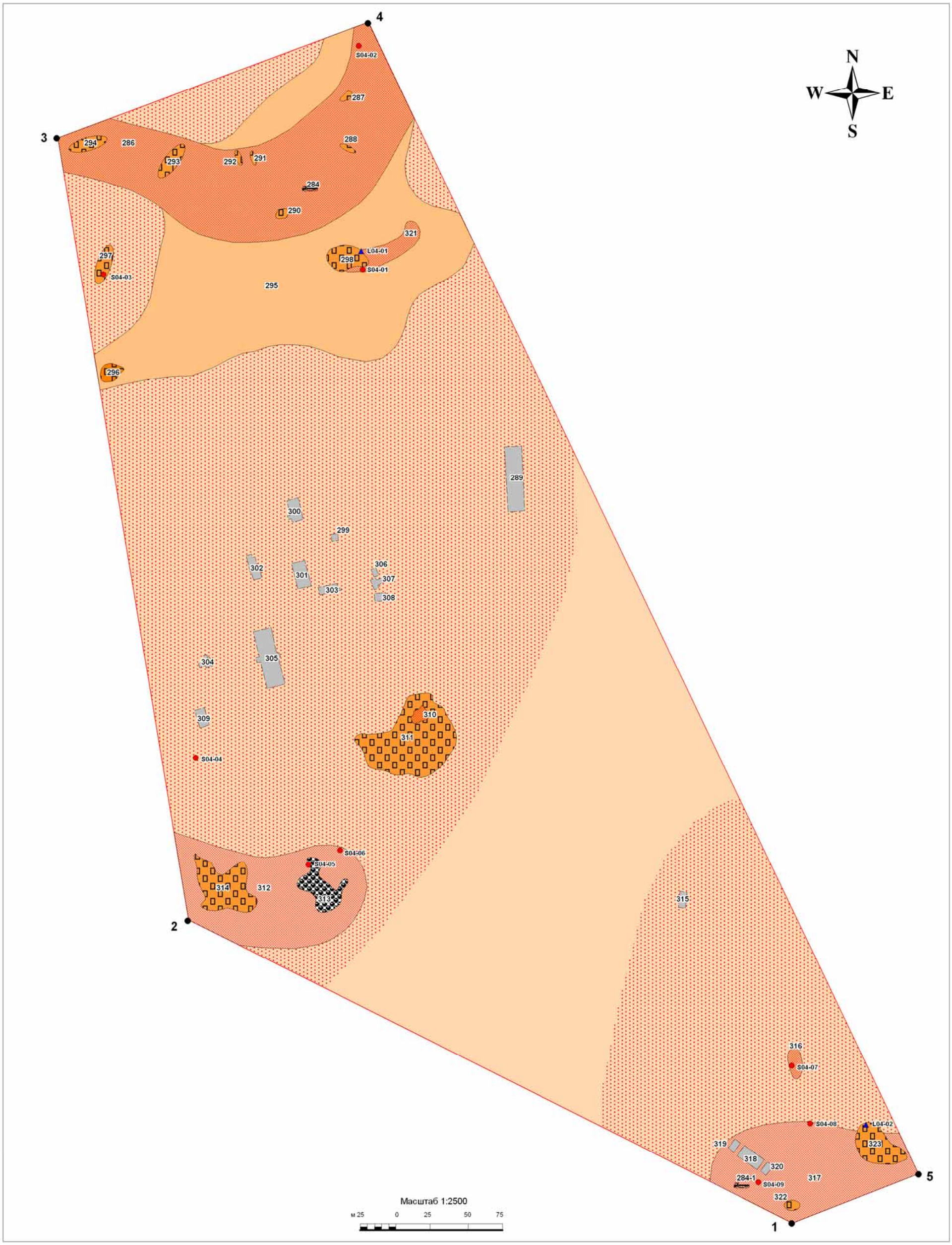


Figure4.3.1 Situational plan of the territory of the radar station commandant's office

Table 4.3.1 Facility record in the territory of the radar station commandant's office

No.	Number of the site on situational plan	Name	Coordinates, WGS-84	
			Latitude	Longitude
1	284	Vehicle (track)	80° 47' 42.8"	47° 32' 06.8"
2	294	Accumulation of drums	80° 47' 43.9"	47° 31' 35.3"
3	293	Accumulation of drums	80° 47' 43.4"	47° 31' 47.0"
4	296	Accumulation of drums	80° 47' 38.7"	47° 31' 36.9"
5	297	Accumulation of drums	80° 47' 40.3"	47° 31' 46.2"
6	289	Destroyed building	80° 47' 35.9"	47° 32' 33.2"
7	299	Destroyed building	80° 47' 34.8"	47° 32' 07.7"
8	300	Destroyed building	80° 47' 35.4"	47° 32' 02.2"
9	301	Destroyed building	80° 47' 33.9"	47° 32' 02.8"
10	302	Destroyed building	80° 47' 34.2"	47° 31' 56.0"
11	303	Destroyed building	80° 47' 33.6"	47° 32' 06.5"
12	304	Destroyed building	80° 47' 32.1"	47° 31' 48.6"
13	305	Destroyed building – radar station commandant's office barrack	80° 47' 32.1"	47° 31' 57.6"
14	306	Destroyed building	80° 47' 33.9"	47° 32' 13.1"
15	307	Destroyed building	80° 47' 33.6"	47° 32' 13.4"
16	308	Destroyed building	80° 47' 33.4"	47° 32' 13.5"
17	309	Destroyed building – bath house	80° 47' 30.8"	47° 31' 47.8"
18	314	Accumulation of drums	80° 47' 27.1"	47° 31' 50.2"
19	313	stack of 200-L drums	80° 47' 27.0"	47° 32' 03.7"
20	310	Dump	80° 47' 30.7"	47° 32' 18.5"
21	316	Accumulator dump	80° 47' 22.4"	47° 33' 09.0"
22	315	Destroyed buildings - radar station commandant's office xheckpoint	80° 47' 26.3"	47° 32' 54.3"
23	323	Accumulation of drums	80° 47' 20.1"	47° 33' 20.7"
24	322	Accumulation of drums	80° 47' 19.3"	47° 33' 07.7"
25	287	Accumulation of drums	80° 47' 44.7"	47° 32' 12.2"
26	288	Accumulation of drums	80° 47' 43.5"	47° 32' 11.9"
27	290	Accumulation of drums	80° 47' 42.1"	47° 32' 02.6"
28	291	Accumulation of drums	80° 47' 43.4"	47° 31' 58.5"
29	292	Accumulation of drums	80° 47' 43.4"	47° 31' 56.5"
30	311	Accumulation of drums	80° 47' 30.2"	47° 32' 16.3"
31	318	Destroyed building – observation post commandant's office	80° 47' 20.0"	47° 33' 09.3"
32	319	Destroyed building (crew box)	80° 47' 20.3"	47° 33' 07.0"
33	320	Destroyed building (crew box)	80° 47' 19.8"	47° 33' 11.5"
34	286	Iscrap metal and metal drum dump	80° 47' 43.9"	47° 31' 40.7"
35	312	Iscrap metal and metal drum dump	80° 47' 26.9"	47° 31' 55.6"
36	317	Iscrap metal and metal drum dump	80° 47' 19.8"	47° 33' 10.9"
37	298	Accumulation of drums	80° 47' 41.0"	47° 32' 11.2"
38	321	Iscrap metal and metal drum dump	80° 47' 41.2"	47° 32' 15.7"

39	295	Territory littered with metal drums more than 20-30 pcs per ha	80° 47' 41.2"	47° 32' 02.1"
40	284-1	Vehicle	80° 47' 19.8"	47° 33' 1.6"

4.3.2 Area of radar station

Radar stations are located 1.7 km south of the settlement of Nagurskoe. The coordinates of the surveyed area boundary turning points in WGS-84 Coordinate System are given in Table 3.1.1. The area of territory is 40.4 thousand square m.

Based on the results of the additional survey with geodetic coupling of the items according to the Global Positioning System is composed situational plan of the area with indicated sources of hazardous pollution in scale of 1:1000 in electronic form in GIS MapInfo format. Situational plans in printing form in scale of 1: 2000 is presented in Figure 4.3.2.

Facility record, given in situational is presented in Table 4.3.2. Table contains a unique serial number, name and coordinates in WGS-84 Coordinate System.

Total number of the elements in the area - 24.

Number of 200-L drums in accumulations (site 171 on situational plan) - 0.06-0.1 thousand pcs.

In the area of radar station:

- transformer and condenser storage facility (site164), filled with technical liquids, containing PCB;
- transformer dump (site 330) of a size of 15x15 m^2.

PCB-containing equipment also revealed in the radar station buildings (items No.169 and 145). Location of PCB-containing equipment is given on situational plan.

There were no areas with PCB in soil in amount multiply exceeding permissible concentrations (PC) according to international standards (report section 5).

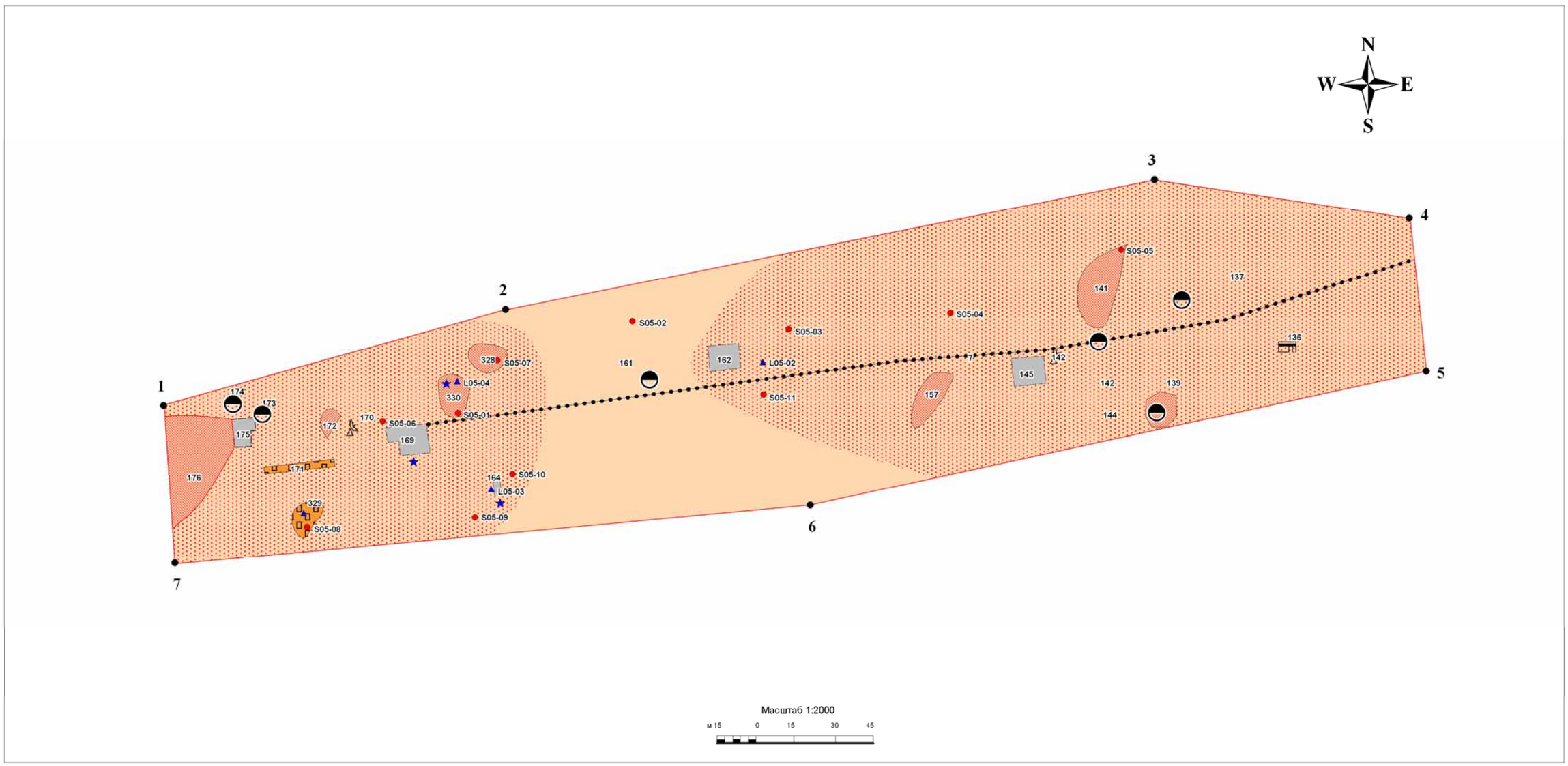


Figure4.3.2 Situational plan of the radar station area

Table 4.3.2 Facility record in the area of radar station

No.	Number of the site on situational plan	Name	Coordinates, WGS-84	
			Latitude	Longitude
1	170	Radar antenna	80° 48' 14.5"	47° 32' 43.8"
2	171	Accumulation of drums with fuel and lubricant	80° 48' 14.1"	47° 32' 39.2"
3	172	Industrial and construction waste dump	80° 48' 14.6"	47° 32' 41.7"
4	169	Destroyed radar station building	80° 48' 14.3"	47° 32' 47.5"
5	162	Destroyed building	80° 48' 15.2"	47° 33' 12.2"
6	164	Destroyed building - transformer and condenser storage facility	80° 48' 13.7"	47° 32' 54.4"
7	157	Industrial and construction waste dump	80° 48' 14.6"	47° 33' 28.2"
8	145	Destroyed radar station building	80° 48' 14.8"	47° 33' 35.5"
9	141	Industrial and construction waste dump	80° 48' 15.9"	47° 33' 41.5"
10	142	Radar antenna	80° 48' 15.0"	47° 33' 38.0"
11	136	Gantry	80° 48' 15.0"	47° 33' 55.6"
12	7	Cable power line	80° 48' 15.1"	47° 33' 37.0"
13	139	Industrial and construction waste dump	80° 48' 14.3"	47° 33' 45.7"
14	175	Destroyed building	80° 48' 14.5"	47° 32' 35.1"
15	176	Industrial and construction waste dump	80° 48' 14.0"	47° 32' 31.3"
16	174	Cistern with fuel and lubricants	80° 48' 15.0"	47° 32' 34.6"
17	173	Cistern with fuel and lubricants	80° 48' 14.9"	47° 32' 37.2"
18	161	Cistern with fuel and lubricants	80° 48' 15.0"	47° 33' 06.7"
19	142	Cistern with fuel and lubricants	80° 48' 15.2"	47° 33' 41.3"
20	137	Cistern with fuel and lubricants	80° 48' 15.6"	47° 33' 47.9"
21	144	Cistern with fuel and lubricants	80° 48' 14.3"	47° 33' 44.1"
22	328	Industrial and construction waste dump	80° 48' 15.3"	47° 32' 54.3"
23	329	Accumulation of 200-L drums	80° 48' 13.5"	47° 32' 39.4"
24	330	Transformer dump	80° 48' 14.6"	47° 32' 41.7"

5 ASSESSMENT OF SOIL AND GROUND POLLUTION IN THE SURVEYED AREAS

5.1 Chemical-analytical characteristics of pollutant groups to be controlled

Petroleum hydrocarbons

Total petroleum hydrocarbons

Oil and products of its processing (oil products), which are the most widely spread environmental pollutants are a complex mixture of different hydrocarbons of aliphatic (paraffinic), naphthenic and aromatic homologous series having a number of carbon atoms from 5 to 70 and organic compounds of other classes such as naphthenic acids, organic compounds of sulfur, nitrogen, etc).
According to the recommendations of Russian and international technical standards, the measurement of total petroleum hydrocarbons was conducted using a method of dispersionless IR spectrophotometry allowing to efficiently monitor the total content of the most typical group of compounds comprising the main part of oil and products of its processing such as non- polar and slightly polar hydrocarbons not sorbed on active aluminum oxide.
This group includes all branched and unbranched alkanes, naphthenic hydrocarbons without condensed nuclei. These types of hydrocarbons are an integral part of the natural geochemical background. Their presence in surface waters at levels of 10-50 mcg/l can be provided by both intake of oil products and the presence of hydrobiont and terrigeneous genesis biogenic lipids.
The content of petroleum hydrocarbons in surface and ground waters in higher concentrations is a sign of the presence of a constant pollution source.
Toxicity of aliphatic and naphthenic hydrocarbons is relatively low, however, due to their high capacity to form emulsions and surface films, their presence even in small concentrations in surface and ground waters and soils causes significant changes in oxygen metabolism, what in its turn, leads to a negative environmental effect such as mass young fish and fish embryo mortality, inhibition of plant growth, etc.

Volatile aromatic hydrocarbons (VAH)

Volatile aromatic hydrocarbons (VAH) such as benzene, toluene and ortho-, para-, and meta-xylenes are highly volatile compounds having high toxic properties, irritant effects and strong characteristic odor, which, due to their high solubility in water (100-800 mg/l) can impart an unpleasant odor and taste to water making it unfit to drink.

Also aromatic hydrocarbons are the most toxic. Due to a the high volatility of these substances even at low temperatures, their presence in natural waters can be observed only in case the presence of a constant source of new oil products and only in close proximity to such sources only.
The high volatility of this group of compounds also explains their significant toxic hazard for personnel and population through an inhalation route.
When accumulating in soils in the locations of accidental oil spill or of burning of mine dumps, the rate of evaporation of VAH significantly varies leading to the increase in the time of exposure of

personnel with the simultaneous decrease of one-time concentrations in atmospheric air and leading to the chronic nature of soil (ground) water contamination with this group of pollutants.

Polycyclic aromatic hydrocarbons (PAH)

The sources of PAH intake into the environment can be divided into anthropogenic and natural ones. The natural sources are volcanic outbursts, hydrocarbon anomalies in tectonically active zones, endogenous geological processes, hydrothermal sources, hydrocarbon fluxes from gas and oil, coal and shale fields, synthesis of PAH in old and modern sedimentary rocks and forest fires. The natural processes leading to the formation of PAH in such a way can be related to the synthesis without the participation of biomass at high (1000 °C and higher), medium (400-500 °C) and low (100-150 °C) temperatures and with the conversion of the components of buried biomass in sedimentary rocks in thermal catalytic reactions at temperatures from 80 to 200 °C.

The main anthropogenic sources of PAH are related to various production processes, among which more than half of emissions come from power generation (due to incomplete combustion of organic fuels such as coal, oil products and woods. Also coke-chemical and oil processing plants and exhaust gases from vehicles make a significant contribution to the total PAH content.

It should be noted that the qualitative composition and structure of PAH from natural abiogenic sources do not differ from those of anthropogenic origin if they are formed as a result of the high and medium temperature processes while the low temperature conversion of organic matter leads to the formation of aryl and alkyl substituted hydrocarbons with a large number of substituents in the aromatic ring and with long-chain branchings.

Among PAH formed during combustion process, the compounds without substituents in the aromatic ring such as phenanthrene, fluoranthene, pyrene, chrysene, benzpyrenes and dibenzpyrenes are dominant, while the content of monomethyl substituted homologs is 3-10 times lower. The ratio of specific PAHs in combustion products does not vary significantly during the transition from one source to the other, at the same time, the prevalence of specific compounds can be explained by their higher thermodynamic stability.

The composition of polycyclic aromatic hydrocarbons of coal and oil origin differs from that of pyrolytic PAHs. In PAHs from coal fields and crude unfractionated oil, methyl derivatives of naphthalene, phenanthrene and chrysene prevail, while in unsubstituted PAHs – phenanthrene and perylene. When hydrocarbons of natural origin are dispersed, PAHs can be directly discharged into ecosystems by means of both their migration and migration of more light hydrocarbons with their further transformation to PAHs in the presence of natural catalysts

The study of trace amounts of PAHs in environmental objects is of great significance due to their relatively high chemical stability and high toxicity manifesting in their oncogenic, mutagenic and teratogenic effects and a capability to cause poisoning and disorder of the immune system when accumulating in organisms. Complex toxic effect on the organism allows to consider PAH to be the agents that transform biosphere, at the same time their effects are reflected both in current and future generations

Among detectable PAHs, benz(a)pyrene and dibenz(a,h)anthracene have the strongest oncogenic properties; during laboratory experiments, tumors appeared even in breed from infected species. The presence of alkyl substituents in the aromatic ring can both increase and decrease oncogenic activity of PAHs. For example, 3.4-8.9- and 3.4-9.10 dibenzpyrene activity decreases after the

introduction of a methyl substituent at position 5 and disappeared after the introduction of two methyl groups. While acene hydrocarbon (naphthalene, anthracene) and anthanthrene activity significantly increases after the introduction of two methyl substituents at position 2 and 6. It should be stressed that the products of PAH degradation in the environment can have even stronger oncogenic effect than initial substances under the influence of physico-chemical and microbiological factors, however, the monitoring of these PAH compounds and metabolites is a quite complex task is not practically carried out now.

Organochlorine compounds

Organochlorine compounds (OCC) are not typical for the nature; they are strictly of anthropogenic origin. OCC are the most hazardous group of persistent organic pollutants and are characterized by low water solubility (about 0.5 - 0.001 mg/l) and high lipid solubility and low solubility in organic solvents and lipids – lipophilicity, low vapor pressure (10^{-3} - 10^{-5} at 20° C) and exceptional microbiological, chemical and thermal stability.
The main persistent organochlorine compounds in the environment are organochlorine pesticides of various kinds (hexachlorocyclohexanes, DDT and its isomers, metabolites and by-products, polychlorocyclodienes, polychlorobenzenes, herbicides and defoliants based on 2,4-D acid and polychlorinated phenols) polychlorinated biphenyls (PCB) as well as polychlorodioxines and polychlorobenzofurans that have never been produced as chemical synthesis products, but have been introduced into the environment either as admixtures of other compounds or have been formed due to the burning of garbage, fires at plants producing chlorine-containing plastics, transformation of waste of paper and other material bleach.

Polychlorinated biphenyls

The group of polychlorinated biphenyls (PCB) includes 209 related compounds (known as congeners) which are the products of chlorination of diphenyl (biphenyl) and differ only in the level of substitution and mutual location of substituents.
The characteristic feature of PCB production is that it is not oriented towards the production of separate compounds by means of direct chlorination of diphenyl but their mixtures of complex composition determined by the conditions and duration of the production process. Such mixtures could contain from 20 to 71 weight percent of chlorine, and its content was usually reflected in the trade name of the product by some means or other.
Decachlorobiphenyl, a product of complete chlorination of diphenyl, was the only substance to be specially produced for the use as casting wax. Small quantities of PCB can be formed as by-products of some types of chemical synthesis during chlorination of water and thermal cracking of chlorine-containing organic substances.
PCB mixtures have unique physical and chemical properties determining their wide use in the industry. They are as follows: nonflammability, resistance to acids and alkalis, oxidation and hydrolysis, low solubility in water, thermal resistance, wide range of dielectric characteristics and low vapor pressure at room temperature. The products synthesized and implemented as complex mixtures of polychlorinated biphenyls are liquids in a very wide range of temperatures (from –50° to 300° C).

Commercial production of PCB began in 1929 in the US by Monsanto Company. They are oily liquids that are non-flammable, do not conduct electricity but conduct heat easily. PCB are resistant to acids and alkalis. Commercial mixtures of chlorination of diphenyl were marketed as Aroclor, Piranol, Inerteen (Monsanto, Westinghouse in USA), Clophen (Bayer, Germany), Fenclor (Caffaro, Italy), Kanechlor and Sibanol (Kanegafuchi, Japan),. Phenoclor and Piralen (Prodolec, France), Delor (Czechoslovakia).

Commercial products based on PCB were widely used as dielectrics – transformer and condenser oils, as cooling liquids in heat-exchange systems (coolants), hydraulic liquids, lubricating and seal oils as well as admixtures of herbicides. PCB were included in the composition of plasticizers for insulation materials and plastics and used as admixtures of paints, varnishes, adhesives and color paper for copying.

In the former USSR and Russia, polychlorinated biphenyls were produced from 1934 through 1995. They were produced under trade marks of Sovol, Sovtol and Geksol. The main producers of Sovols were PA "Orgsteklo" (Dzerzhinsk), PA "Orgsintez" (Novomoskovsk) and VNITIG's (All-Union Research Institute of Herbicides, Ufa) experimental plant.

The oils containing PCB mixtures was used in KSK condensers, which had been produced by SPA Kondensator" (Serpukhov) before 1988; and in power, high-voltage, pulse and other transformers to be produced in many places in Russia.

Intake of polychlorinated biphenyls in the environment is associated with accidental leaks from controlled close systems such as commercial transformers, condensers, heat exchangers and hydraulic devices and also with uncontrolled release due to burning of production and domestic waste. During a long period of intensive use of PCB in industry in many countries of the world, huge amounts of these compounds have been released into the environment, and now the contamination with these xenobiotics affects the whole biosphere. PCB's physico-chemical properties provide a long life (years and decades) in abiotic environments and the capability to accumulate in bottom sediments, soils and fatty tissues of wildlife. Along with organochlorine pesticides, PCB are the most wide spread products contaminating water in natural water bodies. It is considered that PCB concentration in non-polluted fresh waters should not exceed 0.5 ng/l, while in moderately polluted waters – 50 ng/l.

Polychlorinated biphenyls (PCB) belong to the group of persistent organic pollutants (POP), the monitoring of which is obligatory in the industrially developed countries due to their high environmental and health hazard. Persistent organic pollutants (POP) are a group of organic compounds having toxic properties and are persistent and biologically accumulable and able to be transported for a long distance in different environments to lead to negative consequences for human health and the environment.

PCB hazard for human health is, in the first place, that they impair immune system function ("chemical" AIDS). In addition, PCB intake in human organism leads to the development of cancer injury of liver, kidneys, nervous system and skin (neurodermatitis, eczemas and rashes). Penetrating into baby/fetus organism, PCB may cause congenital deformities (developmental delay, decrease in immunity and impairment of hematogenesis). However, the most hazardous PCB impact on human health is the mutagenic effect, which is detrimental to future generations.

Heavy metals

The study of heavy metal content levels is one of the priority tasks of environmental monitoring. Cadmium, lead, copper, nickel, cobalt, chrome, mercury are amongst the most toxic pollutants that penetrate into the environment objects both due to geochemical processes and anthropogenic factors.
Although Iron, manganese and zinc are less toxic, they play an important role in geochemical behavior of other toxic metals.
The toxic effect of heavy metals can be absolutely different depending on the chemical form of the element. For example, if chelating or complexing organic agents are present, the toxic effect becomes less pronounced than the direct effect of ionic forms of heavy metals since organometallic complexes are absorbed significantly less. And vice versa, some organometallic compounds (for example, polybasic organic acids) are much more strong poisons than metals in complete form Many of them are used in agriculture as insecticides and pesticides
Similar compounds can be formed in surface waters with high organic matter content during microbiological processes.
High coefficients of accumulation of heavy metals (from 1000 to 10000) in biological objects, which increases as it is passed through the food web from the lowest trophic level to the highest making it extremely difficult to determine maximum allowable concentrations for specific elements. In addition, lead, cadmium, mercury and some other heavy metals also show considerable mutagenic activity.
The levels of heavy metal content along with other factors determine, to a great extent, the nature and intensity of microbiological and biochemical processes in an active layer of water.

5.2 Methods of assessment of soil and ground pollution

During the evaluation of the level of pollutant content in soil, maximum permissible concentrations (MPC) and approximate permissible concentrations (APC), established by respective Russian regulatory documents; international criteria for environmental assessment of soil contamination according to Building Regulations SP 11-102-97 “Engineering environmental site investigations for construction” were used as standard values, as well as other regulatory documents:

- Health Standard 2.1.7.2041-06 Maximum permissible concentration (MPC) of chemicals in soil;
- Health Standard 2.1.7.2042-06 Approximate permissible concentration (APC) of chemicals in soil;
- International criteria for environmental assessment of soil contamination according to Neue Niederlandische Liste. Altlasten Spektrum 3/95; Building Regulations SP 11-102-97, Annex B

MPC and APC (according to the individual value or sum of compounds from a specific group) have been established by Russian regulatory documents for 22 soil quality indices for 49 pollutants to be monitored. Niederlandische Liste establish permissible concentrations (PC) and intervention level (IL) concentrations (according to the individual value or sum of compounds from a specific group) for 32 compounds. The values of standardized soil pollution indices are given in Table 5.2.1.

Table 5.2.1 Maximum permissible and approxible permissible concentrations (MPC and APC), permissible concentration level (PC) and intervention levels (IL) of pollutants to be controlled in soils according to Russian and foreign standards

Pollutant	Hazard class	Standard по GN 2.1.7.2041-06, GN 2.1.7.2511-09				Standards established by Neue Niederlandische Liste. Altlasten Spektrum 3/95*)	
		MPC, gross content, mg/kg	APC. gross content, for different soils, mg/kg				
			sandy and sabulous	sour (loamy and clayey), pH KCl<5,5	close to neutral, neutral (loamy and clayey), pH KCl>5,5	PC, mg/kg	IL, mg/kg
Mercury	1	2.1	NE	NE	NE	0.3	10
Lead	1	32,0	32	65	130	85	530
Cadmium	1	NE	0.5	1.0	2.0	0.8	12
Cobalt	2	NE	NE	NE	NE	20	40
Nickel	2	NE	20	40	80	35	210
Copper	2	NE	33	66	132	36	190
Zinc	1	NE	55	110	220	140	720
Manganese	3	1500	NE	NE	NE	NE	NE
Chrome	2	NE	NE	NE	NE	100	380
Tin		NE	NE	NE	NE	100**)	300**)
Oil products (total)	3	NE	NE	NE	NE	50	5000
Benz(a)pyrene	1	0.02	NE	NE	NE	NE	NE
Total PAH		NE	NE	NE	NE	1	40
Benzene	1	0.3	NE	NE	NE	0.05	1
Toluene	3	0.3	NE	NE	NE	0.5	130
Xylenes	3	0.3	NE	NE	NE	0.5	25
Ethylbenzene	1	NE	NE	NE	NE	0.05	50
Total VAH		NE	NE	NE	NE	7	70
Total PCB	1	NE	NE	NE	NE	0.02	1

Note: *) **– according to Appendix B to SP 11-102-97.**

) **- according to Brandenburgische Liste. AbschluBentwurf 27.7.1990.

The main criterion of sanitary chemical assessment of soil contamination is the maximum permissible concentration (MPC) or approximate permissible concentration (APC) of chemicals in soil.

The level of hazard of soil contamination with chemicals is assessed for each substance taking into account general regularities:

The more the actual content of soil contaminants exceeds MPC, the higher contamination hazard is.

- The more the actual content of soil contaminants exceeds MPC, the higher the contamination hazard is.
- The higher the class of hazard of a substance to be monitored, its persistency, solubility in water and mobility in soil and thickness of contaminated layer, the higher the contamination hazard is.
- The less soil buffer power, the higher the contamination hazard is.

When soil is contaminated with one inorganic substance, the contamination level is assessed taking into account the class of hazard of the contaminant, its MPC and the maximum value of permissible level of the element content Kmax by one of the four nuisance values.
When soil is contaminated with one organic substance, its hazard is determined by its MPC and class of hazard (Table 5.3-12).

Table 5.2.2 Assessment of chemical soil pollution

Pollution class	Khlebnikov sanitary number	Total pollution index (Zc)	Content in soil (mg/kg)					
			I hazard class		II hazard class		III hazard class	
			Organic compounds	Inorganic compounds	Organic compounds	Inorganic compounds	Organic compounds	Inorganic compounds
Clean *	0.98 and >	-	from background to MPC	from background to MPC	from background to MPC	from background to MPC	from background to MPC	from background to MPC
Permissible	0.98 and >	<16	from 1 up to 2 MPC	from 2 background up to MPC	from 1 up to 2 MPC	from 2 background up to MPC	from 1 up to 2 MPC	from 2 background up to MPC
Moderately hazardous	0.85-0.98	16-32					from 2 to 5 MPC	from MPC to K max
hazardous	0.7-0.85	32-128	from 2 to 5 MPC	from MPC to K max	from 2 to 5 MPC	from MPC до K max	> 5 MPC	> K max
Extremely hazardous	<0.7	>128	>5 MPC	>K max	>5 MPC	>K max		

In case of contamination with several elements, soil contamination hazard level can be assessed for the most toxic element whose content in soil is the highest.
The level of soil contamination as an indicator of adverse impact on human health is assessed by indices developed in the course of complementary geochemical and geohygienic environmental studies of the localities with active contamination sources. These indices are as follows: chemical concentration ratio (Cc). Cc is determined by a ratio of the actual content of the chemical to be determined in soil (Ci) in mg/kg of soil to the regional background value (Cbi):
$Cc = Ci/ Cbi;$

and *total pollution index* (Zc). The total pollution index is equal to a sum of the ratios of concentrations of chemical contaminants and can be expressed by a formula
$Zc = \sum (Cci + \ldots + Ccn) - (n-1),$

where n is a number of summed substances to be determined;
Cci is a concentration ratio of contaminant i.

The level of soil contamination with a series of metals by index Zc is assessed through the use of a rating scale given in Table 5.2-13..

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Table 5.2.3 Approximate rating scale of soil pollution hazard according to (Zc)

Pollution class почв	Value Zc	Changes in human health in pollution focus
Permissible	Less than 16	The lowest level of child morbidity and minimal incidence of functional abnormalities
Moderately hazardous	16-32	The increase in general morbidity
Hazardous	32-128	☒The increase in general morbidity, the number of sickly children, children with chronic diseases, impaired functional status of the cardiovascular system
Extremely hazardous	Nore than 128	The increase in child morbidity, impaired reproductive function of women (ILelichenie toxicosis of pregnancy, the number of premature births, stillbirths, infant malnutrition)

The total pollution index Zc was calculated by 9 contamination parameters: manganese, zinc, copper, nickel, cobalt, lead, cadmium, chrome and mercury. The concentrations of heavy metals in the Far North regions (Taimyr Peninsula and Spitsbergen Archipelago) were used as background values according to long-term observation (Arctic Pollution Issues, AMAP Assessment Report, Norway, Oslo, Arctic Monitoring and Assessment Programme (AMAP), 1998) given in Table 5.3-4).

Table 5.2.4 Background content of heavy metals in the Far North

Element	Background content, mg/kg
Manganese	106.72
Zinc	24.9
Copper	8.3
Nickel	6.5
Cobalt	5.0

Element	Background content, mg/kg
Lead	8.8
Cadmium	0.1
Chrome	7.54
Mercury	0.1

Evaluation of chemical contamination of soils according to international standards is performed by comparing the obtained values of the content of controlled parameters with the values of PC and IL (SP 11-102-97, Appendix B).Permissible concentration (PC) is defined as an estimated set maximum concentration of substance polluting ground that does not cause adverse direct or indirect impact on the environment and human health.

Soil containing contaminants less than DC can be attributed according to the Russian classification to the category of clean acceptably polluted, with the contents higher than PC and less than the intervention level that correspond to the category of pollution from moderately polluted to hazardously polluted.

When the concentrations of pollutants exceeding the intervention level (IL) are detected, soils are considered to be hazardously contaminated and referred to the third and a higher class of risks of

toxic waste. In this case, the removal, transportation, warehousing and storage of soils should be based on a specially designed project agreed in due course.

Due to the lack of nationwide standard MPC and APC for the content of oil products and polychlorinated biphenyls in soil and ground, in assessing the level of contamination with petroleum hydrocarbons and PCB, PC and IL Niederlandische Liste standards were used.

Table 5.2.5 provides a description of soils sampled in the surveyed areas of the territory and the outward signs of contamination.

Table 5.2.5 Description of soil types in samples taken in the surveyed areas

Point no.	Soil type	Pollution signs
Area of industrial and construction dumps near the settlement of Nagurskoe		
S01-01-1	Loam	not vey strong oil product smell, wooden and metal parts
S01-02-2	Rubbly loam	weak oil product smell, wooden and metal parts
S01-03-3	Loam	oil product smell, visible pollution with oil products, wooden and metal parts
Area of fuel and lubricant storage facility in the Severnaya Bay		
S02-01-1	Loam	strong oil product smell, visible pollution with oil products
S02-02-2	Rubbly loam	not vey strong oil product smell
S02-03-3	Rubbly loam	strong oil product smell
S02-04-4	Rubbly loam	strong oil product smell, visible pollution with oil products
S02-05-5	Rubbly loam	weak oil product smell
S02-06-6	Rubbly loam	weak oil product smell
S02-07-7	Loam	weak oil product smell
S02-08-8	Rubbly loam	not vey strong oil product smell
S02-09-9	Loam	weak oil product smell
S02-10-10	Rubbly loam	weak oil product smell
S02-11-11	Rubbly loam	weak oil product smell
S02-12-12	Rubbly loam	strong oil product smell
S02-13-13	Rubbly loam	strong oil product smell
S02-14-14	Rubbly loam	weak oil product smell
Territory of the abandoned polar station		
S03-01-1	Loam	hot bitumen smell, visible pollution with oil products
S03-02-2	Loam	hot bitumen smell, visible pollution with oil products
S03-03-3	Loam	hot bitumen smell, visible pollution with oil products, wooden and metal parts
S03-04-4	Rubbly loam	strong oil product smell, visible pollution with oil products
S03-05-5	Loam	strong oil product smell, visible pollution with oil products
S03-06-6	Rubbly loam	strong oil product smell, visible pollution with oil products
S03-07-7	Rubbly loam	hot bitumen smell, visible pollution with oil products

Point no.	Soil type	Pollution signs
S03-08-8	Rubbly loam	strong oil product smell, visible pollution with oil products
Territory of the radar station commandant's office		
S04-01-1	Rubbly loam	weak oil product smell, wooden and metal parts
S04-02-2	Rubbly loam	weak oil product smell, wooden and metal parts
S04-03-3	Rubbly loam	weak oil product smell
S04-04-4	Loam	weak oil product smell
S04-05-5	Rubbly loam	not vey strong oil product smell
S04-06-6	Rubbly loam	not vey strong oil product smell, wooden and metal parts
S04-07-7	Rubbly loam	not vey strong oil product smell, wooden and metal parts
S04-08-8	Loam	weak oil product smell, wooden and metal parts
S04-09-9	Rubbly loam	weak oil product smell, wooden and metal parts
Area of radar station		
S05-01-1	Loam	weak oil product smell
S05-02-2	Loam	not vey strong oil product smell
S05-03-3	Rubbly loam	weak oil product smell
S05-04-4	Rubbly loam	not vey strong oil product smell
S05-05-5	Rubbly loam	weak oil product smell
S05-06-6	Rubbly loam	weak oil product smell
S05-07-7	Rubbly loam	weak oil product smell, wooden and metal parts
S05-08-8	Loam	weak oil product smell
S05-09-9	Loam	weak oil product smell
S05-10-10	Loam	weak oil product smell
S05-11-11	Rubbly loam	weak oil product smell
Background	Rubbly loam	weak oil product smell

5.3 Area of industrial and construction dumps near the settlement of Nagurskoe

3 soil (ground) samples were collected to assess the level of pollution i**n the surveyed area of the dumps**.

Assessment accoring to the Russian standards

The content of VAH compounds in soils at the site did not exceed tenths of MPC and amounted to:

- for benzene - 0.011 mg/kg (up to 0.036 MPC units),
- for toluene - 0.014 mg/kg (up to 0.046 MPC units)

Content of other controlled VAH compounds did not exceed the lower limit of metrological certified range for the used analysis method.

Content of benz(a)pyrene reached 0.0179 mg/kg (up to 0.89 MPC units point S01-01-1, site 38).

Content of other analyzed PAH compounds is not established by the Russian standards.

Content of heavy metals reached:

- for manganese - 537.8 mg/kg (up to 0.36 MPC units point S01-03-3, site 38);
- for zinc - 176 mg/kg (up to 3.2 APC units, point S01-01-1, site 38);
- for copper - 174.12 mg/kg (up to 5.3 APC units, point S01-03-3, site 38);
- for nickel – 32.1 mg/kg (up to 1.61 APC units, point S01-03-3, site 38);
- for lead – 381.44 mg/kg (up to 11.92 MPC units point S01-01-1, site 38);
- for cadmium - 0.58 mg/kg (up to 1.15 APC units, point S01-01-1, site 38);
- for mercury - 0.068 mg/kg (up to 0.03 MPC units point S01-01-1, site 38).

Table 5.2.6 shows the intervals of pollutant content in soils in the surveyed area, assessment of the area's soil pollution (pollution class), performed according to SanPin requirements 2.1.7.1287-03, based on MPC (APC) and content of controlled pollutants. PC - according to international criteria of environmental assessment.

Table 5.2.6 Concentration of pollutants in soils in the area dumps industrial, construction waste dumps in the settlement of Nagurskoe

Parameter	Unit	Concentration			Concentration in MPC units (APC)			Pollution class			Concentration in PC units		
		min	max	average	min	max	average	from	to	by aver. conc.	min	max	average
pH by KCl	д. pH	5.88	5.98	5.94	н.у.	н.у.	н.у.	-	-	-	н.у.	н.у.	н.у.
Heavy metals:													
Mercury	ng/kg	0.03	0.068	0.048	0.01	0.03	0.02	clean	clean	clean	0.10	0.23	0.16
Lead	ng/kg	2.48	381.44	151.31	0.08	11.92	4.73	clean	extrem	hazard	0.03	4.49	1.78
Cadmium	ng/kg	0.132	0.575	0.324	0.26	1.15	0.65	clean	clean	clean	0.02	0.07	0.04
Cobalt	ng/kg	37.11	59.64	48.69	н.у.	н.у.	н.у.	-	-	-	1.86	2.98	2.44
Nickel	ng/kg	16.9	32.1	24.883	0.85	1.61	1.24	clean	extrem	extrem	0.48	0.92	0.71
Copper	ng/kg	123.02	174.12	147.62	3.73	5.28	4.47	extrem	extrem	extrem	3.42	4.84	4.10
Zinc	ng/kg	93.5	175.55	139.28	1.70	3.19	2.53	hazard	hazard	hazard	0.67	1.25	0.99
Manganese	ng/kg	234.19	537.77	384.98	0.16	0.36	0.26	clean	clean	clean	н.у.	н.у.	н.у.
Chrome	ng/kg	7.12	14.27	10.67	н.у.	н.у.	н.у.	clean	clean	clean	0.07	0.14	0.11
Tin	ng/kg	21.76	35.47	28.49	н.у.	н.у.	н.у.	clean	clean	clean	0.22	0.35	0.28
Petroleum hydrocarbons	ng/kg	615.9	11798	5886.5	н.у.	н.у.	н.у.	hazard	hazard	hazard	12.32	236.00	117.70
VAH:													
Benzene	ng/kg	<0.01	0.011	0.004	0.000	0.036	0.012	clean	clean	clean	0.000	0.218	0.073
Toluene	ng/kg	<0.01	0.014	0.005	0.000	0.046	0.015	clean	clean	clean	0.000	0.028	0.009
Xylenes	ng/kg	<0.05	<0.05	<0.05	0.000	0.000	0.000	clean	clean	clean	0.000	0.000	0.000
Ethylbenzene	ng/kg	<0.01	<0.01	<0.01	н.у.	н.у.	н.у.	-	-	-	0.000	0.000	0.000
Isopropylbenzene (cumene)	ng/kg	<0.01	<0.01	<0.01	н.у.	н.у.	н.у.	-	-	-	н.у.	н.у.	н.у.
1,2,4-trimethylbenzene	ng/kg	<0.01	0.009	0.003	н.у.	н.у.	н.у.	-	-	-	н.у.	н.у.	н.у.

Continuation of Table 5.2.6

Parameter	Unit	Concentration			Concentration in MPC units (APC)			Pollution class			Concentration in PC units		
		min	max	average	min	max	average	from	to	by aver. conc.	min	max	average
PAH													
Naphthalene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(a)pyrene	ng/kg	<0.0012	0.0179	0.0072	0.00	0.89	0.36	Clean	Clean	Clean	NE	NE	NE
Acenaphthylene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Acenaphthene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Fluoranthene	ng/kg	0.0013	0.0040	0.0030	NE	NE	NE	-	-	-	NE	NE	NE
Fluorene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Phenanthrene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Anthracene	ng/kg	<0.0012	0.0044	0.0015	NE	NE	NE	-	-	-	NE	NE	NE
Pyrene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(a)anthracene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Chrysene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(b)fluoranthene	ng/kg	0.0127	0.0728	0.0362	NE	NE	NE	-	-	-	NE	NE	NE
Benz(k)fluoranthene	ng/kg	<0.0012	0.0113	0.0042	NE	NE	NE	-	-	-	NE	NE	NE
Dibenz(a,h)anthracene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Indeno(1,2,3-c,d)-pyrene	ng/kg	<0.0012	0.0656	0.0330	NE	NE	NE	-	-	-	NE	NE	NE
Benz(g,h,i)perylene	ng/kg	<0.0012	0.0210	0.0096	NE	NE	NE	-	-	-	NE	NE	NE
PAH total	ng/kg	0.0141	0.1926	0.0948	NE	NE	NE	Clean	Clean	Clean	0.01	0.19	0.09
PCB													
#28	ng/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
#31	ng/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
#52	ng/kg	<0.00005	0.00787	0.00297	NE	NE	NE	-	-	-	NE	NE	NE
#99	ng/kg	<0.00005	0.00802	0.00309	NE	NE	NE	-	-	-	NE	NE	NE
#101	ng/kg	<0.00005	0.01900	0.00753	NE	NE	NE	-	-	-	NE	NE	NE
#105	ng/kg	<0.00005	0.00582	0.00228	NE	NE	NE	-	-	-	NE	NE	NE
#118	ng/kg	0.00007	0.00457	0.00178	NE	NE	NE	-	-	-	NE	NE	NE
#128	ng/kg	<0.00005	0.00337	0.00135	NE	NE	NE	-	-	-	NE	NE	NE
#138	ng/kg	0.00009	0.02045	0.00784	NE	NE	NE	-	-	-	NE	NE	NE
#153	ng/kg	<0.00005	0.013747	0.005389	NE	NE	NE	-	-	-	NE	NE	NE
#156	ng/kg	<0.00005	0.002274	0.000758	NE	NE	NE	-	-	-	NE	NE	NE
#170	ng/kg	<0.00005	0.001722	0.000675	NE	NE	NE	-	-	-	NE	NE	NE
#180	ng/kg	<0.00005	0.001743	0.000658	NE	NE	NE	-	-	-	NE	NE	NE
#183	ng/kg	<0.00005	0.000351	0.000117	NE	NE	NE	-	-	-	NE	NE	NE
#187	ng/kg	<0.00005	0.000632	0.000211	NE	NE	NE	-	-	-	NE	NE	NE
#209	ng/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
Total 7 PCB	ng/kg	0.00016	0.06738	0.02617	NE	NE	NE	Clean	Hazard	Perm	0.01	3.37	1.31
Total 9 PCB	ng/kg	0.00016	0.07548	0.02921	NE	NE	NE	-	-	-	NE	NE	NE

Total 15 PCB	ng/kg	0.00016	0.08957	0.03465	NE	NE	NE	-	-	-	0.01.	4.48	1.73

*NE – MPC/APC not established

On average content of volatile aromatic hydrocarbons, benz(a)pyrene, the sum of polycyclic aromatic hydrocarbons, manganese, cadmium, chrome, mercury and tin, the area soils of the dumps are classified as clean, the average content of zinc and petroleum hydrocarbons falls into a hazardous pollution class, content of lead - into an extremely hazardous pollution class.
The values of the total soil pollution index Zc calculated for a series of metals varied from 37.4 up to 76.8 (hazardous pollution class).
In point S01-03-3 MPC or APC was exceeded for copper, nickel and values of Kmax (according to MU 2.1.7.730-99), to correspond to very hazardous soil pollution class.
In whole the level of soil pollution of the surveyed area of the radar station can be assessed as hazardous**.**

Assessment according to international standards

Permissible concentrations (PC) of oil products, cobalt, copper and lead were exceeded in the site's soils at separate points, including:

- for oil products - up to 236.0 PC units;
- for total 7 PCB – up to 3.37 PC units;
- for total 15 PCB– up to 4.48 PC units;
- for copper - up to 4.84 PC units
- for lead - up to 4.49 PC units
- for cobalt - up to 2.98 PC units.

The average value of pollutant content for the area was exceeded for oil products - 236 times, total PCB - 3.37 times, for copper 4.1 times.
It is necessary to pay special attention to the fact that the level of soil contamination with oil products at the site exceeds the intervention level both in the average value (1.2 times), and in the values at separate points of geoecological testing (up to 2.4 IL). The average value of total 7 PCB congener is 1.31 PC; The average value of total of 15 PCB congeners is 1.73. The maximum amount of 15 PCB congeners was revealed in point S01-01-1, site 38 (20 m from accumulations of scrap metal and metal drums).
Figures 5.2.1 ,5.2.2 present spatial characteristics of soil and ground pollution of the area of PCB dumps in PC units and pollution with a set of heavy metals (index Zc).

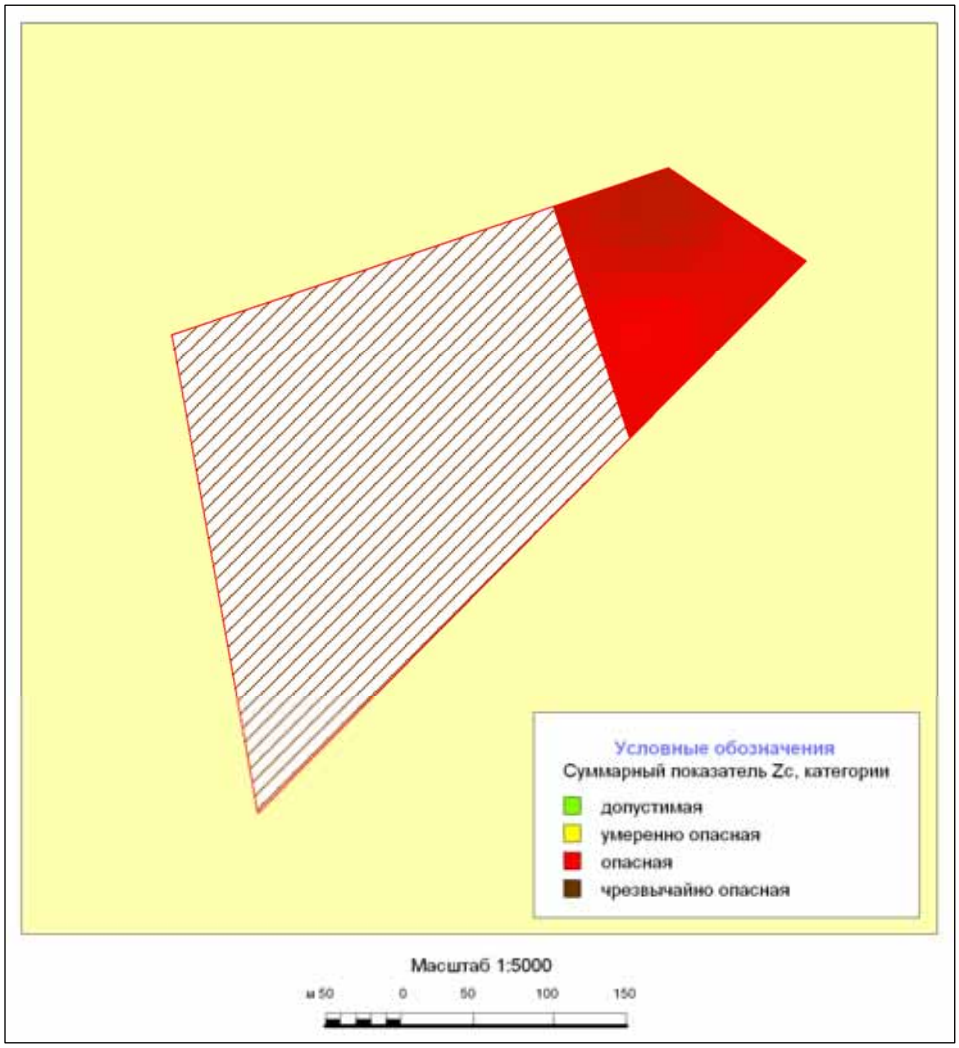

Figure 5.2.1 Spatial characteristics of the level of soil contamination of industrial and construction waste near the settlement of Nagurskoe with heavy metals (Zc)

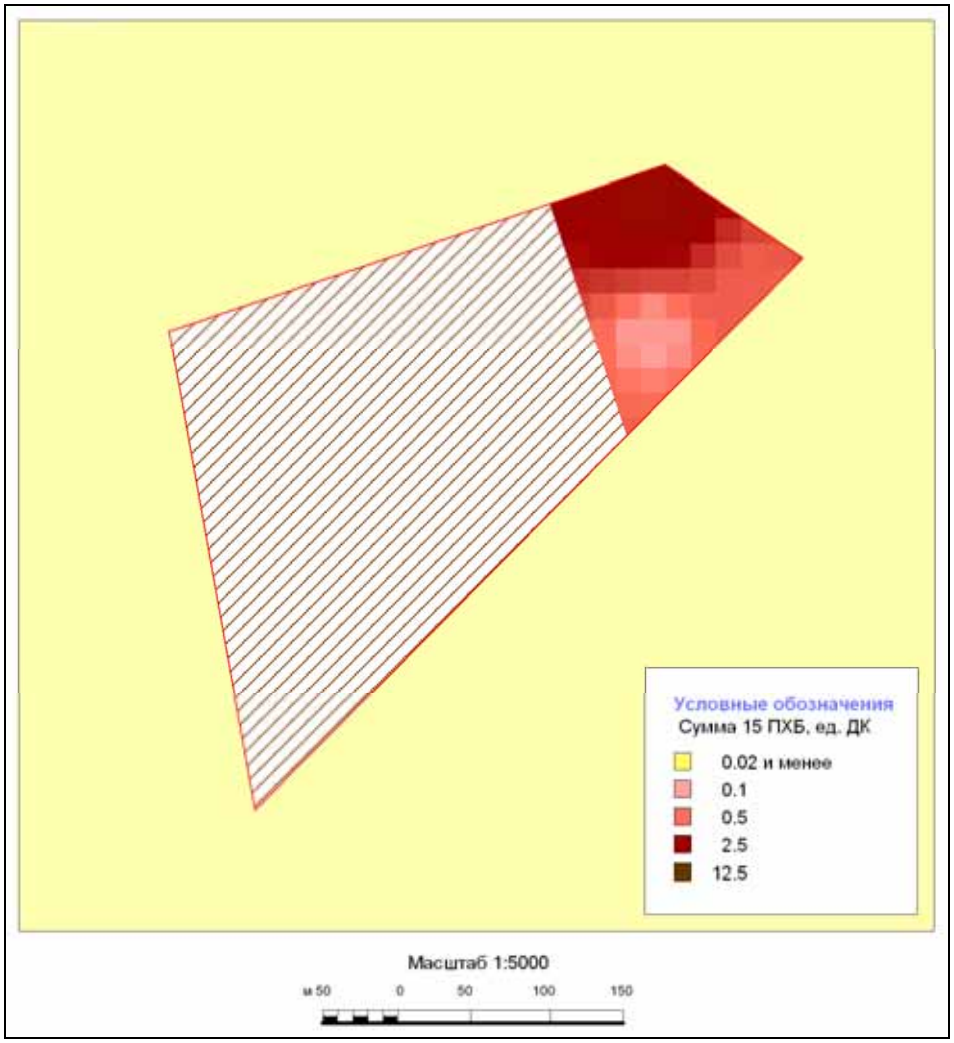

Figure 5.2.2 Spatial characteristics of the level of soil contamination of industrial and construction waste near the settlement of Nagurskoe with PCB

The values of measured concentrations of indices to be monitored are given in summary tables in Book 1 Appendix 5

5.4 Severnaya Bay

5.4.1 Area of fuel and lubricant storage facility near the Severnaya Bay

In the area of fuel and lubricant storage facility in the Severnaya Bay were collected to assess the level of pollution 14 проб почв.

Assessment accoring to the Russian standards

The content of VAH compounds in soils at the site did not exceed tenths of MPC and amounted to:

- for benzene - 0.019 mg/kg (up to 0.37 MPC units);
- for toluene - 0.022 mg/kg (up to 0.04 MPC units);

For xylenes, the content did not exceed the lower limit of certified metrological range for the use manalysis method.

- Content of benz(a)pyrene reached 0.0500 mg/kg (up to 2.50 MPC units point S02-06-6, site 178). Content of other analyzed PAH compounds is not established by the Russian standards.

Content of heavy metals reached:

- for manganese – 494.7 mg/kg (up to 0.33 MPC units point S02-12-12, site 204);
- for zinc – 157.9 mg/kg (up to 1.13 APC units, point S02-02-2, items No.№ 207-248);
- for copper – 308.2 mg/kg (up to 8.56 APC units, point S02-05-5, items No.№ 195-254);
- for nickel – 31.8 mg/kg (up to 0.91 APC units, point S02-01-1, site248);
- for lead – 151.2 mg/kg (up to 1.78 MPC units point S02-02-2, items No. 207-248);
- for cadmium – 1.18 mg/kg (up to 0.15 APC units, point S02-06-6, site 178);
- for mercury - 0.046 mg/kg (up to 0.02 MPC units point S02-01-1, site248).

Table 5.2.7 shows the intervals of pollutant content in soils in the surveyed area of территории, assessment of the area's soil pollution (pollution class), performed according to SanPin requirements 2.1.7.1287-03, based on MPC (APC) and content of controlled pollutants. PC - according to international criteria of environmental assessment.

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Table 5.2.7 Content of pollutants in soils in the area of fuel and lubricant storage facility in the Severnaya Bay

Parameter	Unit	Concentration			Concentration in MPC units (APC)			Pollution class			Concentration in PC units		
		min	max	average	min	max	average	from	to	by aver. conc.	min	max	average
pH by KCl	д. pH	4.76	5.48	5.22	NE	NE	NE	-	-	-	NE	NE	NE
Heavy metals:													
Mercury	ng/kg	0.014	0.046	0.031	0.01	0.02	0.01	clean	clean	clean	0.05	0.15	0.10
Lead	ng/kg	58.10	151.23	83.52	1.82	4.73	2.61	hazard	hazard	hazard	0.68	1.78	0.98
Cadmium	ng/kg	0.063	1.183	0.368	0.13	2.37	0.74	clean	hazard	clean	0.01	0.15	0.05
Cobalt	ng/kg	9.30	54.42	34.87	NE	NE	NE	-	-	-	0.47	2.72	1.74
Nickel	ng/kg	3.00	31.80	19.69	0.15	1.59	0.98	clean		clean	0.09	0.91	0.56
Copper	ng/kg	20.40	308.18	142.60	0.62	9.34	4.32	clean	extrem	extrem	0.57	8.56	3.96
Zinc	ng/kg	42.70	157.87	106.40	0.78	2.87	1.94	clean	hazard	hazard	0.31	1.13	0.76
Manganese	ng/kg	23.80	494.70	268.09	0.02	0.33	0.18	clean	clean	clean	NE	NE	NE
Chrome	ng/kg	3.80	19.04	11.62	NE	NE	NE	clean	clean	clean	0.04	0.19	0.12
Tin	ng/kg	15.91	143.88	54.79	NE	NE	NE	clean	hazard	clean	0.16	1.44	0.55
Petroleum hydrocarbons	ng/kg	235.3	18066	5221.8	NE	NE	NE	hazard	hazard	hazard	4.71	361.30	104.40
VAH:													
Benzene	ng/kg	<0.01	0.019	0.001	0.000	0.062	0.004	clean	clean	clean	0.000	0.371	0.026
Toluene	ng/kg	<0.01	0.022	0.005	0.000	0.074	0.015	clean	clean	clean	0.000	0.044	0.009
Xylenes	ng/kg	<0.05	<0.05	<0.05	0.000	0.000	0.000	clean	clean	clean	0.000	0.000	0.000
Ethylbenzene	ng/kg	<0.01	0.021	0.002	NE	NE	NE	-	-	-	0.000	0.410	0.045
Isopropylbenzene (cumene)	ng/kg	<0.01	0.020	0.001	NE	NE	NE	-	-	-	NE	NE	NE
1,2,4-trimethylbenzene	ng/kg	<0.01	0.030	0.004	NE	NE	NE	-	-	-	NE	NE	NE

Продолжение таблицы 5.2.7

Parameter	Unit	Concentration			Concentration in MPC units (APC)			Pollution class			Concentration in PC units		
		min	max	average	min	max	average	from	to	by aver. conc.	min	max	average
PAH													
Naphthalene	mg/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(a)pyrene	mg/kg	<0.0012	0.0500	0.0181	0.00	2.50	0.91	clean	clean	clean	NE	NE	NE
Acenaphthylene	mg/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Acenaphthene	mg/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Fluoranthene	mg/kg	<0.0012	0.1090	0.0497	NE	NE	NE	-	-	-	NE	NE	NE
Fluorene	mg/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Phenanthrene	mg/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Anthracene	mg/kg	<0.0012	0.0507	0.0202	NE	NE	NE	-	-	-	NE	NE	NE
Pyrene	mg/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(a)anthracene	mg/kg	<0.0012	0.1825	0.0236	NE	NE	NE	-	-	-	NE	NE	NE
Chrysene	mg/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(b)fluoranthene	mg/kg	<0.0012	0.1040	0.0468	NE	NE	NE	-	-	-	NE	NE	NE
Benz(k)fluoranthene	mg/kg	<0.0012	0.0148	0.0065	NE	NE	NE	-	-	-	NE	NE	NE
Dibenz(a,h)anthracene	mg/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Indeno(1,2,3-c,d)-pyrene	mg/kg	<0.0012	0.1846	0.0460	NE	NE	NE	-	-	-	NE	NE	NE
Benz(g,h,i)perylene	mg/kg	<0.0012	0.0746	0.0212	NE	NE	NE	-	-	-	NE	NE	NE
PAH total	mg/kg	0.0186	0.5204	0.2385	NE	NE	NE	clean	clean	clean	0.02	0.52	0.24
PCB													
#28	mg/kg	<0.00005	0.00178	0.00046	NE	NE	NE	-	-	-	NE	NE	NE
#31	mg/kg	<0.00005	0.00119	0.00030	NE	NE	NE	-	-	-	NE	NE	NE
#52	mg/kg	0.00024	0.00640	0.00273	NE	NE	NE	-	-	-	NE	NE	NE
#99	mg/kg	0.00065	0.00491	0.00207	NE	NE	NE	-	-	-	NE	NE	NE
#101	mg/kg	0.00232	0.01416	0.00615	NE	NE	NE	-	-	-	NE	NE	NE
#105	mg/kg	<0.00005	0.00775	0.00264	NE	NE	NE	-	-	-	NE	NE	NE
#118	mg/kg	<0.00005	0.00412	0.00160	NE	NE	NE	-	-	-	NE	NE	NE
#128	mg/kg	<0.00005	0.01054	0.00315	NE	NE	NE	-	-	-	NE	NE	NE
#138	mg/kg	0.00170	0.04064	0.01192	NE	NE	NE	-	-	-	NE	NE	NE
#153	mg/kg	0.00157	0.02709	0.00932	NE	NE	NE	-	-	-	NE	NE	NE
#156	mg/kg	<0.00005	0.00587	0.00162	NE	NE	NE	-	-	-	NE	NE	NE
#170	mg/kg	<0.00005	0.00667	0.00189	NE	NE	NE	-	-	-	NE	NE	NE
#180	mg/kg	<0.00005	0.00821	0.00212	NE	NE	NE	-	-	-	NE	NE	NE
#183	mg/kg	<0.00005	0.00151	0.00044	NE	NE	NE	-	-	-	NE	NE	NE
#187	mg/kg	<0.00005	0.00196	0.00063	NE	NE	NE	-	-	-	NE	NE	NE
#209	mg/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
Total 7 PCB	mg/kg	0.00901	0.10101	0.03440	NE	NE	NE	clean	extrem	доп.	0.451	5.051	1.720
Total 9 PCB	mg/kg	0.00988	0.11463	0.03865	NE	NE	NE	-	-	-	NE	NE	NE
Total 15 PCB	mg/kg	0.01135	0.14141	0.04757	NE	NE	NE	-	-	-	0.57	7.07.	2.38

*NE – MPC/APC not established

On average content of volatile aromatic hydrocarbons, total PAH, manganese, cadmium, mercury, chrome and tin, the soils of fuel and lubricant storage facilitiy in the Severnaya Bay fall in the clean class on average, on average content of total PCB – permissible pollution class; on average content of **lead, zinc, petroleum hydrocarbons – hazardous class**; on average content of **zinc, copper, lead – extremely hazardous pollution class**.

The values of the total soil pollution index Zc calculated for a series of metals varied from 16.3 (**moderately hazardous** pollution class) up to 67.1 (hazardous pollution class), with a site average of 40.1 – **hazardous class**.

At this, in sampling point S02-05-5 (items No. 195-254) MPC or APC was exceeded for copper and values Kmax (according to MU 2.1.7.730-99), to correspond to very hazardous soil pollution class.

In whole, the level of soil pollution of the area of fuel and lubricant storage facility in the Severnaya Bay can be assessed as hazardous**.**

Assessment according to international standards

Permissible concentrations (PC) of oil products, total PCB, cobalt and copper were exceeded in the site's soils at separate points, including:

- for oil products - up to 361 PC units;
- for total 7 PCB– up to 5.0 PC units;
- for total 15 PCB– up to 7.07 PC units;
- for cobalt – up to 2.7 PC units;
- for copper - up to 8.6 PC units;

The average value of pollutant content for the area was exceeded for oil products - 104 times, for total PCB congeners 1.7 times, for copper 4,0 times, for cobalt 1,7 times.

It is necessary to pay special attention to the fact that the level of soil contamination with oil products at the site exceeds the intervention level both in the average value (1.04 times), and in the values at separate points of geoecological testing (up to 3.6 IL). The average value of total 7 PCB congener is 1.72 PC; The average value of total 15 PCB congeners is 12.38 PC on average value. The maximum amount of 15 PCB congeners was revealed in point S02-05-5, items No.№ 195-254 (north oart of the surveyed area of fuel and lubricant storage facility, between accumulations of 200-L drums).

Figures 5.2.3-5.2.5 present spatial characteristics of soil and ground pollution of the area of PCB dumps in PC units and pollution with a set of heavy metals (index).

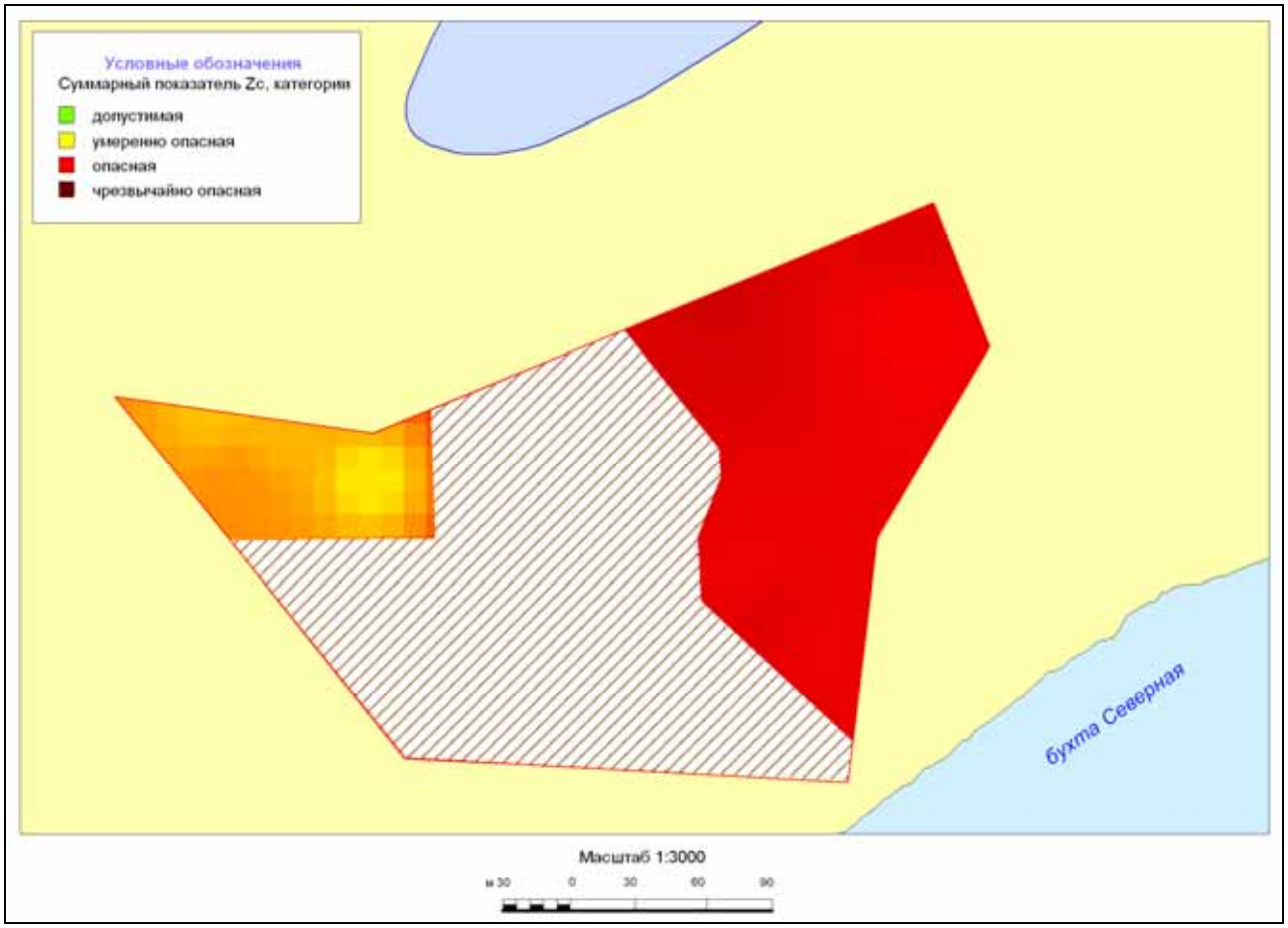

Figure 5.2.3 Spatial characteristics of the level of soil contamination of of the area of fuel and lubricant storage facility near the Severnaya Bay with heavy metals (Zc)

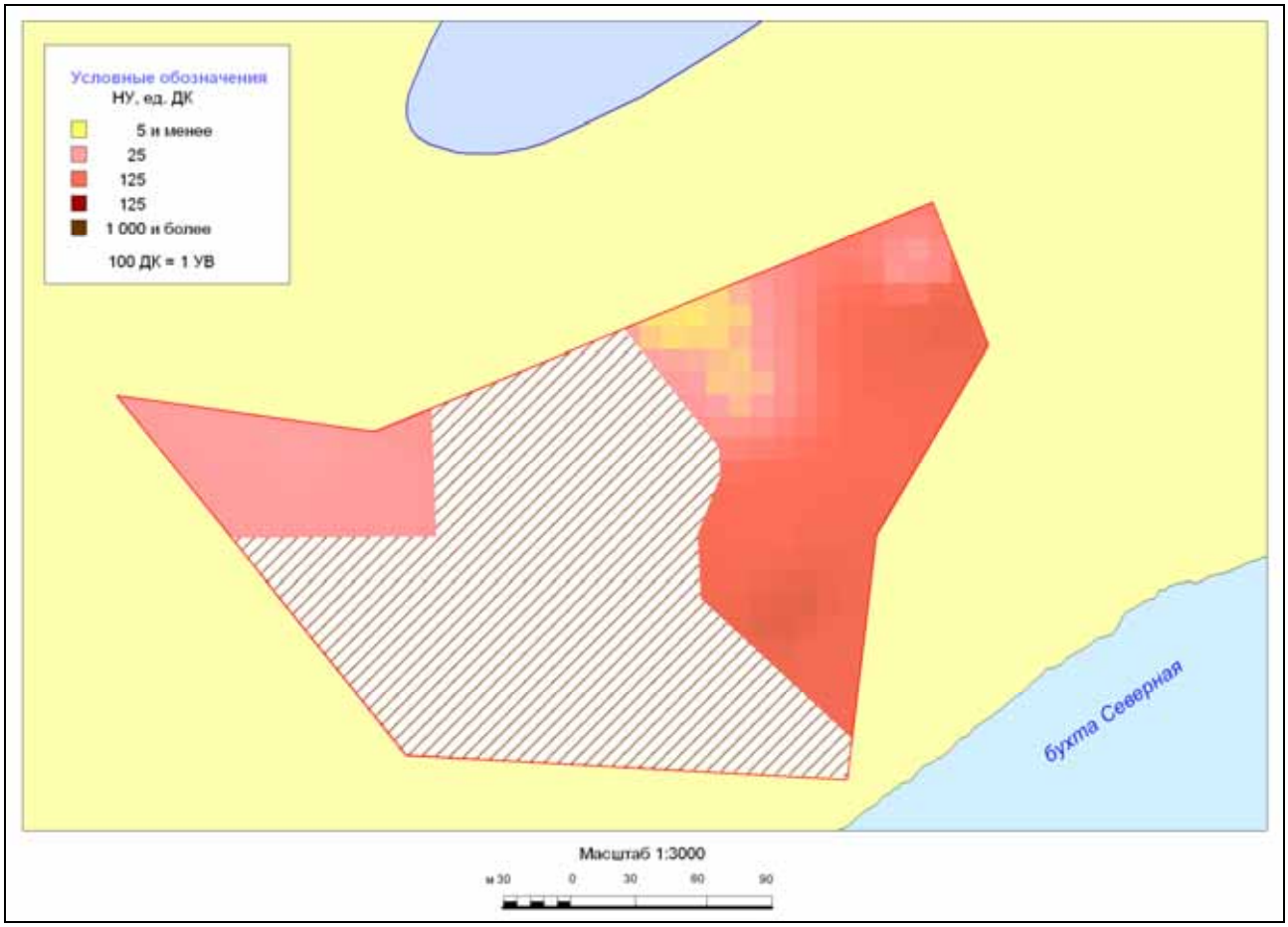

Figure 5.2.4 Spatial characteristics of the level of soil contamination of of the area of fuel and lubricant storage facility near the Severnaya Bay with petroleum hydrocarbons (oil products)

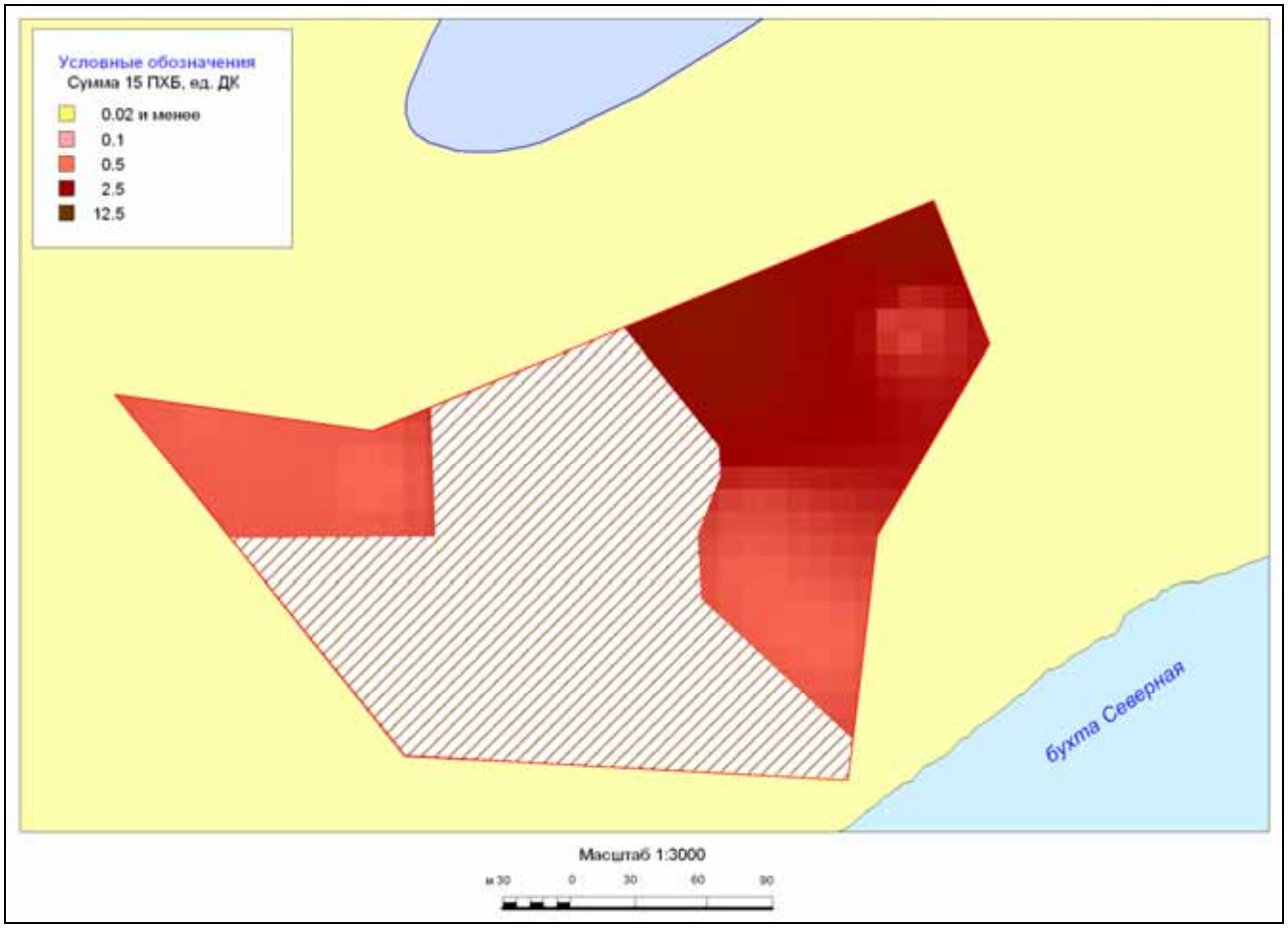

Figure 5.2.5 Spatial characteristics of the level of soil contamination of of the area of fuel and lubricant storage facility near the Severnaya Bay with PCB

The values of measured concentrations of indices to be monitored are given in summary tables in Book 1 Appendix 5

5.4.2 Territory of the abandoned polar station

In the area of the abandoned polar station were collected to assess the level of pollution 8 проб почв.

Assessment accoring to the Russian standards

Content of other controlled VAH compounds did not not exceed the lower limit of metrological certified range for the used analysis method.

Content of benz(a)pyrene reached 0.0046 mg/kg (up to 0.23 MPC units point S03-07-7, site 280).

Content of other analyzed PAH compounds is not established by the Russian standards.

Content of heavy metals reached:

- for manganese – 625.9 mg/kg (up to 0.42 MPC units point S03-08-8, site 274);
- for zinc – 96.3 mg/kg (up to 0.69 APC units, point S03-08-8, site 274);
- for copper – 192.3 mg/kg (up to 5.34 APC units, point S03-07-7, site 280);
- for nickel – 47.5 mg/kg (up to 1.36 APC units, point S03-08-8, site 274);
- for lead – 12.0 mg/kg (up to 0.14 MPC units point S03-07-7, site 280);
- for cadmium – 0.34 mg/kg (up to 0.68 APC units, point S03-08-8, site 274);
- for mercury - 0.108 mg/kg (up to 0.36 MPC units point S03-08-8, site 274).

Table 5.2.8 shows the intervals of pollutant content in soils in the surveyed area of территории, assessment of the area's soil pollution (pollution class), performed according to SanPin requirements 2.1.7.1287-03, based on MPC (APC) and content of controlled pollutants. PC - according to international criteria of environmental assessment..

Table 5.2.8 Content of pollutants in soils in the territory of the abandoned polar station

Parameter	Unit	Concentration			Concentration in MPC units (APC)			Pollution class			Concentration in PC units		
		min	max	average	min	max	average	from	to	by aver. conc.	min	max	average
pH by KCl	pH	4.89	8.16	5.65	NE	NE	NE	-	-	-	NE	NE	NE
Heavy metals:													
Mercury	ng/kg	0.007	0.108	0.049	0.00	0.05	0.02	clean	clean	clean	0.02	0.36	0.16
Lead	ng/kg	3.00	11.95	6.97	0.09	0.37	0.22	clean	clean	clean	0.04	0.14	0.08
Cadmium	ng/kg	0.140	0.339	0.220	0.28	0.68	0.44	clean	clean	clean	0.02	0.04	0.03
Cobalt	ng/kg	47.9	65.55	54.468	NE	NE	NE	extrem	extrem	extrem	2.40	3.28	2.72
Nickel	ng/kg	27.50	47.54	40.52	1.38	2.38	2.03	extrem	extrem	extrem	0.79	1.36	1.16
Copper	ng/kg	140.60	192.34	168.37	4.26	5.83	5.10	extrem	extrem	extrem	3.91	5.34	4.68
Zinc	ng/kg	69.00	96.28	82.43	1.26	1.75	1.50	hazard	hazard	hazard	0.49	0.69	0.59
Manganese	ng/kg	273.30	625.86	415.87	0.18	0.42	0.28	clean	clean	clean	0.15	0.33	0.24
Chrome	ng/kg	15.40	33.09	23.80	NE	NE	NE	clean	clean	clean	0.15	0.33	0.24
Tin	ng/kg	28.38	49.79	40.08	NE	NE	NE	clean	clean	clean	0.28	0.50	0.40
Petroleum hydrocarbons	ng/kg	12440	32898	21417	NE	NE	NE	hazard	hazard	hazard	248.8	658.0	428.3
VAH:													
Benzene	ng/kg	<0.01	<0.01	<0.01	0.000	0.000	0.000	clean	clean	clean	0.000	0.000	0.000
Toluene	ng/kg	<0.01	<0.01	<0.01	0.000	0.000	0.000	clean	clean	clean	0.000	0.000	0.000
Xylenes	ng/kg	<0.05	<0.05	<0.05	0.000	0.000	0.000	clean	clean	clean	0.000	0.000	0.000
Ethylbenzene	ng/kg	<0.01	<0.01	<0.01	NE	NE	NE	-	-	-	0.000	0.000	0.000
Isopropylбен-зол(cumene)	ng/kg	<0.01	<0.01	<0.01	NE	NE	NE	-	-	-	NE	NE	NE
1,2,4-trimethylbenzene	ng/kg	<0.01	0.01	<0.01	NE	NE	NE	-	-	-	NE	NE	NE

Продолжение таблицы 5.2.8

Parameter	Unit	Concentration			Concentration in MPC units (APC)			Pollution class			Concentration in PC units		
		min	max	average	min	max	average	from	to	by aver. conc.	min	max	average
PAH													
Naphthalene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(a)pyrene	ng/kg	<0.0012	0.0046	0.0021	0.00	0.23	0.10	clean	clean	clean	NE	NE	NE
Acenaphthylene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Acenaphthene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Fluoranthene	ng/kg	<0.0012	0.1368	0.0634	NE	NE	NE	-	-	-	NE	NE	NE
Fluorene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Phenanthrene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Anthracene	ng/kg	<0.0012	0.0522	0.0237	NE	NE	NE	-	-	-	NE	NE	NE
Pyrene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(a)anthracene	ng/kg	<0.0012	0.1246	0.0570	NE	NE	NE	-	-	-	NE	NE	NE
Chrysene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(b)fluoranthene	ng/kg	0.0037	0.0301	0.0156	NE	NE	NE	-	-	-	NE	NE	NE
Benz(k)fluoranthene	ng/kg	<0.0012	0.0026	0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Dibenz(a,h)anthracene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Indeno(1,2,3-c,d)-pyrene	ng/kg	<0.0012	0.0198	0.0086	NE	NE	NE	-	-	-	NE	NE	NE
Benz(g,h,i)perylene	ng/kg	<0.0012	0.0072	0.0031	NE	NE	NE	-	-	-	NE	NE	NE
PAH total	ng/kg	0.0037	0.3779	0.1746	NE	NE	NE	clean	clean	clean	0.004	0.378	0.175
PCB													
#28	ng/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
#31	ng/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
#52	ng/kg	0.00124	0.00291	0.00199	NE	NE	NE	-	-	-	NE	NE	NE
#99	ng/kg	<0.00005	0.00079	0.00036	NE	NE	NE	-	-	-	NE	NE	NE
#101	ng/kg	<0.00005	0.00283	0.00123	NE	NE	NE	-	-	-	NE	NE	NE
#105	ng/kg	0.00066	0.00089	0.00083	NE	NE	NE	-	-	-	NE	NE	NE
#118	ng/kg	0.00041	0.00059	0.00051	NE	NE	NE	-	-	-	NE	NE	NE
#128	ng/kg	<0.00005	0.00014	0.00006	NE	NE	NE	-	-	-	NE	NE	NE
#138	ng/kg	0.00065	0.00131	0.00100	NE	NE	NE	-	-	-	NE	NE	NE
#153	ng/kg	0.00102	0.00161	0.00125	NE	NE	NE	-	-	-	NE	NE	NE
#156	ng/kg	<0.00005	0.00013	0.00006	NE	NE	NE	-	-	-	NE	NE	NE
#170	ng/kg	0.00006	0.00008	0.00007	NE	NE	NE	-	-	-	NE	NE	NE
#180	ng/kg	0.00011	0.00019	0.00015	NE	NE	NE	-	-	-	NE	NE	NE
#183	ng/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
#187	ng/kg	0.00065	0.00097	0.00079	NE	NE	NE	-	-	-	NE	NE	NE
#209	ng/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
Total 7 PCB	ng/kg	0.00484	0.00776	0.00599	NE	NE	NE	clean	clean	clean	0.242	0.388	0.299
Total 9 PCB	ng/kg	0.00572	0.00877	0.00687	NE	NE	NE	-	-	-	NE	NE	NE
Total 15 PCB	ng/kg	0.00658	0.01063	0.00815	NE	NE	NE	-	-	-	0.33	0.53	0.41.

*NE – MPC/APC not established

On average content of volatile aromatic hydrocarbons, manganese, lead, cadmium, chrome, tin and mercury the soils of territory of the abandoned polar station falls into vlean class, on average content of **zinc, petroleum hydrocarbons –**Pollution class, on average content of **cobalt, nickel, copper** – .extremely hazardous pollution class.
The values of the total soil pollution index Zc calculated for a series of metals varied from 34.9 up to 52.2 (hazardous pollution class), with a site average of 43.3 – **hazardous class**.
In point S03-08-8, site 274 for nickel, in point S03-07-7, site 280, MPC and APC and values Kmax were exceeded for copper (according to MU 2.1.7.730-99), to correspond to very hazardous soil pollution class.
In whole, the level of soil pollution of the territory of the abandoned polar station can be assessed as hazardous**.**

Assessment according to international standards

Permissible concentrations (PC) of oil products, cobalt, copper, and nickel were exceeded in the site's soils at separate points, including:

- for oil products - up to 658 PC units;
- for cobalt – up to 3.9 PC units;
- for copper - up to 5.3 PC units;
- for nickel – up to 1.4 PC units.

The average value of pollutant content exceeded PC in the area for oil products - 428 times, for copper - 4,7 times, for cobalt в 2,7 times, for nickel - 1.16 times.
It is necessary to pay special attention to the fact that the level of soil contamination with oil products at the site exceeds the intervention level both in the average value (4.28 times), and in the values at separate points of geoecological testing (up to 6.6 IL). It is also should be noted that total **15 PCB** in separate sampling points is 0.53 PC. The maximum amount of 15 PCB congeners was revealed in point S03-08-8, items No. 237 (south part of the polar station area at 8 m from cistern R-25).

Figures 5.2.6-5.2.7 present spatial characteristics of soil and ground pollution of the area of PCB dumps in PC units and pollution with a set of heavy metals (index).

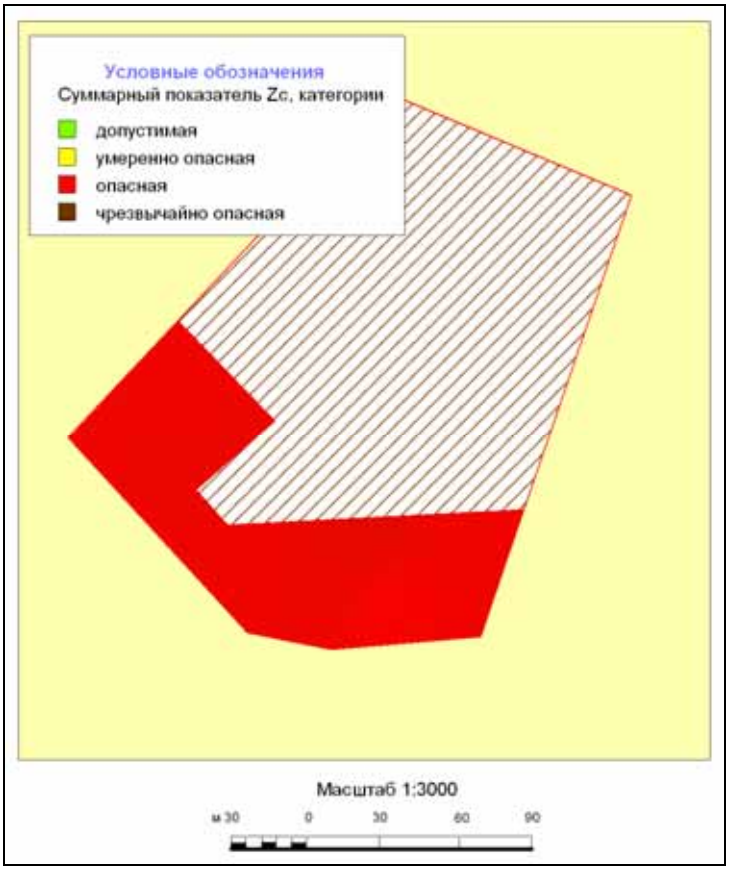

Figure 5.2.6 Spatial characteristics of the level of soil contamination of territory of the abandoned polar station цшер heavy metals (Zc)

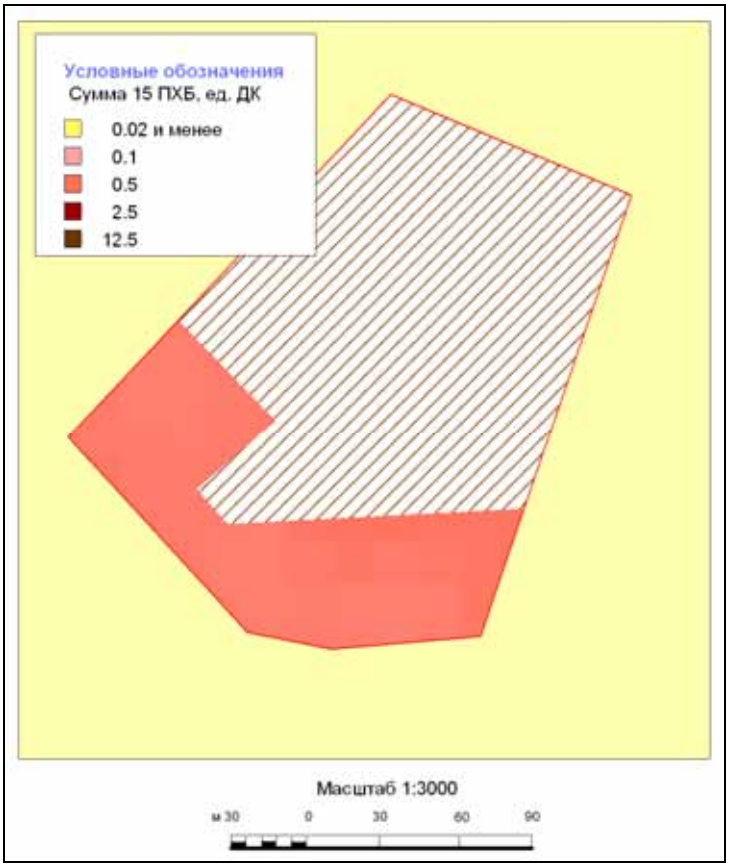

Figure 5.2.7 Spatial characteristics of the level of soil contamination of territory of the abandoned polar station PCB

The values of measured concentrations of indices to be monitored are given in summary tables in Book 1 Appendix 5.

5.5 Area of the abandoned air-defense station.

5.5.1 Territory of the radar station commandant's office

In **the territory of the radar station commandant's office,** 9 soil sampes were collected to assess the level of pollution.

Assessment accoring to the Russian standards

The content of VAH compounds in soils at the site did not exceed tenths of MPC and amounted to:

- for benzene - 0.015 mg/kg (up to 0.05 MPC units);
- for toluene - 0.026 mg/kg (up to 0.09 MPC units);
- for xylenes all values were lower than sensitivity levels for this analysis method.

Content of benz(a)pyrene reached 0.1307 mg/kg (up to 6.53 MPC units point S04-06-6, site 312).
Content of other analyzed PAH compounds is not established by the Russian standards.
Content of heavy metals reached:

- for manganese – 618.8 mg/kg (up to 0.41 MPC units point S04-05-5, site 313);
- for zinc – 125.0 mg/kg (up to 2.27 APC units, point S04-05-5, site 313);
- for copper – 257.8 mg/kg (up to 7.81 APC units, point S04-07-7, site 316);
- for nickel – 34.5 mg/kg (up to 1.72 APC units, point S04-05-5, site 313);
- for lead – 39.2 mg/kg (up to 1.23 MPC units point S04-07-7, site 316);
- for cadmium – 0.68 mg/kg (up to 1.36 APC units, point S04-01-1, site 321);
- for mercury - 0.133 mg/kg (up to 0.06 MPC units point S04-06-6, site 312).

Table 5.2.9 shows the intervals of pollutant content in soils in the surveyed area (pollution class), performed according to SanPin requirements 2.1.7.1287-03, based on MPC (APC) and content of controlled pollutants. PC - according to international criteria of environmental assessment

Table 5.2.9 Content of pollutants in soils in the territory of the radar station commandant's office

Parameter	Unit	Concentration			Concentration in MPC units (APC)			Pollution class			Concentration in PC units		
		min	max	average	min	max	average	from	to	by aver. conc.	min	max	average
pH by KCl	д. pH	4.11	7.64	5.31	NE	NE	NE	-	-	-	NE	NE	NE
Heavy metals:													
Mercury	ng/kg	0.010	0.133	0.060	0.00	0.06	0.03	clean	clean	clean	0.03	0.44	0.20
Lead	ng/kg	2.78	39.20	18.24	0.09	1.23	0.57	clean	hazard	clean	0.03	0.46	0.21
Cadmium	ng/kg	0.051	0.680	0.202	0.10	1.36	0.40	clean	hazard	clean	0.01	0.09	0.03
Cobalt	ng/kg	22.84	62.37	50.19	NE	NE	NE	hazard	extrem	extrem	1.14	3.12	2.51
Nickel	ng/kg	15.20	34.47	24.76	0.76	1.72	1.24	clean	extrem	extrem	0.43	0.98	0.71
Copper	ng/kg	63.79	257.81	180.69	1.93	7.81	5.48	hazard	extrem	extrem	1.77	7.16	5.02
Zinc	ng/kg	43.71	124.99	89.86	0.79	2.27	1.63	clean	hazard	hazard	0.31	0.89	0.64
Manganese	ng/kg	134.70	618.82	447.01	0.09	0.41	0.30	clean	clean	clean	NE	NE	NE
Chrome	ng/kg	5.81	17.50	11.34	NE	NE	NE	clean	clean	clean	0.06	0.18	0.11
Tin	ng/kg	19.41	107.50	43.41	NE	NE	NE	clean	clean	clean	0.19	1.08	0.43
Petroleum hydrocarbons	ng/kg	271.7	7725.3	1631.1	NE	NE	NE	hazard	hazard	hazard	5.4	154.5	32.6
VAH:													
Benzene	ng/kg	<0.01	0.015	0.003	0.000	0.052	0.009	clean	clean	clean	0.000	0.310	0.057
Toluene	ng/kg	<0.01	0.026	0.007	0.000	0.088	0.025	clean	clean	clean	0.000	0.053	0.015
Xylenes	ng/kg	<0.05	<0.05	<0.05	0.000	0.000	0.000	clean	clean	clean	0.000	0.000	0.000
Ethylbenzene	ng/kg	<0.01	0.029	0.005	NE	NE	NE	clean	clean	clean	0.000	0.587	0.095
Isopropylbenzene (cumene)	ng/kg	<0.01	0.037	0.004	NE	NE	NE	-	-	-	NE	NE	NE
1,2,4-trimethylbenzene	ng/kg	<0.01	0.097	0.015	NE	NE	NE	-	-	-	NE	NE	NE

Continuation of Table 5.2.9

Parameter	Unit	Concentration			Concentration in MPC units (APC)			Pollution class			Concentration in PC units		
		min	max	average	min	max	average	from	to	by aver. conc.	min	max	average
PAH													
Naphthalene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(a)pyrene	ng/kg	<0.0012	0.1307	0.0310	0.00	6.53	1.55	clean	extrem	доп.	NE	NE	NE
Acenaphthylene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Acenaphthene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Fluoranthene	ng/kg	<0.0012	0.2383	0.0873	NE	NE	NE	-	-	-	NE	NE	NE
Fluorene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Phenanthrene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Anthracene	ng/kg	<0.0012	0.0517	0.0189	NE	NE	NE	-	-	-	NE	NE	NE
Pyrene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(a)anthracene	ng/kg	<0.0012	0.3421	0.0744	NE	NE	NE	-	-	-	NE	NE	NE
Chrysene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(b)fluoranthene	ng/kg	<0.0012	0.2557	0.0549	NE	NE	NE	-	-	-	NE	NE	NE
Benz(k)fluoranthene	ng/kg	<0.0012	0.0676	0.0158	NE	NE	NE	-	-	-	NE	NE	NE
Dibenz(a,h)anthracene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Indeno(1,2,3-c,d)-pyrene	ng/kg	<0.0012	0.2135	0.0498	NE	NE	NE	-	-	-	NE	NE	NE
Benz(g,h,i)perylene	ng/kg	<0.0012	0.0992	0.0218	NE	NE	NE	-	-	-	NE	NE	NE
PAH total	ng/kg	<0.0012	1.3028	0.3538	NE	NE	NE	clean	perm	clean	0.00	1.30	0.35
PCB													
#28	ng/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
#31	ng/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
#52	ng/kg	<0.00005	0.00410	0.00085	NE	NE	NE	-	-	-	NE	NE	NE
#99	ng/kg	<0.00005	0.00422	0.00108	NE	NE	NE	-	-	-	NE	NE	NE
#101	ng/kg	<0.00005	0.00834	0.00165	NE	NE	NE	-	-	-	NE	NE	NE
#105	ng/kg	<0.00005	0.00589	0.00097	NE	NE	NE	-	-	-	NE	NE	NE
#118	ng/kg	0.00024	0.00748	0.00153	NE	NE	NE	-	-	-	NE	NE	NE
#128	ng/kg	<0.00005	0.00329	0.00060	NE	NE	NE	-	-	-	NE	NE	NE
#138	ng/kg	<0.00005	0.01703	0.00330	NE	NE	NE	-	-	-	NE	NE	NE
#153	ng/kg	<0.00005	0.01051	0.00211	NE	NE	NE	-	-	-	NE	NE	NE
#156	ng/kg	<0.00005	0.00249	0.00040	NE	NE	NE	-	-	-	NE	NE	NE
#170	ng/kg	<0.00005	0.00150	0.00021	NE	NE	NE	-	-	-	NE	NE	NE
#180	ng/kg	<0.00005	0.00168	0.00027	NE	NE	NE	-	-	-	NE	NE	NE
#183	ng/kg	<0.00005	0.00031	0.00004	NE	NE	NE	-	-	-	NE	NE	NE
#187	ng/kg	<0.00005	0.00079	0.00014	NE	NE	NE	-	-	-	NE	NE	NE
#209	ng/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
Total 7 PCB	ng/kg	0.00034	0.04914	0.00971	NE	NE	NE	clean	hazard	clean	0.02	2.46	0.49
Total 9 PCB	ng/kg	0.00034	0.05752	0.01108	NE	NE	NE	-	-	-	NE	NE	NE
Total 15 PCB	ng/kg	0.00034	0.06722	0.01316	NE	NE	NE	-	-	-	0.017	3.36.	0.66

*NE – MPC/APC not established

On average content of volatile aromatic hydrocarbons, total PCB, manganese, cadmium, mercury, lead, chrome and tin the soils of the territory of the radar station commandant's office fall into clean class; on average content of **lead, cadmium, zinc, petroleum hydrocarbons and total PCB –** hazardous class; on average content of **cobalt, copper, nickel and benz(a)pyrene –** extremely hazardous pollution class.

The values of the total soil pollution index Zc calculated for a series of metals varied from 22.0 (**moderately hazardous** pollution class) up to 52.7 (hazardous pollution class), with a site average of 41.6 –**hazardous class**.

In sampling point S04-05-5, site 313 for nickel, in point S04-07-7, site 316 for copper, in point S04-06-6, site 312 for benz(a)pyrene МРС щк АРС and values Кmax were exceeded (according to MU 2.1.7.730-99), to correspond to very hazardous soil pollution class.

In whole, the level of soil pollution of the territory of the radar station commandant's office can be assessed as hazardous**.**

Assessment according to international standards

Permissible concentrations (PC) of oil products, total PAHs, total PCB, cobalt, copper, tin, were exceeded in the site's soils at separate points, including:

- for oil products - up to 154 PC units;
- for cobalt – up to 3.1 PC units;
- for copper - up to 7.2 PC units;
- for tin – up to 1.1 PC units;
- for total PAH – up to 1.3 PC units;
- for total 7 PCB– up to 2.5 PC units;
- for total 15 PCB– до3.4 PC units.

The average value of pollutant content exceeded PC in the area for oil products - 32.6 times, for copper - 5.0 times, for cobalt - 2,5 times.

It is necessary to pay special attention to the fact that the level of soil contamination with oil products at the site exceeds the intervention level both in the average value, and in the values at separate points of geoecological testing (up to 1.5 IL). It is also should be noted that total 7 PCB is up to 2.5 PC, total 15 PCB is 3.4 PC;. The maximum amount of 15 PCB congeners was revealed in point S04-09-9 metal scrap and metal drum dump site 317 (30 m from the observation post of the radar station commandant's office, site 318).

Figures 5.2.8-5.2.9 present spatial characteristics of soil and ground pollution of the area of PCB dumps in PC units and pollution with a set of heavy metals (index Zc).

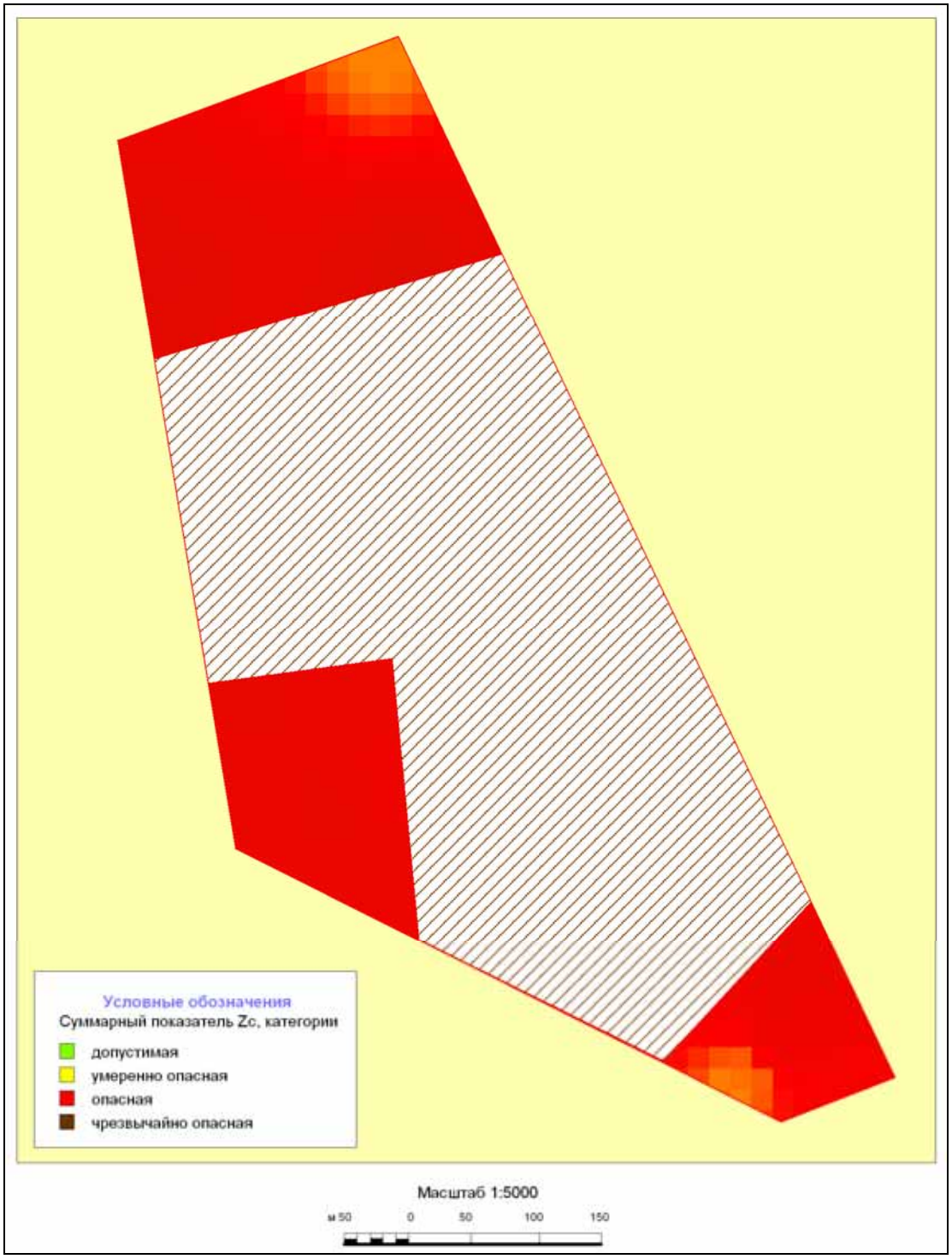

Figure 5.2.8 Spatial characteristics of the level of soil contamination of the territory of the radar station commandant's office with heavy metals (Zc)

Figure 5.2.9 Spatial characteristics of the level of soil contamination of the territory of the radar station commandant's office with PCB

The values of measured concentrations of indices to be monitored are given in summary tables in Book 1 Appendix 5.

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5.5.2 Area of radar station

In the area of radar station 11 soil samples were collected to assess the level of pollution.

Assessment accoring to the Russian standards

The content of VAH compounds in soils at the site did not exceed tenths of MPC and amounted to:

- for benzene - 0.013 mg/kg (up to 0.04 MPC units);
- for toluene - 0.019 mg/kg (up to 0.06 MPC units);
- for xylenes all values were lower than sensitivity levels for this analysis method.

Content of benz(a)pyrene reached 0.0041 mg/kg (up to 0.20 MPC units point S05-10-10, site 164).

Content of other analyzed PAH compounds is not established by the Russian standards.

Content of heavy metals reached:

- for manganese – 341.1 mg/kg (up to 0.23 MPC units point S05-04-4, site 145);
- for zinc – 99.14 mg/kg (up to 1.80 APC units, point S05-02-2, site 162);
- for copper – 141.1 mg/kg (up to 4.28 APC units, point S05-03-3, site 162);
- for nickel – 13.7 mg/kg (up to 0.68 APC units, point S05-07-7, site 328);
- for lead – 31.4 mg/kg (up to 0.98 MPC units point S05-02-2, site 162);
- for cadmium – 0.55 mg/kg (up to 1.11 APC units, point S05-02-2, site 162);
- for mercury - 0.321 mg/kg (up to 0.15 MPC units point S05-08-8, site 329).

Table 5.2.10 shows the intervals of pollutant content in soils in the surveyed area (pollution class), performed according to SanPin requirements 2.1.7.1287-03, based on MPC (APC) and content of controlled pollutants. PC - according to international criteria of environmental assessment.

Table 5.2.10 Content of pollutants in soils in the area of radar station

Parameter	Unit	Concentration			Concentration in MPC units (APC)			Pollution class			Concentration in PC units		
		min	max	average	min	max	average	from	to	by aver. conc.	min	max	average
pH by KCl	д. pH	4.38	5.48	4.86	NE	NE	NE	-	-	-	NE	NE	NE
Heavy metals:													
Mercury	ng/kg	0.006	0.321	0.044	0.00	0.15	0.02	clean	clean	clean	0.02	1.07	0.15
Lead	ng/kg	0.99	31.37	6.62	0.03	0.98	0.21	clean	clean	clean	0.01	0.37	0.08
Cadmium	ng/kg	0.052	0.554	0.155	0.10	1.11	0.31	clean	hazard	clean	0.01	0.07	0.02
Cobalt	ng/kg	22.49	38.69	28.75	NE	NE	NE	hazard	extrem	extrem	1.12	1.93	1.44
Nickel	ng/kg	6.41	13.67	9.79	0.32	0.68	0.49	clean	clean	clean	0.18	0.39	0.28
Copper	ng/kg	29.07	141.07	69.81	0.88	4.28	2.12	clean	extrem	hazard	0.81	3.92	1.94
Zinc	ng/kg	27.89	99.14	51.39	0.51	1.80	0.93	clean	hazard	clean	0.20	0.71	0.37
Manganese	ng/kg	129.88	341.07	223.56	0.09	0.23	0.15	clean	clean	clean	NE	NE	NE
Chrome	ng/kg	3.30	9.67	6.71	NE	NE	NE	clean	clean	clean	0.03	0.10	0.07
Tin	ng/kg	10.65	17.76	14.09	NE	NE	NE	clean	clean	clean	0.11	0.18	0.14
Petroleum hydrocarbons	ng/kg	142.3	4007.1	858.1	NE	NE	NE	hazard	hazard	hazard	2.85	80.14	17.16
VAH:													
Benzene	ng/kg	<0.01	0.013	0.001	0.000	0.042	0.004	clean	clean	clean	0.000	0.251	0.023
Toluene	ng/kg	<0.01	0.019	0.003	0.000	0.064	0.009	clean	clean	clean	0.000	0.039	0.006
Xylenes	ng/kg	<0.05	<0.05	<0.05	0.000	0.000	0.000	clean	clean	clean	0.000	0.000	0.000
Ethylbenzene	ng/kg	<0.01	0.042	0.006	NE	NE	NE	clean	clean	clean	0.000	0.838	0.120
Isopropylbenzene (cumene)	ng/kg	<0.01	0.054	0.008	NE	NE	NE	-	-	-	NE	NE	NE
1,2,4-trimethyl-benzene	ng/kg	<0.01	0.130	0.023	NE	NE	NE	-	-	-	NE	NE	NE

Continuation of Table 5.2.10

Parameter	Unit	Concentration			Concentration in MPC units (APC)			Pollution class			Concentration in PC units		
		min	max	average	min	max	average	from	to	by aver. conc.	min	max	average
PAH													
Naphthalene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(a)pyrene	ng/kg	<0.0012	0.0041	0.0020	0.000	0.205	0.099	clean	clean	clean	NE	NE	NE
Acenaphthylene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Acenaphthene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Fluoranthene	ng/kg	<0.0012	0.0146	0.0074	NE	NE	NE	-	-	-	NE	NE	NE
Fluorene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Phenanthrene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Anthracene	ng/kg	<0.0012	0.0287	0.0040	NE	NE	NE	-	-	-	NE	NE	NE
Pyrene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(a)anthracene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Chrysene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Benz(b)fluoranthene	ng/kg	<0.0012	0.0187	0.0068	NE	NE	NE	-	-	-	NE	NE	NE
Benz(k)fluoranthene	ng/kg	<0.0012	0.0031	0.0009	NE	NE	NE	-	-	-	NE	NE	NE
Dibenz(a,h)anthracene	ng/kg	<0.0012	<0.0012	<0.0012	NE	NE	NE	-	-	-	NE	NE	NE
Indeno(1,2,3-c,d)-pyrene	ng/kg	<0.0012	0.0150	0.0038	NE	NE	NE	-	-	-	NE	NE	NE
Benz(g,h,i)perylene	ng/kg	<0.0012	0.0086	0.0026	NE	NE	NE	-	-	-	NE	NE	NE
PAH total	ng/kg	0.0061	0.0639	0.0274	NE	NE	NE	clean	clean	clean	0.006	0.064	0.027
PCB													
#28	ng/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
#31	ng/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
#52	ng/kg	<0.00005	0.00188	0.00076	NE	NE	NE	-	-	-	NE	NE	NE
#99	ng/kg	<0.00005	0.00171	0.00058	NE	NE	NE	-	-	-	NE	NE	NE
#101	ng/kg	<0.00005	0.00347	0.00107	NE	NE	NE	-	-	-	NE	NE	NE
#105	ng/kg	<0.00005	0.00124	0.00044	NE	NE	NE	-	-	-	NE	NE	NE
#118	ng/kg	0.00013	0.00124	0.00059	NE	NE	NE	-	-	-	NE	NE	NE
#128	ng/kg	<0.00005	0.00073	0.00023	NE	NE	NE	-	-	-	NE	NE	NE
#138	ng/kg	<0.00005	0.00405	0.00144	NE	NE	NE	-	-	-	NE	NE	NE
#153	ng/kg	<0.00005	0.00299	0.00100	NE	NE	NE	-	-	-	NE	NE	NE
#156	ng/kg	<0.00005	0.00047	0.00015	NE	NE	NE	-	-	-	NE	NE	NE
#170	ng/kg	<0.00005	0.00050	0.00007	NE	NE	NE	-	-	-	NE	NE	NE
#180	ng/kg	<0.00005	0.00036	0.00009	NE	NE	NE	-	-	-	NE	NE	NE
#183	ng/kg	<0.00005	0.00007	0.00001	NE	NE	NE	-	-	-	NE	NE	NE
#187	ng/kg	<0.00005	0.00013	0.00002	NE	NE	NE	-	-	-	NE	NE	NE
#209	ng/kg	<0.00005	<0.00005	<0.00005	NE	NE	NE	-	-	-	NE	NE	NE
Total 7 PCB	ng/kg	0.00070	0.01330	0.00494	NE	NE	NE	clean	clean	clean	0.035	0.665	0.247
Total 9 PCB	ng/kg	0.00070	0.01501	0.00554	NE	NE	NE	-	-	-	NE	NE	NE
Total 15 PCB	ng/kg	0.00070	0.01812	0.00645	NE	NE	NE	-	-	-	0.035	0.91	0.32

*NE – MPC/APC not established

On average content of volatile aromatic hydrocarbons, total PCB, manganese, никеля, cadmium, mercury, lead, chrome, tin and benz(a)pyrene the soils of the radar station area falls into clean class; on average content of **cadmium, zinc and petroleum hydrocarbons –** hazardous class; on average content of **cobalt and copper –** extremely hazardous pollution class.
The values of the total soil pollution index Zc calculated for a series of metals varied from 8.0 (**permissible pollution class**) up to 26.1 (**moderately hazardous** pollution class), with a site average of 15.5 – **permissible** class.
At this, in sampling point S05-03-3, site 162 MPC or APC was exceeded for меди Kmax (according to MU 2.1.7.730-99), to correspond to very hazardous soil pollution class.
In whole, the level of soil pollution of he radar station can be assessed as **permissible**.

Assessment according to international standards

Permissible concentrations (PC) of oil products, cobalt and copper were exceeded in the site's soils at separate points, including:

- for oil products - up to 80 PC units;
- for cobalt – up to 1.9 PC units;
- for copper - up to 3.9 PC units.

The average value of pollutant content exceeded PC in the area for oil products - 17.2 times, for copper - 1.9 times, for cobalt - 1.4 times.
It is necessary to pay special attention to the fact that total 7 **PCB** is up to 0.66 PC; total 15 **PCB** is up to 0.91 PC in separate sampling pointe. The maximum amount of 15 PCB congeners was revealed in point S05-02-2, central part of the radar station area at 30 m from the building, site 162.

Figures 5.2.10-5.2.11 present spatial characteristics of soil and ground pollution of the area of PCB dumps in PC units and pollution with a set of heavy metals (index Zc).

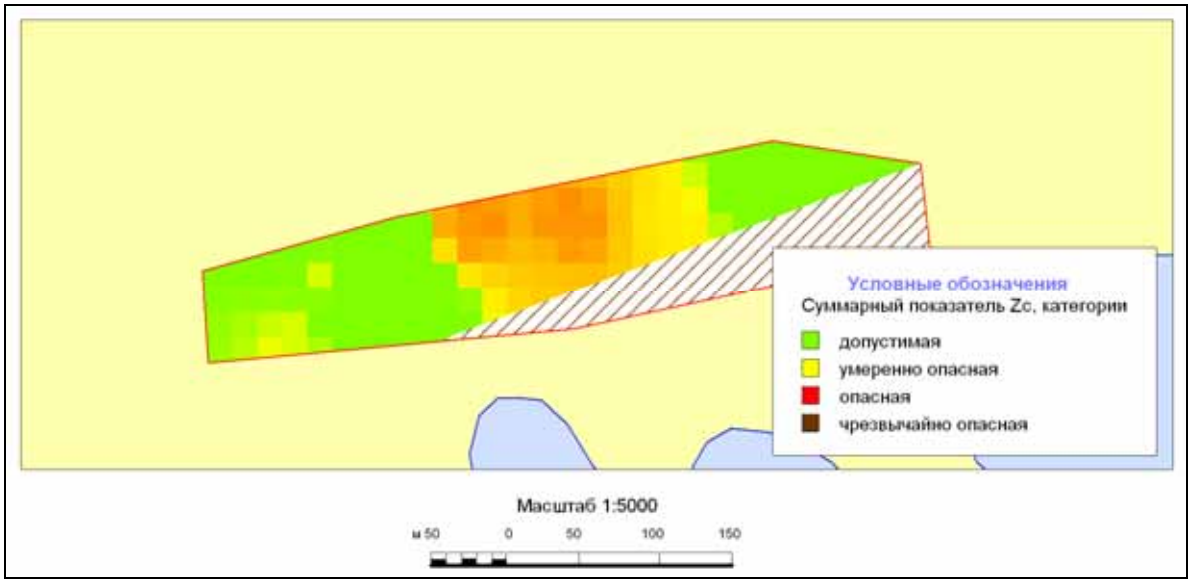

Figure 5.2.10 Spatial characteristics of the level of soil contamination of the radar station area with heavy metals (Zc)

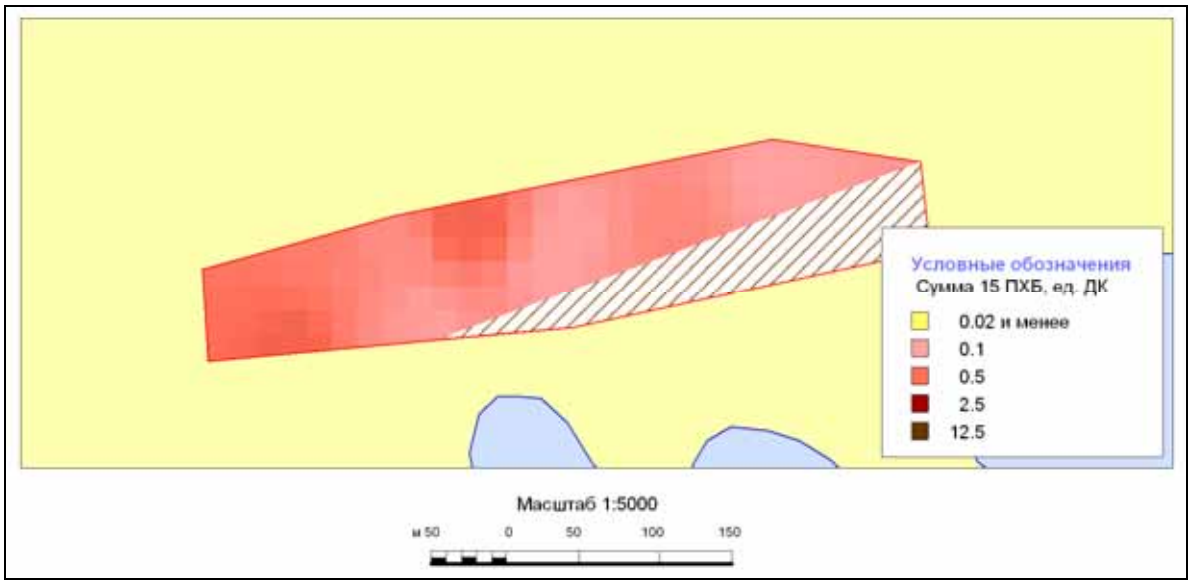

Figure 5.2.11 Spatial characteristics of the level of soil contamination of the radar station area with PCB

The values of measured concentrations of indices to be monitored are given in summary tables in Book 1 Appendix 5.

6. RESULTS OF THE LABORATORY STUDY OF TECHNICAL LIQUIDS

6.1 Results of the laboratory study of composition and properties of oil products for the identification purpose

In the surveyed areas of infrastructure facilities 36 technical liquid specimenswere sampled:
- area of industrial, construction and garbage dumps near the settlement of Nagurskoe - 1 specimen,
-in the area of fuel and lubricant storage facility in the Severnaya Bay - 18 specimens,
-in the territory of the abandoned polar station - 6 specimens,
-near the abandoned air-defense station in the territory of the radar station commandant's office – 2 specimens, in the area of radar station – 10 specimens.
It should be noted that one of the main tasks of the additional survey of decommissioned sites areas of the RF Ministry of Defense was to determine the presence of PCB-containing equipment in the technological infrastructure, as well as PCB reserves in technical liquids (industrial, gear, condenser and transformer oils); therefore, the samples of oil products clearly identified on site as gasoline, kerosene and diesel fuel were not taken.
In course of acceptance and record of technical liquid samples of in the test laboratory "Marintest" a description and sorting of the samples were performed by visual characteristics. The results of preliminary description of samples submitted to the test laboratory are given in Table 6.1.1.

Table 6.1.1 Properties of technical liquid specimens, collected at the sites on Alexandra Island

No. of area, site	No. of sample	Object	Type of tank	Visual characteristics of specimen
Area of industrial and construction dumps and garbage near the settlement of Nagurskoe				
Area 01, site 327	**L01-01-1**	Separate drum	200-L metal drum without labeling	Light-brown liquid with oil product smell, oily, viscous.
Severnaya Bay				
Area of fuel and lubricant storage facility				
Area 02, site 203	**L02-01-1, L02-01-2, L02-01-3**	Stack of 200-L metal drums (25 pcs)	200-L metal drum without labeling	Grayish-brown liquid liquid with oil product smell, oily, viscous.
Area 02, site 248	**L02-02-4, L02-02-5**	Stack of 200-L metal drums (30 pcs)	200-L metal drum without labeling	Dark-brown liquid with oil product smell, oily, viscous. В пробе 02-04 1/10 of volume - water.
Area 02, site 219	**L02-03-6, L02-03-8**	Stack of 200-L metal drums (45 pcs)	200-L metal drum without labeling	Grayish-brown liquid liquid with oil product smell, oily, viscous.

Continuation of Table 6.1.1

No. of area, site	No. of sample	Object	Type of tank	Visual characteristics of specimen
Area 02, site 251	**L02-04-7**	Stack of 200-L drums	200-L metal drum without labeling	Red-brown liquid with oil product smell, oily, viscous, little water sediment.
Area 02, site 219	**L02-05-9, L02-05-10, L02-05-11**	Stack of 200-L metal drums (20 pcs)	200-L metal drum without labeling	Brown liquid with oil product smell, oily, viscous.
Area 02, site 254	**L02-06-12**	Stack of 100-L wooden drums (11 pcs)	Wooden drum 100-L without labeling	Brown liquid with oil product smell, oily, viscous.
Area 02, site 254	**L02-06-13**		Wooden drum 100-L without labeling	Brown-black liquid with oil product smell, very viscous.
Area 02, site 249	**L02-07-14**	Stack of 200-L metal drums (3 pcs)	200-L metal drum without labeling	Brown liquid with oil product smell, oily, viscous.
Area 02, site 250	**L02-08-15**	Stack of 200-L metal drums (3 pcs)	200-L metal drum without labeling	Grayish-brown liquid liquid with oil product smell, oily, viscous, water sediment.
Area 02, site 252	**L02-09-16, L02-09-17**	Stack of 200-L metal drums (35 pcs)	200-L metal drum without labeling	Grayish-brown liquid liquid with oil product smell, oily, viscous.
Territory of the abandoned polar station				
Area 03, site 280	**L03-10-18**	Separate metal tank, V= 15 L	Metal tank 15-L without labeling	Black liquid with oil product smell, oily, very viscous, ¼ water layer at the top.
Area 03, site 273	**L03-11-19, L03-11-20**	Stack of 200-L metal drums (10 pcs)	200-L metal drum without labeling	Brown liquid with oil product smell, oily, viscous.
Area 03, site 277	**L03-12-21, L03-12-22**	Stack of 200-L metal drums (14 pcs)	200-L metal drum, stamp year of 73	Brown liquid with oil product smell, oily, viscous.
Area 03, site 269	**L03-13-23**	Industrial and construction waste dump	Cable drum gearhead , V= 5 L	Light-brown liquid with oil product smell, little viscous, 1/6 of volume – water.
Area of the abandoned air-defense station				
Territory of the radar station commandant's office				
Area 04, site 298	**L04-01-1**	Stack of 200-L metal drums (6 pcs). Labeling MT-1.	200-L metal drum Labeling - MT-1	Black-brown liquid with oil product smell, viscous.
Area 04, site 323	**L04-02-2**	Stack of 200-L metal drums (5 pcs).	200-L metal drum without labeling	Black-brown liquid with oil product smell, viscous, 1/10 of volume – water.
Area of radar station				
Area 05, site 329	**L05-01-1**	Stack of 200-L	200-L metal	Brown liquid with oil product smell,

		metal drums (4 pcs)	drum without labeling	viscous.

Continuation of Table 6.1.1

No. of area, site	No. of sample	Object	Type of tank	Visual characteristics of specimen
Area 05, site 162	**L05-02-2**	Separate drum	200-L metal drum with unreadable labeling	Brown liquid with oil product smell, viscous, solid sediment.
Area 05, site 164	**L05-03-3**	Building of transformer and condenser storage facility	Condenser KBG-P	Light-brown liquid with oil product smell, ungelled.
Area 05, site 164	**L05-03-4**	Building of transformer and condenser storage facility	Condenser KBG-P	Yellow liquidwith oil product smell, ungelled
Area 05, site 164	**L05-03-5, L05-03-5.1**	Building of transformer and condenser storage facility	Transformer	Light yellow liquid with oil product smell, ungelled.
Area 05, site 164	**L05-03-6**	Building of transformer and condenser storage facility	Condenser KBG-P	Light yellow liquid with oil product smell, ungelled
Area 05, site 164	**L05-03-7**	Building of transformer and condenser storage facility	Condenser KBG-P	Yellow-brown liquid with oil product smell, ungelled.
Area 05, site 164	**L05-03-8**	Building of transformer and condenser storage facility	Condenser KBG-P	Light-brown liquid with oil product smell, ungelled.
Area 05, site 330	**L05-04-9**	Transformer dump	Transformer without labeling	Black-brown liquid with oil product smell, ungelled.

Further research was carried out in accordance with the Russian standard GOST and GOST-R requirements and international standards ISO and ASTM recommended for the use. The list of regulatory documents is given in the Appendix.

Oil type and grade was identified based on the compliance of actual test results of controlled parameters with the controlled parameters set by technical conditions for a specific type of product. Based on the trest results the specimens taken are motor, transmission, industrial, transformer and condenser oils and spent oil products

The values physico-chemical characteristics of those oil products are identified by:

GOST 23497-79. Motor Oils M-14V_2Z and M-20V_2. Technical Conditions.

GOST 23652-79. Transmission Oils. Technical Conditions.

GOST 21046-86. Spent Oil Products. General Technical Conditions.

TU 38.1011007-84. Process Oil IMSi-46.

GOST 5775-85. Condenser Oil. Technical Conditions.

Specified values of these parameters according to the above regulatory documents are given in Table 6.1.2.

Table 6.1.2 The values of standardized parameters and properties of oil products according to technical conditions

Parameter to bedetermined, unit of measurement	RD for testing	Motor oil for Diesels M-20V$_2$	Transmissi on oil TAp-15V	Transmissio oil TSp-4gip	Mix of spent oil products	ndustrial oul MSp-46	Sulphuric-acid refining condenser oil
		GOST 23497-79	GOST 23652-79	GOST 23652-79	GOST 21046-86	TU 38.1011007 -84	GOST 5775-85
Density at 20ºC, kg/m³	GOST 3900-85 ISO 12185:1996	not more than 910	not more than 930	not more than 910	not standardiz ed	not more than 1000	not standardiz ed
Kinematic viscosity at 100ºC, mm²/s	GOST 33-2000 (ISO 3104-94) ASTM D 445-97	18 - 22	14.0 – 16.0	≥ 14.0	not standardiz ed	not standardiz ed	not standardiz ed
Kinematic viscosity at 50ºC, mm²/s	GOST 33-2000 (ISO 3104-94) ASTM D 445-97	not standard ized	not standardiz ed	not standardiz ed	not standardiz ed	not standardiz ed	not more than 12.0
Kinematic viscosity at 40ºC, mm²/s	GOST 33-2000 (ISO 3104-94) ASTM D 445-97	not standard ized	not standardiz ed	not standardiz ed	not standardiz ed	40 - 52	not standardiz ed
Kinematic viscosity at 20ºC, mm²/s	GOST 33-2000 (ISO 3104-94) ASTM D 445-97	not standard ized	not standardiz ed	not standardiz ed	not standardiz ed	not standardiz ed	not more than 45.0
Viscosity index	GOST 25371-97 (ISO 2909-81)	not less than 90	not standardiz ed	not less than 85	not standardiz ed	not standardiz ed	not standardiz ed
Open flash point, ºC	GOST 4333-87 ASTM D 92-98a	not lower than 235	not lower than 185	not lower than 215	not standardiz ed	not lower than 200	not standardiz ed
Closed flash point, ºC	GOST 6356-75 ASTM D 93-00	not standard ized	not standardiz ed	not standardiz ed	not standardiz ed	not standardiz ed	not lower than 135
Chill point, ºC	GOST 20287-91 ASTM D 97-96a	not higher than -15	not higher than -20	not higher than -25	not standardiz ed	not standardiz ed	not higher than -14

Continuation of Table 6.1.2

Parameter to bedetermined, unit of measurement	RD for testing	Motor oil for Diesels M-20V$_2$	Transmission oil TAp-15V	Transmission oil TSp-14gip	Mix of spent oil products	Industrial oul IMSp-46	Sulphuric-acid refining condenser oil
		GOST 23497-79	GOST 23652-79	GOST 23652-79	GOST 21046-86	TU 38.1011007-84	GOST 5775-85
Alkalinity, mg KOH per 1 g of oil	GOST 11362-96 (ISO 6619-88) ASTM D 4739-96	not less than 3.5	not standardized	not standardized	not standardized	not standardized	not standardized
Acid number, mg KOH per 1 g of oil	GOST 11362-96 (ISO 6619-88) ASTM D 664-95	not standardized	not standardized	not standardized	not standardized	not standardized	not more than 0.02
Ash content, %	GOST 1461-75 ASTM D 482-00a	not standardized	not standardized	not standardized	not standardized	not more than 0.50	absent
Sulphated ash, %	GOST 12417-94 (ISO 3987-80)	not more than 1.3	not standardized	not standardized	not standardized	not standardized	not standardized
Water content, %	GOST 2477-65 ISO 6296:2000 (E)	not more than 0.03	not more than 0.03	absent	not more than 2.0	not standardized	not standardized
Mechanical impurities, mass %, %	GOST 6370-83 ASTM D 473-81 (1995)	not more than 0.015	not more than 0.03	not more than 0.01	not more than 1.0	not standardized	not standardized
Content of water soluble acids and alkalies	GOST 6307-75	not standardized	absent	not standardized	not standardized	not standardized	absent
Sulhur mass fraction, %	GOST P 51947-2002 ASTM D 4294-2003	not standardized	not standardized, determination is needed	not standardized	not standardized	not standardized	not standardized

Actual values of specified parameters in samples taken from the tanks for fuel and lubricants and its compliacne with identified types of oil products are given in Tables 6.1.3-6.1.16.

6.1.1 Area of industrial and construction dumps near the settlement of Nagurskoe

Table 6.1.3 Study of composition and properties of oil products collected at site 327 (Separate 200-L drum, filled by ¾)

Parameter to bedetermined, unit of measurement	Standard for M-20V_2 по GOST 23497-79	Actual values of paramaters based on testing results
		L01-01-1
Density at 20ºC, kg/m³	not more than 910	891.0
Kinematic viscosity at 100ºC, mm²/s	18 - 22	19.15
Viscosity index	not less than 90	132
Open flash point, ºC	not lower than 235	278
Chill point, ºC	not higher than -15	-22.7
Alkalinity , mg KOH per 1 g of oil	not less than 3.5	4.43
Sulphated ash, %	not more than 1.3	0.74
Water content, %	not more than 0.03	0.203
Content of mechanical impurities, %	not more than 0.015	0.0038
Conclusion	The results of laboratory study of physico-chemical characteristics of oil products show that specimen L01-01-1 is motor oil for Diesels **M-20V_2**. For all major regulatory indicators, it meets the requirements GOST 23497-79. Water content in the specimen exceeds GOST values by 6.77 times.	
Type of oil product according to GOST		Motor oil for Diesels M-20V_2

Specimen L01-01-1 from a separate 200-L drum from the area of industrial and construction waste dump near the settlement of Nagurskoe was identified as motor oil for Diesels.

6.1.2 Severnaya Bay area

Area of fuel and lubricant storage facility.

Table 6.1.4 Study of composition and properties of oil products collected at site* 203, 248

Parameter to bedetermined, unit of measurement	Standard for M-20V_2 по GOST 23497-79	Actual values of paramaters based on testing results			
		L02-01-1	L02-01-3	L02-01-4	L02-01-5
Density at 20ºC, kg/m³	not more than 910	910.8	897.3	911.0	910.4
Kinematic viscosity at 100ºC, mm²/s	18 - 22	18.69	19.23	18.69	18.70
Viscosity index	not less than 90	159	110	153	152
Open flash point, ºC	not lower than 235	250	292	274	264
Chill point, ºC	not higher than -15	-20.9	-19.1	-22.0	-22.6
Alkalinity , mg KOH per 1 g of oil	not less than 3.5	2.03	1.78	2.33	2.26
Sulphated ash, %	not more than 1.3	0.47	0.72	0.60	0.57
Water content, %	not more than 0.03	0.138	0.416	1.109	0.276
Content of mechanical impurities, %	not more than 0.015	0.0467	0.0057	0.0831	0.0701
Conclusion	The results of laboratory study of physico-chemical characteristics of oil products show that specimen L02-01-1, L02-01-3, L02-01-4, L02-01-5 is motor oil for Diesels **M-20V_2**. Such standard parameters as kinematic viscosity at 100ºC, viscosity index, open flash point, chill point, sulphated ash meet the requirements of GOST 23497-79. Density at 20ºC specimen L02-01-3 meets GOST requirements. In specimens L02-01-1, L02-01-4 and L02-01-5 this parameter exceeds the GOST's one by 0.09, 0.11 and 0.04% respectively. Alkalinity of no specimen meets GOST requirements. This parameter in all specimens is lower by 1.72, 1.97, 1.50 and 1.55 times respectively. Water content exceeds GOST values in all specimens: in specimen L02-01-1 - by 4.6 times, in specimen L02-01-3 - by 13.87 times, in specimen L02-01-4 – by 36.97 times and in specimen L02-01-5 – by 9.2 times. Conten of mechanical impurities of specimen L02-01-3 only meets GOST requirements, in specimens L02-01-1, L02-01-4 and L02-01-5 they are exceeded by 3.11, 5.54 and 4.67 times respectively.				
Type of oil product according to GOST		Motor oil for Diesel M-20V_2	Motor oil for Diesel M-20V_2	Motor oil for Diesel M-20V_2	Motor oil for Diesel M-20V_2

*203, 248-Stack of 200-L metal drums

Table 6.1.5 Study of composition and properties of oil products collected at site* 203, 219

Parameter to bedetermined, unit of measurement	Standard for TAp-15V по GOST 23652-79	Actual values of paramaters based on testing results					
		L02-01-2	L02-03-6	L02-03-8	L02-05-9	L02-05-10	L02-05-11
Density at 20ºC, kg/m³	not more than 930	894.9	891.1	894.9	897.6	894.8	898.4
Kinematic viscosity at 100ºC, mm²/s	14.0 – 16.0	15.40	15.60	15.01	15.46	15.27	15.21
Open flash point, ºC	not lower than 185	254	246	264	238	256	246
Chill point, ºC	not higher than -20	-32.4	-22.7	-28.5	-33.9	-28.2	-35.7
Water content, %	not more than 0.03	0.131	0.158	0.216	0.177	0.100	0.138
Content of mechanical impurities, %	not more than 0.03	0.0029	0.0030	0.0010	0.0035	0.0018	0.0064
Content water soluble acids and alkalies	absent	absent	absent	absent	absent	absent	absent
Sulhur mass fraction, %	not standardized, determination is needed	0.802	0.657	0.910	1.220	0.919	1.250
Conclusion	The results of laboratory study of physico-chemical characteristics of oil products show that specimen L02-01-2, L02-03-6, L02-03-8, L02-05-9, L02-05-10, L02-05-11 is transmission oils of viscosity class 18 **TAp-15V**. All other parameters meet the requirements of GOST 23652-79. Water content exceeds GOST values in all specimens: by 4.37, 5.27, 7.2, 5.9, 3.33 and 4.6 times respectively.						
Type of oil product according to GOST		Transmission oil TAp-15V	Transmission oil TAp-15V	Transmission oil TAp-15V	Transmission oil TAp-15V	Transmission oil TAp-15V	Transmission oil TAp-15V

* 203-Stack of 200-L metal drums, 219-Accumulation of drums with fuel and lubricant

Tables 6.1.6 Study of composition and properties of oil products collected at site* 249, 250, 252

Parameter to bedetermined, unit of measurement	Standard for TAp-15V по GOST 23652-79	Actual values of paramaters based on testing results			
		L02-07-14	L02-08-15	L02-09-16	L02-09-17
Density at 20ºC, kg/m³	not more than 930	894.4	896.5	892.8	884.4
Kinematic viscosity at 100ºC, mm²/s	14.0 – 16.0	15.02	15.89	15.69	15.19
Open flash point, ºC	not lower than 185	236	244	236	242
Chill point, ºC	not higher than -20	-34.4	-31.8	-32.4	-35.1
Water content, %	not more than 0.03	0.380	3.042	0.084	0.095
Content of mechanical impurities, %	not more than 0.03	0.0079	0.0130	0.0009	0.0020
Content water soluble acids and alkalies	absent	absent	absent	absent	absent
Sulhur mass fraction, %	not standardized, determination is needed	1.060	0.970	0.850	0.356
Conclusion	The results of laboratory study of physico-chemical characteristics of oil products show that specimen L02-07-14, L02-08-15, L02-09-16, L02-09-17 is transmission oils of viscosity class 18 **TAp-15V**. All other parameters meet the requirements of GOST 23652-79. Water content exceeds GOST values in in all specimens: в 12.67, 101.4, 2.8 and 3.17 times respectively.				
Type of oil product according to GOST		Transmission oil TAp-15V	Transmission oil TAp-15V	Transmission oil TAp-15V	Transmission oil TAp-15V

*249, 250, 252-Accumulation of metal drums

Table 6.1.7 Study of composition and properties of oil products collected at site* 251, 254

Parameter to bedetermined, unit of measurement	Standard for TSp-14gip по GOST 23652-79	Actual values of paramaters based on testing results	
		L02-04-7	L02-06-12
Density at 20ºC, kg/m³	not more than 910	900.0	907.0
Kinematic viscosity at 100ºC, mm²/s	≥ 14.0	16.79	16.54
Viscosity index	not less than 85	220	212
Open flash point, ºC	not lower than 215	244	228
Chill point, ºC	not higher than -25	-31.2	-22.8
Water content, %	absent	0.365	0.648
Content of mechanical impurities, %	not more than 0.01	0.0054	0.0040
Conclusion	The results of laboratory study of physico-chemical characteristics of oil products show that specimen L02-04-7 and L02-06-12 is transmission oils of viscosity class 18 **TSp-14gip**. All other parameters meet the requirements of GOST 23652-79. In specimen L02-06-12 chill point is lower than GOST by 2.2ºC. Water content exceeds GOST values in in all specimens – by 0.365 and 0.648% respectively.		

*251-Stack of 200-L drums, 254- Accumulation of wooden drums with technical liquids

Table 6.1.8 Study of composition and properties of oil products collected at site 254 (Accumulation of wooden drums with technical liquids)

Parameter to bedetermined, unit of measurement	Standard for CHO по GOST 21046-86	Actual values of paramaters based on testing results
		L02-06-13
Water content, %	not more than 2.0	0.719
Content of mechanical impurities, %	not more than 1.0	0.0385
Conclusion	The results of laboratory study of physico-chemical characteristics of oil products show that specimen L02-06-13 is mix of spent oil products. All main parameters meet the requirements of GOST 21046-86.	
Type of oil product according to GOST		Mix of spent oil products

In the area of fuel and lubricant storage facility near the Severnaya Bay 1 specimen was identified as a mix of spent oil products; 4 specimens – as motor oil for Diesels and 12 specimens – as transmission oils of viscosity class 18.

Territory of the abandoned polar station..

Table 6.1.9 Study of composition and properties of oil products collected at site 280 (Wooden building – Diesel room)

Parameter to bedetermined, unit of measurement	Standard for CHO no GOST 21046-86	Actual values of paramaters based on testing results
		L03-10-18
Water content, %	not more than 2.0	2.411
Content of mechanical impurities, %	not more than 1.0	0.0625
Conclusion	The results of laboratory study of physico-chemical characteristics of oil products show that specimen L03-10-18 is mix of spent oil products. All main parameters meet the requirements of GOST 21046-86. Water content exceeds GOST values in specimen by 1.21 times.	
Type of oil product according to GOST		Mix of spent oil products

Table 6.1.10 Study of composition and properties of oil products collected at site* 273, 277

Parameter to bedetermined, unit of measurement	Standard for TAp-15V no GOST 23652-79	Actual values of paramaters based on testing results			
		L03-11-19	L03-11-20	L03-12-21	L03-12-22
Density at 20ºC, kg/m³	not more than 930	893.1	893.0	893.1	895.1
Kinematic viscosity at 100ºC, mm²/s	14.0 – 16.0	15.82	15.69	15.69	15.40
Open flash point, ºC	not lower than 185	252	242	254	260
Chill point, ºC	not higher than -20	-33.3	-34.1	-22.4	-33.2
Water content, %	not more than 0.03	0.110	0.245	0.400	0.094
Content of mechanical impurities, %	not more than 0.03	0.0074	0.0019	0.0000	0.0046
Content water soluble acids and alkalies	absent	absent	absent	absent	absent
Sulhur mass fraction, %	not standardized, determination is needed	0.805	0.801	0.787	1.17
Conclusion	The results of laboratory study of physico-chemical characteristics of oil products show that specimen L03-11-19, L03-11-20, L03-12-21, L03-12-22 is transmission oils of viscosity class 18 **TAp-15V**. All other parameters meet the requirements of GOST 23652-79. Water content exceeds GOST values in in all specimens: by 3.67, 8.17, 13.33 and 3.13 times respectively.				
Type of oil product according to TU		Transmission oil TAp-15V	Transmission oil TAp-15V	Transmission oil TAp-15V	Transmission oil TAp-15V

*273,277- Accumulation of 200-L metal drums

Table 6.1.11 Study of composition and properties of oil products collected at site 269 (Industrial and construction waste dump)

Parameter to bedetermined, unit of measurement	Standard for IMSp-46 по ТУ 38.1011007-84	Actual values of paramaters based on testing results
		L03-13-23
Density at 20ºC, kg/m³	not more than 1000	890.3
Kinematic viscosity at 40ºC, mm²/s	40 - 52	41.63
Open flash point, ºC	not lower than 200	212
Ash content, %	not more than 0.50	0.04
Conclusion	The results of laboratory study of physico-chemical characteristics show that specimen L03-13-23 **is industrial oil IMSp-46.** For all major regulatory indicators, it meets the requirements ТУ 38.1011007-84.	
Type of oil product according to TU		Industrial oil IMSp-46

In the territory of the abandoned polar station 1 specimen was identified as a mix of spent oil products, 4 specimens – as transmission oils of viscosity class 18 and 1 specimen – as industrial oil.

6.1.3. Area of the abandoned air-defense station

Territory of the radar station commandant's office

Table 6.1.12 Study of composition and properties of oil products collected at site 298 (Accumulation of drums)

Parameter to bedetermined, unit of measurement	Standard for TSp-14gip no GOST 23652-79	Actual values of paramaters based on testing results
		L04-01-1
Density at 20ºC, kg/m³	not more than 910	894.0
Kinematic viscosity at 100ºC, mm²/s	≥ 14.0	20.00
Viscosity index	not less than 85	128
Open flash point, ºC	not lower than 215	274
Chill point, ºC	not higher than -25	-25
Water content, %	absent	0.095
Content of mechanical impurities, %	not more than 0.01	absent
Conclusion	The results of laboratory study of physico-chemical characteristics show that specimen L04-01-1 is transmission oils of viscosity class 18 **TSp-14gip**. For all major regulatory indicators, it meets the requirements GOST 23652-79. Water content in specimen L04-01-1 GOST is exceed by 0.095%.	
Type of oil product according to GOST		Transmission oil TSp-14gip

Table 6.1.13 Study of composition and properties of oil products collected at site 323 (Accumulation of drums)

Parameter to bedetermined, unit of measurement	Standard for TSp-14gip по GOST 23652-79	Actual values of paramaters based on testing results
		L04-02-2
Density at 20ºC, kg/m³	not more than 910	899.4
Kinematic viscosity at 100ºC, mm²/s	≥ 14.0	19.83
Viscosity index	not less than 85	109
Open flash point, ºC	not lower than 215	280
Chill point, ºC	not higher than -25	-24.4
Water content, %	absent	1.302
Content of mechanical impurities, %	not more than 0.01	0.0283
Conclusion	The results of laboratory study of physico-chemical characteristics show that specimen L04-02-2 is transmission oils of viscosity class 18 **TSp-14gip**. For all major regulatory indicators, it meets the requirements GOST 23652-79. As for specimen chill point L04-02-2 GOST is exceed by 0.6ºC. Water content exceeds GOST values by 1.302%. Content of mechanical impurities exceeds GOST by 2.83 times.	
Type of oil product according to GOST		Transmission oil TSp-14gip

The specimens from the area of the radar station commandant's office were identified as transmission oils of viscosity class 18.

Area of radar station

Table 6.1.14 Study of composition and properties of oil products collected at site* 329, 162

Parameter to bedetermined, unit of measurement	Standard for TSp-14gip по GOST 23652-79	Actual values of paramaters based on testing results	
		L05-01-1	L05-02-2
Density at 20ºC, kg/m³	not more than 910	913.2	881.1
Kinematic viscosity at 100ºC, mm²/s	≥ 14.0	16.98	17.46
Viscosity index	not less than 85	196	288
Open flash point, ºC	not lower than 215	234	240
Chill point, ºC	not higher than -25	-31.2	-30.6
Water content, %	absent	0.432	0.258
Content of mechanical impurities, %	not more than 0.01	0.0216	0.0038
Conclusion	The results of laboratory study of physico-chemical characteristics show that specimens L05-01-1 and L05-02-2 is transmission oils of viscosity class 18 **TSp-14gip**. Such standard parameters as kinematic viscosity at 100ºC, viscosity index, open flash point, chill point meet the requirements of GOST 23652-79. Such parameters as density at 20ºC and content of mechanical impurities meet the requirements of GOST, in specimen L05-01-1 GOST's density at 20ºC is exceeded by 0.35%, while content of mechanical impurities - by 2.16 times. Water content exceeds GOST values in both specimens – by 0.432 and 0.258% respectively.		
Type of oil product according to GOST		Transmission oil TSp-14gip	Transmission oil TSp-14gip

*329-Accumulation of 200-L drums, 162- Destroyed building

Table 6.1.15 Study of composition and properties of oil products collected at site 164 (Destroyed building - transformer and condenser storage facility)

Parameter to bedetermined, unit of measurement	Standard for Sulphuric-acid refining condenser oil according to GOST 5775-85	Actual values of paramaters based on testing results			
		L05-03-3	L05-03-4	L05-03-5	L05-03-5.1
Density at 20ºC, kg/m³	-	900.2	875.6	876.2	876.4
Kinematic viscosity at 50ºC, mm²/s	not more than 12.0	11.16	12.32	11.99	11.52
Kinematic viscosity at 20ºC, mm²/s	not more than 45.0	33.11	35.89	34.61	32.81
Closed flash point, ºC	not lower than 135	137	145	161	153
Chill point, ºC	not higher than -14	-49.8	-43.3	-49.5	-47.6
Acid number, mg KOH per 1 g of oil	not more than 0.02	0.036	0.082	0.026	0.032
Ash content, %	absent	absent	absent	absent	absent
Content water soluble acids and alkalies	absent	absent	absent	absent	absent
Conclusion	The results of laboratory study of physico-chemical characteristics show that specimens L05-03-3, L05-03-4, L05-03-5 and L05-03-5.1 is sulphuric-acid refining condenser oil. As for such parameters as kinematic viscosity at 20ºC, closed flash point, chill point, ash content and content water soluble acids and alkalies, all specimens meet the requirements of GOST 5775-85. As for parameter kinematic viscosity at 50ºC specimens L05-03-3, L05-03-5, L05-03-5.1 meet GOST requirements, while specimen L05-03-4 does not meet. This parameter in specimen L05-03-4 exceeds GOST by 1.03 times. Parameter acid number, exceeds GOST in all specimens: by 1.8, 4.1, 1.3 and 1.6 times respectively.				
Type of oil product according to GOST		Sulphuric-acid refining condenser oil	Sulphuric-acid refining condenser oil	Sulphuric-acid refining condenser oil	Sulphuric-acid refining condenser oil

Tables 6.1.16 Study of composition and properties of oil products collected at site* 164, 330

Parameter to bedetermined, unit of measurement	Standard for Sulphuric-acid refining condenser oil according to GOST 5775-85	Actual values of paramaters based on testing results			
		L05-03-6	L05-03-7	L05-03-8	L05-04-9
Density at 20ºC, kg/m³	-	877.3	873.9	873.8	884.8
Kinematic viscosity at 50ºC, mm²/s	not more than 12.0	11.77	10.57	10.51	10.51
Kinematic viscosity at 20ºC, mm²/s	not more than 45.0	33.76	29.25	29.03	29.03
Closed flash point, ºC	not lower than 135	153	145	141	147
Chill point, ºC	not higher than -14	-48.8	-53.3	-53.9	< -56.6
Acid number, mg KOH per 1 g of oil	not more than 0.02	0.057	0.008	0.015	0.055
Ash content, %	absent	absent	absent	absent	absent
Content water soluble acids and alkalies	absent	absent	absent	absent	absent
Conclusion	The results of laboratory study of physico-chemical characteristics show that specimens L05-03-6, L05-03-7, L05-03-8, L05-04-9 is sulphuric-acid refining condenser oil. As for such parameters as kinematic viscosity at 50ºC and 20ºC, closed flash point, chill point, ash content and content water soluble acids and alkalies, all specimens meet the requirements of GOST 5775-85. parameter acid number in specimens L05-03-7 and L05-03-8 meet GOST requirements, in specimens L05-03-6 and L05-04-9 this parameter is higher by 2.85 and 2.75 times respectively.				
Type of oil product according to GOST		Sulphuric-acid refining condenser oil	Sulphuric-acid refining condenser oil	Sulphuric-acid refining condenser oil	Sulphuric-acid refining condenser oil

*164-Destroyed building-transformer and condenser storage facility, 330-Transformer and condenser dump

In the area of radar station 2 specimens were identified as transmission oils of viscosity class 18 and 8 specimens – as sulphuric-acid refining condenser oil according to GOST 5775-85

6.2 Results of laboratory study of PCB and HM content in oil products

PCB and heavy metal content in oil product specimens was determined to specify the presence in the technological infrastructure PCB-containing equipment and other equipment, which is a source of extremely high pollution with highly toxic and hazardous pollutants as well as unknown stock of PCB-based organic products, sovols, svotols and hexanols.
PCB and heavy metals were analuzed after the identification of oil products in collected specimens based on labolratory control of the parmaters of oil product composition and properties according to GOST and Technical Conditions reuirements.

The results of PCB and heavy metal content identification in industrial and motor oils as well as in the mix of spent oil products taken from the surveyed areas of decommissioned military sites of the RF Ministry of Defense on Alexandra Island are given in Tables 6.2.1-6.2.10.

Table 6.2.1 PCB content in motor oil specimen from a separate drum in the area of industrial and construction dumps near the settlement of Nagurskoe

No. of site	No. of sample	Grade (type)	PCB content, mg/kg		
			Total 7PCB	Total 9PCB	Total 15 PCB
327	L01-01-1	M20-V_2	<0.00005	<0.00005	<0.00005

7PCB-#28, #52, #101, #118, #138, #153, #180
9PCB-#28, #52, #101, #118, #153, #105, #138, #156, #180

15 PCB-#28

Table 6.2.2 Content of heavy metals in motor oil specimen from a separate drum in the area of industrial and construction dumps near the settlement of Nagurskoe

No. of site	No. of sample	Grade (type)	Content of heavy metals, mg/kg								
			Lead	Cadmium	Cobalt	Nickel	Copper	Zinc	Manganese	Chrome	Tin
327	L01-01-1	M20-V_2	0.013	0.012	0.022	0.329	0.01	575.7	0.334	0.045	<0.01

Table 6.2.3 PCB content in specimens of motor and transmission oils and mix of spent oil products in the area of fuel and lubricant storage facility near the Severnaya Bay

No. of site	No. of sample	Grade (type)	PCB content, mg/kg		
			Total 7PCB	Total 9PCB	Total 15 PCB
203	**L02-01-1**	M20-V_2	< 0.000050	< 0.000050	< 0.000050
203	**L02-01-2**	M20-V_2	< 0.000050	< 0.000050	< 0.000050
203	**L02-01-3**	TAp-15V	665.944	796.516	1011.422
248	**L02-02-4**	M20-V_2	< 0.000050	< 0.000050	< 0.000050
248	**L02-02-5**	M20-V_2	< 0.000050	< 0.000050	< 0.000050
219	**L02-03-6**	TAp-15V	1055.546	1290.539	1539.939
251	**L02-04-7**	TSp-14gip	9.288	19.196	29.095
219	**L02-03-8**	TAp-15V	4.490	4.490	4.502
219	**L02-05-9**	TAp-15V	169.124	220.130	252.061
219	**L02-05-10**	TAp-15V	1.557	1.557	1.557
219	**L02-05-11**	TAp-15V	54.524	54.524	63.602
254	**L02-06-12**	TSp-14gip	388.696	450.567	523.430
254	**L02-06-13**	CHO	13.638	13.638	16.640
249	**L02-07-14**	TAp-15V	68.000	80.780	98.961
250	**L02-08-15**	TAp-15V	1665.199	1957.454	2339.835
252	**L02-09-16**	TAp-15V	368.840	450.474	568.903
252	**L02-09-17**	TAp-15V	3125.859	3747.830	4523.891

7PCB-#28, #52, #101, #118, #138, #153, #180

9PCB-#28, #52, #101, #118, #153, #105, #138, #156, #180

15 PCB-#28, #31, #52, #99, #101, #105, #118, #128, #138, #153, #156, #170, #180, #183, #187

Table 6.2.4 Content of heavy metals in specimens of motor and transmission oils and mix of spent oil products in the area of fuel and lubricant storage facility near the Severnaya Bay

No. of site	No. of sample	Grade (type)	Content of heavy metals, mg/kg								
			Lead	Cadmium	Cobalt	Nickel	Copper	Zinc	Manganese	Chrome	Tin
203	**L02-01-1**	M20-V_2	<0.2	<0.01	<0.2	0.116	0.089	0.340	0.296	0.017	<0.01
203	**L02-01-2**	M20-V_2	<0.2	0.0011	0.015	0.059	0.032	105.684	0.583	0.06	<0.01
203	**L02-01-3**	TAp-15V	<0.2	0.0011	<0.2	0.038	0.047	4.933	0.838	0.025	0.064
248	**L02-02-4**	M20-V_2	<0.2	<0.01	0.023	0.079	0.092	0.153	0.025	0.179	<0.01
248	**L02-02-5**	M20-V_2	<0.2	<0.01	0.015	0.038	0.094	<1.0	0.195	0.025	<0.01
219	**L02-03-6**	TAp-15V	<0.2	0.0005	<0.2	<0.3	0.092	29.345	0.141	0.667	<0.01
251	**L02-04-7**	TSp-14gip	<0.2	0.0008	<0.2	0.346	1.21	1.858	0.021	0.041	<0.01
219	**L02-03-8**	TAp-15V	<0.2	<0.01	<0.2	0.155	0.167	33.498	0.162	0.106	<0.01
219	**L02-05-9**	TAp-15V	<0.2	0.003	0.018	0.125	0.104	149.752	0.130	0.02	<0.01
219	**L02-05-10**	TAp-15V	<0.2	<0.01	<0.2	<0.3	0.031	90.582	0.138	0.062	<0.01
219	**L02-05-11**	TAp-15V	<0.2	0.0125	0.014	<0.3	0.008	164.444	0.147	0.131	<0.01
254	**L02-06-12**	TSp-14gip	<0.2	0.0061	0.006	<0.3	0.111	8.036	<0.2	0.06	<0.01
254	**L02-06-13**	CHO	0.452	0.001	0.779	14.636	0.097	0.833	0.232	0.117	0.622
249	**L02-07-14**	TAp-15V	<0.2	0.0068	0.017	<0.3	0.160	107.151	0.076	0.061	<0.01
250	**L02-08-15**	TAp-15V	<0.2	<0.01	0.012	<0.3	0.043	7.538	0.005	0.023	<0.01
252	**L02-09-16**	TAp-15V	<0.2	0.0015	0.006	0.282	0.051	15.812	0.008	0.068	<0.01
252	**L02-09-17**	TAp-15V	<0.2	0.0025	<0.2	<0.3	0.004	35.13	0.110	0.169	<0.01

Table 6.2.5 PCB content in specimens of industrial and transmission oils and mix of spent oil products in the area of the abandoned polar station

No. of site	No. of sample	Grade (type)	PCB content, mg/kg		
			Total 7PCB	Total 9PCB	Total 15 PCB
280	L03-10-18	mix	15264.550	18471.662	22729.716
273	L03-11-19	TAp-15V	1537.375	1891.750	2231.652
273	L03-11-20	TAp-15V	2185.014	2673.097	3194.259
277	L03-12-21	TAp-15V	< 0.000050	< 0.000050	< 0.000050
277	L03-12-22	TAp-15V	< 0.000050	< 0.000050	< 0.000050
269	L03-13-23	IMSp-46	< 0.000050	< 0.000050	< 0.000050

7PCB-#28, #52, #101, #118, #138, #153, #180

9PCB-#28, #52, #101, #118, #153, #105, #138, #156, #180

15 PCB-#28

Table 6.2.6 Content of heavy metals in specimens of industrial and transmission oils and mix of spent oil products in the area of the abandoned polar station

No. of site	No. of sample	Grade (type)	Content of heavy metals, mg/kg								
			Lead	Cadmium	Cobalt	Nickel	Copper	Zinc	Manganese	Chrome	Tin
280	L03-10-18	mix	-	-	-	-	-	-	-	-	-
273	L03-11-19	TAp-15V	<0.2	0.0004	0.006	0.658	0.182	33.435	0.137	0.110	<0.01
273	L03-11-20	TAp-15V	<0.2	0.0012	<0.2	0.066	0.585	78.897	0.172	0.103	<0.01
277	L03-12-21	TAp-15V	<0.2	<0.01	0.012	<0.3	0.254	58.298	0.033	0.087	<0.01
277	L03-12-22	TAp-15V	<0.2	<0.01	0.013	<0.3	0.239	37.842	0.095	0.052	<0.01
269	L03-13-23	IMSp-46	1.08	0.0026	0.014	<0.3	72.102	0.132	0.138	0.098	<0.01

Table 6.2.7 PCB content in specimens of transmission oils inthe territory of the radar station commandant's office

No. of site	No. of sample	Grade (type)	PCB content, mg/kg		
			Total 7PCB	Total 9PCB	Total 15 PCB
298	L04-01-1	TSp-14gip	< 0.000050	< 0.000050	< 0.000050
323	L04-02-2	TSp-14gip	< 0.000050	< 0.000050	< 0.000050

7PCB-#28, #52, #101, #118, #138, #153, #180

9PCB-#28, #52, #101, #118, #153, #105, #138, #156, #180

15 PCB-#28, #31, #52, #99, #101, #105, #118, #128, #138, #153, #156, #170, #180, #183, #187

Table 6.2.8 Content of heavy metals in specimens of transmission oils inthe territory of the radar station commandant's office

No. of site	No. of sample	Grade (type)	Content of heavy metals, mg/kg								
			Lead	Cadmium	Cobalt	Nickel	Copper	Zinc	Manganese	Chrome	Tin
298	**L04-01-1**	TSp-14gip	<0.2	0.0003	0.025	<0.3	<0.2	<1.0	<0.2	0.032	<0.01
323	**L04-02-2**	TSp-14gip	<0.2	0.0005	0.019	<0.3	0.161	12.179	0.135	0.061	<0.01

Table 6.2.9 PCB content в in specimens of transmission and condenser oilsin the area of radar station

No. of site	No. of sample	Grade (type)	PCB content, mg/kg		
			Total 7PCB	Total 9PCB	Total 15 PCB
329	**L05-01-1**	TSp-14gip	1.937	1.937	1.937
162	**L05-02-2**	TSp-14gip	4.319	4.319	4.319
164	**L05-03-3**	Sulphuric-acid refining condenser oil	0.484	0.484	0.484
164	**L05-03-4**	Sulphuric-acid refining condenser oil	18.060	18.060	20.164
164	**L05-03-5**	Sulphuric-acid refining condenser oil	< 0.000050	< 0.000050	< 0.000050
164	**L05-03-5.1**	Sulphuric-acid refining condenser oil	4.098	4.098	4.098
164	**L05-03-6**	Sulphuric-acid refining condenser oil	< 0.000050	< 0.000050	< 0.000050
164	**L05-03-7**	Sulphuric-acid refining condenser oil	< 0.000050	< 0.000050	< 0.000050
164	**L05-03-8**	Sulphuric-acid refining condenser oil	< 0.000050	< 0.000050	< 0.000050
330	**L05-04-9**	Sulphuric-acid refining condenser oil	< 0.000050	< 0.000050	< 0.000050

7PCB-#28, #52, #101, #118, #138, #153, #180

9PCB-#28, #52, #101, #118, #153, #105, #138, #156, #180

15 PCB-#28, #31, #52, #99, #101, #105, #118, #128, #138, #153, #156, #170, #180, #183, #187

Table 6.2.10 Content of heavy metals в in specimens of transmission and condenser oilsin the area of radar station

No. of site	No. of samp	Grade (type)	Content of heavy metals, mg/kg								
			Lead	Cadmium	Cobalt	Nickel	Copper	Zinc	Manganese	Chrome	Tin
329	L05-01-1	TSp-14gip	<0.2	<0.01	<0.2	2.01	0.056	1.014	0.009	0.098	0.0
162	L05-02-2	TSp-14gip	<0.2	0.0042	<0.2	0.593	0.123	795.763	0.171	0.06	0.072
164	L05-03-3	Sulphuric-acid refining condenser oil	0.939	0.005	<0.2	0.171	0.017	2.423	0.003	0.075	0.178
164	L05-03-4	Sulphuric-acid refining condenser oil	0.225	0.0079	<0.2	0.244	0.097	1.101	0.007	0.065	0.395
164	L05-03-5	Sulphuric-acid refining condenser oil	<0.2	0.0005	<0.2	<0.3	<0.2	0.172	<0.2	0.064	0.0
164	L05-03-5.1	Sulphuric-acid refining condenser oil	<0.2	0.0029	0.006	<0.3	0.023	0.046	<0.2	0.037	0.0
164	L05-03-6	Sulphuric-acid refining condenser oil	0.540	0.0536	<0.2	<0.3	0.058	14.118	<0.2	0.054	0.16
164	L05-03-7	Sulphuric-acid refining condenser oil	0.203	0.0189	<0.2	0.356	0.518	2.614	<0.2	0.12	0.0
164	L05-03-8	Sulphuric-acid refining condenser oil	0.341	0.0045	0.012	0.063	0.566	0.801	0.004	0.056	0.0

In specimen L01-01-1 – motor oil M20-V_2 sampled from the area of industrial and construction dumps near the settlement of Nagurskoe, polychlorinated biphenyls were revealed in trace quantities. The content of all analyzed heavy metals does not exceed 0.1 mg/kg that is unsignificant and cannot be a source of pollution with this group of pollutant.

In oil product specimens collected from in the area of fuel and lubricant storage facility in the Severnaya Bay: L02-01-1, L02-01-2, L02-02-4, L02-02-5 – motor oil M20-V_2 the total 15 PCB does not exceed the lower limit of metrological certified range for the used analysis method. In transmission and condenser oil specimens sampled from the surveyed area 15 PCB content was from 0.016 up to 0.45 mass percents. The maximum PCB content - 4,5 g/kg of oil product was reavealed in transmission oil specimen of viscosity class 18 TAp-15V L02-09-17, (site 252, stack of 200-L drums). A higher PCB content is typical for the surveyed area; the maximum one (up to 7.07 PC units – point S02-05) was revealed near the object m254 (accumulation of drums). The maximum HM content in the specimens under study does not exceed 1 mg/kg for specific elements which is a norm for those oil products.

In oil product specimens sampled from the area of the abandoned polar station: L03-12-21, L03-12-22 transmission oil of viscosity class 18 TAp-15V and L03-13-23 – industrial oil IMSp-46, polychlorinated biphenyls were revealed in trace quantities. In specimen L03-10-18 - mix of spent oil products, the total 15 PCB was 2,3 mass percents (23 g/kg) (site280, a 1.5-L separate metal drum; in specimens L03-11-19 and L03-11-20 transmission oil of viscosity class 18 TAp-15V the total 15 PCB was 0,22 mass percents (2,2 g/kg) and 0,32 mass percents (3,2 g/kg) (site 273 stack of 200-L drums). For the same surveyed area, a relatively high PCB content in soil – up to 0.53 PC units – point S03-08 is typical. The maximum HM content in the specimens under study does not exceed 1 mg/kg for specific elements which is a norm for those oil products.

In specimens L04-01-1 and L04-02-2, transformer oil TSp-14gip from the territory of the radar station commandant's office, the total 15 PCB does not exceed the lower limit of metrological certified range for the used analysis method. The maximum HM content in the specimens under study does not exceed 1 mg/kg for specific elements which is a norm for those oil products.

In oil product specimens sampled from the area of radar station: L05-01-1, L05-02-2 - transmission oil of viscosity class 18 TAp-15V, the total 15 PCB was 1,94 mg/kg (site 329 stack of 200-L drums) and 4,3 mg/kg (site 162 a separate drum) respectively. In specimens L05-03-3, L05-03-4 and L05-03-5.1 – sulphuric-acid refining condenser oil according to GOST 5775-85, the total 15 PCB was 0,0005, 0,02 and 0,004 mass percents. Among the specimens collected in the area, the maximum 15 PCB congeners - 20.2 mg/kg of oil product was revealed in specimen L05-03-4 – sulphuric-acid refining condenser oil according to GOST 5775-85, site 164 (Condenser KBG-P). For the same surveyed area, a relatively high PCB content in soil – up to 0.91 PC units is typical. The HM content in the specimens under study does not exceed 0.5 mg/kg for specific elements which is a norm for those oil products.

7. SUBSTANTIATION OF EXPERIMENTAL SITE SELECTION FOR CLEAN UP

Materials based on the results of additional survey:
- situational plans of the areas with a specified number and location of hazardous and other technological infrastructure elements (report sections 4.1-4.3);
- identification of types and grades of oil products to be disposed based on laboratory testing methods and study of PCB and HM content in oils (report sections 5.2-5.5);-
- it allows us to recommend the area in south-west part of fuel and lubricant storage facility in the Severnaya Bay near the object 203 (Stack of drums) as the main experimental site, which contains a significant number of drums with transmission oil containing PCB in amount exceeding 1 g per 1 kg of oil product. The total numer of drums in the stack is estimated as 1600.

The area in west part of the storage facility can be recommended as an additional site, near objects 178, 249, 250, 252, where a significant number of drums with transmission oil containing PCB amounting for 4.5 1 g per 1 kg of oil product were revealed.

Taking into account an experimental nature of work and limited funding, the clean up of other surveyed areas is not expedient at this stage due to a significantly less number of accumulations and stacks of drums with fuel and lubricant, absence of technical liquids having significant PCB content, level of soil pollution and a larger scope of work needed to remove drums and other equipment from the ice.

Location of the objects containing oil products with high PCB content and level of soil pollution in the location of especially hazardous technological infrastructure elements are shown in schematic mapd (Figures 7.1-7.5)

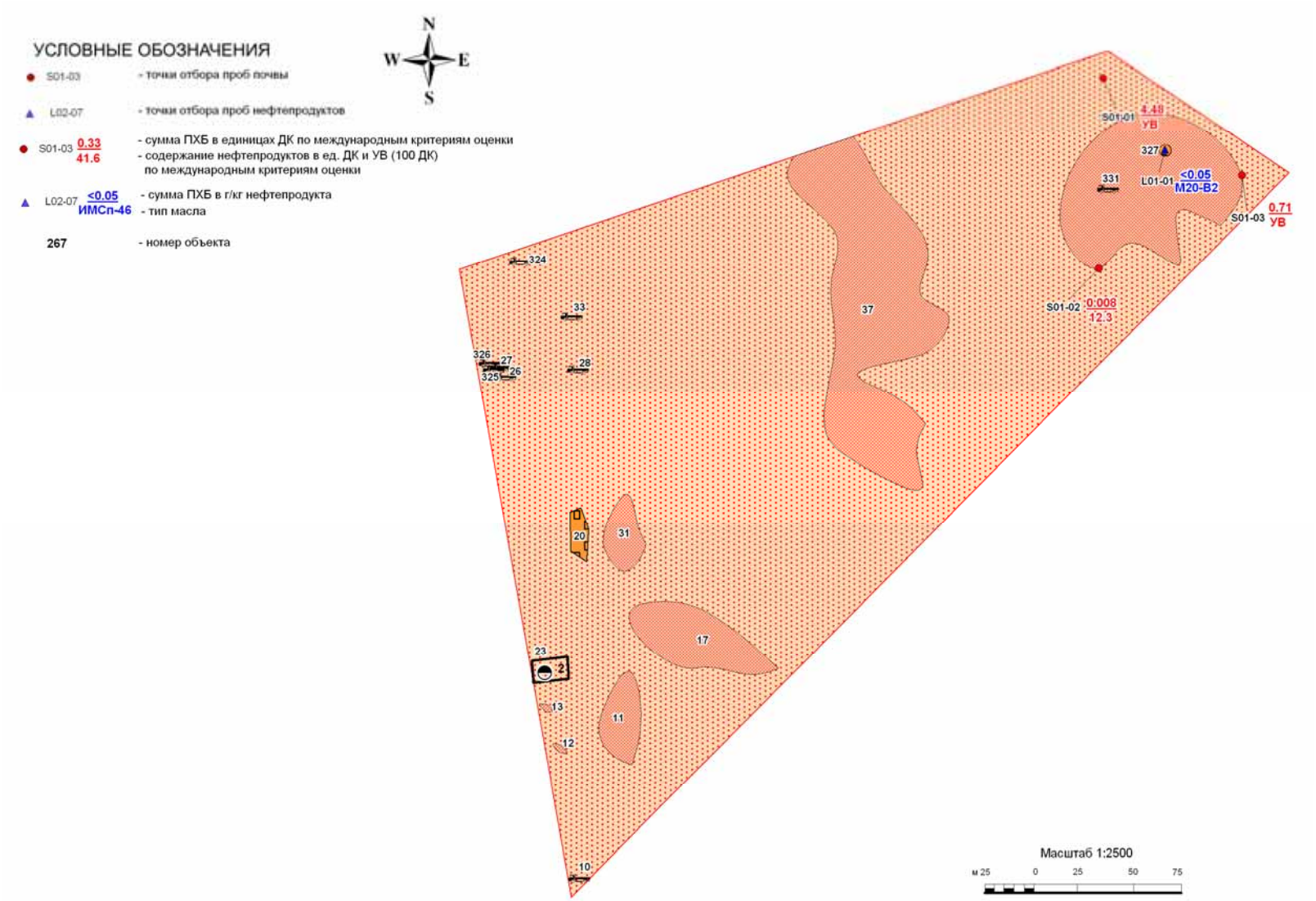

Figure 7.1 Location of the objects containing oil products with high PCB content and level of soil pollution in the location of especially hazardous technological infrastructure elements in the area of industrial and construction dumps near the settlement of Nagurskoe

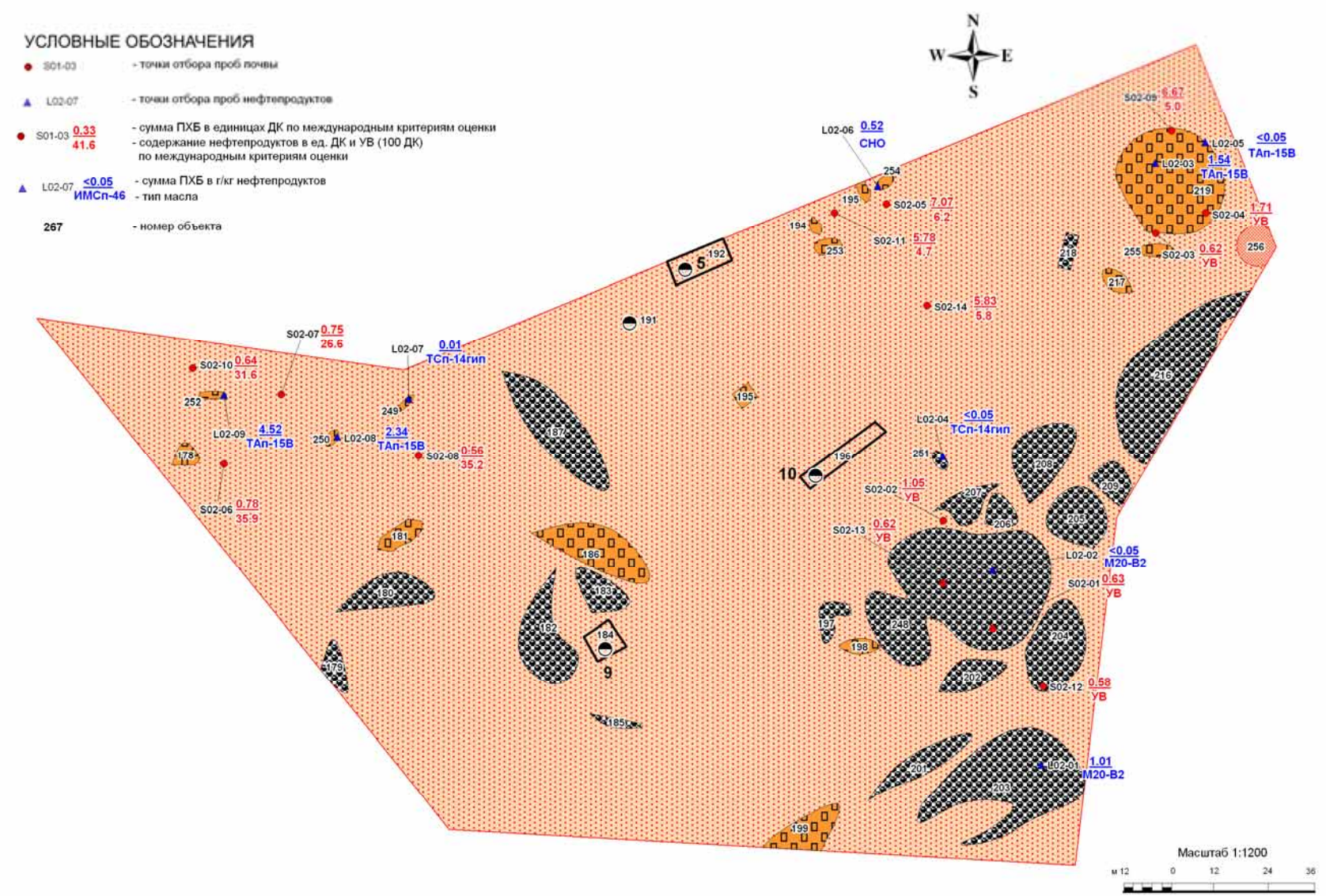

Figure 7.2 Location of the objects containing oil products with high PCB content and level of soil pollution in the location of especially hazardous technological infrastructure elements in the area of fuel and lubricant storage facility in the Severnaya Bay

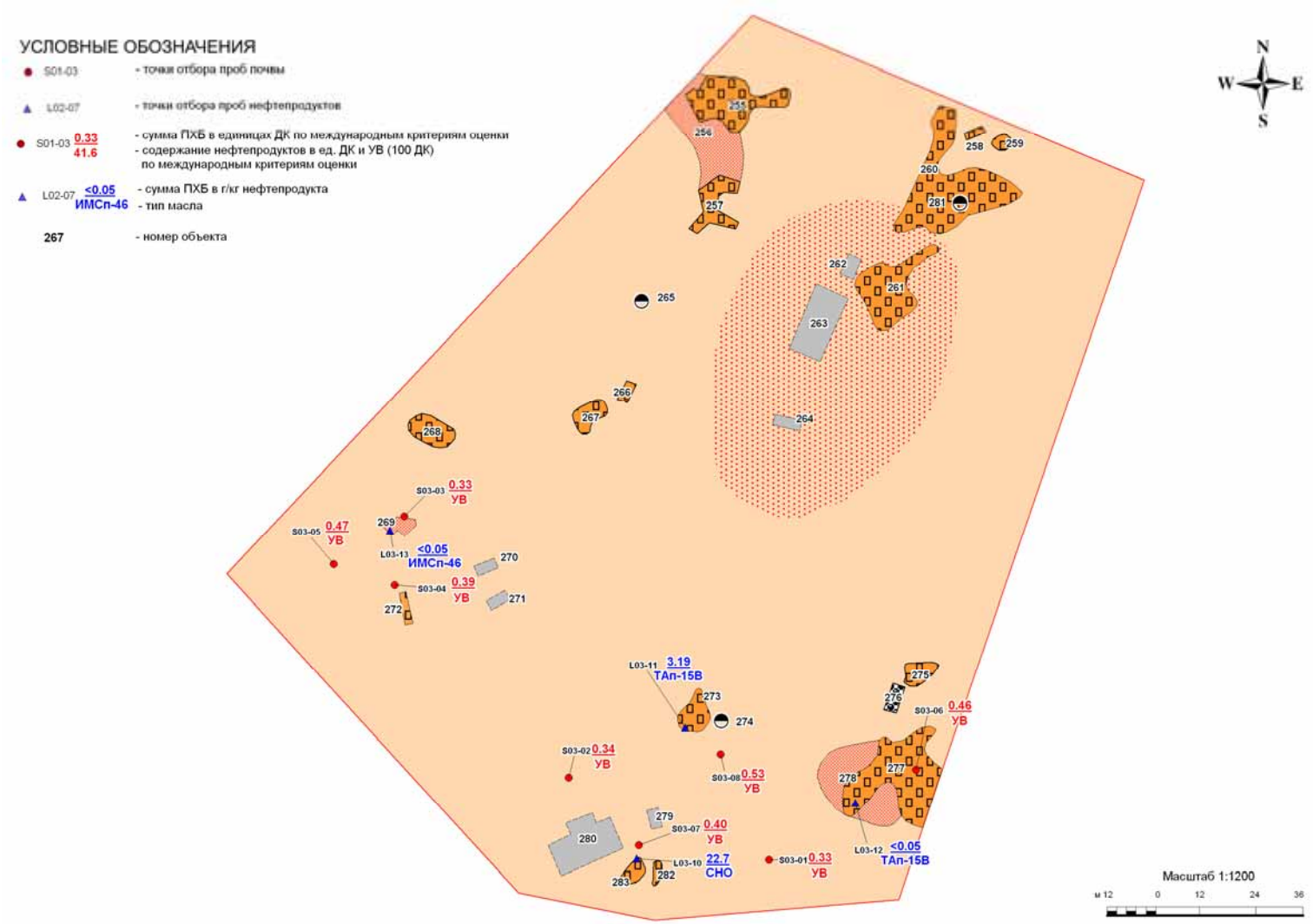

Figure 7.3 Location of the objects containing oil products with high PCB content and level of soil pollution in the location of especially hazardous technological infrastructure elements in the territory of the abandoned polar station

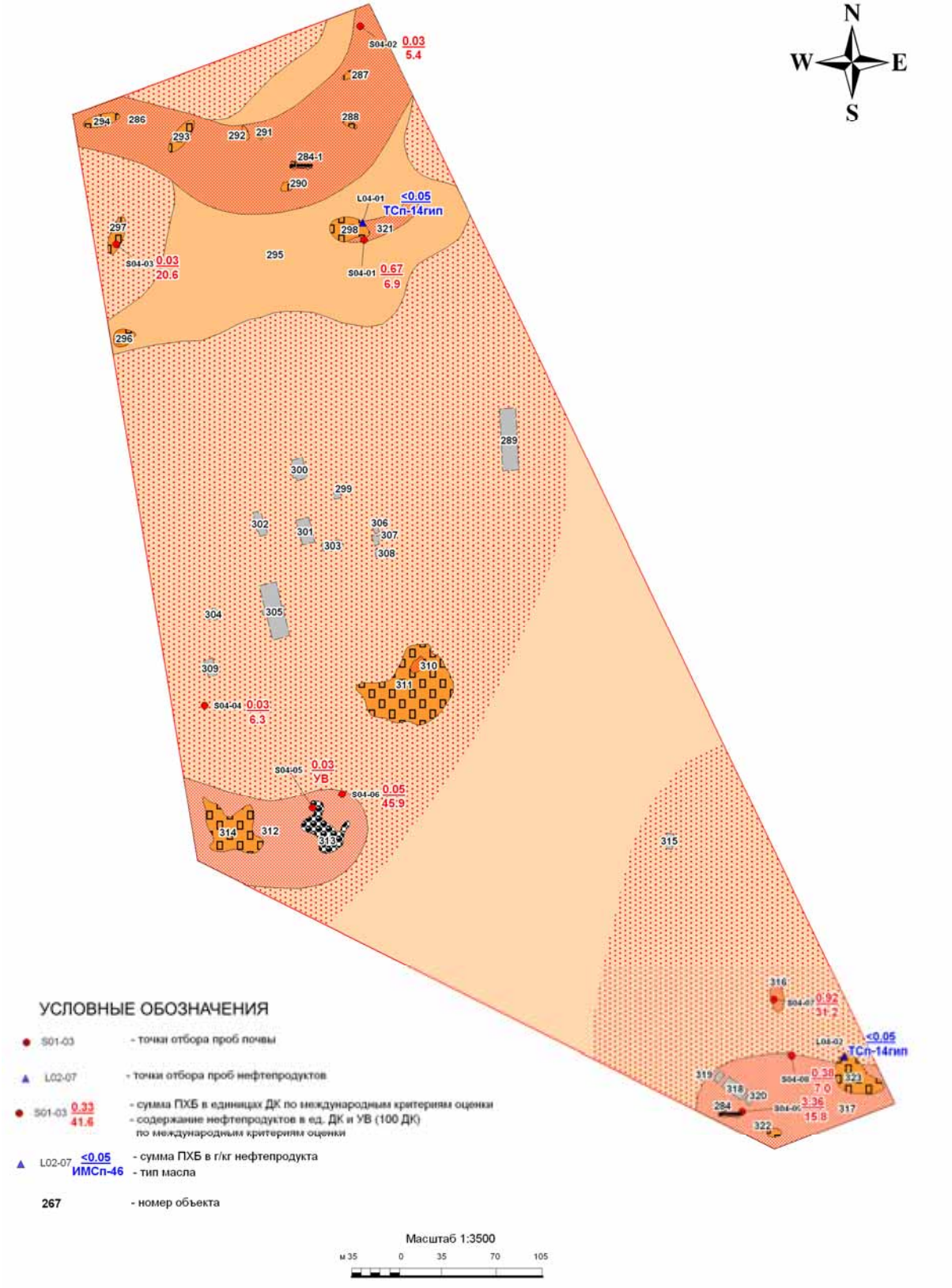

Figure7.4 Location of the objects containing oil products with high PCB content and level of soil pollution in the location of especially hazardous technological infrastructure elements in the territory of the radar station commandant's office

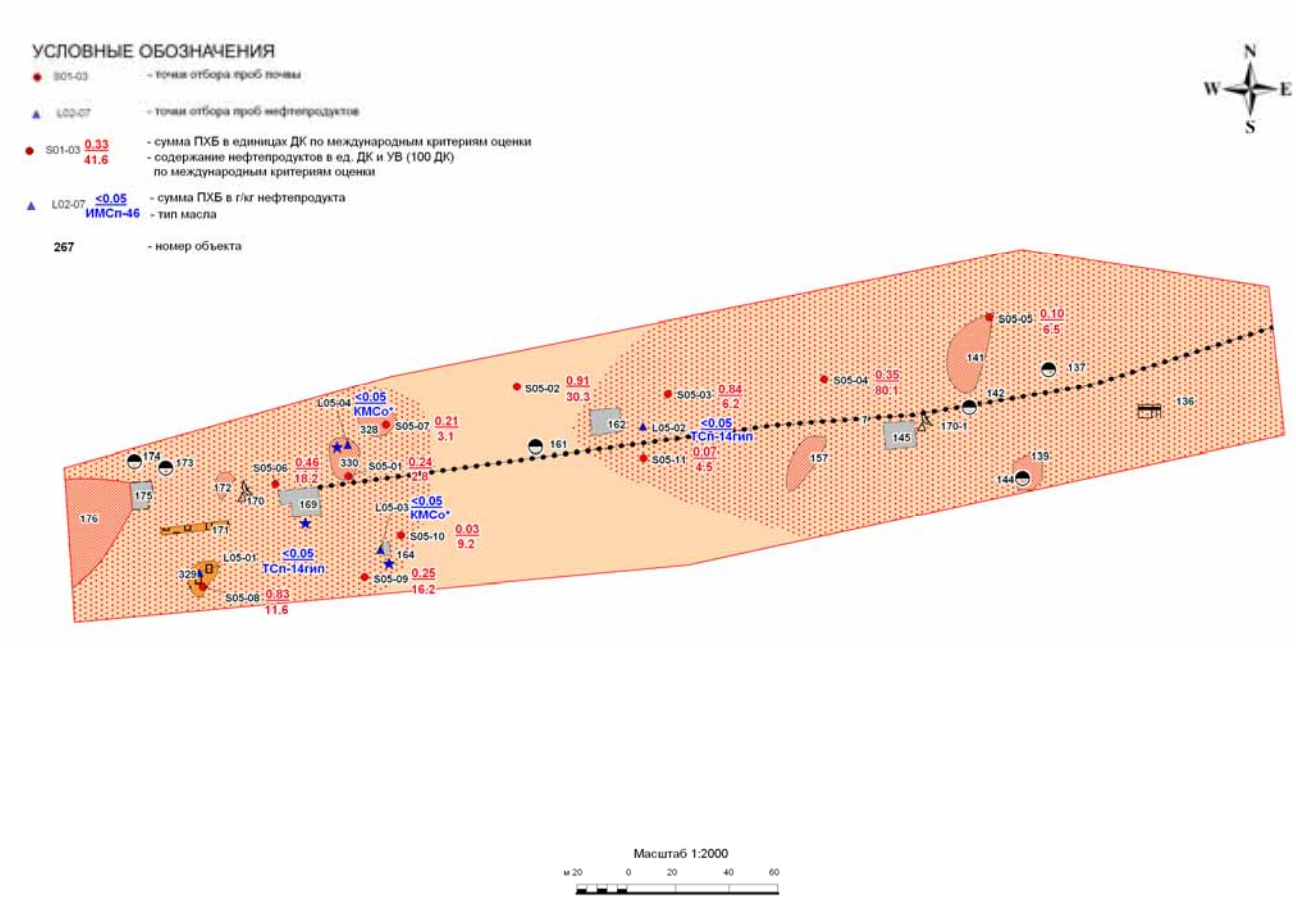

Figure 7.5 Location of the objects containing oil products with high PCB content and level of soil pollution in the location of especially hazardous technological infrastructure elements at the radar station

8. DETERMINATION OF INNOVATIVE TECHNOLOGIES OF REMOVAL OF SPENT TECHNICAL LIQUIDS AND OILS, CONTAINING ESPECIALLY HAZARDOUS SUBSTANCES

8.1. Analysis of technologies of removal of hazardous wastes and substantiation of the best development direction.

Data presented in Appendix 1 show that the number of the state-of-the-art methods and technologies of elimination of hazardous organic waste amounts for hundreds of developments. In this context, having regard to the elimination of organic waste in the Arctic zone it is useful to systematize primary data for further substantiation of the most appropriate technology.
This subsection is dedicated to this direction of research. It provides summary information presented in [52] concerning, primarily, the elimination of the most hazardous types of waste – PCB both in the main technological equipment and the most hazardous substance itself.

8.1.1. Analysis of PCB deactivation technologies in contaminated transformers an containers

The technologies of decontamination (washing) of transformers and containers currently used are divided into two main groups.
The first, the biggest group is the technologies of PCB washing with the further elimination of transformers and containers.
The second, small group is the technologies of washing transformer inside from PCB with subsequent filling the alternative liquid (retrofill).
Foreign industrial technology belonging to the first group are united by the common principles of their implementation. This modus operandi is to pre-wash transformer "in assembly", and then dismantle and additionally wash metal parts till PCB content on the surface reaches less than 50 ppm (mg / kg). Metal parts with such a low residual PCB content belong to non-hazardous waste according European standards and can be disposed of by any acceptable way. The rest of the transformer, wooden and cardboard waste containing more than 50 ppm (mg / kg) of PCB are burned or disposed of in special landfills in compliance with the stringent requirements of environmental safety.
Therefore, foreign industrial cleaning technologies of washing transformers and containers from PCB using a solvent are a multiple-stage process involving both expensive and relatively cheap equipment [53 - 55]. Performance of foreign plants to wash transformers and containers from PCB is from 2000 to 30000 tons per year. The cost of washing a ton of transformers and containers is from 800 to 1650 U.S. dollars.
The examination of three Russian technologies of washing transformers and containers from PCB showed that they all belong to technology group 1:
washing from PCB methylene chloride vapors, is recommended by JSC Petrokhim-Tekhnologia together with RSC Prikladnaya Khimia, after checking in a pilot scale [56,57];
washing from PCB using toluene is presented by enterprise "GITOS" after pilot testing [58];
washing from PCB using water wash liquid was recommended by Novolipetsk Metallurgical Complex after pilot testing [59].
All Russian technologies provide for cleaning transformers from PCB "in-assembly" only with their subsequent disassembly and disposal of metal parts

The preliminary technical and environmental assessment of proposed technologies has shown that the implementation of PCB washing technology water detergent, a residual PCB content on metal parts amounted to about 5000 ppm, which classifies them as hazardous waste according to European standards, requiring additional measures for their elimination or disposal. So - this technology has not been selected for further technical and economic assessment.
To justify the preliminary selection of technological scheme and basic equipment to wash transformers and containers from PCB: the methods of the complete removal of PCB from transformers; technical means used for this purpose, methods of solvent removal from flushed system and its regeneration, the ability to re-use of transformers after cleaning, basic data of design calculations and selection of basic equipment have been discussed.
Comparison of technical characteristics of two technological workflows of washing from PCB showed [58, 59] that the technological workflows using toluene is more complicated in comparison with the technology, using methylene chloride. This is due to the additional application of steam to displace toluene vapor from the inside of transformer, causing a need for an additional stages of condensation of toluene and water vapor, their separation and subsequent treatment of PCB contaminated waste water.
Comparison of environmental characteristics of two technologies of washing transformers and containers from PCB showed that both technologies achieve the full clean of metal parts (less than 50 ppm). However, unlike the technology using methylene chloride, in which there is no waste water and solid waste, the use of technology with toluene forms contaminated PCB waste water and solid waste requiring further treatment.
Thus, for washing transformers and containers from PCB the most appropriate technology is to use methylene chloride vapors as a solvent.
However, the installation for washing electrical equipment from PCB is to be designed and operated in future in such a way that stringent standard requirements were met in terms of protecting the personnel and the environment. appropriate precautions to prevent the effects of PCB and methylene chloride on installation operators should be provided. It should be remembered about the possible carcinogenic properties, not only of PCB but also of methylene chloride. Therefore, it should be taken effective measures to prevent leaks and emissions of these substances into the atmosphere and water. Hazardous waste from the installations should be handled in an environmentally safe manner

8.1.2 Analysis of the methods of elimination of PCB-containing condensers

Condenser design features define the solutions of their deactivation. In the world industrial practice, the process of deactivation of PCB-containing condensers is carried out in two directions [52]:
elimination of condensers;
deactivation of condensers with further disposal of metal.
The elimination is sufficiently studied, and quite common for the disposal of PCB-containing condensers. Some companies use high-temperature incineration of PCB-containing condensers, which had previously been crushed. The cost of such processing is 1600 U.S. dollars per a ton of condensers.

The decontamination of condensers with subsequent recycling of metals involves washing of condensers, their dismantling, second wash of their cases and core. After this, the cases containing less than 50 ppm, are sent for disposal, as the core is crushed and additionally washed from PCB, usually with a hot solvent. Cleaned and crushed aluminum core contains less than 50 ppm of PCB, and is also sent for disposal. The cost of processing of one ton of condensers is about $ 2200 U.S.

The technologies of condenser deactivation existing in Russia are also divided into two groups by their implementation. The first one is combustion methods, which use [52]:

explosion of packaged explosive, containing chemically neutralized PCB in the particles of crushed condensers;

fuel in the high-powdered mixture of filtration combustion (PSFG);

bubble furnace with afterburner systems and neutralization of waste gases.

The second one is condenser burning-in.

The examination of technical and environmental characteristics of Russian methods of disposal of PCB-containing condensers showed that technology with using explosion, tested on an industrial scale and technology using PSFG fuel tested on pilot scale for other waste are quite simple. However, for environmental reasons, they can not be recommended for further examination, since it does not allow us to guarantee the absence of emissions of both undecomposed PCB and dioxins. The cost of creating a single unit with explosion of 500 tons of condensers per year is 2 million dollars and the cost of the elimination of one ton of condensers is 1350 U.S. dollars. The cost of creating a plant using PSFG fuel is 70000 U.S. dollars and the cost of processing one ton of condensers is from 4000 to 6000 U.S. dollars.

Tested in industrial conditions on Metallurgical Complex the technology of decontamination of condensers by their calcination and subsequent disposal of metal also cannot be recommended for further replication in Russia, because the completeness of the transformation of PCB and dioxins in waste gases is unknown.

Upon the review of these technologies from a technical, environmental and economic point of view, the most appropriate technology is that using bubbling melting furnace with afterburner systems and neutralization of waste gases.

Despite the absence of a full-scale testing, this technology should meet the European requirements for the degree of PCB conversion - no less than 99.9999% and the content of dioxins in flue gases - less than 0.1 ng / m^3, which is provided by the technological conditions of the process.

The cost of such an installation capacity of 4000 tons of condensers in the year amounted to 1,6 million U.S. and the cost of processing one ton of condensers to be about 1000 U.S.dollars.

8.1.3 Analysis of technologies of PCB and spent oil elimination

Existing in the Russian Federation, methods and technologies of neutralization of PCB and spent oils, by analogy with the global practice can be divided into three options for their implementation [52]:

burial of waste in accordance with applicable rules, regulations and security measures to protect the environment;

elimination;
processing to produce non-toxic substances.
Technologically theurial is quite simple. Environmentally the burial carried out in accordance with strict regulatory requirements, does not eliminate hazards that could re-emerge due to PCB. Therefore, the disposal relates to the deferred time disposal of PCB by any method available. The cost of burial in different countries varies from 700 to $ 1000 per 1 ton of PCB-containing wastes. The cost of burial of PCB-containing wastes in Russia at the landfill Krasny Bor is $ 700 per 1 ton.
Abroad, as a rule, only liquid wastes containing less than 1% PCB chemically processed. Chemical processing equipment consists of large equipment, in which the required process parameters are easily achieved. Abroad, chemical processing technology provides non-hazardous products in which the PCB content is less than 50 ppm.
In Russia, liquid waste containing about 90% of PCB are chemically processed. sulfonation PCB source eith oleum to further decontaminate the product does not allow to reach the degree of conversion of PCB of more than 99%. As a result the products contain more than 50 ppm of PCB what is classifies by European standards as hazardous waste, and requires their elimination or disposal in special landfills. Abroad, the cost of chemical processing of PCB-containing wastes varies from 2000 to 4000 U.S. dollars. In Russia the cost of chemical processing of 1 ton of PCB is about 3000 U.S. dollars.
the international experience of PCB elimination shows that the main method adopted in world practice, is a high-temperature oxidation using reactors with different design features. The basic technology of high-oxidation of PCB are installations using a rotary furnace, a static furnace, with the injection of liquid wastes and plasma.
Russia has developed several methods for elimination of chlorinated wastes, including PCB. The most promising are the methods of incineration, which use [52]:
high-temperature furnace with a cyclone reactor;
high-temperature combustion chamber of rocket engines;
installations based on liquid rocket engines;
installations based on a plasma-chemical technology;
elimination in the flow of hot gases;
explosion of patronized explosive, containing chemically neutralized containing PCB;
high-temperature combustion and contact heating fuel;
blast furnaces;
cement furnaces.
Among the methods of extreme physical and chemical effects it is expedient to describe the methods of supercritical water oxidation and electro-hydraulic shock [60, 61].
The method of supercritical water [60] oxidation is based on the oxidation of organic compounds with oxygen or hydrogen peroxide in supercritical water to form environmentally safe substances: water, carbon dioxide and nitrogen. Process is completed within several minutes due to the fact that supercritical water (pressure over 22.1 MPa, temperature above 374 0C) completely dissolves any organic compounds and oxygen.
Results of preliminary research method SCWO showed that neutralization of sewage-contaminated nitroefirnymi components, dimethylformamide, acetic acid, ethanol, tolueneom or

unidentified substances occurs with high efficiency. This method provides a degree of transformation of organic pollutants into nontoxic components of at least 99,9%.
Along with the advantage of the method is necessary to note its shortcomings. These are, first and foremost, you must include the following aspects.
First, the unit cost method SCWO is much higher than almost all existing methods of elimination of industrial hazardous wastes.
Second, it is required to develop the preliminary preparation procedure of waste to be eliminated, including deactivation of toxic substances. The need to prepare water solutions of pollutants to be eliminated may lead to economic unprofitability of the method.
Third, the restriction can be traced to the possibility of highly toxic substances elimination using SCWO due to their preliminary neutralization. Thus, in the case of detoxication of compounds with reagent method, a multicomponent system will be created containing an organic component of exhaust gases (mainly - acid gases). It will require the development of a preliminary stage of clean up sufficiently large in size and power consumption for further implementation of SCWO. This situation applies fully to the preparation using the methods of physical effects: UV, IR - radiation, thermal effects, etc.
Fourth, the unresolved problem is the deposition of solid products resulting from water oxidation and the consequent blockage of communications and stop of the process.
The method of electrohydraulic [61] shock is based on the effect of short-pulse high-voltage electrohydraulic discharge on the organic components in a liquid medium. EHS combines simultaneous effect on the substance of strong mechanical compression of powerful ultrasound, hard X-ray, ultraviolet and infrared radiation. The electromagnetic fields formed during the discharge also have a strong impact both on the discharge itself, and on the ionic processes occurring in surrounding fluid. Under their influence different physical and chemical changes and chemical reactions occur in the processed materials
.
The effectiveness of this method is confirmed by the results of studies by Russian scientists [62.63], which established the possibility of coversion of wastewater containing benzene, phenol, saturated hydrocarbons into environmentally safe compounds - elementary carbon carbon (soot), carbon monoxide (IV), water. In addition, high efficiency was proven of disinfection of wastewater from E. coli, spores of anthrax vaccine and antrakoida.
Analyzing the above method, it should be noted that significant negative aspects exist in terms of its applicability to the problem of the elimination of POPs: high cost of installation and power consumption, the need for preliminary preparation of water solutions (suspensions) of drugs, etc.
On the basis of existing technical, environmental and economic requirements for POPs Elimination Technologies, all possible processes of PCB and spent oil elimination of PCB have been preliminarily assessed.
The assessment shows that the most appropriate technologies for elimination of PCB is thermal method based on the technology of high-temperature oxidation.
Thermal method of treatment is the most popular in the world practice of disposal of carbonic industrial and domestic waste. In addition, this method is cost effective and acceptable in terms of sanitary-hygienic rules, i.e. the final content of hazardous impurities after thermal decontamination does not exceed their maximum permissible concentrations.

Available information on the technical and economic feasibility of the technology of high temperature oxidation in terms of the main economic indicators i.e. the cost of manufacturing of the installation and the cost of processing of 1 ton of PCB have shown the advantages of using cyclone reactors [52].

However, the available information on this technology shows the expediency of its application in large-scale elimination of PCB in the steady-state conditions. Approximate cost of a stationary installation capable to process 1000 tons of PCB per year will be 653,000 U.S. dollars with an estimated cost of processing equal to 320 USD per 1 ton of PCB.

Moreover, there is structural complexity, high cost of mobile version, as well as a number of technical difficulties related to blockage of nozzles and impossibility to operate at low temperatures.

Among similar methods of high-temperature oxidation, the method of burning up toxic waste in a specially designed furnace can be distinguished [64], in which the combustion process is a combination of two consecutive phases:

conversion of a hazardous substance into the gas phase;

combustion itself of vapors of dangerous substances in the furnace and their subsequent reburning and end gas cleaning.

An experimental study of this method of disposal of hazardous waste, including the example of the elimination of pesticides [65] has shown prospectivity of its implementation for solving the problem of the elimination of POPs.

In addition, work in this field is being carried out within the framework of experimental development "Agriculture", funded from the federal budget for the federal target program "The National System of Chemical and Biological Security of the Russian Federation (2009 - 2013)". In this regard, the reworking of technologies addressed to the disposal of liquid PCB waste and spent oil can be significantly reduced compared to the installation of a cyclone furnace.

8.1.4 Substantiation of technology of elimination of spent technical liquids and oils as applied to Alexandra Island

Particularities of the pollution on the island are the presence of hazardous technical liquids in different containers and locations.

So, according to preliminary inventory in 2008, spent oils M-20V2, TAP-15V, TSC - 14gip, IMSp – 46 are in 200-L drums. According the quantitative chemical analysis, PCB content does not exceed trace amounts in most drums.

However, the PCB content in a number of drums with oil TAP-15V and TSC - 14gip reaches about 4.3 mg /kg. The main PCB content (more than 20.2 mg / kg) is found in sulphuric-acid refining condenser oil, in condensers KBG-P and transformers at the destroyed storage facility and transformer dump.

Additional studies in September 2010, showed that in addition to information received in recent years on the location and quality of technical liquids a secondary detection and identification occurs of hazardous PCB-containing wastes. There were found about eight new PCB sources, located within the mapped areas.

Thus, spent technical liquidss, including those containing PCB, may be located in different

places.
In this connection, with regard to the peculiarities of the elimination of spent technical liquids and oils, located on Alexandra Land, it should be implemented a complex technology. To implement this technology, it is expedient to highlight the most important stages.
The first stage of technology should include the identification of waste, based on express method s and their subsequent transfer of two to three industrial sites. In this case, the main goal of the actions is the formation of waste identified in its qualitative composition according to their hazard degree. Since most available drums are in poor state, it should be possible to retrieve the waste in a safe into drums or tanks.
The second stage should be aimed at carrying out the decontamination of emptied containers (including - transformers and condensers), with further compaction and recycling.
emptied drums must be decontaminated before compaction.
Decontamination of drums from fuel and lubricant residual can be made either by the reagent, or burning them up Fakel-1M-type installation. Decontamination of containers after removal of PCB-containing technical liquids is a more complex process.
Based on the analysis of available technologies and methods for decontamination of condensers and transformers, it is expedient to wash capacitive PCB-containing equipment with vapors of methylene chloride up to a required level of safety.
According to the system adopted by the developer of technology "Petrohim-technology, technological scheme includes:

- collection of transformers and placing them in a special place;
- preheating of each transformer, emptying it at the expense of gravity and the collection of liquid PCB in a separate tank for disposal;
- carrying out the cleaning cycle of the transformer using methylene chloride vapors;
- disassembly of the transformer and sorting of components.

It was established that in course of cleaning methylene chloride vapors, metal parts inside the transformer are cleaned to such an extent that they are not considered hazardous waste and can be recycled without no difficults;
wooden details, cardboard and paper, which may still contain a residual amount of PCB, are sent for incineration or simple burial, if the concentration of the remaining PCB complies with the environmental requirements for disposal (PCB content less than 50 mg / kg).
All techno-economic and environmental parameters of the disposal of persistent organic pollutants were confirmed on a laboratory installation using natural samples of PCB-containing wastes.

Summarizing the above, some preliminary conclusions should be made.
First, with account for data available for the first phase of work the most appropriate technology of elimination of waste liquids and oils is a complex of interrelated steps, including the stage of identification and subsequent collection of liquid waste, decontamination of emptied containers and the elimination itself of the collected spent oils and technical liquids.
Second, the most efficient decontamination of capacity equipment from PCB is that using reagents. The technology using methylene chloride vapors is the most appropriate one. It is

expedient to decontaminate drums from fuel and lubricant residuals using reagents or burning up in Fakel-1M.

Third, the analysis of existing technologies and methods of disposal of hazardous chemicals showed that the main main of deactivating hazardous organic pollutants is a high-temperature oxidation (combustion) with afterburner systems and neutralization of end gases.
It is to implement the process of eliminating hazardous wastes based on the technology of using a rotating pipe furnace as a thermal cracking unit and a plasma afterburner and a plasma afterburner, as well as 3-stage end gas cleaning system on the basis of complex treatment technologies and automatic quality control.

8.2. Technological cycle of drums disposal

The technological cycle of drum disposal as applied to the elimination process peculiarities of spent liquids and oils on Alexandra Island was developed based on the technology mentioned above.
It should be given a number of general provisions, arising from the results of field technological works.
According to the results of positioning and identification of pollution sources the major technical facilities for disposal of drums must be placed in the Severnaya Bay.
To ensure the productivity of the elimination of pollutants it is necessary to provide a permanent operation for 3,5 - 4,0 months (June - September). At the same time in the planning of future work detailed calculations should be carried out of necessary equipment and number of expedition members. It is also necessary to take into account the cost of subsistence (lodging, meals, etc.).
Rather labour-intensive process of burning using available equipment showed that it is necessary either to modify the design of equipment, or consider the use of furnaces for melting scrap in place. In this case, there will be no need for burning. In addition, such furnaces will dispose of not only the drums, but also other man-made metal debris.
as for the production cycle iself it should be noted as follows.
The first stage technology of the identification of waste, based on express-methods and their subsequent transfer to two-three industrial sites is linkedti a number of organizational and technical measures.
Among those measures are the selection of site to locate the main and auxiliary equipment, its installation, layout and binding to the work site particularities, organization of material flows both in the technological sector and disposed objects themselves.
In accordance with the operational documentation of the production equipment pre-commissioning is conducted to reach a required operation mode with account for performance and safety operations.
Handling operations and delivery of drums to site for identification and sorting are performed by truck and trailers.
At the site samples areselected from not-labeled drums using express-method (for example, by the qualitative reactions of organochlorine compounds with copper according to flame color), it

is determined whether a waste is fuel and lubricant residual or PCB-containing wastes. Identified waste is formed in two flows at additional sites.

Flow of dtums with fuel and lubricant residuals or empty drums (with frozen water).

The disposal of drums consisting of two modules, a special press, Fakel-1M installation, 25-50 m^3 containers.

The disposal modules include:

heat generator for thawing of drums, frozen fuel and lubricant remains or water;

equipment for cleaning drums;

equipment for opening drums.

In order to ensure environmental cleanliness of the operations, the modules are equipped with trays to prevent the spill of fuel and lubricant residues and flushing water.

equipment for opening drums opens the drum top bottom, after which it is sent either to Fakel-1M to remove its fuel and lubricant residuals, or to equipment for cleaning drums.

Fakel-1M [67] burns up fuel and lubricant and water-oil emulsion residuals collected from the disposal facility. If it is not possible to burn up, liquid waste are moved to a 25-50 m^3 tank for temporary storage. Control of gas emissions and waste incineration is carried out continuously by using special equipment.

After the heat treatment of or cleaning fuel and lubricant residuals, drum is sent to a special 25-t press for compaction. Briquettes are packed in metal foil and placed on pallets for subsequent transportation to the mainland

Flow of dtums with with PCB-containing waste.

PCB-filled waste drums are sent to the mobile extraction complex for washing and elimination. the mobile unit includes:

- draining and flushing unit;
- solvent recovery unit;
- high-thermal oxidation unit (rotating pipe furnace);
- nitrogen preparation amd gas drying unit;
- end gas cleaning;
- unit for receiving and packaging solid and liquid wastes.

The draining process is carried out in a temperature controlled unit. Removing the liquid phase of PCB waste is carried out using peristaltic submersible pumps to ensure pumping of very viscous liquids.

Extracted components are collected in an intermediate container in which an averaged sample is collected for qualitative and quantitative analysis.

Emptied containers are dcontaminated by of methylene chloride vapors in accordance with the adopted technology. The process of decontamination is completed when the concentration of PCB in the condensate flowing from the tank is no more than 50 ppm. The condensate is sent to a solvent recovery unit.

Decontaminated containers are sent to the flow of empty drums for thermal decontamination and subsequent compaction. Spent activated carbon from the suction traps and non-metal wastes are sent to the same flow,

Collected in the intermediate tank of PCB waste after conducting qualitative and quantitative analysis goes on hoses for the installation of high-temperature oxidation of a given flow rate. The installation of high-temperature oxidation by thermal cracking of PCB-containing wastes. The choice of temperature, time of thermal treatment is carried out according to the analysis.

In the process of thermal cracking, the ash residual is analyzed for PCB content. When the content of less than 50 ppm it is packed in plastic bags and stored till sending to the mainland. This kind of waste can be used as a filler for various industries

9. DEVELOPMENT OF TECHMOLOGICAL PROJECT OF MASS DISPOSAL OF DRUMS CONTAINING ESPECIALLY HAZARDOUS SUBSTANCES, SAFE ELIMINATION OF CONTENT, COMPACTING AND TRANSPORTATION OF DRUMS TO A DROP-OFF STATION IN ARKHANGELSK.

9.1. Main technological solutions

In developing the main technology solutions we take into account the need for further replication of the technology to other former sites of the Russian Defense Ministry located on Alexander Island of Franz Josef Land archipelago after testing the mass disposal of drums. Since the results of fieldwork on Alexandra Land showed [68] that the main pollutants are making fuel and lubricant residuals, then the term "especially hazardous substances" will mean not only the liquid waste of hazard class 1 and 2, but also spent oils, fuel and other technical liquids.

In this connection the technology project contains information on the key technical solutions that reflect two trends:

mass disposal of drums containing remains of particularly dangerous substances;

mass disposal of drums with remains of substances of hazard class 3-4 by the example of spent oils and technical liquids.

The main technological solution is to develop a mobile unit in modular design to allow using the modules in a single technological process system, and for the organization of separate stages of production. This technical solution will allow the initial stages of the elimination in the vicinity of hazardous waste areas not having developed infrastructure (energy, transport, etc.), followed by the final stages in the developed industrial areas.

Provides for the use of four modules.

Module of identification and sorting (MIS)

For the mass disposal of drums containing the remains of particularly dangerous substances, the MIS in its composition should include a laboratory certified and licensed for thestudy of substances of hazard class 1 and 2, placed in a half-timbered house.

The module also includes a forklift truck and transport vehicles for transportation of containers from the place of the previous storage to the laboratory or subsequent process modules.

In the laboratory, the samples of eliminated waste are selected for their identification or confirmation of the qualitative and quantitative composition. In addition, the lab controls solid, liquid and gaseous wastes to assess the correctness of implemented process and environmental safety.

Equipment for express analysis that provides fuel and lubricant identification by indicators of density, viscosity, flash point, as well as qualitative responses can be used instead the certified laboratory for the mass disposal of drums with the remnants of spent oils and technical liquids (eg, by the qualitative reactions of organochlorine compounds with copper according to flame color).

Gas emissions are controlled by using portable gas analyzers, such as hydrocarbon gas analyzer GIAM - 315.

Module of waste extraction and drum decontamination

With regard to the technology of mass disposal of drums containing the remains of particularly dangerous substances, waste recovery module and the neutralization of the drums (MIN) consists of the following main parts:
airtight ventilated work chamber in which the operations are done of opening drums, mixing, extracting liquid wastes and deactivating drums' interiors;
reinforcement group, which is a separate stand, where stop-control valves and instrumentation are mounted that enable manufacturing operations with the drum in the chamber;
Automated control system for MIN, which includes a control cabinet with integrated programmable electronic system and local control panel with built-in monitor.
In the chamber there are 3 windows for visual observation by the attendants.
Sent to MIN for processing the drum of waste is overloaded electric by crane PT20 with a special gripper mounted on a trolley in a container of the working chamber. The operator then manually fixes a drum, closes the chamber and turns on the air cleaning system.
The operator starts the process of opening (drilling) a drum.
vertical feed drill installation is switchedon, the drill is automatically fed to drum and drills it, plunging into the inner space by 30-35 mm.
Then drill and drill unit comes back to the starting position and the drilling installation is switched off.
Drilling chips are collected by electromagnetic chips trap and after the return of the drill in its original position chips are placed in chip collector.
End of drilling is shown on the monitor and the operator can start moving truck to the position of waste extraction.
After lifting the drilling installation truck with the drum in the container is moved to the position of waste recovery and decontamination of drum.
At the position of waste recovery and neutralization of the drum an evacuator drive of vertical displacements is on, lowering it all the way to the surface of the drum. At the same time siphon tube of evacuation head falls into a drum through the drill hole.
When ready to recover waste operator presses the button to transmit a signal to start operation. In this case, the valve is opened at the receiving capacity of liquid wastes, which created suction (vacuum). Before the transfer of waste reception capacity is pre-filled by 20-30% of reagent. Due to vacuum, waste removal is provided from the drum to the receiver tank. Receiving tank is equipped with exhaust gas clean, and has temperature sensors and cooling circuit to maintain the required temperature regime in the case of the exothermic neutralization reaction between the waste and reagent.
At the end of extracting waste fluid flows through the siphon head and the associated pipeline stops that can be detected visually through the observation lamp or sensor.
After finishing waste extraction operation the process begins of filling drums with neutralizing agent from the collector. The choice of agent depends on the type of hazardous waste being destroyed.
When ready to supply the reagent to drum the operator presses the button to transmit signal of the beginning of the operation.
The reagent is discharged into drum through the evacuation head siphon, the end gases from the drum interior are cleaned in the air clean system of the working chamber.

Amount reagent is determined by standard the drum to be processed (80 liters to 100 liters drums or 200 l for 250 l drums) and controlled by flow meter (device FR03), determining the end of its feeding.
At the end of the processing of drum operator transmits a signal to start operation of reagent extraction. In this case, the valve is opened at the receiving capacity of the module, providing a vacuum tap into them spent reagent from the drum.
The process of evacuation of the reagent is monitored by sensors in the MIN and the volume of evacuated reagent. The process of evacuation of the reagent from the drum ends with analysis of information on the equality of selection and volume of filling the drum degasser.
After that evacuator drive of vertical movement is on, lifting it to its original position, taking the siphon tube from the drum.
After lifting evacuator to its original position trolley decoupled from the mixing unit and the operator's command is derived from the working chamber MIN. Emptied drum is fed to the module of compaction of emptied containers.
In the receiving tank due to partial neutralization of hazardous waste its hazard class is lowered. Residual content is controlled by laboratory of identification and sorting module, and, if necessary, reagent or solvent is added to achieve the required hazard class.
To implement technology of disposal of drums with the remnants of spent oils and technical liquids the following process equipment, placed in frame construction is sufficient to use:
boiler for melting drums, frozen remnants of fuel or water;
equipment for opening drums (an angle grinder, mechanical shearing, etc.);
equipment for cleaning drums;
Fakel-1M installation;
25-50 m^3 receiving tank.
In order to ensure environmental cleanliness of operations, the modules must be equipped with trays to prevent the spill of fuel and lubricant residuals and flushing water.
The construction of frame buildings must correspond to the technological scheme, and may be as that (Figure 9.1.1):

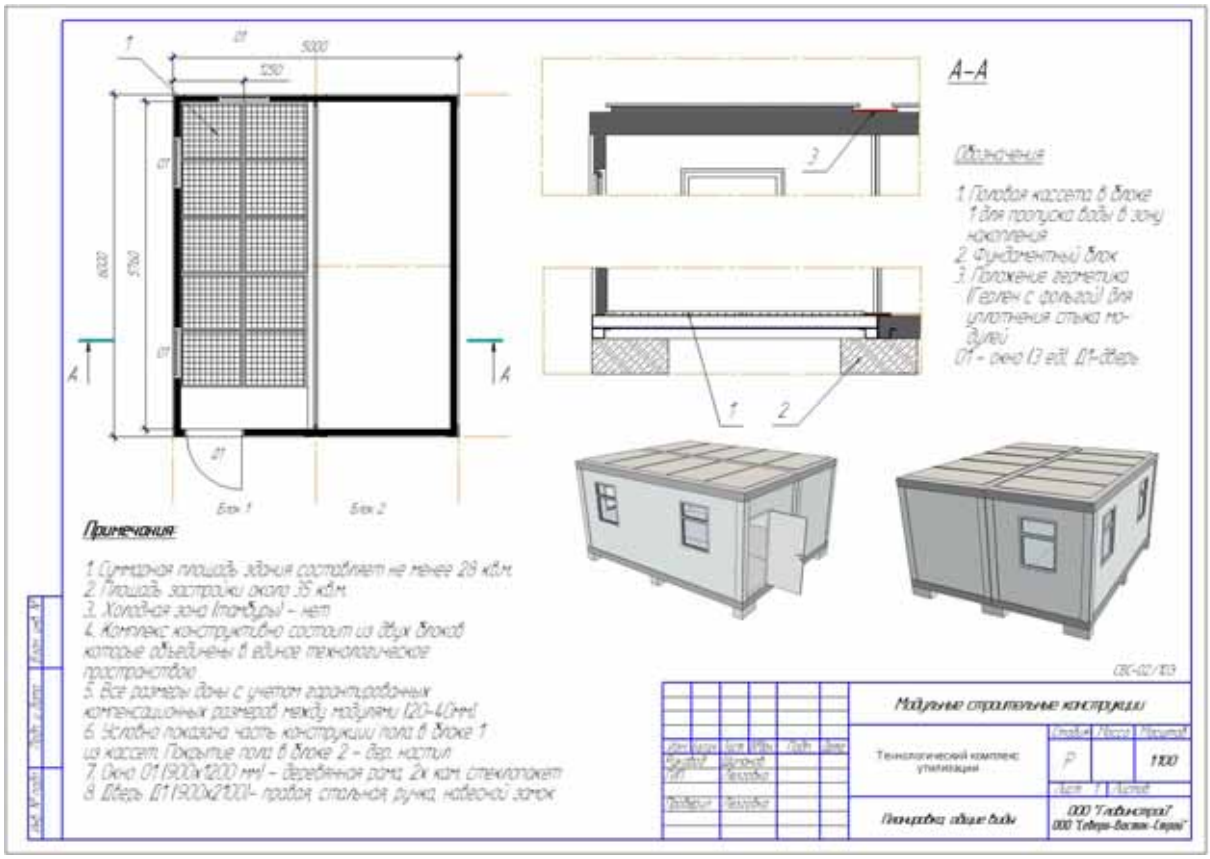

Figure 9.1.1 half-timbered house for the implementation of the technologies of disposal of drums with spent oil and technical liquid residuals.

On the unit of thawing drums after opening cap the level of oil product content is controlled by control probe.
When filling the drums for more than 2 / 3 of volume oil product is pumped up to the required level of the receiving container by submersible pumps Grundfos JP.
If the drum is filled with oip products is not more than 2 / 3 volume, it goes directly to the installation of thermal decontamination Fakel-1M.
If there is only melted water (ie in the absence of oil) it is withdrawn into the reception tank and drum itself is sent to the washing unit.
Before placing drums to Fakel-1M or washing unit the drum upper bottom is opend using a special equipment. To prevent explosion in the removal of bottom of the drum filled with water. oil residues are burned up in accordance with the requirements of Fakel-1M operational documentation.
After the heat treatment of fuel and lubricant residuals or cleaning, the drum is fed to the module of compacting drums.
Upon completion of the neutralization of all eliminated drum. wash water, water-oil fraction collected in the receiving tank are eliminate in Fakel-1M.

Module of deactivation of liquid waste

Module of deactivation of liquid waste (MNO) can be used along with extraction and waste and neutralization of drums module or as a standalone technology unit for the elimination of

hazardous waste only.

The principle of operation of the module is based on the implementation of the technology of thermal cracking of reaction mass formed in the receiving tank of the module of extraction and neutralization of drums. This technology is based on a set of systems of high-temperature oxidation (thermal cracking unit) and neutralization of end gases.

Module of neutralization of liquid waste includes the following main parts:

- liquid waste transportation unit;
- thermal cracking unit;
- preparation and dispensing of reagent unit;
- automated control system for MNO, which includes remote control with built-in programmable electronic system;
- unit of cleaning end gases.

Liquid waste transport unit is a block with stop and control valves, pumps and flow meter, which allows to carry out processing operations for transportation of the reaction mass from the module of waste extraction to thermal cracking with required flow rate.

When operator control panel command transfers reaction mixture from the receiving vessel via to the pump of liquid waste. Reaction mass through the pipeline enters the balancing reservoir, from which gravity is sent it to thermal cracking unit. Required flow rate of waste supplied to the combustion is controlled by the flowmeter.

Thermal cracking of waste unit consists of a rotary furnace and end gas cleaning system, mounted in a single unit.

The furnace design allows speed control and tilt tubes, purging the working chamber and the air temperature from 400 up to 1400 0C.

Liquid waste enters the receiving tank, on which is fed into tube furnace heating zone and moves further along the pipe through the zone of combustion and pre-cooling. The resulting ash residue poured from the pipe end in the hopper, cool and collected in a soft container (rubber bag) for recycling.

For the implementation of high-temperature oxidation through the tube current waste flow forced air flow is applied. Air is supplied through the suction port of the jet compressor, articulated with a tube furnace in the cooling zone. the mode of the furnace operation (the temperature in the reaction zone, the speed of the pipe, the angle of inclination, the volumetric flow rate of air oxidation) is selcted by the introduction of pre-programmed modes of operation by remote control.

Kiln gases, trapped by jet compressor gas flow, are partially cooled. The concentration of potential pollutants in the stream is reduced by dilution with compressed air. The cooled waste gas flow is fed into the system of 3-step purification of exhaust gases.

The first stage of the process embodied in the form of a hollow scrubber and combines the function of quenching gas, its absorption by aerosol treatment, a series of acid gases and organic compounds. Efficient operation is due to the use in the scheme of the jet compressor.

In the scrubber, due to adiabatic expansion of gas and a reagent counter-motion scheme a sharp decrease in exhaust gas temperatures occurs down to 250 C. At this stage there end gas is cleaned from aerosols (particle size up to 0,5 mkm) with an efficiency of not less than 95%.

In the scrubber, depending on the type of waste being destroyed, various reagents can be used as the scrubbing liquid.
The second stage of the process consists of a series of consecutive absorbers. The adsorber performs posttreatment of exhaust gases from the products of incomplete thermal oxidation with an efficiency of not less than 98%.
In addition, at the entrance to the second stage further cooling of gas occurs down to temperatures of about 20^{o}C with simultaneous withdrawal of the condensate stream and sprays.
The third step is necessary to ensure the final cleaning of gas from all pollutants up to a level not higher than MPC, including - of dioxin-like compounds with the maximum concentration at 0.1 ng/Nm^3 of dioxin equivalents.
For this purpose this stage includes two serially connected units: bag filter and an automatic interlocking of end gases.
Automatic locking of end gas is a line of additional gas cleaning.
The composition of this line includes plasma-optical camera and monitoring unit of end gases.
In normal operation of the plant gases through the unit for monitoring and flow-switching device are discharged into the atmosphere.
If signal received onexcess levels of incomplete combustion produces a signal is sent to the actuator to switch the direction of flow and the additional stage of gas purification.
After the normalization process of gas purification in the absence of a signal from the monitoring unit flue gas the flow is switched to discharge into the atmosphere.
Ubit of preparation and dispensing of reagents is used for preparation of scrubbing liquid, and liquids for absorbers irrigation. Preparation of reagents is carried out using distilled water in the tank, which is enameled a vertical cylindrical apparatus with elliptical bottom and lid, with the shirt.
Distilled water is fed into the pump capacity from a host of obtaining distilled water and is measured by the level.
Initial industrial solutions of the reagents used in packaging are supplied to the measuring tank, and from it by a pump – to the tank of reagent preparation.
reactants in the vessel are mixed by means of a circulation pump.
The resulting working solution from the tank is pumped to consumers: scrubber and absorber. A pump signalization is provided.

Module of compacting of drums (MKB)

This module is designed for processing the resulting scrap metal as utility waste, preparation for shipment to smelters during disposal of drums, cleaned from the remnants of particularly hazardous substances and fuel and lubricants.
Module in its composition has mechanical deformation area and the packing.
Plot of mechanical deformation can be located on open ground (under canopy), and in the production room.
Mechanical deformation of the drums is done in two stages: preparation for compaction and compression iself.
Drums come from MIN, are unloaded at the site. Using angle grinders or shears for metal lid drums are removed. Removed caps are mobbed by vehicles to package site.

Drum with removed is placed to a special 25 t press.
Pressing of drums is made in two directions:

- horizontal - for pre-crimping the side wall drum
- vertical - to form a metal pancake.

Pressing process is conducted in a semi-automatic mode: feed drum and extracting the metal pancake is done by hand, the direct compression - according to the instruction manual press.
The pressed metal truck moves to package site.
On site packaging landed dumps cover and metal separately stacked pancakes are placed in a stack on a pallet, binded by mounting tape.

9.2. Options for the implementation of technological solutions

The above basic technological solutions allow to implement various methods of mass disposal of drums. Figure 9.2.1 shows the block diagram of the complex technology of mass disposal of drums containing various types of contaminants.

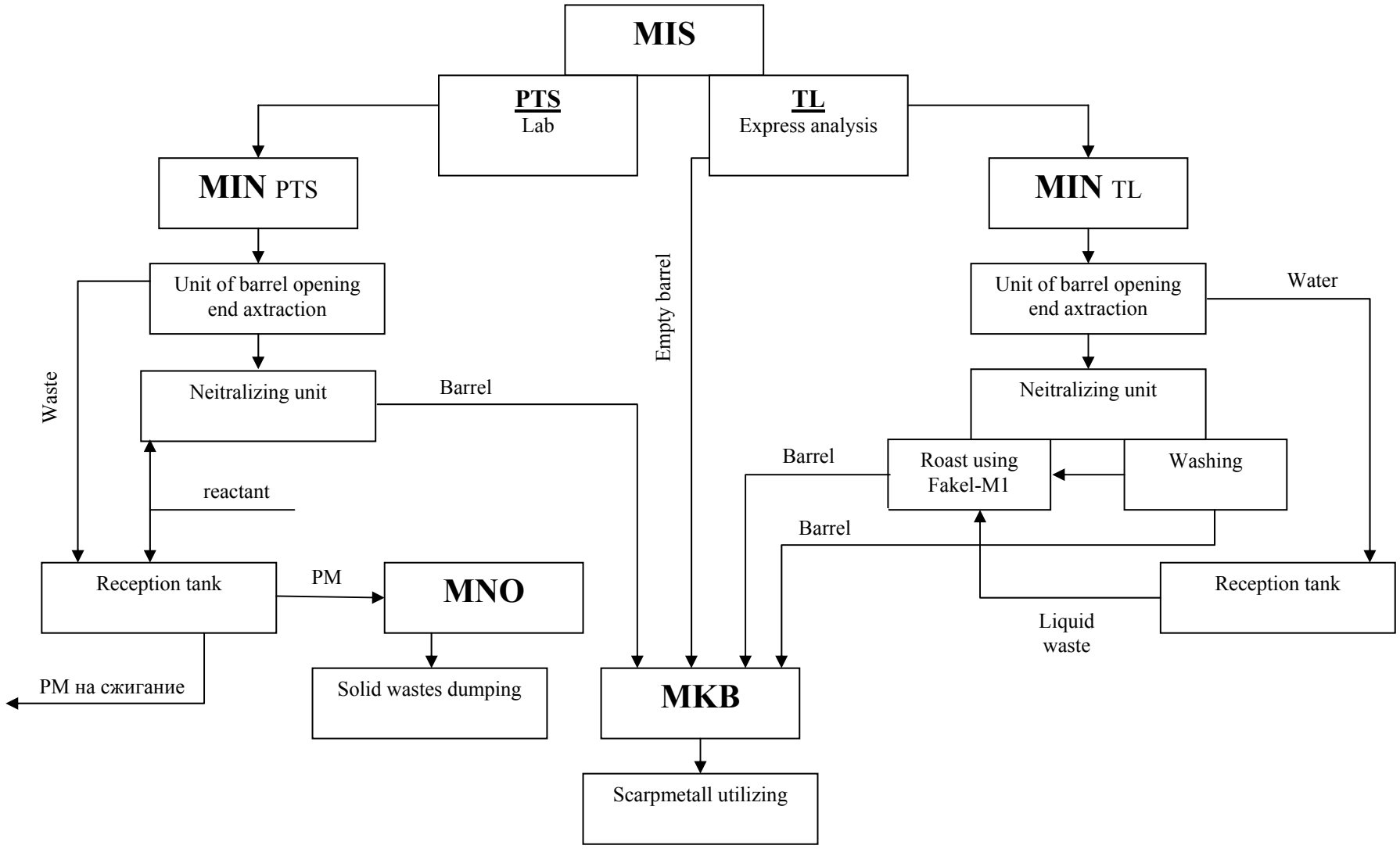

Figure 9.2.1 - Block diagram of complex technology of mass disposal of drums containing various types of contaminants.

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In accordance with the submitted scheme it becomes possible to implement a different set of technological equipment for disposal of drums. Let us consider the main options for implementing technological solutions.

Drums containing especially hazardous substances (EHS), can be disposed using the following method.

The minimum set of modules for disposal of drums includes modules of MIS and MIN.Specified modules should be used in the conditions when waste t obe destroyed are located in areas without infrastructure and transport network. In this case, module MIN implements chemical treatment of extracted hazardous wastes, and received reaction mass (RM) and empty containers are stored. In this case, obtained in the module MIN empty drums and the reaction mass will be classified as waste Class 3 or 4 and does not adversely affect the environment.

In a subsequent waste generated can be sent for elimination (MNO module and MKB module, respectively).

MNO module can be placed in the territory, providing the lowest economic costs of implementing the process of high-temperature oxidation of reaction mass, ie used in the existing production, taking into account the possibility of transporting it to the RM. If there is economic feasibility module MNO can be delivered directly to the place of disposal of drums.

MKB module can be placed either in conjunction with the module MNO, or delivered to the location of the drums after the neutralization of liquid waste.

Under conditions that ensure the economic feasibility of the entire cycle of disposal of waste drums, modules MIS, MIN, MNO and MKB can be used jointly

Drums containing technical liquids (TL), are disposed using the following method.

The minimum set of modules for the disposal of drums includes modules of MIS and MKB. In this case, you may eliminate any empty drums or drums containing natural water (rain, melted snow water residues, etc.). With this set in the module MIS based on the express analysis methods it is assessed whether contamination is on the surface of the drum or contained in the liquid phase and in the absence of pollutants, the decision is made to compact in MKB.

MKB module in terms of process equipment must be the united both during the disposal of drums containing especially hazardous substances, and in the disposal of drums technical liquid residuals, including oil products.

MIN module can be used as a whole, and part of the equipment. Thus, in the presence of liquid waste only frozen water fraction it may be appropriate to use unit opening and extracting waste, which provides the thawing of liquids.

If necessary, MIN may be added with a separate unit of neutralization drums, consisting of the installation of burning up (such as Fakel-1M) or drum washer.

Analyzing the overall proposed technological solutions, it should be noted that the selection of the desired type and number of modules, as well as a complete set of equipment will step to solve the problem of mass disposal of drums. In this case, taking into account the environmental component of the process, a set of methods used to the greatest extent will be focused on specific conditions for the implementation of technology.

9.3. Industrial safety requirements

Implementation of the mass disposal of drums containing especially hazardous substances, means primarily the creation of conditions which exclude the impact of hazardous substances in the environment due to the unsatisfactory state of the container and its storage conditions. However, the process of disposal of drums itself can also lead to contamination of both air and soil and groundwater. In this regard, the requirements for organizational and technical measures were developed to prevent the emission of eliminated substances and their products during the launch phase and operation.

Safety requirements before launching into operation processing facility (or individual units) of mass elimination drums imply an integrated commissioning and testing of all technology systems and individual equipment.

In the course of these works on drums layouts should:

conduct external inspection and ensure proper condition of all equipment and communications;

check the functioning of the shut-off and control valves communications technology of all units installed;

check the operation of all locks of the actuators of the entire installation, in particular modules MIN and MNO;

test instrumentation and other means of automation;

verify the completeness of individual packages in the self-first aid kit;

establish the technological parameters of the elimination of dangerous substances with the use of drums of all sizes, and then refine them in trial runs of individual components and the entire installation as a whole.

Before running each type of equipment it is necessary to convert it in a regulated state and check:

availability of uninterrupted power supply and pressure of compressed air in pneumatic systems;

the presence of regulated air pressure differential between the working chamber MIN and the environment created by the ventilation system;

have a working vacuum in the technological tying launched site installation;

the presence of a regulated supply of reagent to enter into MIN;

availability of technical liquids in containers of consumables;

the filling of collections, measuring tanks, receiving tanks, reagent solutions;

compliance with state perenalazhennogo equipment, parts and components frame size drums allocated to extract the substance;

original position of all equipment, all units and mechanisms.

In conducting the process of mass of disposal of drums should be provided for the following activities:

working space in which operations are carried out by extracting, pumping or chemical neutralization of highly dangerous substances (hereinafter - the "dirty room"), with optional forced-air ventilation;

All work performed during the operation of supply and exhaust ventilation;

state ambient air of industrial premises should be continuously monitored;

All persons working in "dirty rooms" are provided with personal protective equipment (PPE);

production staff of "dirty room" up to and after the work has to undergo a medical examination;

All work associated with sampling starting material, the reaction mixture, used reagents and

wash water should be composed of at least two people.
In conducting the process must be adhered to the norms of technological regime.
During the operation of the equipment or separate sites must comply with the requirements stipulated by regulations on labor protection and safety for a particular module and used manufacturing equipment.

10. DEVELOPMENT OF TECHMOLOGICAL PROJECT FOR HANDLING OF WASTE, TECHNOLOGICAL EQUIPMENT AND ITS PARTS CONTAINING HEAVY METALS

10.1. Main technological solutions

In developing the main technology solutions we take into account the need for further replication of the technology to other former sites of the Russian Defense Ministry located on Alexander Island of Franz Josef Land archipelago after the experimental work on the preservation of wastes containing heavy metals.

According to the results of field work conducted in 2010 on Alexandra Island [69], it was found that heavy metals were identified in oils of grades M20-V2, TAp-15V, IMSp-46, TSp-14gip and sulfur acid treatment condenser oil.

The content of heavy metals in these sources of pollution does not exceed the level of 0,5 ... 1,0 mg / kg, which corresponds to the norm for a particular type of oil products.

Given the fact that the Russian Defense Ministry sites may contain significant amounts of heavy metals (eg scrap of heavy metals, spent oils and technical liquids, battery fluids, etc.) in the development process of the project two ways were worked out:

extraction of heavy metals from waste for use in chemical-technological complex of Russia;

chemical treatment of waste in order to convert heavy metals into insoluble forms to reduce the risk of their spread in the environment.

The main technological solution is to develop a mobile unit in modular design to allow use of modules as a single system process, and for the organization of separate stages of production. This technical solution will allow the initial stages of the elimination in the vicinity of hazardous waste without a developed infrastructure (energy, transport, etc.), followed by the final stages in the development of industrial areas.

Provides for the use of three modules.

Grading module (MR)

Grading module is designed to group waste types (solid, liquid), the qualitative and quantitative content of heavy metals in the waste is destroyed, as well as for expert risk assessment of existing waste on the environment to identify priority actions to destroy them.

In the structure module, grading laboratory must be included, placed in a separate Frame construction, as well as cargo-handling equipment to move waste to the production sites required by process modules.

In the laboratory, the sampling of waste to be destroyed their identification and qualitative composition and quantitative content of heavy metals. Based on the results obtained by sorting of waste for the direction for future technological modules in order to destroy (the direction of the smelter, the allocation of heavy metals from liquid wastes or their deposition in insoluble form).

In addition, the lab is controlled of solid, liquid and gaseous wastes to assess the correctness of implemented process and environmental safety.

Solid-waste recycling module (MPT)

Solid-waste recycling module is designed for initial preparations for the existing waste for further processing at specialized enterprises.
Module in its composition has mechanical deformation area and the packing.
Plot of mechanical deformation can be located on open ground (under canopy), and in the production room.
Mechanical deformation of scrap that contains heavy metals, is carried out in two flows:
cutting oversized waste to the possibility of its further packing and transportation,
pressing small plastic waste metals (lead, tin and so on).
Solid waste is received from the MC, unloaded at the site.
Using angle grinders or mechanical (hydraulic) shears for metal cutting is bulky items into pieces the size of which provides transportation to a recycling facility used vehicles.
Small waste (chips, chips, radio parts, etc.) are served on a special press with a force of not less than 25 tons for compaction. Special press should provide a vertical pressing escape in a special container for forming a metal pancake.
Pressing process is conducted in a semi-automatic mode: Loading waste into the container and the extraction of metal pancake is done by hand, the direct compression - according to the instruction manual press.
The pressed metal truck moves to the site of the package.
At the packing is also fed waste containing very hard alloys with heavy metals. This type of waste is packed by hand in special containers.

Liquid-waste recycling module (MLT)
This module is designed to implement processes for the elimination of liquid wastes containing heavy metals in three streams:
Stream elimination of liquid organic waste;
flux annihilation liquid mineral waste (organic content of impurities less than 1 ... 5%);
Stream elimination of any liquid waste, causing environmental pollution due to adverse storage conditions.
Based on the results of the analysis and examination, conducted in the laboratory module MR incoming liquid waste goes into one of these process streams.
Each process stream structure represents the layout of the technological equipment for waste disposal.
The composition of the flow of liquid organic waste elimination includes two types of technological equipment:
equipment for processing (recycling);
equipment for elimination.
The equipment for the recycling of organic waste (oily) may be used:
installation of vapor-gas mixture separation, based on the exothermic reactor cracking Shah - Stage 1;
installation of a deep magnetic purification of distillates - 2 stage.
Specified technological equipment will allow for the processing of liquid organic waste to produce diesel fuel Euro-4 standard.
It should be noted that the processing equipment can be purchased in the form of a mini-mill and

placed in the same room at the industrial site, not larger than 6X6 meters [70].
Formed after the recycling of concentrated sludge containing heavy metals may be sent for further processing at specialized enterprises.
The equipment for the elimination of organic liquid wastes are encouraged to use the installation of high-temperature oxidation, as described in detail in section 4 of this report (MIN and MNO).
The composition of the flow of the elimination of liquid mineral waste includes technological equipment used for the treatment of industrial effluents from heavy metal ions. This equipment is offered to use galvanokoagulyator to host training retreat [71].
In galvanocoagulator as the anode can be used by waste metal - steel shavings, sawdust, cutting. As the cathode is used coke breeze mass 4-10 times less than the anode material. Value of feed material is 4:1.
When cleaning galvanokoagulyatsionnoy formed ferromagnetic slurry containing crystalline ferrite heavy and non-ferrous metals: CuO * Fe2O3, ZnO * Fe2O3, NiO * Fe2O3, FeO * Cr_2O_3. The compounds according to available estimates and have biotesting IV class of danger, do not dissolve in solutions of acids and alkalis. In addition, they can be used as a flux in the manufacture of ceramics and additives in a red brick, in irresponsible casting. In addition, the sediment has hydrophobic properties, can therefore be used as the underlying insulating layer on landfills.
Node preparation of waste is a stop-control apparatus with capacitive equipment and is designed to generate the required pH, which provides full use ferropulpy for the formation of iron extractable heavy metals.
Realization of this production equipment will eliminate the need for gas cleaning system, as gas bubble in the process galvanokoagulyatsii happens.
In the process stream destroy any liquid waste (emergency treatment of waste) by precipitation of heavy metal ions through the formation of insoluble forms, or adsorption on the surface of the chemical (biological) absorber.
In this case, since the flow is implemented as a first step to reduce the negative effects of heavy metals on the environment, the used process equipment includes a set of simple technical means:
tank for storage of reagents or sorbents;
dosing of reagents (sorbents) in a container of liquid waste;
mobile mixing device;
capacity for peretarivaniya waste from leaking tanks;
nozzle for extracting waste from leaking tanks;
nutsch filter and vacuum pump;
container for temporary storage of sediment.
Technological process reduces the deposition of heavy metals from the waste chemical (injection of reagents) or physical (the introduction of the sorbent) method.
In chemical deposition method from the waste [72], containing heavy metals by the selection of the stoichiometric amount of precipitating hydroxides followed by dissolving the filtered sediment in excess of the precipitant.
Thus, under the influence of the stoichiometric amount of lime, heavy metals, main group (Ni, Co, Cu, Cd, Fe) and an amphoteric group (Zn, Pb, Sn, Cr, Mo, etc.) go to precipitate as

hydroxides and hydroxy.
When exposed to the resulting solution of excess alkali heavy metals, the core group moving in the sediment and can be separated from the solution by filtration.
From a solution of an amphoteric metal hydroxo group selection in the form of their hydroxide precipitate is due to the introduction of sulfuric acid followed by filtration.
On physical vapor deposition method of waste [73-76], containing heavy metals by the selection of metal ions on the surface of the sorbent. As a sorbent can be used various compounds that meet the objectives of the operations (biosorbent from native or inactivated biomass composite sorbents based on strongly acidic cation exchanger KU-2-8, and iron hydroxide (III), kompleksooborazuyuschie sorbents modified material based on iron-manganese nodules, humates ammonium, sodium or potassium, etc.).
Agents (sorbents) are introduced into the container with liquid waste and mixed to increase the efficiency of extraction of heavy metals.
After sorption of heavy metals from solution by exudation on nutch-filter, followed by its peretarivaniem in special containers.
Precipitation received during the implementation of the chemical or physical methods, and containing the insoluble forms of metals, can be temporarily stored and subsequently sent for further processing .

10.2. Options for the implementation of technological solutions

The above basic technological solutions allow us to implement various methods of disposal of waste containing heavy metals. In Figure 10.2.1 shows the block diagram of the complex technology of waste treatment and processing equipment, containing heavy metals.

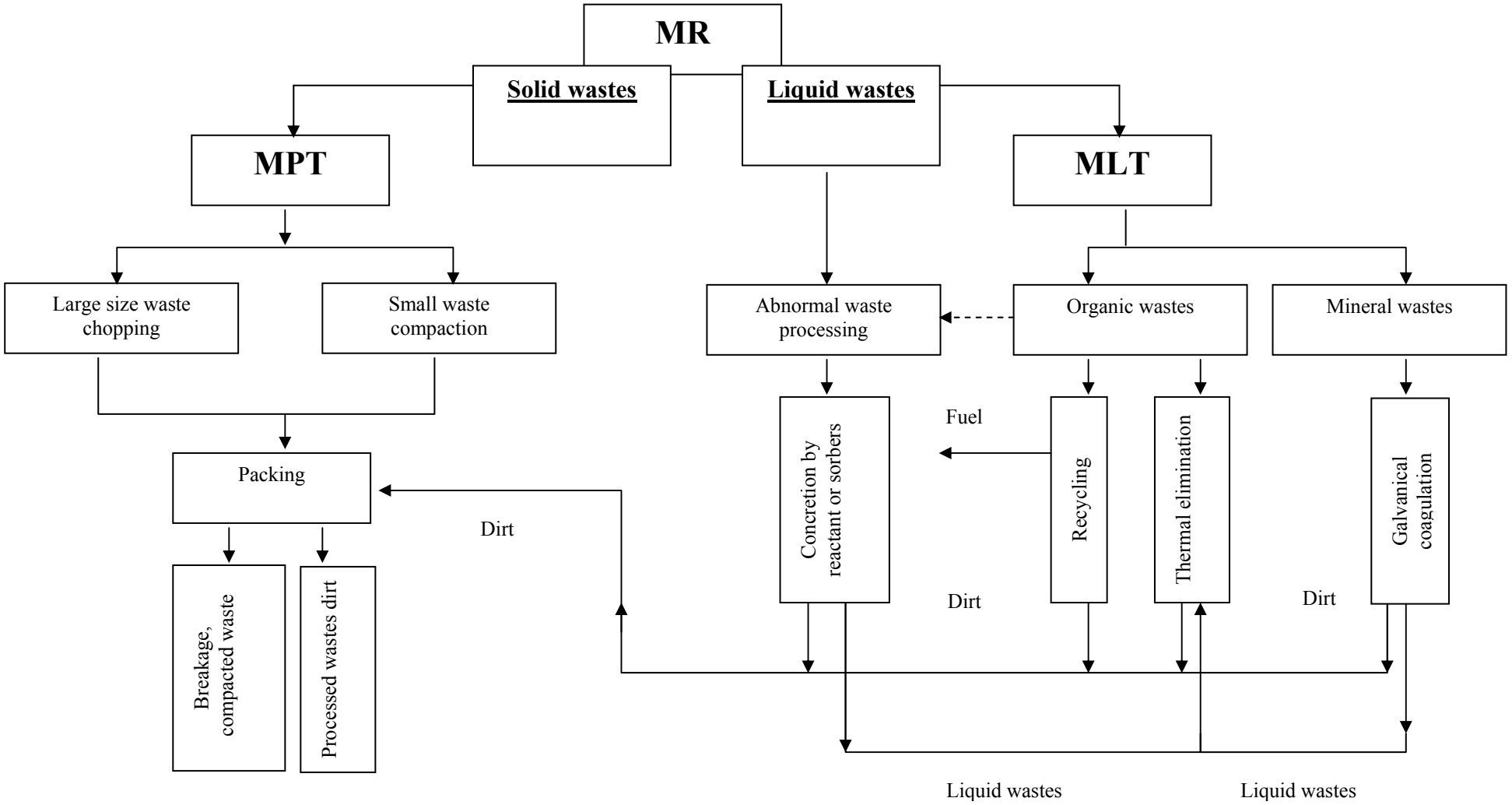

Figure 10.2.1 - Block diagram of the complex technology of waste treatment and processing of equipment, containing heavy metals.

In accordance with the submitted block diagram becomes possible to implement a different set of technological equipment for the disposal of waste containing heavy metals. We consider the main options for implementing technological solutions.
MPT module can be organized as separate units. At the same time, if necessary, nodes compaction of fine waste and cutting oversize items can be assimilated to the MKB module, which is part of the technological cycle of mass of disposal of drums.
MSA module can be implemented as a separate independent units. In this case, the node thermal decontamination can be used by installing high-temperature oxidation of modules MIN and MNO, included in the technological cycle of mass of disposal of drums.
It should also be noted that the module MR can be assimilated with the MIS module.
Implementation of recycling processes or galvanokoagulyatsii be subject to the economic feasibility of implementing this process.
Emergency treatment of waste can be carried out in conjunction with a complex of technological equipment MSA, and separately as a set of simple technical means described above.
Thus, the implementation of the proposed flowsheet, indeed, is the development of two separate sites - recycling and galvanokoagulyatsii.
Analyzing the overall proposed technological solutions should be noted that these methods and technical solutions provide a differentiated approach to the elimination of a particular type of waste and the possibility of interconnecting a large part of the process equipment.
In this set of methods and technological solutions to the maximum extent independent of each other and can be targeted to a specific target implementation technology.

10.3. Industrial safety requirements

Implementation of the mass disposal of wastes containing heavy metals, has as its main goal - the exception of exposure to hazardous substances in the environment due to the unsatisfactory state of the container and its storage conditions.
In this regard, in terms of highest risk, the emergency treatment of waste requires the highest attention to security requirements. This approach is due to the following:
in the management process occurs in direct contact with hazardous waste;
greatly increases the role of "human factor";
necessary is to use a special skin protection and respiratory system;
high probability of formation of spillage and contamination of air at peretarivanii liquid component.
For this type of work should be developed instructions for safely conducting emergency operations, waste treatment plants.
Before starting work, personnel must know the physical, chemical and toxicological properties of waste being destroyed, terms of use of PPE and first aid measures, the order (regulation) of manufacturing operations on site the work.
Before working personnel should be briefed on safety requirements, check the condition of PPE.
During the emergency operations performers must clearly fulfill the requirements of regulations to work, if necessary, to localize the source Strait (spraying) of waste.
Safety requirements before launching into operation process module (or separate units) imply an integrated commissioning and testing of all technology systems and individual equipment.

In the course of these investigations:
conduct an external inspection and to ensure proper condition of all equipment and communications;
check the functioning of the shut-off and control valves communications technology of all units installed;
check the operation of all locks of the actuators used the site;
test instrumentation and other means of automation;
verify the completeness of individual packages in the self-first aid kit;
establish the technological parameters of a given process of waste disposal;
In conducting the process waste shall be provided the following activities:
state ambient air of industrial premises should be continuously monitored;
production staff up to and after the work has to undergo a medical examination;
All work associated with sampling starting material, waste chemicals, sludge and wash water should be conducted of at least two people.
In conducting the process must be adhered to the norms of technological regime.
During the operation of the equipment or separate sites must comply with the requirements stipulated by regulations on labor protection and safety for a particular module and used manufacturing equipment.

11. DEVELOPMENT OF TECHMOLOGICAL PROJECT FOR CONSERVATION OF OBJECTS CONTAINING SOVTOL OR OTHER PCB-CONTAINING LIQUIDS

11.1. General information.

Reconnaissance survey of existing environmental condition of the territory of the decommissioned site of the Russian Defense Ministry on Alexandra Island shows significant levels of pollution and degradation of soil [69]. Techno disturbed areas are presented mainly by four species.

The first - organized (stockpiled) and disorganized accumulations of drums and tanks (even with fuel and lubricant) on the shore, near frontier "Nagurskaya", near an abandoned military base, as well as along the road from the coast (berthing) to the frontier "Nagurskaya.

The second - an abandoned military, transport and other equipment in the area of retiring military facility. Part of the abandoned equipment remaining technical liquids containing PCB and heavy metals.

Third - broken pipes from shore (anchorage) to the frontier "Nagurskaya" and to decommissioned military facility.

Fourth - the ruins of buildings of the old frontier Nagurskaya, retiring military installation, construction and household garbage.

The level of contamination at all sites geoenvironmental survey Alexandra Island can be rated as extremely dangerous.

Technical fluids containing sovtol and other PCB-containing liquids, refer to the first and second class of danger.

Due to the absence of demand data of land on the archipelago of Franz Josef Land, the Government of the Russian Federation has organized the work on their integration into the economy. In this connection, the Russian Government on April 23, 1994 N 571-p proposal was approved by the Ministry of Russia and Minnatsa Russia to establish state natural reserve of the federal purpose "Franz Josef Land," Ministry of Russia.

Realization of the full project remediation of decommissioned objects of the Ministry of Defence in the high Arctic region requires the use of specialized technological schemes, especially in the disposal of hazardous wastes and hazardous waste and the subsequent land reclamation.

Therefore, in addition to the development of a full-scale rehabilitation project in the high Arctic territory of the feasibility of a number of pilot projects to test and improve different technical solutions, most of which can be carried out on experimental grounds of the specialized enterprises with the subsequent transfer of technology under field conditions.

Technological project for the conservation of objects containing sovtol and other PCB-containing fluid, located on the island of Alexandra Island archipelago Franz Josef Land, designed to further replication in other sites of former Russian Defense Ministry after a trial.

Technology project contains information on basic technical solutions used for the safe conduct of the process of conservation sites containing PCB-containing liquids.

In developing the technological project of conservation of objects containing sovtol and other PCB-containing liquids, comply with the requirements of the Federal Law "On industrial safety of hazardous production facilities" on July 21, 1997.

11.2. Technological solutions for conservation of sovtol and other pcb-containing liquids.

The sequence of work on conservation projects on the territory of former military bases remaining substandard sovtol Defense, and other PCB-containing fluids in transformers and condensers in which they are stored is determined by the implementation of two ways:
commissioning of the mobile unit high-temperature oxidation directly at the site of Alexandra Island;
conduct pre-processing of waste collected by special agents to transfer them to a lower hazard class and send it off to a specialized company for recycling or use in the archipelago for future use (in paste form to impregnate the wood from rot).
The main technological solution to the first direction is to develop a mobile unit in modular design to allow use of modules as a single system process, and for the organization of separate stages of production. This technical solution will allow the initial stages of elimination (conservation) in the vicinity of hazardous waste without a developed infrastructure (energy, transport, etc.), followed, if necessary, to conduct the final stages in the development of industrial areas. Provides for the use of four modules:
Module identification and sorting (MIS);
Module extraction and neutralization of waste drums;
Module neutralization of liquid waste;
Module compacting drums (IBC).
The main technological solution in the second direction is to develop a mobile unit that enables processing sovtol special reagents to convert it to a lower hazard class and then use a special form of pastes. The process involves sulfonation sovtol oleum at 100-180 ° C and subsequent neutralization of the salt-forming agent triethanolamine.

11.3 Plan and procedures for conservation (liquidation) of drums, transformers and condensers containing sovtol and other PCB-containing liquids.

11.3.1 Plan and technological cycle for conservation of objects containing sovtol and other PCB-containing liquids

Plan for conservation of objects containing sovtol and other PCB-containing liquids is constructed based on the level of pollution and the number of items contaminated PCB. The structure plan includes elements such as: object, subject to conservation; stages of the operations (technologies), time to perform the operations, the type and amount of waste, the composition of forces and means for preservation, storage areas materiel; layout of production lines and safe transportation feedstock and products; sequence of personnel in case of emergency, financial, medical, consumer and other types of software.
Plan for conservation of objects should take into account all types of vessels, their quantity, as well as filling them with fuel, lubricants and technical liquids.
Virtually all elements of steel drums, transformers and other metal structures are not visually suitable for transportation by sea, should be prepared for disposal as scrap metal.
Exempt PCB-containing liquids drums, transformers and other equipment located on the territory

in question should move to a pre-determined and prepared storage areas to be inspected, their preparation (removal of residual PCB, the possible washing or steaming for processing) and the subsequent conversion to a mechanized suitable for safe transportation of the shape of the secondary metal. Such places in the scheme may be one or more depending on the chosen methods of processing and mobility hardware processing.

In this case, the plan should indicate not only the working and storage areas, but also bringing up the path, and prepared facilities and equipment, ensuring the protection of the environment of secondary contamination of waste and emissions released into the general recycling of decommissioned units of the Defense Ministry.

The development of the technological cycle utilization of transformers in relation to the peculiarities of the elimination of waste PCB-containing liquids in the territory of parts of the Defense Ministry, is based on sound less complex technology.

It should be noted a number of general provisions, arising from the results of field technological works.

To ensure the productivity of production for the elimination of pollutants is necessary to provide round the clock job for the northern areas for 3,5 - 4,0 months (June - September). At the same time in the planning of future work should be carried out detailed calculations of the necessary equipment and the number of expedition ended. It is also necessary to take into account the costs of subsistence (lodging, meals, etc.).

With respect to direct production cycle should note the following stages of the technology.

The first stage technology allows the identification of waste, based on rapid methods and their subsequent movement of two to three industrial sites raises a number of organizational and technical measures.

As part of activities carried out site selection location of main and auxiliary equipment, its installation, layout and binding to the technological platform, the organization of material flow, as in the processing facility, and directly recyclable objects.

In accordance with the operational documentation of the manufacturing equipment by conducting pre-commissioning, providing access to the desired operation mode for performance and security operations.

Loading and unloading and delivery of transformers and other equipment is carried out truck and trailer to transport to site identification and sorting.

At the site for the sampling of the depersonalized brought drums, transformers and other equipment and with the help of rapid method (eg, the qualitative response of organochlorine compounds with copperyu the color of the flame) determine the membership of departure to fuel and lubricant residuals, or PCB-containing wastes. Identified waste generated in the two streams to additional sites.

The second stage of technology, provides clearance (washing), drums, transformers and containers of PCB-containing waste from the recycling them as scrap metal.Empty (washed), drums, transformers and containers are fed into the compaction unit liberated the packaging. Depending on the concentration of PCB-containing liquids, this type of waste generated in the two streams to additional sites.

The third stage of the technology for elimination of PCB-containing liquids with a concentration of active ingredient (DE) below 90% is a high-temperature oxidation, based on the use of a

rotary kiln, with the injection of liquid wastes and plasma incinerator flue gases.
When the concentration of IR PCB-containing liquids above 90% oleum sulfonation technology is used in excess relative to sovtol oleum at a temperature of 100-180 ° C and subsequent neutralization of the salt-forming agent, triethanolamine, to give an organic compound triethanolamine salts of sulfonated sovtol PHDS-T.
This compound is a preservative 4-hazard class, and used to impregnate the wood from rot. Provides a lifetime of wooden poles up to 40 years.

11.3.2 Procedures for conservation (liquidation) of drums containing sovtol and other PCB-containing liquids.

PCB-filled waste drums are sent to the mobile complex extraction component, cleaning containers, compaction and elimination.
In the mobile system has:

- node draining and flushing tanks;
- site solvent recovery;
- Site preparation of the nitrogen drying gas;
- site cleaning of flue gases;
- site transportation of liquid waste;
- thermal cracking unit;
- site preparation and dispensing of reagents;
- site of chemical neutralization;
- node receiving and packaging of solid and liquid wastes.

Mobile complex structure consists of four modules.
Module of identification and sorting (MIS)
For the mass disposal of drums containing the remains of particularly dangerous substances, MIS in its composition should include an accredited and licensed laboratories working in the field of research with the substances 1 and 2 hazard class and placed in a separate Frame construction. The module also includes a forklift truck and transport vehicles for transportation from the place of the previous drum storage to the laboratory or to the subsequent process modules.
In the laboratory, the sampling of waste destroyed for the purpose of identification or confirmation of the qualitative and quantitative composition. In addition, the lab is controlled of solid, liquid and gaseous wastes to assess the correctness of implemented process and environmental safety.

Module of PCB-containing waste extraction and drum decontamination
With regard to the technology of mass disposal of drums containing the remains of particularly dangerous substances, waste recovery module and the neutralization of the drums (MIN) consists of the following main parts:
airtight ventilated work chamber in which the operations are done opening drums, mixing, extracting liquid wastes and neutralize internal cavity drums;
reinforcement group, which is a separate stand, where mounted stop-control valves and

instrumentation that enable manufacturing operations with the drum in the chamber;
Automated control system for MIN, which includes a control cabinet with integrated programmable electronic system and local control panel with built-in monitor.
In the chamber there are 3 windows for visual observation of the attendants followed the trial.
Filed for processing at MIN drum of waste is reloaded electrically operated type PT20 with a special gripper mounted on a trolley in a container of the working chamber. The operator then manually fix a drum, closing the chamber and includes air purification systems. The operator starts the process of opening the (drilling) a drum.
Switched drive vertical feed drill installation, the drill is automatically fed to the drum and bores her, plunging into the inner space of 30-35 mm.
Then drill and drill site rise to the starting position and the drilling installation is disabled.
Generated during drilling cuttings collected electromagnetic struzhkoulavlivatelem and after the return of the bit in its original position in the collection of discarded chips.
End of the drilling is shown on the monitor and the operator can start moving truck to retrieve the position of departure.
After lifting the drilling installation truck with the drum in the container is moved to the position of waste recovery and neutralization of the drum.
The position of waste recovery and neutralization of the drum includes evacuator drive vertical displacement, lower it all the way up to the surface of the drum. At the same time siphon tube heads evacuation falls into a drum through the bore in her position drill hole.
When ready to recover waste operator button transmits a signal to start operation. In this case, the valve is opened at the receiving capacity of liquid wastes, which created suction (vacuum). Before the transfer of waste receiving tank is pre-populated to 20-30% of the reagent. Due to the vacuum waste removal is provided from the drum in the receiver tank. Receiving tank is equipped with a clean exhaust gases, and has temperature sensors and cooling circuit to maintain the required temperature regime in the event exothermic neutralization reaction between the waste and reagent.
At the end of extracting waste fluid flow through the siphon head of the evacuation and the associated pipeline stops that can be detected visually through the observation lamp or sensor.
After finishing surgery recovery retreat begins the process of filling drums a neutralizing agent of the collection. The choice of agent is dependent on the type of hazardous waste being destroyed.
When ready to supply the reagent in a drum of the operator by pressing the transmit signal at the beginning of the operation. The reagent is discharged into the drum of the siphon head evacuation, the exhaust from the internal cavity of the drum gases are cleaned in the clean air of the working chamber. Number of standard size is determined by the reagent are working on the drum (80 liters to 100 liters drums or 200 l for 250 l drums) and controlled the flow meter (device type FR03), defining the end of its filing.
At the end of the processing time by pressing the drum operator transmits a signal to start operation extraction reagent. In this case, the valve is opened at the receiving capacity of the module, providing a vacuum tap into them spent reagent from the drum.
The process of evacuation of the reagent is monitored by sensors in the MIN and evacuated volume of the reagent. The process of evacuation of the reagent from the drum end, with analysis

of information on the equality of selection and volume of filling the drum degasser. After that turn drive the vertical movements of evacuator, lifting it to its original position, taking the siphon tube from the drum.
After lifting evacuator to its original position trolley decoupled from the mixing unit and the operator's command is derived from the working chamber MIN. Emptying the drum is fed into the compaction unit liberated the packaging.
In the receiving tank due to partial neutralization of hazardous waste a reduction in class of its hazard. Residual PCB controlled laboratory module identification and sorting.
Neutralization process is completed when the concentration of PCB in the run-off from the reagent containers not exceeding 50 ppm. If necessary, by adding a reagent or solvent to achieve the required hazard class.
Major part of this system is certainly a technological scheme for purification of drums pairs of solvent - methylene chloride (Figure 11.3.1).
The main technological aids schemes are:
heat chamber (Block 1);
cu-solvent evaporator (unit 2);
condenser, cooled by the refrigerant from the refrigeration unit (Unit 3);
capacity for PCB (Block 4).
Technological process of discharging PCB from containers and their subsequent removal of residual PCB up to environmentally safe levels includes the following operations [66]:
discharge of PCB from containers (Unit 1);
removal of PCB undrainable residue from the bottom of the drums - methylene chloride, which is the cube-evaporator (unit 2) enters the drum, located in an oven (Block 1) and then into the condenser (block 3);
output from the system PCB, washed from the drums of methylene chloride, which evaporates from the cube-evaporator (unit 2) is condensed in cooled drums (Block 1) and accumulates in them. High-boiling PCB remain in the cube-evaporator (unit 2) and after the distillation of methylene chloride was fused into the vessel (Block 4);
release of drums that are still in the oven (Block 1), from methylene chloride. C in an oven is just neslitogo distillation residue of methylene chloride from the bottom of the drums through the condenser (block 3), cooled refrigerant from the refrigeration unit in a cube°For this heat chamber is transferred to the cooling mode, heater cold water on the radiator steam heating mode and a temperature of 60-70 -unit (unit 2).

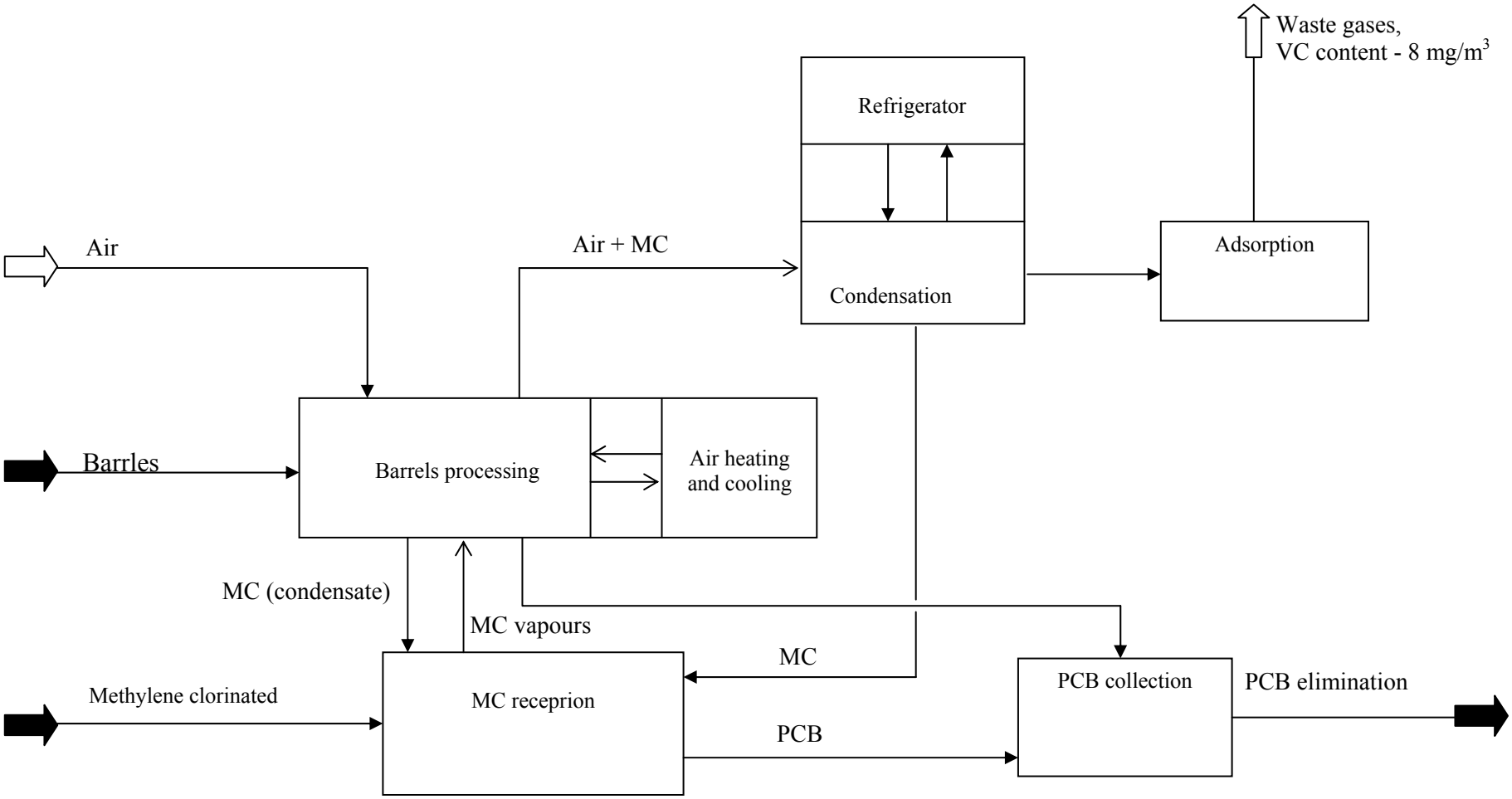

Figure 11.3.1 – Block diagram of clean up of drums from PCB with очистки бочек от PCB methylene chloride (MC)

After that the drum purged for stripping the gas phase of methylene chloride through an external condenser (unit 3) with the remaining solvent condensation and subsequent air vent to the atmosphere through the adsorber with activated charcoal (Block 5).
Konets purge determined based on analysis of samples of air blown through them.After purging the contents of methylene chloride should be at the MPC to the working area (50 mg/m3). The content of methylene chloride in the air emitted into the atmosphere does not exceed 8 mg / m 3.
Technological scheme allows one technological circuit, using an oven, a cube-evaporator and condenser, cooled by the refrigeration machine, make all necessary technological operations.
Internal surface bochek conducted by pairs of pure solvent. This provides a mass transfer at all intended for the cleaning stations.
The process is conducted without the use of centrifugal and vacuum pumps, the use of which in the case of an accident, can lead to spills.
Control scheme technological operation processing pairs of methylene chloride, based on a regulated supply of steam into the jacket of a cube in accordance with the specified and measured flow condensation of methylene chloride, drained from the transformer into a cube - a simple and reliable in operation.
C and MPC work area-50 mg/m3 is acceptable both in terms of energy consumption and safety compared with other high-boiling solvents.°Use as a solvent - methylene chloride, which has a boiling point of 40
Used for the process of neutralizing transformers solvent - methylene chloride is a readily combustible liquid with concentration limits of flame propagation:
lower - 16,2% vol.
Top - 19,1% vol.
C.°Autoignition temperature - 580
Methylene chloride is a substance of Class 4 of the MPC in the work zone and ambient air, and 3 classes of MPC in the water.
Constantly ongoing process of regeneration of methylene chloride and treatment of couples, rather than liquid to minimize the amount of solvent circulating in the loop, regardless of the size of the transformer.
When using this technology, several drums (depending on size), filled with PCB are processed within a work shift, including the stage of discharge of PCB and clean the inner surface of the drums.
Drums that have passed the stage of neutralization technology used to contain the residual amount of PCB in the solvent does not exceed 50 mg / kg.
According to the NGO "Petrohim technology, after stripping residual solvent from the internal volume bochek up to a level below the MPC working area of methylene chloride (less than 50 mg/m3) content of residual PCB in the air is blowing - 50 mg/m3, well below the MPC to PCB (1 mg/m3). In addition, the technology with the use of methylene chloride is classified as B and does not require fire suppression systems.
Collected in the intermediate tank of PCB waste after conducting qualitative and quantitative analysis goes on hoses for the installation of high-temperature oxidation (tubular rotary kiln) with a given flow.

Module of deactivation of liquid waste

Module of deactivation of liquid waste (MNO) can be used in conjunction with module extraction and neutralization of waste drums or as a standalone technology node for the elimination of only hazardous waste.

The principle of operation of the module is based on the implementation of the technology of thermal cracking reaction mass formed in the receiving capacity of the module extraction and neutralization of waste drums.

The main unit of the module is to install high-temperature oxidation, carrying out the thermal cracking of PCB-containing wastes.

High-temperature oxidation is conducted in a specially designed furnace [64, 65]. The choice of temperature, time of thermal treatment is carried out according to the analysis.

This technology is based on a set of systems of high-temperature oxidation (node thermal expansion) and neutralization of waste gases.

Module neutralization of liquid waste includes the following main parts:

site transportation of liquid waste;

thermal cracking unit;

site preparation and dispensing of reagents;

Automated control system for the INR, which includes remote control with built-in programmable electronic system;

site cleaning of flue gases.

Node transport liquid waste is a block with stop and control valves, pumps and flow meter, which allows to carry out manufacturing operations for transportation of the reaction mass from the module extraction waste site thermal cracking with the desired flow rate.

When a reaction mixture from the receiving vessel operator via remote control command is given to the pump of liquid waste. Reaction mass through the pipeline enters the balancing reservoir, from which gravity is sent to the site of thermal cracking. Required flow rate of waste supplied to the combustion is controlled by the flowmeter.

Thermal cracking unit of waste is from a rotary furnace and flue gas cleaning system, mounted in a single unit.

The furnace design allows speed control and tilt tubes, purging the working chamber and the air temperature from 400 up to 1400 0C.

Liquid waste enters the receiving device, on which is fed into a heating zone tube furnace and moves further along the pipe through the zone of combustion and pre-cooling. The resulting ash residue poured from the pipe end in the hopper, cool and collected in a soft container (rubber bag) for recycling.

For the implementation of high-temperature oxidation through the tube current waste flow by forced air flow. Air is supplied through the suction port of the jet compressor, articulated with a tube furnace in the cooling zone. Selecting the mode of the furnace (the temperature in the reaction zone, the speed of the pipe, the angle of inclination, the volumetric flow rate of air oxidation) is performed by introducing a pre-programmed modes of operation by remote control.

Kiln gases trapped gas flow jet compressor, partially cooled. The concentration of potential pollutants in the stream is reduced by dilution with compressed air. The cooled waste gas flow is

fed into the system 3-step purification of exhaust gases.
The first stage of the process embodied in the form of a hollow scrubber and combines the function of quenching gas, its absorption by aerosol treatment, a series of acid gases and organic compounds. Efficient operation stage due to the use in the scheme of the jet compressor.
In the scrubber, due to adiabatic expansion of gas and a counter-motion scheme reagent by a sharp decrease in exhaust gas temperatures up to 250 0C. At this stage there is cleaning exhaust gas from aerosols (particle size up to 0,5 mkm) with an efficiency of not less than 95%.
In the scrubber, depending on the type of waste being destroyed, as the scrubbing liquid can be used by various reagents.
The second stage of the process consists of a series of consecutive absorbers. The adsorber by posttreatment of exhaust gases from the products of incomplete thermal oxidation with an efficiency of not less than 98%.
In addition, at the entrance to the second stage by further cooling of gas up to temperatures of about 20 0 C with simultaneous withdrawal of the condensate stream and sprays.
The third step is necessary to ensure the final cleaning of gas from all the pollutants up to a level not higher than MPC, including - of dioxin-like compounds with the maximum concentration at 0.1 ng/Nm3 of dioxin equivalents.
With this purpose in this stage includes two serially connected units: bag filter and an automatic interlocking flue gases.
Automatic Locking flue gas is a line of additional gas cleaning.
The composition of this line includes plasma-optical camera and monitoring unit off-gas with an actuating device switch thread.
In normal operation of the plant gases through the unit for monitoring and flow-switching device is discharged into the atmosphere.
When issuing a unit signal for excess levels of incomplete combustion produces a signal to the actuator to switch the direction of flow and the additional stage of gas purification.
After the normalization process of gas purification in the absence of a signal from the monitoring unit flue gas by switching the flow to discharge into the atmosphere.
Node preparation and dispensing of reagents used for preparation of scrubbing liquid, and liquids for irrigation absorbers. Preparation of reagents is carried out using distilled water in the tank, which is enameled a vertical cylindrical apparatus with elliptical bottom and lid, with the shirt.
Distilled water is fed into the pump capacity from a host of obtaining distilled water and is measured by the level.
Initial industrial solutions of the reagents used in packaging are served in the measuring tank, and from it by a pump - in the capacity of reagent preparation.
Mixing of reactants in the vessel by means of a circulation pump.
The resulting working solution from the tank is pumped to consumers: the scrubber and absorber. Set an alarm of the pump.
In the process of thermal cracking of the resulting bottom ash is analyzed for PCB. When the content of less than 50 ppm it is packed in plastic bags and stored up to the moment of sending to the mainland. This kind of waste can be used as a filler for various industries.

Module of compacting of drums (MKB)

This module is designed for the processing of the liberated during the of disposal of drumsand preparation for shipment of scrap metal is formed as a secondary raw material forsteel plants. Description of the module and the basic technological processes carried out therein are given above, in Section 10.1.

11.3.3 Procedures for conservation (liquidation) transformers, condensers and containers containing sovtol and other PCB-containing liquids.

In the above mobile unit in modular design uses the same technology decontamination (washing), transformers, condensers and containers as drums [66]. It boils down to the washing of PCB-containing wastes with the subsequent elimination of this waste by mobile plant high-temperature oxidation and utilization of transformers, condensers and containers as scrap.
Chemical processing are only liquid wastes with PCB content of about 90% and above. Oleum sulfonation source of PCB to further neutralize the product does not allow to reach the degree of conversion of PCB for more than 99%. This results in a product can contain more than 50 ppm PCB, which requires an additional step (distillation or leaching PCB) from the resulting paste PHDS-T. This paste can be applied to the archipelago to impregnate the wood from rot.
The initial stage of decontamination technologies (cleaning), transformers, condensers and containers is in the preliminary washing their "assembly", then they are disassembled and additional washing of metal parts up to PCB on the surface of less than 50 ppm (mg / kg). Metal parts with such a low content of residual PCB belong to the European standards for non-hazardous waste and can be disposed of in any acceptable manner. The rest of the disassembly of the transformer, wooden and cardboard waste containing more than 50 ppm (mg / kg) of PCB are burned or to be disposed of in designated landfills in compliance with the stringent requirements of environmental safety.
Design features of condensers allow them to render a similar technology, as well as transformers. Neutralization condensers, then throw shells provides washing condensers, their dismantling, a second wash the shells and the core. After this case, containing less than 50 ppm, sent for recycling, as crushed core and additionally washed from the PCB, usually a hot solvent. Peeled and crushed aluminum core contains less than 50 ppm PCB, and also sent for recycling.
With regard to the peculiarities of the elimination sovtol and other PCB-containing liquids in the territory of the island of Alexandra Island, should use previously mentioned complex technology. To implement this it is worthwhile to highlight the most important stage.
The first stage of technology should include the identification of waste, based on rapid methods and their subsequent movement of two to three industrial sites.
In this case, the main goal of the event - the formation identified in the qualitative composition of the waste according to the degree of danger. Since most of the available drums, transformers and condensers are in poor condition, should be possible to retrieve the waste in drums or containers are safe.
The second stage should be directed to carry out the neutralization of the liberated packaging (including - transformers and condensers), with subsequent compaction and recycling. Excepted transformers and condensers before compaction to be neutralized. This is a more complicated process than the neutralization of the drums after removal of PCB-containing

technical liquids.
Initial decontamination of condensers and transformers is carried out by flushing a capacitive PCB-containing equipment in pairs of methylene chloride up to the required level of security.
According to the system adopted by the developer of technology, technological scheme includes:
collection of transformers (condensers) and placing them in a special place;
preheating of each transformer (condenser), emptying it at the expense of gravity and the collection of liquid PCB in a separate tank for disposal;
carrying out the cleaning cycle of the transformer (condenser) with vapors of methylene chloride;
disassembly of the transformer (condenser) and sorting of components. Established that the cleaning process pairs of methylene chloride metal parts inside the transformer (condenser) cleaned up to such an extent that they are not considered hazardous waste and can be recycled without any problems;
details of wood construction, cardboard and paper, which may still contain a residual amount of PCB, are sent for incineration.
However, in order to maintain ecological safety of the Arctic zone flowsheet washing transformers (condensers) of PCB disposal technology, complemented by a solvent after the washing of PCB-containing equipment, which will intensify the work site cleaning of transformers (condensers) to regenerate the solvent up to environmentally acceptable standards for impurity content of PCB.
For these purposes, uses technology developed by LLC NIITS "Synthesis." The general technological scheme for cleaning PCB-containing transformers (condenser) is shown in Figure 11.3.2 and comprises the following steps:
discharge of PCB;
washing equipment with methylene chloride,
regeneration of the solvent.
In the third stage of technology by the direct elimination of collected spent oils and technical liquids containing sovtol, and other PCB-containing liquids.
The elimination process is solved by the implementation of two ways:
operating mobile plant high-temperature oxidation directly at the site of Alexandra Island;
carrying out chemical processing of the collected waste to transfer them to a lower class of danger.
Select the direction of the third stage of technology is determined by the concentration of PCB-containing liquids. When the concentration of active ingredient of PCB 90% oleum sulfonation technology is used in excess relative to sovtol oleum, followed by neutralization of the salt-forming agent triethanolamine. Sulfonation process is conducted at a temperature of 100-180 ° C to yield a result of an organic compound triethanolamine salts of sulfonated sovtol PHDS-T.

11.3.3.1 PCB discharge stage
The first step in the processing of transformers (condensers), containing PCB, is draining dielectric fluid from them. In the presence of lower discharge valve and the upper vent valve such an operation seems to drain fairly simple. In fact, this operation is not simple for several reasons:

drain valve is usually not installed in the bottom of the hull, and on the side of the transformer. Therefore, when the bulk fluid drain on the bottom left of the PCB, which can not be drained. For a complete discharge of PCB transformer is tilted, which requires a special device; Domestic sovtol-10 (90% PCB and 10% trihlorbenzenea) is an extremely viscous liquid. sovtol C is equal to 14,000°Viscosity at 20 C - 100 centistoke.°centistoke, at 30 Transformer before discharge of PCB, if the temperature C, must be heated;°is below 20-25
draining hinder small gaps between the internal elements of the transformer (condenser); wood screws, cardboard and paper materials are porous and retain well-PCB.
Applicants to the processing of transformer (condenser) is discharged from the car on the unloading platform, equipped with individual trays in case of leakage of transformer. Then the transformer is installed on the site drain placed in the oven. The scheme of treatment with the transformer is shown in Figure 5.3.2
With the help of flexible hoses connected to the mains transformer system flush. Draining of the condensers is carried out on site drainage by drilling holes in the lower and upper cavity of the casing. After draining the bulk of oil produced threading and connection through flexible hoses to pipelines drain system.
To provide more complete draining of PCB its viscosity decreases due to heating of the transformer (condenser) up to 30 ° C by circulating hot air oven. Air circulation fans by B1 and B2. The air is heated in the electric heating coil T1.
Upon reaching the desired temperature in the casing of the transformer (condenser) starts gravity drain sovtol-10 in the collection, E2, calculated on the possibility of accepting PCB from any of the transformer (condenser).
As you fill the collection E2 PCB using a pump H2 is passed to the receiving capacity of the installation of thermal incineration of PCB.
Collection E2, H2 pump and piping for the transportation of PCB are heated by flexible electric heating elements.

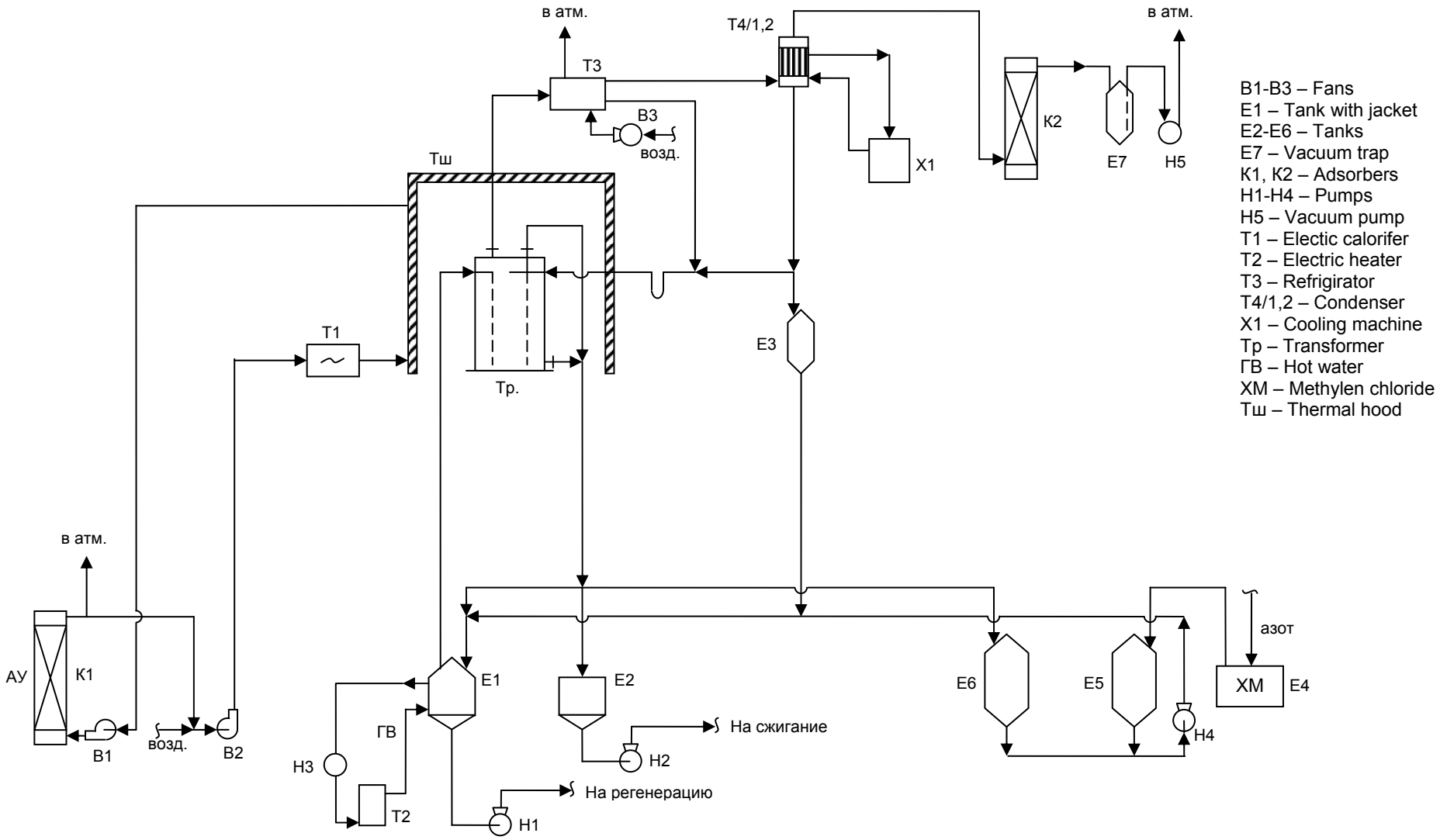

Figure 11.3.2 – Scheme of PCB discharge from of transformer (condenser) and washing with methylene chloride

11.3.3.2 Stage of washing of transformer (condenser) with methylene chloride

After draining the transformer (the condenser) must be rinsed from the inside up to environmental requirements to be able to disassemble and recycle its components

To remove the liquid layer PCB with the inner surfaces of the transformer (condenser) it served a pair of methylene chloride from the tank with a jacket E1, a cube-vaporizer.

Solvent vapors, condensing the contaminated items, and dissolve and wash away the remnants of PCB. Contaminated with methylene chloride by gravity back into a cube-evaporator E1.

Heating and evaporation of methylene chloride by circulating hot water fed into the jacket vessel E1. Hot water circulation pump is H3, heated water in heat exchanger T2.

Treatment process is repeated several times, washed from the transformer PCB accumulate in the tank E1.

At the stage of clearance transformer must be cooled to remove heat of condensation of methylene chloride. For this heat chamber is transferred to the cooling mode by blowing unheated air fed fan B2.

Control over the amount of methylene chloride is circulating on the return flow from the transformer (condenser) of condensate, is 100-150 l / h.

Methylene chloride vapor condensation inside the transformer (condenser) is at a temperature of 44-48 ° C and pressure of 0,3-0,5 bar. Uncondensed pairs of methylene chloride enter the air-cooled condenser T3. He served in the air blower B3.

If necessary, can be connected condenser T4 / 1,2-cooled refrigerant with a temperature of minus 50-70oC. Condensate is fed into a transformer (condenser) for irrigation of the active part.

The process of neutralization of the transformer (condenser) is completed when the PCB concentrations in runoff from the transformer (condenser) the condensate is not more than 50 ppm.

The duration of the cleaning process of the transformer (condenser) - not less than 72 hours. For quality control of neutralization of the transformer (condenser) is the bay with a clean (fresh or regenerated) with methylene chloride. After holding the liquid is discharged into the collection of the E6 and analyzed for PCB.

Fresh methylene chloride comes into production in drums, of which the pressure of compressed nitrogen peredavlivaetsya in a container from which it is sent to the pump capacity E1 H4.

In the process of neutralizing transformer (condenser) is applied vacuum system using a vacuum pump H5 in operations:

suction undrainable remainder of the transformer (condenser);

suction of the solvent vapor and purge nitrogen from the transformer (condenser) before disassembly;

preliminary evacuation of the transformer (condenser) and the system before disposing.

Suction gas mixture after the condenser T4 / 1,2 before entering the vacuum pump H5 purified from impurities in the adsorber K2 with activated charcoal. Between the column K2 and the vacuum pump is installed H5 vacuum trap E7.

To clean the air circulating through the heat chamber during heating of the transformer (condenser), the impurities of PCB vapors and air blown through the oven at the transformer cooling (condenser) in the process of flushing impurities from methylene chloride before release into the atmosphere is set K1 adsorber with activated charcoal. The service activated carbon is determined by its brand name and sorption capacity. The spent carbon is returned to the installation of thermal decontamination.

Inactivated transformer (condenser) after purging with nitrogen up to the content of methylene chloride in nitrogen, less than 50 mg/m3 is broken down into its constituent parts. Metal components and building a

residual content of less than 50 ppm PCB are sent for recycling as secondary raw materials, and nonmetallic materials are subject to thermal disposal.

11.3.3.3 Solvent regeneration stage

Technological scheme of solvent recovery is shown in Figure 11.3.3 Regeneration of the solvent - a selection of pure methylene chloride from its mixture with the remnants of PCB is carried out periodically. To do this, PCB pollution of methylene chloride from the cube-evaporator E1 install cleaning of the transformer is pumped into the vessel through the side E8 fitting. Evaporation of methylene chloride is produced by heating the hot water tank through a shirt E8. As the spray droplet separator liquid with vigorous boiling is a layer of nozzles at the top of the tank.

Pair of methylene chloride from tank E8 coming into the condenser T5 cooled brine. Condensed methylene chloride is discharged into the tank E9 cooled brine. Pickle served in a tank shirt E9, and from it comes in a condenser T5.

Regenerated solvent - methylene chloride - back to the installation of the transformer cleaning for reuse.

Pair of methylene chloride from tank E9 trapped in absorber K3 with activated charcoal. The service activated carbon is determined by its sorption capacity.

Completion of the distillation of methylene chloride from a mixture of PCB determined in the following two criteria:

termination of reducing capacity in the E8;

increase in temperature of the liquid in the tank E8.

The exact content of residual dichloromethane in the bottoms liquid is determined by chromatographic analysis and is equal to 3 ± 1 %.

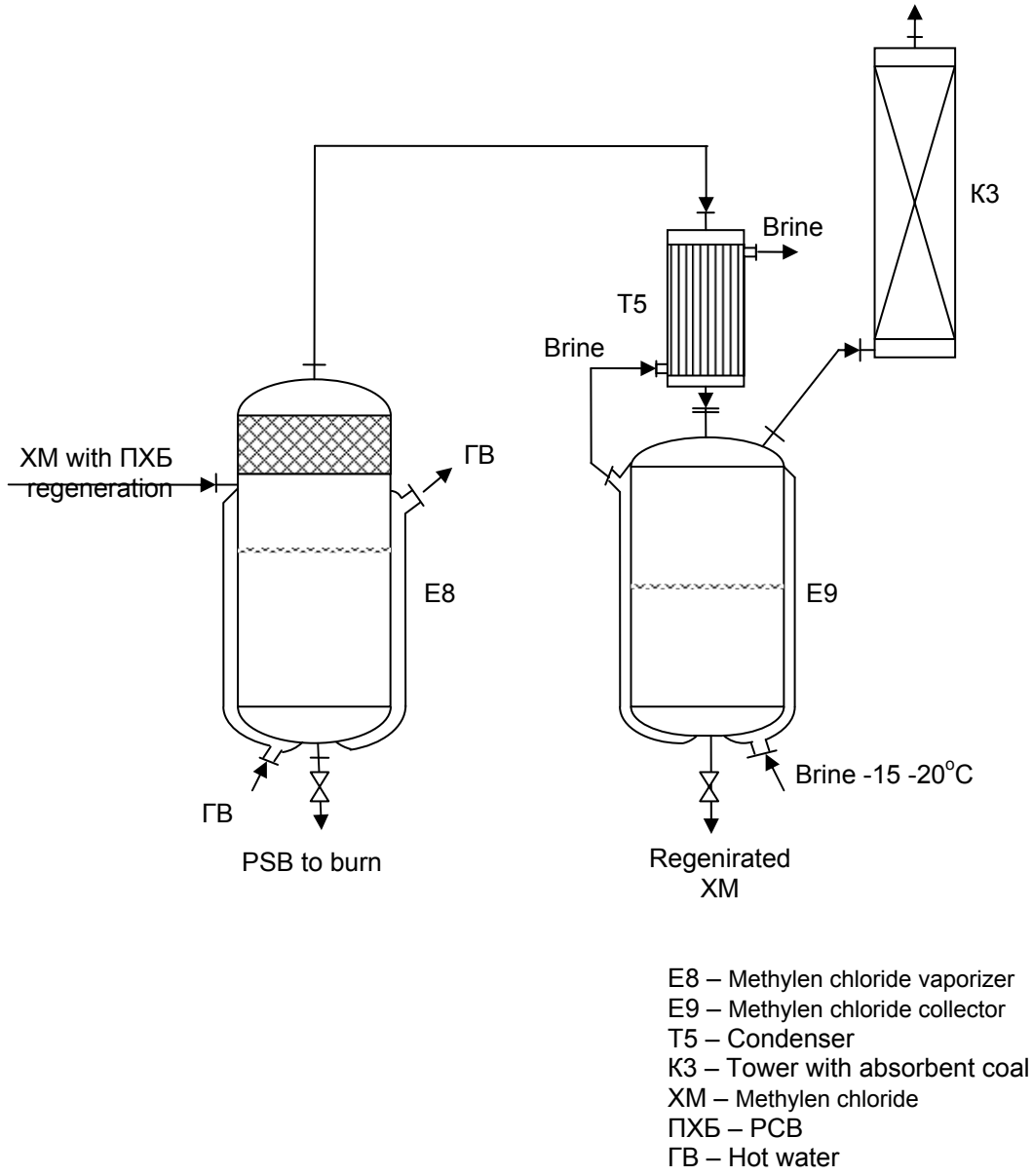

Figure 11.3.3 – Scheme of solvent (methylene chloride) regeneration

11.3.4 Procedures for conservation (liquidation) of sovtol and other PCB-containing liquids .

11.3.4.1 Stage of high-temperature oxidation of PCB-waste.
At low concentrations of the active substance in the PCB-containing liquids, the most expedient at the moment is the high-temperature oxidation of PCB-waste directly at the site of Alexandra Island using a mobile unit. In this case, the high-temperature oxidation (combustion) of PCB waste is implemented based on technology developed by LLC "NIITONH i BT» [64, 65].
This technology is based on a set of systems of high-temperature oxidation (node thermal expansion), afterburner and neutralization of waste gases. Thermal cracking unit of waste (Figure 11.3.4) invited to perform in a rotating tube furnace and a plasma afterburner.

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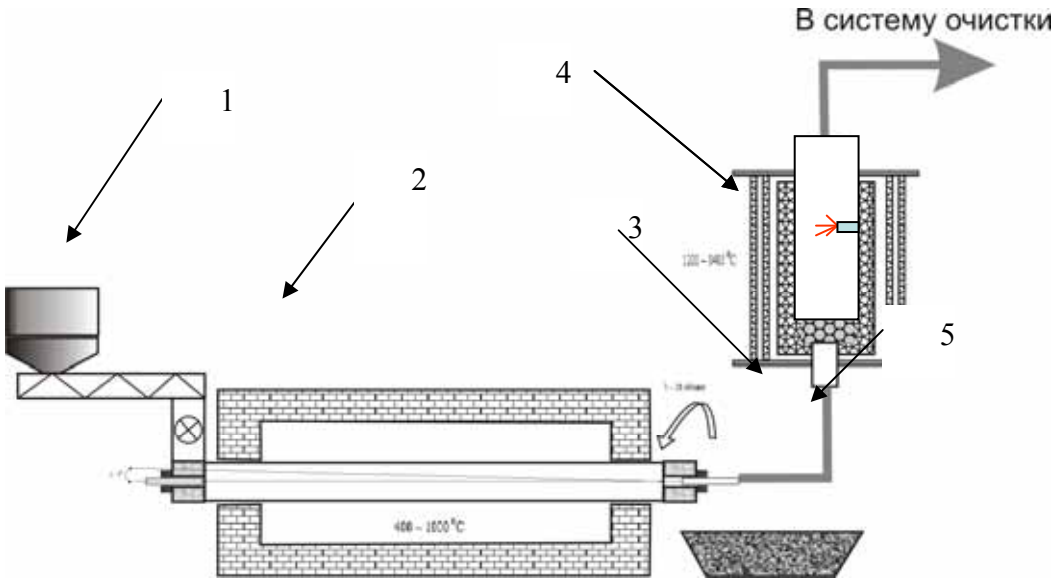

Figure 11.3.4 – Scheme of thermal cracking of PCB-waste
1 – waste feed node; 2 – pipe furnace; 3 – jet compressor;
4 – afterburner; 5 – tank for collecting refuse burnout

The furnace design allows speed control and tilt tubes, purging the working chamber and the air temperature from 400 up to 1000 0C. Plasma afterburner is designed for complete thermal elimination of waste from the furnace gases at a temperature of about 1400 0C.
These design features allow you to:
maintain the desired temperature of the furnace depending on the class of waste, and the possibility of making PCB component in the gas phase of withdrawal from the provision of energy saving on heating;
conduct regulation time, the thermal cracking of waste due to changes in speed and angle of the pipe;
implement processes in a furnace or oxidative pyrolysis, pyrolysis, or depending on the physicochemical properties of toxicants and the material is destroyed;
for complete thermal degradation of organic compounds in the plasma afterburner.
In the construction site of the thermal cracking of waste jet compressor and afterburner attached to a function of the provisional stage flue gas cleaning. Thus, the use of the scheme jet compressor (3), provides a pre-cooling the exhaust gases, dilution of gaseous pollutants by compressed air and flow into

the cavity in the afterburner (4).
The design of afterburner is a nozzle with a channel filled with gas-permeable nozzle (balls, cylinders, Raschig rings, bulk material).
Use of this technical solution will ensure the elimination of the laminar boundary layer of cold gas, which is responsible for the formation and preservation of toxic compounds. In addition, attachment facilitates the relative delay in the chamber of solid carbon particles, which are the main source material for the resynthesis of dioxins and thus - for their active burnout. The necessary contact time can be provided either free of the inner channel. Flow sheet of the gas cleaning system (Figure 11.3.5) provides a 3-step purification of exhaust gases from pollution by different methods.

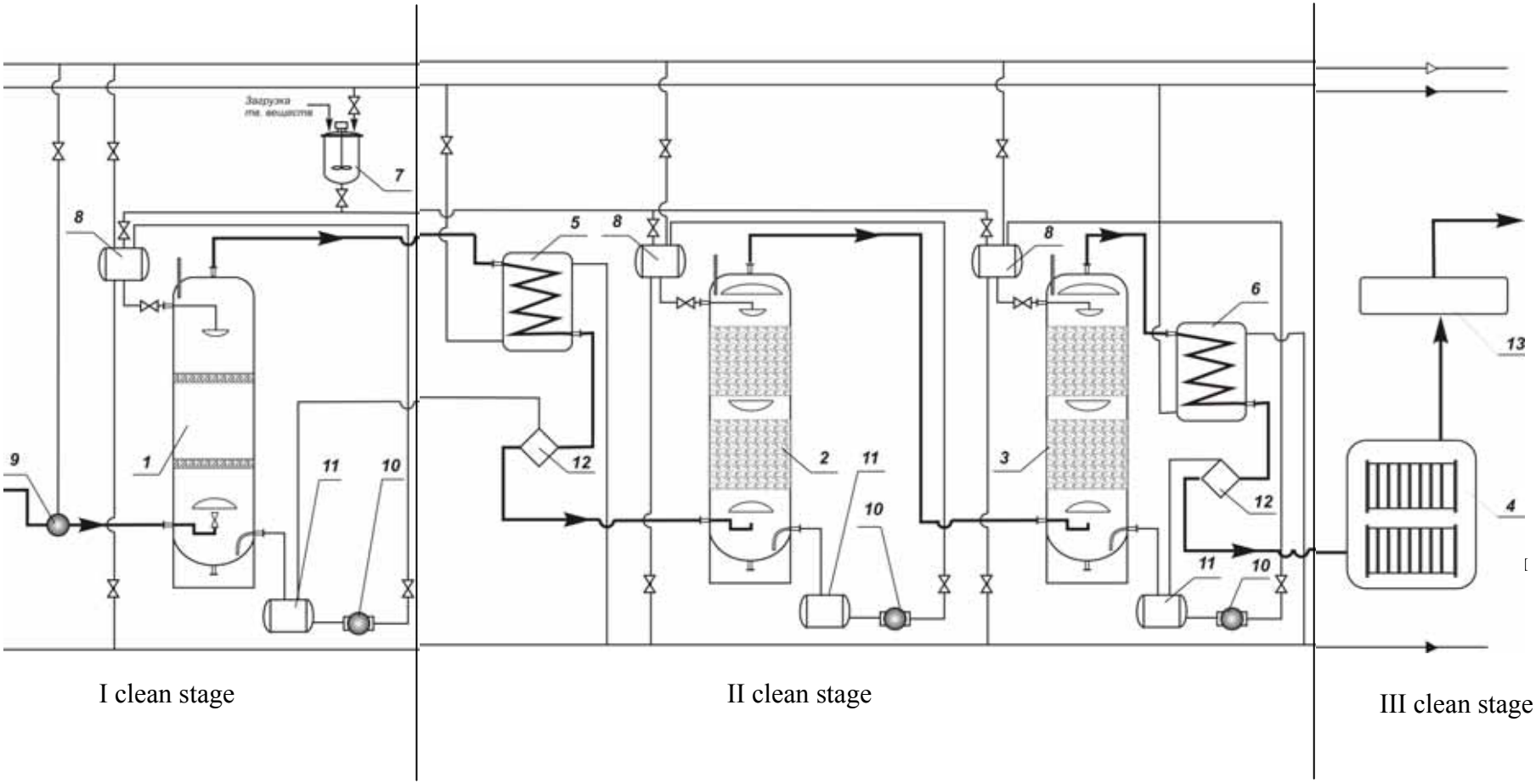

Figure 11.3.5 - Process flow diagram of gas treatment system

1 - Gas scrubber with tempering end gases; 2, 3- Absorber of end gases; 4 - Bag filter; 5,6 - immersed condenser;

7- Equipment for preparing solutions; 8 - Holding tank; 9 - Jet compressor; 10 - Impeller pump;

11 - Receiver tank; 12 – Condensate trap; 13 – Automated end gas interlocking device.

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Assembly of equipment off-gas cleaning system consists of a series of successive scrubbers and absorbers, which allows the purification of waste acid gases from products of incomplete thermal oxidation with an efficiency of not less than 98%. In addition, by further cooling of gas up to temperatures of about 20 0 C with simultaneous withdrawal of the condensate stream and sprays. In addition, the 3-step purification of exhaust gases provides the final purification of all the pollutants up to a level not higher than 0,5 MPC, including - of dioxin-like compounds with the maximum concentration at 0.1 ng/Nm3 of dioxin equivalents. To this end, the gas purification system includes two serially connected units: bag filter (4) and an automatic locker exhaust gases (13). By its very nature (Figure 11.3.6) automatic interlocking flue gas is a line of additional gas cleaning.

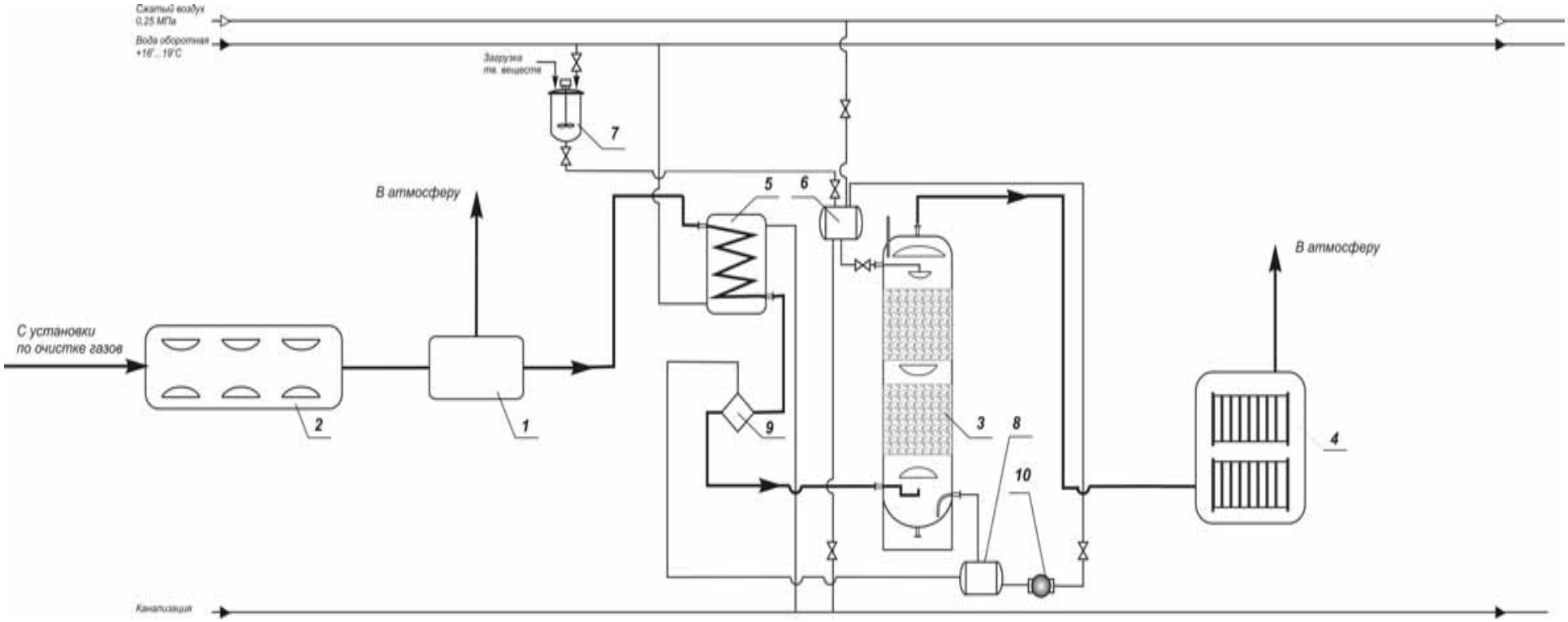


Figure 11.3.6 - Process flow diagram of automated end gas interlocking device

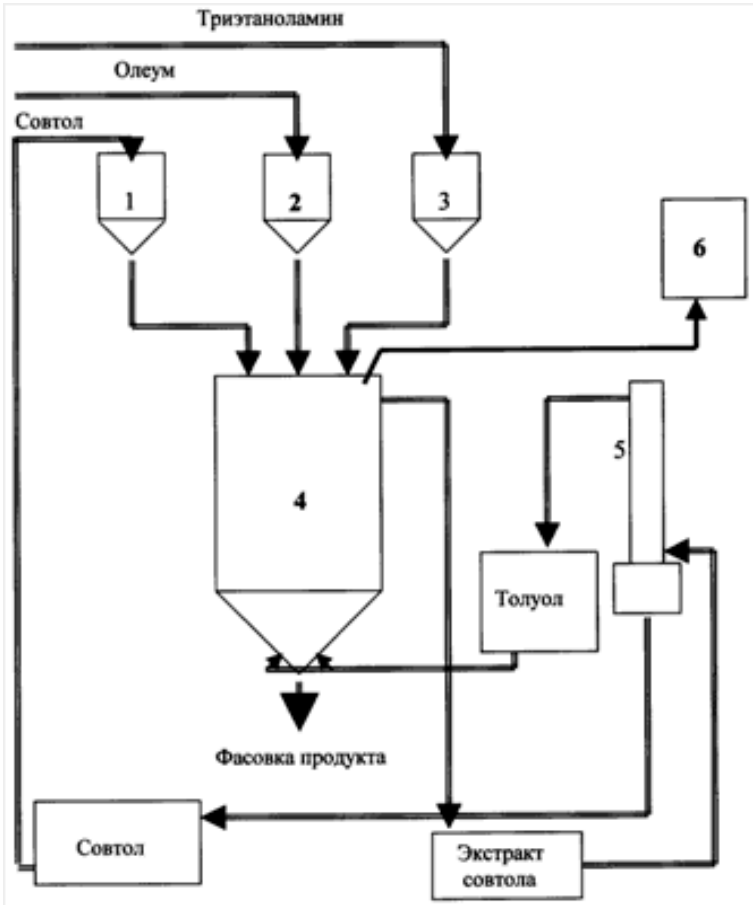
1 – End gas monitoring unit; 2 – Plasma optical chamber; 3 - Absorber of end gases;

4 – Tail filter; 5 - immersed condenser; 6 - Holding tank; 7 - Equipment for preparing solutions;

8 - Receiver tank; 9 - Condensate trap; 10 - Impeller pump

The composition of this line includes plasma-optical camera and monitoring unit off-gas with an actuating device switch thread. In normal operation of the plant gases through the unit for monitoring and flow-switching device is discharged into the atmosphere.
When issuing a unit signal for excess levels of incomplete combustion produces a signal to the actuator to switch the direction of flow and the additional stage of gas purification.
After the normalization process of gas purification in the absence of a signal from the monitoring unit flue gas by switching the flow to discharge into the atmosphere.
All the techno-economic and environmental performance of the disposal of persistent organic pollutants were confirmed in a laboratory setting using a full-scale specimens of PCB-containing wastes.

11.3.4.2 Stage of PCB-waste sulphonation with further neutraliztion by salt-forming agent.
Select the direction of the third stage of technology, as mentioned above, determined by the concentration of PCB-containing liquids. When the concentration of active ingredient of PCB for more than 90% used mobile installation, which uses technology oleum sulfonation followed by treatment with salt-forming agent (method sovtol patent RU 2341509 C1) [52].
The process involves sulfonation with oleum excess sovtol relatively oleum at a temperature of 100-180 ° C and subsequent neutralization of the salt-forming agents - triethanolamine.
Sulfonation reaction is carried out at a molar ratio sovtol: oleum of 1: (from 0,55 up to less than 0,6), after neutralization of the reaction mixture was extracted with a solvent free sovtol - tolueneom, whose amount is equal to 0,75% of the initial mass sovtol after then extracted with toluene sovtol regenerate, bottoms - sovtol return to the stage of sulfonation, and toluene on the stage of extraction.
Block diagram of sulfonation of PCB wastes, followed by neutralization salt-forming agent is shown in Figure 11.3.7.



1 – Tank with sovtol feeding jacket; 2 – Tank of oleum feeding; 3 – Tank with triethanolamine feeding jacket; 4 – kettle; 5 – pump; 6 – opposite cooler and gase cleaning unit.

Figure 11.3.7 – Process flow diagram of the PCB-wastes sulpanation and further neutralizing of salt-forming reactants.

Extraction of free sovtol are cyclically up to achieve a desired content of residual sovtol in the final product less than 0.1%, or continuously flowing toluene under pressure while stirring the reaction mixture through a layer from the bottom up, the extract sovtol in toluenee from the surface of the paste is removed. Technical result - Recycling polihlordifenilsoderzhaschih substances up to achieve a free, residual sovtol in the final product less than 0.1%.
Conventionally, process flow diagram disposal of PCB waste (Figure 5.3.7) can be divided into three units: reactor building (units 1-4), Department of pasta selection - triethanolamine salts of sulfonated sovtol PHDS-T (Florentine vessel and the pump 5) purification and separation gas (node 6).
To prevent the expansion of oleum moist air in the apparatus of the technological scheme (1 - 4) create an inert atmosphere by using nitrogen. The work of the reactor compartment is carried out in batch mode, and the separation and purification separation and purification of the reaction product gas is organized as a continuous process.
Appropriateness of the use of elements of the technological scheme for the installation of recycling sovtol the following reasons:

sovtol can be recycled;
recycling technology are identical on operations and the mode of detoxification of PCB-containing liquids;
construction vehicles and materials from which they are made, provide the necessary technological processes;
availability of treatment sites (waste gas, waste solvents, the reaction product);
minimization of qualified staff trained in working with highly toxic substances;
minimize the availability and use of special means of protection, indicating, and degassing coppertsinskogo control;
absence of special warehouses and storage facilities, service shops and services;
the possibility of converting the elements of the technological scheme of the installation for disposal of other toxic elements;
lack of transportation of the product to the mainland, and its application in economic activity at the site.

In addition to these causes is important factor in capital costs, which in the case of retrofitting existing technological schemes will be significantly lower than in the design and creation of any new plant for the elimination of PCB-containing liquids.

11.4 Conclusions and recommendations.

Summarizing all the above on the technological project of preservation of objects containing sovtol and other PCB-containing liquids should draw some conclusions and recommendations.

Firstly, taking into account the available experimental data on the performance of work, the most appropriate technology, the elimination of waste liquids and oils, containing PCB, is a set of interrelated stages, including the steps of: identifying, collecting liquid waste container and neutralize the liberated stage of immediate elimination (recycling) collected spent oils and technical liquids.

Second, the neutralization capacity equipment from the PCB, most effectively by way of neutralizing reagent.

As this method is most appropriate implementation technology with the use of methylene chloride vapor. Neutralization of the drums and other equipment from residual PCB useful to carry out reagent method, and spent activated carbon from the site clean exhaust gases disposed in the installation of high-temperature oxidation.

Thirdly, wood and other combustible waste must be sorted. Waste with high concentrations of especially dangerous pollutants such as PCB, are due for elimination in high temperature plants. The remaining unusable wood waste, grind and useful as a fuel or combustible material to burn a simple to install high-temperature combustion (incinerator) or to install "Fakel - 1M. Likewise it is recommended to deal with other combustible solid waste, including rubber and plastic products, paper and cardboard, paper and remnants of clothing and uniforms, etc. Exceptions should be made of polyvinyl chloride products, which are burning in the vast majority (not equipped with special systems flue gas) incinerators is unacceptable. This kind of waste must be burned in the installation of high-temperature incineration.

Fourthly, it was found that the basic technology of neutralization of hazardous organic pollutants such as PCB is high temperature oxidation (combustion) with afterburner systems and neutralization of waste gases.

The process of destroying hazardous wastes is most advisable to implement technology-based, providing for the use as a node in the thermal cracking of a rotary furnace and a plasma afterburner, as well as 3-stage flue gas cleaning systems on the basis of complex treatment technologies and automatic control.

Fifth, the preservation of elements of buildings, brick and wood, chemical control in the past for safety and are not intended to restore and use for its intended purpose, is not provided - these objects should be destroyed. Concrete and brick secondary materials should grind up to the size and gravel used for road bank filling in their accomplishment, as the rubble is in the manufacture of light weight concrete coatings storage, recreation, other sites etc.

Sixthly, the soil in field work on o.Alexandra Island is a mixture of various size fragments, mostly of basaltic origin, sand and very small amounts of organic residues. Therefore, oil pollution is not included in the structure of the soil, but remains in the form of spots and inclusions in various mineral residues.

Therefore, the preservation of industrial sites and storage sites containing sovtol and other PCB-containing liquids must be carried out chemical and mechanical methods that worked well in the Far North.

The chemical method is based on the transformation of toxic hydrocarbons into non-toxic compound or the curing of toxic substances in the form of a gel or solid. Drug use "Ekonaft (oxides of mineral sorbents) with a high sorption capacity for chemical decontamination and neutralization of toxic neftemasloothodov will allow them to adsorb uniformly to give a dry, persistent storage powdery substance consisting of tiny granules, which are microparticles neftemasloothodov enclosed in calcareous shell capsules, regularly spaced in the mass of the product. Method is recommended for cleaning contaminated soil on the ground only for technical purposes.

In the mechanical methods used to collect oil in the liquid (unbound form) is produced by the "mud" pump (sludge tank), allowing to collect any oil viscosity and mechanical impurities (eg, soil). It is recommended to use domestic vacuum-type setting - «VAU-1», «VAU -2» with a load capacity of 200-300 liters. If you can not collect toxic oil from the ground using a "collecting plants" must use the method of fixation (immobilization), a toxic agent (vitrification, cementation, melting the ground, encapsulation).

Grouting should be considered as part of technology-specific methods of decontamination and disposal of soil with a relatively low PCB content. In particular, it is actually possible to build on contaminated soil using cement building materials with biocidal properties.

12. PURCHASE AND TESTING OF NECESSARY TECHNOLOGICAL EQUIPMENT.

To carry out planned for 3 phase of the project works in season 2010. works in accordance with developed technological solutions were purchased the following equipment and materials:

- technological frame modular construction of two modules profuced by LLC "Severo-Vostok-Stroy";
- minitractor CRAFTSMAN tractor 28908;
- enhanced hydraulic press TM-22TPF with power of up to 26 t, produced by "Tochnaya Mekhanika" plant;
- 5 kW Diesel generating set TSS SDG6500E,
- 5 kW (one-phase) and 7kW (three-phase) gasoline generators "Vepr" with "HONDA" engine;
- Diesel transfer pumps Grundfos JP – 3 pcs.;
- GPS-navigator GARMIN Etrex Legend;
- carbon gas analyzer "GIAM – 315" (lease hold from State Institution "N.N. Zubov State Oceanographic Institute");
- 0,5 dm^3 sealed container with screw cap - 20 pcs;
- gasoline AI-92 – 1200 L in drums, Diesel fuel – 800 L in drums;
- 2 kW electrothermal fan and Diesel fan heater WITH electrical candle;
- tools: angle grinders, electric shears, reciprocating saw, hand screws, tool cases,
- household equipment and materials (sealant, timber for installation of equipment, pallets, plastic film, first aid kit, flashlights, etc.), clothing and food.The main part of equipment is a standard device and requires no special tests. To test the suitability tests were carried out enhanced hydraulic press TM-22TPF with power of up to 26 t, produced by "Tochnaya Mekhanika" plant (Appendix 3). As the compressible objects used thick (up to 1,5 mm), 200L drums, similar to those located on Alexandra Island. The tests were successfully made the press has shown ability as a whole compacting drums, and drums with remote bottoms

13. SELECTION OF INDUSTRIAL SITE AND INSTALLATION OF EQUIPMENT

13.1. Determination of boundaries drum storage facility and dump near the Severnaya Bay

In the framework of works on the third phase of the pilot project was carried out additional determination of boundaries drum storage facility and dump near the Severnaya Bay.

As a result of this work it was found that the property line store fuel and lubricant near the Severnaya Bay, as defined in the May expedition of 2010, generally carried out correctly, but does not include landfill drum adjacent to the warehouse, because the landfill, consisting, in mainly from the underlying drums were during the works (May 2010) covered with snow. More precise boundaries of the site (Figure 2.1.) Dumps these into account. The new boundaries of the site held the right bank of the creek, which connects Lake Pinegina with the Severnaya Bay, on the southern shore of the lake. Then the boundary passes through land in the general direction of south-west up to the watershed, further to the south up to the shore of the bay. The southern boundary runs along the bank of the Severnaya Bay. Turning points of the new border of the plot are given in Table 2.1. On visual estimates at this site is about 15 - 18 000 drums. Approximately 60% - 70% of these drums are empty, about 15% of total (TC, oil, working out, etc.), the remaining drums are filled with half or less. Right (east) of the selected site borders on the beach the Severnaya Bay and on the slopes of a landfill, mostly empty drums. On visual estimates there are about 1000 drums. Because this dump does not apply to the storage fuel and lubricant in the Severnaya Bay, it is not mapped.

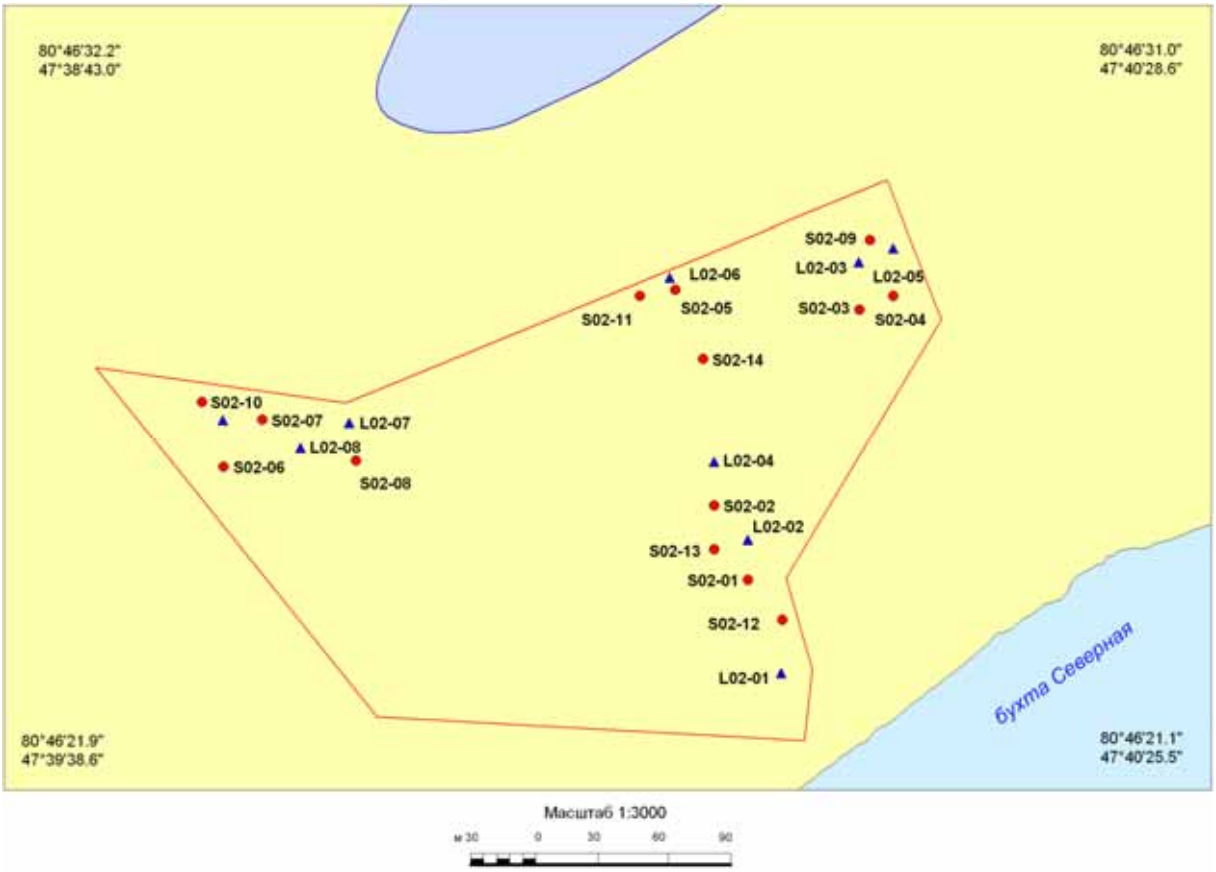


Figure 13.1. Schematic map of sampling points in the area of fuel and lubricant storage facility and свалки near the Severnaya Bay

Table 13.1 - Coordinates of points of new area boundaries

Number of Point	N	E	Notes
056	80°46'28,8"	47°40'53,0"	Sea coast, creek inflow
057	80°46'31,3"	47°40'39,8"	Creek bank
058	80°46'32,9"	47°40'33,3"	Lakeside, creek headwater
059	80°46'32,1"	47°40'18,4"	Lakeside
060	80°46'30,2"	47°39'48,3"	Slope near the lake (there are drums and logs)
061	80°46'32,0"	47°39'34,7"	Lakeside (cisterns)
062	80°46'32,2"	47°39'13,9"	Lakeside (upward turning point)
063	80°46'28,8"	47°39'08,5"	Slope (Accumulation of drums with TS 200 – 500 pcs
064	80°46'26,0"	47°38'56,6"	Watershed (plateau)
065	80°46'23,9"	47°38'53,7"	Upper clift near sea
066	80°46'22,0"	47°39'02,8"	Lower plateau near sea
067	80°46'20,4"	47°39'33,6"	Lower clift near sea
068	80°46'20,7"	47°39'50,0"	Sea coast
069	80°46'24,0"	47°40'17,2"	Sea coast (half-sunk tow is nearby)
070	80°46'26,3"	47°40'40,5"	Sea coast (small cape)

13.2. Selection of industrial site to place experimental processing line and installation of equipment

Choosing technological platform based on the fact as to ensure easy transportation of the drums, subject to compaction, convenience and environmental safety of the operations.
To select the technology platform in preparation for the expedition, 30 - 31 May, the chief curator of the expedition and flew to FJL on frontier post Nagurskoe to select sites for future work. Principles of site selection were the following requirements:

- compact (not further than 150 m) the location of empty and partially filled with a large (at least several thousand) the number of drums from the place of work
- presence of a flat area measuring 70 x 70 meters free of drum and other wastes for placement process modules and equipment, and safe helicopter landing
- possible entrance to the site by road during the summer (with no or little snow cover)

Given these requirements, as well as the results clarify the boundaries dump fuel and lubricant, we chose a site with the coordinates of the center 80 ° 46'25, 9"N 47 ° 39'56, 6"E Deployment plan for the technological platform in printed form at 1:1000 scale with the geodetic reference objects according to the Global Positioning System is presented in Figure 2.2 ..
Indicated the location of the site due to the following benefits:
- A relatively smooth surface ensures compliance with requirements for installation of manufacturing equipment;
- 130 meters to the northwest are whole empty tanks (tank) capacity of 25 cubic meters, which can be draining technical liquids from containers;
- In the immediate vicinity of the technological platform is accumulation of drums from the technical liquids, which greatly facilitates their transportation to the work site;
- Distance from the shoreline, as well as the prevailing wind direction during the experimental work to minimize possible negative effects on the environment;
- After the experimental work can be done to transport compacted drum for subsequent shipment to a specialized company

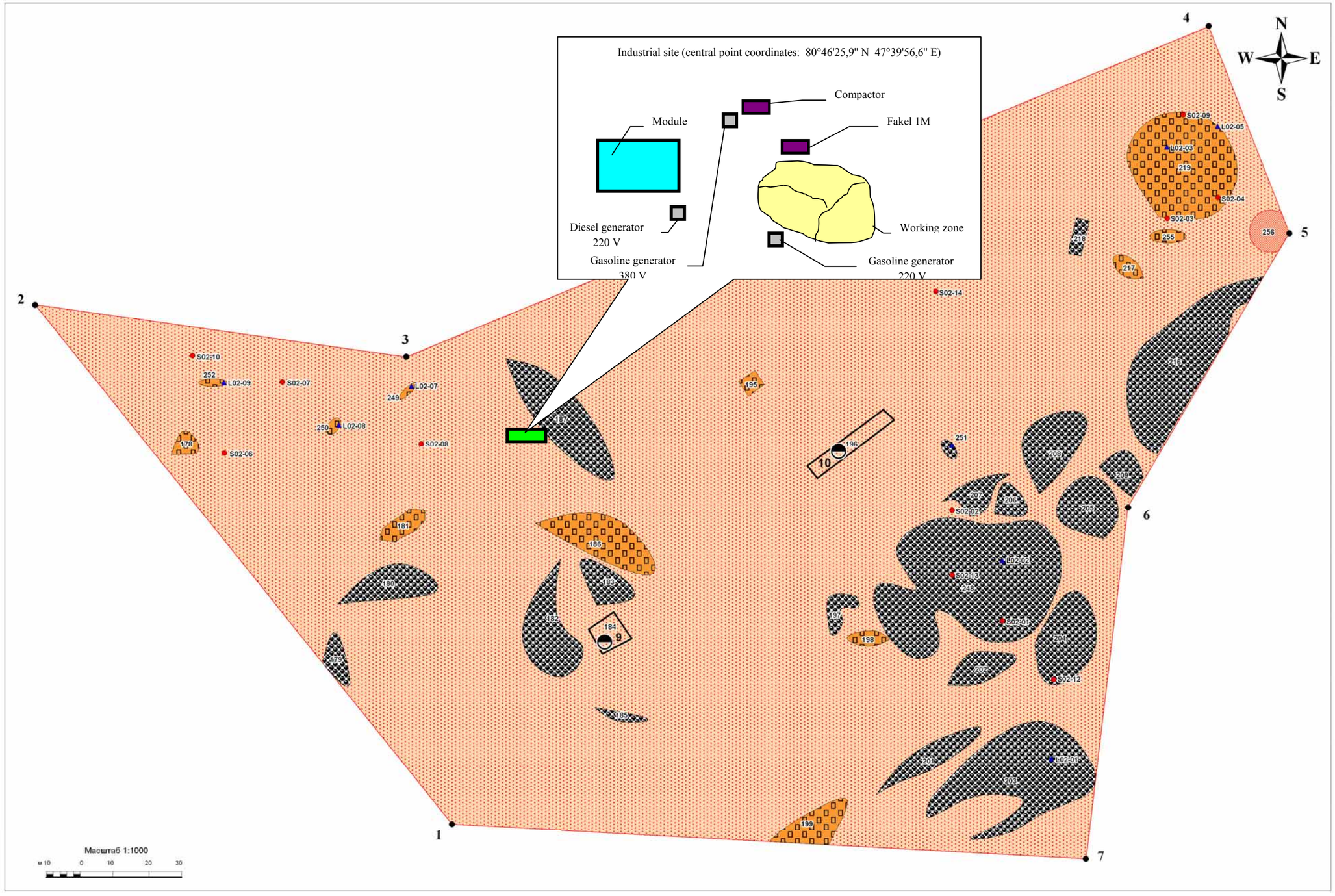


Figure13.2 Situational plan of of the area of fuel and lubricant storage facility near the Severnaya Bay

Table 13.2 Facility record in the area of fuel and lubricant storage facility near the Severnaya Bay

No.	Number of the site on situational plan	Name	Coordinates, WGS-84	
			Latitude	Longitude
1	178	Accumulation of drums with fuel and lubricant	80° 46' 26.0"	47° 38' 56.1"
2	181	Accumulation of drums with fuel and lubricant	80° 46' 25.1"	47° 39' 09.4"
3	179	Stack of 200-L drums	80° 46' 23.8"	47° 39' 05.0"
4	180	Stack of 200-L drums	80° 46' 24.6"	47° 39' 08.4"
5	187	Stack of 200-L drums	80° 46' 26.1"	47° 39' 19.5"
6	192	Fuel and lubricant cisterns	80° 46' 27.8"	47° 39' 29.1"
7	194	Accumulation of drums with fuel and lubricant	80° 46' 28.1"	47° 39' 36.6"
8	195-1	Accumulation of drums with fuel and lubricant	80° 46' 28.5"	47° 39' 39.5"
9	219	Accumulation of drums with fuel and lubricant	80° 46' 28.3"	47° 39' 58.6"
10	218	Fuel and lubricant cisterns	80° 46' 27.7"	47° 39' 52.4"
11	217	Accumulation of drums with fuel and lubricant	80° 46' 27.4"	47° 39' 55.3"
12	208	Stack of 200-L drums	80° 46' 25.6"	47° 39' 50.1"
13	209	Stack of 200-L drums	80° 46' 25.3"	47° 39' 54.3"
14	207	Stack of 200-L drums	80° 46' 25.2"	47° 39' 45.2"
15	195	Accumulation of drums with fuel and lubricant	80° 46' 26.4"	47° 39' 31.5"
16	196	Fuel and lubricant cisterns	80° 46' 25.7"	47° 39' 37.5"
17	186	Accumulation of drums with fuel and lubricant	80° 46' 24.9"	47° 39' 21.4"
18	184	Fuel and lubricant cisterns	80° 46' 24.0"	47° 39' 22.1"
19	185	Stack of 200-L drums	80° 46' 23.1"	47° 39' 22.5"
20	199	Accumulation of drums with fuel and lubricant	80° 46' 22.0"	47° 39' 33.8"
21	198	Accumulation of drums with fuel and lubricant	80° 46' 23.8"	47° 39' 38.2"
22	202	Stack of 200-L drums	80° 46' 23.4"	47° 39' 45.1"
23	204	Stack of 200-L drums	80° 46' 23.7"	47° 39' 50.0"
24	201	Stack of 200-L drums	80° 46' 22.5"	47° 39' 41.4"
25	216	Stack of 200-L drums	80° 46' 26.4"	47° 40' 00.0"
26	205	Stack of 200-L drums	80° 46' 25.0"	47° 39' 52.0"
27	206	Stack of 200-L drums	80° 46' 25.1"	47° 39' 47.4"
28	183	Stack of 200-L drums	80° 46' 24.5"	47° 39' 22.1"
29	197	Stack of 200-L drums	80° 46' 24.1"	47° 39' 36.0"
30	203	Stack of 200-L drums	80° 46' 22.3"	47° 39' 46.6"
31	182	Stack of 200-L drums	80° 46' 24.1"	47° 39' 18.5"
32	248	Stack of 200-L drums	80° 46' 24.2"	47° 39' 44.4"
33	249	Accumulation of 200-L drums	80° 46' 26.4"	47° 39' 10.7"
34	250	Accumulation of 200-L drums	80° 46' 26.1"	47° 39' 05.0"

35	251	Stack of 200-L drums	80° 46' 25.7"	47° 39' 43.5"
36	252	Accumulation of 200-L drums	80° 46' 26.6"	47° 38' 57.6"
37	253	Accumulation of wooden drums with semisolid lubricant	80° 46' 27.8"	47° 39' 37.7"
38	254	Accumulation of wooden drums with technical liquids	80° 46' 28.6"	47° 39' 43.8"
39	255	Accumulation of wooden drums with industrial waste	80° 46' 27.7"	47° 39' 57.7"
40	256	Iscrap metal dump	80° 46' 27.7"	47° 40' 04.2"
41	191	Fuel and lubricant cisterns	80° 46' 27.2"	47° 39' 24.9"

Before the start of the compacting drum supporting expeditionary group has prepared a working platform. Unloading RV "Mikhail Somov" performed by helicopter. On the bank of the auxiliary expedition group, and half of the main Expeditionary Unit. The second half of the main Expeditionary Unit helped the crew to deliver expeditionary cargo from the hold, and ship them to the helicopter. Total for unloading cargo forwarding has been involved eight flights helicopter. Unloading equipment from RV "Mikhail Somov" in the following manner:
First flight (08.08.) Went part of the expedition staff (4 persons) from the expedition cargo was taken only bars, mini tractor and a portion of the working tool (jack, crowbars).
Until the helicopter returned for the next installment of the expedition cargo (half a module), Expeditionary Group at the bank have been placed on the prepared jobsite six boards as the foundation.
The second flight was taken half a module. Expeditionary Force took one half-module and align it on the bars.
The third flight was taken to the second half of the working module. Expeditionary Force docked both halves on the uneven bars.
The fourth flight was taken to the press and installed on site.
The fifth, sixth and seventh flights brought three containers of equipment, food, generators, clothing, etc. on the frontier post Nagurskoe.
Eighth flight of the remainder of the expedition was brought to the frontier post Nagurskoe.
After collecting the entire Expeditionary Unit on the frontier post Nagurskoe and accommodation in a hostel, was produced by disassembling containers. All tools, kiln drum, gasoline and diesel oil have been stored on the ramp next to the hostel. Not the next day 09.08. the entire cargo was delivered to the jobsite. The whole day was spent in the assembly of the module, run the press and the kiln.
Placed on the technological platform equipment (see Figure 2.2.3) included the following items:
- Technological module placed in their heat generator for thawing drums, the frozen remains of fuel and lubricant or water, and equipment for opening and cleaning the drums;
- drum thermal decontmination instllation Fakel-1M;
- hydraulic press TM-22TPF produced by "Tochnaya Mekhanika";
- 220 v and 380 v gasolene and Diesel generators for energy consumers.
Technological equipment (press, Fakel-1M, gasolene generators) wasradially installed at a distance of 7,0 ... 11,0 m from the production module in an easterly direction. Such an arrangement of equipment allowed to form a working platform (Work area), which provides free

access to technological equipment and required the organization of material flows.
Assembly of the module consisted in equalizing gender approach both halves of the module on the possible minimum distance, the contraction of bolts (included in the module) of both halves and sealing (special foam sealant) roofs, walls and floors. To heat a working module in it were installed diesel stove with electric ignition and teploelektroventilyator 2 kW.
On-site installed two GASOLINE and a diesel generator. GASOLINE one with a supply voltage 380 was intended only to supply the press. Diesel generator with a supply voltage 220 was intended to supply working modules and tools (angular schlifmashiny, Scissors on metal reciprocating saw). Second GASOLINE (at 220) has also been designed to operate instrument and, in addition to the pumps for pumping fuel and lubricant.
When installing the press shot factory packaging, press tucked special oil press was connected to GASOLINE and carried out a trial run.
Installation of kiln was performed according to manufacturer 's instructions (installation of pipes, filling the engine to an air pump, installation of a tank firing).

Figure 13.3. View of the former frontier post Nagurskoe building, place of residence of the field crew.

Figure 13.4. General view of job site

Figure 13.5. Process module

Figure 13.6. Accumulation of drums for processing

Figure 13.7. Installation of “Fakel -1M”;

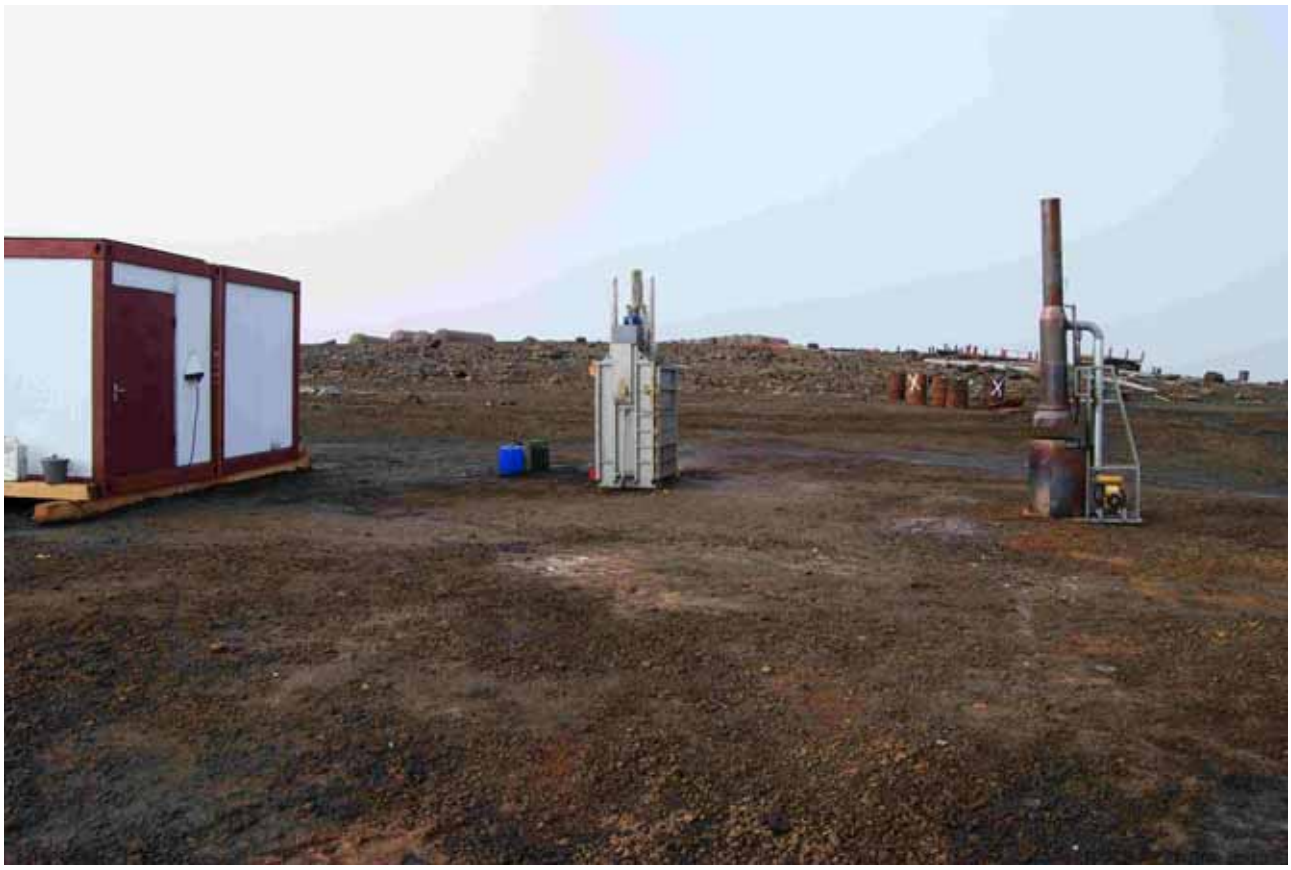


Figure 13.8. press TM-22TPF and “Fakel -1M” on job site..

14. EXPERIMENTAL TESTING OF MODERN TECHNOLOGIES OF DRUM DISPOSAL IN ARCTIC CONDITIONS WITH LARGE NUMBER OF DRUMS OF DIFFERENT PERIODS OF PRODUCTION AND CONTENT

Experiment disposal of drums was conducted according to the following schedule of work (Table 14.1)

Table 14.1 - Schedule of disposal of drums

No.	Scope of work	Dates
1	Selection of drum disposal method (compacting), development of the SoW.	February - March
2	Selection of suppliers of equipment, tools and materials.	April
3	Order and purchase of equipment, tools and material.	May - June
4	Delivery of equipment, tools and materials from Moscow to Arkhangelsk (Bakatitsa Port).	02.07. – 04.07. and 07.07. – 09.07.
5	Purchase of food stuff, small tools and materials in Arkhangelsk.	03.07. – 17.07.
6	Shipment of equipment, tools, materials and food stuff on the RV “Mikhail Somov”.	12.07. – 16.07.
7	Transportation by air of the main group (8 people) to Amderma to embark on-board the RV “Mikhail Somov”.	18.07.
8	Transportation of auxiliary expedition group (2 people) to frontier post Nagurskoe	30.07.
9	Waiting for RV “Mikhail Somov” by the main expedition group in Amderma.	18.07. – 28.07.
10	Preparation of the study site residence by auxiliary expedition group on Alexandra Island.	31.07. – 07.08.
11	Sailing of the main group onboard the “Mikhail Somov” from Amderma to Alexandra Island.	28.07. – 07.08.
12	Discharge of equipment, tools, materials and food stuff from the RV “Mikhail Somov”.	08.08.
13	Installation of the working module and equipment at the study site. Soil sampling at the study.	09.08.
14	Opening of the drums, draining fuel and lubricant residual in cisterns (if the drums are not empty), washing od drums with water (if the drums are not empty) removal of top covers, pressing and storing the drums. All work was done by full expedition staff.	10.08 – 12.08.
15	Air state control.	11.08.
16	Delivery of four expedition members to Arkhangelsk by charter flight due to a lack of seats onboard the RF Frontier Service aircraft	13.08.
15	Opening of the drums, draining fuel and lubricant residual in cisterns (if the drums are not empty), removal of top covers, pressing and	14.08. – 15.08. and 17.08. – 23.08.

	storing the drums. All work ws done by expedition staff of six people	
16	Air state control	14.08.
17	Air state control	15.08.
18	Dead time, storm.	16.08.
19	Air baseline sampling.	18.08.
20	Fuel and lubricant sampling (oil, spent oil, etc.) and soil sampling, labeling of accumulations of drums цшер fuel and lubricant (oil, spent oil, etc.), containing PCB or possibly containing PCB.	20.08.
21	Determination of new boundaries of the area of the Severnaya Bay. Sea water sampling.	21.08.
22	Fround sampling (soil).	23.08
23	Conservation of work module and equipment.	24.08.
24	Crossing from scratch house (old barrack) to a new building of frontier post Nagurskoe.	25.08.
25	Packing of pressed drums per 14 – 17 pcs.	26.08. – 29.08.
26	Shipment of pressed and packed drums on-board tanker Kotlas.	30.08.
27	Waiting for a charter flight Arkhangelsk, preparation of the report	31.08. – 01.09.
28	Charter flight - frontier post Nagurskoe – Murmansk – Arkhangelsk.	02.09.
29	Transportation of three members to Moscow.	03.09.
30	Receiving of pressed and packed drums from tanker Kotlas in Arkhangelsk and submission to LLC AMG for disposal	04.09. – 05.09.
31	Return of the head of expedition to Moscow.	06.09.
32	Preparation of the report.	07.09. – 30.09.

14.1. Experimental disposal of drums by burning up and compacting

For the experimental work on the of disposal of drums used the following scheme works:
1. Arbitrary collection of empty, partially filled with fuel and lubricant, and full fuel and lubricant drums, subject to recycling.
2. Autopsy (if available) tubes drums and clarify the amount of waste in a drum.
3. Express check drums of liquid waste in the presence of PCB in the fuel and lubricant quality by the reaction of organochlorine compounds with copperyu the color of the flame.
4. Collection drums containing ice, heat module.
5. Pumping of fuel and lubricant residues from drums in the tank.
6. Rinsing with water pumped out of drums.
7. Removal from the drum top cover with angle grinders (Bulgarian), reciprocating saws and electric scissors for metal.
8. Firing uncovered drums by installing Fakel-1M.
9. Pressing drums with hydraulic press TM-22TPF.
10. Warehousing and packing drums on the shore
11. Loading packed drums per vessel.

12. Filing drums for disposal in Arkhangelsk.

During the work, the drum with a mini-tractor with a cart going to the work area number 1 of technological platforms.
When collecting drum zone number 1 autopsy was performed tube drum in order to determine in her presence and the approximate volume of process fluid (probe).
In the case of presence in a vat of liquid phase fluid, it is using the truck passed into the zone number 2 for the rapid analysis of liquids for the presence of PCB compounds and the subsequent opening of the bottom, after emptying the drums, in the absence of such contaminants.
In the absence of the presence of PCB compounds in drums made the following operations:
- To be destroyed if a drum was filled with more than 2 / 3 of its volume, it is transported by truck to tanks where the process of pumping the liquid in the tank. Pumping of liquids carried out by a pump Grundof.
- If the discarded drum was filled in less than 2 / 3 of its volume, it passed into the zone number 3 for the burning of residues on the setting Fakel-1M, followed by compaction by the press.
In that case, if drum was solid phase (ice), it is by truck passed in the technological unit for pre-thawing. After thawing samples and proximate analysis was carried out in accordance with the method described above.
If the drum was empty and did not contain any technical liquids, was passed on to the compaction press.
Drums of detecting signs of PCB compounds were marked with white paint and dumped on a separate site.
Thus, the organization of technological process in the area number 3 is carried out in two streams:
stream of drums to be sent to the compaction (initial empty drums, empty drums after removing remnants of technical liquids and washing);

stream of drums to be sent to a preliminary roasting, followed by compaction (drums filled with less than 2 / 3 of the volume in the absence of their PCB waste).
After the implementation of the firing and compacting drums held their storage. Pressed for storage casks used two platforms. First on the shore of the bay, about 300 m ESE from the work site, the second in the 100 - 130 m to the ESE of the construction site. On the first landing compacted drums were filled with three wooden, metal containers that are convenient for the subsequent transport of the drums on the ship. A total of 130 containers were placed in drums.
The second site was chosen near the job site, on the horizontal section on the windward side. On this site had been stored 870 drums. These drums were tied with wire in bundles, 14 - 17 pieces for ease of onward transport.
In carrying out the work in the area number 1 it was found that of 1,238 drums of selected about 87 pieces have been partially filled with kerosene, about 78 pieces - diesel fuel. Drums containing the remains of gasoline, was not. Drums of gasoline were under a dry and empty, or full of holes and the remnants of only water.
The number of drums, containing PCB-waste, was 8 pieces.

The remaining drums were empty.
In the zone number 2 showdown bottom of the drums was carried out angle grinder (grinder).
Experimental work carried out by firing the drums with the use of mobile plant incineration of waste fuel and lubricant type Fakel-1M.
Connection setup performed with an electric motor was carried out after ground installation and trial inclusion.
Initially, the combustion chamber fell to the bottom position, then wore the top tips. After installing the nozzle combustion chamber rose to its highest position.
Is filled drums (initial load - no more than 5-10 kg), so as to avoid pollution at its outer surface.
Filled drum mounted on the frame and down the combustion chamber in the drum so that the lower part of the combustion chamber with the guide ribs is in the cask. Produced ignition, after ignition of residual fuel and lubricant included blower and sets minimum speed. After the installation mode (about three minutes), blower speed is set so as to maintain a minimum dymlenie and reaches its maximum fullness of burning waste. After graduating from burning waste plant will not turn off up to a complete cessation of the burning process and cool the hot parts (2 -3 minutes). The subsequent firing of drums in a similar way.
While working at the facility Fakel-1M meet the following safety requirements:
- Working personnel previously trained and briefed on safety requirements;
- The installation was properly grounded;
- Fixing the combustion chamber was carried out for each position of a safety stopper;
- Intermediate storage of subsequent destroyed 4.3 drums was carried out at least 20 meters from the plant;
- Subsequent loading of oil into the drum performed only after complete cooling drums.
After the elimination of waste burnt drum staged by pressing.
Pressing process was carried out as follows.
Prepared by compacting a drum (ie drum, which has been removed bedplate and received either install Fakel-1M, or an empty drum from the zone number 2) by two operators press mounted vertically in the working chamber of the press.
After installing the drum closed gate chamber and was pressing

Figure 14.1 Placement of burnt drums in the press

Upon completion of compaction gate opened, the resulting pancake was removed from the press by hand and passed on to the site packing of finished products. Carrying out works in accordance with the above regulations are presented in Figures 14.1 and 14.2

Figure 14.2 Pressing result according to procedures

In the course of experimental work on the compaction drum revealed the following.
Carrying out work on the regulations (Figures 8.2 and 8.3) showed that the volume of the resulting pancake is about (3 - 4) x 2.10 m3. Weight of the pancake is about 20 kg. Given the density of iron, it is easy to calculate that the amount of 20 kg of iron scrap metal should be about 2500 cm3, the same volume of the resulting pancake is about 35,000 cm3. Thus, when transportation will be transported more than 90% air.
In this regard, progress has been decided to change the routine operations on the pressing drum. Changes were primarily ways of setting up drums in the chamber press - it is installed horizontally with the open gate (Figures 3.3 and 3.4)

Figure 14.3 Placement of burnt drums in the press without closing gate

Figure 14.4 Pressing result with change of procedures

In the course of experimental work on compacting drums, it was determined that the amount received will be a pancake, approximately 2.5 X10-2 m3. In this case, transportation will be transported no more than 70% air.
In this regard, mass compaction drum carried out in accordance with the amended regulations. The work on the new regulations were developed additional guidance to ensure the safety and held a second press briefing of operators.
Under the new rules of the press to further developed the provisions of the security requirements included the following requirements:
- Operations for loading and unloading of drums in the cooking chamber by two operators;
- When pressing the operator should be at the side of the press;
- It is obligatory to use protective eyewear;
- Inclusion of the press is carried out only by a team of senior operator in the absence of persons in front of the press at a distance of not less than 7 m.

Figure 14.5. Progress of work on the site. In the foreground – minitractor CRAFTSMAN 28908

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Figure14.6. Drum broaching using reciprocating saw

Figure 14.7. Drum broaching using angle grinder

Figure14.8. Liquid transfer to a 25 t cistern

Figure 14.9. Fakel-1M in operation

Figure14.10. Drum compacting

Figure 14.11. Compacted drums on pellets

Figure 14.12. Compacted drums preparede for loading.

14.2 Experimental handling of waste containing heavy metals and PCB

In accordance with paragraph 3 of the third phase of the project within the framework of experimental works on the treatment of PCB wastes, the following activities:
- Rapid analysis of the contents of the drums on the presence of significant quantities of PCB in the progress of compaction drum, and as part of work on the treatment of PCB wastes;
- Labeling and sorting of drums of PCB waste was identified by the technical condition of the drums and the level of risk of inadvertent elimination:
with good body condition - moving on a platform that provides secure storage;
the poor condition of the body - left in place to avoid possible leaks.
Conduct a rapid analysis was carried out well-known simple method used to determine the organochlorine compounds. To this end, the drum of the surveyed were selected by means of a siphon 30 - 50 ml of fluid and she was transferred to the process module for analysis.
In the analysis of used copper wire and an alcohol burner. Before beginning the analysis of copper wire burned in the fire of the stove up to as long as the color of the flame disappears green. Then the wire was immersed in the liquid under study and entered into the flames. The presence of green color in the flame indicates the presence of organochlorine compounds in waste.
To confirm the results of a qualitative color reaction in addition to 2 ml of liquid was added dropwise 2-3 drops of 1% aqueous solution of silver nitrate. In the event that a white precipitate, which indicates the presence of organochlorine compounds, this sample was identified as "PCB waste", and the drum itself is labeled with white paint and, depending on the technical state or moved to a new site or left in place.
As part of the treatment of PCB wastes Severnaya Bay was mapped 12 sites (accumulations of drums and some drums), where the results of express-analysis there is a suspicion of the presence of PCB. These drums were marked with white paint. In the case of finding the drums of PCB among empty drums and their relatively large clusters, there was a common border of the cluster. Results of sampling are shown in Table 14.2

Table 14.2 – Coordinates of points of the fuel and lubricant and description of the sampling sites

No. of site	No. of points at the site	Coordinates of points at the site		Number of drums with PCB and others, description of sampling objects	Отбор проб	№ проб
		N	E			
1	035	80°46'22,1"	47°39'42,4"	Accumulation of empty drums 200 – 250 pcs, among which 3 – 5 drums with spent oil. Points are accumulation boundaries. Sampling was done in May, 2010. PCB was detected	-	
	036	80°46'22,4"	47°39'44,6"		-	
	037	80°46'22,7"	47°39'48,3"		+	01-037
	038	80°46'22,1"	47°39'52,3"		-	
	039	80°46'21,8"	47°39'46,6"		-	
2	040	80°46'23,9"	47°39'44,6"	Small accumulation of drums,	-	

				including 2 drums with spent oil. Sampling was done in May, 2010 . PCB was detected		
3	041	80°46'26,7"	47°39'51,8"	Small accumulation of drums, including 4 drums with oil and spent oil.	+	02-041
4	042	80°46'27,2"	47°39'55,7"	3 drums with spent oil – 2, solid oil – 1	+	03-042
5	043	80°46'26,9"	47°39'58,0"	Accumulation of 9 drums with solid oil	-	
6	044	80°46'28,1"	47°39'57,1"	Accumulation of из 30 – 50 drums with spent oil and empty drums for oil. Points are accumulation boundaries.	-	
	045	80°46'27,8"	47°39'56,9"		+	04-045
	046	80°46'27,7"	47°39'58,0"		-	
	047	80°46'27,7"	47°40'01,8"		-	
	048	80°46'28,1"	47°40'01,8"		-	
	049	80°46'28,1"	47°39'59,3"		-	
7	050	80°46'28,0"	47°39'38,3"	Two groups of wooden drums, spent oil and solid oil. Sampling was done in May, 2010 . PCB was detected	-	
8	051	80°46'26,7"	47°39'09,8"	3 drums with oil	-	
9	052	80°46'26,5"	47°39'05,4"	3 drums with spent oil	+	05-052
10	053	80°46'26,1"	47°38'59,6"	33 drums with spent oil, oil, empty	-	
11	054	80°46'24,1"	47°38'54,3"	5 drums with spent oil, very viscous	+	06-054
12	055	80°46'25,1"	47°39'11,2"	17 drums with spent oil	+	07-055

As part of the compacting drum was found that the number of drums, containing PCB-waste, was 8 pieces. Indicated drums were marked with white paint, and moved to temporary storage site approximately 100m south of the working platform.

Figure 14.13. Marking of PCB-containing drum with white paint.

Figure 14.14. Determination of the coordinates of a separate drum with PCB

Figure 14.15. Accumulation of drums, containing PCB, at the fuel and lubricant storage facility in the Severnaya Bay

Figure14.16. Wooden drums with PCB-containing spent oil and solid oil.

14.3 Control sampling on-site and conservation of equipment

For the control of pollution at the production site were performed the following work:
- sampling of fuel and lubricant (oil, mining and so on liquids) from the drums for the determination of PCB and other contaminants;
- Sampling of soil (soil), including at the site of disposal works drum, for the determination of PCB, petroleum hydrocarbons, heavy metals.
Samples of soil and soil were collected in accordance with GOST 17.4.3.01-83, 17.4.402-84 from the surface layer up to the depth of freezing.
Sampling for identification of oip products on the basis of laboratory control of physico-chemical characteristics on the technical specifications were made using a handheld sampler in accordance with GOST 2517-85.
Soil sampling (soil) for the pollutant produced in the last day of work. The soil sample on site to strip twice, first, up to start work, and the inclusion of the mechanisms. Results of sampling are shown in Table 3.3.

Table 14.3 – Coordinates soil sampling and description of sampling point sites

Number of Point	Number of Point по GPS	Coordinates of points at the site		Number of drums with PCB and others, description of sampling objects	No. of samples
		N	E		
01	016	80°46'26,2"	47°39'12,3"	Study site, a furnace of burning up drums is nearby. Sampling depth – down to 15cm	P01-016/1
02	054	80°46'24,1"	47°38'54,3"	Sample was collrcted at site 11, where 5 leaking drums with very viscous spent oil are located. . Sampling depth – down to 25cm	P02-054
03	046	80°46'27,7"	47°39'58,0"	Sample was collrcted at site 6, in the area of accumulation of 30 – 50 drums with spent oil and empty drums for oil. Sampling depth – down to 25cm	P03-046
04	016	80°46'26,2"	47°39'12,3"	Study site, a furnace of burning up drums is nearby. Sampling depth – down to 15cm	P04-016/2

In addition to sampling of fuel and lubricant, and the soil was taken in one sample of sea water near the mouth of the creek (coordinates: 80 ° 46'28, 8"N, 47 ° 40'53, 0"E) to determine the OU. At this point, visually there is a significant oil slick in the form of an iridescent film.
Water sample was taken in 5-liter plastic bottle with no air bubbles. Bottle was kept in refrigerator, then was transported to the laboratory State Enterprise SOI. The laboratory was carried out extraction of petroleum hydrocarbons by carbon tetrachloride from 1 liter of water. Then, the quantitative content of petroleum hydrocarbons was determined by IR spectrometry. The following result - the concentration of petroleum hydrocarbons is 3.8 mg / dm 3, which corresponds to 76 MPC.

Soil samples and fuel and lubricant, selected during the fieldwork, analyzed the content of pollutants in accordance with the procedures set forth in subsection 1.5 of this report.
Results from samples fuel and lubricant and soil are given in Tables 14.4 and 14.5

Table 14.4 - Результаты of analysis of fuel and lubricant samples for PCB content

No. of sample	Total 15 PCB в mg/kg
01-037	890,457
02-041	43,211
03-042	1374,803
04-045	1723,034
05-052	27,640
06-054	4782,651
07-055	583,361

Table 14.5 - Results of analysis of soil samples for PCB, heavy metals and petroleum hydrocarbons

No. of sample	Parameters to analyze (all in mg/kg)											
	PCB	Hg	Pb	Cd	Co	Ni	Cu	Zn	Mn	Cr	Sn	PH
P01-016/1	0,00642	0,019	98,23	0,384	24,07	18,65	154,72	109,40	165,31	10,03	53,74	7832,8
P02-054	0,12734	0,037	76,15	0,451	58,72	17,87	380,17	152,73	153,59	9,45	45,76	18371,2
P03-046	0,06395	0,028	129,34	0,329	34,98	21,43	269,85	128,07	184,13	8,97	48,39	12659,0
P04-016/2	0,00628	0,019	99,65	0,376	24,43	18,59	155,04	108,96	165,28	10,09	53,67	8659,4

Analysis of the results presented in Tables 14.4 and 14.5, shows that the new data, compared with the data presented in the report for the first stage, essentially, no. PCB content in oils, working out, and so liquids in the range of tens of mg / kg up to nearly five thousand mg / kg. Ie in the same range, which was documented in a report on the first stage. Analysis of three (the fourth test again) of soil samples on PCB, HM, and petroleum hydrocarbons also gave excellent data on the results of the first phase.
Increase in the level of contamination of the site during the work there (and could not happen), only one parameter - petroleum hydrocarbons. Other parameters remained unchanged.
During the field work was carried out as control of air pollution at the site of case studies.
In terms of air pollution to bring contaminants from the used process equipment, can two GASOLINE, diesel generators, mini-tractors and kiln drum.
Simultaneous operation and use of all generators and mini tractors on the total power corresponds to the work of a modern passenger subcompact car (engine capacity up to 1,3 l capacity up to 60 hp). Air pollution from the operation of these engines in such a way is virtually absent.
Consequently, a decisive influence on the state of air pollution can only kiln drum.
During the burning of residual fuel and lubricant held control of products of incomplete

combustion. The results of the analysis revealed the following:

- in a stream of exhaust gases of CO were no detected;
- CO2 content is located within 300 mg/m3;
- content of NO2 in the range 1.4 mg/m3;
- total hydrocarbon content does not exceed 170 mg/m3.

The analysis of scrapings from the charred drum surface showed that the total hydrocarbon content below the detection limit, ie completeness of processing is achieved.

Thus, the combustion of fuel and lubricant in a stream of air carbon monoxide (CO) is formed. As a result of burning fuel and lubricant produced carbon dioxide (CO2), as well as due to high temperature, nitrogen, air partially oxidized up to nitrogen dioxide (NO2). Also, when firing the drums from the oil, mining, etc. can form soot, as possibly incomplete combustion of hydrocarbons, used as the installation is not a burner with the flame, and installation, pumps air into the tank to burn fuel and lubricant.

At the disposal of the expedition had the amount of hydrocarbon gas analyzer "GIAM - 315" - a device for control of the hydrocarbons. Results for the control of the hydrocarbons are given in Table 14.6.

Table 14.6 – Data on content of of total mass concentrations of saturated hydrocarbons in air (in carbon equivalent)

Number of Point	N	E	Date	Time	Конц. mg/m^3	Note
017	80°46'24,8"	47°39'48,6"	11.08.10.	10:30	132	Point is located a bit west of the site and far from the sea. Sampling was done during work and 0.5 hour before or after work.
			11.08.10.	12:07	138	
			14.08.10.	10:12	140	
			14.08.10.	12:34	145	
			15.08.10.	13:57	162	
			15.08.10.	16:14	126	
018	80°46'23,0"	47°39'48,6"	11.08.10.	10:35	108	Point is located a bit west of the site and close to the sea. Sampling was done during work and 0.5 hour before or after work
			11.08.10.	12:13	135	
			14.08.10.	10:18	123	
			14.08.10.	12:40	140	
			15.08.10.	14:02	133	
			15.08.10.	16:19	114	
019	80°46'27,5"	47°40'23,0"	11.08.10.	10:47	125	Point is located a bit east of the site and close to the sea. Sampling was done during work and 0.5 hour before or after work
			11.08.10.	12:26	147	
			14.08.10.	10:31	134	
			14.08.10.	12:52	157	
			15.08.10.	14:15	136	
			15.08.10.	16:33	146	
020	80°46'29,0"	47°40'05,3"	11.08.10.	10:51	158	Point is located a bit east of the site and far from the sea. Sampling was done during work and 0.5 hour before or after work
			11.08.10.	12:33	160	
			14.08.10.	10:35	155	
			14.08.10.	12:57	160	
			15.08.10.	14:20	136	
			15.08.10.	16:37	146	
016	80°46'25,9"	47°39'56,6"	11.08.10.	10:59	158	Point is located at the study site

			11.08.10.	12:41	170	near the furnace for burning. Sampling was done during work and 0.5 hour before or after work
			14.08.10.	10:43	143	
			14.08.10.	13:06	160	
			15.08.10.	14:29	155	
			15.08.10.	16:45	185	
			20.08.10.	14:37	68	Point is located at over 4 km from the frontier post at the ocean coast. No accumulation of drums and other garbage have been found nearby.

Table 14.7 presents information on eather conditions during practical work.

Table 14.7 – Weather data

Date	Time	Wind direct.	Wind speed	Weather phenomena, visibility	Cloud amount, lower edge	Temperature	Pressure
07.08.10.	08:00	160°	3	V – 8	solid 200	+2	762
	17:00	160°	5 – 7	V – 5	solid 150	+2	764
08.08.10.	08:00	160°	8	V – 10	signif. 300	+2	762
	17:00	160°	8	V – 3	solid 100	+1	755
09.08.10.	08:00	150°	2	V – 4 , rain	solid 150	+1	752
	17:00	270°	10	V – 1,5	solid 100	-1	749
10.08.10.	08:00	180°	10 – 12	V – 3	solid 100	-1	749
	17:00	260°	7 – 10	V – 3	solid 100	-1	750
11.08.10.	08:00	250°	7 – 10	V – 10	solid 300	+1	754
	17:00	130°	7 – 10	V – 8 , snow	solid 200	0	752
12.08.10.	08:00	170°	5	V – 5	solid 200	+1	749
	17:00	340°	6 – 8	V – 10	solid 350	-2	753
13.08.10.	08:00	250°	3 – 5	V – 10	solid 300	-1	756
	17:00	140°	5 – 7	V – 10	signif. 300	-2	756
14.08.10.	08:00	080°	3	V – 10	solid 200	+2	755
	17:00	050°	5	V – 10	solid 180	0	752
15.08.10.	08:00	250°	3 – 5	V – 5	solid 100	+1	751
	17:00	050°	5 – 7	V – 5	solid 100	0	748
16.08.10.	08:00	020°	16 – 18	V – 5 , snow	solid 180	0	743
	17:00	020°	12 – 20	V – 2 , snow, snowstorm	solid 100	0	743
17.08.10.	08:00	070°	6 – 8	V – 10	signif. 200	+1	749
	17:00	040°	6 – 8	V – 5	solid 100	0	756
18.08.10.	08:00	030°	8 – 10	V – 5	solid 100	0	760
	17:00	350°	6 – 8	V – 8	solid 130	0	758
19.08.10.	08:00	070°	3 – 5	V – 1 fog	solid 80	0	759
	17:00	040°	6	V – 8	solid 150	-1	760
20.08.10.	08:00	010°	6 – 8	V – 5	solid 100	+1	759
	17:00	010°	3 – 5	V – 500 fog	solid 80	0	759
21.08.10.	08:00	350°	4 – 6	V – 500 fog	solid 90	0	759
	17:00	360°	4 – 6	V – 500 fog	solid 100	0	760

22.08.10.	08:00	020°	4 – 6	V – 1,5	solid 200	0	759
	17:00	340°	5	V –500 fog	solid 100	0	758
23.08.10.	08:00	020°	4 – 7	V – 5	solid 200	0	756
	17:00	неуст.	3 – 5	V – 5	solid 100	-3	755
24.08.10.	08:00	010°	5 – 7	V – 5	solid 180	0	753
	17:00	010°	9	V – 8	solid 150	-2	753
25.08.10.	08:00	360°	8	V – 5 , snow	solid 200	-1	751
	17:00	010°	7	V – 8	solid 100	-1	749

Analysis of data of tables 14.6 and 14.7 shows that taking into account the accuracy of the method for determining the total mass concentration of saturated hydrocarbons in the air (in terms of carbon) device "GIAM - 315» - (± 75 mg/m3), we can conclude that the work mechanisms and the kiln drum does not influence the content of saturated hydrocarbons in the air. Correlation between the content of saturated hydrocarbons with the weather conditions is also not observed. Level of pollution of the atmosphere saturated hydrocarbons determined by the total background, depending on the amount of fuel and lubricant, is located nearby, OU soil pollution, etc. The comparison of net area show air environment near the Severnaya Bay saturated hydrocarbons contaminated with man-made origin.
After completion of the work was carried out conservation of technological equipment.
Press. Drained hydraulic fluid (oil). All external parts of the hydraulic guide thoroughly lubricated with a thick layer (~ 2 - 3 mm) with petroleum jelly. The entire press was covered in several layers of plastic wrap and tied a rope. Press left on site due to lack of a crane.
Kiln drum was disassembled and diesel fuel from the tank to the fan burned up to the end. Dismantled furnace was stored in a working module.
As gasoline and diesel fuel resources (gas station) has been worked out completely. Open the rotating parts are lubricated with petroleum jelly. Generators are stored in a working module.
Gasoline from the mini tractors have merged completely, the engine outside smeared with petroleum jelly, oil in the engine crankcase and the gearbox has been reviewed (it was filled with snow lubricant). Tractor truck and stockpiled in a working module.
Pumps for fuel and lubricant, heat gun, small electrical, instrument stockpiled in a working module.
The amount of hydrocarbon gas analyzer, a camera, GPS-navigator taken to Moscow.
Work module is closed with a padlock, a window sewn plywood.

After doing all the work and the preservation of equipment was carried out export compacted drum. Packed in bundles, drums and drums of wood and metal containers on Aug. 30 were transferred to the on-board vehicle (owned frontier post Nagurskoe) and loaded manually on a pontoon vessel "Kotlas. Loading of the tanker carried the team. Hereinafter referred to drum was delivered in Arkhangelsk and presented for processing to a specialized company LLC "AMG".

15. RECOMMENDATIONS FOR USE AND ADAPTATION OF TECHNOLOGY TO OTS IMPLEMENTATION CONDITIONS

This section of the report presents recommendations on the adaptation of technology used directly to an object of research, as well as recommendations for use of variants of complex technology developed in the framework of the second phase work.

15.1. Development of recommendations for adaptation of technologies of drums disposal by burning up and compacting

As to the study object the process of drums with fuel and lubricant residuals recycling with fuel and lubricant residuals is advisable to organize as follows.

For work in arctic conditions is necessary to use three technological areas: the area of identification and grading, site waste recovery and neutralization, as well as plot compacting drums. In this case, it becomes possible elimination as empty drums or drums containing natural water (rain, melted snow water residues, etc.) and remnants of fuel and lubricant.

This approach to implement the technology cycle as a whole was tested during the experimental work on recycling drum.

Thus, identification of contaminants in the presence of PCB simple methods of rapid analysis provided the opportunity to secure the organization of pilot production. In general, sampling, analysis and subsequent organization of the material flow modeled the module MIS proposed as part of a complex technology. Thus, the site identification and sorting can be fully realized on the basis of technological methods used.

The site work for the media, organized in the course of experimental work, simulated execution of operations in the module MKB (see report on Phase 2 of this paper).

The results of these studies showed that the used process equipment allows you to organize the required workflows.

However, on the basis of these experimental works, it becomes necessary to adapt the technology in the following areas.

Organization of work appropriate to carry out on two sites: the site of mechanical deformation and packing area.

Conducted study show that in the area of mechanical deformation impractical to remove the cover drum as the most appropriate is the assignment of this feature on site identification and sorting.

In addition, the necessary revision of the press, providing the pressing drums on two tracks:
horizontal - for pre-crimping the side wall drum
vertical - to form a metal pancake.

Pressing process must be conducted in a semi-automatic mode: feed drum and extracting the metal pancake is done by hand, the direct compression - according to the instruction manual press.

Additionally it should be noted that the movement of compressed scrap metal to the site of packaging should be done with the mandatory use of forklifts.

Forming part extraction and waste neutralization advisable to perform as a technologically articulated units - process module and direct installation of thermal neutralization drums. In this

case, it becomes possible to utilize the heat which is formed by installing termoobezvrezhivaniya for heating drums for defrosting and preheating of the liquid phase for cleaning drums.
Analyzing the overall proposed recommendations on adapting technology compacting drums, it should be noted that their implementation, as well as the complete set of equipment will step to solve the problem of mass of disposal of drums. In this case, taking into account the environmental component of the process, a set of methods used to the greatest extent will be focused on specific conditions for the implementation of technology

15.2 Development of recommendations for handling of waste containing heavy metals and PCB

Drums for disposal, PCB containing waste and heavy metals at this stage it is expedient to carry out work on two sites: the site identification and sorting (similar project compacting drums) and the site of extraction and neutralization.
In general, during the experimental work was implemented technology developed under the second phase. However, as shown by the results of experimental work on the site of extraction and neutralization of waste is currently difficult to impose requirements on the chemical (thermal) processing of waste
In our opinion, in Arctic conditions, when destroyed by waste are located in areas without infrastructure and transport network, the most feasible is the development of devices, metering and mixing devices which provide physical and chemical processes to reduce waste hazard class. Thus, during the cyclic process conditions due to meteorological factors, the most beneficial is the introduction of reagents into the receiving vessel, used as an intermediate storage of liquids extracted.
In this case, during the recess of the technological cycle obtained by the reaction mass will "ripen", which will provide a possibility of its transport to the mainland for further elimination, or elimination (recycling) on the job site, but as a waste of the third or even fourth-class risk.

16. FINDINGS

Under the terms of the pilot project work helped to develop and test technology for removal of hazardous waste contaminated with high-latitude areas in the Arctic by the example of the experimental site, located in the decommissioned facility eksplutatatsii Russia's Defense Ministry on Alexandra Island.
All under terms of reference works were performed and proved to be essential for the overall project.
In the first phase of the pilot project was carried out works on the supplementary survey of contaminated areas of Alexandra Island of Franz Josef Land archipelago in order to select an experimental site for production work. Of the five sites examined in an experimental area to be treated was chosen area of fuel and lubricant storage facility in North Bay (south-eastern part of the surveyed area in the vicinity of the object 203-Stack of drums and the western part of the warehouse, in an area obektov178, 249, 250 , 252).
In the course of further investigation were found drums of motor oil and testing of a PCB content up to 2-4% mass of fluid. This confirms the assumption in 2007 about the presence on the island a permanent source of PCB pollution, and requires considerable care in the execution of work under a pilot project.
In the course of work under the second phase of the pilot project: the project was a technological mass disposal of drums containing especially hazardous substances, the safe elimination of contents, compacting drums and export them to the receiving station in Arkhangelsk. In accordance with the project has developed a program of works to implement the third phase of the pilot project and the procurement of necessary equipment, components, items and consumables.
At the request of the Contractor at the plant "Precision Engineering" the experience of work in 2007 was improved hydraulic press TM-22TPF with a force of up to 26t and successfully tested for compaction of thick-walled steel drums with a wall thickness up to 1,5 mm (Appendix 3).

Specialists field team have been trained in handling hazardous wastes in ANGO "Center of training and designing in the field of handling of industrial waste". In the production of field work they produced instructing technical personnel and field team osuschstvlyali supervision over their actions.
The third phase was carried out works on the experimental utilization of mass number of 200-L drums of fuel and lubricant under a different model year, uncontrolled stored in decommissioned military site on Alexandra Island archipelago of Franz Josef Land.
Work carried out in accordance with our program.
Purchased production equipment has been delivered to the archipelago on board the RV "Mikhail Somov" and assembled on site in the district of the stock fuel and lubricant in the Severnaya Bay using the Mi-8T.
In the course of the work was cleaned and skompaktirovano 1000 dvuhsotlitrovyh metal drums of different years of release, including 87 drums partially filled with kerosene, and 78 drums - diesel fuel.
The application of engineering schemes have proved effective enough. A small field team was in

a fairly short time away, drained, cleaned of residual fuel and lubricant, briquette using a hydraulic press and take on the great land of 1,000 drums a fuel and lubricant, thereby starting the practical work to clean up the archipelago.

Studies in Progress measurement of air pollution have shown that the application of high temperature burning residual fuel and lubricant from the drum-type plants Fakel-1M significant environmental pollution does not occur, and at the same time, the drum is completely cleared of residual fuel and lubricant.

Performed during the pilot project work has shown that the proposed modifications of the process, developed and implemented technology can really be a good basis for work on large-scale utilization of sources of pollution nefteuglerodnogo FJL and, subsequently, replicated to work on other areas of the high-Arctic.

Particular attention should be given fluids containing particularly hazardous substances such as PCB. It is doubtful that in the high-Arctic could be organized certified production for the elimination of PCB. The most acceptable solution from our perspective is the development and use of devices that reduce the hazard class of waste to be transported to the mainland for disposal.

17. LIST OF ACRONYMS

AAS A2 – Atomic Absorption Spectrophotometer (AAS) A-02

APC – Approximate Permissible Concentration

DBOFB – Dibromoctafluorobiphenyl

DDT – Dichlorodiphenyltrichloroethane

FJL – Franz Josef Land

GIS – Geographic Information System

IR – Infrared

MPC – Maximum Permissible Concentration

PAH – Polycyclic Aromatic Hydrocarbons

PC – Permissible Concentration

PCB – Polychlorinated Biphenyls

PND F – Federal Environmental Protection Normative Documents

POP – persistent organic pollutants

RD – Regulatory Documents

SanPiN – Sanitary Regulations and Standards

SPA – Scientific Production Association

TBA – tetrabutylammonium

TCN – naphthalene tetrachloride

VAH – Volatile Aromatic Hydrocarbons

VIP-2M – Vibration Hydrometer VIP-2M

Zc – Total Soil Pollution Index

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