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OAO Tiksi Sea Port

Summary Report

Services under Contract No.CS-NPA-Arctic-07/2008 dated 01 July 2008

Under Pilot Project

CLEANUP OF THE BAY OF TIKSI SEAFLOOR FROM SUNKEN LOGS AND WRECKS

Client: Executive Directorate of the National Pollution Abatement Facility

Executing Agency: OAO Tiksi Sea Port

Tiksi, 2009

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Title
CLEANUP OF THE BAY OF TIKSI SEAFLOOR FROM SUNKEN LOGS AND WRECKS

Basis
Contract No.CS-NPA-Arctic-07/2008 dated 01 July 2008

Client
Executive Directorate of the National Pollution Abatement Facility (ED NPAF), with its registered office at 117218, Moscow, 23 Krizhizhanovsky st. Building 5 (mailing address is 119991, Moscow, GSP-1, Leninsky Prospect, 19) INN 7710269619.

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INTRODUCTION

Tiksi is Yakutia's sea gate. It was established in 1934 as part of the Northern Sea Route Initiative. It is located on the coast of the Bay of Tiksi and Gulf of Bulunkan.

The Bay of Tiksi is of great fishery importance and is nursery grounds. Kirillin F.N., the famous Yakut ichthyologist, wrote in his work "Fish of the Bay of Tiksi", (1951, published by Tomsk State University (p. 155 - 162)), that the marine waters of the Bay of Tiksi are home to 14 species of fish fauna: sturgeon, herring, Siberian white salmon, whitefish, Arctic cisco, garganey, lake herring, Coregonus muksun, grayling, and smelt. There are also such fish as flounder, cod and Myoxocephalus quadricornis labradoricus. Of these 6 species - sturgeon, Siberian white salmon, whitefish, garganey, lake herring, Coregonus muksun - are valuable whitefish species of fish.

More than 70 years of man-induced impacts on the Bay of Tiksi resulted in many environmental problems, some of which have not been addressed so far.

Leftovers of the earlier round wood rafts, sunken logs, strapping steel wire and steel wire ropes and half-sunk skeletons of ships and wrecks that are still in the bay, decaying and rusting, emit harmful substances (organic, biogenic, etc.) and these lead to loss of all forms of plankton (bacteriaplankton, phytoplankton, zooplankton) and zoobenthos, and hence, to the potential loss of the principal nursery grounds of valuable northern species of fish populations.

The extraction of nutrients from sunken logs is a very long process. The loss of the existing ecosystem is the problem of regional importance, affecting the entire system of the World oceans and seas with all the ensuing consequences.

The 1990 study of sediment samples from the Bay of Tiksi showed that the sediment condition was such that it would not only result in the disturbance of biotic community, but would also lead to the extinction of some of its species.

Further contamination of the Bay of Tiksi waters may result in the disturbance of biotic community and in the extinction of some of its species. The loss of the feeding function of the largest fishery, which is also the nearest fishery to the Lena spawning grounds, will result in a reduction of stocks of the valuable species and the withdrawal of fish from the region. There is a direct threat to human life and health, particularly among the indigenous peoples of the North.

In accordance with the Terms of Reference (TOR) of the Project, the main purpose of this activity was to protect the biosphere in the marine and coastal zone of the Bay of Tiksi and the Gulf of Bulunkan from man-induced pollution.

Prior to commencement of the work, domestic and foreign experience in the cleanup of the water area was analyzed.

The analysis covered a number of federal and regional programs, technologies and methods aimed at improving the water environment:

- The Revival of the Volga Federal Program;
- The Krai Program "The Cleanup and Pollution Abatement Activities in the Marine Waters and at Ports of the Primorsky Krai";
- The Targeted Program "The Cleanup of Rivers and Canals in St. - Petersburg" and the scheme of bottom-cleaning operations;
- The Sectoral Program "the Cleanup of the Volga River from Sunken and Abandoned Craft";
- The cleanup of water bodies in Western Europe through the removal and flotation of contaminated soil at the specialized hydrocyclones, etc.;

The study of the sunken logs lifting experience helped arrive at the conclusion that clamshell dragging or trawling would be the most rational and effective method for the pilot project.

When cleaning up the bay water from wrecks, the Project reviewed several technological approaches to vessel lifting, transportation and cutting of sunken vessels. Each case could be addressed by applying a specific method or a combination of those techniques that are most consistent with the technical possibilities and conditions of vessel salvaging. The choice of technology was influenced by various factors. The most important of these included the integrity of the target and its location, as well as natural conditions that influenced accessibility of the targets and the way they could be approached.

The cleanup technology was defined by the Port Technical Council, which was guided by the data from the engineering and underwater survey and ensuing recommendations.

The main salvaging technologies included:

- Lifting and transportation while maintaining the integrity of the hull;
- Cutting in-situ and raising the hull parts;
- Dragging and gradually cutting the hull by its components.

The Project entered into an agreement with the Federal State Organization "The State Nature Reserve Ust' - Lensky" to conduct two studies: (i) "The Pre-Cleanup Assessment of the Pollution Levels of the Bay of Tiksi Water Area from Man-Induced Impacts"; and (ii) "Study, Analysis and Assessment of the Environmental Status of the Bay of Tiksi and the Gulf of Bulunkan as a Follow Up of the Cleanup Operations".

Work Stages

Stage 1

1.1. At the first stage, the Project analyzed the existing domestic and foreign experience in the water area cleanup operations, prepared the design documentation, and trained the Port technical personnel in the safety and quality of the cleanup operations in the bay.

The Project also carried out the depreservation and repair and restoration works on small vessels, lifting equipment and small tools and equipment such as:

- The RBT "Wave" Tower Boat - 1 unit;
- The Ganz Floating Crane - 1 unit;
- The Pontoon (seaborne barge) - 2 units;
- The SOKOL" Gantry Crane - 2 units;
- The Ganz Gantry Crane 2 units;
- The RDK Crawler Crane - 1 unit;
- A Forklift - 2 units;
- The Terberg Port tractor- 1 unit;
- A Roll-trailer - 5 units;
- The TT-4 Skidders - 1 unit;
- The Nissan Condor Truck with a handling crane "" - 1 unit;
- The Kubota Diesel generator welder;

The works were carried out with the following machines and handling equipment:

- The RDK-250 Crawler crane;
- A Nissan Forklift;
- The GANZ Gantry crane;

The machines options were based on the technology selected to cleanup the seafloor of the Bay of Tiksi from sunken logs and wrecks.

1.2. The Project assessed the pre-cleanup pollution levels in the Bay of Tiksi. Based on the Goodnight - Wheatley index and Woodywiss F. Biotic index, assessment of the pre-cleanup pollution levels in the Bay of Tiksi for water zooplankton and zoobenthos indicators showed that:

- The quality of waters in the Gulf of Bulunkan was **worse** than in the open waters of the Bay of Tiksi;
- The water saprobity class was defined as mezasaprobity;
- The water quality prior to the cleanup operations was determined as **moderately contaminated.**

Stage 2
From August 1 to October 2, 2008 (the navigation period) the seafloor of the Gulf of Bulunkan was dredged with a grappler installed on the floating crane to lift the sunken logs, load them onto a pontoon or seaborne barge, and transport the logs to the onshore offloading point. The barges were towed by the VOLNA RBT harbor pusher tug. On the shore, the logs were unloaded, graded and stacked.

From August 12 to 23, and September 1 to 11, 2008, the following wrecks were handled:

- IBE - 406 "(sea barge - platform);
- L – 1311 (dry cargo lighter);
- Murmanets (sea tug);
- Hero ASYAMOV (estuary launch);
- AUGA (cargo ship)

Concerning these wrecks, the Project carried out the following activities:

(a) It conducted underwater survey;
(b) It repaired damaged hulls of the sunken vessels by welding 5 watertight patches in order to lift them to the surface;
(c) The Port Technical Council defined and approved the methodology for lifting the wrecks:
    - The Wrecks "IBE - 406", "Hero ASYAMOV", the motor vessel "AUGA" would be lifted in one piece by setting them afloat and towing them to the repair or cutting site;
    - Sunk near the coast, the Murmanets sea tug and L – 1311 dry cargo lighter would be dragged along the seafloor with traction hoists and crawler cranes since the hulls were severely damaged.

Phase 3
From July 27 to August 11, 2009 (the navigation period) the seafloor of the Gulf of Bulunkan was dredged with a grappler installed on the floating crane to lift the sunken logs, load them onto a pontoon or seaborne barge, and transport the logs to the onshore offloading point. The barges were towed by the VOLNA RBT harbour pusher tug. On the shore, the logs were unloaded, graded and stockpiled.

The third phase activities, scheduled under the Contract for the winter period, were carried out in the 2009 navigation season due to the fact that the continuous snowstorm (December 2008 - January 2009) and rather warm – for this period - weather prevented the normal growth of ice in the Gulf of Bulunkan. To bear heavy machines (the RDC crawler crane in this case) the ice cover in the gulf should be sufficiently thick. Since it was not possible to take the trawler crane onto the ice and do the trawling in January-February 2009, the Project Directorate was consulted and this activity was shifted to the summer season of 2009.

Phase 4

Based on the results of the activities carried out at the key stages of the pilot project "Cleanup of the Bay of Tiksi Seafloor from Sunken Logs and Wrecks", Stage 4 conducted another study of the water quality in the Bay of Tiksi and the Gulf of Bulunkan. Following this, the Federal State Organization "The State Nature Reserve Ust' - Lensky" carried out a comparative analysis of the water contamination before and after the cleanup, as well as assessment of the environmental status of the bay waters.

From the "Study, Analysis and Assessment of the Environmental Status of the Waters in the Bay of Tiksi and the Gulf of BULUNKAN" Report one may conclude that the cleanup operations (removal of sunken logs and metal pieces such as chains, pieces of wire rope, and wire that were used when rafting timber to Tiksi in 1960 - 1985) had positive effects on the environmental status of the water area.

The Pre-Cleanup and Post-Cleanup Report data concerning the seafloor of the Gulf of BULUNKAN suggest that the amount of pollutants, in particular phenols, was reduced due the reduction in the amount of decaying wood, a source of phenols. The comparative analysis of the quantitative characteristics of zooplankton in 2008-2009 demonstrated a trend towards the changes in the values of density of the community and biomass after the clean-up operations on the seafloor of the Gulf of BULUNKAN. The density of communities in the sampling period of 2008 changed from 0.87 mg / l in October to 0.36 mg / l in August. Maximum values were observed on 10.08.2008. In 2009, following the cleanup of the seafloor from sunken logs, the change values were in the range from 0.89 mg / l in October to 0.86 mg / liter. On 25.08.2009, the study recorded the highest values of the community density. Against the background of the general increase in values, this indicates a relative improvement in the environmental status for the existence of benthic organisms.

Assessment of the Pre-cleanup and Post-Cleanup Water Pollution Levels in the Bay of Tiksi

Prior to the cleanup of the seafloor in the Gulf of Bulunkan (1 August 2008), the Project carried out hydrobiological monitoring of the zooplankton and zoobenthos in the waters of Bay of Tiksi and the Gulf of BULUNKAN. The water pollution levels (water quality based on hydrobiological indicators) was assessed through the use of the Goodnight - Wheatley index and Woodywiss F. Biotic index for water zooplankton and zoobenthos and the oligohet ratio to the overall number of zoobenthos organisms.

The long-term monitoring showed that the Gulf of BULUNKAN as compared to the Bay of Tiksi is characterized by lower values of abundance, biomass and species composition of zooplankton (9 species versus 20). This is due to man-induced pollution, low oxygen content in winter and high levels of sulphides and chlorides. The species composition of blue-green and green algae is poor, dominated by diotom species of algae. The scientific study of the samples of zooplankton and zoobenthos showed that water is of moderate contamination. The water saprobity class was defined as mezasaprobity, i.e. there is pollution.

Environmental degradation in the shallow waters of the Gulf of BULUNKAN as compared to the Bay of Tiksi was caused by a combination of various detrimental factors. The biggest contribution to the water pollution is phenols accumulating from rotting sunken logs and wood residues. According to the characteristics of the bottom-dwelling biocommunity obtained in the course of the monitoring period (August to October), all the Gulf samples showed that water (water purity grade) was moderately polluted, while water in the Bay of Tiksi was clean. In other words, the quality of water in the Gulf of BULUNKAN was worse than that of the open water area of the Bay.

The purpose of the cleanup operations was to determine the effect of the effort to trawl out the decaying timber over one season on the subsequent status of the Bay water. The 2008 seafloor trawling was launched in the shore area of the southeastern part of the Bay. In 2009, trawling continued in the shore area 400 m wide, in the western part of the Bay up to the Cape of Ice (the works were completed on 8 August 2009).

The seafloor cleanup operations (the diagram is attached) were carried out on an area of over 500,000 m2 (0.56 km2). All in all, 41 shifts produced 1,900 m3 of logs lifted from the seafloor. Most of it (over 80%) was rotten causing biological contamination of water, in particular with phenols. In addition, the cleanup operations lifted from the seafloor 22 tons of steel wire, wire ropes and chains taken onshore for recycling.

We may calculate accumulation of the decaying timber per square meter of the seafloor by dividing the amount of the timber lifted (1,900 m3) by the seafloor area cleaned up (560,000 m2) to receive 0.0034 m3/m2.

Thus, in order to lift 1 m3 of logs from the seafloor, it will be necessary to trawl about 300 m2 (294 m3 is an area of 20*15 m). This will require up to 100 cycles of the lift-lower movements of the clamshell. In other words, the seafloor cleanup operations were very intensive.

Upon the completion of the seafloor cleanup operation, the Project carried out another hydrobiological and hydrochemical analysis of the water samples taken at the site of the cleanup operation in the Gulf of Bulunkan, as well as at the site of

the operations in the Bay of Tiksi. It was found that organisms of the Arctic Ocean have a wide tolerance range. They are rather adaptive to quick changes in water temperature and mineral content. But the same organisms are very sensitive to man-induced pollution including sulfide and chlorine one.

Entering the coastal waters, pollutants have a repelling impact on the fish and change the conditions of fish feeding, wintering and spawning. They also contribute to high concentrations of fish shoals within a limited area, while keeping the fish from the fodder organisms making it difficult to use the feeding resources and reducing the biological productivity of the water body as a whole.

Direct poisoning of water with toxic pollutants and industrial waste, reduced aeration of the water body due to the freezing up or man-induced contamination with oxidizing organic pollutants, in particular caused by the accumulation of decaying vegetation, timber or development of toxic microorganisms may generate fish kill conditions or kill fish outright because of insufficient amount of oxygen in the water of the Gulf of Bulunkan. Water is especially oxygen-poor in winter and as ice cover grows thicker. The thicker the ice cap is the less the amount of water in the bay and this contributes to the concentration of organic, biogenic, and polluting substances in the bay. Also, the Lena River carries less fresh oxygen-rich water into the Bay of Tiksi and Gulf of Bulunkan. Decomposition and decaying of the sunken logs intensifies generation of pollutants and uptake of oxygen.

The comparative analysis against the 2008 initial studies showed improvement in the water quality demonstrated clearly by an overall increase in the density of communities and biomass of both zoobenthos and zooplankton. The analysis also found that following the cleanup the bay seafloor amount of pollutants, in particular phenols, was reduced due the reduction in the amount of decaying wood, a source of phenols. The analysis yielded the following conclusions on the results of the cleanup operations:

- There has been a relative improvement in the environmental conditions for the benthic organisms existence demonstrated by an increase in their overall count;

- Concentrations of pollutants tend to decrease with a distance from the Lena river delta branches to the sea and with the increasing depth of the sea. In some periods, volley discharges of pollutants in the river runoff at the mouth of the Lena River, including sulfides and chlorides, lead to fluctuations in the abundance and biomass of zooplankton and the mobile benthos. These data indicate that contaminated river water may have an impact on the coastal shallow part of the Laptev Sea shelf;

- The cleanup operations demonstrated the need in cleaning the seafloor from decaying timber, even if such an operation is small scale and carried out for a short period of time.

CONCLUSIONS

1. The trawling of the seafloor in the Gulf of Bulunkan and the good results of the water quality analysis following the cleanup operations indicate that the clamshell trawling and the respective machines and equipment were the right choice.

2. The preparatory work on the hulls of the wrecks was carried out in accordance with the terms of the Contract. The quality of work suggests that it would be possible to reduce time and complexity of work concerning the lifting and disposal of wrecks.

3. The improved water quality, having resulted in an overall increase in the density of communities and biomass of zoobenthos and zooplankton only after one season of the cleanup operations suggests that such work should also be continued at the second phase of the Contract.

4. The future expansion of the cleanup seafloor area (the second phase of the Contract will cover up to six hundred thousand square meters) towards the central part of the Gulf of Bulunkan, from the entrance gate to the former site of intensive raft accumulation site, would increase the amount of the decaying timber to be lifted from the seafloor due to the high rate of sunk timber accumulation in this area. The timber to be lifted may amount up to 2,500 – 3,000 cu. meters.

5. Future cleanup operations will lead to significant improvements in the environmental status of the Bay of Tiksi and the Gulf of BULUNKAN basins.

6. Providing local (indigenous) people with firewood from the logs so lifted will help conserve forests since there will be no need for felling forests. The local population used to gather timber for construction and firewood from rafts crashed by bad weather but after the termination of the timber rafting people started cutting down larger quantities of trees in the forest-tundra.

7. Intensive decaying of the sunken logs (more than eighty percent of the total amount of the sunken logs), particularly of the inner middle part of logs, leads to dangerous and toxic chemical contamination of water, which is clearly seen in the photographs. Chemical contamination of water has a negative impact on wintering, feeding and spawning of the most valuable

commercial species of the Arctic fish. This requires not only the continuation of cleanup operations, but their intensification.

8. Developed and tested at the port, the clamshell trawling method can be applied in other Arctic regions in shallow fisheries and "fattening" water bodies.

9. As a result of the preparatory work on the wrecks they are ready for lifting and recycling during the second phase of the Project.

ANNEX:

1. The layout of the seafloor of the Gulf of BULUNKAN: the operations for cleaning this area from the sunken logs and for cleaning up in the future: 1 page;

2. Photos of the seafloor dragging, carrying to the shore, unloading from the pontoon, grading and stacking of the seafloor (decaying) timber.


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