FINAL
17 AUGUST 2017

2016 Annual Operation and Maintenance Report

Operable Unit 1

CONTRACT NO. N44255-14-D-9011, TASK ORDER 27

Naval Base Kitsap

Keyport, Washington

Department of the Navy
Naval Facilities Engineering Command Northwest
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Silverdale, WA 98315-1101

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LTM/OM / TASK ORDER 27

FINAL
2016 ANNUAL OPERATION AND MAINTENANCE REPORT
OPERABLE UNIT 1

NAVAL BASE KITSAP KEYPORT
KEYPORT, WASHINGTON

AUGUST 17, 2017

SEALASKA ENVIRONMENTAL SERVICES, LLC
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ACRONYMS AND ABBREVIATIONS

ABS	Advanced Biological Solutions
COC	chemical of concern
cVOC	chlorinated volatile organic compound
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
FCR	Field Change Request
LTM	long-term monitoring
msl	mean sea level
NAVFAC	Naval Facilities Engineering Command
Navy	United States Navy
NBK	Naval Base Kitsap
O&M	operation and maintenance
OU	operable unit
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
QCP	Quality Control Plan
RG	remediation goal
ROD	Record of Decision
Sealaska	Sealaska Environmental Services, LLC
TCA	trichloroethane
TCE	trichloroethene
TO	task order
VOC	volatile organic compound

1. INTRODUCTION

This report summarizes the background, objectives, field activities, and tree and tide gate inspections and maintenance conducted May 2016 through November 2016 for the phytoremediation operation and maintenance (O&M) remedy at Operable Unit (OU) 1, Area 1, Naval Base Kitsap (NBK) Keyport, Washington. As originally defined in the Record of Decision (ROD) (Navy, EPA, and Ecology 1998), long-term monitoring (LTM) at OU 1 consists of three components: phytoremediation monitoring (Table 11-1 of the ROD); intrinsic bioremediation monitoring (Table 11-2 of the ROD); and site-wide (OU 1) risk and compliance monitoring (Table 11-3 of the ROD). The specific monitoring requirements of the LTM components have been defined and updated in project work plans developed by the United States Navy (Navy), revised by Sealaska Environmental Services, LLC (Sealaska), and reviewed and approved by the Washington State Department of Ecology (Ecology), the United States Environmental Protection Agency (EPA), and the Suquamish Tribe.
This annual O&M Report focuses specifically on the phytoremediation monitoring component and does not address site-wide risk and compliance monitoring or intrinsic bioremediation at OU 1. Results of risk and compliance monitoring and intrinsic bioremediation are discussed in the OU 1 Spring 2016 LTM Report (Sealaska 2016a).

The activities documented in this report were conducted in accordance with the Site Work Plan, which is part of the Project Work Plans (Sealaska 2012), the Quality Control Plan (QCP) (Sealaska 2014) for OU's 1 and 2, Field Change Request (FCR) TO 27 FCR-01 (Appendix A), and recommendations from the 2015 Keyport O&M Annual Report (Sealaska 2016b). The Site Work Plan includes the O&M Plan as an appendix which covers phytoremediation activities for OU 1. Other activities covered by this report include inspections and maintenance of the tide gate. The activities documented in this report were conducted under Navy Contract No. N44255-14-D-9011, Task Order (TO) 27, for Naval Facilities Engineering Command (NAVFAC) Northwest. As the prime contractor, Sealaska conducted the inspection and maintenance activities described herein and prepared this report.

1.1 SITE DESCRIPTION AND BACKGROUND

NBK Keyport occupies 340 acres (including tidelands) adjacent to the town of Keyport in Kitsap County, Washington, on a small peninsula in the central portion of Puget Sound. The peninsula is bordered by Dogfish Bay to the west and northwest, Liberty Bay to the north and northeast, and Port Orchard Bay to the east and southeast (Figure 1-1). The topography

of the base rises gently from the shoreline to an average elevation of 25 to 30 feet above mean sea level (msl), then rises steeply at the southeast corner of the base to approximately 130 feet above msl.

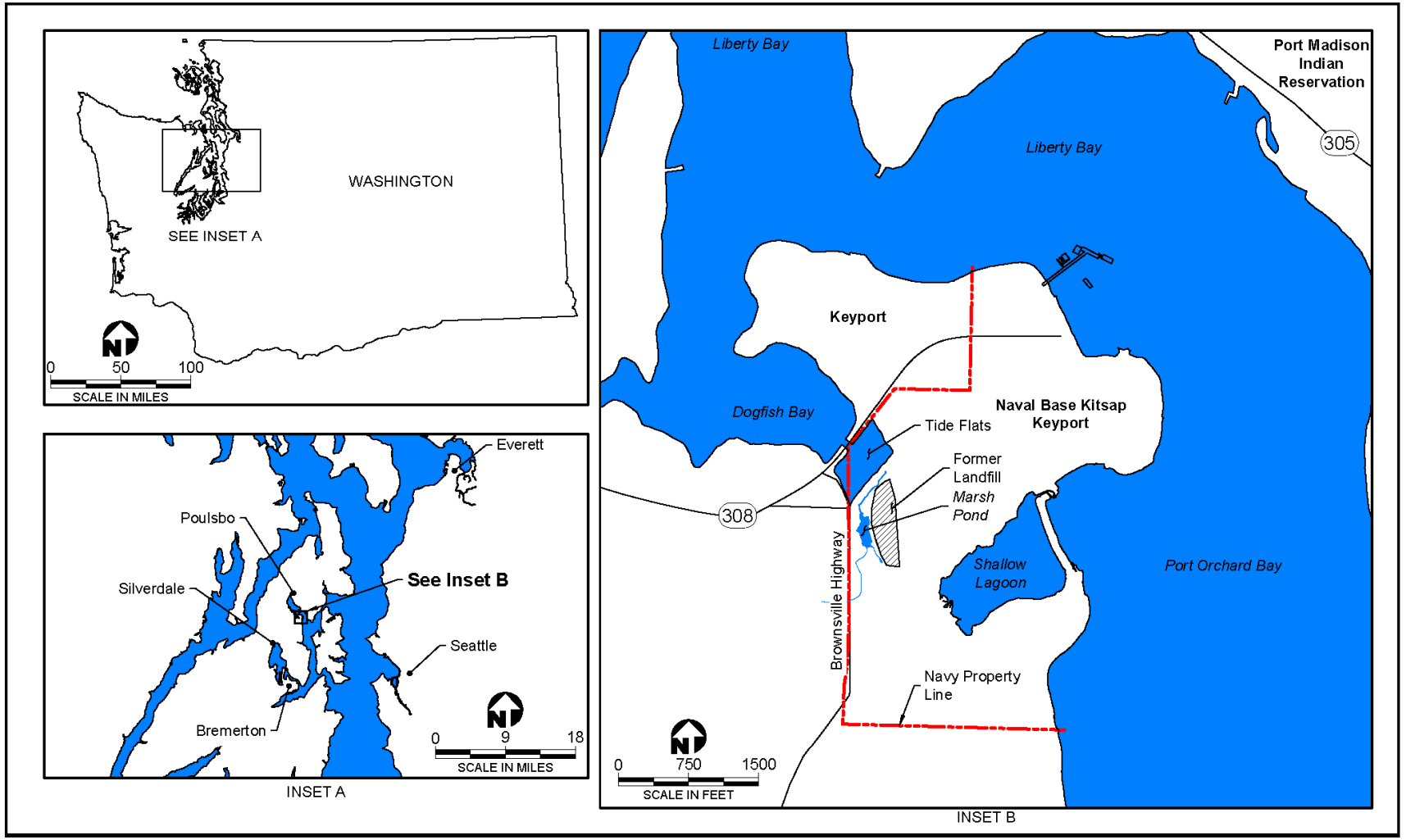
Other marine or brackish surface water bodies on and near the base include tide flats, a marsh, and a shallow lagoon.

The OU 1 portion of NBK Keyport consists of the former base landfill, approximately 9 acres in size, and the surrounding environment under land use controls (Figure 1-2). The landfill area was formerly marshland, and a portion of the marsh remains on the western and southern sides of the landfill. Fresh water bodies in the vicinity of the landfill include two creeks that flow into and through the marsh, discharging to the tide flats through a tide gate and culvert (Figure 1-3). The landfill was the primary disposal area for both domestic and industrial wastes generated by the base from the 1930s until use was discontinued in 1973. The landfill is unlined at the bottom and is covered with areas of grass, trees, concrete, and asphalt. Preliminary environmental site investigations and assessments conducted between 1984 and 1988 concluded that Area 1 (equivalent to the current OU 1) was suspected to have contamination with the potential for impacting the environment. A remedial investigation and a feasibility study were conducted at OU 1 between 1988 and 1993 followed by human health and ecological risk assessments (Navy 1993). A preferred remedial alternative was selected based on this data, but met with public disapproval.

To address public concerns, the Navy, Ecology, and EPA conducted further site investigations to supplement the remedial investigation, including five quarterly sampling events conducted between 1995 and September of 1996. The supplemental data obtained were used to evaluate the potential for risks from the following three exposure pathways identified at OU 1:

- Drinking water
- Seafood ingestion
- Ecological

The media with the potential to environmentally impact the pathways are groundwater and surface water, as well as sediment locations downgradient from OU 1. New data gathered from the site characterizations were discussed and evaluated in a summary data assessment report (Navy 1997) that supplemented the remedial investigation. A supplemental focused feasibility study was then conducted to evaluate several additional remedial options, from which a new preferred remedial alternative was selected and eventually accepted, based upon public comments. The OU 1 ROD was executed in September 1998.



U.S. NAVY	SEALASKA	Figure 1-1 NBK Keyport Vicinity Map	NBK Keyport, 2016 OU 1 Annual O&M Report

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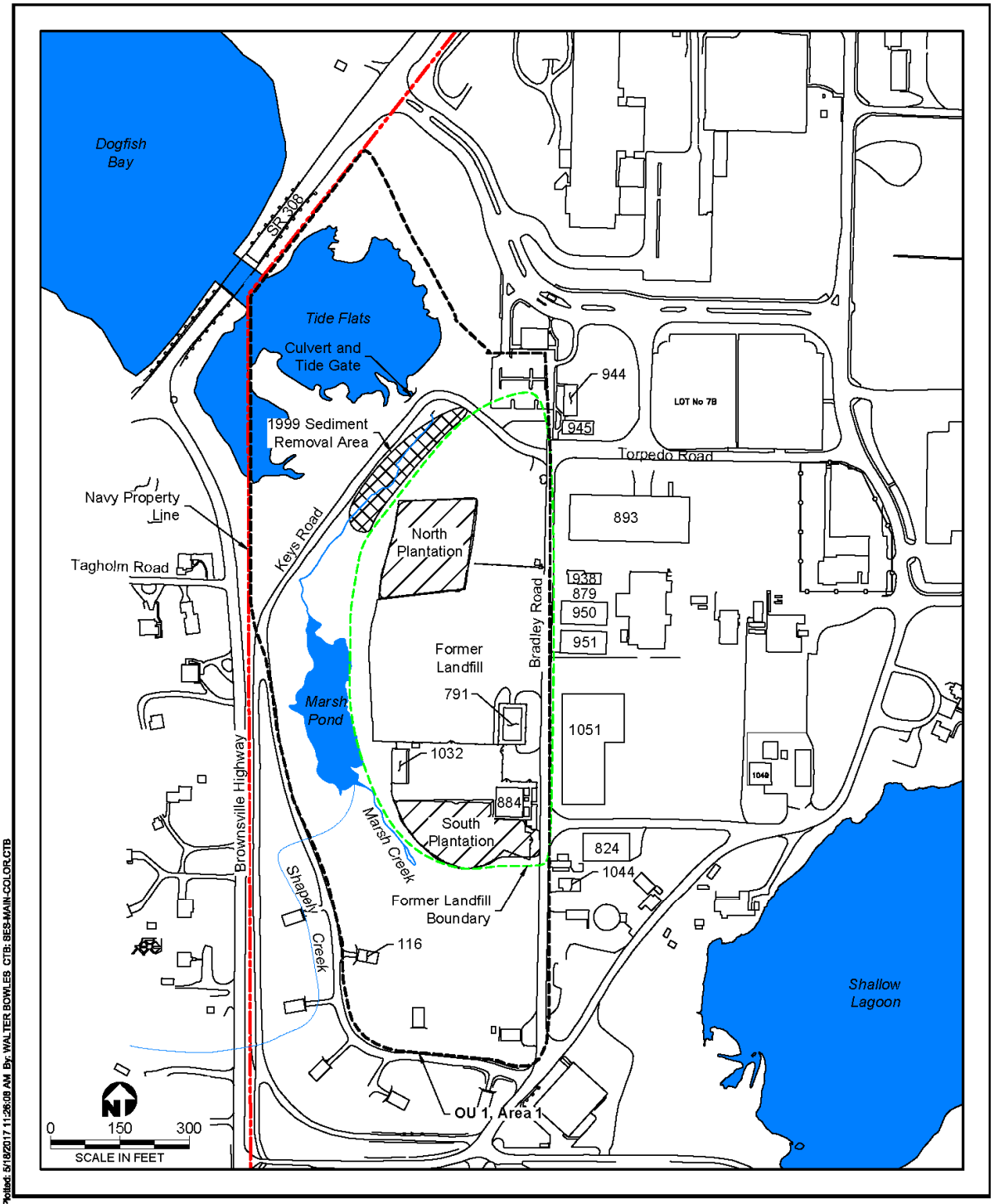
U.S. NAVY	SEALASKA	Figure 1-2 OU 1, Area 1 Site Location Map	NBK Keyport, 2016 OU 1 Annual O&M Report



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U.S. NAVY SEALASKA	Figure 1-3 Layout of OU 1, Area 1	NBK Keyport, 2016 OU 1 Annual O&M Report

The ROD lists two general classes of chemicals of concern (COCs) for the three potential exposure pathways at the former landfill: chlorinated volatile organic compounds (cVOCs) and polychlorinated biphenyls (PCBs). The cVOCs were identified as COCs based on the drinking water and seafood ingestion pathways, and PCBs were identified as COCs due to their potential to bioaccumulate and possibly impact the seafood ingestion pathway.

The cVOCs are present in the groundwater of the upper and intermediate aquifers beneath the former landfill, with contaminant concentrations in the upper aquifer exceeding those in the intermediate aquifer by an order of magnitude or more. Dense non-aqueous phase liquid was not found in the upper or intermediate aquifers. Groundwater from the southern portion of the landfill has historically contained the greatest concentrations of cVOCs, and some cVOCs have been detected in adjacent surface water in the marsh downgradient of the landfill. The detections of cVOCs in marsh water appear to be the result of ongoing groundwater discharge from the upper aquifer into the marsh. Hydrogeological conditions at the site direct groundwater from both the upper and intermediate aquifers into the adjacent surface waters and away from areas where drinking water wells exist.

To achieve the remedial action objectives, the preferred remedial actions specified in the OU 1 ROD included the following:

- Treat volatile organic compound (VOC) hotspots in the landfill by phytoremediation using poplar trees in concert with natural attenuation.
- Remove PCB contaminated sediments from around the seep area, which has the highest PCB concentrations.
- Upgrade the tide gate to protect the landfill from flooding and erosion during extreme tide events.
- Upgrade and maintain the landfill cover.
- Conduct long-term monitoring, including phytoremediation monitoring, intrinsic biodegradation monitoring, and risk and compliance monitoring.
- Take contingent actions for off-base domestic wells, if necessary.
- Implement institutional controls.

All remedy components have been implemented. The phytoremediation component of the remedy was implemented in 1999 by establishing two plantations of hybrid poplar trees (clonal line No. 15-029) designated as the “North Plantation” and the “South Plantation” (Figure 1-3). One phytoremediation plantation was established at each of the two cVOC source areas identified during remedial investigations of the landfill. The purpose of

phytoremediation at OU 1 is to remove and treat contaminated groundwater from the areas with the highest concentrations of cVOCs beneath the landfill. The goal is to help reduce the long-term potential for the migration of contaminants from the site. Further details of the site history and setting are available in the OU 1 ROD. Additional information regarding the implementation of phytoremediation is available in the Closure Report (Navy 1999).

The conclusions of the Third and Fourth Five-Year Reviews (Navy 2010, 2015) found that phytoremediation at the South Plantation has not been as effective as originally anticipated when it was evaluated during remedy selection. COC concentrations along the southern edge of the South Plantation remain elevated and the remediation goals (RGs) for trichloroethene (TCE) and vinyl chloride have been consistently exceeded at the adjacent surface water station MA12. Concern has arisen that the phytoremediation and natural attenuation remediation will extend beyond the current expectation of 30- to 50-years to achieve compliance with the RGs. Therefore, a supplemental subsurface investigation of the former landfill to study the feasibility of optimizing the remedial action at the South Plantation was conducted in the summer of 2016 in accordance with recommendations of the Fourth Five-Year Review (Navy 2015). Results, conclusions, and recommendations of that study were reported in detail under separate cover (Navy 2017), and will be incorporated, where appropriate, into the upcoming Spring 2017 LTM Report and the upcoming 2017 Annual O&M Report.

To further investigate hotspot areas in the landfill and the effectiveness of the plantations, a Phase I investigation was conducted in August 2014 that, in part, evaluated tree core samples from the plantations and included a geophysical survey of the landfill. It was determined from the geophysical survey that underground anomalies did not correlate with high contaminant concentrations in groundwater, indicating that the remaining buried sources are not primary sources (such as a drum containing pure product) (URS 2015). The tree core sampling results (URS 2015) also support that some degree of cVOC degradation by tree metabolism is occurring. The overall effectiveness of phytoremediation at the site is inconclusive; although contaminant concentrations appear to show a general decline over time, the contribution of phytoremediation processes to the noted decreases cannot be quantified. Significant migration of contaminants has not been observed, suggesting that phytoremediation may have aided in controlling contaminant migration offsite. As previously discussed, additional subsurface investigation of OU 1 was performed during the summer of 2016. Results, conclusions, and recommendations of that study will be incorporated, where appropriate, into the upcoming Spring 2017 LTM Report and the

upcoming 2017 Annual O&M Report. The conceptual site model will be reevaluated based on the data obtained from the supplemental investigation (Navy 2015).

The conclusions of the 2015 Annual O&M Report were that healthy trees are present at both the North and South Plantations with no pest infestations or signs of stress from lack of water (Sealaska 2016b). However, the leaf canopy appeared to be less full in 2014 and 2015. In response to this observation, recommendations from the 2015 O&M Annual Report (Sealaska 2016b) included increasing the number of inspections and maintenance events to pre-2011 levels, from four to eight events per year, to provide more frequent inspection and better maintenance of tree health. Additionally, it was recommended that granular high-nitrogen urea fertilizer should be applied to the ground surface at both plantations in 2016 to promote leaf growth and overall tree health.

Selected remedies for the site include installation and ongoing O&M of a tide gate and culvert. The remedy also included a limited sediment removal action which was conducted in 1998 along the marsh pond outlet channel when the new tide gate was installed (Figure 1-3). The new tide gate was field tested and commissioned in June 1999. The upgraded tide gate and associated culvert are intended to provide better control of tidal fluctuation in the marsh and to protect the landfill from extreme tidal events that could inundate the landfill and erode the embankment at the toe of the landfill, potentially exposing the landfill contents. The upgraded tide gate is automatic and self-regulating, controlled solely by tidal fluctuations acting on floats attached to the tide gate.

A Tidegate Inspection and Maintenance Plan was prepared and implemented in 2002 (Navy 2002), based on the manufacturer's O&M manual and site-specific conditions. The tide gate inspection and maintenance plan was integrated into the project work plan in 2004 and provides overall guidance for the long-term tide gate inspection and maintenance program. The plan also provides the approach and procedures for tide gate inspection, routine maintenance, minor repairs, and debris and sediment removal. The long-term tide gate inspection and maintenance program is detailed in the Site Work Plan (Sealaska 2012).

1.2 OBJECTIVES

The overall objective for remediation at OU 1 is to reduce cVOC concentrations in groundwater and surface water to meet the RGs established in the ROD for OU 1. Maintenance of the phytoremediation component of the OU 1 remedy and maintenance of the tide gate help to meet that overall objective and is the focus of this annual O&M Report. The objectives of the O&M program are:

- To maintain and document continued tree health, composed of tree maintenance and nurturing activities including periodic inspections, weed control, fertilizer application, and minor pruning; and
- Inspection and maintenance of the tide gate, along with monitoring to confirm that it is operating as intended.

1.3 PERFORMANCE CRITERIA

The criteria for evaluation of the effectiveness of phytoremediation at OU 1 are described in the O&M Plan for Phytoremediation at OU 1 (Sealaska 2012). Effectiveness is measured in terms of "weight of evidence" rather than specific numerical criteria. As specified in the ROD, evaluation of effectiveness is based on consideration of the following performance criteria:

- Tree health: Healthy trees suggest water uptake by the trees. When the trees take up water containing TCE-family compounds, those compounds are metabolized.
- Groundwater flow: Changes in groundwater flow patterns that reduce contaminant migration are expected seasonally as a result of groundwater uptake by the trees. Changes in the groundwater flow patterns will be evaluated using groundwater surface elevation contour maps generated from depth to water data collected from monitoring wells to judge the effectiveness of phytoremediation.
- Contaminant concentrations: A downward trend in concentrations of tetrachloroethene (PCE)-family and trichloroethane (TCA)-family compounds in groundwater and surface water samples collected from the immediate vicinity of the plantations will be considered as evidence of the positive effectiveness of phytoremediation.

This report presents the results of tree health and tide gate monitoring and maintenance. Details of groundwater flow and contaminant concentration data are presented in the Spring 2016 OU 1 LTM Report (Sealaska 2016a), and summarized herein.

2. TREE HEALTH MONITORING, MAINTENANCE, AND NURTURING

The following sections summarize tree health monitoring, maintenance, and nurturing.

2.1 SUMMARY OF TREE HEALTH INSPECTIONS

The phytoremediation plantations were inspected to monitor and maintain continued tree health throughout the 2016 growing and dormant seasons. Activities performed in February 2016 were reported in the previous annual report (Sealaska 2016b). Inspections and maintenance included in this report were conducted during May, June, July, August, September, and November 2016. Planned inspections and maintenance for January and February 2017 during the dormant winter season will be reported in the 2017 annual O&M report. Phytoremediation inspection and maintenance e-mail reports for each event are included in Appendix B. The number of inspections was increased from four to eight events per year which was a change to site work, as recommended by the 2015 Annual Report (Navy 2016) and promulgated under TO 27 FCR-01 (Appendix A).

In general, the trees were observed to be in good health during the inspections. Noted during the June 2016 inspection, two smaller trees appeared to be dead within the northwest portion of the North Plantation. Four other trees within the North Plantation had dead secondary leaders (i.e., tops). The exact causes of these occurrences is not known, however crowding from other trees may be a factor. Over the last year, no other trees were lost to disease or other causes. However, two large trees located near the eastern margin of the South Plantation that presented a potential fall hazard to humans and overhead utility wires were cut and removed by a NAVFAC Northwest subcontractor prior to the November 2016 inspection and maintenance event.

Most of the lower limbs of the trees have died over the past several years, and have either fallen from their trunks or have been pruned and removed during maintenance. The dead branches likely resulted from the blockage of direct sunlight beneath the canopy due to the relatively close spacing of the trees. However, as reported during 2015, one tree in the southwest portion of the North Plantation had healthy-appearing branches and leaves in the lower portion of the tree but branches that appeared dead (no leaves) on the upper two-thirds. Other trees exhibited some new branch and leaf growth on lower areas where branches had previously died.

During the growing season the leaves were green and healthy in appearance. As in the past, minor leaf curl and very minor blight fungus outbreaks were observed over the summer but were not considered to represent serious, long-term problems. It was estimated that less than 5% of the leaves were affected by blight, primarily along the plantation perimeter areas. While it is typical to observe blight during the growing season, the blight conditions observed this year appeared to be less severe than those observed in the past. Overall, the leafed canopy during the growing season appeared as dense as in 2014 and 2015; however, about 10 percent less dense than in 2013. During the growing season, most trees within interior areas of both plantations only had leaves remaining on the upper approximately 25 percent of their trunks. By the time of the August inspection, trees within the North Plantation, primarily along the eastern and northern margins and within interior areas of the plantation, exhibited loss of approximately 80 percent or more of their leaves. In the fall of 2016, the leaf abscission prior to August in the North Plantation occurred unusually early compared to the South Plantation. Additionally, the 2016 North Plantation leaf abscission occurred earlier in the season than that observed in previous years at both plantations.

Much warmer temperatures and drier conditions during the summers of 2014 and 2015 did not result in similar early leaf abscission during the late summers of those years, and no early leaf abscission was observed in the South Plantation in August 2016; therefore, stress from lack of water does not appear to be the cause. In addition, observations of other deciduous trees in the Puget Sound area suggested that fall seasonal tree conditions started earlier than in past years, as evidenced by apples ripening earlier and falling from trees by late August rather than the usual timing for this occurrence of late September. By the November inspection, the trees had dropped all but approximately 10 percent of their leaves, which was normal. No pest infestations were observed, with the exception of minor occurrence of tent caterpillar nests up to approximately 6-inches long at the ends of less than 1 percent of the branches. Damage to foliage from tent caterpillars during 2016 was very minimal.

Vertical cracks have occurred in bark on the lower areas of many of the tree trunks over approximately the past 4 years. The cracks, which are likely the result of relatively rapid temperature changes from warm to cold during the fall and winter seasons, do not appear to be adversely affecting the overall health of the trees. No evidence of insects was observed within or near the bark cracks.

During 2015, it was observed that 15 tree trunks in the South Plantation had shallow (bark depth) BB-sized holes that were made in horizontal rows. The holes were believed to have been made by Sapsuckers (woodpeckers). No new sapsucker holes were observed during

2016. The holes do not currently appear to be adversely affecting the health of the trees. Ongoing observation of this condition as possible entry points for harmful insects or disease has not indicated any evidence of the presence of, or damage from, insects or disease.

As noted during inspections in past years, standing water occurred occasionally immediately after periods of heavy precipitation at the northwest and northeast margins of the North Plantation and along the eastern fence and gate of the South Plantation during this reporting period. This standing-water condition has been observed at these locations during past fall and winter inspections when precipitation rates and volumes seasonally increase.

2.2 FERTILIZATION

Fertilizer application was conducted during each growing season through 2010 to help sustain tree growth and health. It was discontinued in 2011 at the request of the Navy. Granular urea fertilizer (high nitrogen [46%]) ground-surface application was conducted in both plantations during the early growing season (May and June) of 2016. A broadcast spreader was used to evenly apply 150 pounds to the North Plantation and 125 pounds to the South Plantation during each event. Following fertilizer application during the June event, because dry conditions were expected for several weeks or more, both plantation surfaces were watered with a hose connected to the NBK Keyport domestic water supply system. Application of water was conducted to dissolve the granulated urea into solution, thereby increasing the potential for the nitrogen to be adsorbed into the soil and taken up by tree roots.

During August, September, and October 2016, Advanced Biological Solutions (ABS) root and tree health enhancer was applied to the ground surface at the base of a single tree in the North Plantation designated as TC-10. TC-10 is the northernmost tree in the third row east of the northwest corner of the plantation, and is located approximately 25 feet upgradient from groundwater monitoring well MW1-02. In accordance with recommendations of the manufacturer, the ABS liquid was mixed at the ratio of 1 gallon ABS with 50 gallons of Keyport drinking (tap) water (i.e., a 2-percent ABS-water solution) and applied directly to the ground surface at the base of tree TC-10. A total of 250 gallons of 2-percent ABS-water solution was applied to the base of tree TC-10 over the course of the three events. It is hoped that the limited application of ABS solution will result in significant improvement to the overall health of tree TC-10, thereby improving its effectiveness in reducing cVOCs in groundwater. Evaluation of the effectiveness of the ABS application in improving the health of tree TC-10, and its effect on enhancing biodegradation of cVOCs in groundwater at well MW1-02, will be made through observations during inspections conducted throughout the

spring, summer, and fall of 2017 and the following spring 2017 groundwater sampling. Recommendations with respect to further application of ABS at tree TC-10 and/or other appropriate areas of OU 1 will be based upon those results.

2.3 PEST CONTROL

As previously discussed, minor occurrences of tent caterpillar "tents" up to approximately 6-inches long at the ends of less than 1 percent of the branches were observed in June 2016. Damage to foliage from tent caterpillars during 2016 was very minimal. Major infestations of wasp nests and caterpillar "tents" were last observed in 2006. The grounds maintenance contractor, Peninsula Services, applied a systemic pesticide in March 2010 and no significant caterpillar or other insect damage has been observed during inspections conducted since that time.

As previously discussed, holes in bark from Sapsucker activity were present on 15 trees in the South Plantation, however the holes do not appear to be adversely affecting the trees. No new Sapsucker holes in tree bark were observed during 2016. Therefore, no action with respect to Sapsucker activity is currently warranted.

2.4 IRRIGATION

No irrigation was conducted during the 2016 growing season. Irrigation was discontinued in July 2013 in an effort to maximize uptake of shallow groundwater by the trees. Temperatures were approximately normal and precipitation (volume and frequency) was above normal during the winter and spring months, below normal at the site during the summer months, and approximately normal during the fall months in 2016, when compared to typical temperatures and precipitation levels for the Keyport vicinity. The trees did not exhibit visual evidence of stress from lack of water, however two smaller trees within the northwest portion of the North Plantation died prior to spring 2016. As previously discussed, their deaths are not attributed to lack of water, but rather to crowding (i.e., shaded from sunlight by larger adjacent trees).

2.5 WEED CONTROL

During the six maintenance events, grasses and weeds were physically cut down or pulled throughout the plantations from May through November 2016. Hand-pulling techniques, gas-powered engine string trimmers, scythes, and hand-tool loppers were used to cut and remove grasses and weeds. The majority of the weeds removed consisted of blackberries, ivy, and holly. Some Scotch broom (mostly in plantation perimeter areas), morning glory,

laurel, maple trees, alder trees, and evergreen trees were observed in or adjacent to one or both plantations, primarily during the spring and summer months. The weeds and trees were pulled by their roots or cut, and then disposed of in the on-site Building 824 dumpster assigned to Sealaska for disposal of weeds.

In an effort to prevent encroachment of weeds and other undesirable plants and trees, as well as to maintain pathways, an approximately 5-foot wide swath of vegetation immediately surrounding the perimeter of the plantation fences was cut back.

2.6 THINNING AND PRUNING

No thinning was conducted during the May to November 2016 maintenance events. Minor pruning to remove dead limbs from the lower portions of the tree trunks was conducted in June and August 2015. A few suckers growing from tree stumps and roots were present and were pruned in May through September 2016. No suckers were noted during the November inspection.

2.7 FALLEN TREE REMOVAL

In early 2016, a Navy subcontractor finished taking down the tree in the South Plantation that was found uprooted and suspended in adjacent trees in late December 2015 (Sealaska 2016b). The remaining tree trunk inside the plantation fencing was cut into 4-foot length pieces and left next to the tree stump. The trunk pieces were cut into smaller pieces and removed from the South Plantation during June 2016 plantation maintenance work.

2.8 REBAR REMOVAL

Steel rebar stakes were present along the western margin of the North Plantation (80 pieces) and the southern and southwestern margins of the South Plantation (188 pieces). The rebar, 4 feet in length and protruding from the ground to heights of approximately 2 feet, had been installed as part of the erosion control system at the plantations during construction and planting of the trees. Since the rebar no longer served its intended purpose, it was pulled during the May 2016 O&M event, and transported to NBK Bangor for recycling.

3. TIDE GATE INSPECTION AND MAINTENANCE

During this reporting period, tide gate inspection and maintenance events were conducted on a quarterly basis in May, August, and November 2016. During the operation and inspection events, the tide gate was found to be working as intended and designed, preventing tidal flooding of the marsh, which could cause erosion of the landfill and/or adversely affect tree health. Routine tide gate maintenance and cleaning was conducted during each inspection and maintenance event, and consisted of scraping and removing sediment, barnacles, mussels, sticks, and seaweed on all accessible exterior surfaces, floats, side door interiors, accessible interior portions of the culvert (within approximately 4 feet of the door), and the upper culvert security gate.

During the May and August 2016 inspections, all tide gate components were intact and appeared in good condition. During the August 2016 inspection the side floats on the tide gate frame were found to be somewhat impeded due to growth of barnacles on both the floats and inside the float sleeves on each side of the tide gate. The barnacles were scraped from the side floats and their float sleeves so that they would actuate more freely. These floats only serve as dampers to reduce oscillation of the tide gate door during closure. Therefore, the barnacle growth did not prevent the door from closing at the designated seawater-level elevation (i.e., approximately 3 feet above the tide gate invert).

Throughout the fall of 2016, low tides were too high to allow safe access to the beach during daylight hours. Consequently, the November inspection and maintenance event was limited to a visual inspection of the tide gate components before operational monitoring was conducted. All visible tide gate components were intact and appeared in good condition. Maintenance was limited to removing barnacles, mussels, and leaves only from the upper culvert security gate.

Some minor cracking in the top of the vacuum break air vent and minor pitting of metal surfaces was present, which appear to be in the same condition as previously reported. No repairs were required during this reporting timeframe, since neither the small cracks or the pitting impact the functionality of the tide gate.

Tide Gate Inspection Reports for each of the three inspection and maintenance events conducted in May, August, and November are included in Appendix C.

The tide gate operation was monitored through high tide cycles on May 23, 2016, August 29, 2016, and November 22, 2016. Temporary staff gauges were installed on both sides of the tide gate culvert and tide gate operation was monitored for approximately 4 hours around high tide. Water level measurements were recorded every half hour on both

sides of the tide gate. High tides were selected for inspections using the web site http://tidesandcurrents.noaa.gov /noaatidepredictions for the "Poulsbo, Liberty Bay" location.

Measurements of water levels and observations of tide gate position were used to document the transition of the tide gate from an open to a closed position. The tide gate began oscillating and was deemed fully closed over periods ranging from 0 to 9 minutes, and at water levels ranging between 2.82 to 3.10 feet during the three inspections conducted for this reporting period. This operation matched expectations from design and previous observations that the gate should close when the incoming tide reaches approximately 3 feet above the tide gate invert. Water levels remained stable on the marsh side of the tide gate following closure, indicating negligible leakage of seawater into the culvert and marsh through the closed gate.

4. SUMMARY OF O&M ACTIVITIES AND EVALUATION OF PERFORMANCE CRITERIA

The following sections summarize the O&M activities and evaluation of performance criteria.

4.1 DOCUMENTATION OF CONTINUED TREE HEALTH

Trees at both plantations remained generally healthy throughout the 2016 growing season. Granular high-nitrogen urea fertilizer was applied during the May and June 2016 maintenance events in an effort to enhance tree health. No pesticide was applied in 2011 through 2016, and no significant pest infestations occurred. Physical weeding greatly reduced the competition to trees from weeds. Irrigation of the plantations was not conducted in 2016 in an effort to maximize up-take of upper aquifer groundwater by the trees. Growth throughout the year was not directly measured, but appeared to be in the range of the modest growth expected considering the mature nature of the trees and the poor condition of the soils at the site. The closed leaf canopy was maintained, although leaves only remain on the upper approximately 25 percent of their trunks as most of the lower branches have died. The trees weathered the late winter 2016 through fall 2016 months with minimal limb breakage. No pruning was necessary to control rust, which can form when excessive moisture remains on leaves. Temperatures were generally normal and precipitation (volume and frequency) was above normal at the site during spring 2016, below normal during summer 2016, and above normal during fall 2016, compared to typical temperatures and precipitation levels for the Keyport vicinity. The trees did not exhibit visual evidence of stress from lack of water.

Only four trees died during the reporting timeframe, two smaller trees in the northwest portion of the North Plantation appeared to have died by the time of the June 2016 inspection. Additionally, two larger trees near the eastern margin of the South Plantation posed a fall hazard and were cut down and removed in fall 2016.

4.2 EVALUATION AGAINST PERFORMANCE CRITERIA

A conclusion of the Third and Fourth Five-Year Reviews (Navy 2010, 2015) was that phytoremediation has not been as effective as originally anticipated when it was evaluated during remedy selection. The following report subsections discuss the maintenance and monitoring results from the 2016 growing season as they relate to the performance criteria summarized in Section 1.3. The evaluation of performance criteria is inconclusive regarding the effectiveness of phytoremediation at the site. Although contaminant concentrations

appear to show a general decline over time (with the exception of those in wells MW1-17, MW1-04, and MW1-05, piezometer P1-7, and surface water location MA12) the contribution of phytoremediation processes to the noted decreases cannot be quantified. However, significant migration of contaminants has not been observed, suggesting that phytoremediation may have aided in controlling contaminant migration offsite. Additional subsurface investigation of OU 1 was conducted during the summer of 2016. However, results have not yet been reported. The conceptual site model will be reevaluated based on the data obtained from the investigation following completion of reporting.

In general, good tree health was documented throughout the 2016 growing season and, based upon inference from documentation by URS, Sealaska and TetraTech Joint Venture, and Sealaska of conditions and data from 2005 through 2016, some degree of cVOC degradation by tree metabolism is occurring (Sealaska 2016c).

As concluded by URS in the Phase I Report (URS 2015), tree core sampling in the North and South Plantations indicates that phytoremediation is having some degree of positive effect on contaminant reduction. At the least, the phytoremediation process does not appear to be impeding, and is likely having a beneficial effect on the naturally occurring biodegradation processes at OU 1.

4.2.1 Tree Health

The performance criteria for determining the effectiveness of phytoremediation is partially measured by tree health (Section 1.3, Performance Criteria). The overall health of the trees remains good. The trees did not exhibit any visual evidence of stress from lack of water. Additionally, the trees were free of significant pest infestations and no pruning was necessary to control rust, which can form when excessive moisture remains on leaves, so the trees were considered healthy. Therefore, the weight of evidence demonstrates healthy trees are present at both plantations.

4.2.2 Groundwater Flow

Biennial groundwater levels in the upper aquifer were recorded in OU 1 wells during June 2016, and elevation measurements were calculated. The 2016 groundwater elevation data were found to be similar to those collected since the inception of phytoremediation at OU 1, Area 1 (Sealaska 2016a). As in the past, the data do not reveal any discernible effect from the trees on groundwater flow direction or gradient.

However, with groundwater velocities estimated at 0.04 to 0.5 feet per day (Navy, EPA, and Ecology 1998), significant migration of contaminants since remedy implementation in 1999 has not been observed. This suggests that phytoremediation has aided in controlling/slowing contaminant migration offsite.

4.2.3 Contaminant Concentration Trends

As documented in the Spring 2016 LTM Report for OU 1 (Sealaska 2016a), one or more cVOC concentrations at two of the three North Plantation phytoremediation monitoring stations (e.g., wells 1MW-1 and MW1-02) and four of the five South Plantation phytoremediation monitoring stations (e.g., wells MW1-04, MW1-05, MW1-16, and the single phytoremediation surface water station MA12) remain above RGs. As anticipated by the OU 1 ROD (Navy, EPA, and Ecology 1998, page 67, lines 16-28) and demonstrated by trend data, these COCs are expected to remain above RGs for a considerable time.

Statistical trend analysis of COC concentrations was performed for locations MW1-04, MW1-05, and MA12. Of these locations MW1-04 and MA12 showed statistically significant decreasing trends in COC concentrations over time (Sealaska 2016a). Although statistical trend analysis was not conducted for 1MW-1 and MW1-02, the trend charts for those wells appear to demonstrate stability with overall decreasing trends.

Data trends remain consistent with historical trends estimated at OU 1, Area 1, with TCE and TCE-degradation daughter product cVOCs in well MW1-04, piezometer P1-7, and surface water location MA12 remaining high.

4.3 CONCLUSIONS

Six inspection and maintenance events for the plantations were completed from May 2016 through November 2016 per the scope of work and following approved work plans for the project. Healthy trees are present at both the North and South Plantations with no significant pest infestations or signs of stress from lack of water. Overall, the leaf canopy has appeared to be less full the last 3 years (i.e., approximately 30 percent less in 2014 and approximately 10 percent less in 2015/2016 when compared to 2013). Two smaller trees died, likely as a result of being crowded by surrounding larger trees and therefore not receiving adequate sunlight. Weeds were removed from the plantations and the plantation perimeters were maintained for accessibility and tree health. Granular high-nitrogen fertilizer was applied during the May and June 2016 growing season.

The tide gate was inspected and maintained during the three quarterly events during May, August, and November 2016. No repairs were need. The inspections verified the tide gate was operational. All three inspections confirmed the tide gate closed at the prescribed water level of approximately 3 feet above the tide gate invert and that stable water levels remained on the inland, marsh side of the tide gate culvert, indicating negligible water leakage through the gate.

Interpretations regarding biodegradation are addressed more comprehensively by other portions of the OU 1 monitoring program. While decreasing contaminant trends are found in many site wells, the portion of biodegradation occurring at the site as a direct result of phytoremediation processes cannot be ascertained from the LTM program data alone, as concluded in the Spring 2016 LTM Report for OU 1 (Sealaska 2016a).

The persistently high concentrations of TCE and TCE daughter products at MW1-04 and P1-7 are consistent with an on-going source of TCE within the South Plantation (Navy 2015). As a result, contaminant-migration reduction by the trees at the South Plantation has not progressed as expected. Additionally, monitoring of groundwater elevations do not reveal any discernable influence of the trees on water levels of the upper aquifer.

However, with groundwater velocities estimated at 0.04 to 0.5 feet per day (Navy, EPA, and Ecology 1998), significant migration of contaminants since remedy implementation in 1999 has not been observed. This suggests that phytoremediation has aided in controlling/slowing contaminant migration offsite (Navy 2015). Good tree health was documented throughout the 2016 growing season and, by inference from tree core sampling results presented in the OU 1 Phase I Report prepared by URS (URS 2015), some degree of cVOC degradation by tree metabolism is occurring. At the least, the phytoremediation process does not appear to be impeding, and is likely having a beneficial effect on the naturally occurring biodegradation processes at OU 1. Results of supplemental subsurface sampling and testing investigations during the summer of 2016 have not yet been reported. The conceptual site model will be reevaluated based on the data and conclusions obtained from the supplemental investigation.

Future planned activities include eight plantation inspection and maintenance events per year, to provide more frequent inspection and better maintenance of tree health. Additionally, application of granular high-nitrogen urea fertilizer to the ground surface at both plantations is planned in May and June 2016 to promote leaf growth and overall tree health. The tide gate will be inspected, cleaned, and monitored in February 2017, and then on a quarterly basis thereafter throughout 2017.

5. REFERENCES

Navy (United States Navy). 1993. Remedial Investigation Report, Naval Undersea Warfare Center Keyport. Prepared by URS Consultants and Science Applications International Corporation for EFA NW under CLEAN Contract No. N62474-89-D-9295, CTO 10. Poulsbo, Washington.

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Navy. 2016. Annual Operation and Maintenance Report, 2015, Operable Unit 1. Prepared by Sealaska under Contract No. N44255-14-D-9011, TO 13 for NAVFAC Northwest. August 2016.

Navy. 2017. Final, OU 1 Phase II Investigation Report, Naval Base Kitsap Keyport, Keyport, Washington. Prepared by Resolution Consultants, a Joint Venture of AECOM and EnSafe, under Contract N62470-11-D-8013, CTO JP09.

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Sealaska. 2014. Final Quality Control Plan, Long-Term Monitoring at Areas 1, 2, and 8, Operable Units 1 and 2, Naval Base Kitsap, Keyport, Washington. Prepared by Sealaska for NAVFAC Northwest, under Contract No. N44255-09-D-4005, CTO 084. Poulsbo, Washington. June 10, 2014.

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APPENDIX A

FIELD CHANGE REQUEST (FCRS TO 27 FCR-01 AND FCR-04)

SEALASKA ENVIRONMENTAL SERVICES

CONTRACT NUMBER: N44255-14-D-9011

FIELD CHANGE REQUEST (FCR)

TASK ORDER # 27 **FCR #** TO 27 FCR-01 **DATE** 05/10/16

LOCATION: NBK Keyport, WA **NTR / RPM** Charlie Escola / Carlotta Cellucci

1. Document to be changed. Identify revision, date, section, drawing, etc.

Project Work Plans for LTM, Revision 3, 29 Feb 2012: Site Work Plan - Section 6.6.1 Fertilization

2. Description of existing requirement and proposed change (Attach sheet if necessary)

REQUIREMENT: Last sentence of the section states "Further fertilizer application is not planned unless tree and or site conditions warrant its implementation again."
PROPOSED CHANGE: High nitrogen fertilizer (urea) pellets will be applied to ground surfaces at tree dripline areas during the May and June 2016 plantation O&M events. Approximately 135 pounds of granulated urea will be applied to each plantation during each of the May and June 2016 O&M events.

3. Reason for Change (Attach sheet if necessary)

The in-progress, revised Project Work Plans (including the O&M Plan), which are being updated to include recommendations of the Fourth Five-Year Review and the current PWS, will not be finalized until after the spring / early summer 2016 O&M event has been conducted. Fertilizer application is proposed for the spring / early summer 2016 event, in accordance with the TO 27 Statement of Work, in an effort to enhance growing conditions and the overall health of the trees.

4. Originator: (print name and sign) James Ruef James R. Ruef		**Title** Task Order Manager/Project Quality Control Manager	**Date** 05/10/16
Reviewed by: (print name and sign) Sherri Wunderlich Sherri L Wunderlich		**Title** Program QC Manager	**Date** 05/10/16
Site Superintendent (Print name and sign) Robert Boyd (Alternate SS) Robert Boyd	**Date** 05/10/16	**Task Order Manager (Print name and sign)** James Ruef James R. Ruef	**Date** 05/10/16
Program QC Manager (Print Name and Sign) Sherri Wunderlich Sherri L Wunderlich	**Date** 05/10/16	**NTR Acknowledgement (Print name and sign)** RPM Carlotta Cellucci	**Date** 5/16/16

SEALASKA ENVIRONMENTAL SERVICES

CONTRACT NUMBER: N44255-14-D-9011

FIELD CHANGE REQUEST (FCR)

TASK ORDER # 27 **FCR #** TO 27 FCR-04 **DATE** 10/19/16

LOCATION: NBK Keyport, WA **NTR / RPM** Charlie Escola/ Carlotta Cellucci

1. Document to be changed. Identify revision, date, section, drawing, etc.

Project Work Plans for LTM. Revision 3, 29 February 2012: Site Work Plan Area 1, Operable Unit 1, Section 7.5 - Maintenance Schedule.

2. Description of existing requirement and proposed change (Attach sheet if necessary)

Existing requirement:
Section 7.5 Maintenance Schedule: "Because of the rapid accumulation of barnacles and mussels observed during the first several years of maintenance events, the cleaning and maintenance activities will be conducted on a quarterly basis, scheduled during low tides."

The objective of the inspection and maintenance program is to conduct periodic checks on the tidegate to ensure it is functioning properly. The physical condition of the critical components/parts will be inspected, and the functionality observed during a tidal cycle (checking for the opening and closing as well as the back float operation in response to rising and receding tides). The tidegate requires manual scraping of marine organisms and removal of biofouling or debris from the culvert that may obstruct the operation of the tidegate or block the culvert. Additionally, cleaning the tidegate facilitates the visual inspection of the tidegate system components (as described in Section 7.4 of the Site Work Plan).

Proposed changes:
No tidegate cleaning will be performed during the fall quarterly event, which is scheduled for November 2016. However, the tidegate will be visually inspected and monitored (opening/closing) during the scheduled November quarterly maintenance activities, and cleaning the tidegate will be performed next quarter, in February 2017. Sealaska will conduct periodic visual checks every 2-4 weeks until the next cleaning to ensure that the tide gate is closed at high tide and open at low tide.

3. Reason for Change (Attach sheet if necessary)

No predicted tide during the fourth quarter of 2016 has an adequately low enough tide during daylight hours to safely access the tidegate system (and culvert) to perform manual scraping and cleaning.

4. Originator: (print name and sign) Cara Alferness		**Title** Alternate TOM	**Date** 10/19/16
Reviewed by: (print name and sign) James Ruef		**Title** TOM	**Date** 10/19/16
Site Superintendent (Print name and sign) Andy Lewis	**Date** 10/25/16	**Task Order Manager (Print name and sign)** James Ruef	**Date** 10/19/16
Program QC Manager (Print Name and Sign) Sherri Wunderlich	**Date** 10/19/16	**NTR Acknowledgement (Print name and sign)** CELLUCCI.CARLOTTA.1383387546 Digitally signed by CELLUCCI.CARLOTTA.1383387546 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=CELLUCCI.CARLOTTA.1383387546 Date: 2016.11.02 14:38:38 -07'00'	**Date** 11/2/16

APPENDIX B

PHYTOREMEDIATION INSPECTION REPORTS

(PROVIDED ON DISC)

MAY 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

INTRODUCTION

The spring 2016 phytoremediation inspection for Naval Base Kitsap Keyport (NBK Keyport), Washington was conducted by Sealaska Environmental Services, LLC (Sealaska). The work was completed under the long-term monitoring and operations and maintenance (LTM/OM) Contract N44255-14-D-9011, Task Order (TO) 27. This report summarizes the field activities, results, and recommendations for the phytoremediation plantation inspection and maintenance completed by Sealaska on May 23 and 24, 2016 at Operable Unit (OU) 1 North and South Plantations. Completed field inspection forms are included as Attachment 1.

OBJECTIVE AND SCOPE

Tree health at the North and South Plantations has been monitored and maintained since the trees were planted in 1999. Sealaska has been tasked under TO 27 to conduct periodic inspections and maintenance tasks to ensure the health of the plantation trees. The inspection and maintenance requirements are described in Revision 3 of the Project Work Plans for OU 1 Long-Term Monitoring (LTM), Site Work Plan for OU 1 and the Operation and Maintenance (O&M) Plan for Phytoremediation at OU 1 (United States Navy 2012). This report summarizes the field activities conducted at the plantations during May 2016, and represents the first of eight planned phytoremediation inspection and maintenance events for TO 27 in 2016-17.

Inspection and maintenance activities have typically occurred in the past on a monthly basis during the growing seasons and once during the dormant season. The current plans and schedule call for the phytoremediation O&M events to be conducted eight times from May 2016 to February 2017, including May, June, July, August, September, and November 2016 and January and February 2017. Irrigation had been conducted as needed during late spring and summer through 2012 to supplement the low upper-aquifer permeability. During 2013, irrigation was restricted to the early summer to maximize groundwater uptake by the trees and, to that end, no watering has been conducted since July 18, 2013. No irrigation is planned for the remainder of TO 27, unless extremely dry and warm temperature conditions cause observable stress to the trees. Irrigation will only be conducted at the direction of the Navy's Remedial Project Manager (RPM) for NBK Keyport LTM.

Major nurturing and maintenance activities have been contracted by the Navy to other contractors. These activities may include herbicide and pesticide applications and major pruning. Systemic-pesticide application was conducted most recently by Peninsula Services during March 2010. There have been no significant pest infestations since the last pesticide application.

MAY 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

FIELD ACTIVITIES

The first of eight scheduled tree inspection and maintenance events for 2016-17 under TO 27 was conducted on May 23 and 24, 2016. Maintenance activities performed included extensive weed and grass cutting, pulling and removal of weeds, inspection of tree health, and application of high-nitrogen urea fertilizer.

RESULTS

Observations made during the May 2016 inspections of the North and South Plantations at NBK Keyport Area 1 are summarized below.

General Tree Health. A thorough inspection of each plantation was completed and the overall health of both plantations appeared to be good. No pest infestations were observed, with the exception of some tent caterpillar nests up to approximately 6-inches long at the ends of less than 1 percent of the branches. Damage to foliage from tent caterpillars was very minimal. The trees were fully leafed-out with the overall canopy appearing to be approximately as dense as conditions noted during June 2015, and much denser than in June 2014. Some bare branches with sparse leaf growth were observed, mostly along the northern margins of both of the plantations. A few trees exhibited some new branch and leaf growth on lower areas where branches had previously died. Overall, the leaves were green and healthy in appearance, with no evidence of disease or other abnormalities observed. A minor degree of leaf blight (less than five percent of the leaves on the trees, primarily along the plantation perimeter areas) was observed, which is typical for these trees during the early-to-mid growing season. With some exceptions, most of the lowest branches on all the trees are dead, likely the result of very little direct sunlight beneath the canopy due to the relatively close spacing of the trees. A few suckers growing from shallow roots were present. Holes in bark from Sapsucker activity were present on three trees in the South Plantation. As observed during previous inspections, the bark on several of the lower tree trunks in both plantations has cracked, likely resulting from past rapid temperature changes during fall and winter seasons.

Pruning. No major pruning was performed. Some of the remaining dead lower branches and some suckers growing from roots were pruned and removed from the plantations.

Pest Control. A minor volume of tent caterpillar nests were seen on a few of the trees in both plantations. The nests were approximately 6 inches in length, and most caterpillars had already hatched from them. Damage to leaves from caterpillars appeared to be minimal, however this

condition will be closely monitored during the upcoming June 2016 tree inspection and maintenance event. No other insect infestations were observed. A systemic pesticide was last applied during March 2010 by Peninsula Services.

Weed Control. Growth of grasses and weeds leading up to the time of the May 2016 inspection was found to be heavy in and around both plantations. The most prolific weed and grass growth was primarily near the margins of the plantations and not under the plantation canopies. Hand-pulling techniques, gas-powered engine string trimmers, and hand-tool loppers were used to cut and remove grasses and weeds within, as well as outside of perimeter fencing, of both plantations. Invasive species growth is minimized at both plantations by the removal of blackberry, ivy, holly, Scotch broom, salmonberry, laurel, and a few small maple and alder trees from the plantations. During May, invasive vegetation removed or cut inside the plantations consisted primarily of ivy, holly, blackberry, laurel, maple, and grasses. The plantation-perimeter area weeds cut back or pulled and removed consisted primarily of blackberry, Scotch broom, and grasses. Weeds that were pulled were placed in a designated dumpster located near the South Plantation. A few suckers growing from tree stumps and roots were present and were pruned. Dead lower branches, several of which had fallen from their tree trunks, were removed from the plantations. In an effort to prevent encroachment of weeds and other undesirable plants and trees, Sealaska cut back vegetation immediately surrounding the perimeter of the plantation fences in an approximately 5-foot or wider swath, and will continue to do so during the upcoming summer tree inspections and maintenance scheduled for the week of June 20, 2016. No standing water was present, and surface soils were generally slightly moist to dry. No evidence of physical damage resulting from humans or animals was observed.

Fertilizer Application. Granulated high-nitrogen urea fertilizer was applied to the ground surfaces of both plantations during May 2016 maintenance. A broadcast spreader was used to evenly apply 150 pounds to the North Plantation and 125 pounds to the South Plantation.

Irrigation. No irrigation has been conducted since July 18, 2013. Irrigation during summer 2013 was reduced by approximately 58 percent when compared to the 2012 growing season, and no irrigation was conducted in 2014, 2015, or thus far during 2016, to maximize uptake of shallow-aquifer groundwater by the trees. It is hoped that the reduced irrigation served to optimize metabolism of volatile organic compound contaminants (VOCs) through phytoremediation processes during the mid-summer to fall seasons. The drip irrigation system was winterized during the October 2013 plantations inspection and maintenance, and will not be activated again by Sealaska unless so directed by the Navy RPM for TO 13.

Rebar Removal. Steel rebar stakes were present along the western margin of the North Plantation (80 pieces) and the southern and southwestern margins of the South Plantation (188 pieces). The rebar, 4 feet in length, had been installed as part of the erosion control system at the plantations during construction and planting of the trees. Since the rebar no longer served its intended purpose, it was pulled during the May 2016 O&M event, and transported to NBK Bangor and placed in the metals recycling bin to be recycled.

FUTURE ACTIVITIES

The following activities by Sealaska are planned at the tree plantations over the course of several days from approximately June 23-29, 2016:

- Conduct the second of eight planned TO 27 2016-17 plantations inspections.
- Conduct grass and weed control.
- Remove dead branches from plantations.
- Remove the sections of tree trunk of the fallen tree in the southwest corner of the South Plantation.
- Cut and remove suckers, including those growing from the tree trunk of the fallen tree in the South Plantation.
- Apply 275 pounds of high-nitrogen granulated urea fertilizer to the plantations.

REFERENCES

U.S. Navy. 2012. *Long-Term Monitoring Project Work Plans, Operable Units 1 and 2, Naval Base Kitsap, Keyport, Washington, Final, Revision 3.* Prepared by Sealaska Environmental Services, LLC (Sealaska) for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

U.S. Navy. 2012. *Revised Operation and Maintenance Plan for Phytoremediation at Operable Unit 1, Naval Undersea Warfare Center Division, Keyport, Washington. Final, Revision 2.* Prepared by Sealaska for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

MAY 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

INSPECTION FORMS

T6 27

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☒ South Plantation ☐ **Date:** 05/24/2016

Reason for Inspection:

Base Line ☐ Monthly Inspection ☒ Fertilization ☒ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Chipping ☐ Field Meeting ☐
Other ☒ REBAR REMOVAL

Inspection Attendants: J. RUEF, S. PATTERSON, R. BOYD, M. TILLOTSON

Specific Inspection Activity:
- INSPECTION OF TREE HEALTH
- WEED CONTROL ACTIVITIES
- FERTILIZER APPLICATION (150 lbs)
- REBAR REMOVAL

Inspection Results: TREES ARE FULLY LEAFED OUT. LEAF BLIGHT CURRENTLY AFFECTING <5% OF LEAVES. TENT CATAPILLAR NESTS OBSERVED WITHIN THE PLANTATION. DEAD BRANCHES WERE OBSERVED. SEVERAL BROKEN BRANCHES WERE REMOVED FROM THE PLANTATION. SEVERAL TREES HAVE CRACKS IN THE BARK OF THEIR TRUNKS, THIS CONDITION HAS BEEN PREVIOUSLY NOTED AND IS LIKELY DUE TO RAPID CHANGES IN TEMPERATURE AND MOISTURE. SOIL IS DRY AND HARD WITH NO STANDING WATER. GAS POWERED TRIMMERS WERE USED TO CUT BACK WEED GROWTH: GRASSES, BLACKBERRIES, HOLLY, IVY, LAUREL, MAPLE. TO PREVENT ENCROACHMENT 5 FT WAS CLEARED ALONG THE OUTTER PERIMETER. FERTILIZER, 150 lbs, WAS APPLIED TO THE PLANTATION. NO SIGNS OF PHYSICAL DAMAGE FROM HUMANS OR ANIMALS. REBAR REMOVED FROM WESTERN EDGE, 80 PIECES.

Further Action Recommended:
- CONTINUED MONITORING OF TREE HEALTH
- CONTINUED WEED CONTROL

Total Hours: 3 5/24/16 30 Office: POULSBO, WA Inspector V. SUNRISE PATTERSON
Field: NA Correspondence: NA Sheet 1 of 1
Mileage: NA.

Routing: 1 Copy to Inspection File

To 27

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Date:** 05/24/2016

Reason for Inspection:

Base Line ☐ Monthly Inspection ☒ Fertilization ☒ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Chipping ☐ Field Meeting ☐
Other ☒ REBAR REMOVAL

Inspection Attendants: J. RUEF, S. PATTERSON, R. BOND, M. TILLOTSON

Specific Inspection Activity:
- INSPECTION OF TREE HEALTH
- WEED CONTROL ACTIVITIES
- FERTILIZER APPLICATION (125 lbs)
- REBAR REMOVAL

Inspection Results: TREES ARE FULLY LEAFED OUT. LEAF BLIGHT CURRENTLY AFFECTING <5% OF LEAVES. TENT CATAPILLAR NESTS WERE OBSERVED WITHIN THE PLANTATION. SEVERAL OBSERVED DEAD BRANCHES WERE CUT BACK AND REMOVED ALONG WITH SEVERAL BROKEN BRANCHES. SEVERAL TREES WERE NOTED WITH WEEPING AND OR CRACKS IN THE BARK OF THE TREE'S TRUNK. THIS CONDITION HAS BEEN PREVIOUSLY NOTED. THE CRACKS IN THE TREE TRUNKS IN LIKELY DUE TO RAPID CHANGES IN TEMPERATURE AND MOISTURE. SAP SUCKER HOLES WERE NOTED IN AT LEAST THREE TREE TRUNKS. SOIL CONDITION IS DRY AND HARD WITH NO STANDING WATER OBSERVED. GAS POWERED STRING CUTTERS WERE USED TO CUT BACK GRASS, BLACKBERRY, HOLLY, IVY, LAUREL AND MAPLE. TO PREVENT ENCROACHMENT SAT WAS CLEARED ALONG THE OUTTER PERIMETER. FERTILIZER, 125 LBS, WAS APPLIED TO THE PLANTATION. NO SIGNS OF PHYSICAL DAMAGE FROM HUMANS OBSERVED. REBAR REMOVED FROM SOUTHERN AND WESTERN EDGES, 188 PIECES

Further Action Recommended:
- CONTINUED MONITORING OF TREE HEALTH
- CONTINUED WEED CONTROL

Total Hours: 35 Office: POULSBO, WA Inspector V. SUNRISE PATTERSON
Field: NA Correspondence: NA Sheet 1 of 1
Mileage: NA

Routing: 1 Copy to Inspection File

JUNE 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

INTRODUCTION

The June 2016 phytoremediation inspection for Naval Base Kitsap Keyport (NBK Keyport), Washington was conducted by Sealaska Environmental Services, LLC (Sealaska). The work was completed under the long-term monitoring and operations and maintenance (LTM/OM) Contract N44255-14-D-9011, Task Order (TO) 27. This report summarizes the field activities, results, and recommendations for the phytoremediation plantation inspection and maintenance completed by Sealaska on June 27, 2016 at Operable Unit (OU) 1 North and South Plantations. Completed field inspection forms are included as Attachment 1.

OBJECTIVE AND SCOPE

Tree health at the North and South Plantations has been monitored and maintained since the trees were planted in 1999. Sealaska has been tasked under TO 27 to conduct periodic inspections and maintenance tasks to ensure the health of the plantation trees. The inspection and maintenance requirements are described in Revision 3 of the Project Work Plans for OU 1 Long-Term Monitoring (LTM), Site Work Plan for OU 1 and the Operation and Maintenance (O&M) Plan for Phytoremediation at OU 1 (United States Navy 2012). This report summarizes the field activities conducted at the plantations during June 2016, and represents the second of eight planned phytoremediation inspection and maintenance events for TO 27 in 2016-17.

Inspection and maintenance activities have typically occurred in the past on a monthly basis during the growing seasons and once during the dormant season. The current plans and schedule call for the phytoremediation O&M events to be conducted eight times from May 2016 to February 2017, including May, June, July, August, September, and November 2016 and January and February 2017. Irrigation had been conducted as needed during late spring and summer through 2012 to supplement the low upper-aquifer permeability. During 2013, irrigation was restricted to the early summer to maximize groundwater uptake by the trees and, to that end, no watering has been conducted since July 18, 2013. No irrigation is planned for the remainder of TO 27, unless extremely dry and warm temperature conditions cause observable stress to the trees. Irrigation will only be conducted at the direction of the Navy's Remedial Project Manager (RPM) for NBK Keyport LTM.

Major nurturing and maintenance activities have been contracted by the Navy to other contractors. These activities may include herbicide and pesticide applications and major pruning. Systemic-pesticide application was conducted most recently by Peninsula Services during March 2010. There have been no significant pest infestations since the last pesticide application.

JUNE 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

FIELD ACTIVITIES

The second of eight scheduled tree inspection and maintenance events for 2016-17 under TO 27 was conducted on June 27, 2016. Maintenance activities performed included extensive weed and grass cutting, pulling and removal of weeds, inspection of tree health, and application of high-nitrogen urea fertilizer.

RESULTS

Observations made during the June 2016 inspections of the North and South Plantations at NBK Keyport Area 1 are summarized below.

General Tree Health. A thorough inspection of each plantation was completed and the overall health of both plantations appeared to be good. No pest infestations were observed, with the exception of some tent caterpillar nests up to approximately 6-inches long at the ends of less than 1 percent of the branches. Damage to foliage from tent caterpillars was very minimal. The trees were fully leafed-out with the overall canopy appearing to be approximately as dense as conditions noted during June 2015, and much denser than in June 2014. Most trees within interior areas of both plantations only have leaves remaining on the upper approximately 25 percent of their trunks. Trees in perimeter areas of the plantations generally have leaves throughout their entire trunks. A few trees exhibited some new branch and leaf growth on lower areas where branches had previously died. Overall, the leaves were green and healthy in appearance, with no evidence of disease or other abnormalities observed. A minor degree of leaf blight (less than five percent of the leaves on the trees, primarily along the plantation perimeter areas) was observed, which is typical for these trees during the early-to-mid growing season. Two smaller trees within the North Plantation appear to be dead and four trees have a dead secondary leader. With some exceptions, most of the lowest branches on all the trees are dead, likely the result of very little direct sunlight beneath the canopy due to the relatively close spacing of the trees. A few suckers growing from shallow roots were present. Holes in bark from Sapsucker activity were present on fifteen trees in the South Plantation, however the holes do not appear to be adversely affecting the trees. As observed during previous inspections, the bark on several of the lower tree trunks in both plantations has cracked, likely resulting from past rapid temperature changes during fall and winter seasons.

Pruning. No major pruning was performed. Some of the remaining dead lower branches and some suckers growing from roots were pruned and removed from the plantations.

Pest Control. A minor volume of tent caterpillar nests were seen on a few of the trees in both plantations. The nests were approximately 6 inches in length, and most caterpillars had already hatched from them. Damage to leaves from caterpillars appeared to be minimal, however this condition will continue to be monitored during the upcoming July 2016 tree inspection and maintenance event. No other insect infestations were observed. A systemic pesticide was last applied during March 2010 by Peninsula Services.

Weed Control. Growth of grasses and weeds leading up to the time of the June 2016 inspection was found to be heavy in and around both plantations. The most prolific weed and grass growth was primarily near the margins of the plantations and not under the plantation canopies. Hand-pulling techniques, gas-powered engine string trimmers, and hand-tool loppers were used to cut and remove grasses and weeds within, as well as outside of perimeter fencing, of both plantations. Invasive species growth is minimized at both plantations by the removal of blackberry, ivy, holly, Scotch broom, salmonberry, laurel, and a few small maple and alder trees from the plantations. During June, invasive vegetation removed or cut inside the plantations consisted primarily of ivy, holly, blackberry, laurel, maple, and grasses. The plantation-perimeter area weeds cut back or pulled and removed consisted primarily of blackberry, Scotch broom, and grasses. Weeds that were pulled were placed in a designated dumpster located near the South Plantation. A few suckers growing from tree stumps and roots were present and were pruned. Dead lower branches, several of which had fallen from their tree trunks, were removed from the plantations. In an effort to prevent encroachment of weeds and other undesirable plants and trees, Sealaska cut back vegetation immediately surrounding the perimeter of the plantation fences in an approximately 5-foot or wider swath, and will continue to do so during the upcoming summer tree inspections and maintenance scheduled for July 26, 2016. No standing water was present, and surface soils were generally dry. No evidence of physical damage resulting from humans or animals was observed.

Fertilizer Application. Granulated high-nitrogen urea fertilizer was applied to the ground surfaces of both plantations during June 2016 maintenance. A broadcast spreader was used to evenly apply 150 pounds to the North Plantation and 125 pounds to the South Plantation. Following fertilizer application, both plantation surfaces were watered with a hose connected to the NBK Keyport domestic water supply system. Application of water was conducted to dissolve the granulated urea into solution, thereby increasing the potential for the nitrogen to be adsorbed into the soil and taken up by tree roots.

Irrigation. No irrigation has been conducted since July 18, 2013. Irrigation during summer 2013 was reduced by approximately 58 percent when compared to the 2012 growing season, and no irrigation was conducted in 2014, 2015, or thus far during 2016, to maximize uptake of shallow-aquifer groundwater by the trees. It is hoped that the reduced irrigation served to optimize metabolism of volatile organic compound contaminants (VOCs) through phytoremediation processes during the mid-summer to fall seasons. The drip irrigation system was winterized during the October 2013 plantations inspection and maintenance, and will not be activated again by Sealaska unless so directed by the Navy RPM for TO 13.

Stake and Tree Trunk Removal. A steel pipe and a copper grounding rod along the northeastern margin of the North Plantation were pulled and removed during the June 2016 O&M event. The sections of tree trunk of the fallen tree in the southeast corner of the South Plantation were cut into small pieces and removed from the site.

FUTURE ACTIVITIES

The following activities by Sealaska are planned at the tree plantations over the course of several days from approximately July 26, 2016:

- Conduct the third of eight planned TO 27 2016-17 plantations inspections.
- Conduct grass and weed control.
- Remove dead branches from plantations.
- Cut and remove suckers.

REFERENCES

U.S. Navy. 2012. *Long-Term Monitoring Project Work Plans, Operable Units 1 and 2, Naval Base Kitsap, Keyport, Washington, Final, Revision 3.* Prepared by Sealaska Environmental Services, LLC (Sealaska) for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

U.S. Navy. 2012. *Revised Operation and Maintenance Plan for Phytoremediation at Operable Unit 1, Naval Undersea Warfare Center Division, Keyport, Washington. Final, Revision 2.* Prepared by Sealaska for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

JUNE 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

INSPECTION FORMS

TO 27
Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation [X] South Plantation [ ] **Date:** 06/27/2016

Reason for Inspection:

Base Line [ ] Monthly Inspection [X] Fertilization [X] Weed Control [X] Pest Control [ ]
Irrigation [ ] Thinning and Pruning [ ] Chipping [ ] Field Meeting [ ]
Other [ ] _____

Inspection Attendants: J. RUEF, A. LEWIS, S. PATTERSON

Specific Inspection Activity:
- INSPECTION OF TREE HEALTH
- WEED CONTROL ACTIVITIES
- FERTILIZER APPLICATION (150 lbs)

Inspection Results: TREES ARE FULLY LEAFED OUT. IN GENERAL, INTERIOR TREES ONLY HAVE LEAVES ON THE UPPER 25%. EXTERIOR TREES HAVE LEAF COVERAGE THROUGH OUT. MINIMAL LEAF BLIGHT WAS OBSERVED AFFECTING <5% OF LEAVES. TENT CATAPILAR NESTS WERE OBSERVED, BUT NO SIGNIFICANT DAMAGE WAS NOTED. SEVERAL DEAD AND/OR BROKEN LOWER BRANCHES WERE REMOVED FROM TREES. TWO TREES APPEAR DEAD (2D, 14N). FOUR TREES ONLY HAVE PRIMARILY NEW GROWTH ON THE BOTTOM 10 FT (15F, 12C, 6G, ROW 4 SECOND TO LAST TREE). FOUR TREES HAVE A DEAD SECONDARY LEADER (8G, 10H, 11N, 14K). EIGHT TREES HAVE MINIMAL GROWTH (3B, 5C, 8P, 12D, 14D, 15I 15A, ROW 13 THIRD TO LAST TREE). NEW GROWTH OBSERVED ON SEVERAL TREES. CRACKS WERE OBSERVED IN THE TRUNKS OF SEVERAL TREES, PREVIOUSLY NOTED CRACKS ARE FREE OF INSECT INFESTATIONS. SOIL CONDITIONS ARE DRY WITH NO AREAS OF STANDING WATER. GAS POWERED STRING CUTTER USED TO CUT BACK: GRASSES, WEEDS, BLACKBERRIES, HOLLY, IVY, TO PREVENT ENCROACHMENT 5 FT WAS CLEARED ALONG THE OUTTER PERIMETER. FERTILIZER, 15-10-10, WAS APPLIED TO THE PLANTATION THE PLANTATION WAS LIGHTLY HANDWATERED TO ALLOW THE FERTILIZER TO GO INTO SOLUTION. NO SIGNS OF PHYSICAL DAMAGE FROM HUMANS, ANIMALS OR INSECTS. TWO PIECES OF REBAR WERE REMOVED

Further Action Recommended:
- CONTINUED MONITORING OF TREE HEALTH
- CONTINUED WEED CONTROL

Total Hours: 10 Office: POULSBO, WA
Field: N/A Correspondence: N/A
Mileage: N/A

Inspector V. SUNRISE PATTERSON
Sheet 1 of 1

Routing: 1 Copy to Inspection File

TO 27

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Date:** 06/27/2016

Reason for Inspection:

Base Line ☐ Monthly Inspection ☒ Fertilization ☒ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Chipping ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: J. RUEF, A. LEWIS, S. PATTERSON

Specific Inspection Activity:
- INSPECTION OF TREE HEALTH
- WEED CONTROL ACTIVITIES
- FERTILIZER APPLICATION (125 lbs)

Inspection Results: TREES ARE FULLY LEAFED OUT. IN GENERAL INTERIOR TREES ONLY HAVE LEAVES ON THE UPPER 25%. EXTERIOR TREES HAVE LEAF COVER THROUGH OUT. MINIMAL LEAF BLIGHT WAS OBSERVED AFFECTING <5% OF LEAVES. FIFTEEN TREES WERE NOTED WITH SAPSUCKER HOLES: 1A, 1B, 10A, 12A, 13A, 16A, 17A, 18B, 22A, 22B, 24A, 25A, 26A, 26B, 26D, NOT ADVERSELY AFFECTING TREES. A SMALL BEEHIVE WAS OBSERVED IN 11C. SEVERAL DEAD AND/OR BROKEN BRANCHES WERE REMOVED FROM TREES. NEW GROWTH WAS OBSERVED ON SEVERAL TREES. PREVIOUSLY NOTED CRACKS IN TREE TRUNKS WERE FREE OF INSECT INFESTATIONS. SOIL CONDITIONS ARE DRY WITH NO AREAS OF STANDING WATER. A GAS POWERED STRING CUTTER WAS USED TO CUT BACK: GRASSES, WEEDS, BLACKBERRIES, HOLLY, IVY. TO PREVENT ENCROACHMENT. SFT WAS CLEARED ALONG THE OUTER PERIMETER. REMOVED WOOD FROM FALLEN TREE FOR DISPOSAL. FERTILIZER, 125 lbs, WAS APPLIED TO THE PLANTATION. THE PLANTATION WAS LIGHTLY HAND WATERED TO ALLOW THE FERTILIZER TO GO INTO SOLUTION. NO OTHER SIGNS OF DAMAGE FROM HUMANS, ANIMAL OR INSECTS WERE OBSERVED.

Further Action Recommended:
- CONTINUED MONITORING OF TREE HEALTH
- CONTINUED WEED CONTROL

Total Hours: 10 Office: POULSBO, WA Inspector V. SUNRISE PATTERSON
Field: NA Correspondence: NA Sheet 1 of 1
Mileage: NA

Routing: 1 Copy to Inspection File

JULY 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

INTRODUCTION

The July 2016 phytoremediation inspection for Naval Base Kitsap Keyport (NBK Keyport), Washington was conducted by Sealaska Environmental Services, LLC (Sealaska). The work was completed under the long-term monitoring and operations and maintenance (LTM/OM) Contract N44255-14-D-9011, Task Order (TO) 27. This report summarizes the field activities, results, and recommendations for the phytoremediation plantation inspection and maintenance completed by Sealaska on July 26, 2016 at Operable Unit (OU) 1 North and South Plantations. Completed field inspection forms are included as Attachment 1.

OBJECTIVE AND SCOPE

Tree health at the North and South Plantations has been monitored and maintained since the trees were planted in 1999. Sealaska has been tasked under TO 27 to conduct periodic inspections and maintenance tasks to ensure the health of the plantation trees. The inspection and maintenance requirements are described in Revision 3 of the Project Work Plans for OU 1 Long-Term Monitoring (LTM), Site Work Plan for OU 1 and the Operation and Maintenance (O&M) Plan for Phytoremediation at OU 1 (United States Navy 2012). This report summarizes the field activities conducted at the plantations during July 2016, and represents the third of eight planned phytoremediation inspection and maintenance events for TO 27 in 2016-17.

Inspection and maintenance activities have typically occurred in the past on a monthly basis during the growing seasons and once during the dormant season. The current plans and schedule call for the phytoremediation O&M events to be conducted eight times from May 2016 to February 2017, including May, June, July, August, September, and November 2016 and January and February 2017. Irrigation had been conducted as needed during late spring and summer through 2012 to supplement the low upper-aquifer permeability. During 2013, irrigation was restricted to the early summer to maximize groundwater uptake by the trees and, to that end, no watering has been conducted since July 18, 2013. No irrigation is planned for the remainder of TO 27, unless extremely dry and warm temperature conditions cause observable stress to the trees. Irrigation will only be conducted at the direction of the Navy's Remedial Project Manager (RPM) for NBK Keyport LTM.

Major nurturing and maintenance activities have been contracted by the Navy to other contractors. These activities may include herbicide and pesticide applications and major pruning. Systemic-pesticide application was conducted most recently by Peninsula Services during March 2010. There have been no significant pest infestations since the last pesticide application.

JULY 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

FIELD ACTIVITIES

The third of eight scheduled tree inspection and maintenance events for 2016-17 under TO 27 was conducted on July 26, 2016. Maintenance activities performed included weed and grass cutting, pulling and removal of weeds, and inspection of tree health.

RESULTS

Observations made during the July 2016 inspections of the North and South Plantations at NBK Keyport Area 1 are summarized below.

General Tree Health. A thorough inspection of each plantation was completed and the overall health of both plantations appeared to be good. No new pest infestations were observed. Some tent caterpillar nests up to approximately 6-inches long at the ends of less than 1 percent of the branches had been observed during the June 2016 inspection. During the July 2016 inspection, damage to foliage from the tent caterpillars was observed to be very minimal. The trees were fully leafed-out with the overall canopy appearing to be approximately as dense as conditions noted during the summer of 2015. As noted during previous 2016 inspections, most trees within interior areas of both plantations only have leaves remaining on the upper approximately 25 percent of their trunks. Trees in perimeter areas of the plantations generally have leaves throughout their entire trunks, with a few exceptions. A few trees exhibited some new branch and leaf growth on lower areas where branches had previously died. Overall, the leaves were green with some in the seasonal process of changing color to yellow. The leaves were healthy in appearance, with no evidence of disease or other abnormalities observed. A minor degree of leaf blight (less than five percent of the leaves on the trees, primarily along the plantation perimeter areas) was observed, which is typical for these trees during the mid-summer growing season. As observed during the June 2016 inspection, two smaller trees within the North Plantation appear to be dead and four trees have a dead secondary leader (i.e., second top). With some exceptions, most of the lowest branches on all the trees are dead, likely the result of very little direct sunlight beneath the canopy due to the relatively close spacing of the trees. A few suckers growing from shallow roots were present. Holes in bark from Sapsucker activity were present on fifteen trees in the South Plantation (i.e., the same number as during the June 2016 inspection), however the holes do not appear to be adversely affecting the trees. As observed during previous inspections, the bark on several of the lower tree trunks in both plantations has cracked, likely resulting from past rapid temperature changes during fall and winter seasons. No insects or evidence of them appeared to be present in or around the cracks, or elsewhere on the trees.

Pruning. No major pruning was performed. Some of the remaining dead lower branches and some suckers growing from roots were pruned and removed from the plantations.

Pest Control. Caterpillars had already hatched and emerged from the minor volume of tent caterpillar nests that were seen on a few of the trees in both plantations during the June and July 2016 inspections. Damage to leaves from caterpillars appeared to be minimal. No other insect infestations were observed. A systemic pesticide was last applied during March 2010 by Peninsula Services.

Weed Control. Growth of grasses and weeds leading up to the time of the July 2016 inspection was found to be minimal in and around both plantations. The most prolific weed and grass growth was primarily near the margins of the plantations and not under the plantation canopies. Hand-pulling techniques, scythes, and hand-tool loppers were used to cut and remove grasses and weeds within, as well as outside of perimeter fencing, of both plantations. Invasive species growth is minimized at both plantations by the removal of blackberry, ivy, holly, Scotch broom, salmonberry, laurel, and a few small maple and alder trees from the plantations. During July, invasive vegetation removed or cut inside the plantations consisted primarily of ivy, holly, blackberry, Scotch broom, dandelions, and grasses. The plantation-perimeter area weeds cut back or pulled and removed consisted primarily of blackberry, Scotch broom, dandelions, and grasses. Weeds that were pulled were placed in a designated dumpster located near the South Plantation. A few suckers growing from tree stumps and roots were present and were pruned. Dead lower branches, several of which had fallen from their tree trunks, were removed from the plantations. In an effort to prevent encroachment of weeds and other undesirable plants and trees, Sealaska cut back vegetation immediately surrounding the perimeter of the plantation fences in an approximately 5-foot or wider swath, and will continue to do so as needed during the upcoming late summer and fall tree inspections and maintenance scheduled for August, September, and November 2016. No standing water was present, and surface soils were generally dry. No evidence of physical damage resulting from humans or animals was observed.

Fertilizer Application. Granulated high-nitrogen urea fertilizer was applied to the ground surfaces of both plantations during the May and June 2016 maintenance events. No further fertilizer application is planned until spring 2017.

Irrigation. No irrigation has been conducted since July 18, 2013. Irrigation during summer 2013 was reduced by approximately 58 percent when compared to the 2012 growing season, and no irrigation was conducted in 2014, 2015, or thus far during 2016, to maximize uptake of shallow-

aquifer groundwater by the trees. It is hoped that the reduced irrigation served to optimize metabolism of volatile organic compound contaminants (VOCs) through phytoremediation processes during the mid-summer to fall seasons. The drip irrigation system was winterized during the October 2013 plantations inspection and maintenance, and will not be activated again by Sealaska unless so directed by the Navy RPM for TO 13.

FUTURE ACTIVITIES

The following activities by Sealaska are planned at the tree plantations for August 29, 2016:

- Conduct the fourth of eight planned TO 27 2016-17 plantations inspections.
- Conduct grass and weed control.
- Remove dead branches from plantations.
- Cut and remove suckers.

REFERENCES

U.S. Navy. 2012. *Long-Term Monitoring Project Work Plans, Operable Units 1 and 2, Naval Base Kitsap, Keyport, Washington, Final, Revision 3.* Prepared by Sealaska Environmental Services, LLC (Sealaska) for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

U.S. Navy. 2012. *Revised Operation and Maintenance Plan for Phytoremediation at Operable Unit 1, Naval Undersea Warfare Center Division, Keyport, Washington. Final, Revision 2.* Prepared by Sealaska for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

JULY 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

INSPECTION FORMS

To 27
Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☒ South Plantation ☐ **Date:** 07/26/2016

Reason for Inspection:

Base Line ☐ Monthly Inspection ☒ Fertilization ☐ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Chipping ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: K. Watson, J. Ruef

Specific Inspection Activity:
- Tree health inspection
- Weed control activities

Inspection Results: Trees fully leafed out, with exterior-area trees having leaves top-to-bottom and most interior trees having leaves on upper 25% only, with a few exceptions. Leaf blight remains on <5% of leaves. No significant damage from tent caterpillars or other pests. Some leaves turning yellow (from green). Cracks previously noted in bark appear to remain free of pests. Some dead lower branches have fallen and were removed. Soil conditions dry to slightly moist, with no standing water. Weed/grass growth minimal since June inspection; used hand scythe + loppers + handpulling to cut/remove vegetation: grasses, dandelions, ivy, holly, blackberry, scotch broom. No damage to trees from lack of water or from humans was apparent. Vegetation around outside of fencing was cut back at least 5 feet. Pulled weeds placed in designated dumpster by Bldg. 824.

Further Action Recommended:
- Continued tree health inspections; +
- Weed control

Total Hours: 3.5 Office: Poulsbo, WA Inspector Jim Ruef
Field: N/A Correspondence: N/A Sheet 1 of 1
Mileage: N/A

Jamie Ruef 07/26/16

Routing: 1 Copy to Inspection File

TO 27
Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Date:** 07/26/2016

Reason for Inspection:

Base Line ☐ Monthly Inspection ☒ Fertilization ☐ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Chipping ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: K. Watson, J. Ruef

Specific Inspection Activity:
- Tree health inspection
- Weed control activities

Inspection Results: Trees fully leafed out, with exterior-area trees having leaves top-to-bottom and most interior trees with leaves on upper 25% only, with some exceptions. Leaf blight remains on 25% of leaves, with some leaves turning yellow (from green). Damage from tent caterpillars minimal, with no new sapsucker holes noted since the June inspection. The sapsucker holes in bark appear to remain free of pests, as do bark cracks previously noted. Several dead lower branches had fallen and were removed, along with a few suckers that were cut and removed. Soil conditions were dry to slightly moist, with no standing water. Weed/grass growth was minimal since the June inspection. Used hand scythe, loppers, and handpulling to cut/remove vegetation: grasses, dandelions, ivy, holly, blackberry, Scotch broom, alder. Pulled weeds placed in dumpster by Bldg. 824. Vegetation around outside of fencing was cut back at least 5 feet. No stress from lack of water or human damage to trees was apparent.

Further Action Recommended:
- Continued tree health inspections; and
- weed control

Total Hours: 3.5 Office: Poulsbo, WA Inspector Jim Ruef
Field: N/A Correspondence: N/A Sheet 1 of 1
Mileage: N/A

Jaymes Ruef 07/26/16

Routing: 1 Copy to Inspection File

AUGUST 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

INTRODUCTION

The August 2016 phytoremediation inspection for Naval Base Kitsap Keyport (NBK Keyport), Washington was conducted by Sealaska Environmental Services, LLC (Sealaska). The work was completed under the long-term monitoring and operations and maintenance (LTM/OM) Contract N44255-14-D-9011, Task Order (TO) 27. This report summarizes the field activities, results, and recommendations for the phytoremediation plantation inspection and maintenance completed by Sealaska on August 29, 2016 at Operable Unit (OU) 1 North and South Plantations. Completed field inspection forms are included as Attachment 1.

OBJECTIVE AND SCOPE

Tree health at the North and South Plantations has been monitored and maintained since the trees were planted in 1999. Sealaska has been tasked under TO 27 to conduct periodic inspections and maintenance tasks to ensure the health of the plantation trees. The inspection and maintenance requirements are described in Revision 3 of the Project Work Plans for OU 1 Long-Term Monitoring (LTM), Site Work Plan for OU 1 and the Operation and Maintenance (O&M) Plan for Phytoremediation at OU 1 (United States Navy 2012). This report summarizes the field activities conducted at the plantations during August 2016, and represents the fourth of eight planned phytoremediation inspection and maintenance events for TO 27 in 2016-17.

Inspection and maintenance activities have typically occurred in the past on a monthly basis during the growing seasons and once during the dormant season. The current plans and schedule call for the phytoremediation O&M events to be conducted eight times from May 2016 to February 2017, including May, June, July, August, September, and November 2016 and January and February 2017. Irrigation had been conducted as needed during late spring and summer through 2012 to supplement the low upper-aquifer permeability. During 2013, irrigation was restricted to the early summer to maximize groundwater uptake by the trees and, to that end, no watering has been conducted since July 18, 2013. No irrigation is planned for the remainder of TO 27, unless extremely dry and warm temperature conditions cause observable stress to the trees. Irrigation will only be conducted at the direction of the Navy's Remedial Project Manager (RPM) for NBK Keyport LTM.

Major nurturing and maintenance activities have been contracted by the Navy to other contractors. These activities may include herbicide and pesticide applications and major pruning. Systemic-pesticide application was conducted most recently by Peninsula Services during March 2010. There have been no significant pest infestations since the last pesticide application.

AUGUST 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

FIELD ACTIVITIES

The fourth of eight scheduled tree inspection and maintenance events for 2016-17 under TO 27 was conducted on August 29, 2016. Maintenance activities performed included weed and grass cutting, pulling and removal of weeds, inspection of tree health, and limited application of a root and tree health enhancement solution at a single location in the North Plantation to evaluate its effectiveness.

RESULTS

Observations made during the August 2016 inspections of the North and South Plantations at NBK Keyport Area 1 are summarized below.

General Tree Health. A thorough inspection of each plantation was completed and the overall health of the South Plantation trees appeared to be good, with leaves beginning their seasonal change of color from green to yellow. However, trees within the North Plantation, primarily along the eastern and northern margins and within interior areas of the plantation, exhibited loss of approximately 80 percent or more of their leaves. That occurrence is unusually early compared to observations of leaf abscission during the late summers and falls of previous years at both plantations and compared to the South Plantation tree conditions during August 2016. Stress from lack of water could be a factor, however much warmer temperatures and drier conditions during the summers of 2014 and 2015 did not result in similar early leaf abscission during the late summers of those years and no early leaf abscission was observed in the South Plantation in August 2016; therefore stress from lack of water does not appear to be the cause. In addition, observations of other deciduous trees in the Puget Sound area suggest that fall seasonal tree conditions have started earlier than in past years, as evidenced by apples ripening earlier and falling from their trees by late August rather than the usual timing for this occurrence of late September. No evidence of new pest infestations were observed. As observed during the June and July 2016 inspections, two smaller trees within the North Plantation appear to be dead and four trees have a dead secondary leader (i.e., second top). With some exceptions, most of the lowest branches on all the trees are dead, likely the result of very little direct sunlight beneath the canopy due to the relatively close spacing of the trees. A few suckers growing from shallow roots and tree stumps were present. No new holes in bark from Sapsucker activity appeared to be present (fifteen trees in the South Plantation had previous holes as noted during the June and July 2016 inspections). The holes appear to free of insects, and do not appear to be adversely affecting the trees. As observed during previous inspections, the bark on several of the lower tree

trunks in both plantations has cracked, likely resulting from past rapid temperature changes during fall and winter seasons. No insects or evidence of them appeared to be present in or around the cracks, or elsewhere on the trees.

Pruning. No major pruning was performed. Some of the remaining dead lower branches and some suckers growing from roots and tree stumps were pruned and removed from the plantations.

Pest Control. No insect infestations were observed. A systemic pesticide was last applied during March 2010 by Peninsula Services.

Weed Control. Growth of grasses and weeds leading up to the time of the August 2016 inspection was found to be minimal in and around both plantations. The most prolific weed and grass growth was primarily near the margins of the plantations and not under the plantation canopies. Hand-pulling techniques, scythes, and hand-tool loppers were used to cut and remove grasses and weeds within, as well as outside of perimeter fencing, of both plantations. Invasive species growth is minimized at both plantations by the removal of blackberry, ivy, holly, Scotch broom, salmonberry, laurel, and a few small maple and alder trees from the plantations. During August, invasive vegetation removed or cut inside the plantations consisted primarily of ivy, holly, and blackberry. The plantation-perimeter area weeds cut back or pulled and removed consisted primarily of blackberry and Scotch broom. Weeds that were pulled were placed in a designated dumpster located near the South Plantation. A few suckers growing from tree stumps and roots were present and were pruned. Dead lower branches, several of which had fallen from their tree trunks, were removed from the plantations. In an effort to prevent encroachment of weeds and other undesirable plants and trees, Sealaska cut back vegetation immediately surrounding the perimeter of the plantation fences in an approximately 5-foot or wider swath, and will continue to do so as needed during the upcoming fall tree inspections and maintenance scheduled for September and November 2016. No standing water was present, and surface soils were generally dry. No evidence of physical damage resulting from humans or animals was observed.

Fertilizer Application. Granulated high-nitrogen urea fertilizer was applied to the ground surfaces of both plantations during the May and June 2016 maintenance events. No further fertilizer application is planned until spring 2017. During August 2016 maintenance, two gallons of Advanced Biological Treatment (ABS) root and tree health enhancer was mixed with 100 gallons of Keyport drinking water and applied directly to the ground surface at the base of one

tree in the North Plantation. Because ABS is an oxidizer, to avoid impacting the reductive dechlorination occurring in the South Plantation, and to focus on an area with residual vinyl chloride that could benefit from oxidation and on a tree that could benefit from health enhancement, tree TC-10 in the North Plantation was selected for treatment. TC-10 is the northernmost tree in the third row east of the northwest corner of the plantation, and is located approximately 25 feet upgradient from groundwater monitoring well MW1-2. The ABS will be applied over three events occurring every 2 to 4 weeks; therefore 1.5 gallons of ABS mixed with 75 gallons of tap water will be applied at the same location (i.e., to the ground surface at tree TC-10) during September and October. It is hoped that the limited application of ABS solution will result in significant improvement to the overall health of tree TC-10, thereby improving its effectiveness in reducing volatile organic compounds (VOCs) in groundwater.

Irrigation. No irrigation has been conducted since July 18, 2013. Irrigation during summer 2013 was reduced by approximately 58 percent when compared to the 2012 growing season, and no irrigation was conducted in 2014, 2015, or thus far during 2016, to maximize uptake of shallow-aquifer groundwater by the trees. It is hoped that the reduced irrigation served to optimize metabolism of VOCs through phytoremediation processes during the mid-summer to fall seasons. The drip irrigation system was winterized during the October 2013 plantations inspection and maintenance, and will not be activated again by Sealaska unless so directed by the Navy RPM for TO 13.

FUTURE ACTIVITIES

The following activities by Sealaska are planned at the tree plantations for September 23, 2016:

- Conduct the fifth of eight planned TO 27 2016-17 plantations inspections.
- Conduct grass and weed control.
- Remove dead branches from plantations.
- Cut and remove suckers.
- Apply 1.5 gallons of root enhancer mixed with 75 gallons of Keyport drinking water to the ground area immediately surrounding North Plantation tree TC-10.

REFERENCES

U.S. Navy. 2012. *Long-Term Monitoring Project Work Plans, Operable Units 1 and 2, Naval Base Kitsap, Keyport, Washington, Final, Revision 3.* Prepared by Sealaska Environmental Services, LLC (Sealaska) for Naval Facilities Engineering Command

Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

U.S. Navy. 2012. *Revised Operation and Maintenance Plan for Phytoremediation at Operable Unit 1, Naval Undersea Warfare Center Division, Keyport, Washington. Final, Revision 2.* Prepared by Sealaska for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

AUGUST 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

INSPECTION FORMS

TO 27

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation [X] South Plantation [ ] **Date:** 08/29/2016

Reason for Inspection:

Base Line [ ] Monthly Inspection [X] Fertilization [ ] Weed Control [X] Pest Control [ ]
Irrigation [ ] Thinning and Pruning [ ] Chipping [ ] Field Meeting [ ]
Other [ ] _____

Inspection Attendants: J. Ruef, C. Alferness

Specific Inspection Activity:
- Tree health inspection.
- Weed control activities.
- Apply 2 gal's (diluted with 100 gal's tap water) ABS root enhancer to ground around N-most tree in 3rd row from NWC of plantation ("TC-10").

Inspection Results: Many trees along E & N borders and within interior areas of plantation have dropped 80% or more of their leaves. Trees near SEC and along S. & W. margins remain largely fully leafed out with mostly green leaves. Most ground surfaces covered with fallen leaves. Very minor weed occurrence (ivy, blackberry, holly) and minor grass growth have occurred since July 26, 2016 inspection. Pulled weeds placed in Bldg. 824 dumpster. No evidence of pest damage or human damage observed. Cracks in tree bark, as noted in the past, still prevalent. No standing water present. Soil dry and hard. Mixed 2 gal's. ABS liquid with 100 gal's tap water (from shed irrigation system) and applied to root ball area of TC-10 out to approx. 6' radius. Occurrence of large leaf droppage this early before onset of fall season is unusual; may be a result of very little rainfall since end of June, however exact cause not known.

Further Action Recommended Continued tree health inspection; weed control; apply ABS/water mix (1.5 gal. ABS/75 gal. water) to base of TC-10.

Total Hours: 2 Office: N/A Inspector Jim Ruef
Field: 2 Correspondence: N/A Sheet 1 of 1
Mileage: N/A

Jim Ruef 08/29/2016

Routing: 1 Copy to Inspection File

TO 27
Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Date:** 08/29/2016

Reason for Inspection:

Base Line ☐ Monthly Inspection ☒ Fertilization ☐ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Chipping ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: J. Ruef, C. Alferness

Specific Inspection Activity: • Tree health inspection
• Weed control activities

Inspection Results: Navy conducting subsurface drilling/sampling investigation. Most trees remain fully leafed, with some deer having fallen (approx 5-10%) mostly from trees within plantation interior areas. Weed and grass growth very minor (ivy, blackberry, holly) since July 26, 2016 inspection. Pulled weeds placed in Bldg. 824 dumpster. Cut back blackberries along outside pathway adjacent fence. Cracks in tree bark, as noted during previous inspections, still prevalent. No damage from humans or animals/pests noted, except for previously observed sap sucker holes in bark.

Further Action Recommended: Ground surface hard and dry, with no standing water. Leaves staying to turn yellow. Cut back suckers from Jan. 2016 fallen tree stump/roots and from other roots.

Continued tree health inspections; weed control; remove dead branches from in and adjacent plantations.

Total Hours: 1 Office: N/A
Field: 1 Correspondence: _____
Mileage: N/A

Inspector Jim Ruef
Sheet 1 of 1

James Ruef
8/29/2016

Routing: 1 Copy to Inspection File

SEPTEMBER 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

INTRODUCTION

The September 2016 phytoremediation inspection for Naval Base Kitsap Keyport (NBK Keyport), Washington was conducted by Sealaska Environmental Services, LLC (Sealaska). The work was completed under the long-term monitoring and operations and maintenance (LTM/OM) Contract N44255-14-D-9011, Task Order (TO) 27. This report summarizes the field activities, results, and recommendations for the phytoremediation plantation inspection and maintenance completed by Sealaska on September 23, 2016 at Operable Unit (OU) 1 North and South Plantations. Completed field inspection forms are included as Attachment 1.

OBJECTIVE AND SCOPE

Tree health at the North and South Plantations has been monitored and maintained since the trees were planted in 1999. Sealaska has been tasked under TO 27 to conduct periodic inspections and maintenance tasks to ensure the health of the plantation trees. The inspection and maintenance requirements are described in Revision 3 of the Project Work Plans for OU 1 Long-Term Monitoring (LTM), Site Work Plan for OU 1 and the Operation and Maintenance (O&M) Plan for Phytoremediation at OU 1 (United States Navy 2012). This report summarizes the field activities conducted at the plantations during September 2016, and represents the fifth of eight planned phytoremediation inspection and maintenance events for TO 27 in 2016-17.

Inspection and maintenance activities have typically occurred in the past on a monthly basis during the growing seasons and once during the dormant season. The current plans and schedule call for the phytoremediation O&M events to be conducted eight times from May 2016 to February 2017, including May, June, July, August, September, and November 2016 and January and February 2017. Irrigation had been conducted as needed during late spring and summer through 2012 to supplement the low upper-aquifer permeability. During 2013, irrigation was restricted to the early summer to maximize groundwater uptake by the trees and, to that end, no watering has been conducted since July 18, 2013. No irrigation is planned for the remainder of TO 27, unless extremely dry and warm temperature conditions cause observable stress to the trees. Irrigation will only be conducted at the direction of the Navy's Remedial Project Manager (RPM) for NBK Keyport LTM.

Major nurturing and maintenance activities have been contracted by the Navy to other contractors. These activities may include herbicide and pesticide applications and major pruning. Systemic-pesticide application was conducted most recently by Peninsula Services during March 2010. There have been no significant pest infestations since the last pesticide application.

SEPTEMBER 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

FIELD ACTIVITIES

The fifth of eight scheduled tree inspection and maintenance events for 2016-17 under TO 27 was conducted on September 23, 2016. Maintenance activities performed included weed and grass cutting, pulling and removal of weeds, inspection of tree health, and limited application (the second of three planned) of a root and tree health enhancement solution at a single location in the North Plantation to evaluate its effectiveness.

RESULTS

Observations made during the September 2016 inspections of the North and South Plantations at NBK Keyport Area 1 are summarized below.

General Tree Health. A thorough inspection of each plantation was completed and the overall health of the South Plantation trees appeared to be good, with leaves undergoing their seasonal change of color from green to yellow and having dropped approximately 25 percent of their leaves. As first noted during the August 29, 2016 inspection, trees within the North Plantation, primarily along the eastern and northern margins and within interior areas of the plantation, have undergone an earlier fall seasonal transition, with abscission of approximately 80 to 90 percent of their leaves. That occurrence is unusually early compared to observations of leaf abscission during the late summers and falls of previous years. However, observations of other deciduous trees in the Puget Sound area suggest that fall seasonal tree conditions (i.e., leaves yellowing and fruit and/or leaves falling) have started earlier than in past years. As first observed during the June 2016 inspection, two smaller trees within the North Plantation appear to be dead and four trees have a dead secondary leader (i.e., second top); no other trees appear to have died in either plantation. With some exceptions, most of the lowest branches on all the trees are dead, likely the result of very little direct sunlight beneath the canopy due to the relatively close spacing of the trees. A few suckers growing from shallow roots and tree stumps were present in the South Plantation. No new holes in bark from Sapsucker activity appeared to be present (fifteen trees in the South Plantation had previous holes as first noted during the June 2016 inspections). The holes appear to free of insects, and do not appear to be adversely affecting the trees. As observed during previous inspections over the past several years, the bark on many of the lower tree trunks in both plantations has cracked, likely resulting from past rapid temperature changes during fall and winter seasons. No insects or evidence of them appeared to be present in or around the cracks, or elsewhere on the trees.

Pruning. No major pruning was performed. Some of the remaining dead lower branches, and a few suckers growing from roots and tree stumps (South Plantation only), were pruned and removed from the plantations.

Pest Control. No insect infestations were observed. A systemic pesticide was last applied during March 2010 by Peninsula Services.

Weed Control. Growth of grasses and weeds leading up to the time of the September 2016 inspection was found to be light-to-moderate in and around both plantations. Grasses were approximately 4 to 6 inches in height. Most ground surfaces within the North Plantation were covered with fallen leaves. The most prolific weed and grass growth was primarily near the margins of the plantations and not under the plantation canopies. Hand-pulling techniques and hand-tool loppers were used to cut and remove grasses and weeds within, as well as outside of perimeter fencing, of both plantations. Invasive species growth is minimized at both plantations by the removal of blackberry, ivy, holly, Scotch broom, salmonberry, laurel, and small maple and alder trees from the plantations. During September, invasive vegetation removed or cut inside the plantations consisted primarily of ivy, holly, and blackberry. The plantation-perimeter area weeds cut back or pulled and removed consisted primarily of blackberry, ivy, with very few Scotch broom. Weeds that were pulled were placed in a designated dumpster at Building 824 located near the South Plantation. A few suckers growing from tree stumps and roots were present in the South Plantation and were pruned. Dead lower branches, several of which had fallen from their tree trunks, were removed from the plantations. In an effort to prevent encroachment of weeds and other undesirable plants and trees, Sealaska cut back vegetation immediately surrounding the perimeter of the plantation fences in an approximately 5-foot or wider swath, and will continue to do so as needed during the upcoming late-fall tree inspections and maintenance scheduled for November 2016. No standing water was present within or around the perimeter of the plantations, and surface soils were generally moist. No evidence of physical damage to the trees or plantation areas resulting from humans or animals was observed.

Fertilizer Application. Granulated high-nitrogen urea fertilizer was applied to the ground surfaces of both plantations during the May and June 2016 maintenance events. No further fertilizer application is planned until spring 2017. During the August and September 2016 maintenance events, Advanced Biological Treatment (ABS) root and tree health enhancer was applied to the ground surface at the base of a single tree in the North Plantation designated as TC-10. TC-10 is the northernmost tree in the third row east of the northwest corner of the plantation, and is located approximately 25 feet upgradient from groundwater monitoring well

MW1-2. In accordance with recommendations of the manufacture, the ABS liquid was mixed at the ratio of 1 gallon ABS with 50 gallons of Keyport drinking (tap) water (i.e., a 2-percent ABS-water solution) and applied directly to the ground surface at the base of tree TC-10. During the August and September 2016 O&M events, 100 gallons and 75 gallons of 2-percent ABS-water solution, respectively, was applied to the base of tree TC-10. A final application (the third of three) of 75 gallons of 2-percent ABS-water solution is planned for October 20, 2016. It is hoped that the limited application of ABS solution will result in significant improvement to the overall health of tree TC-10, thereby improving its effectiveness in reducing volatile organic compounds (VOCs) in groundwater. Evaluation of the effectiveness of the ABS application in improving the health of tree TC-10, and its effect on enhancing biodegradation of VOCs in groundwater at well MW1-2, will be made through observations during inspections conducted throughout the spring, summer, and fall of 2017 and following spring groundwater sampling. Recommendations with respect to further application of ABS at tree TC-10 and/or other appropriate areas of OU 1 will be based upon those results.

Irrigation. No irrigation has been conducted since July 18, 2013. Irrigation during summer 2013 was reduced by approximately 58 percent when compared to the 2012 growing season, and no irrigation was conducted in 2014, 2015, or thus far during 2016, to maximize uptake of shallow-aquifer groundwater by the trees. It is hoped that the reduced irrigation served to optimize metabolism of VOCs through phytoremediation processes during the mid-summer to fall seasons. Because the drip irrigation system was activated to provide tap water for general use (not irrigation) during summer 2016 drilling and maintenance activities, the entire system will be winterized during the upcoming November 2016 plantations inspection and maintenance event. The irrigation system will not be activated again for irrigation purposes unless so directed by the Navy RPM for NBK Keyport.

FUTURE ACTIVITIES

The following activities by Sealaska are planned at the tree plantations for October 20, 2016:

- Conduct the third of three applications of ABS (2-percent solution) at tree TC-10.

The following activities by Sealaska are planned at the tree plantations for November 22, 2016:

- Conduct the sixth of eight planned TO 27 2016-17 plantations inspections.
- Conduct grass and weed control.
- Remove dead branches from plantations.

- Cut and remove suckers.
- Winterize the irrigation system (blow residual water out of the pipes using compressed air).

REFERENCES

U.S. Navy. 2012. *Long-Term Monitoring Project Work Plans, Operable Units 1 and 2, Naval Base Kitsap, Keyport, Washington, Final, Revision 3.* Prepared by Sealaska Environmental Services, LLC (Sealaska) for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

U.S. Navy. 2012. *Revised Operation and Maintenance Plan for Phytoremediation at Operable Unit 1, Naval Undersea Warfare Center Division, Keyport, Washington. Final, Revision 2.* Prepared by Sealaska for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

SEPTEMBER 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

INSPECTION FORMS

To 27

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☒ South Plantation ☐ **Date:** 09/23/16

Reason for Inspection:

Base Line ☐ Monthly Inspection ☒ Fertilization ☐ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Chipping ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: J. Ruef, K. Watson

Specific Inspection Activity: Tree health inspection; weed control; application of 1.5 gal's. (diluted with 75 gal's tap water) ABS root/bio enhancer to ground surface at base of tree TC-10 (N-most tree in 3rd row E. of NWC of N. Plantation).

Inspection Results: Tree appearance similar to Aug. 2016 inspection. Leaves yellowing with approx. 80-90% having dropped, except border trees along W and S. margins of plantation which have dropped approx. 25% of leaves. Cracks in bark on lower trunk areas appear free of pests. No additional dead trees beyond the two noted in June 2016. Ground surfaces moist; no standing water. Weed occurrence light-to-moderate; mostly ivy, holly, and blackberry. No suckers seen. Very few fallen dead lower branches removed to areas outside of plantation. Cut back vegetation around outside of fencing at least 5'. Pulled weeds inside plantation and disposed in Bldg. BZ4 dumpster. Mixed 1.5 gal's. ABS liquid with 75 gal's. Keyport's tap water and applied to ground surface around tree TC-10.

Further Action Recommended: In 3-4 weeks, apply final 1.5 gal's ABS fluid (mixed with 75 gal's water) to tree TC-10. Conduct scheduled late Nov. inspections/weed control. Winterize the irrigation system (blow out water from piping).

Total Hours: 3.5 Office: N/A Inspector J. Ruef
Field: 3.5 Correspondence: N/A Sheet 1 of 1
Mileage: N/A

James Ruef 09/23/16

Routing: 1 Copy to Inspection File

To 27

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Date:** 09/23/16

Reason for Inspection:

Base Line ☐ Monthly Inspection ☒ Fertilization ☐ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Chipping ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: J. Ruef, K. Watson

Specific Inspection Activity: Tree health inspection; weed control.

Inspection Results: Leaves yellowing with approx. 25% having fallen. No damage from pests or mast observed (no new sap sucker holes in bark seen). Cracks remain in lower trunk areas, but have not worsened, and no pests/insects seen around openings. Ground surfaces/soils moist; no standing water present. Weeds light-to-moderate, mostly ivy, holly, and blackberry. Pulled weeds and disposed in Bldg. 6321 dumpster. Cut back weeds around outside of fencing at least 5'. Cut back several suckers from stumps and roots. Fallen dead lower branches removed to areas outside plantation. Approx. 20' of fencing remains open (from Navy drilling in July 2016). Gate lock latch out of alignment; not locked (from soil in post hole during Navy drilling work - needs to be cleaned out to lock.

Further Action Recommended: Continued tree health inspections and weed control. Winterize the irrigation system (blow out water from piping).

Total Hours: 3 Office: N/A Inspector J. Ruef
Field: 3 Correspondence: N/A Sheet 1 of 1
Mileage: N/A

James Ruef 09/23/16

Routing: 1 Copy to Inspection File

NOVEMBER 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

INTRODUCTION

The November 2016 phytoremediation inspection for Naval Base Kitsap Keyport (NBK Keyport), Washington was conducted by Sealaska Environmental Services, LLC (Sealaska). The work was completed under the long-term monitoring and operations and maintenance (LTM/OM) Contract N44255-14-D-9011, Task Order (TO) 27. This report summarizes the field activities, results, and recommendations for the phytoremediation plantation inspection and maintenance completed by Sealaska on November 22, 2016 at Operable Unit (OU) 1 North and South Plantations. Completed field inspection forms are included as Attachment 1.

OBJECTIVE AND SCOPE

Tree health at the North and South Plantations has been monitored and maintained since the trees were planted in 1999. Sealaska has been tasked under TO 27 to conduct periodic inspections and maintenance tasks to ensure the health of the plantation trees. The inspection and maintenance requirements are described in Revision 3 of the Project Work Plans for OU 1 Long-Term Monitoring (LTM), Site Work Plan for OU 1 and the Operation and Maintenance (O&M) Plan for Phytoremediation at OU 1 (United States Navy 2012). This report summarizes the field activities conducted at the plantations during November 2016, and represents the sixth of eight planned phytoremediation inspection and maintenance events for TO 27 in 2016-17.

Inspection and maintenance activities have typically occurred in the past on a monthly basis during the growing seasons and once during the dormant season. The current plans and schedule call for the phytoremediation O&M events to be conducted eight times from May 2016 to February 2017, including May, June, July, August, September, and November 2016 and January and February 2017. Irrigation had been conducted as needed during late spring and summer through 2012 to supplement the low upper-aquifer permeability. During 2013, irrigation was restricted to the early summer to maximize groundwater uptake by the trees and, to that end, no watering has been conducted since July 18, 2013. No irrigation is planned for the remainder of TO 27, unless extremely dry and warm temperature conditions cause observable stress to the trees. Irrigation will only be conducted at the direction of the Navy's Remedial Project Manager (RPM) for NBK Keyport LTM.

Major nurturing and maintenance activities have been contracted by the Navy to other contractors. These activities may include herbicide and pesticide applications and major pruning. Systemic-pesticide application was conducted most recently by Peninsula Services during March 2010. There have been no significant pest infestations since the last pesticide application.

NOVEMBER 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

FIELD ACTIVITIES

The sixth of eight scheduled tree inspection and maintenance events for 2016-17 under TO 27 was conducted on November 22, 2016. Maintenance activities performed included pulling and removal of weeds, inspection of tree health, and winterization of the drip irrigation system.

RESULTS

Observations made during the November 2016 inspections of the North and South Plantations at NBK Keyport Area 1 are summarized below.

General Tree Health. A thorough inspection of each plantation was completed and the overall health of the North and South Plantation trees appeared to be good. The trees had dropped approximately 90 percent of their leaves, typical for conditions during the mid-fall season. As first observed during the June 2016 inspection, two smaller trees within the North Plantation appear to be dead. A single tree near the southeast corner of the South Plantation had up-rooted and partially fallen in late December 2015; the tree was later cut down and removed during winter 2016. Two large trees located near the eastern margin of the South Plantation that presented a potential fall hazard to humans and overhead utility wires were cut and removed by a NAVFAC Northwest subcontractor prior to the November 22, 2016 maintenance event. No other trees appear to have died in either plantation since the previous inspection. With some exceptions, most of the lowest branches on all the trees are dead, likely the result of very little direct sunlight beneath the canopy due to the relatively close spacing of the trees. No suckers growing from shallow roots and tree stumps were present in either plantation. No new holes in bark from Sapsucker activity appeared to be present (fifteen trees in the South Plantation had previous holes as first noted during the June 2016 inspections). The holes appear to free of insects, and do not appear to be adversely affecting the trees. As observed during previous inspections over the past several years, the bark on many of the lower tree trunks in both plantations has cracked, likely resulting from past rapid temperature changes during fall and winter seasons. No evidence of the presence of insects was observed in or around the cracks, or elsewhere on the trees.

Pruning. No major pruning was performed.

Pest Control. No insect infestations were observed. A systemic pesticide was last applied during March 2010 by Peninsula Services.

Weed Control. Growth of grasses and weeds leading up to the time of the November 2016 inspection was found to be light-to-moderate in and around both plantations. Grasses were approximately 4 to 6 inches in height. Most ground surfaces were covered with fallen leaves. The most prolific weed and grass growth was primarily near the margins of the plantations and not under the plantation canopies. Hand-pulling techniques and hand-tool loppers were used to cut and remove weeds within, as well as outside of perimeter fencing, of both plantations. Invasive species growth is minimized at both plantations by the removal of blackberry, ivy, holly, Scotch broom, salmonberry, laurel, and small maple and alder trees from the plantations. During November, invasive vegetation removed or cut inside the plantations consisted primarily of ivy, holly, and blackberry, with a few laurel and maple. Weeds that were pulled were placed in a designated dumpster at Building 824 located near the South Plantation. Dead lower branches, several of which had fallen from their tree trunks, were removed from the plantations. In an effort to prevent encroachment of weeds and other undesirable plants and trees, Sealaska cut back vegetation immediately surrounding the perimeter of the plantation fences in an approximately 5-foot or wider swath, and will continue to do so if needed during the upcoming winter tree inspection and maintenance scheduled for January 5, 2017. The few plantation-perimeter area weeds cut back or pulled and removed consisted primarily of blackberry and ivy. Standing water was present along the northeastern margin and at the northwest corner of the North Plantation. Surface soils were generally very moist to wet. No evidence of stress or physical damage to the trees or plantation areas resulting from humans or animals, other than the two trees cut and removed from the South Plantation, was observed.

Fertilizer Application. Granulated high-nitrogen urea fertilizer was applied to the ground surfaces of both plantations during the May and June 2016 maintenance events. No further fertilizer application is planned until spring 2017. During August, September, and October 2016, Advanced Biological Treatment (ABS) root and tree health enhancer was applied to the ground surface at the base of a single tree in the North Plantation designated as TC-10. TC-10 is the northernmost tree in the third row east of the northwest corner of the plantation, and is located approximately 25 feet upgradient from groundwater monitoring well MW1-02. In accordance with recommendations of the manufacturer, the ABS liquid was mixed at the ratio of 1 gallon ABS with 50 gallons of Keyport drinking (tap) water (i.e., a 2-percent ABS-water solution) and applied directly to the ground surface at the base of tree TC-10. A total of 250 gallons of 2-percent ABS-water solution was applied to the base of tree TC-10 over the course of the three events. It is hoped that the limited application of ABS solution will result in significant improvement to the overall health of tree TC-10, thereby improving its effectiveness in reducing

volatile organic compounds (VOCs) in groundwater. Evaluation of the effectiveness of the ABS application in improving the health of tree TC-10, and its effect on enhancing biodegradation of VOCs in groundwater at well MW1-02, will be made through observations during inspections conducted throughout the spring, summer, and fall of 2017 and following spring 2017 groundwater sampling. Recommendations with respect to further application of ABS at tree TC-10 and/or other appropriate areas of OU 1 will be based upon those results.

Irrigation. No irrigation has been conducted since July 18, 2013. Irrigation during summer 2013 was reduced by approximately 58 percent when compared to the 2012 growing season, and no irrigation was conducted in 2014, 2015, or thus far during 2016, to maximize uptake of shallow-aquifer groundwater by the trees. It is hoped that the reduced irrigation served to optimize metabolism of VOCs through phytoremediation processes during the mid-summer to fall seasons. Because the drip irrigation system was activated to provide tap water for general use (not irrigation) during summer 2016 drilling and maintenance activities, the entire system was winterized during the November 22, 2016 inspection and maintenance event. All irrigation system valves within the plantations were opened, and compressed air was then blown through the system piping for an hour to eject water from the system. The plantation piping valves were then closed. The irrigation system will not be activated again for irrigation purposes unless so directed by the Navy RPM for NBK Keyport.

FUTURE ACTIVITIES

The following activities by Sealaska are planned at the tree plantations for January 5, 2017:

- Conduct the seventh of eight planned TO 27 2016-17 plantations inspections.
- Conduct grass and weed control.
- Remove dead branches from plantations.

REFERENCES

U.S. Navy. 2012. *Long-Term Monitoring Project Work Plans, Operable Units 1 and 2, Naval Base Kitsap, Keyport, Washington, Final, Revision 3.* Prepared by Sealaska Environmental Services, LLC (Sealaska) for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

U.S. Navy. 2012. *Revised Operation and Maintenance Plan for Phytoremediation at Operable Unit 1, Naval Undersea Warfare Center Division, Keyport, Washington. Final, Revision 2.* Prepared by Sealaska for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

NOVEMBER 2016 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

INSPECTION FORMS

Sealaska
TO 27

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☒ South Plantation ☐ **Date:** 11/22/2016

Reason for Inspection:

Base Line ☐ Monthly Inspection ☒ Fertilization ☐ Weed Control ☒ Pest Control ☐
Irrigation ☒ Thinning and Pruning ☐ Chipping ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: S. PATTERSON, K. WATSON

Specific Inspection Activity:
- INSPECTION OF TREE HEALTH
- WEED CONTROL ACTIVITIES
- IRRIGATION SYSTEM WINTERIZATION

Inspection Results: FEW LEAVES REMAIN ON THE TREES, OVER 90% OF THE LEAVES HAVE DROPPED, TYPICAL FOR THE TIME OF YEAR. A FEW BROKEN BRANCHES WERE REMOVED FROM THE PLANTATION, LIKELY CAUSED BY WIND. CRACKS IN BARK OF TREE TRUNKS LIKELY DUE TO RAPID CHANGES IN TEMPERATURE OR MOISTURE. CRACKS APPEAR TO BE FREE OF INSECTS. CRACKS NOTED IN PREVIOUS INSPECTIONS. NO SIGNS OF PHYSICAL DAMAGE CAUSED BY HUMANS, ANIMALS, OR INSECTS. GROUND IS MOIST WITH TWO SMALL AREAS OF STANDING WATER: EASTERN EDGE AND NORTHWEST CORNER. NO OTHER SIGNS OF STRESS, DEFICIENCY OR DISEASE WERE NOTED. WEED GROWTH LIGHT TO MODERATE. INVASIVE SPECIES REMOVED INCLUDED: BLACKBERRY, HOLLY, IVY, LAUREL, MAPLE. NO SUCKERS OBSERVED. DISPOSED OF PULLED WEEDS IN BUILDING 824 DUMPSTER. OPENED ALL VALVES, FUNCTIONAL, CONNECTED AIR COMPRESSOR ALLOWED AIR COMPRESSOR TO RUN FOR OVER 1 HOUR. CLOSED ALL VALVES.

Further Action Recommended:
- CONTINUED MONITORING OF TREE HEALTH
- CONTINUED WEED CONTROL ACTIVITIES

Total Hours: 4 Office: POULSBO, WA N/A Inspector S.P., K.W.
Field: 4 Correspondence: N/A Sheet 1 of 1
Mileage: N/A

VMP 11/22/2016

Routing: 1 Copy to Inspection File

Sealaska
TO 27

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Date:** 11/22/2016

Reason for Inspection:

Base Line ☐ Monthly Inspection ☒ Fertilization ☐ Weed Control ☒ Pest Control ☐
Irrigation ☒ Thinning and Pruning ☐ Chipping ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: S. PATTERSON, K. WATSON

Specific Inspection Activity:
- INSPECTION OF TREE HEALTH
- WEED CONTROL ACTIVITIES
- IRRIGATION SYSTEM WINTERIZATION

Inspection Results: TWO TREES HAVE BEEN REMOVED. REMAINING TREES HAVE ONLY A FEW LEAVES REMAINING. OVER 90% OF THE LEVES HAVE DROPPED, TYPICAL FOR THE TIME OF YEAR. A FEW BROKEN BRANCHES WERE REMOVED FROM THE PLANTATION, LIKELY CAUSED BY WIND. AS NOTED IN PREVIOUS INSPECTIONS SOME TREE TRUNKS CONTAIN CRACKS AND/OR SAP SUCKER HOLES, NO NEW ONES NOTED. CRACKS APPEAR FREE OF INSECTS NO ADDITIONAL SIGNS OF DAMAGE CAUSED BY HUMANS, ANIMALS, OR INSECTS NOTED. GROUND IS MOIST WITH NO AREAS OF STANDING WATER, BUT THE AREA NEAR THE GATE IS VERY MUDDY, NO OTHER SIGNS OF STRESS DEFICIENCY OR DISEASE NOTED. WEED GROWTH MINIMAL. INVASIVE/UNWANTED SPECIES REMOVED INCLUDED: BLACK BERRY, HOLLY, IVY, LAUREL, MAPLE. NO SUCKERS OBSERVED. DISPOSED OF PULLED VEGETATION IN BUILDING 824 DUMPSTER. OPENED ALL FUNCTIONAL VALVES CONNECTED AIR COMPRESSOR. AND ALLOWED AIR COMPRESSOR TO RUN FOR OVER 1 HOUR. APPROX 20FT OF FENCING REMAINS OPEN FROM NAVY DRILLING IN JULY 2016. GATE NOT LOCKED HOLES OUT OF ALIGNMENT SOIL IN FENCE POST HOLE FROM NAVY DRILLING JULY 2016, NEEDS TO BE CLEANED OUT TO LOCK.

Further Action Recommended:
- CONTINUED MONITORING OF TREE HEALTH
- CONTINUED WEED CONTROL

Total Hours: 4 Office: POULSBO, WA NA Inspector S.P, K.W.
Field: 4 Correspondence: NA Sheet 1 of 1
Mileage: NA

VAP 11/22/2016

Routing: 1 Copy to Inspection File

APPENDIX C

TIDE GATE INSPECTION REPORTS

(PROVIDED ON DISC)

MAY 2016 TIDE GATE INSPECTION REPORT

NAVAL BASE KITSAP AT KEYPORT

OPERABLE UNIT 1

INTRODUCTION

This report documents the spring 2016 inspection and maintenance of the tide gate at Operable Unit (OU) 1, Naval Base Kitsap (NBK) Keyport, Keyport, Washington. The work was conducted by Sealaska Environmental Services, LLC (Sealaska) under long-term monitoring / operations and maintenance (LTM/OM) Contract N44255-14-D-9011, Task Order (TO) 27. Maintenance, inspection, and monitoring was conducted in accordance with the O&M Plan (U.S. Navy 2012). Sealaska performed tide gate cleaning and inspection, as well as monitoring operation through a high-tide cycle, on May 23, 2016. The tide gate was found to be in good condition and performed as designed during operational monitoring through a high tide.

INSPECTION AND MAINTENANCE

Inspection and maintenance of the OU 1 tide gate at NBK Keyport was performed on May 23, 2016 during low tide. Sealaska completed hand scraping and removal of barnacles, mussels, silt, seaweed, and branches/twigs on all accessible exterior surfaces, floats, side door interiors, accessible interior portions of the culvert (within approximately 4 feet of the door), and on the upper culvert security gate. The tide gate, upper culvert security gate, and surrounding structures were scraped free of marine growth. The vacuum break vent was observed to be clear of debris and in good working order. Small cracks in the top of the vent, present for several years, do not affect the operation of the tide gate and therefore requires no additional maintenance or repair. Some minor pitting of the upper surface of the metal frame assembly exists, as noted during previous inspections, but this condition requires no additional maintenance or repair at this time. All tide gate components were intact and appeared to be in good condition. Field forms documenting this activity are presented in Attachment 1.

TIDE GATE OPERATION

The tide gate operation was monitored through a high tide cycle on May 23, 2016. Temporary staff gauges were installed on both sides of the tide gate culvert and tide gate operation was monitored from 2.5 hours before high tide to 1.5 hours after high tide. Table 1 presents results of the monitoring (in which “Tide Flats” refers to the seaward side/tide gate and “Marsh” refers to the landward side/upper culvert). Water level measurements were recorded every half hour on both sides of the tide gate. A high tide of 11.6 feet at 1958 hours (7:58 pm) was predicted for May 23, 2016 on the web site http://tidesandcurrents.noaa.gov/noaatidepredictions for the

"Poulsbo, Liberty Bay" location, with other predicted tide levels in Table 1 estimated from a tide chart.

As summarized in Table 1, measurements of water levels and observations of tide gate position documented the transition of the tide gate from an open position to a closed position. The tide gate fully closed with no oscillation at 1801 hours at a water level of 2.82 feet above the tide-gate invert (i.e., on the Tide Flats side of the gate). This operation matched expectations from design and previous observations that the gate should close when the incoming tide reaches approximately 3 feet above the tide gate invert. Water levels remained stable on the marsh side of the tide gate following closure, indicating negligible leakage into the culvert and marsh through the closed gate. The tide gate appears to be preventing tidal flooding of the marsh, which could otherwise cause erosion of the former landfill and possibly adversely affect the health of the trees within the plantations.

Table 1. May 23, 2016 Tide Gate Monitoring.

Time	Predicted Tide Level (feet MSL)	Tide Flats (feet above invert)	Marsh (feet above invert)	Notes
17:28	7.9	1.44	2.28	2.5 hours before high tide
17:58	9.1	2.61	3.42	Tide gate fully closed with no oscillation at 18:01
18:28	10.1	3.59	2.83	
18:58	10.7	4.20	2.88	
19:28	11.1	4.61	2.87	
19:58	11.6	4.70	2.88	High tide
20:28	11.3	4.61	2.88	
20:58	10.9	4.35	2.90	
21:28	10.3	4.05	2.90	

SUMMARY AND CONCLUSIONS

Cleaning of the tide gate and related components May 23, 2016 removed barnacles and mussels (moderate to extensive growth) that had attached and grown since the previous cleaning in February 2016 as well as seaweed and small branches. A thin layer of sediment at the top of the tide gate and on other tide-gate component surfaces was removed. All components of the tide gate were found to be intact and functioning. Observations of the tide gate performance through a high tide cycle on May 23, 2016 confirmed that the tide gate closed as designed, preventing flow of salt water into the marsh areas at high tide.

The next tide gate maintenance, inspection, and monitoring event is scheduled for August 29, 2016.

REFERENCE

U.S. Navy. 2012. *Long-Term Monitoring Project Work Plans, Operable Units 1 and 2, Naval Base Kitsap, Keyport, Washington, Final, Revision 3.* Prepared by Sealaska Environmental Services, LLC (Sealaska) for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

MAY 2016 TIDE GATE INSPECTION REPORT

NAVAL BASE KITSAP AT KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

TIDE GATE INSPECTION AND MAINTENANCE FORM

Sealaska 3 Pages

TIDE GATE INSPECTION AND MAINTENANCE FORM

Keyport OU 1 Tide Gate at Tide Flats

Date/time: 05/23/2016

Tidal Condition: Low: -1.43 @ 1750 High: 11.63 @ 1958

Weather Condition: OVERCAST, LIGHT WIND

FIELD INSPECTION

1) **Any visible damage to the tide gate, concrete collar and/or the culvert?** X **Yes** ___ **No**

If yes, describe damage and recommended action(s):
SMALL PITS WERE OBSERVED ON THE TIDE GATE. THE PITS ARE NOT AFFECTING THE WORKING CONDITION OR INTEGRITY OF THE TIDE GATE AND NOT REQUIRE ANY ACTION AT THIS TIME

2) **Are the back floats in good working conditions?** X **Yes** _____ **No**

If not, describe problem and recommended actions: NA

3) **Inspect the condition of the vacuum break vent. Describe condition and recommended action(s):** TWO SMALL, PREVIOUSLY DOCUMENT, CRACKS WERE OBSERVED AT THE TOP OF THE VENT. SILT BUILD UP WITH BARNACLES AND MUSSELS WERE REMOVED DURING MAINTENANCE. NO ADDITIONAL ACTIONS REQUIRED AT THIS TIME.

4) **Are all moving parts of the tide gate in good working orders?** X **Yes** _____ **No**

If no, describe the condition and recommended action: NA

5) **Are plastic isolation sleeves and washers at contact points in good conditions?**
X **Yes** _____ **No** **If no, describe condition and recommended action(s)**

NA

6) **Is the security gate at upper end of culvert in place and without damage?**

__X__ **Yes** _____ **No** **If no, describe recommended action** NA

7) **Is the paint in good condition?** __X__ **Yes** _____ **No** **If no, describe condition and recommended action(s)**

NA

8) **Any debris lodged or accumulated on the tide gate or culvert?** __X__ **Yes** ___ **No**

If yes, describe the maintenance action in the Field Maintenance Section below

9) **Check the water elevation above the tide gate invert when the gate begins closing: Elevation:** 2.82 **. Does the measured elevation match (or is it close to) the design water elevation for gate closure?** __X__ **Yes** ___ **No**

If no, describe the recommended action NA

10) **Record time, water level measurements and predicted tidal levels**

Time	Predicted Tide Level	Water elevation above upper culvert	Water elevation at tide gate	
1728	7.9	2.28	1.44	
1758	9.1	3.42	2.61	
1828	10.1	2.83	3.59	
1858	10.7	2.88	4.20	
1928	11.1	2.87	4.61	
1958	11.63	2.88	4.70	HIGH TIDE
2028	11.3	2.88	4.61	
2058	10.9	2.90	4.35	
2128	10.3	2.90	4.05	
1801	TIDE GATE CLOSED	3.48	2.82	(NO OSCILLATION)

FIELD MAINTENANCE

Were field maintenance actions required during this inspection? X **Yes** ___ **No**

If yes, continue to complete the rest of the form.

11) Describe the maintenance action(s) conducted:

REMOVED BARNACLES, MUSSLES, SILT, SEDIMENT & SEAWEED FROM THE OUTSIDE AND INSIDE OF TIDE GATE, USING SCRAPING TOOLS AND BRUSHES

Inspector's Signature 05/23/14 **Date**

FOLLOW-UP REPAIR AND/OR RE-INSPECTION

Do the inspection and field maintenance actions require repair and re-inspection at a later date? ___ **Yes** X **No** **If yes, describe the follow up action and resolution:**

Repair and/or Re-inspection conducted by:

Organization **Signature** **Date**

AUGUST 2016 TIDE GATE INSPECTION REPORT

NAVAL BASE KITSAP AT KEYPORT

OPERABLE UNIT 1

INTRODUCTION

This report documents the summer 2016 inspection and maintenance of the tide gate at Operable Unit (OU) 1, Naval Base Kitsap (NBK) Keyport, Keyport, Washington. The work was conducted by Sealaska Environmental Services, LLC (Sealaska) under long-term monitoring / operations and maintenance (LTM/OM) Contract N44255-14-D-9011, Task Order (TO) 27. Maintenance, inspection, and monitoring was conducted in accordance with the O&M Plan (U.S. Navy 2012). Sealaska performed tide gate cleaning and inspection, as well as monitoring operation through a high-tide cycle, on August 29, 2016. The tide gate was found to be in good condition and performed as designed during operational monitoring through a high tide.

INSPECTION AND MAINTENANCE

Inspection and maintenance of the OU 1 tide gate at NBK Keyport was performed on August 29, 2016 during low tide. Sealaska completed hand scraping and removal of barnacles, mussels, silt, seaweed, leaves, and branches/twigs on all accessible exterior surfaces, floats, side door interiors, accessible interior portions of the culvert (within approximately 4 feet of the door), and on the upper culvert security gate. The tide-gate side floats (i.e., vertical floats located in the tide-gate frame) were slightly sticking due to growth of barnacles. Because the vertical floats only serve as dampers to attenuate tide-gate door oscillation during closure at high tide, this condition does not prevent the door from closing when the seawater level reaches approximately 3 feet above the tide gate invert. The tide gate, upper culvert security gate, and surrounding structures were scraped free of marine growth. The vacuum break vent was observed to be clear of debris and in good working order. Small cracks in the top of the vent, present for several years, do not affect the operation of the tide gate and therefore requires no additional maintenance or repair. Some minor pitting of the upper surface of the metal frame assembly exists, as noted during previous inspections, but this condition requires no additional maintenance or repair at this time. All tide gate components were intact and appeared to be in good condition. Field forms documenting this activity are presented in Attachment 1.

TIDE GATE OPERATION

The tide gate operation was monitored through a high tide cycle on August 29, 2016. Temporary staff gauges were installed on both sides of the tide gate culvert and tide gate operation was monitored from approximately 2.5 hours before high tide to 1.5 hours after high tide. Table 1 presents results of the monitoring (in which “Tide Flats” refers to the seaward side/tide gate and

"Marsh" refers to the landward side/upper culvert). Water level measurements were recorded every half hour on both sides of the tide gate. A high tide of 11.4 feet at 1653 hours (4:53 pm) was predicted for August 29, 2016 on the web site http://tidesandcurrents.noaa.gov/noaatidepredictions for the "Poulsbo, Liberty Bay" location, with other predicted tide levels in Table 1 estimated from a tide chart.

As summarized in Table 1, measurements of water levels and observations of tide gate position documented the transition of the tide gate from an open position to a closed position. The tide gate began oscillation at 1451 hours at a water level of 2.84 feet above the tide-gate invert and fully closed 9 minutes later at 1500 hours at a water level of 3.02 feet above the tide-gate invert (i.e., on the Tide Flats side of the gate). This operation matched expectations from design and previous observations that the gate should close when the incoming tide reaches approximately 3 feet above the tide-gate invert. Water levels remained stable on the marsh side of the tide gate following closure, indicating negligible leakage into the culvert and marsh through the closed gate. The tide gate appears to be preventing tidal flooding of the marsh, which could otherwise cause erosion of the former landfill and possibly adversely affect the health of the trees within the plantations.

Table 1. August 29, 2016 Tide Gate Monitoring.

Time	Predicted Tide Level (feet MSL)	Tide Flats (feet above invert)	Marsh (feet above invert)	Notes
14:35	9.0	2.20	2.52	Approx. 2.5 hours before high tide
14:53	9.6	2.88	3.02	Tide gate fully closed at 15:00
15:23	10.4	3.70	2.48	
15:53	10.7	4.28	2.51	
16:23	11.2	4.58	2.52	
16:53	11.4	4.58	2.52	High tide
17:23	11.2	4.44	2.54	
17:53	10.7	4.12	2.58	
18:23	9.8	3.52	2.60	

SUMMARY AND CONCLUSIONS

Cleaning of the tide gate and related components August 29, 2016 removed barnacles and mussels (moderate to extensive growth) that had attached and grown since the previous cleaning in February 2016 as well as seaweed, leaves and small branches/twigs. A thin layer of sediment at the top of the tide gate and on other tide-gate component surfaces was removed. All components of the tide gate were found to be intact and functioning, with the exception of the side floats (vertical floats located in the tide-gate frame) slightly sticking due to barnacle growth. Barnacles were removed from the side floats and their sleeves to allow the side floats to freely slide up and down during high-low tide cycles. As previously discussed, this condition does not prevent the tide-gate door from closing during high tide when the seawater level reaches approximately 3 feet above the tide gate invert. Observations of the tide gate performance through a high tide cycle on August 29, 2016 confirmed that the tide gate closed as designed, preventing flow of salt water into the marsh areas at high tide.

The next tide gate maintenance, inspection, and monitoring event is scheduled for November 21, 2016.

REFERENCE

U.S. Navy. 2012. *Long-Term Monitoring Project Work Plans, Operable Units 1 and 2, Naval Base Kitsap, Keyport, Washington, Final, Revision 3.* Prepared by Sealaska Environmental Services, LLC (Sealaska) for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

AUGUST 2016 TIDE GATE INSPECTION REPORT

NAVAL BASE KITSAP AT KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

TIDE GATE INSPECTION AND MAINTENANCE FORM

To 27

Sealaska 3 Pages

TIDE GATE INSPECTION AND MAINTENANCE FORM

Keyport OU 1 Tide Gate at Tide Flats

Date/time: 08/29/2016 – clean: 0800 & monitor: 1430

Tidal Condition: Low: -0.6' 0933 / High: 11.4' 1653

Weather Condition: Sunny; 58°-76°, light breeze.

FIELD INSPECTION

1) **Any visible damage to the tide gate, concrete collar and/or the culvert?** ___Yes X No

If yes, describe damage and recommended action(s):
Some minor pitting of paint and metal surfaces. Does not require further action at this time.

2) **Are the back floats in good working conditions?** X Yes _____ No

If not, describe problem and recommended actions: _____

3) **Inspect the condition of the vacuum break vent. Describe condition and recommended action(s):** Small cracks at top of vent pipe are insignificant and do not affect operation.

4) **Are all moving parts of the tide gate in good working orders?** X Yes _____ No

If no, describe the condition and recommended action: Side floats slightly sticking in place. Removed barnacles which allowed ~~feet~~ free movement of floats.

5) **Are plastic isolation sleeves and washers at contact points in good conditions?**
X Yes _____ No **If no, describe condition and recommended action(s)**

JRR/8-29-16

6) **Is the security gate at upper end of culvert in place and without damage?**

X Yes ____ No If no, describe recommended action Removed a few sticks, leaves, seaweed pieces from grate.

7) **Is the paint in good condition?** X **Yes** ____ **No If no, describe condition and recommended action(s)**

Some minor pitting and oxidation of paint.

8) **Any debris lodged or accumulated on the tide gate or culvert?** X **Yes** ___ **No**

If yes, describe the maintenance action in the Field Maintenance Section below

9) **Check the water elevation above the tide gate invert when the gate begins closing: Elevation:** 2.84' **. Does the measured elevation match (or is it close to) the design water elevation for gate closure?** X **Yes** ___ **No**

If no, describe the recommended action ____

10) **Record time, water level measurements and predicted tidal levels**

Time	Predicted Tide Level	Water elevation above upper culvert	Water elevation at tide gate	
1435	9.0	2.52	2.20	
1453	~~10.2~~ 9.6 (8/29/16)	3.02	2.88	flutter start: 1451
1523	10.4	2.48	3.70	
1553	10.7	2.51	4.28	
1623	11.2	2.52	4.58	
1653	11.4	2.52	4.58	High Tide
1723	11.2	2.54	4.44	
1753	10.7	2.58	4.12	
1823	9.8	2.60	3.52	
1451	flutter start	3.00	2.84	
1500	tide gate closed	2.88	3.02	

JRR/8-29-16

TO 27

FIELD MAINTENANCE

Were field maintenance actions required during this inspection? X **Yes** ___ **No**

If yes, continue to complete the rest of the form.

11) Describe the maintenance action(s) conducted:

Scraped and removed barnacles, mussels, silt, sediment, seaweed, leaves & sticks from outside and inside the tide gate and tide flat end of culvert. Scraped barnacles to free up the stuck side floats. Removed sticks, leaves, and mussels from upper culvert grate.

James R. Ruef
Inspector's Signature

08/29/16
Date

FOLLOW-UP REPAIR AND/OR RE-INSPECTION

Do the inspection and field maintenance actions require repair and re-inspection at a later date? ___ **Yes** X **No** **If yes, describe the follow up action and resolution:**

_____

_____

_____

Repair and/or Re-inspection conducted by:

Organization	**Signature**	**Date**

NOVEMBER 2016 TIDE GATE INSPECTION REPORT

NAVAL BASE KITSAP AT KEYPORT

OPERABLE UNIT 1

INTRODUCTION

This report documents the fall 2016 inspection and monitoring of the tide gate at Operable Unit (OU) 1, Naval Base Kitsap (NBK) Keyport, Keyport, Washington. The work was conducted by Sealaska Environmental Services, LLC (Sealaska) under long-term monitoring / operations and maintenance (LTM/OM) Contract N44255-14-D-9011, Task Order (TO) 27. Limited inspection and monitoring was conducted in accordance with the O&M Plan (U.S. Navy 2012). Sealaska performed tide gate inspection and monitoring of operation through a high-tide cycle on November 22, 2016. The tide gate was found to be in good condition and performed as designed during operational monitoring through a high tide.

INSPECTION AND MAINTENANCE

Limited inspection and monitoring of the OU 1 tide gate at NBK Keyport was performed on November 22, 2016 during a high-tide cycle. As a result of the minimum low tides throughout fall 2016 being too high to allow safe access to the beach during daylight hours to conduct cleaning and inspection of the tide gate, Sealaska completed limited inspection from atop the concrete wall above the tide gate of visible tide gate components before and during operational monitoring. Cleaning of barnacles, mussels, and leaves from the upper culvert security grate was conducted. The tide gate vacuum break vent was observed to be clear of debris and in good working order. Small cracks in the top of the vent, present for several years, do not affect the operation of the tide gate and therefore requires no additional maintenance or repair. The back floats and assemblies were intact and in good working condition. The vertical (tide-gate door side) floats appeared to be operational. All other visible tide gate components were intact and appeared to be in good condition. Field forms documenting this activity are presented in Attachment 1.

TIDE GATE OPERATION

The tide gate operation was monitored through a high tide cycle on November 22, 2016. Temporary staff gauges were installed on both sides of the tide gate culvert and tide gate operation was monitored from approximately 3.5 hours before high tide to 0.5 hours after high tide. Table 1 presents results of the monitoring (in which “Tide Flats” refers to the seaward side/tide gate and “Marsh” refers to the landward side/upper culvert). Water level measurements were recorded every half hour on both sides of the tide gate. A high tide of 11.9 feet at 1200 hours (noon) was predicted for November 22, 2016 on the web site

http://tidesandcurrents.noaa.gov/noaatidepredictions for the "Poulsbo, Liberty Bay" location, with other predicted tide levels in Table 1 estimated from a tide chart.

As summarized in Table 1, measurements of water levels and observations of tide gate position documented the transition of the tide gate from an open position to a closed position. The tide gate began oscillation at 0917 hours at a water level of 2.80 feet above the tide-gate invert and fully closed 8 minutes later at 0925 hours at a water level of 3.10 feet above the tide-gate invert (i.e., on the Tide Flats side of the gate). This operation matched expectations from design and previous observations that the gate should close when the incoming tide reaches approximately 3 feet above the tide-gate invert. Water levels remained stable on the marsh side of the tide gate following closure, indicating negligible leakage into the culvert and marsh through the closed gate. The tide gate appears to be preventing tidal flooding of the marsh, which could otherwise cause erosion of the former landfill and possibly adversely affect the health of the trees within the plantations.

Table 1. November 22, 2016 Tide Gate Monitoring.

Time	Predicted Tide Level (feet MSL)	Tide Flats (feet above invert)	Marsh (feet above invert)	Notes
08:30	6.8	0.98	1.90	3.5 hours before high tide
09:00	7.9	2.08	2.96	
09:30	9.1	3.26	3.08	Tide gate fully closed at 09:25
10:00	10.1	4.20	2.96	
10:30	10.8	5.04	3.00	
11:00	11.6	5.70	3.07	
11:30	11.8	6.00	3.15	
12:00	11.9	6.04	3.38	High tide
12:30	11.8	5.96	3.49	

NOVEMBER 2016 TIDE GATE INSPECTION REPORT

NAVAL BASE KITSAP AT KEYPORT

OPERABLE UNIT 1

SUMMARY AND CONCLUSIONS

Limited inspection and cleaning of the tide gate and related components on November 22, 2016 removed barnacles, mussels, and leaves from the upper culvert security grate. Cleaning of the tide gate components within the tide flats was precluded by fall tides that were not low enough to allow safe beach access during daylight hours. Inspection was limited to observations of visible tide gate components made from the concrete wall above the tide gate before and during operational monitoring. All visible components of the tide gate were found to be intact and functioning. Observations of the tide gate performance through a high tide cycle on November 22, 2016 confirmed that the tide gate closed as designed, preventing flow of salt water from the tide flats into the marsh areas at high tide.

The next tide gate maintenance, inspection, and monitoring event is scheduled for February 17, 2017.

REFERENCE

U.S. Navy. 2012. *Long-Term Monitoring Project Work Plans, Operable Units 1 and 2, Naval Base Kitsap, Keyport, Washington, Final, Revision 3.* Prepared by Sealaska Environmental Services, LLC (Sealaska) for Naval Facilities Engineering Command Northwest, under Contract No. N44255-09-D-4005, TO 44. Poulsbo, Washington. February 29, 2012.

NOVEMBER 2016 TIDE GATE INSPECTION REPORT

NAVAL BASE KITSAP AT KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

TIDE GATE INSPECTION AND MAINTENANCE FORM

Sealaska
TO 27

3 Pages

TIDE GATE INSPECTION AND MAINTENANCE FORM

Keyport OU 1 Tide Gate at Tide Flats

Date/time: 22NOV2016 0800-1300

Tidal Condition: HIGH TIDE: 11.9FT @ 1200

Weather Condition: CLOUDY & RAIN, 44-50°F, WIND 5-10MPH

FIELD INSPECTION

1) **Any visible damage to the tide gate, concrete collar and/or the culvert?** ___Yes X No
If yes, describe damage and recommended action(s):
FULL INSPECTION NOT CONDUCTED AS PER FCR-04, NO DAMAGE NOTED DURING MONITORING

2) **Are the back floats in good working conditions?** X Yes _____ No
If not, describe problem and recommended actions: _____

3) **Inspect the condition of the vacuum break vent. Describe condition and recommended action(s):**
SMALL CRACK VISIBLE AT TOP OF VENT PIPE, DOES NOT AFFECT OPERATION, DOES NOT REQUIRE REPAIR

4) **Are all moving parts of the tide gate in good working orders?** X Yes _____ No
If no, describe the condition and recommended action: FULL INSPECTION NOT CONDUCTED AS PER FCR-04, TIDE GATE WORKING AS INTENDED DURING MONITORING

5) **Are plastic isolation sleeves and washers at contact points in good conditions?**
_____ Yes _____ No **If no, describe condition and recommended action(s)**
NA - NOT VISIBLE DURING MONITORING, FULL INSPECTION NOT CONDUCTED AS PER FCR-04

11/22/2016

TO 27

6) Is the security gate at upper end of culvert in place and without damage?

X Yes ____ No If no, describe recommended action REMOVED SOME BARNACLE GROWTH AND MUSSEL GROWTH

7) Is the paint in good condition? X Yes ____ No If no, describe condition and recommended action(s)

FULL INSPECTION NOT CONDUCTED AS PER FCR-04, NO SIGNIFICANT DAMAGE NOTED DURING MONITORING

8) Any debris lodged or accumulated on the tide gate or culvert? ___Yes ___ No
NA FULL INSPECTION NOT CONDUCTED AS PER FCR-04
If yes, describe the maintenance action in the Field Maintenance Section below

9) Check the water elevation above the tide gate invert when the gate begins closing: Elevation: 2.80. Does the measured elevation match (or is it close to) the design water elevation for gate closure? X Yes ___ No

If no, describe the recommended action NA

10) Record time, water level measurements and predicted tidal levels

Time	Predicted Tide Level	Water elevation above upper culvert	Water elevation at tide gate	
0830	6.8	1.90	0.98	
0900	7.9	2.96	2.08	
0930	9.1	3.08	3.26	
1000	10.1	2.96	4.20	
1030	10.8	3.00	5.04	
1100	11.6	3.07	5.70	
1130	11.8	3.15	6.00	
1200	11.9	3.38	6.04	HIGH TIDE
1230	11.8	3.49	5.96	
0917	FLUTTER START	3.44	2.80	
0925	FLUTTER STOP	3.29	3.10	

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FIELD MAINTENANCE

Were field maintenance actions required during this inspection? ___Yes X No

If yes, continue to complete the rest of the form.

11) Describe the maintenance action(s) conducted:

FULL INSPECTION/MAINTENANCE NOT CONDUCTED AS PER FCR-04.

Inspector's Signature 11/22/2016 **Date**

FOLLOW-UP REPAIR AND/OR RE-INSPECTION

Do the inspection and field maintenance actions require repair and re-inspection at a later date? ___Yes X No If yes, describe the follow up action and resolution:

Repair and/or Re-inspection conducted by:

Organization **Signature** **Date**

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APPENDIX D

RESPONSE TO AGENCY COMMENTS ON DRAFT REPORT

Responses to Comments on Draft 2016 OU 1 Annual Operation and Maintenance Report

Washington State Department of Ecology Comments:

1. Page 1-7, Line 13-16: "Therefore, a supplemental subsurface investigation of the former landfill to study the feasibility of optimizing the remedial action at the South Plantation was conducted in the summer of 2016 (Navy 2015). Results, conclusions, and recommendations of that study have not yet been reported."

   It seem the reference is incorrect. In addition, results of the Phase II recharacterization study (2016 investigation) is by April 2017. Summary results, conclusions, and recommendations should be reported here.

   Response: The "Navy 2015" reference is for the Final Fourth Five-Year Review in which the supplemental subsurface investigation at OU 1 was recommended. Therefore, we will rewrite the first sentence above to read "Therefore, a supplemental subsurface investigation of the former landfill to study the feasibility of optimizing the remedial action at the South Plantation was conducted in the summer of 2016 in accordance with recommendations of the Fourth Five-Year Review (Navy 2015)."

   This O&M report is intended to describe operation and maintenance at OU 1 conducted in 2016, and was written several months prior to the final results and conclusions of the 2016 supplemental subsurface investigation, which were reported in 2017. Therefore, the final sentence above will be edited to: "Final results, conclusions, and recommendations of that study were reported in detail under separate cover (Navy 2017), and will be incorporated, where appropriate, into the upcoming Spring 2017 LTM Report and the upcoming 2017 Annual O&M Report." The reference for the 2017-reported supplemental subsurface investigation will be added to the list of references on Page 5-2.

2. Page 1-7, Line 28-30: "As previously discussed, additional subsurface investigation of OU 1 was performed during the summer of 2016; results, conclusions, and recommendations have not yet been reported."

   Please see the previous comment.

   Response: See response under Comment #1. Sentence will be revised to "As previously discussed, final results, conclusions, and recommendations of that study were reported in detail under separate cover (Navy 2017), and will be incorporated, where appropriate, into the upcoming Spring 2017 LTM Report and the upcoming 2017 Annual O&M Report."

3. Page 1-7, Line 28-30: "The upgraded tide gate is automatic and self-regulating, controlled solely by tidal fluctuations acting on floats attached to the tide gate."

   Does this automatic tide gate have an alarm system in case of any malfunctions? In the event of any malfunctions, is there any other methods of detection other than the monthly inspection? Please clarify.

Response: The Navy has selected to employ regularly-scheduled visual inspections and maintenance, rather than a remote alarm, to ensure that the tide gate is functioning as designed. The tide gate has been designed to operate with only a single back float assembly should the second back float assembly fail. Its operational record of zero closure malfunctions (i.e., failure to close as designed) since its installation in 1999 supports the conclusion that regular inspections and maintenance preclude the need for a remote alarm system.

Note: There were no comments from The Suquamish Tribe or the United States Environmental Protection Agency on the Draft 2016 Annual O&M Report.