FINAL
18 SEPTEMBER 2018

2017 Annual Operation and Maintenance Report

Operable Unit 1

CONTRACT NO. N44255-14-D-9011, TASK ORDER 46

Naval Base Kitsap

Keyport, Washington

Department of the Navy
Naval Facilities Engineering Command Northwest
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LTM/OM / TASK ORDER 46

FINAL
2017 ANNUAL OPERATION AND MAINTENANCE REPORT
OPERABLE UNIT 1

NAVAL BASE KITSAP KEYPORT
KEYPORT, WASHINGTON

SEPTEMBER 18, 2018

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ACRONYMS AND ABBREVIATIONS

DCE	dichloroethene
ABS	Advanced Biological Solutions
COC	chemical of concern
cVOC	chlorinated volatile organic compound
DNAPL	dense non-aqueous phase liquid
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
trans-1,2-DCE	trans-1,2-dichloroethene

1. INTRODUCTION

This report summarizes the background, objectives, field activities, and tree and tide gate inspections and maintenance conducted February 2017 through March 2018 for operation and maintenance (O&M) of the phytoremediation 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 (Navy 2017a) and the OU 1 Spring 2017 LTM Report (in progress).

The activities documented in this report were conducted in accordance with the Site Work Plan, which is part of the Project Work Plans (Navy 2012); the Quality Control Plan (QCP) (Navy 2014) for OU's 1 and 2, and Field Change Request (FCR) TO 46 FCR-01 (Appendix A). The Site Work Plan includes the O&M Plan as an appendix, which covers phytoremediation and tide gate activities for OU 1. The O&M Plan was revised and finalized in September 2017 (Navy 2017b), and was applied to the September, October, and November 2017 and February and March 2018 O&M. The activities documented in this report were conducted under Navy Contract No. N44255-14-D-9011, Task Order (TO) 46, 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.

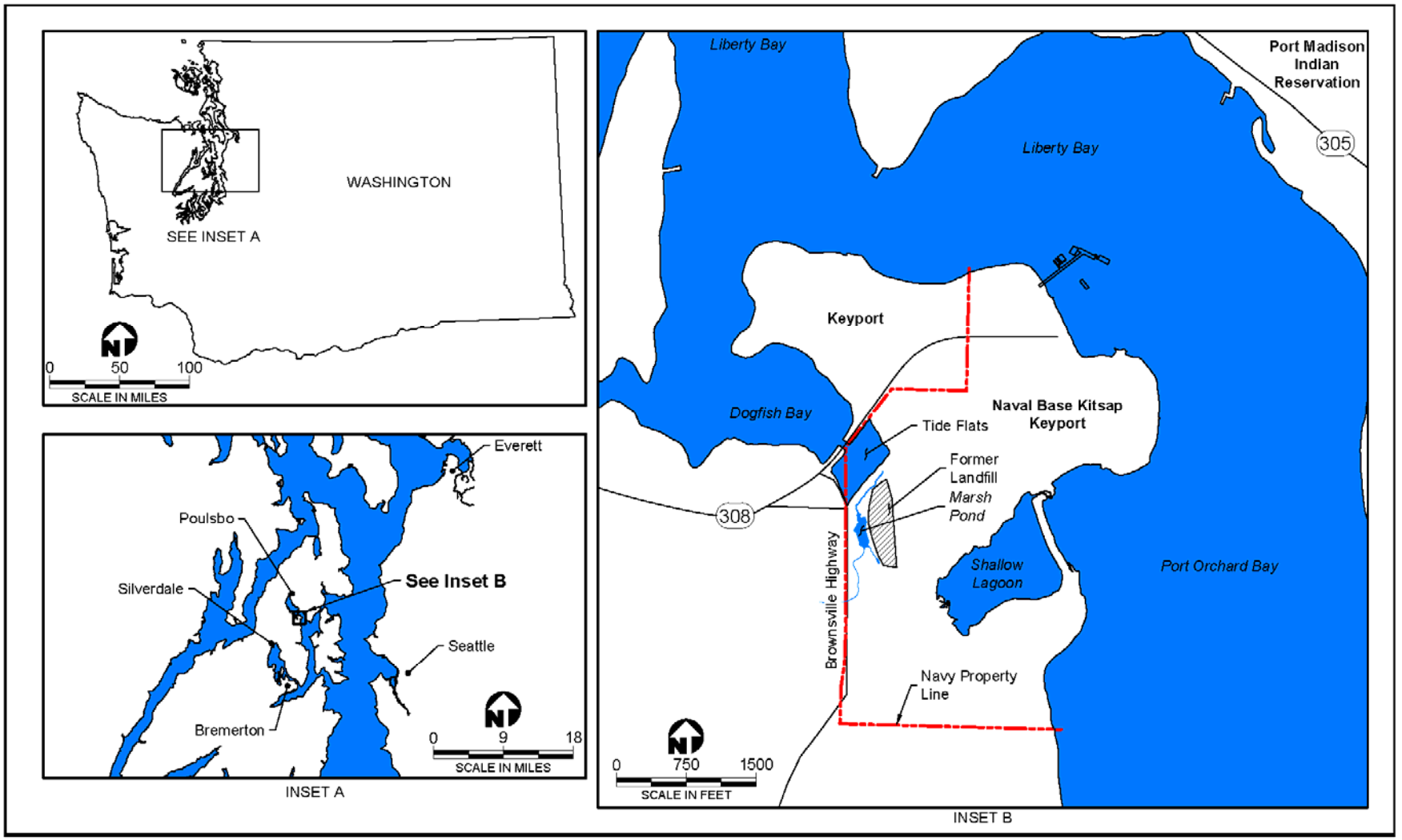
Other marine or brackish surface water bodies on and near the base include tide flats, a marsh, and a shallow lagoon.

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, as established in the ROD (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 near 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 to impact 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

Groundwater and surface water, as well as sediment locations downgradient from OU 1, are the sources of potential exposure by these three pathways. New data gathered from the site characterizations were discussed and evaluated in a summary data assessment report (Navy 1997), which supplemented the remedial investigation. Subsequently, a supplemental focused feasibility study was conducted to evaluate several additional remedial options, and opened for public comment. A preferred remedial alternative was selected and the OU 1 ROD was executed in September 1998.



U.S. NAVY	SEALASKA	Figure 1-1 NBK Keyport Vicinity Map	NBK Keyport, 2017 OU 1 Annual O&M Report

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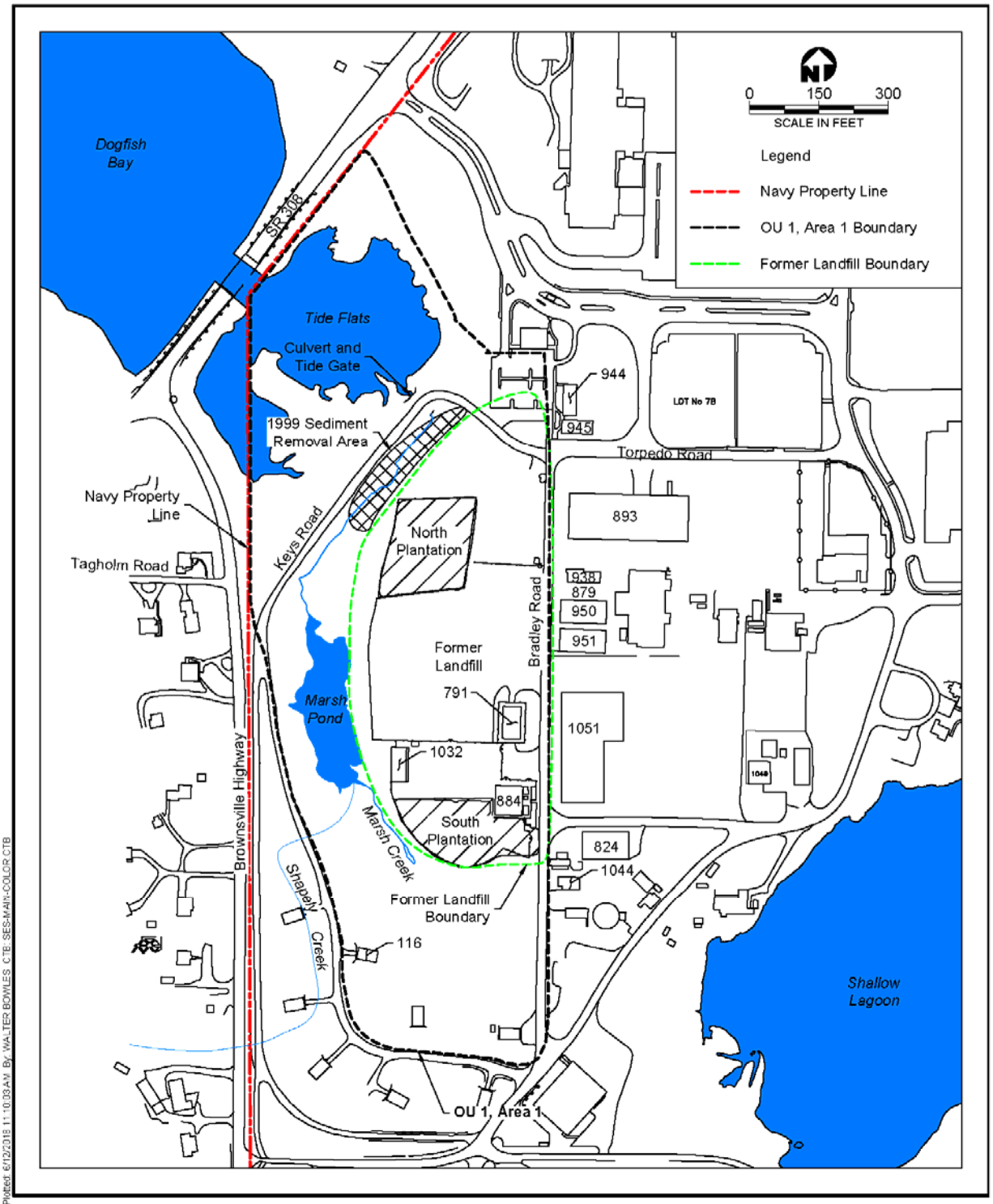
U.S. NAVY	SEALASKA	Figure 1-2 OU 1, Area 1 Site Location Map	NBK Keyport, 2017 OU 1 Annual O&M Report



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U.S. NAVY	SEALASKA	Figure 1-3 Layout of OU 1, Area 1	NBK Keyport, 2017 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, potentially affecting the seafood ingestion pathway.

The cVOCs are present in the landfill/marsh groundwater and water table aquifer beneath the former landfill. Dense non-aqueous phase liquid (DNAPL) was not found in the landfill/marsh groundwater or water table aquifer prior to the ROD. 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 of landfill/marsh groundwater into the marsh. Hydrogeological conditions at the site direct landfill/marsh groundwater 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 (cVOC) 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 LTM, 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, with the exception of contingent actions for off-base domestic wells, which have not been required. 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 pre-ROD 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 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, 2015a) found that phytoremediation at the South Plantation has not been as effective as originally anticipated during evaluation for remedy selection. COC concentrations along the southern edge of the South Plantation remain elevated, and trichloroethene (TCE) and vinyl chloride have consistently exceeded the remediation goals (RGs) at an adjacent surface water station in the marsh (Navy 2017a). Concern arose during the public comment period that the phytoremediation and natural attenuation remediation would extend beyond the current expectation of 30- to 50-years to achieve compliance with the RGs.

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. The geophysical survey determined that underground anomalies did not correlate with high contaminant concentrations in groundwater, indicating that the remaining buried sources were not primary sources (such as a drum containing pure product; Navy 2015b). The tree core sampling results (Navy 2015b) supported that some degree of cVOC degradation by tree metabolism was occurring. The overall effectiveness of phytoremediation at the site is inconclusive. Although contaminant concentrations appear to be generally declining over time, the contribution of phytoremediation processes to the decreases is not quantifiable. Significant migration of contaminants has not been observed, suggesting that phytoremediation may have aided in controlling the migration of contaminants to offsite areas.

In 2016 and 2017, and in accordance with recommendations of the Fourth Five-Year Review (Navy 2015a), a supplemental qualitative subsurface Phase II investigation of the former landfill was conducted to identify potential hotspots and evaluate hotspot treatments designed to reduce the restoration timeframe. Results, conclusions, and recommendations of that study were reported in detail under separate cover (Navy 2017c). Based on study findings, additional investigation was conducted in the summer and fall of 2017, including installation of eighteen new groundwater monitoring wells at OU 1 (report in progress). Current plans call for selected new wells to be incorporated into the OU 1 LTM program, in coordination with the Navy, Ecology, and EPA, for ongoing groundwater quality evaluation.

The conceptual site model will be reevaluated, as appropriate, based on data obtained from the supplemental investigations.

The 2016 Annual O&M Report concluded that healthy trees are present at both the North and South Plantations with no pest infestations or signs of stress from lack of water (Navy 2017c). However, the leaf canopy appeared to be less full in 2014 through 2016. In response to this observation, recommendations from the 2015 O&M Annual Report (Navy 2016) included increasing the number of inspection and maintenance events to pre-2011 levels, from four to eight events per year, to more quickly address possible declines in tree health. Additionally, it was recommended that granular high-nitrogen urea fertilizer should be applied to the ground surface at both plantations during spring O&M 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 activity which was conducted in 1999 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 tide gate upgrades and associated culvert were intended to provide better control of tidal fluctuation in the marsh and to protect the landfill from extreme tidal events that could expose the landfill contents by inundating the landfill and eroding the embankment at the toe of the landfill. The upgraded tide gate is automatic and self-regulating, controlled solely by tidal fluctuations that act 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 first 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 marine growth, debris, and sediment removal. The long-term tide gate inspection and maintenance program is detailed in the Site Work Plan (Navy 2012), and in the revised O&M Plan (Navy 2017b).

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 OU 1 ROD. Maintenance of the phytoremediation component of the OU 1 remedy along with maintenance of the tide gate, help to meet that overall objective and is the focus of this annual O&M Report. The objectives of this 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
- Inspect, maintain, and monitor the tide gate 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 Plans for Phytoremediation (Navy 2012; 2017b). 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, the 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. These data can be used 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 (Navy 2017a) and Spring 2017 OU 1 LTM Report (in progress), and are 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 continued tree health throughout the 2017 growing and dormant seasons. Inspections and maintenance included in this report were conducted during February, May, June, July, August, September, and November 2017, and February and March 2018. Phytoremediation inspection and maintenance e-mail reports for each event are included in Appendix B.

In general, the trees were observed to be in fair to good health during the inspections. During the May 2017 inspection of the North Plantation, seven trees were noted as dead, and ten had minimal growth on the lower halves of the trees. During June and July 2017 inspections, one additional tree with minimal growth, primarily on the lower half, was noted. In July 2017, sparse canopy growth was added to the inspection, with six trees noted. By the end of the growing season, in August 2017, a total of eight relatively smaller trees in the North Plantation appeared to be dead, exhibiting no leaf growth whatsoever. These trees are R2T4, R3T2, R5T3, R6T7, R13T15, R14T14, R15T1, and R15T4 (where R = row starting at the eastern edge of the plantation and moving west, and T = tree starting at the southern margin of the plantation and heading north). Nine other trees in the North Plantation exhibited minimal leaf growth, primarily on the lower half of each tree. As defined by previous nomenclature, trees with minimal growth are R4T17, R8T16, R9T18, R11T14, R12T3, R12T15, R14T15, R16T16, and R17T4. Seven other North Plantation trees had very minimal canopy growth. These trees are R2T2, R2T3, R10T19, R12T15, R14T8, R14T12, and R16T14. One tree (R7T4) in the South Plantation had growth on the lower 25 feet only, and another very small tree (approximately 15 to 20 feet tall) in the central portion of the Southern Plantation is dead.

The cause of these occurrences is not known, however crowding from other trees may be a factor, along with poor soil nutrient conditions and the age of the trees. Two large trees, located near the eastern margin of the South Plantation, presented a potential fall hazard to humans and overhead utility wires. These trees were removed by a NAVFAC Northwest subcontractor prior to the November 2016 inspection and maintenance event. A single, partially fallen tree, also near the eastern margin of the South Plantation, was cut and removed over a period in late 2015 and early 2016.

Most of the lower limbs of the trees have died over the past several years. The dead limbs have either fallen to the ground, or 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 first 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. Although breakage of tree tops has rarely occurred in the plantations over the years, a single tree (R1T3) adjacent to the South Plantation gate has a broken top (approximately its upper 15 feet) that occurred in late 2016.

During the growing season, the leaves were green and healthy in appearance. As in years 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. Inspection personnel estimated that less than 5 percent of the leaves were affected by blight, and this was noticed 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 denser in 2017 than in 2016; approximately as dense as 2015. During the growing season, most trees within interior areas of both plantations had leaves remaining only on the upper approximately 25 to 30 percent of their trunks. Unlike conditions noted during the August 2016 inspection, where trees within the North Plantation exhibited early leaf abscission of approximately 80 percent or more leaves, the trees remained more fully leafed out throughout early fall, which is similar to conditions observed in 2015 and previous years.

The cause of the early leaf abscission in late summer and fall of 2016 is not known. 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 during the same period. Given this, stress from lack of water does not appear to be the cause. However, observations of other deciduous trees in the Puget Sound area suggested that fall 2016 seasonal tree conditions started earlier than in previous 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 2017 inspection, leaves had turned yellow and approximately 10 to 20 percent had dropped to the ground, as observed during years prior to 2016. No pest infestations were observed.

Vertical cracks have occurred in bark on the lower areas of many of the tree trunks over approximately the past 5 years. The cracks, which are likely the result of relatively rapid temperature changes between warm and cold during the fall and winter seasons, do not appear to be adversely affecting the overall health of the trees. Some pin-sized, very shallow holes in wood were observed within several of the bark cracks on five trees in the South Plantation in August 2017. These holes may be the result of insects, however the condition is minor, did not worsen during fall 2017, and does not appear to be causing significant harm to the trees. No other 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 (any of four species of woodpeckers). No new sapsucker holes were observed during 2016 or 2017. The holes do not currently appear to be adversely affecting tree health. Ongoing observation of this condition as possible entry points for harmful insects or disease has not indicated any evidence of the presence or damage from insects or disease.

Moss has been observed growing on tree trucks for several years, and some minor occurrence of weeping has been observed on some trees.

As noted during inspections in past years, observations during this reporting period indicated that standing water occasionally occurs 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. This standing-water condition has been observed at these locations during past fall and winter inspections when precipitation rates and volumes seasonally increase.

Due to high winds over the weekend, the OU 1 plantations were re-inspected on February 20, 2018, to check on the trees. No tree damage was noted in the South Plantation. North Plantation tree R16T16, previously identified as a “minimal growth” tree (a “smaller” tree, 3rd row from west fence, approximately 45 feet tall with 6-inch diameter trunk at the base) was snapped off at ground level and completely fallen to the ground. The tree trunk was very pithy (spongy and rotting). The top 25 feet of tree R17T12 (another “smaller” tree) was snapped off and had fallen to the ground, leaving approximately 30 feet of the trunk standing. No damage to other trees from the fallen trees or from the winds, other than dead branches being blown down, was identified. Based on those findings, no further actions were conducted at that time.

2.2 FERTILIZATION

Fertilizer application was conducted during each growing season through 2010 to help sustain tree growth and health. At the request of the Navy, fertilization was discontinued in 2011. According to the requirements of TO 46 FCR-01 (Appendix A), ground-surface application of granular urea fertilizer (high nitrogen [46%]) was conducted in both plantations during the early growing season (May and June) of 2016 and again in May and June 2017. A broadcast spreader was used to evenly apply 150 pounds to the North Plantation and 125 pounds to the South Plantation during each fertilizer application, which was conducted just prior to rainfall events to increase the potential for the nitrogen to be adsorbed into the soil and taken up by tree roots.

During August, September, and October 2016 maintenance, Advanced Biological Solutions (ABS), a root and tree health enhancer, was mixed with Keyport tap water and applied directly to the ground surface at the base of a tree in the North Plantation designated as R16T19. 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 R16T19 (also known as TC-10) in the North Plantation was selected for treatment. Tree R16T19 is the northernmost tree (T19) in the 16th row (R16) starting at the southeast corner of the North Plantation. It 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 to 50 gallons of clean water (i.e., a 2-percent ABS/water solution) and was applied directly to the ground surface at the base of tree R16T19. A total of 250 gallons of 2 percent ABS solution was applied to the base of tree R16T19 over the course of the three events. Two percent ABS solution was applied to evaluate its effectiveness in improving the overall health of tree R16T19, and thereby improving the tree's effectiveness in reducing cVOCs in groundwater.

As discussed in the OU 1 Spring 2017 LTM Report (in progress), while TCE concentration in MW1-02 groundwater increased from June 2016 (1.2 micrograms per liter [µg/L]) to June 2017 (2.1 µg/L), TCE-degradation daughter products 1,1-dichloroethene (1,1-DCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride all decreased significantly in June 2017 compared to their concentrations in June 2016. The chemical 1,1-DCE declined from 1.2 µg/L to 0.65 µg/L; cis-1,2-DCE declined from 330 µg/L to 200 µg/L; trans-1,2-DCE declined from 11 µg/L to 6.6 µg/L; and vinyl chloride declined from 89 µg/L to 54 µg/L. Although the overall health of tree R16T19 appears to be good, other factors besides the ABS application may be responsible for the reduction in

TCE-degradation daughter products from June 2016 to June 2017. However, application of ABS appears promising in enhancing tree health and, possibly, in the degradation of cVOCs in groundwater.

2.3 PEST CONTROL

No occurrences of tent caterpillar "tents" or other significant infestations were observed in 2017. Damage to foliage from tent caterpillars during 2016 was 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 since that application, no significant caterpillar or other insect damage has been observed during inspections.

As previously discussed, some pin-sized, very shallow holes in wood were observed within several of the bark cracks on five trees in the South Plantation during August 2017. These may be the result of insects. The condition appears to be minor, did not worsen during fall 2017, and does not appear to be causing significant harm to the trees. No other evidence of insects was observed within or near the bark cracks.

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 or 2017. Therefore, no action with respect to Sapsucker activity is currently warranted.

2.4 IRRIGATION

No irrigation was conducted during 2017. Irrigation was discontinued in July 2013 in an effort to maximize uptake of shallow groundwater by the trees. Temperatures were approximately normal throughout the year when compared to typical temperatures for the Keyport vicinity. Precipitation (volume and frequency) was above normal during the winter and spring months, below normal and very dry at the site during the summer months, and approximately normal during the fall months in 2017, when compared to typical precipitation levels for the Keyport vicinity. In general, the trees did not exhibit visual evidence of stress from lack of water. However, six additional smaller trees within the northwest portion of the North Plantation died prior to spring 2017 (two died prior to spring 2016). Nine other trees in the North Plantation exhibited minimal leaf growth, primarily on the lower half of the tree, and seven other North Plantation trees had minimal canopy growth. One tree in the South Plantation had growth only on its lower 25 feet, and another very small tree (approximately 15 to 20 feet tall) is dead. As previously discussed, the tree

deaths and minimal leaf growth are not attributed to lack of water, but rather to crowding (i.e., shaded from sunlight by larger adjacent trees), poor soil nutrient conditions and the age of the trees.

2.5 WEED CONTROL

During the 2017 maintenance events, grasses and weeds were cut down or pulled throughout the plantations from February 2017 through March 2018. Hand-pulling techniques, gas-powered string trimmers, scythes, and lopper hand-tools were used to cut and remove grasses and weeds. The majority of the weeds removed consisted of blackberries, ivy, and holly. Some Scotch broom (*Cytisus scoparius*; 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 by Keyport personnel.

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 was cut immediately surrounding the perimeter of the plantation fences.

2.6 THINNING AND PRUNING

No thinning was conducted during the February 2017 through March 2018 maintenance events. Minor pruning to remove dead limbs from the lower portions of the tree trunks was conducted as needed during 2017. A few suckers growing from tree stumps and roots were found and pruned in May through August 2017. No suckers were observed during the November 2017 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 (Navy 2016). The remaining tree trunk inside the plantation fencing was cut into 4-foot 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. Additionally, 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 (Navy 2017d).

As noted above, the OU 1 plantations were re-inspected on February 20, 2018 due to high winds over the preceding weekend. No tree damage was noted in the South Plantation. However, North Plantation tree R16T16, was snapped off at ground level and completely fallen to the ground and the top 25 feet of tree R17T12 was snapped off and had fallen to the ground. No other fallen trees were observed. During March 2018 maintenance, the fallen trees were cut into small pieces and moved to a location near the North Plantation gate for later transport off the site.

3. TIDE GATE INSPECTION AND MAINTENANCE

During this reporting period, tide gate inspection and maintenance events were conducted quarterly in February, May, August, and October/November 2017, and February/March 2018. 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 plantation tree health. Routine tide gate maintenance and cleaning was conducted during each inspection and maintenance event. Maintenance 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 inspections, all tide gate components were intact and appeared in good condition. As observed during the August 2016 inspection, the side floats on the tide gate frame are occasionally impeded due to growth of barnacles on both the floats and inside the float sleeves on each side of the tide gate. Barnacles are scraped from the side floats and their float sleeves so that the floats actuate more freely. These floats only serve as dampers to reduce oscillation of the tide gate door during closure. Therefore, barnacle growth does not prevent the door from closing at the designated sea-level elevation of approximately 3 feet above the tide gate invert (bottom).

Similar to conditions in 2016, low tides were too high in November 2017 to allow safe access to the beach during daylight hours. Consequently, the November inspection and maintenance event was conducted on October 16, 2017 as authorized by the Navy Remedial Project Manager to allow safe access to the tide gate for cleaning and inspections. All visible tide gate components were intact and appeared in good condition. Tide gate closure monitoring was conducted later during the scheduled maintenance event in November 2017.

Some minor cracking in the top of the vacuum break air vent and minor pitting of metal surfaces was present, but appear to be in the same condition as previously reported. No repairs were required during this reporting timeframe, as neither the small cracks nor the pitting impact the functionality of the tide gate.

Tide Gate Inspection Reports for each of the four inspection and maintenance events conducted in February, May, August, October/November 2017, and February/March 2018 are included as Appendix C.

The tide gate operation was monitored through high tide cycles on February 17, 2017, May 9, 2017, August 21, 2017, November 30, 2017 and February 6, 2018. Temporary staff gauges were installed on both sides of the tide gate culvert and tide gate operation was

monitored for approximately 4 hours around the predicted time of the 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 website 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 fully closed over periods ranging from 2 to 10 minutes at water levels ranging between 2.74 feet (minimum at start of oscillation) to 3.18 feet (maximum when fully closed) during the five monitoring events conducted during 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.

Due to high winds over the weekend, the tide gate was re-inspected on February 20, 2018, and one of the screw-hole flanges for securing the eastern-most door-float release rod (for release of the horizontal float at the base of the tide gate door) was found to be broken. The western-most door-float release rod assembly was intact and therefore the tide gate continued to operate as designed. On March 15, a temporary repair of the eastern-most door-float release rod at the top of the tide-gate door assembly was conducted using heavy-duty zip-ties to secure the float release rod to the top of the tide gate assembly. This repair will be inspected and maintained during each maintenance event until a permanent repair can be performed in late 2018. Photographs of the damaged flange and the temporary repair are attached to the February-March 2018 Tide Gate Inspection e-mail report in Appendix C.

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 fair to healthy throughout the 2017 growing season. Granular high-nitrogen urea fertilizer was applied during the May and June 2017 maintenance events in an effort to enhance tree health. No pesticide was applied in 2011 through early 2018, and no significant pest infestations occurred. Physical weeding greatly reduced the competition to trees from weeds. Irrigation of the plantations was not conducted in 2017 or early 2018 in an effort to maximize up-take of landfill/marsh groundwater by the trees. Growth throughout the year was not directly measured, but appeared to be 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 to 30 percent of the trunks, as most of the lower branches have died. The trees weathered the late winter 2017 through fall 2017 months with minimal limb breakage. However, two trees in the North Plantation were damaged by high winds in February 2018, one being snapped off at ground level and one having its top 25 feet snapped off. A single tree adjacent to the South Plantation gate has a broken top (approximately its upper 15 feet) that occurred in late 2016. No pruning was necessary to control rust, a fungal disease which can occur when excessive moisture remains on leaves. Temperatures were generally normal and precipitation (volume and frequency) was above normal at the site during late winter and spring 2017, below normal during summer 2017, and above normal during fall 2017 and early 2018, compared to typical temperatures and precipitation levels for the Keyport vicinity. The trees did not exhibit visual evidence of stress from lack of water.

Six additional trees in the North Plantation died during this reporting period. Two smaller trees in the northwest portion of the North Plantation had already died by the time of the June 2016 inspection. Additionally, one partially fallen tree and two larger trees, near the eastern margin of the South Plantation, posed a fall hazard and were cut down and removed in late 2015 to early 2016. Nine other trees in the North Plantation exhibited minimal leaf growth, primarily on their lower halves. In the South Plantation, a single very small tree is dead, and another tree only exhibits branch and leaf growth on its lower approximately 25

feet. A single tree adjacent to the South Plantation gate has a broken top (approximately its upper 15 feet) that occurred in late 2016.

4.2 EVALUATION AGAINST PERFORMANCE CRITERIA

A conclusion of the Third and Fourth Five-Year Reviews (Navy 2010, 2015a) was that phytoremediation has not been as effective as originally anticipated when it was evaluated during remedy selection. The following subsections of this report discuss the maintenance and monitoring results from this reporting period 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 (Navy 2017a). However, significant migration of contaminants has not been observed, suggesting that phytoremediation may have aided in controlling the migration of contaminants outward from the site boundaries. Additional subsurface investigation of OU 1 was conducted during the summer of 2016, and additional groundwater monitoring wells were constructed in 2017. The conceptual site model will be reevaluated based on the data obtained from those investigations following completion of all reporting. The Navy is planning to add selected new groundwater monitoring wells to the current LTM program at OU 1 in consultation with Ecology, EPA, and the Suquamish Tribe.

In general, fair to good tree health was documented throughout the 2017 growing season and, based upon inference from documentation by URS, Sealaska and TetraTech Joint Venture, and Sealaska of conditions and data from 2005 through 2017, some degree of cVOC degradation by tree metabolism is occurring (Navy 2017a).

As concluded by URS in the Phase I Report (Navy 2015b), tree core sampling in the North and South Plantations indicates that phytoremediation is having some degree of positive effect on contaminant reduction. At a minimum, 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 fair to 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 the fungal disease known as 'rust', so the trees are considered healthy. Therefore, the weight of evidence demonstrates healthy trees are present at both plantations.

4.2.2 Groundwater Flow

Biennial groundwater levels were recorded for 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 (Navy 2017a). As in the past, the data do not reveal any discernible effect from the trees on groundwater flow direction or gradient.

However, although groundwater velocities were estimated at 0.04 to 0.5 foot per day in the ROD (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.

4.2.3 Contaminant Concentration Trends

As documented in the Spring 2016 LTM Report for OU 1 (Navy 2017a) and the Spring 2017 LTM Report (in progress), one or more cVOC concentrations remain above RGs at: two of the three North Plantation phytoremediation monitoring stations (wells 1MW-1 and MW1-02); four of the five South Plantation phytoremediation monitoring stations (wells MW1-04, MW1-05, MW1-16, and the single phytoremediation surface water station MA12); and a single well between the two plantations (MW1-17). 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, MW1-16, MW1-17, and MA12. Of these locations, MW1-04 and MA12 showed statistically significant decreasing trends in COC concentrations over time. 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.

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

4.3 CONCLUSIONS

Nine inspection and maintenance events for the plantations were completed from February 2017 through March 2018 per the scope of work and following approved work plans for the project. Trees exhibit fair to good health 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 4 years (i.e., approximately 30 percent less in 2014 and approximately 10 percent less in 2015, 2016, and 2017 when compared to 2013). Six additional trees died in the North Plantation and one tree fell due to high winds over this reporting period, in addition to the two smaller trees that died in 2016. The deaths were likely due to crowding by surrounding larger trees thereby not receiving adequate sunlight. A single very small tree died in the South Plantation, also likely the result of overcrowding. 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 2017 growing season.

Current plans for 2018 call for the dead trees be felled and removed to prevent them from falling and damaging other nearby trees and to remove the risk of injury to base and/or subcontractor personnel.

Quarterly maintenance and inspection of the tide gate occurred during February, May, August, and October/November 2017, and February 2018. Due to damage from high winds in February 2018, a temporary repair was conducted in March 2018. All inspections verified the tide gate was operational. All monitoring events 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 after closure, 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 (Navy 2017a) and the Spring 2017 LTM Report (in progress).

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 2015a). 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 from trees on water levels.

However, although groundwater velocities were estimated at 0.04 to 0.5 foot per day in the ROD (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 (Navy 2015a). Good tree health was documented throughout the 2016 growing season and, by inference from tree core sample results presented in the OU 1 Phase I Report prepared by URS (Navy 2015b), some degree of cVOC degradation by tree metabolism is occurring. At a minimum, 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.

The Navy, in consultation with EPA, Ecology, and the Suquamish Tribe, performed an initial qualitative investigation and a subsequent quantitative investigation at OU 1 during the summers of 2016 and 2017 (Navy 2017c) to determine if previously undetected source areas exist. Results and evaluation of those investigations indicated that:

- Contamination extends to approximately 30 feet below ground surface in the eastern portion of the South Plantation, which is deeper than the existing LTM well network. The most significant source observed during the investigation is located on the east side of the landfill adjacent to Bradley Road, south of the former Hazardous Waste Building (Building 884). The distribution pattern exhibits characteristics consistent with DNAPL or residual DNAPL.
- Contamination extends to approximately 32 feet below ground surface in the western portion of the central landfill, which is deeper than the existing LTM well network.

Based upon the results of the subsurface investigations conducted during the summers of 2016 and 2017, 18 new groundwater monitoring wells were constructed at selected OU 1 locations beginning in early October 2017. The new wells extend to greater depths than the existing network of LTM wells to further assess the extent of groundwater contamination and confirm the groundwater flow patterns within the aquifer beneath the South Plantation and the central landfill. Results for the new wells have not been fully evaluated. Source areas beneath the South Plantation, the central portion of the landfill, and/or at other locations may explain the current contaminant trends and why phytoremediation, especially in the South Plantation, appears to be performing below expectations. If an on-going source of TCE is treated, contaminant trends following treatment are expected to exhibit a downward trend overall for TCE, and a more normal ratio of its daughter products. Project

Work Plan modifications will be recommended based upon final results of the supplemental investigations.

It is recommended that the spring 2018 LTM at OU 1 be suspended until the Conceptual Site Model is updated, the LTM well network and sampling effort have been revised based on the new data, and the Management and Monitoring Approach Sampling and Analysis Plan (Navy 2017e) has been revised to reflect these changes.

Planned activities include plantation inspection and maintenance events in June, July, August, September, and December 2018, and in March 2019, to provide frequent inspection and maintenance of tree health. The tide gate will be inspected, cleaned, and monitored on a quarterly basis throughout the next reporting period.

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APPENDIX A

FIELD CHANGE REQUEST (TO 46 FCR-01)

SEALASKA ENVIRONMENTAL SERVICES

CONTRACT NUMBER: N44255-14-D-9011

FIELD CHANGE REQUEST (FCR)

TASK ORDER # 46 **FCR #** TO 46 FCR-01 **DATE** 4/26/17

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 2017 plantation O&M events. Approximately 135 pounds of granulated urea will be applied to each plantation during each event.

3. Reason for Change (Attach sheet if necessary)

For TO 27 in 2016, an FCR (# TO 27 FCR-01) was used to update the O&M Plan with regard to fertilizer application. This FCR only addressed the TO 27 field events that occurred in 2016.
The in-progress O&M Plan will not be finalized until after the spring and summer 2017 field events have been conducted. Fertilizer application is proposed for the spring (May) and summer (June) 2017 events in an effort to enhance growing conditions and the overall health of the trees and is required in the TO 46 Award (Project Work Requirement Subtask 3.6.1).

4. Originator: (print name and sign) Cara Alferness		**Title** Project Quality Control Manager	**Date** 4/26/17
Reviewed by: (print name and sign) Sherri Wunderlich		**Title** Program Quality Control Manager	**Date** 4/26/17
Site Superintendent (Print name and sign)	**Date** 4/26/17	**Task Order Manager (Print name and sign)** James Ruef	**Date** 4/26/17
Program QC Manager (Print Name and Sign) Sherri Wunderlich	**Date** 4/26/17	**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: 2017.05.03 09:55:27 -07'00'	**Date** 5/3/2017

APPENDIX B

PHYTOREMEDIATION INSPECTION REPORTS

(PROVIDED ON DISC)

FEBRUARY 2017 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

INTRODUCTION

The February 2017 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 February 17, 2017 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 February 2017, and represents the eighth and final 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 or for the upcoming TO 46, 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.

FEBRUARY 2017 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

FIELD ACTIVITIES

The eighth of eight scheduled tree inspection and maintenance events for 2016-17 under TO 27 was conducted on February 17, 2017. Maintenance activities performed included pulling and removal of weeds and inspection of tree health.

RESULTS

Observations made during the February 2017 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 tree branches had significantly developed buds on them. As first observed during the June 2016 inspection, two smaller trees within the North Plantation appear to be dead. A single small tree near the southeast corner of the North Plantation (row 2, tree 4) appears to be dead or severely stunted, however may have a few remaining living buds and branches near its top. Closer observation of this tree and any remaining foliage on it will be made during the upcoming May 2017 inspections. 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 early 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 or exhibit any evidence of significant damage in either plantation since the previous inspection in January 2017. 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. However, some trees are exhibiting new branch growth on their lower trunks. No suckers growing from shallow roots and tree stumps were present in either plantation. During January 2017, a small hole was observed in the bark of a North Plantation tree (row 13, tree 15), likely caused by a bird. The hole did not appear to have worsened since January. Although a few new holes in bark from Sapsucker activity were present on seven South Plantation trees in January 2017 (fifteen trees in the South Plantation had previous holes as first noted during the June 2016 inspections), no new holes were observed during the February 2017 inspections. The existing 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 and/or moisture 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. Significant moss growth is occurring on most of the trees in both plantations, a condition noted over the past few years.

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 February 2017 inspection was found to be light in and around both plantations. Grasses were approximately 4 inches in height, with prevalent blooming dandelions. 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 February 2017, invasive vegetation removed or cut inside the plantations consisted primarily of ivy, blackberry, and holly. 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 during the upcoming spring 2017 tree inspection and maintenance scheduled for May 9 and 10, 2017. The few plantation-perimeter area weeds cut back or pulled and removed consisted primarily of blackberry and ivy. Standing water was present on the northeastern corner and at the northwest corner of the North Plantation and near the southeast corner of the South Plantation, all normal occurrences during the winter and spring months at these locations. Surface soils were 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 and the bird-caused holes in tree bark, 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 May and June 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 June 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 May 9 and 10, 2017:

- Conduct the first of eight planned TO 46 2017-18 plantations inspections.

FEBRUARY 2017 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

- Conduct grass and weed control.
- Remove dead branches from plantations.
- Apply 135 pounds of high-nitrogen urea fertilizer to each of 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.

FEBRUARY 2017 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

INSPECTION FORMS

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

TO 27

INSPECTOR'S DAILY LOG

Location: North Plantation ☒ South Plantation ☐ **Date:** 02/17/17

Reason for Inspection:

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

Inspection Attendants: J. Ruef, R. Boyd, W. Boules

Specific Inspection Activity:
- Inspection of tree health
- Weed control activities

Inspection Results: Tree appearance typical for season w/ majority of trees budded out. Several broken branches were removed from plantation, likely caused from wind/snow events. Previously documented cracks in tree trunks appear to be free of insects. Standing water in NE corner of plantation. Row 2 Tree 4 - growth appears to have been stunted/ceased. Previously documented holes in Row 13 Tree 15 still present. Some dandelion growth throughout plantation. Removed ivy, blackberries, & holly from plantation. No other damage caused by humans, animals, or insects identified. No other signs of stress, deficiency, or disease noted. Some moss on trees.

Further Action Recommended: Continue monitoring of tree health & weed control activities

Total Hours: 3
Field: ~~02/17/17 NA~~ 3
Mileage: NA

Office: Poulsbo, WA
Correspondence: NA

Inspector RB, JR, WB
Sheet 1 of 1

Routing: 1 Copy to Inspection File

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Date:** 02/17/17

Reason for Inspection:

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

Inspection Attendants: J. Ruef, R. Boyd, W. Bowles

Specific Inspection Activity:
- Inspection of tree health
- Weed control activities

Inspection Results: Tree appearance typical for season w/ some buds on majority of trees. Several broken branches were removed from plantation, likely caused by wind/snow events. Previously documented cracks in trunks and/or sapsucker holes still present. Ground surface is saturated w/ some standing water around gate. Removed ivy, holly, blackberries, & laurel from plantation. Front gate does not lock & ~12 Ft section of fencing missing from other east-site activities at South fence line. Some moss on trees. No other damage from human, animals, or insects, or signs of stress, disease, or deficiency noted.

Further Action Recommended: Continue monitoring of tree health & weed control activities. Recommend repairing locking gate & downed fence.

Total Hours: 3 Office: Poulsbo, WA Inspector RB, JR, WB
Field: 3 Correspondence: NA Sheet 1 of 1
Mileage: NA

Routing: 1 Copy to Inspection File

Photograph 1: Large developed buds on a tree in the northeastern portion of the North Plantation, with areas of standing water from recent heavy precipitation. Moss growth and cracks in bark (tree at right) are prevalent throughout the plantations.

MAY 2017 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

INTRODUCTION

The spring 2017 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) 46. This report summarizes the field activities, results, and recommendations for the phytoremediation plantation inspection and maintenance completed by Sealaska on May 9, 2017 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 46 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 2017, and represents the first of eight planned phytoremediation inspection and maintenance events for TO 46 in 2017-18.

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 2017 to February 2018, including May, June, July, August, September, and November 2017 and January and February 2018. 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 46, 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 2017 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

FIELD ACTIVITIES

The first of eight scheduled tree inspection and maintenance events for 2017-18 under TO 46 was conducted on May 9, 2017. 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 2017 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 fair (North Plantation) to good (South Plantation). No pest infestations were observed. The trees were leafed-out, although some of the leaves had not yet reached their full size. The overall canopy appeared to be approximately as dense as conditions noted during May 2016 and June 2015, and denser than in June 2014. Seven trees in the North Plantation appeared to be dead, exhibiting no leaf growth whatsoever, including: R2T4; R3T2; R5T3; R13T15; R13T14; R15T4; and R15T1 (where R = row starting at the eastern edge of the plantation and moving west, and T = tree starting at the southern margin of the plantation and heading north). Ten other trees in the North Plantation exhibited minimal leaf growth, including: R4T17; R6T7; R8T16; R9T18; R11T14; R12T3; R12T15; R14T15; R16T16; and R17T4. 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. The top approximately 15 feet of South Plantation tree R1T3 was broken and dangling, likely caused by late winter high winds. A few suckers growing from shallow roots and stumps were present. No new holes in bark from Sapsucker activity were present in the South Plantation; none have been observed in the North Plantation to date. 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 and/or moisture changes during fall and winter seasons.

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

Pest Control. No tent caterpillar or 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 2017 inspection was found to be heavy in and around both plantations. Gas-powered engine string trimmers, hand-tool loppers, and hand-pulling techniques were used to cut and remove vegetation, including grasses, weeds, and small trees, within both plantations as well as in areas outside of perimeter fencing. 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 grasses, dandelions, blackberry, ivy, maple, and alders. 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 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 late spring/early summer tree inspections and maintenance scheduled for the week of June 19, 2017. A small area of perimeter-area vegetation outside the northeast corner of the North Plantation was left uncut due to the presence of four baby rabbits. A small area of standing water was present along the northeast margin of the North Plantation, and surface soils in both plantations were generally moist. No evidence of physical damage resulting from humans or animals was observed.

Fertilizer Application. Granulated high-nitrogen granulated urea fertilizer was applied to the ground surfaces of both plantations during May 2017 maintenance. A broadcast spreader was used to evenly apply 150 pounds of urea to the North Plantation and 125 pounds of urea 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 has been conducted since 2013 to maximize uptake of shallow-aquifer groundwater by

the trees. It is hoped that the reduced irrigation will 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 November 2016 plantations inspection and maintenance, and will not be activated again by Sealaska unless so directed by the Navy RPM for TO 46.

FUTURE ACTIVITIES

The following activities by Sealaska are planned at the tree plantations over the course of several days from approximately June 19-23, 2017:

- Conduct the second of eight planned TO 46, 2017-18 plantations inspections.
- Conduct grass and weed control by cutting and pulling.
- Remove dead branches from plantations.
- Prune suckers from roots and tree trunks.
- 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 2017 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

INSPECTION FORMS

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☒ South Plantation ☐ **Date:** 05/09/2017

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, R. BOYD

Specific Inspection Activity:
- INSPECTION OF TREE HEALTH
- WEED CONTROL ACTIVITIES
- FERTILIZER APPLICATION

Inspection Results: THE TREES ARE LEAFED OUT. MOST OF THE GROWTH IS ON THE UPPER HALF OF THE TREES. SEVERAL BROKEN, DEAD AND/OR FALLEN BRANCHES WERE CUT BACK AND/OR REMOVED BRANCHES WITH NO NEW GROWTH WERE NOTED ON NEARLY ALL OF THE TREES. THIS INCLUDES SEVERAL LARGE BRANCHES. TREES WITH NO NEW GROWTH WERE NOTED: R3T2, R2T4, R5T3, R13T15, R13T14, R15T4, R15T1. TREES WITH MINIMAL GROWTH WERE NOTED: R4T17, R6, T7, R8T16, R9T18, R11T14, R12T3, R12T15, R14T15, R16T16, R17T4. AS PREVIOUSLY NOTED, SEVERAL TREE TRUNKS CONTAIN CRACKS IN THE BARK. SOIL CONDITIONS WERE MOIST WITH ONE SMALL AREA OF STANDING WATER ALONG THE EASTERN EDGE. NO SIGNS OF DAMAGE CAUSED BY HUMANS, ANIMALS OR INSECTS WERE NOTED.

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

NO SIGNS OF DISEASE, DEFICIENCIES OR STRESS WERE NOTED. GAS POWERED STRING CUTTERS WERE USED TO CUT BACK GRASSES AND WEEDS APPROX. 36" IN TALL, BLACKBERRIES, MAPLES AND IVY. TO PREVENT ENCROACHMENT 5 FT WAS CLEARED ALONG THE OUTER PERIMETER. THE NORTHWEST CORNER WAS NOT CUT BACK DUE TO THE PRESENCE OF BABY BUNNIES. 150 LBS OF FERTILIZER WAS APPLIED TO THE PLANTATION

R = ROW T = TREE

Total Hours: 16 Office: POULSBO, WA Inspector V.S. PATTERSON
Field: N/A Correspondence: N/A Sheet 1 of 1
Mileage: N/A

Routing: 1 Copy to Inspection File

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Date:** 05/09/2017

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, R. BOYD

Specific Inspection Activity:
- INSPECTION OF TREE HEALTH
- WEED CONTROL ACTIVITIES
- FERTILIZER APPLICATION

Inspection Results: THE TREES ARE LEAFED OUT. MOST OF THE GROWTH IS ON THE UPPER HALF OF THE TREES. SEVERAL BROKEN, DEAD AND/OR FALLEN BRANCHES WERE CUT BACK AND/OR REMOVED. BRANCHES WITH NO NEW GROWTH WERE NOTED ON NEARLY ALL OF THE TREES, THIS INCLUDES SEVERAL LARGE BRANCHES. THE TOP OF R1T3 IS BROKEN. AS PREVIOUSLY NOTED, SEVERAL TREE TRUNKS CONTAIN CRACKS IN THE BARK. SOIL CONDITIONS WERE MOIST WITH NO AREAS OF STANDING WATER. NO SIGNS OF DAMAGE CAUSED BY HUMANS, ANIMALS OR INSECTS, NO SIGNS OF DISEASE, DEFICIENCIES OR STRESS OBSERVED. GAS POWERED STRING CUTTERS WERE USED TO CUT BACK GRASSES AND WEEDS APPROX. 36 IN TALL, BLACKBERRIES, MAPLES, ALDERS AND IVY. TO PREVENT ENCROACHMENT 5FT WAS CLEARED ALONG THE OUTTER PERIMETER. 125 lbs OF FERTILIZER WAS APPLIED TO THE PLANTATION

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

R=ROW T=TREE

Total Hours: 16 Office: POULSBO, WA Inspector V.S. PATTERSON
Field: NA Correspondence: NA Sheet 1 of 1
Mileage: NA

Routing: 1 Copy to Inspection File

JUNE 2017 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

INTRODUCTION

The June 2017 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) 46. This report summarizes the field activities, results, and recommendations for the phytoremediation plantation inspection and maintenance completed on June 13 and 22, 2017 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 46 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 2017, and represents the second of eight planned phytoremediation inspection and maintenance events for TO 46 in 2017-18.

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 2017 to February 2018, including May, June, July, August, September, and November 2017 and January and February 2018. 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 46, 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 2017 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

FIELD ACTIVITIES

The second of eight scheduled tree inspection and maintenance events for 2017-18 under TO 46 consisted of application of high-nitrogen urea fertilizer on June 13, 2017 and extensive weed and grass cutting, pulling and removal of weeds, and inspection of tree health on June 22, 2017.

RESULTS

Observations made during the June 2017 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 fair to good. No pest infestations were observed. The overall canopy appeared to be approximately as dense as it was during June 2016 and June 2015. As previously observed and reported, seven trees in the North Plantation appear to be dead, exhibiting no leaf growth whatsoever, including: R2T4; R3T2; R5T3; R13T15; R14T14; R15T4; and R15T1 (where R = row starting at the eastern edge of the plantation and moving west, and T = tree starting at the southern margin of the plantation and heading north). Eleven other trees in the North Plantation exhibited minimal leaf growth, primarily on their lower halves, including: R4T17; R6T7; R8T16; R9T18; R11T14; R12T3; R12T15; R14T15; R15T1; R16T16; and R17T4. One tree (R7T4) in the South Plantation only had growth on its lower 25 feet. A few dead leaves that appeared to be attached to small broken branches were observed within the canopy in both 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. 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 stumps were present. Sapsucker holes in tree bark have previously been observed on South Plantation trees R12T1; R13T1; R16T1; R23T6; R26T1; and R26T2. No new holes in bark from Sapsucker activity were present in the South Plantation; none have been observed in the North Plantation to date. 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 and/or moisture changes during fall and winter seasons.

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

Pest Control. No tent caterpillar or 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 2017 inspection was found to be heavy in and around both plantations, with grasses and dandelions up to 2 feet in height. Gas-powered engine string trimmers, hand-tool loppers, and hand-pulling techniques were used to cut and remove vegetation, including grasses, weeds, and small trees, within both plantations as well as in areas outside of perimeter fencing. 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 grasses, dandelions, blackberry, holly, laurel, and ivy. The plantation-perimeter area weeds cut back or pulled and removed consisted primarily of blackberry, Scotch broom, grasses, and dandelions. Weeds that were pulled were placed in a designated dumpster located near the South Plantation. A few suckers were pruned from tree stumps and roots. Dead lower branches, several of which had fallen to the ground, 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 late summer tree inspections and maintenance scheduled for July 17, 2017. No standing water was present in either plantation, and surface soils in both plantations were generally damp to dry. No evidence of physical damage resulting from humans or animals was observed.

Fertilizer Application. Granulated high-nitrogen granulated urea fertilizer was applied to the ground surfaces of both plantations on June 13, 2017 maintenance. A broadcast spreader was used to evenly apply 150 pounds of urea to the North Plantation and 125 pounds of urea to the South Plantation. This application was the second of two planned applications for 2017, with the first occurring in May 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 has been conducted since 2013 to maximize uptake of shallow-aquifer groundwater by the trees. It is hoped that the reduced irrigation will 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 November 2016 plantations

inspection and maintenance, and will not be activated again by Sealaska unless so directed by the Navy RPM for TO 46.

FUTURE ACTIVITIES

The following activities by Sealaska are planned at the tree plantations for July 17, 2017:

- Conduct the third of eight planned TO 46, 2017-18 plantations inspections.
- Conduct grass and weed control by cutting and pulling.
- Remove dead branches from plantations.
- Prune suckers from roots and tree trunks.

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 2017 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

INSPECTION FORMS

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☒ South Plantation ☐ **Date:** 06/21/2017

Reason for Inspection:

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

Inspection Attendants: A. LEWIS, S. PATTERSON, M. HALDANE

Specific Inspection Activity: • INSPECTION OF TREE HEALTH
• WEED CONTROL ACTIVITIES
(FERTILIZER APPLICATION COMPLETED ON 06/13/17 BY J. RUEF & R. BOYD)

Inspection Results: THE TREES ARE LEAFED OUT. A FEW DEAD LEAVES WERE NOTED IN THE CANOPY. (<5%) APPEAR TO BE ATTACHED TO BROKEN SMALL BRANCHES. MOST OF THE GROWTH IS ON THE UPPER HALF OF THE TREES. SEVERAL BROKEN, DEAD AND/OR FALLEN BRANCHES WERE CUT BACK AND/OR REMOVED. BRANCHES WITH NO NEW GROWTH WERE NOTED ON NEARLY ALL OF THE TREES. THIS INCLUDES SEVERAL LARGE BRANCHES. TREES WITHOUT GROWTH: R2T4, R3T2, R5T3, R13, T15, R14T14, R15T4. TREES WITH MINIMAL GROWTH CONCENTRATED ON THE LOWER PORTION OF THE TREE: R4T17, R6T7, R5T16, R9T18, R11, T14, R17T3, R12T15, R14T15, R15T1, R16T16, R17T4. AS PREVIOUSLY NOTED, SEVERAL TREE TRUNKS CONTAIN CRACKS IN THE BARK. LICHEN AND MOSS WERE NOTED ON TREES. WEEPING WAS NOTED ON FIVE TREES. SOIL CONDITIONS WERE DAMP TO DRY. NO SIGNS OF DAMAGE CAUSED BY HUMANS, ANIMALS OR INSECTS WERE NOTED. NO SIGNS OF DISEASE, DEFICIENCIES OR STRESS WERE NOTED. GAS POWERED STRING CUTTERS WERE USED TO CUT BACK GRASSES AND UNWANTED VEGETATION APPROX 24 IN TALL INCLUDING BLACKBERRIES. TO PREVENT ENCROACHMENT 5FT WAS CLEARED ALONG TO OUTER PERIMETER.
150 LBS OF FERTILIZER WAS APPLIED TO THE PLANTATION ON 6/13/17 BY J. RUEF & R. BOYD.

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

Total Hours: 13 Office: POULSBO, WA Inspector V.S. PATTERSON
Field: N/A Correspondence: N/A Sheet 1 of 1
Mileage: N/A

R=ROW T=TREE

Routing: 1 Copy to Inspection File

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Date:** 06/21/2017

Reason for Inspection:

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

Inspection Attendants: A. LEWIS, S. PATTERSON, M. HALDANE

Specific Inspection Activity: • INSPECTION OF TREE HEALTH
• WEED CONTROL ACTIVITIES
(FERTILIZER APPLICATION WAS CONDUCTED ON 06/13/17 BY J. RUEF & R. BOYD)

Inspection Results: THE TREES ARE LEAFED OUT. A FEW DEAD LEAVES WERE NOTED IN THE CANOPY (<5%) APPEAR TO BE ATTACHED TO SMALL BROKEN BRANCHES. TWO TREES WERE NOTED TO HAVE A SMALLER LEAF SIZE AND MINIMAL GROWTH. MOST OF THE GROWTH IN THE PLANTATION IS ON THE UPPER HALF OF THE TREES. SEVERAL BROKEN, DEAD AND/OR FALLEN BRANCHES WERE CUT BACK AND/OR REMOVED. BRANCHES WITH NO NEW GROWTH WERE NOTED ON NEARLY ALL THE TREES, THIS INCLUDES SEVERAL LARGE BRANCHES. ONE TREE (R7T4) ONLY HAD GROWTH ON THE LOWER 25FT OF THE TREE. AS PREVIOUSLY NOTED, SEVERAL TREE TRUNKS CONTAIN CRACKS IN THE BARK. LICHEN AND MOSS WERE NOTED ON THE TREES. WEEPING WAS NOTED ON TWO TREES. SOIL CONDITION WERE DAMP TO DRY. SAP SUCKER HOLES WERE NOTED: R12T1, R13T1, R16T1, R23T6, R26T1, R26T2. NO OTHER SIGNS OF DAMAGE CAUSED BY HUMANS, ANIMALS, OR INSECTS WERE NOTED. NO SIGNS OF DISEASE, DEFICIENCY OR STRESS WERE NOTED. GAS POWERED STRING CUTTERS WERE USED TO CUT BACK GRASSES AND UNWANTED VEGETATION APPROX 24IN TALL INCLUDING BLACKBERRIES, HOLLY, LAUREL, IVY. SUCKER WERE REMOVED FROM TREE STUMPS. TO PREVENT ENCROACHMENT 5FT WAS CLEARED ALONG THE OUTER PERIMETER.
125 LBS OF FERTILIZER WAS APPLIED TO THE PLANTATION ON 06/13/17 BY J. RUEF & R. BOYD

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

Total Hours: 13 Office: POULSBO, WA Inspector V.S. PATTERSON
Field: NA Correspondence: NA Sheet 1 of 1
Mileage: NA

R=ROW T=TREE

Routing: 1 Copy to Inspection File

JULY 2017 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

INTRODUCTION

The July 2017 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) 46. This report summarizes the field activities, results, and recommendations for the phytoremediation plantation inspection and maintenance completed on July 17, 2017 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 46 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 2017, and represents the third of eight planned phytoremediation inspection and maintenance events for TO 46 in 2017-18.

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 2017 to February 2018, including May, June, July, August, September, and November 2017 and January and February 2018. 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 46, 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 2017 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

FIELD ACTIVITIES

The third of eight scheduled tree inspection and maintenance events for 2017-18 under TO 46 was conducted on July 17, 2017, and consisted of weed cutting and pulling, cutting and removal of suckers and some of the dead lower tree limbs, and inspection of tree health.

RESULTS

Observations made during the July 2017 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 fair to good. No pest infestations were observed. The overall canopy appeared to be approximately as dense as it was during July 2016 and July 2015. As previously observed and reported, seven trees in the North Plantation appear to be dead, exhibiting no leaf growth whatsoever, including: R2T4; R3T2; R5T3; R13T15; R14T14; R15T4; and R15T1 (where R = row starting at the eastern edge of the plantation and moving west, and T = tree starting at the southern margin of the plantation and heading north). Eleven other trees in the North Plantation exhibited minimal leaf growth, primarily on their lower halves, including: R4T17; R6T7; R8T16; R9T18; R11T14; R12T3; R12T15; R14T15; R15T1; R16T16; and R17T4. Six other North Plantation trees had very minimal canopy growth, including: R2T2; R2T3; R10T19; R12T15; R14T8; and R16T14. One tree (R7T4) in the South Plantation only had growth on its lower 25 feet. Very few yellow leaves were observed on the tree branches or ground surfaces within both 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. 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 stumps were present. Sapsucker holes in tree bark have previously been observed on South Plantation trees R12T1; R13T1; R16T1; R23T6; R26T1; and R26T2. No new holes in bark from Sapsucker activity were present in the South Plantation; none have been observed in the North Plantation to date. 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 and/or moisture changes during fall and winter seasons.

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

Pest Control. No tent caterpillar or 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 2017 inspection was found to be very light to moderate in and around both plantations, with grasses short and brown. Dandelions up to 2 feet in height were spread throughout both plantations and around perimeter areas. A hand scythe, hand-tool loppers, and hand-pulling techniques were used to cut and remove unwanted vegetation within both plantations as well as in areas outside of perimeter fencing. 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 dandelions, blackberry, holly, laurel, and ivy. The plantation-perimeter area weeds cut back or pulled and removed consisted primarily of blackberry, Scotch broom, and dandelions. Weeds that were pulled were placed in a designated dumpster located near the South Plantation. A few suckers were pruned from tree stumps and roots, and a few lower-trunk dead branches were cut and 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 late summer tree inspections and maintenance scheduled for August 21, 2017. No standing water was present in either plantation, and surface soils in both plantations were dry. No evidence of physical damage resulting from humans or animals was observed.

Fertilizer Application. Granulated high-nitrogen granulated urea fertilizer was applied to the ground surfaces of both plantations during May and June 2017 maintenance. During each event, a broadcast spreader was used to evenly apply 150 pounds of urea to the North Plantation and 125 pounds of urea to the South Plantation. No further fertilizer application is planned until May and June 2018.

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 has been conducted since 2013 to maximize uptake of shallow-aquifer groundwater by the trees. It is hoped that the reduced irrigation will 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 November 2016 plantations inspection and maintenance, and will not be activated again by Sealaska unless so directed by the Navy RPM for TO 46.

FUTURE ACTIVITIES

The following activities by Sealaska are planned at the tree plantations for August 21, 2017:

- Conduct the fourth of eight planned TO 46, 2017-18 plantations inspections.
- Conduct grass and weed control by cutting and pulling.
- Remove dead branches from plantations.
- Prune suckers from roots and tree trunks.

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 2017 PHYTOREMEDIATION INSPECTION REPORT

NAVAL BASE KITSAP KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

INSPECTION FORMS

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation [X] South Plantation [ ] **Date:** 07/17/2017

Reason for Inspection:

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

Inspection Attendants: C. Alferness, J. Ruef

Specific Inspection Activity: • Inspection of tree health.
• Weed control activities.

Inspection Results: Dead trees noted: R3T2, R2T4, R4T17 (suckers at 3' from base only, grown on tree), R5T3, R6T7 (one small sucker), R8T16 (sucker), R9T18 (sucker), R11T14 (sucker), R12T3 (sucker), R13T15, R14T14, R14T15 (sucker), R15T4, R15T11 (sucker), R16T16 (sucker), R17T4 (sucker only).
• Some trees with very few leaves/small canopy – R2T2, R2T3, ~~R2T4~~ (A 7/17/17), R10T19 (end, small canopy), R14T8, ~~R14T15~~ (A 7/17/17), R16T14, R12T15 (suckers halfway up). The trees are leafed out, with most of the growth in the canopy. Dead branches near the walking areas were removed.
R6T7, R16T16: both are not marked with flagging. Soil condition dry. No damage caused by sheepmans, fence looked upon arrival.

Further Action Recommended:
~~Arrival~~ (A 7/17/17)
• Continue tree health monitoring
• Continue weed control

No insects or weeping tree sap noted. Hand pulled weeds and manual weed wacking of weeds. Minor amounts of Ivy, blackberry, laurel and dandelions removed. Very few leaves (yellow) on ground in SE corner. Grass within the plantation was short and brown or dormant, no mowing needed. Photos of stressed trees and of tree with fertilizer enhanced treatment taken.

R = Row (from E row) T = tree (from S to N)

Total Hours: _____ Office: ~~NA~~ 07/17/17 Poulsbo, WA
Field: NA Correspondence: NA
Mileage: NA

Inspector C. Alferness / J. Ruef
Sheet 1 of 1

Routing: 1 Copy to Inspection File

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Date:** 07/17/2017

Reason for Inspection:

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

Inspection Attendants: C. Alferness, J. Ruef

Specific Inspection Activity: • Inspection of tree health.
• Weed control activities.

Inspection Results: The trees are leafed out. Most of the growth is in the upper half of the trees. Minimal yellow leaves fallen on ground. R14T2 has only one live branch and a few suckers. R7T4 similar to past inspections with growth only on lower half. Very few trees with sap sucker holes that appear new (no moss growth). No weeping or insect damage noted. No animal or other human caused damage, cracks in bark and lichen/moss similar to previous inspections. No signs of disease, deficiency or stress. Hand removed weeds such as dandelion, ivy, holly and blackberries, also cut by hand with loppers/trimmer. Grass was dry & short. No need for mowing. Soil condition dry. Removed suckers from stumps at east end of Plantation.

Further Action Recommended:
• Continued monitoring for tree health
• Continued weed removal

R = Row T = Tree (Counted South to North, & east to west)

Total Hours: _____ Office: Poulsbo, WA Inspector C. Alferness / J. Ruef
Field: NA Correspondence: NA Sheet 1 of 1
Mileage: NA

Routing: 1 Copy to Inspection File

AUGUST AND SEPTEMBER 2017 PHYTOREMEDIATION INSPECTION REPORT (REV. 1) NAVAL BASE KITSAP KEYPORT OPERABLE UNIT 1

INTRODUCTION

The August and September 2017 phytoremediation inspections and maintenance for Naval Base Kitsap (NBK) Keyport, Washington were conducted by Sealaska Environmental Services, LLC (Sealaska). The work was completed under the long-term monitoring, operations and maintenance (LTM/OM) Contract N44255-14-D-9011, Task Order (TO) 46. This report summarizes the field activities, results, and recommendations for the phytoremediation plantation inspections and maintenance completed on August 21 and September 21, 2017 at Operable Unit (OU) 1 North and South Plantations. Completed field inspection forms for the two events 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. TO 46 requires Sealaska to conduct periodic inspections and maintenance to ensure the health of the plantation trees, such as weeding and fertilizer application. The inspection and maintenance requirements are described in the Project Work Plan (Navy 2012a) and the Operation and Maintenance (O&M) Plan for Phytoremediation at OU 1 (Navy 2012b). This report summarizes the field activities conducted at the plantations during August and September 2017, and are the fourth and fifth of eight planned phytoremediation inspection and maintenance events for TO 46 in 2017-2018.

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 2017 to February 2018, including May, June, July, August, September, and November 2017 and January and March 2018.

No irrigation is planned for the remainder of TO 46, 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. Irrigation had been conducted as needed during late spring and summer through 2012. 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. It is hoped

that the reduced irrigation will optimize metabolism of volatile organic compound contaminants (VOCs) through phytoremediation processes during the mid-summer to fall seasons. Irrigation will not be conducted again by Sealaska unless so directed by the Navy RPM for TO 46.

In the past, a high-nitrogen (urea) fertilizer was applied twice during the growing season based on observations of tree health and the nutrient poor soils present at both plantations. The application of fertilizer to the plantations was conducted in spring 2017 under field change request (FCR) TO 46 FCR-01 to the O&M Plan which states that "no further application of fertilizer is planned unless tree and/or site conditions warrant its implementation again." High-nitrogen granulated urea fertilizer was applied to the ground surfaces of both plantations during May and June 2016 and again in May and June 2017. During each event, a broadcast spreader was used to evenly apply 150 pounds of urea to the North Plantation and 125 pounds of urea to the South Plantation.

Major nurturing and maintenance activities are 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. In addition, one tree that had fallen and two other trees with the potential to fall were removed from the South Plantation by the Base Operations Service Contractor, Chugach, in 2016.

FIELD ACTIVITIES

The fourth and fifth of eight scheduled tree inspection and maintenance events for 2017-2018 under TO 46 were conducted on August 21 and September 21, 2017, respectively, and consisted of weed cutting and pulling, cutting and removal of suckers from a few tree stumps, and inspection of tree health.

RESULTS

Observations made during the August and September 2017 inspections of the North and South Plantations at NBK Keyport Area 1 were very similar for the two events, and are summarized below.

General Tree Health. A thorough inspection of each plantation was completed and the overall health of both plantations appeared to be fair to good. No pest infestations were observed. The overall canopy appeared to be denser than it was during late summer 2016, and approximately the same as during late summer 2015. Eight trees in the North Plantation

appear to be dead, exhibiting no leaf growth whatsoever, including: R2T4, R3T2, R5T3, R6T7, R13T15, R14T14, R15T1, and R15T4 (where R = row starting at the eastern edge of the plantation and moving west, and T = tree starting at the southern margin of the plantation and heading north). Nine other trees in the North Plantation exhibited minimal leaf growth, primarily on their lower halves, including: R4T17, R8T16, R9T18, R11T14, R12T3, R12T15, R14T15, R16T16, and R17T4. Seven other North Plantation trees had very minimal canopy growth, including: R2T2, R2T3, R10T19, R12T15, R14T8, R14T12, and R16T14. One tree (R7T4) in the South Plantation only had growth on its lower 25 feet, and another very small tree (approximately 15 to 20 feet tall) is dead.

Leaves remain largely green with very few having turned yellow, and only approximately 5 percent having fallen to the ground within both plantations. A few trees exhibited some new branch and leaf growth on lower areas where branches had previously died. Overall, the leaves were healthy in appearance, with no evidence of disease or other abnormalities observed. 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 stumps were present and cut with hand tools. Sapsucker holes in tree bark have previously been observed on South Plantation trees R12T1, R13T1, R16T1, R23T6, R26T1, and R26T2. No new holes in bark from Sapsucker activity were present in the South Plantation; none have been observed in the North Plantation to date.

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 and/or moisture changes during fall and winter seasons. The tree wood appears to be thickening where the bark has cracked. Although a few very tiny (pin-hole size) holes were seen in August 2017 in wood where bark has previously cracked, no new holes or worsening of the condition were observed during the September 2017 inspection. No evidence of significant damage to the trees from humans or animals were observed over the course of the two inspections.

Pruning. No major pruning was performed. A few suckers growing from roots and stumps were pruned and removed from the plantations.

Pest Control. No tent caterpillar or other insect infestations were observed.

Weed Control. Growth of grasses and weeds leading up to the time of the August and September 2017 inspections was found to be very light in and around both plantations, with

grasses short and brown. A hand scythe, hand-tool loppers, and hand-pulling techniques were used to cut and remove unwanted vegetation within both plantations, as well as in areas outside of perimeter fencing. A gas-engine weed trimmer was also used along perimeter areas of the South Plantation during September 2017 to cut back blackberries in the pathway and at two planned NAVFAC Northwest new well locations. 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 and September 2017, invasive vegetation removed or cut inside the plantations consisted primarily of blackberry, holly, ivy, and laurel. The plantation-perimeter area weeds cut back or pulled and removed consisted primarily of blackberry with a few Scotch broom. Weeds that were pulled were placed in a designated dumpster located near the South Plantation. A few suckers were pruned from tree stumps and roots and 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 late summer tree inspections and maintenance scheduled for late November, 2017. No standing water was present in either plantation during August and September, 2017. Surface soils and vegetation in both plantations were dry during August and wet during September.

Fertilizer Application. No fertilizer is applied after the growing season is completed. No further application is planned unless warranted and authorized by the Navy RPM.

Irrigation. The drip irrigation system will be winterized (i.e., compressed air will be introduced to the system piping to blow out any water that may be present) during the November 2017 plantations inspection and maintenance.

FUTURE ACTIVITIES

The following activities by Sealaska are planned at the tree plantations for November 30, 2017:

- Conduct the sixth of eight planned TO 46, 2017-18 plantations inspections.
- Conduct grass and weed control, if needed, by cutting and pulling.
- Remove dead branches from plantations.
- Prune suckers from roots and tree trunks.
- Winterize the irrigation system.

REFERENCES

Navy (U. S. Navy). 2012a. 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.

Navy. 2012b. 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.

Navy. 2017. Operation and Maintenance Plan for Phytoremediation and Tide Gate, Operable Unit 1, Naval Base Kitsap, Keyport, Washington. Prepared by Sealaska for Naval Facilities Engineering Command Northwest, under Contract No. N44255-14-D-9011, TO 27. Poulsbo, Washington. September 20, 2017.

ATTACHMENT 1

INSPECTION FORMS

AUGUST AND SEPTEMBER 2017

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☒ South Plantation ☐ **Date:** 8/21/17

Reason for Inspection:

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

Inspection Attendants: Jim Ruef, Barb Schleiger

Specific Inspection Activity:
- Monthly tree health inspection
- Weed control activities

Inspection Results: Overall health: fair-to-good. Leaves green with very few having turned yellow and fallen (unlike Aug. 2016). Grasses short and brown. Weeds cut or pulled and removed to dumpster, mostly ivy, blackberry, and holly with some maple and laurel. 8 trees are dead: R2T4; R3T1; R5T3; R6T7; R13T15; R14T14; R15T1; R15T4. 9 trees have only 1 to a few suckers at their base: R4T17; R8T16; R9T18; R11T4; R12T3; R12T15; R14T15; R16T16; R17T4. 7 trees have a small canopy: R2T2; R2T3; R10T19; R14T8; R12T15; R14T12; R16T14. The ABS treatment tree (R16T19) is doing well, but has no branches with leaves on its E, S, or W sides on its lower 7 ft. Ground surface: hard and dry. No damage from animals or human activity. Cut back weeds around outside perimeter fencing. No evidence of pests/insects was seen. JRR 8/21/17 1050

Further Action Recommended: Conduct tree health monitoring and weed control in September 2017.

Total Hours: 3 Office: Poulsbo, WA Inspector J. Ruef/B. Schleiger
Field: 3 Correspondence: N/A Sheet 1 of 1
Mileage: N/A

JRR - 8/21/17

Routing: 1 Copy to Inspection File

Sealaska

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Date:** 8/21/17

Reason for Inspection:

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

Inspection Attendants: Jim Ruef, Barb Schleiger

Specific Inspection Activity: • Monthly tree health inspection
• Weed control activities

Inspection Results: Trees are in good health overall, although canopy is limited to upper approximately 30% of trees, except around outer areas of plantation. Leaves are largely green, with very few having turned yellow and/or fallen. Grass short and brown. Weeds cut or pulled and removed to dumpster, mostly ivy, holly, blackberry with some laurel. Scotch broom and blackberry cut back around outside of fence pathways. A few tiny pin-size holes were seen in wood of approx. 5 trees where bark had cracked in the past exposing wood beneath. No new sapsucker holes were seen. No damage from animals or humans was seen. Ground surfaces were hard and dry. Cut back heavy sucker growth from stumps. R14T2 has minimal growth; R11T4 similar to past with growth on lower half only.

Further Action Recommended Conduct tree health monitoring and weed control in Sept. 2017. Closely observe pin holes in wood in cracks to see if condition worsens.

Total Hours: 1.5 Office: Poulsbo, WA Inspector J. Ruef / B. Schleiger
Field: 1.5 Correspondence: N/A Sheet 1 of 1
Mileage: N/A

JRR - 8/21/17

Routing: 1 Copy to Inspection File

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation X South Plantation ☐ **Task Order/Date:** TO 46 / 9-21-17

Reason for Inspection:
Monthly Inspection X Fertilization ☐ Weed Control X Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: Jim Ruef, Barb Schleiger

Specific Inspection Activity:
- Monthly tree health inspection
- Weed control activities

Inspection Results: Overall tree health fair-to good. Leaves remain mostly green, with only approx. 5% having fallen. Grasses short and brown, with ground surface wet, but no standing water. Tree wood thickening where cracks in bark have occurred. No pest infestations seen in bark cracks or elsewhere on trees. Weeds sparse, mostly ivy, holly, blackberry, and laurel - cut with hand tools or pulled and removed to dumpster. Dead trees (8 total) same as noted during August 2017 inspection. Trees with very little growth (9 total) same as noted in August 2017. Trees with sparse canopy (7 total) same as noted in August 2017. ABS treatment tree doing well. No damage from humans or animals was seen throughout plantation. Cut back blackberries around outside perimeter fencing paths.

Soils are being stockpiled in parking/laydown area adjacent NE portion of plantation from Keyport Base waterline replacement project on Bradley Road.

Further Action Recommended: Conduct tree health monitoring and weed control in November 2017. Blow out irrigation system water with compressed air.

Inspector J. Ruef Jamie R. Ruef 9/21/17 Sheet 1 of 1

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Task Order/Date:** TO 46/9-21-17

Reason for Inspection:
Monthly Inspection ☒ Fertilization ☐ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: Jim Ruef, Barb Schleiger

Specific Inspection Activity:
- Monthly tree health inspection
- Weed control activities

Inspection Results: Overall tree health fair-to-good. Leaves remain mostly green, with only approx. 5% having fallen. Grasses short and brown. Ground surface wet, but no standing water. Tree wood is thickening where cracks in bark have occurred. No pest infestations seen in bark cracks, or elsewhere on trees. No new Sapsucker holes were seen. Weed occurrence was sparse, mostly ivy, holly, blackberry and laurel. Cut weeds with hand tools or pulled and removed to dumpster. Cut back blackberry along south perimeter fence in pathway and around NAVFAC NW planned well locations. No new occurrence of small pin-size holes where tree cracks have occurred were seen, as first observed in August 2017. No damage from humans or animals was seen. Two small trees continue to exhibit very little growth.

Further Action Recommended: Conduct tree health monitoring and weed control in November 2017.

Inspector J. Ruef James F. Ruef 9/21/17 Sheet 1 of 1

NOVEMBER 2017 PHYTOREMEDIATION INSPECTION REPORT NAVAL BASE KITSAP KEYPORT OPERABLE UNIT 1

INTRODUCTION

The November 2017 phytoremediation inspections and maintenance for Naval Base Kitsap (NBK) Keyport, Washington were conducted by Sealaska Environmental Services, LLC (Sealaska). The work was completed under the long-term monitoring, operations and maintenance (LTM/OM) Contract N44255-14-D-9011, Task Order (TO) 46. This report summarizes the field activities, results, and recommendations for the phytoremediation plantation inspections and maintenance completed on November 30, 2017 at Operable Unit (OU) 1 North and South Plantations. Completed field inspection forms for the event 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. TO 46 requires Sealaska to conduct periodic inspections and maintenance to ensure the health of the plantation trees, such as weeding and fertilizer application. The inspection and maintenance requirements are described in the Operation and Maintenance (O&M) Plan for Phytoremediation at OU 1 (Navy 2017). This report summarizes the field activities conducted at the plantations during November 2017, and is the sixth of eight planned phytoremediation inspection and maintenance events for TO 46 in 2017-2018.

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 2017 to March 2018, including May, June, July, August, September, and November 2017 and January/February and March 2018.

No irrigation is planned for the remainder of TO 46. Irrigation had been conducted as needed during late spring and summer through 2012. 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. It is hoped that the reduced irrigation will optimize metabolism of volatile organic compound contaminants (VOCs) through phytoremediation processes during the mid-summer to fall seasons. Irrigation will not be

conducted again by Sealaska unless so directed by the Navy Remedial Project Manager (RPM) for TO 46.

In the past, a high-nitrogen (urea) fertilizer was applied twice during the growing season based on observations of tree health and the nutrient poor soils present at both plantations. The application of fertilizer to the plantations was conducted in spring 2017 under field change request (FCR) TO 46 FCR-01 to the O&M Plan which states that "no further application of fertilizer is planned unless tree and/or site conditions warrant its implementation again." High-nitrogen granulated urea fertilizer was applied to the ground surfaces of both plantations during May and June 2016 and again in May and June 2017. During each event, a broadcast spreader was used to evenly apply 150 pounds of urea to the North Plantation and 125 pounds of urea to the South Plantation.

Major nurturing and maintenance activities are 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. In addition, one tree that had fallen and two other trees with the potential to fall were removed from the South Plantation by the Base Operations Service Contractor, Chugach, in 2016.

FIELD ACTIVITIES

The sixth of eight scheduled tree inspection and maintenance events for 2017-2018 under TO 46 was conducted on November 30, 2017, and consisted of weed cutting and pulling and inspection of tree health.

RESULTS

Observations made during the November 2017 inspection of the North and South Plantations at NBK Keyport OU 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 fair to good. No pest infestations were observed. Leaves were all yellow, with approximately 10 to 20 percent of leaves remaining on tree branches. The remaining leaves were healthy in appearance, with no evidence of disease or other abnormalities observed. 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.

As reported previously, eight trees in the North Plantation appear to be dead, exhibiting no leaf growth whatsoever during spring and summer 2017 inspections, including: R2T4, R3T2, R5T3, R6T7, R13T15, R14T14, R15T1, and R15T4 (where R = row starting at the eastern edge of the plantation and moving west, and T = tree starting at the southern margin of the plantation and heading north). No other trees appeared to be dead during the November 2017 inspection.

Sapsucker holes in tree bark have previously been observed on South Plantation trees R12T1, R13T1, R16T1, R23T6, R26T1, and R26T2. No new holes in bark from Sapsucker activity were present in the South Plantation; none have been observed in the North Plantation to date.

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 and/or moisture changes during fall and winter seasons. The tree wood appears to be thickening where the bark has cracked. Although a few very tiny (pin-hole size) holes were seen in August 2017 in wood where bark had previously cracked, no new holes or worsening of the condition were observed during the September or November 2017 inspections. No evidence of significant damage to the trees from humans or animals were observed over the course of the two inspections.

Rainwater puddles were observed within the northwest and northeast portions of the North Plantation and in the southeast corner of the South Plantation, which are normal occurrences during the rainy season. Surface soils and vegetation in both plantations were very moist to wet.

Pruning. No major pruning was performed. A few dead and fallen branches were removed from the plantations.

Pest Control. No tent caterpillar or other insect infestations were observed.

Weed Control. Growth of grasses and weeds leading up to the time of the November 2017 inspection was found to be very light in and around both plantations, with grasses short and brown. A hand scythe, hand-tool loppers, and hand-pulling techniques were used to cut and remove unwanted vegetation within both plantations, as well as in areas outside of perimeter fencing. 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 November 2017, invasive vegetation removed or cut inside the plantations consisted primarily of blackberry, ivy, and holly. 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. 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 tree inspections and maintenance scheduled for early February and mid-March, 2018.

Fertilizer Application. No fertilizer is applied after the growing season is completed. No further application is planned unless warranted and authorized by the Navy RPM.

Irrigation. The drip irrigation system was winterized (i.e., compressed air was blown through the system piping to blow out any water that was present) during the November 2017 plantations inspection and maintenance.

FUTURE ACTIVITIES

The following activities by Sealaska are planned at the tree plantations for February 6, 2018:

- Conduct the seventh of eight planned TO 46, 2017-18 plantations inspections.
- Conduct grass and weed control, if needed, by cutting and pulling.
- Remove dead, fallen branches from plantations.
- Prune suckers from roots and tree trunks.

REFERENCE

Navy. 2017. Operation and Maintenance Plan for Phytoremediation and Tide Gate, Operable Unit 1, Naval Base Kitsap, Keyport, Washington. Prepared by Sealaska for Naval Facilities Engineering Command Northwest, under Contract No. N44255-14-D-9011, TO 27. Poulsbo, Washington. September 20, 2017.

ATTACHMENT 1

INSPECTION FORMS

NOVEMBER 2017

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation [X] South Plantation [ ] **Task Order/Date:** TO #6/11-30-17

Reason for Inspection:
Monthly Inspection [X] Fertilization [ ] Weed Control [X] Pest Control [ ]
Irrigation [ ] Thinning and Pruning [ ] Field Meeting [ ]
Other [ ] _____

Inspection Attendants: Jim Ruef and Mitch Haldane

Specific Inspection Activity: -Monthly tree health inspection.
-Weed control activities.
-Winterize irrigation system piping.

Inspection Results: Overall tree health is fair-to-good. Leaves have turned yellow with approximately 10-20 percent remaining on tree branches. No new trees have died since September 2017 inspection. No broken tops or large branches broken off. No new damage from humans or animals noted. Water pooled near NW corner and NE corner of plantation; a normal occurence for the rainy season. Weed occurence very sparse, mostly blackberry and ivy. Cut and pulled weeds and placed in dumpster by Bldg. 824. Moved few dead branches to areas outside plantation fencing. Cut back weeds in perimeter-area pathways.

8 dead trees remain (see August 21, 2017 event for list of specific trees). Vertical cracks (cracks) in bark very prominent.

Winterized irrigation system by blowing compressed air through system piping to remove water.

Further Action Recommended: Conduct winter tree health monitoring and weed control in early February 2018.

Inspector Jim Ruef James R. Ruef 11/30/17 Sheet 1 of 1

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Task Order/Date:** TO 46 / 11-30-17

Reason for Inspection:
Monthly Inspection ☒ Fertilization ☐ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: Jim Ruef and Mitch Haldane

Specific Inspection Activity: - Monthly tree inspection.
- Weed control activities.
- Winterize irrigation system piping.

Inspection Results: Overall tree health is fair-to-good. Leaves have all turned yellow with approximately 10-20 percent remaining on tree branches. No new occurrence of dead trees since Sept. 2017 inspection (two small trees with minimal growth noted then). No large branches or broken tree tops seen. Vertical cracks in bark still occuring; no pests seen in cracks. No damage from humans or animals seen, except some grass areas recovering after extensive drilling and well construction during summer and fall 2017. Water ponded near east and NE margin of plantation, normal for rainy season. Very minor occurrence of weeds, mostly blackberry, ivy and holly; weeds pulled or cut and disposed in Bldg. 874 dumpster. Two areas of fencing remain down along S. perimeter fence; removed for drilling rig access. Moved several small branches to areas outside of fencing.

Further Action Recommended: Conduct winter tree health monitoring and weed control in early February 2018.

Inspector Jim Ruef Jamm R Ruef 11/30/17 Sheet 1 of 1

FEBRUARY AND MARCH 2018 PHYTOREMEDIATION INSPECTION REPORT NAVAL BASE KITSAP KEYPORT OPERABLE UNIT 1

INTRODUCTION

The February and March 2018 phytoremediation inspections and maintenance for Naval Base Kitsap (NBK) Keyport, Washington were conducted by Sealaska Environmental Services, LLC (Sealaska). The work was completed under the long-term monitoring, operations and maintenance (LTM/OM) Contract N44255-14-D-9011, Task Order (TO) 46. This report summarizes the field activities, results, and recommendations for the phytoremediation plantation inspections and maintenance completed on February 6 and March 15, 2018 at Operable Unit (OU) 1 North and South Plantations. Completed field inspection forms for the two events 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. TO 46 requires Sealaska to conduct periodic inspections and maintenance to ensure the health of the plantation trees, such as weeding and fertilizer application. The inspection and maintenance requirements are described in the Operation and Maintenance (O&M) Plan for Phytoremediation at OU 1 (Navy 2017). This report summarizes the field activities conducted at the plantations during February and March, 2018, and are the seventh and eighth of eight planned phytoremediation inspection and maintenance events for TO 46 in 2017-2018.

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 2017 to March 2018, including May, June, July, August, September, and November 2017 and January/February and March 2018.

No irrigation is planned for the remainder of TO 46. Irrigation had been conducted as needed during late spring and summer through 2012. 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. It is hoped that the reduced irrigation will optimize metabolism of volatile organic compound contaminants (VOCs) through phytoremediation processes during the mid-summer to fall seasons. Irrigation will not be

conducted again by Sealaska unless so directed by the Navy Remedial Project Manager (RPM) for TO 46.

In the past, a high-nitrogen (urea) fertilizer was applied twice during the growing season based on observations of tree health and the nutrient poor soils present at both plantations. The application of fertilizer to the plantations was conducted in spring 2017 under field change request (FCR) TO 46 FCR-01 to the O&M Plan which states that "no further application of fertilizer is planned unless tree and/or site conditions warrant its implementation again." High-nitrogen granulated urea fertilizer was applied to the ground surfaces of both plantations during May and June 2016 and again in May and June 2017. During each event, a broadcast spreader was used to evenly apply 150 pounds of urea to the North Plantation and 125 pounds of urea to the South Plantation.

Major nurturing and maintenance activities are 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. In addition, one tree that had fallen and two other trees with the potential to fall were removed from the South Plantation by the Base Operations Service Contractor, Chugach, in 2016.

FIELD ACTIVITIES

The seventh and eighth of eight scheduled tree inspection and maintenance events for 2017-2018 under TO 46 were conducted on February 6 and March 15, 2018, and consisted of weed cutting and pulling and inspection of tree health.

RESULTS

Observations made during the February and March 2018 inspections of the North and South Plantations at NBK Keyport OU 1 were very similar, and are summarized below.

General Tree Health. A thorough inspection of each plantation was completed and the overall health of both plantations appeared to be fair to good. No pest infestations were observed. All leaves had dropped from the trees. No evidence of disease or other abnormalities observed. 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.

As reported previously, eight trees that remain standing in the North Plantation appear to be dead, exhibiting no leaf growth whatsoever during earlier spring and summer 2017

inspections, including: R2T4, R3T2, R5T3, R6T7, R13T15, R14T14, R15T1, and R15T4 (where R = row starting at the eastern edge of the plantation and moving west, and T = tree starting at the southern margin of the plantation and heading north).

Due to high winds over the weekend of February 17 and 18, 2018, the OU 1 plantations were re-inspected on February 20, 2018. No tree damage was noted in the South Plantation. North Plantation tree R16T16, previously identified as a “minimal growth” tree (a “smaller” tree, approximately 45 feet tall with a 6-inch diameter trunk at the base) was snapped off at ground level and had completely fallen to the ground. The tree trunk was very pithy (spongy and rotting). The top 25 feet of tree R17T12 (another “smaller” tree) was snapped off and had fallen to the ground, leaving approximately 30 feet of the trunk standing. No damage to other trees was identified, such as from trees falling or from the wind, except that there were numerous dead branches that had blown down. During March 15, 2018 maintenance, the branches on the fallen trees were cut and removed to areas outside the plantations and the trunks were cut into smaller pieces and moved to a location next to, and inside of, the North Plantation gate. Current plans by the Navy under the upcoming new Task Order call for felling and removing the remaining dead trees from the North Plantation during summer or fall 2018.

Sapsucker holes in tree bark have previously been observed on South Plantation trees R12T1, R13T1, R16T1, R23T6, R26T1, and R26T2. No new holes in bark from Sapsucker activity were present in the South Plantation during February and March, 2018; none have been observed in the North Plantation to date.

As observed during previous inspections over the past several years, the bark on many of the lower tree trunks in both plantations has cracked, a condition that appears to be worsening. The cracks are likely caused by rapid temperature and/or moisture changes during fall and winter seasons. The tree wood appears to be thickening at some locations where the bark has cracked. Although a few very tiny (pin-hole size) holes were first seen in August 2017 in wood where bark had previously cracked, no new holes were observed during subsequent inspections spanning September 2017 through March 2018. No evidence of significant damage to the trees from humans or animals were observed over the course of the inspections.

Rainwater puddles were observed within the northwest and northeast portions of the North Plantation and in the southeast corner of the South Plantation, which are normal occurrences at those locations during the rainy seasons. Surface soils and vegetation in both plantations were very moist to wet.

Pruning. No pruning was performed with the exception of a few small, dead lower-trunk branches. Dead and fallen branches were removed from the plantations.

Pest Control. No tent caterpillar or other insect infestations were observed.

Weed Control. Growth of grasses and weeds leading up to the time of the February and March 2018 inspections was found to be very light in and around both plantations, with grasses short and brown in February but starting spring growth and greening by March 2018. A hand scythe, hand-tool loppers, and hand-pulling techniques were used to cut and remove unwanted vegetation within both plantations, as well as in areas outside of perimeter fencing. 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 February and March 2018, invasive vegetation removed or cut inside the plantations consisted primarily of blackberry, ivy, and holly. 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. 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 tree inspections and maintenance in 2018 and 2019.

Fertilizer Application. No fertilizer is applied after the growing season is completed. No further application is planned unless warranted and authorized by the Navy RPM.

Irrigation. The drip irrigation system was winterized (i.e., compressed air was blown through the system piping to blow out any water that was present) during the November 2017 plantations inspection and maintenance.

FUTURE ACTIVITIES

The following activities by Sealaska are planned at the tree plantations for early summer, 2018:

- Conduct the first of six planned 2018-19 plantations inspections.
- Conduct grass and weed control by cutting and pulling.
- Remove dead, fallen branches from plantations.
- Prune suckers from roots and tree trunks.

REFERENCE

Navy. 2017. Operation and Maintenance Plan for Phytoremediation and Tide Gate, Operable Unit 1, Naval Base Kitsap, Keyport, Washington. Prepared by Sealaska for Naval Facilities Engineering Command Northwest, under Contract No. N44255-14-D-9011, TO 27. Poulsbo, Washington. September 20, 2017.

ATTACHMENT 1

INSPECTION FORMS

FEBRUARY AND MARCH 2018

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☒ South Plantation ☐ **Task Order/Date:** TO46 / 2-6-18

Reason for Inspection:
Monthly Inspection ☒ Fertilization ☐ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: A. Lewis, J. Ruef, W. Kaage

Specific Inspection Activity: monthly tree health, weed control, plantation inspections

Inspection Results: Overall tree health is in good condition. All leafs have fallen from trees. As noted in the previous inspections. Dead trees remain, without new tops fallen. Pooled water observed in the NE corner and the NW corner of the plantations. Very minimal weed growth, weeds were collected and placed in a dumpster at building 1824. Weeds that were collected; Black berries, ivy, and scotts broom. Fallen branches were removed from the plantation. Inspected and cut back weeds from around the perimeter of the plantation.

Additionally the pooled water at the NE corner of the plantation is cloudy brown due to runoff from construction laydown directly east of plantation.

Further Action Recommended: Continue winter tree health monitoring and weed control.

Inspector _____ 2-6-18 Sheet 1 of 1

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Task Order/Date:** TO46 2-6-18

Reason for Inspection:
Monthly Inspection ☒ Fertilization ☐ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: A. Lewis, J. Ruef, W. Kaage

Specific Inspection Activity: Monthly tree health, weed control, plantation inspections

Inspection Results: Overall tree health is in good condition. All leafs have fallen from tree's. As noted in previous inspections one tree is dead, no changes. Pooled water observed in the SE corner of the plantations. Very minimal weed growth, unwanted weeds were collected and placed in the dumpster at building 1824. Weeds that were collected; blackberry, ivy, and scotts broom. Fallen branches were removed from plantations. Inspected and cut weed growth back from around perimeter fence line.

Three open/pulled back sections of fence were noted from 2017 construction work. Multiple irrigation system locations were observed damaged from the 2017 construction work. Main gate into the plantation doesn't lock any longer since 2017 construction work. At approx. 15ft x 18inch water line pipe, metal was observed in the NW corner from the ongoing site water line work.

Further Action Recommended: Continue winter tree health monitoring and weed control.

Inspector _____

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☒ South Plantation ☐ **Task Order/Date:** T046 / 3-15-18

Reason for Inspection:
Monthly Inspection ☒ Fertilization ☐ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Field Meeting ☐
Other ☒ cut fallen trees

Inspection Attendants: Andy Lewis & Mitch Haldane

Specific Inspection Activity: monthly tree health, weed control, plantation inspections, and tree removal.

Inspection Results: Overall the tree's are in good health. All the leafs have fallen from trees. As noted in previus inspections, eight trees are dead with others with lost tops. Since previus inspections, One tree in the Northwest section has fallen and the top of a tree in the Westin section of the plantation. Both trees were cut and placed near the entery gate waiting direction. Minimal weed growth, ivy, scotts broom, and blackberries were pulled out by the root and placed in the side dumpster near the Southern plantation. Fallen braneks were removed from the plantations. Inspected and cleared pathway around the parimeter fence. As noted in previus inspections water was present in the North east section of the plantation, coming in from construction side, water was cloudy

Further Action Recommended: Continue tree health monitoring and weed removal.

Inspector _____ 3-15-18 Sheet 1 of 1

KEYPORT PHYTOREMEDIATION MONITORING

INSPECTOR'S DAILY LOG

Location: North Plantation ☐ South Plantation ☒ **Task Order/Date:** T046 / 3-15-18

Reason for Inspection:
Monthly Inspection ☒ Fertilization ☐ Weed Control ☒ Pest Control ☐
Irrigation ☐ Thinning and Pruning ☐ Field Meeting ☐
Other ☐ _____

Inspection Attendants: Andy Lewis & Mitch Haldane

Specific Inspection Activity: monthly tree health, weed control, and plantation inspections

Inspection Results: Overall tree health is in good condition, all leafs have fallen from trees. As noted in previous inspections one tree is dead, without any changes. Pooled water was observed in the southeast section of the plantations, soil is very moist, water likely flows through fence since there is evidence of wet soil on the outside near front gate. Very minimal weed growth, ivy, Scotts broom, and blackberries were pulled out by the root and disposed of in dumpster near the south plantations. Branches were removed from inside the plantations. Inspected and cut weeds back from outside the parameter fence.

Three sections in the fence all on the South side have been opened for new well installation, no changes since last inspections. Construction lay down area in the North west corner of the tree Plantation (out side plantation) is still present. They have ~~three~~ soil stock piles, only one is covered. Their construction debris are blowing into the Plantations, items moved back to their area were; two child pools, conduct, plastic sheeting, sand bags, and many peices of Styrophoam. The metal pipe previously noted has been moved. A 3x3ft by 18inch deep hole was observed in the North east section with a cone inside it, appears to be a manhole I.d.

Further Action Recommended: Continue monthly tree health inspections and weed control

Inspector _____ 3-15-18 Sheet 1 of 1

APPENDIX C

TIDE GATE INSPECTION REPORTS

(PROVIDED ON DISC)

FEBRUARY 2017 TIDE GATE INSPECTION REPORT

NAVAL BASE KITSAP AT KEYPORT

OPERABLE UNIT 1

INTRODUCTION

This report documents the February 2017 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 February 17, 2017. The tide gate was found to be in good condition and performed as designed during operational monitoring through a high-tide cycle.

INSPECTION AND MAINTENANCE

Inspection and maintenance of the OU 1 tide gate at NBK Keyport was performed on February 17, 2017 during an afternoon 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, 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 require 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 the morning of February 17, 2017. Temporary staff gauges were installed on both sides of the tide gate culvert and tide gate operation was monitored from approximately 3 hours before high tide to 1 hour 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 mean lower low water (MLLW) at 0906 hours (9:06 am) was predicted for February 17, 2017 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 provided on the NOAA website (see Attachment 1).

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 door began oscillation at 0650 hours at a water level of 2.90 feet above the tide gate invert and fully closed 8 minutes later at 0658 hours at a water level of 3.18 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 a height of 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. February 17, 2017 Tide Gate Monitoring.

Time	Predicted Tide Level (feet above MLLW)	Tide Flats (feet above tide gate invert)	Marsh (feet above marsh floor at upper culvert security gate)	Notes
06:12	8.2	1.88	2.70	Approx. 3 hours before high tide
06:36	9.6	2.50	3.39	
07:06	10.0	3.30	3.34	Tide gate fully closed at 06:58
07:36	10.5	4.00	3.37	
08:06	10.9	4.62	3.40	
08:36	11.1	4.98	3.45	
09:06	11.4	5.06	3.47	High tide
09:36	11.2	5.02	3.48	
10:06	10.8	4.68	3.51	

FEBRUARY 2017 TIDE GATE INSPECTION REPORT

NAVAL BASE KITSAP AT KEYPORT

OPERABLE UNIT 1

SUMMARY AND CONCLUSIONS

Cleaning of the tide gate and related components February 17, 2017 removed barnacles and mussels (light to moderate growth) that had attached and grown since the previous cleaning in August 2016. Seaweed, leaves and small branches/twigs were removed from the tide gate and the upper culvert security gate. 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 February 17, 2017 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 May 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.

FEBRUARY 2017 TIDE GATE INSPECTION REPORT

NAVAL BASE KITSAP AT KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

TIDE GATE INSPECTION AND MAINTENANCE FORM

NOAA WEBSITE TIDE CHART FOR FEBRUARY 17, 2017

Sealaska

3 Pages

TIDE GATE INSPECTION AND MAINTENANCE FORM

Keyport OU 1 Tide Gate at Tide Flats

Date/time: 02/17/2017

Tidal Condition: High-11.37' @ 0906 / Low-2.58' @ 1559

Weather Condition: Lt. overcast, calm winds to 5 mph, 45°-50° F.

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 in painted surfaces were observed on the tide gate, however pits are not adversely affecting the working condition or integrity of the tidegate. No action recommended.

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 cracks at the top of the vent were observed (previously documented) Silt & vegetation were removed from vent during maintenance activities.

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)**

Minor areas of pitting observed, however pitting does not adversely affect tide gate function or integrity

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:** 2.90 **. 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
0612	8.2	2.70	1.88
0636	9.6	3.39	2.50
0706	10.0	3.34	3.30
0736	10.5	3.37	4.00
0806	10.9	3.40	4.62
0836	11.1	3.45	4.98
0906	11.4	3.47	5.06
0936	~~11.4~~ 11.7	3.48	5.02
1006	~~11.7~~ 10.8	3.51	4.68

0650 flatter start : 2.90 at T.G. / 3.72 at upper culvert

0658 gate fully closed : 3.18 at T.G. / 3.48 at upper culvert

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 silt/sediment, barnacle/mussel, & vegetation accumulation from inside/outside of tide gate using scraping tools & brushes

Robert Brul
Inspector's Signature

02/17/17
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**

Poulsbo, Liberty Bay, WA StationId: 9445719

Published Tide Tables Formats		
Annual PDF	Annual TXT	Annual XML

Referenced to Station: Seattle (9447130)
Time offset in mins (high:5 low: 12) Height offset in feet (high:* 1.03 low: *1.01)

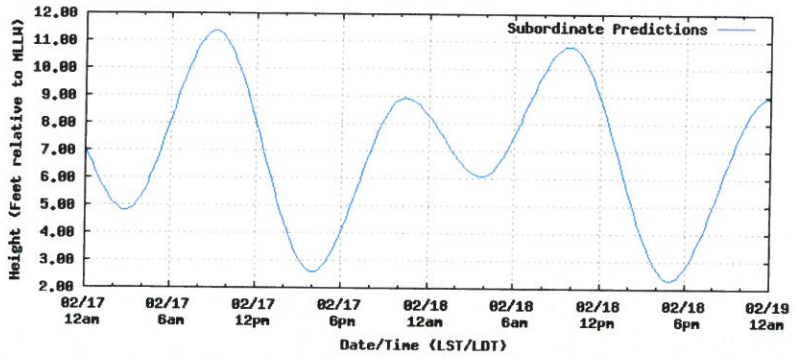
(./redirect.jsp)
Printer Friendly

Daily Tide Prediction in **Feet**
Time Zone: **LST/LDT**
Datum: **MLLW**

(./NOAATidesFacade.jsp?Stationid=9445719&bmon=02&bday=16&byear=2017&edate=&timelength=daily&timeZone=2&dataUnits=1&datum=MLLW&timeU
2017/02/17 - 2017/02/18
(./NOAATidesFacade.jsp?Stationid=9445719&bmon=02&bday=18&byear=2017&edate=&timelength=daily&timeZone=2&dataUnits=1&datum=MLLW&timeU

Back to Station Listing
Help (/PageHelp.html)

High/Low Tide Predictions in Feet
from 2017/02/17 - 2017/02/18
Download: TXT XML



Date	Day	Time	Hgt
02/17	Fri	02:52 AM	4.81 L
02/17	Fri	09:06 AM	11.37 H
02/17	Fri	03:59 PM	2.58 L
02/17	Fri	10:21 PM	8.94 H
02/18	Sat	03:44 AM	6.09 L
02/18	Sat	09:48 AM	10.83 H
02/18	Sat	04:53 PM	2.33 L
02/18	Sat	11:54 PM	8.97 H

Disclaimer: These data are based upon the latest information available as of the date of your request, and may differ from the published tide tables.
Note: For predictions of Subordinate stations, the solid blue line depicts a curve fit between the high and low values and approximates the segments between.

Begin Date: **Time Range:** **Time Zone:** **Data Units:**

(./NOAATidesFacade.jsp?Stationid=9445719&bmon=02&bday=16&byear=2017&edate=&timelength=daily&timeZone=2&dataUnits=1&datum=MLLW&timeUnits=2&interval=highlow&format=Submit)

Feb 17 2017

(./NOAATidesFacade.jsp?Stationid=9445719&bmon=02&bday=18&byear=2017&edate=&timelength=daily&timeZone=2&dataUnits=1&datum=MLLW&timeUnits=2&interval=highlow&format=Submit)

Show Advanced Options

Submit Reset

Photograph 1: Tide gate following monitoring and cleaning.

MAY 2017 TIDE GATE INSPECTION REPORT

NAVAL BASE KITSAP AT KEYPORT

OPERABLE UNIT 1

INTRODUCTION

This report documents the May 2017 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) 46. Maintenance, inspection, and monitoring were 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 9, 2017. The tide gate was found to be in good condition and performed as designed during operational monitoring through a high-tide cycle.

INSPECTION AND MAINTENANCE

Inspection and maintenance of the OU 1 tide gate at NBK Keyport was performed on May 9, 2017 during a morning low tide. Sealaska conducted hand scraping and removal of barnacles, mussels, silt, seaweed, and branches/twigs on all accessible exterior surfaces, floats, side door interiors, surrounding structures, accessible interior portions of the culvert (within approximately 4 feet of the door), and on the upper culvert security gate. 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 require 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 the afternoon and evening of May 9, 2017. Temporary staff gauges were installed on both sides of the tide gate culvert and tide gate operation was monitored from approximately 2 hours before high tide to 2 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 10.6 feet mean lower low water (MLLW) at 1803 hours (6:03 pm) was predicted for May 9, 2017 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 provided on the NOAA website (see Attachment 1).

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 door began oscillation at 1629 hours at a water level of 2.82 feet above the tide gate invert and fully closed 2 minutes later at 1631 hours at a water level of 2.89 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 a height of 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 9, 2017 Tide Gate Monitoring.

Time	Predicted Tide Level (feet above MLLW)	Tide Flats (feet above tide gate invert)	Marsh (feet above marsh floor at upper culvert security gate)	Notes
16:03	8.8	1.95	2.80	2 hours before high tide
16:33	9.8	2.90	3.35	Tide gate fully closed at 16:31
17:03	10.3	3.48	2.91	
17:33	10.4	3.83	2.92	
18:03	10.6	3.83	2.96	High tide
18:33	10.4	3.65	2.97	
19:03	10.3	3.34	2.97	
19:33	10.0	2.80	2.98	
20:03	9.0	2.28	2.99	

MAY 2017 TIDE GATE INSPECTION REPORT

NAVAL BASE KITSAP AT KEYPORT

OPERABLE UNIT 1

SUMMARY AND CONCLUSIONS

Cleaning of the tide gate and related components May 9, 2017 removed barnacles and mussels (light to moderate growth) that had attached and grown since the previous cleaning in February 2017, along with seaweed. Barnacles and tree branches were removed from the upper culvert security gate. 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 9, 2017 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 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.

MAY 2017 TIDE GATE INSPECTION REPORT

NAVAL BASE KITSAP AT KEYPORT

OPERABLE UNIT 1

ATTACHMENT 1

TIDE GATE INSPECTION AND MAINTENANCE FORM

NOAA WEBSITE TIDE CHART FOR MAY 9, 2017

Sealaska

3 Pages

TIDE GATE INSPECTION AND MAINTENANCE FORM

Keyport OU 1 Tide Gate at Tide Flats

Date/time: 05/09/2017

Tidal Condition: Low: 0.2' @ 1121 / High 10.6' @ 1803

Weather Condition: Sunny, 66°, lt. 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 painted surface. Does not affect tide gate operation, and does not require action at this time.

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

If not, describe problem and recommended actions: Some silt buildup. Cleaned during maintenance.

3) **Inspect the condition of the vacuum break vent. Describe condition and recommended action(s):** Two small cracks at top of vent. Do not affect operation and do not require action 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: N/A

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

To 46
JRR

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

X Yes ____ No If no, describe recommended action N/A

Removed several tree limbs 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. No action currently required.

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 N/A

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

Time	Predicted Tide Level	Water elevation above upper culvert	Water elevation at tide gate	
1603	8.8	2.80	1.95	
1633	9.8	3.35	2.90	
1703	10.3 ~~8.76~~ 5/9/17 @16:56	2.91	3.48	
1733	10.4	2.92	3.83	
1803	10.58	2.96	3.83	HIGH TIDE
1833	10.4	2.97	3.65	
1903	10.3	2.97	3.34	
1933	10.0	2.98	2.80	
2003	9.0	2.99	2.28	
flutter start 1629		3.50	2.82	
" end 1631		3.35	2.89	

TO 46
JRR

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, mussels, seaweed, silt, and sediment from outside and inside the tide gate. Removed branches and barnacles from the upper culvert security grate. Used hand tools and brusher for cleaning.

Jomeah Ruel
Inspector's Signature

05/09/2017
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:**

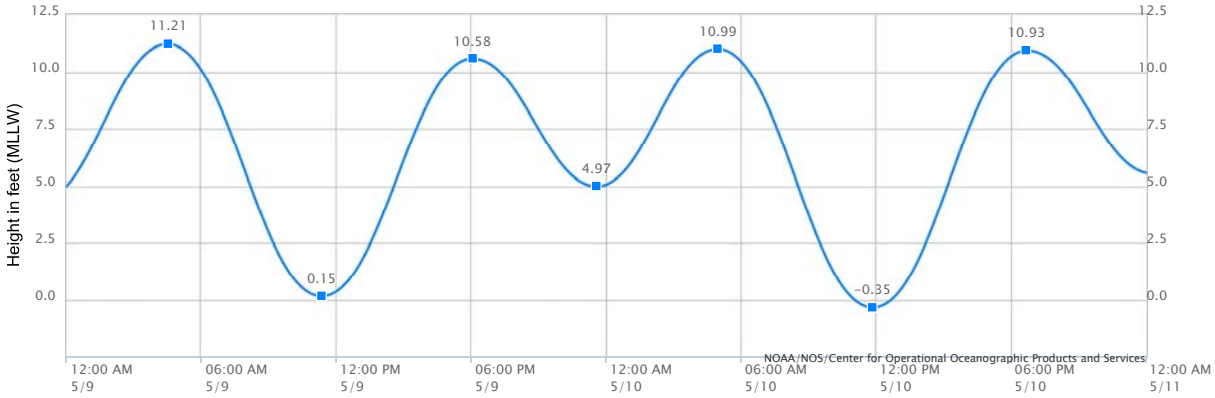
Repair and/or Re-inspection conducted by:

Organization	**Signature**	**Date**

TO 46
JRR

Help Print

NOAA/NOS/CO-OPS
Tide Predictions at 9445719, POULSBO WA
From 2017/05/09 12:00 AM LST/LDT to 2017/05/10 11:59 PM LST/LDT
Subordinate Station | Ref. Station (Seattle 9447130) | Time offsets (high: 5 min. low: 12 min.) | Height offsets (high: *1.03 ft. low: *1.01 ft.)



Note: The interval is High/Low, the solid blue line depicts a curve fit between the high and low values and approximates the segments between.
Disclaimer: These data are based upon the latest information available as of the date of your request, and may differ from the published tide tables.

High/Low Tide Prediction Data Listing

Station Name: POULSBO, WA
Action: Daily
Product: Tide Predictions
Start Date & Time: 2017/5/9 12:00 AM
End Date & Time: 2017/5/10 11:59 PM

Source: NOAA/NOS/CO-OPS
Prediction Type: Subordinate
Datum: MLLW
Height Units: Feet
Time Zone: LST/LDT

Date	Day	Time	Hgt	Time	Hgt	Time	Hgt	Time	Hgt
2017/05/09	Tue	04:30 AM	11.21 H	11:21 AM	0.15 L	6:03 PM	10.58 H	11:34 PM	4.97 L
2017/05/10	Wed	04:57 AM	10.99 H	11:50 AM	-0.35 L	6:41 PM	10.93 H		

AUGUST 2017 TIDE GATE INSPECTION REPORT, NAVAL BASE KITSAP KEYPORT, OPERABLE UNIT 1

INTRODUCTION

This report documents the August 2017 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) 46. Maintenance, inspection, and monitoring were conducted in accordance with the Operation and Maintenance Plan (Navy 2012). Sealaska performed tide gate inspection and maintenance, and monitored operation on August 21, 2017. The tide gate was found to be in good condition and performed as designed during operational monitoring.

INSPECTION AND MAINTENANCE

Inspection and maintenance of the OU 1 tide gate at NBK Keyport was performed on August 21, 2017 during a morning low tide. Sealaska conducted hand-scraping and removed barnacles, mussels, silt, seaweed, and branches/twigs on all accessible exterior surfaces, floats, side door interiors, surrounding structures, accessible interior portions of the culvert (within approximately 4 feet of the door), and on the upper culvert security gate. 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 require 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 the afternoon and evening of August 21, 2017. 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 12.1 feet mean lower low water (MLLW) at 1818 hours (6:18 pm) was predicted for August 21, 2017 on the web site https://tidesandcurrents.noaa.gov/tide_predictions.html for

the "Washington, Puget Sound, Poulsbo, Liberty Bay" location, with other predicted tide levels in Table 1 estimated from a tide chart provided on the NOAA website (Attachment 2).

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 door began oscillation at 1624 hours at a water level of 2.74 feet above the tide gate invert and fully closed 10 minutes later at 1634 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 a height of 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 21, 2017 Tide Gate Monitoring

Time	Predicted Tide Level (feet above MLLW)	Tide Flats (feet above tide gate invert)	Marsh (feet above marsh floor at upper culvert security gate)	Notes
15:48	8.8	0.78	1.42	2.5 hours before high tide
16:18	9.5	2.46	2.96	
16:48	10.6	3.58	2.59	Tide gate fully closed at 16:31
17:18	11.5	4.36	2.50	
17:48	12.0	4.90	2.51	
18:18	12.1	4.96	2.52	High tide
18:48	11.9	4.78	2.55	
19:18	11.5	4.44	2.55	
19:48	11.0	3.96	2.55	

Note:
MLLW – mean lower low water

SUMMARY AND CONCLUSIONS

Cleaning of the tide gate and related components August 21, 2017 removed barnacles (heavy growth) and mussels (light to moderate growth) that had attached and grown since the previous cleaning in May 2017, along with seaweed. A moderate accumulation of sediment at the top of the tide gate and on other tide gate component surfaces was removed. Seaweed and tree branches were removed from the upper culvert security gate. 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 August 21, 2017 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 and inspection is scheduled for October 16, 2017, with follow-up tide gate door monitoring through a high tide cycle scheduled for November 30, 2017. The cleaning/inspections are being performed during the early portion of the fall quarter to enable access to the tide gate via the beach during daylight hours and during a low enough low tide to safely conduct the work. Monitoring of the tide gate door closure will be conducted per the current schedule.

REFERENCE

Navy (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.

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: 8/21/17

Tidal Condition: LT -1.77' @ 11:20 / HT 12.09' @ 18:18

Weather Condition: Sunny, 78°, wind NNW 3-5 mph

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):
Very minor pitting in some of the surfaces. Does not affect operation of tide gate and does not require any repair at this time.

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

If not, describe problem and recommended actions: N/A

3) **Inspect the condition of the vacuum break vent. Describe condition and recommended action(s):** Good condition. Removed barnacles and silt/seaweed. No further action required.

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

If no, describe the condition and recommended action: N/A

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

Received PCM Cara Jefferness 8/29/17

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

X Yes ____ No If no, describe recommended action Removed seaweed and sticks.

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

Paint has oxidized (faded) somewhat, with some very minor pitting. No further action currently needed.

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: 2.74. 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 N/A

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

Time	Predicted Tide Level	Water elevation above upper culvert	Water elevation at tide gate	
15:48	8.8	1.42	0.78	
16:18	9.5	2.96	2.46	
16:48	10.6	2.59	3.58	
17:18	11.5	2.50	4.36	
17:48	12.0	2.51	4.90	
18:18	12.1	2.52	4.96	High Tide
18:48	11.9	2.55	4.78	
19:18	11.5	2.55	4.44	
19:48	11.0	2.55	3.96	
16:24	flutter start	UC 3.19	LC 2.74	
16:34	flutter end	2.86	3.10	

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:

Seaweed and sticks removed from upper culvert gate. Scraped and removed heavy growth of barnacles from tide gate surfaces, and removed moderate accumulation of silt, seaweed, and mussels from tide gate surfaces and from inside the lower culvert within approximately five feet of the outlet/tide gate door.

James R. Ruef
Inspector's Signature

8/21/17
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:

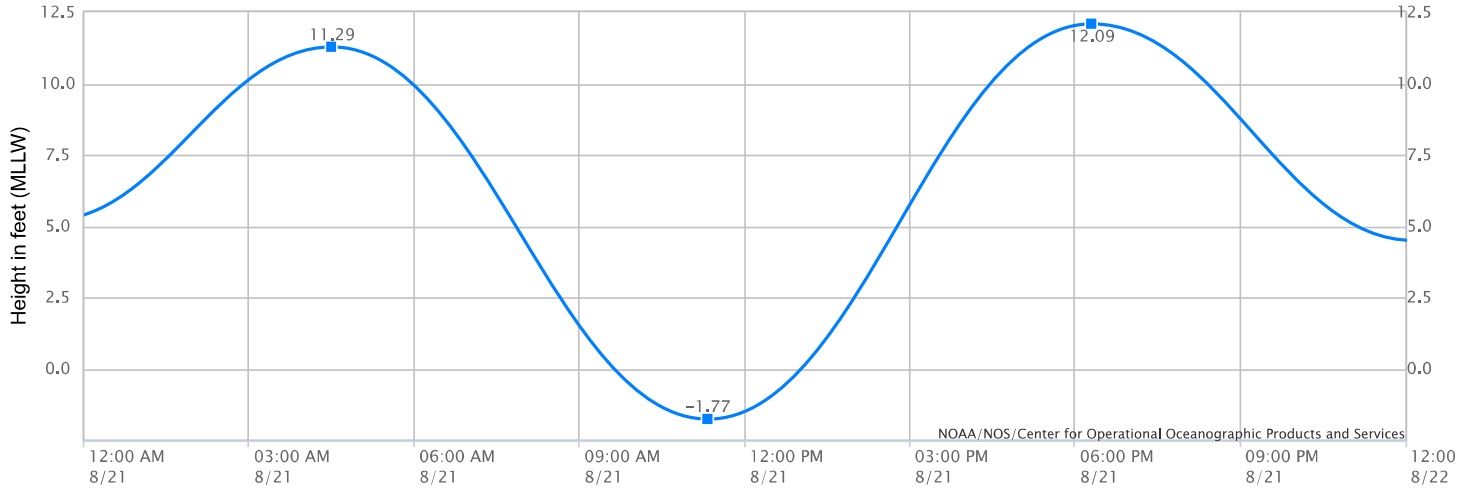
Organization	**Signature**	**Date**

ATTACHMENT 2

NOAA WEBSITE TIDE CHART FOR AUGUST 21, 2017

Help Print

NOAA/NOS/CO-OPS
Tide Predictions at 9445719, POULSBO WA
From 2017/08/21 12:00 AM LST/LDT to 2017/08/21 11:59 PM LST/LDT
Subordinate Station | Ref. Station (Seattle 9447130) | Time offsets (high: 5 min. low: 12 min.) | Height offsets (high: *1.03 ft. low: *1.01 ft.)



Note: The interval is High/Low, the solid blue line depicts a curve fit between the high and low values and approximates the segments between.
Disclaimer: These data are based upon the latest information available as of the date of your request, and may differ from the published tide tables.

High/Low Tide Prediction Data Listing

Station Name: POULSBO, WA
Action: Daily
Product: Tide Predictions
Start Date & Time: 2017/8/21 12:00 AM
End Date & Time: 2017/8/21 11:59 PM

Source: NOAA/NOS/CO-OPS
Prediction Type: Subordinate
Datum: MLLW
Height Units: Feet
Time Zone: LST/LDT

Date	Day	Time	Hgt	Time	Hgt	Time	Hgt	Time	Hgt
2017/08/21	Mon	04:30 AM	11.29 H	11:20 AM	-1.77 L	6:18 PM	12.09 H		

OCTOBER / NOVEMBER 2017 TIDE GATE INSPECTION REPORT, NAVAL BASE KITSAP KEYPORT, OPERABLE UNIT 1

INTRODUCTION

This report documents the October and November 2017 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) 46. Maintenance, inspection, and monitoring were conducted in accordance with the Operation and Maintenance (O&M) Plan (Navy 2017). Sealaska performed tide gate inspection and maintenance on October 16, 2017 during a low tide, and monitored operation on November 30, 2017 during a high tide. The tide gate was found to be in good condition and performed as designed during operational monitoring.

INSPECTION AND MAINTENANCE

Inspection and maintenance of the OU 1 tide gate at NBK Keyport was performed on October 16, 2017 during a morning low tide. The tide gate was cleaned ahead of its scheduled November 30, 2017 O&M event for personnel safety considerations (i.e., to allow access from the beach during a low tide occurring during daylight). Sealaska conducted hand-scraping and removed barnacles, mussels, silt, seaweed, and branches/twigs on all accessible exterior surfaces, floats, side door interiors, surrounding structures, accessible interior portions of the culvert (within approximately 4 feet of the door), and on the upper culvert security gate. 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 require 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 during the late morning and early afternoon of November 30, 2017. Temporary staff gauges were installed on both sides of the tide gate culvert and tide gate operation was monitored from 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 12.3 feet mean lower low water (MLLW) at 1341 hours (1:41 pm) was predicted for November 30, 2017 on the web site https://tidesandcurrents.noaa.gov/tide_predictions.html for the "Washington, Puget Sound, Poulsbo, Liberty Bay" location, with other predicted tide levels in Table 1 estimated from a tide chart provided on the NOAA website (Attachment 2).

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 door began oscillation at 1138 hours at a water level of 2.82 feet above the tide gate invert and fully closed 10 minutes later at 1148 hours at a water level of 3.12 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 a height of 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 30, 2017 Tide Gate Monitoring

Time	Predicted Tide Level (feet above MLLW)	Tide Flats (feet above tide gate invert)	Marsh (feet above marsh floor at upper culvert security gate)	Notes
10:11	7.5	0.34	1.00	3.5 hours before high tide
10:41	8.7	1.14	1.63	
11:11	9.8	2.06	2.46	
11:41	11.1	2.90	3.10	Tide gate fully closed at 16:31
12:11	11.5	3.78	2.87	
12:41	12.0	4.52	2.92	
13:11	12.2	5.06	2.95	
13:41	12.3	5.32	2.96	High tide
14:11	12.2	5.18	2.97	

Note:
MLLW – mean lower low water

SUMMARY AND CONCLUSIONS

Cleaning of the tide gate and related components occurred on October 16, 2017. Hand-scraping removed barnacles (moderate growth), mussels (light growth), and seaweed that had attached and grown since the previous cleaning in August 2017. A heavy accumulation of sediment at the top of the tide gate and on other tide gate component surfaces was removed. Tree branches and leaves were removed from the upper culvert security gate.

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 November 30, 2017 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 is scheduled for February 6, 2018.

REFERENCE

Navy. 2017. Operation and Maintenance Plan for Phytoremediation and Tide Gate, Operable Unit 1, Naval Base Kitsap, Keyport, Washington. Prepared by Sealaska for Naval Facilities Engineering Command Northwest, under Contract No. N44255-14-D-9011, TO 27. Poulsbo, Washington. September 20, 2017.

ATTACHMENT 1

TIDE GATE INSPECTION AND MAINTENANCE FORM

TIDE GATE INSPECTION AND MAINTENANCE FORM

Inspectors: Jim Ruef, Mitch Haddane Task Order: To 46

Keyport OU 1 Tide Gate at Tide Flats

Date/time: 10/16/17 (cleaning/inspection) & 11/30/17 (monitoring)

Tidal Condition: 10/16/17: L.T. 1.5' @ 0906; 11/30/17: HT 12.3' @ 1341

Weather Condition: 10/16/17: clear to lt. overcast; 42°-52°F.; calm to lt. breeze.
11/30/17: cloudy w/rain; 41°-45°F; lt. wind S. to 5 mph.

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):
Very minor pitting of some metal surfaces. Does not require repair at this time, and does not affect operation of gate.

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

If not, describe problem and recommended actions: N/A

3) Inspect the condition of the vacuum break vent. Describe condition and recommended action(s):

Vent in good condition with no blockage. Two minor cracks at top of vent pipe. No repair required.

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

If no, describe the condition and recommended action: All moving parts fully operational. No repair required.

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

N/A

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 and leaves. Gate is in good condition.

JRR - 11/30/17

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

Paint has oxidized (faded) somewhat; no repair required at this time.

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 N/A

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

Time	Predicted Tide Level	Water elevation above upper culvert	Water elevation at tide gate	
1011	7.5	1.00	0.34	
1041	8.7	1.63	1.14	
1111	9.8	2.46	2.06	
1141	11.1	3.10	2.90	
1211	11.5	2.87	3.78	
1241	12.0	2.92	4.52	
1311	12.2	2.95	5.06	
1341	12.3	2.96	5.32	high tide
1411	12.2	2.97	5.18	

Tide gate flutter start time / elevations: 11:38 UC: 3.02 TG: 2.82

Tide gate fully closed time / elevations: 11:48 UC: 3.05 TG: 3.12

JRR-12/30/17

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 moderate growth of barnacles from exterior surfaces of tide gate and inside lower culvert. Scrubbed and removed heavy layer of silt from exterior surfaces and components. A few mussels removed from inside and below the lower culvert. Sticks and leaves removed from upper culvert gate.

James R. Ruff (cleaning/inspection) - 10/16/17
James R. Ruff (gate closure monitoring) - 11/30/17

Inspector's Signature **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___ **No** X **If yes, describe the follow up action and resolution:**

_____

_____

_____

_____

_____

_____

_____

Repair and/or Re-inspection conducted by:

Organization	**Signature**	**Date**

JRR - 11/30/17

ATTACHMENT 2

NOAA WEBSITE TIDE CHART

Search

PRODUCTS (/products.html) Data, Analyses, and Publications | **PROGRAMS** (/programs.html) Serving the Nation | **EDUCATION** (/education.html) Tides, Currents, and Predictions | **HELP & ABOUT** (/about.html) Info and how to reach us

Home (/) / Products (products.html) / NOAA Tide Predictions (tide_predictions.html) / 9445719 POULSBO, WA

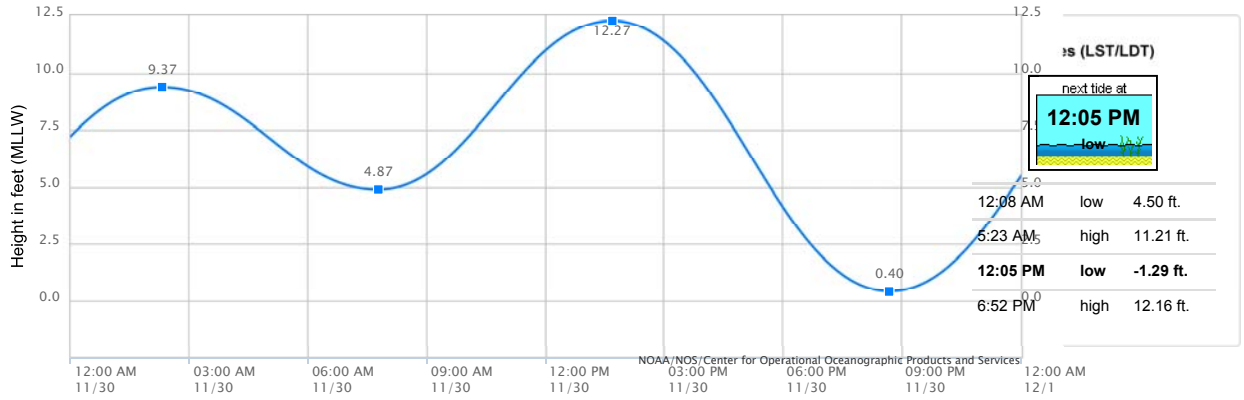
Station Info | Tides/Water Levels | Meteorological Obs. (/met.html?id=9445719) | Phys. Oceanography (/physocean.html?id=9445719)

Back to Station Listing (/tide_predictions.html) | Help (noaatidepredictionshelp.html)

Printer View

Click Here for Annual Published Tide Tables (/noaatideannual.html?id=9445719)

NOAA/NOS/CO-OPS
Tide Predictions at 9445719, POULSBO WA
From 2017/11/30 12:00 AM LST/LDT to 2017/11/30 11:59 PM LST/LDT
Subordinate Station | Ref. Station (Seattle 9447130) | Time offsets (high: 5 min. low: 12 min.) | Height offsets (high: *1.03 ft. low: *1.01 ft.)



Options for
9445719 POULSBO, WA

From:
Nov 30 2017

To:
Nov 30 2017

Note: The maximum range is 31 days.

Units
Feet

Timezone
LST/LDT

Datum (datum_options.html)
MLLW

12 Hour/24 Hour Clock
12 Hour

Data Interval
High/Low

Shift Dates
Back 1 Day | Forward 1 Day

Threshold Direction
>=

Threshold Value

Update
Plot Daily
Plot Calendar
Data Only

Date **Day of the Week** **Time (LST/LDT)** **Predicted (ft)**
Data Listing High/Low
Web Services | Download TXT | Download XML

Date	Day of the Week	Time (LST/LDT)	Predicted (ft)	High/Low
2017/11/30	Thu	02:18 AM	9.37	H
2017/11/30	Thu	07:46 AM	4.87	L
2017/11/30	Thu	1:41 PM	12.27	H
2017/11/30	Thu	8:41 PM	0.40	L

Disclaimer: These data are based upon the latest information available as of the date of your request, and may differ from the published tide tables.

Note: The interval above is High/Low, the solid blue line depicts a curve fit between the high and low values and approximates the segments between.

FEBRUARY / MARCH 2018 TIDE GATE INSPECTION REPORT, NAVAL BASE KITSAP KEYPORT, OPERABLE UNIT 1

INTRODUCTION

This report documents the February and March 2018 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) 46. Maintenance, inspection, and monitoring were conducted in accordance with the Operation and Maintenance Plan (Navy 2017). Sealaska performed tide gate inspection and maintenance and monitored operation on February 6, 2018. The tide gate was found to be in good condition and performed as designed during operational monitoring.

A winter storm-event occurred on the weekend of February 17-18, 2018, and a follow-up inspection was made on February 20, 2018. During that inspection, it was discovered that the screw-hole flange for securing the eastern-most door-float release rod (one of two for releasing the tide-gate door float attached to the bottom of the door) had broken, allowing the door-float release rod to move slightly. The door-float release rod was moved back to its unactuated (locked) position and secured using zip ties on March 15, 2018 to provide temporary repair until permanent repair can be made by the Navy.

INSPECTION AND MAINTENANCE

Inspection and maintenance of the OU 1 tide gate at NBK Keyport was performed on February 6, 2018 during an afternoon low tide. Sealaska conducted hand-scraping and removed barnacles, mussels, silt, seaweed, and branches/twigs on all accessible exterior surfaces, floats, side door interiors, surrounding structures, accessible interior portions of the culvert (within approximately 4 feet of the door), and on the upper culvert security gate. 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 require 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 during the morning of February 6, 2018. Temporary staff gauges were installed on both sides of the tide gate culvert and tide gate operation was monitored from 3 hours before high tide to 1 hour 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 12.4 feet mean lower low water (MLLW) at 0917 hours (9:17 am) was predicted for February 6, 2018 on the web site http://www.saltwatertides.com/cgi-bin/washington.cgi for the "Washington, Puget Sound, Poulsbo, Liberty Bay" location, with other predicted tide levels in Table 1 estimated from the tide chart (Attachment 2).

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 door began oscillation at 0714 hours at a water level of 2.92 feet above the tide gate invert and fully closed 9 minutes later at 0723 hours at a water level of 3.18 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 a height of 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. February 6, 2018 Tide Gate Monitoring

Time	Predicted Tide Level (feet above MLLW)	Tide Flats (feet above tide gate invert)	Marsh (feet above marsh floor at upper culvert security gate)	Notes
06:17	8.7	1.14	1.96	3 hours before high tide
06:47	9.2	1.96	2.69	
07:17	10.2	2.98	3.48	Tide gate fully closed at 07:23
07:47	11.2	3.94	2.98	
08:17	11.9	4.64	3.02	
08:47	12.3	5.04	3.04	
09:17	12.4	5.11	3.05	High tide
09:47	12.3	5.00	3.07	
10:17	11.9	4.58	3.10	

Note: MLLW – mean lower low water

SUMMARY AND CONCLUSIONS

Cleaning of the tide gate and related components occurred on February 6, 2018. Hand-scraping removed barnacles (moderate growth), mussels (light growth), and seaweed that had attached and grown since the previous cleaning in October 2017. A heavy accumulation of sediment at the top of the tide gate and on other tide gate component surfaces was removed. Tree branches and leaves were removed from the upper culvert security gate.

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 February 6, 2018 confirmed that the tide gate closed as designed, preventing flow of salt water into the marsh areas at high tide.

As previously discussed, during a winter storm-event follow-up inspection conducted on February 20, 2018, it was discovered that the screw-hole flange for securing the eastern-most door-float release rod (one of two for releasing the float attached to the bottom of the tide gate door) had broken (see Attachment 2, Photograph #1), allowing the door-float release rod to move 90 degrees (half-actuated position). The door-float release rod was moved back to its unactuated (locked) position and secured using zip ties on March 15, 2018 to provide temporary repair until permanent repair can be made by the Navy (see Attachment 2, Photograph #2). This condition did not affect operation of the tide gate.

The next tide gate maintenance, inspection, and monitoring is scheduled for summer 2018.

REFERENCE

Navy. 2017. Operation and Maintenance Plan for Phytoremediation and Tide Gate, Operable Unit 1, Naval Base Kitsap, Keyport, Washington. Prepared by Sealaska for Naval Facilities Engineering Command Northwest, under Contract No. N44255-14-D-9011, TO 27. Poulsbo, Washington. September 20, 2017.

ATTACHMENT 1

TIDE GATE INSPECTION AND MAINTENANCE FORM

TIDE GATE INSPECTION AND MAINTENANCE FORM

Inspectors: A. Lewis, J. Ruef, W. Kauge Task Order: 46

Keyport OU 1 Tide Gate at Tide Flats

Date/time: 2-6-18 0550-1600

Tidal Condition: HT: 0917 AM 12.4 ft, LT: 1609 pm 2.7 ft

Weather Condition: 40°-54°F, SW wind at 10mph / gust 15mph, possible rain showers

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):
minor pitting on metal surfaces, No repairs are required at this time and is not affecting operations

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):

The vent is in good condition with no blockage. Two minor cracks at the top of the vent pipe. No repairs are required

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

If no, describe the condition and recommended action: ___

All working parts are in good operating condition. No repairs needed

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

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 stick and cleared of leafs, Gate is in good Condition.

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

Paint has faded, no repairs are required.

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:** 2.92 ~~2.83~~ **. Does the measured elevation match (or is it close to) the design water elevation for gate closure?** X **Yes** _____ **No**

gr - 05/10/18

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
0617	8.7	1.96	1.14
0647	9.2	2.69	1.96
0717	10.2	3.48	2.98
0747	11.2	2.98	3.94
0817	11.9	3.02	4.64
0847	12.3	3.04	5.04
0917	12.4	3.05	5.11
0947	12.3	3.07	5.00
1017	11.9	3.10	4.58

Tide gate flutter start time / elevations: 0714 ; upper culv. 3.35 , Tidegate 2.92

Tide gate fully closed time / elevations: 0723 ; upper culv. 3.28 , Tidegate 3.18

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 light growth of barnacles from the exterior surfaces of the tidegate and inside the lower culvert. Scraped and scrubbed a moderate layer of silt from the exterior of the tidegate and components. Very minimal mussels were removed from inside the tidegate. A single stick and leafs were removed from the upper culvert gate.

Inspector's Signature 2-6-18 **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___ **No**_X_ **If yes, describe the follow up action and resolution:**

Repair and/or Re-inspection conducted by:

Organization **Signature** **Date**

ATTACHMENT 2

TIDE CHART AND PHOTOGRAPHS

Tides for Poulsbo, Liberty Bay starting with February 5, 2018.

Day		High /Low	Tide Time	Height Feet	Sunrise Sunset	Moon Time	% Moon Visible
M	5	Low	2:02 AM	1.6	7:32 AM	Set 10:23 AM	77
	5	High	8:38 AM	12.8	5:18 PM	Rise 11:45 PM	
	5	Low	3:14 PM	3.1			
	5	High	8:54 PM	9.4			
Tu	6	Low	2:50 AM	3.3	7:30 AM	Set 10:50 AM	68
	6	High	9:17 AM	12.4	5:19 PM		
	6	Low	4:09 PM	2.7			
	6	High	10:12 PM	9.0			
W	7	Low	3:44 AM	5.0	7:29 AM	Rise 12:50 AM	58
	7	High	10:00 AM	11.7	5:21 PM	Set 11:18 AM	
	7	Low	5:08 PM	2.2			
	7	High	11:53 PM	9.0			

Return to the Washington selection page, the FAQs/definitions page, the region selection page, the script licensing page, or to the home page.

For information on regulations for fishing in Washington contact: Washington Department of Fish and Wildlife

Typhoons, Hurricanes, etc., are NOT included in the predictions. Tidal current direction changes and tide high and low time predictions can be very different. Tide predictions are PREDICTIONS, they can be wrong so use common sense.

Daylight Savings Time included when appropriate.

Photograph #1: Tide gate upper door assembly showing broken screw-hole flange (indicated by arrow) for securing the eastern-most door-float release rod.

Photograph #2: Tide gate upper door mechanism after temporarily securing the eastern-most door-float release rod in its unactuated (locked) position.

APPENDIX D

WELLHEAD MAINTENANCE DOCUMENTATION

From:	James Ruef
To:	Carlotta Cellucci - NAVFAC NW (carlotta.cellucci@navy.mil)
Cc:	Annette Franzen (Annette.Franzen@sealaska.com); Andy Lewis (andy.lewis@sealaska.com); Cara Alferness (Cara.Alferness@sealaska.com)
Subject:	9011 TO 46 Keyport Wellhead Maintenance Nov 30 2017
Date:	Friday, December 08, 2017 11:40:00 AM

Carlotta,

Sealaska performed wellhead maintenance at NBK Keyport, Operable Units 1 and 2, on November 30, 2017. The following specific maintenance was performed:

OU 1

MW1-04: replaced padlock

MW1-17: replaced j-plug, padlock and 1 stripped bolt

MW1-20: replaced monument lid seal and padlock

OU 2, Area 2

No maintenance required (2MW-1 j-plug and lock replaced June 2017)

OU 2, Area 8

MW8-8: replaced 3 stripped bolts

MW8-9: replaced monument lid seal, installed 3 helicoils in bolt holes

MW8-11: replaced 2 stripped bolts

MW8-12: replaced monument lid seal and 3 stripped bolts

MW8-14: replaced j-plug, padlock, and 2 stripped bolts

MW8-15: replaced monument lid seal, installed 1 helicoil in bolt hole
(Note: two bolt hole flanges on the wellhead monument are broken away and missing)

MW8-16: replaced j-plug, padlock, and monument lid seal, installed 3 helicoils in bolt holes

Inspection of LTM wellheads will be conducted again during the upcoming spring 2018 monitoring event, and maintenance performed if needed. Thank you,

Jim

James Ruef, LG - Project Manager
Sealaska Environmental Services, LLC
SEA Discovery Center

PO Box 869
18743 Front Street NE, Suite 201
Poulsbo, WA 98370

Email: james.ruef@sealaska.com
Cell: 206-930-9623

APPENDIX E

AGENCY COMMENTS ON DRAFT REPORT

From: Cellucci, Carlotta CIV NAVFAC NW, EV31
To: Scott Elkind; James Ruef
Cc: Cara Alferness
Subject: FW: Draft 2017 Annual O&M Report for Keyport OU 1
Date: Tuesday, August 07, 2018 12:13:12 PM

Tribe comments on the subject report are below...

C.

Carlotta Cellucci, R.G.
Remedial Project Manager
NAVFAC Northwest
(360) 396-0060 Office
(206) 595-6711 Cell
carlotta.cellucci@navy.mil

Those who can make you believe absurdities can make you commit atrocities.
-Voltaire

-----Original Message-----
From: Denice Taylor <dtaylor@suquamish.nsn.us>
Sent: Monday, July 30, 2018 11:45 AM
To: Cellucci, Carlotta CIV NAVFAC NW, EV31 <carlotta.cellucci@navy.mil>
Cc: Alam, Mahbub (ECY) <MALA461@ECY.WA.GOV>; craig.harry@epa.gov; JoAnn Grady (joanngrady@gmail.com) <joanngrady@gmail.com>
Subject: [Non-DoD Source] Draft 2017 Annual O&M Report for Keyport OU 1

Carlotta,

I have reviewed the draft 2017 Annual O&M report for Keyport OU 1, which focuses on evaluating tree health for the phytoremediation remedy component and tide gate inspections and maintenance.

I don't have any comments or suggested revisions. I'm in agreement with the recommendations included in Section 4.3.

Please let me know if comment resolution is necessary.

Thanks,

Denice

From: Cellucci, Carlotta CIV NAVFAC NW, EV31
To: Alam, Mahbub (ECY)
Cc: Scott Elkind; James Ruef
Subject: RE: 2017 Annual O&M report Keyport OU1
Date: Wednesday, August 29, 2018 8:20:35 AM

Thanks so much Mahbub!

C.

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Those who can make you believe absurdities can make you commit atrocities.
-Voltaire

-----Original Message-----
From: Alam, Mahbub (ECY) <MALA461@ECY.WA.GOV>
Sent: Tuesday, August 28, 2018 5:50 PM
To: Cellucci, Carlotta CIV NAVFAC NW, EV31 <carlotta.cellucci@navy.mil>
Subject: [Non-DoD Source] 2017 Annual O&M report Keyport OU1

Hi, Carlotta:

Ecology reviewed the 2017 Annual Operation and Maintenance Report for NBK Keyport OU1 site. Ecology does not have any comments.

Thanks for the opportunity to review the report.

Sincerely,

Mahbub Alam, PhD, PE

Environmental Engineer, Toxics Cleanup Program

Department of Ecology

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