Appendix G
Cultural Resources Report

CULTURAL RESOURCE SURVEY FOR THE PROPOSED KALAMA MANUFACTURING AND MARINE EXPORT FACILITY PROJECT, COWLITZ COUNTY, WASHINGTON

Prepared for
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CULTURAL RESOURCE SURVEY FOR THE PROPOSED KALAMA MANUFACTURING AND MARINE EXPORT FACILITY PROJECT, COWLITZ COUNTY, WASHINGTON

PROJECT: Proposed construction of a methanol manufacturing facility and dock

TYPE: Cultural resource survey

LOCATION: Sections 25 and 36, Township 7 North, Range 2 West, and
Sections 31 and 30, Township 7 North, Range 1 West, Willamette Meridian

USGS QUADS: *Kalama, WA-OR,* 7.5-minute, 1990
Rainier, OR-WA, 7.5-minute, 1990

COUNTY: Cowlitz

PROJECT AREA: 116 acres

AREA SURVEYED: 90 acres

FINDINGS: Archaeological Resources:

- Three archaeological sites (45CO372, 45CO373, and 45CO374) were identified.
- The archaeological resources are recommended to be *not eligible* for listing in the National Register of Historic Places.

Historic Resources:

- No historic-period buildings or structures were present within the project area.

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INTRODUCTION

Archaeological Investigations Northwest, Inc. (AINW), has conducted a cultural resource survey for the proposed Kalama Manufacturing and Marine Export Facility (KMMEF) project in Cowlitz County, Washington. The proposed project includes design, construction, and operation of a methanol manufacturing facility and new dock, and possible wetland mitigation areas. These project areas are located in Sections 25 and 36 of Township 7 North, Range 2 West, and in Sections 31 and 30 of Township 7 North, Range 1 West, Willamette Meridian (Figure 1). The project is adjacent to and north of existing Port of Kalama facilities on the Columbia River between the communities of Kalama and Carrolls, Washington.

The project is subject to State Environmental Policy Act (SEPA) review, may require a permit from the U.S. Army Corps of Engineers (Corps), and may be subject to review under Section 106 of the National Historic Preservation Act (NHPA). The work was completed by

AINW staff meeting the professional qualification standards of the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation. The study was also performed to meet the standards of the Washington State Department of Archaeology and Historic Preservation (DAHP).

The proposed KMMEF project is proposed by Northwest Innovation Works, LLC (NWIW) and would be located at the Port of Kalama's North Port site, as shown on Figure 1. The proposed manufacturing facility and dock would receive natural gas from the Kalama Lateral Pipeline, to be constructed by Northwest Pipeline GP. Wetland mitigation tasks for the KMMEF project may include riparian enhancement, engineered log jams, and piling removal.

The current project area was surveyed for cultural resources by AINW in 2013 as part of a study completed for a prior Port of Kalama project to develop a bulk handling terminal and berthing facility expansion (Figure 2). The Port's plans for development subsequently changed; the bulk handling terminal was not built and the previous cultural resource survey report was not completed. The methods and results of AINW's cultural resource survey, completed in 2013, are presented for the first time in this report. Between June 1 and June 3, 2015, AINW conducted a subsurface geoarchaeological survey of the KMMEF project area. The findings of that survey are presented here.

The previous AINW cultural resource survey area almost entirely overlaps the current project site and extends outside of the current project area to the north and east. Exceptions to the previous cultural resource survey fieldwork coverage of the current project are an area located on the southeastern portion of the project site that is surfaced with thick deposits of modern dredge material and an area inundated by Columbia River water located on the western portion of the project site. AINW's subsurface survey used mechanical Geoprobe excavation to sample native soil beneath the dredge materials.

Three historic-period timber piers or docks, in ruin (45CO372, 45CO373, and 45CO374), have been identified within the project area. The three docks/piers are recommended to be not eligible for listing in the National Register of Historic Places (NRHP) (Figures 2 and 3; Photos 9 through 16). Washington Archaeological Site Inventory Forms for each resource are appended to this report. The pilings from sites 45CO372 and 45CO374 are proposed for removal as part of wetland mitigation identified for the project. Another set of historic-period timber pier or dock pilings (45CO374) are located in the wetland mitigation area in the Columbia River on the west side of the current project area (Figures 2 and 3; Photos 15 and 16).

ENVIRONMENTAL SETTING

The project area is located at the confluence of the Columbia River and Carrolls Channel, 0.8 kilometer (km) (0.5 mile [mi]) north and downstream of where the Kalama River drains into the Columbia River (Figure 1). The southern extent of Cottonwood Island is located 300 meters (m) (985 feet [ft]) north of the project area. The island separates Carrolls Channel from the Columbia River and the island's northern extent is at the mouth of the Cowlitz River. Two distinctive landforms are prominent in this area: Drays Mound to the south and Carrolls Bluff to the north.

The project area is within the Puget Trough physiographic province, which ranges from the border of Washington with Canada to the north and the border with Oregon to the south (Franklin and Dyrness 1973:16). The Willapa Hills and the Cascade Range respectively mark the western and eastern boundaries of the southern half of the province. The Puget Trough

province is generally composed of Tertiary rock formations and Eocene basalt flows (Franklin and Dyrness 1973:17). Surface sediments in the current project area are composed of Quaternary-age alluvium as well as dune sand, loess, and artificial fill (Phillips 1987; Washington State Department of Natural Resources [WSDNR] 2013). The bedrock of the surrounding area that borders the project to the east is composed of Eocene-age andesite flows known as the Goble Volcanics (Orr and Orr 1996:321; Phillips 1987; WSDNR 2013).

The project is in an area known as Kalama Gap, which is formed by the narrowing of the Columbia River floodplain by Carrolls Bluff and the hills of northeastern Columbia County near Rainier, Oregon. Kalama Gap played a role in shaping the landscape of the region as it was a major constriction of the Columbia River drainage during the late Pleistocene Missoula Floods (Allen et al. 2009:160). The floods were caused when glacial Lake Missoula repeatedly breached its ice dam, sending catastrophic floodwaters across the Channeled Scabland and down the Columbia River valley to the Pacific Ocean between 19,000 and 13,000 years before present (B.P.) (Benito and O'Connor 2003:624, 637). Kalama Gap temporarily impeded the flow of the floodwaters, causing ponding behind the narrowed flow channels and forcing water to backflood into the Willamette Valley as far south as Eugene, Oregon (Minervini et al. 2003). The KMMEF project area currently lies at about 7.6 m (25 ft) above sea level. The water during the Missoula flood events reached at least 122 m (400 ft) above sea level, completely inundating the area (Allen et al. 2009:182).

The project area lies within the *Tsuga heterophylla* vegetation zone, which is characterized by Douglas fir, western hemlock, and western red cedar trees. Riparian flora such as grasses, cottonwood, and willow are common along lakes and creeks in the area (Franklin and Dyrness 1973:72). The vegetation in the current project area includes some sporadic populations of scrub-shrub and weedy herbaceous plants. There are numerous streams, inlets, channels, and a larger slough to the north of the proposed project. Some of the streams or channels have been artificially created or enhanced.

In general, the soils for this area consist of riverwash, silt loams, and silty clay loams (U.S. Department of Agriculture, Natural Resources Conservation Service 2002, 2005). Three soils are mapped in the project area; these soils are Caples silty clay loam, Maytown silt loam, and riverwash. Maytown and Caples soils are formed in mixed alluvium on low terraces and floodplains. Maytown soils are deep and moderately well drained, while Caples soils are deep and somewhat poorly drained. Riverwash is unconsolidated alluvium which has been reworked so frequently that it has not developed a mature soil. These soils are covered by more than 750,000 cubic yards of dredge material from the Columbia River.

CULTURAL SETTING

The project area is within the Northwest Coast culture area, which extends along the Pacific Ocean from southwest Alaska to northern California. More specifically, the project is within the southern coast sub-area, which includes areas south of Vancouver Island (Ames and Maschner 1999:16, 19).

Pre-contact

The earliest prehistoric populations in the southern Northwest Coast have been documented based on rare finds of fluted projectile points (Avey n.d.; LeTourneau 2010; Meltzer and Dunnell 1987:64; Osborne 1956). The nearest to the project area were two fluted "Clovis" points found separately, west of Olympia, approximately 105 km (65 mi) north of the project area (Osborne 1956:41, 42). Evidence of Clovis technologies throughout North America

has been tightly dated to between 11,050 and 10,800 radiocarbon years B.P. (Waters and Stafford 2007). A growing body of evidence demonstrates that pre-Clovis cultures were established in the West as well (Jenkins et al. 2012; Waters et al. 2011). The time period encompassing Clovis cultures in the Northwest Coast area is typically referred to as the Paleoindian Period.

Paleoindian and subsequent Archaic Period archaeological sites are rare in this region and some speculate that sites of this age may be buried under deep Holocene sediments (Aikens 1993:190; Ames and Maschner 1999:67). Identified sites dating to these periods tend to be at elevations above the river floodplains (Pettigrew 1990:519-520). During the Archaic Period (12,450 to 6350 B.P.), there is evidence of increased specialization and sedentism in the form of winter villages and diverse stone tool assemblages.

Archaeological sites dating to the Archaic Period in this region include Gee Creek, Layser Cave, and Judd Peak Rockshelters. Numerous sites have been identified along Gee Creek in northwestern Clark County. One of the sites along Gee Creek, site 45CL632 approximately 33 km (20 mi) southeast of the project area, included numerous hearths, fire pits, and earth ovens dating to the Archaic Period (Punke et al. 2009). Rich deposits of faunal remains and stone tools were identified at Layser Cave (45LE223) and Judd Peak Rockshelters (45LE222), both located near the Cowlitz River approximately 90 km (56 mi) northeast of the current project area (Daugherty et al. 1987a, 1987b; Evans 2009; McClure 1986).

The Pacific Period dates from 6350 B.P. to historic-period times and reflects important social, economic, and subsistence changes including population growth, storage-based economies, heavy reliance on salmon fishing, and increased social stratification (Ames and Maschner 1999). The nearest site of this period to the project area is the Trojan Site (35CO1), located approximately 1.4 km (0.9 mi) to the west on the west side of the Columbia River. Many artifacts and human remains were identified at the site, which was extensively excavated between 1968 and 1970. The artifacts included pestles, bowls, pipes, drills, awls, abraders, net weights, bone tools, projectile points, and cobble tools. The artifacts found suggest that the site was a residential site where fishing and hunting activities took place (Burtchard 1989:15; Warner and Warner 1975). Other well-documented Pacific Period sites in the region include site 45CL631 at Gee Creek and 45CL1 (Cathlapotle) on Lake River to the south; and 45LE172 on the Newaukum River, 45LE521 on Berwick Creek, and 45LE611 on the Chehalis River to the north (Ames et al. 1999; Foutch et al. 2012; Jermann 1980; Ozbun et al. 2008; Punke et al. 2009).

Native Peoples

The project area is located within lands historically occupied by both Salishan and Chinookan-speaking peoples. Southwestern Coast Salish comprises at least four languages, the southernmost of which is Cowlitz, spoken by people occupying the Lower Cowlitz River valley (Hajda 1990:503-505). Chinookan languages were spoken by peoples of the Lower Columbia River and consist of two main language branches, one of which (Upper Chinookan) is further divided into three dialects (Silverstein 1990:533). The current project area near Kalama is located within in an area likely utilized by people who spoke the Cowlitz language as well as the Chinookan Cathlamet and Multnomah dialects. Historical conflict, trading, and personal relationships between Cowlitz and Chinookan-speaking peoples have been documented (Boyd 2011:82; Hajda 1990:505; Silverstein 1990:534).

Ethnographic information indicates that the peoples of the Lower Columbia region lived in large villages that consisted of one or more plankhouses. Subsistence was based on seasonal availability and included seasonal runs of salmon, sturgeon, eulachon, and resident

freshwater fish such as minnow and suckers. Birds, aquatic mammals, and terrestrial mammals (primarily deer and elk) were also part of the subsistence for peoples living in the Lower Columbia region. Plant foods were also seasonal and included berries, nuts, and roots and tubers such as wapato and camas (French and French 1998). Many resources were found along rivers, while others were available in the interior at upstream locations (Boyd and Hajda 1987). The Cowlitz harvested camas to trade with neighboring groups occupying areas where camas was less abundant (Hajda 1990:507). People moved to temporary camps or villages at hunting, fishing, and gathering locations based upon seasonal availability of resources while maintaining permanent winter villages (Silverstein 1990).

One or two ethnographically documented villages were located where the Kalama River flows into the Columbia River, approximately 0.5 km (0.3 mi) south of the current project area. According to Silverstein (1990) and Hajda (1984), these villages were occupied by Chinookan-speaking peoples of the Cathlamet dialect. Hajda (1984:111-112) postulates that there was one main village at this location which may have been called "Callamak," "Wakalama," or "Cathlahaws" that had as many as nine houses. Silverstein (1990:534, 545) maps two villages at this location, one called "Tlakalama" or "Klakalama" (north side of the Kalama River) and the other "Cath la haws" (south side of the Kalama River). The word "kalama" means "those of the rock" (Silverstein 1990:545).

The Chinook and Cowlitz ways of life were dramatically altered by diseases that preceded the arrival of Euroamericans to the area. Successive epidemics of smallpox, measles, malaria, and dysentery that spread upriver from the first contacts with Europeans and Euroamericans along the Pacific Coast in the late 1700s and early 1800s resulted in a demographic collapse (Boyd 1985; Silverstein 1990). Many surviving Cowlitz and Chinookan-speaking peoples went to reservations at Yakama, Warm Springs, and Grand Ronde after treaties were negotiated in 1855, although not all families chose to relocate (French and French 1998:360).

Historic Background

Early explorers had visited the Kalama region by 1792 when William Broughton, part of the Vancouver Expedition, sailed the Columbia River between the Pacific Ocean and the east end of the Columbia River Gorge at the mouth of the Sandy River (Lamb 1984:112). Broughton named Coffin Rock (opposite side of the river from the project area) during his visit because he saw human remains in Native American canoes at this location (Moulton 1990:29; Urrutia 1998:19). The Lewis and Clark Expedition passed the project area on their way to the Pacific Ocean on November 6, 1805. William Clark writes that they passed "a long narrow Island," which may be Cottonwood Island (Moulton 1990:26), and "a high clift [*sic*] of Black rocks," which may be Carrolls Bluff (Moulton 1990:27).

Euroamericans began settling in the vicinity of Kalama in the mid-1800s (General Land Office [GLO] 1857a). Maps from 1857 depict the project area and the surrounding vicinity as generally undeveloped (GLO 1857b, 1857c). A transportation corridor labeled "Trail from Monticello to Fort Vancouver" was mapped approximately 0.6 km (0.4 mi) to the east (GLO 1857b) of the project area. The hills and drainages east of the Columbia River were labeled "Broken and Mountainous Unfit for Settlement or Cultivation" (GLO 1857b). Cottonwood Island was named such by 1857, likely due to the tree type common on the island (GLO 1857c).

The first settlers in the vicinity of the project area were the Dray and Ward families who were granted land under the Donation Land Claim (DLC) Act of 1850. This act entitled many settlers within Oregon Territory (which at the time included present-day Washington State) to

claim up to 640 acres of land (Bergquist 1957:28). Joseph and Elizabeth Dray were issued 317 acres in 1865 under DLC Nos. 37 and 40 (Bureau of Land Management [BLM] 1865a). Their property encompassed the majority of the current project area including the southeastern quarter of Section 36 in Township 7 North, Range 2 West, and the southwest quarter of Section 31, Township 7 North, Range 1 West (GLO 1863a, 1863b). The nearby Dray's Mound was likely named after this family, many of whom claimed land in this area.

Francis and Maria Ward were issued 320 acres of land in 1870 under DLC No. 41 (BLM 1870). This area included the northwestern quarter of Section 31, Township 7 North, Range 1 West, and the northeastern quarter of Section 36, Township 7 North, Range 2 West (GLO 1863a, 1863b). One residence was mapped ("Anderson") north of the current project area on an earlier map that did not depict the Ward or Dray claims (GLO 1857b). This was Neils Anderson who was issued a claim (DLC No. 42) on the Columbia River and established the dock at Carrollton (later to become Carrolls) which provided a place for steamers to unload goods for loggers and settlers (BLM 1865b; Urrutia 1998:89).

Northern Pacific built the first railroad on the Washington side of the Columbia River in the 1870s (Asay 1991). The company's decision to build its headquarters at Kalama initiated the larger settlement and development there (Urrutia 1998:93). The railroad was completed between Kalama and Tacoma by 1873. Kalama became the company's western headquarters for its transcontinental railroad at that time (*Railway* 1999). Burlington Northern Santa Fe Railway (BNSF) operates the current railroad after Northern Pacific's merger with four other railroad companies in 1970 (*Railway* 1999).

The area afforded high quality resources for logging and mill industries which would dominate this region throughout the twentieth century. The Monticello Convention, which created Washington Territory, was held in Cowlitz County in 1852. Kalama was the Cowlitz County seat between 1906 and 1922 (Urrutia 1998:137-138).

The Port of Kalama was organized in 1920 and initially consisted of 600 acres on the east side of the Columbia River (Urrutia 1998:157). The Pacific Highway was completed in 1923 and by 1960 Interstate 5 (I-5) followed a similar route as a result of the Federal-Aid Highway Act of 1956. The Corps began dredging the Columbia River to improve navigation when the Rivers and Harbors Act of 1962 was passed. Dredge deposits were placed on the Port of Kalama shoreline between 1962 and 1969 to create a 5.5-m (18-ft) tall, 182-m (600-ft) long berm of sand, rocks, and logs to help reduce periodic flooding (Urrutia 1998:185). A portion of this berm became the existing Port of Kalama marina, located 2.6 km (4.6 mi) south of the current project area. The current project area was purchased by the Port of Kalama in 1980 and the existing marine terminal was built in 1997 (*Trade Winds* 2010).

The eruption of Mt. St. Helens on May 18, 1980, caused a huge flow of ash and debris to flow down the Toutle River, into the Cowlitz River, and into the Columbia River just downstream from the Port of Kalama (Urrutia 1998:198). The volcanic debris brought ship traffic in the Columbia River to a halt prompting the Corps to initiate extensive dredging. These dredging activities deposited large amounts of sand onto the current project area allowing the Port of Kalama to develop the existing BHP Steel Port Facility on top of dredge materials and maintain the area north of the current project area for wildlife (Urrutia 1998:198). This development within the project area is visible when comparing the U.S. Geological Survey (USGS) maps (USGS 1953, 1990).

PREVIOUS CULTURAL RESOURCE STUDIES

AINW conducted a review of records and reports held by DAHP that are available through the Washington Information System for Architectural and Archaeological Records Data (WISAARD) online database. Materials in the AINW library, including historical maps and published secondary sources, were also reviewed to determine if archaeological or historic-period resources have been identified within or near the project area and to determine if surrounding areas have been surveyed.

No previously recorded archaeological sites or historic-period resources have been recorded within the project area. One previous cultural resource study took place within the current project area (Ellwood et al. 2012) (Figure 2). The 2012 study was conducted for the Kalama Lateral Pipeline, which included a pedestrian survey of the previously disturbed and developed portion of the current project area. No cultural resources were identified within the current project area during the 2012 study (Ellwood et al. 2012).

The nearest previously recorded cultural resource to the KMMEF project is the BNSF Railroad (formerly the Northern Pacific Railroad) located approximately 40 m (131 ft) to the east (Figure 2). A modern spur of the existing BNSF line extends into the current project area. A 29-km (18-mi) long section of the BNSF Railroad was recorded and evaluated as part of the Kelso-Martin's Bluff Rail project in 2003, which proposed the addition of another rail line adjacent to the existing lines (Jones & Stokes 2003). The recorded section of the BNSF Railroad (including the portion adjacent to the current project area) was recommended to be not eligible for listing in the NRHP based on the loss of integrity of materials (Brush 2003; Jones & Stokes 2003).

While the railroad has been recommended as not eligible for listing in the NRHP, the railroad's Kalama River Bridge crossing has been recorded and determined as eligible for listing in the NRHP (Holstine 2013). The bridge is located 1 km (0.6 mi) south of the current project area. A nearby road bridge, the Modrow Bridge (also known as 45CW149) located 2 km (1.2 mi) east on the Kalama River, is listed on the Washington Register of Historic Places (George 2001).

The Meeker Drive Bridge that crosses the Kalama River to the north of Kalama, Washington, was constructed in 1952. The bridge is located 1.21 km (0.75 mi) southeast of the current project area, parallel to I-5. The bridge was recorded and recommended as not eligible for listing in the NRHP, as part of the cultural resource survey for the East Port Regional Forcemain project (Walker and Borth 2014).

The nearest recorded archaeological resources to the project area are four prehistoric sites located along the Kalama River to the south and one historic-period archaeological site located to the east. Sites 45CW4, 45CW5, and 45CW11 were recorded on Washington Site Archaeological Inventory forms but there is little data regarding the content or boundaries of these archaeological sites (Smith and Hudziak 1948a, 1948b; Warren and Eng 1955). A number of cultural resource studies have attempted to relocate two of these sites but no archaeological material has been found at the recorded locations of 45CW4 or 45CW5 (Ellis 1982; Freed 1980; Harvey and Crandall 1980; Jermann and Hollenbeck 1976; Martin 1984, 1985). A cultural resource survey was conducted in the vicinity of site 45CW11 and no evidence of the site was identified although information obtained from local residents suggested that the site was farther downstream on the Kalama River than its recorded location (Sharma et al. 2007). Site 45CW127 was recorded on the basis of landowner information only (Munsell n.d.). Archaeological site 45CW232 was a historic-period debris scatter recorded during a

cultural resource survey for the Port of Kalama's Eastport Development (Hambelton and Ozbun 2011).

Other archaeological studies conducted in the vicinity of the proposed KMMEF project include studies within the BNSF right-of-way as part of a fiber optic project (Chapman et al. 1996; Hartmann 1999). Cultural resource studies conducted at locations somewhat farther from the current project and not described above have included archaeological surveys, assessments, or reconnaissance studies. Archaeological resources were not identified at those locations during the earlier studies (Arrington 2009; Forsman et al. 2000; Harder and Hannum 2006; Musil 2000).

There is a high probability that prehistoric archaeological resources could lie within the KMMEF project area below about 5 m (15 ft) of dredge materials based on ethnographic information and archaeological resources documented in the 1940s and 1950s. However, active alluvial erosion and deposition along the Kalama River and Columbia River, Columbia River dredge and fill activities (see Harder and Hannum 2006:7; Musil 2000:2), and events such as the eruption of Mt. St. Helens and its effect on the rivers all suggest that finding intact and/or relatively shallow archaeological deposits during this cultural resource survey may be unlikely. Historic-period use of the general region since the mid-1800s has been well documented but the same natural and artificial impacts to the project area have likely affected those potential deposits. Apart from the timber pilings described in this report, no evidence of buildings, structures, or use of the exact project area has been found in historic documents. This indicates that the types of historic-period resources that may be found would likely be isolated artifacts or artifacts related to the nearby railroad built in the 1870s.

ARCHAEOLOGICAL FIELD SURVEY METHODS AND FINDINGS FROM THE 2013 FIELDWORK

The archaeological pedestrian survey and shovel testing were conducted between November 4 and November 7, 2013, by AINW field archaeologists Lea Loiselle, B.A., Marci Monaco, B.S., Andrew Polta, B.A., and Joey Veysey, B.A. The fieldwork was directed by Sara J. Davis, M.A., R.P.A., and the project was under the overall supervision of AINW project manager Terry L. Ozbun, M.A., R.P.A.

The field survey work was conducted based on plans for a previous project but covered the current KMMEF project area. Ninety acres of the current 116-acre project area (26 acres were inaccessible) were covered by survey fieldwork in 2012 and 2013 as follows:

- 33 acres were surveyed in 2013;
- 57 acres had been previously surveyed (Ellwood et al. 2012); and
- 10 acres in the Columbia River and 16 acres in fenced/developed areas (Photos 1 and 2) were not accessible for survey in 2013.

A Trimble Geo XT Global Positioning System (GPS) unit, aerial maps, and USGS quadrangle maps were used for orientation and to map the position of shovel tests.

The pedestrian survey was conducted by two or four archaeologists using meandering transects to cover the majority of the project area (Figure 2). The portion of the current project area surveyed is crossed by dirt roads and covered in dredge fill (Photos 3 and 4). This area appears to be used frequently by visitors as it is easily accessible from a parking area and modern trash was commonly observed on the ground surface.

The Columbia River shorelines and the dredge material piles in the project had 80 to 100% ground surface visibility (Photos 3 and 4). These areas are mainly stockpiles of sand used by the Port of Kalama and used by visitors for recreational ATV activities (Photo 5). The eastern portion of the project follows an existing road and had between 10 and 20% ground surface visibility and appeared to be disturbed (Photo 6).

One area was not covered by pedestrian transects. Although the area was not subject to pedestrian survey, visual inspection was sufficient to determine that this area has been previously developed and there was no native soil on the surface as it was covered with a thick unit of dredge materials (Photo 1). The depth of modern fill (dredge materials) in this area would not allow manual shovel test/auger excavations to penetrate to native soils.

To determine if subsurface archaeological deposits were present, 30 shovel tests (ST-1 through ST-30) were excavated for the previous (2013) project area. Two of these shovel tests (ST-29 and ST-30) are located within the current project area (Figure 2). The shovel tests were 30 centimeters (cm) (12 inches [in]) in diameter. Shovel test ST-29 was excavated to 75 cm (30 in) below the ground surface. The excavation depth of shovel test ST-30 was extended from 75 to 200 cm (30 to 80 in) below the surface using a 15-cm (6-in) diameter hand auger to test for deeper buried sediments. Excavated sediment was screened through nested 6.4- and 3.2-millimeter (¼- and ⅛-in) mesh hardware cloth. The locations of the shovel tests were mapped using the Trimble Geo XT GPS unit and using landmarks on aerial photographs. The shovel test data were recorded on AINW shovel test record forms and the holes were backfilled after excavation was completed.

Soils encountered in both shovel tests ST-29 and ST-30 located in the current project area were yellowish brown sand with few gravels and no clear soil development (Photo 7). The sand likely represents modern dredge fill. Shovel tests containing these dredge materials were all located at the western edge of the project area, on the west side of the fenced developed area (Photo 8). No other shovel tests were excavated in the current project area because of the extensive dredge fill covering the area. No artifacts were found in the shovel tests.

No artifacts were observed on the ground surface or in shovel testing during the survey. However, three archaeological resources consisting of pilings representing remnants of piers of docks were recorded (45CO372, 45CO373, and 45CO374). Sites 45CO372 and 45CO374 were re-documented on June 1 and June 3, 2015, by AINW Senior Geoarchaeologist Eva Hulse, Ph.D., R.P.A., and AINW Staff Archaeologist Kelley Prince, B.S.

45CO372

Site 45CO372 (formerly assigned temporary number 13/2150-1) is the remnant of a pier or dock structure and consists of parallel rows of wood pilings (Figure 2). A Washington Archaeological Site Inventory Form for the resource is appended to this report. The pilings are visible in three locations: across the main slough (Photo 9), across a small slough to the west (Photo 10), and extending into the Columbia River (Photo 11). The Columbia River portion corresponds to the location of an inventoried Corps pile dike at River Mile 71.59 (AECOM 2011). The AECOM (2011) survey records its condition as deteriorating, but states that it may have been intended to stabilize the channel and alter water flow. There is a pier or dock structure depicted on the 1953 USGS *Kalama* 7.5-minute quadrangle map in the same general vicinity as the pilings recorded at 45CO372 (Figure 3). The age of the map indicates that the structure pre-dates 1953.

The two westernmost locations of pilings appear to have been separated by sandy deposits and have been buried. It is unclear if these were once connected to the easternmost

pilings but based on historic-period maps this was once a single structure. At each location where the pilings are visible, there are two parallel rows of pilings separated by a distance of approximately 1.27 m (4.16 ft). Each pile is approximately 30 cm (12 in) in diameter. Many of these piles have rusted metal bolts that connect each pair of wood pilings and supported elements of a super structure (now mostly gone) (Photo 12). At the eastern end of the central set of pilings (across the small slough) there are rocks which are partially in the water and partially on land (indicated with a yellow arrow in Photo 10). These appear to be the remnants of a rock crib or other structure that once supported the pier or dock. The structure currently traps sediment and may have been intended to stabilize the location of the shoreline. South of the main alignment, within the small slough, are five wooden pilings in a group (Photo 13), as well as two isolated pilings.

45CO373

Site 45CO373 (formerly assigned temporary number 14/2245-1) is the remnant of a pier or dock structure and consists of parallel rows of wood pilings (Figure 2). A Washington Archaeological Site Inventory Form for the resource is appended to this report. The pilings are visible across the main slough near its confluence with the Columbia River (Photo 14). There are two parallel rows of paired pilings separated by a distance of approximately 2.7 m (9 ft). On the west end, the pilings form a square with approximately five pilings 3.2 m (10.5 ft) apart. Additional fieldwork may be needed to document details of pile configuration or possible association with artifacts or other structures.

There is a structure depicted on the 1921 USGS *Kalama* 15-minute map in the same location as the pilings recorded as site 45CO373 (Figure 3). The 1953 USGS *Kalama* 7.5-minute map also shows this feature as a line labeled "Jetty," which can mean a wharf or landing pier as well as a breakwater. Based on the 1921 map, the pier or dock may have once been connected to the railroad tracks allowing materials to be loaded or unloaded from boat or ship to train (USGS 1921). The pier or dock that these pilings once supported is gone and the pilings are in various states of decay and some are missing.

The date of construction for the pier or dock that the pilings once supported is unknown. The structure is visible on the 1921 USGS *Kalama* map, but is not depicted on the 1857 or 1863 GLO maps (GLO 1857a, 1857b, 1857c, 1863a, 1863b; USGS 1921). As noted above, the 1921 USGS *Kalama* map shows that the pier or dock may have connected to the Northern Pacific railroad. Construction of the Northern Pacific railroad between 1870 and 1873 was an important event in formation of the Kalama community and the shipping industry along the Columbia River. Before the railroad bridge across the Columbia River in Vancouver was constructed in 1908, Kalama train cars were ferried by boat on the *Tacoma* across the Columbia River to tracks in Globe, Oregon.

The dock or pier super structure is gone with only the pilings remaining. The decay and discontinuity of the piling remnants prevents the resource from conveying its historic context. The pilings are tangentially related to the railroad, which lacks integrity in this area (Brush 2003).

45CO374

Site 45CO374 (formerly assigned temporary number 14/2245-2) corresponds to the mapped location of a Corps pile dike at River Mile 71.87 (AECOM 2011). It consists of parallel rows of wood pilings (Figure 2). AECOM's (2011) inventory lists it as a structure in poor condition, and as serving no function. There is a pier or dock structure depicted on the 1953 USGS *Kalama* 7.5-minute quadrangle map in the same general vicinity as the pilings recorded

at site 45CO372 (Figure 3). The age of the map indicates that the structure pre-dates 1953. A Washington Archaeological Site Inventory Form for the resource is appended to this report. The pilings are located along the western edge of the project area, and extend from the shore into the Columbia River (Photo 15). The two parallel rows of pilings are separated by a distance of approximately 0.69 m (2.25 ft). Each piling is staggered from the one opposite in a zigzag pattern. The construction is similar to that of 45CO372, and it may have served a similar shoreline-stabilizing function (Photo 16). At present, there are no additional data on the configuration of the pilings and their possible association with artifacts or other structures.

Recommendations Regarding NRHP Eligibility

All three archaeological resources (45CO372, 45CO373, and 45CO374) are similar and therefore the following recommendation applies to all three sites. None of the three sites (45CO372, 45CO373, and 45CO374) are recommended to be eligible for listing in the NRHP under Criterion A because they are not directly associated with identifiable historically important events. Research into the history of Cowlitz County, the communities of Carrolls and Kalama, the original railroad, and the history of the Port of Kalama did not reveal an association of any of the piling remnants or the former piers or docks with the lives of persons significant in our past. All three sites (45CO372, 45CO373, and 45CO374) are therefore recommended to be not eligible for listing in the NRHP under Criterion B. Wood pilings such as those identified at sites 45CO372, 45CO373, and 45CO374 are not architecturally unique and are ubiquitous in this area including throughout Carrolls Channel, at Cottonwood Island, and at Prescott on the Oregon side of the Columbia River. The piling remnants do not embody distinctive characteristics of a type, period, or method of construction; do not represent the work of a master; do not possess high artistic values; and do not represent a significant and distinguishable entity whose components may lack individual distinction. Sites 45CO372, 45CO373, and 45CO374 are recommended to be not eligible for listing in the NRHP under Criterion C.

The physical integrity of the piling remnants has been compromised by decades of water flow and by local industry and fill materials. There are no additional artifacts or features associated with any of the piling remnants beyond one rock support structure in ruin at site 45CO372. Sites 45CO372, 45CO373, and 45CO374 have not yielded and are not likely to yield information important in history and are therefore not recommended to be eligible for listing in the NRHP under Criterion D.

GEOARCHAEOLOGICAL FIELD SURVEY METHODS AND FINDINGS

The Geoprobe survey was conducted on June 1 through June 3, 2015, by Dr. Hulse and Ms. Prince. The project was managed by Mr. Ozbun. In order to look for deeply buried surfaces which could have supported human settlement, AINW collected Geoprobe borings B1 through B11 to a maximum depth of 18.2 m (60 ft) below the surface (Table 1; Figures 2 and 4). The transect covered a total east-west distance of 0.75 km (0.5 mi). The borings were placed to avoid the deepest deposits of dredged material, visible as machine-graded hills and terraces within the project area. The consistent stratigraphy across the collected borings provided sufficient data on the former landscapes to produce a cross-section of the buried landforms beneath the fill.

The Geoprobe is a mobile and compact, track-mounted, direct-push hydraulic drill rig (Photo 17) which collects continuous cores in intact 1.5-m (5-ft) segments within a plastic sleeve. This sleeve was cut open in the field for immediate inspection and sampling (Photo 18), although it can also be capped and stored for later analysis or transport to a laboratory facility.

The diameter of the samples measures 6.4 cm (2.5 in) when using the MC-5 sampling system. The maximum depth of each boring is presented in Table 1. To minimize cross-contamination, the drilling equipment was washed (decontaminated) with water in between borings. After the completion of each boring, the resulting holes were re-filled with a grouting compound to maintain the stability of the sediment matrix and to seal any gaps which could introduce contaminants into the groundwater. Sediments from completed borings were discarded in unpaved areas near each sampling location. The boring locations were recorded using a Trimble Geo XT GPS unit and are shown on Figure 2.

TABLE 1

DEPTHS OF ALL BORINGS, AS COLLECTED

BORING NO.	DEPTH OF BORING	REASON FOR TERMINATION
B1	9.1 m / 30 ft	no cultural materials or stable soils
B2	9.1 m / 30 ft	no cultural materials or stable soils
B3	9.1 m / 30 ft	no cultural materials or stable soils
B4	9.1 m / 30 ft	no cultural materials or stable soils
B5	9.1 m / 30 ft	no cultural materials or stable soils
B6	9.1 m / 30 ft	no cultural materials or stable soils
B7	18.2 m / 60 ft	no cultural materials or stable soils
B8	9.1 m / 30 ft	no cultural materials or stable soils
B9	9.1 m / 30 ft	no cultural materials or stable soils
B10	9.1 m / 30 ft	no cultural materials or stable soils
B11	16.7 m / 55 ft	no cultural materials or stable soils

The borings were split, photographed, and described in the field by Dr. Hulse and Ms. Prince. Stratigraphic transitions and inclusions were noted, and the sediments were described using standard lithological terminology for texture, structure, consistency, and stratigraphic transition type. Colors were recorded using the Munsell system[1]. The sediments were carefully inspected for evidence of archaeological deposits, including but not limited to:

- color changes or charcoal enrichment associated with hearth features and trash dumps;
- debris associated with making stone tools;
- burned bone or shell;
- fragments of wood or fiber which may be associated with fishing technology;
- historic materials such as ceramic, metal, and glass;
- changes in color, texture, structure, and consistency associated with a buried soil. Buried soils were screened through nested 6.4- and 3.2-millimeter (¼- and ⅛-in) mesh hardware cloth (Photo 18).

[1] All colors are classified according to the 2009 revision of the Munsell system.

The GPS elevations were calibrated based on LiDAR elevation data collected in 2005 (Puget Sound LiDAR Consortium 2014). Aerial photographs indicate that the area immediately adjacent to Eastwind Road has not undergone major grading or filling since 2005, and boring B10 is assumed to have an unchanged surface elevation of 7.7 m (25.3 ft) above sea level (asl) using the NAVD88 datum. The relative elevations of the other borings were calculated using the GPS data to account for filling and grading across the project area since the LiDAR elevations were recorded.

Stratigraphy within the borings followed a consistent pattern across the area (Figure 4). The major lithostratigraphic units are defined according to physical characteristics as well as position in the chronological sequence and the type of depositional environment, and are presented in stratigraphic order in Table 2 with the oldest unit at the bottom of the table. Rooted sands and peats are those sediments containing rootlets, indicating that they once supported a stable land surface.

Several bands of likely volcanic ash (tephras) or volcanic mudflow sediment (lahars) were observed in the profile. These are not likely to be primary airfall deposits because prevailing winds tend to blow volcanic ash from Mount St. Helens away from the project APE. The volcanic sediments were identified within well-sorted water-laid sediments and appear to be secondary deposits carried down the Toutle, Cowlitz, or Kalama Rivers to the Columbia River. All of the volcanic units are referred to as tephras for the purposes of this analysis.

Two visually distinctive tephras (marker tephras) were used to identify buried wetland surfaces. These marker tephras may be dated and sourced to a specific eruption using geochemical analysis. These tephras aid in the identification of buried landforms, but more precise identification and dating is not needed since the landforms do not have the potential to support human settlement. For the present study, the marker tephras are correlated based on visual inspection only. The uppermost marker tephra (labeled PT in Figure 4a) is a pinkish-hued gray (10YR 5/1) to grayish brown (10YR 5/2) subangular blocky to angular blocky silt or sandy silt embedded within the uppermost wetland deposit. The lower marker tephra (labeled BGT in Figure 4a) is a couplet of two bands: a dark grayish brown (10YR 4/2) or very dark grayish brown (10YR 3/2), firm, angular blocky, very fine silt or silty sand, capping a gray (10YR 5/1) or light gray (Gley 1 7/N), firm, angular blocky silt. The BGT tephra blankets the surface of an older wetland deposit. Based on visual inspection alone, it is possible that these tephras are associated with the set X (A.D. 1482 to 1750) and set W (A.D. 1479 to 1482) Mount St. Helens eruptions (Clynne et al. 2008; Mullineaux 1996; Peterson et al. 2012).

The deepest portion of the uppermost sandy fill deposit (Unit 6) may include pumice and sand deposited naturally after the 1980 Mount St. Helens eruption. Laminae and bands of pumice show evidence of size-sorting by flowing water in Unit 6. The remainder of the deposit is sediment dredged out of the river and re-deposited onshore. The fill is deepest in borings B6 and B7 where the fill surface elevation increases over a buried swale formation. This deposit represents modern disturbance and will not contain intact archaeological materials.

The 1980 dredge deposit caps the remains of a wetland within a tidal flat on the river's edge prior to the 1980 eruption (Unit 5, Photo 19). The contact between the dredge deposit and the wetland unit represents a stratigraphic unconformity, or gap, in the geologic record. The wetland silt has a rooted, vegetated surface. This surface lies at the current mean high water level and used to be the sub-aerial surface of a tidally inundated mudflat at the northern edge of the Kalama River delta. This wetland surface, while historic in age, would have been unsuitable for human settlement because of its waterlogged setting.

TABLE 2

LITHOSTRATIGRAPHIC UNITS

UNIT[2]	DEPTH	SETTING	DESCRIPTION
6	0 to 4.9 m / 0 to 16 ft	sandy fill	Loose, single-grain, poorly sorted pumiceous sand
5	4.9 to 5.2 m / 16 to 17 ft	historic tidal mudflat	Firm, angular blocky, black (10YR 2/1), rooted silt and clay silt
4	5.2 to 5.8 m / 17 to 19 ft	buried soil	Capped by PT marker tephra. Firm, granular to subangular blocky, black (10YR 2/1) to dark gray (10YR 4/1), rooted silt
3	5.8 to 8.4 m / 19 to 27.5 ft	later floodplain channel with tephra	Loose single grain and friable weakly subangular blocky, very dark gray (Gley 1 3/N) sand banded with fine ash and coarse pumice
2	8.4 to 9.3 m / 27.5 to 30.5 ft	early wetland	Capped by BGT marker tephra. Friable, subangular blocky, dark grayish brown (10YR 4/2) silt with few rootlets and decomposed plant fragments
1	9.3 to 18.3 m / 30.5 to 60 ft	early floodplain channel with tephra	Loose, single grain, very dark gray (Gley 1 3/N), bands of poorly sorted medium and coarse grained sand, and well-sorted fine-grained sand; pumice common at the top of the stratum and decreasing with depth, few wood fragments

The two easternmost borings in the transect (B10 and B11) contained a buried soil beneath the uppermost mudflat sediment (Unit 4, Photo 20). The PT marker tephra/buried soil contact represents a stratigraphic unconformity, which is also present within the wetland sediments in borings B5 through B9 (Photo 21). This tephra traces the upper surface of a ridge-and-swale complex that pre-dates the 1980 surface. The parent sediment of this soil is a wetland silt, but weathering and exposure to dry conditions formed a granular soil with roots and root pores. The eastern part of the project area appears to abut the western edge of an old riverbank. This area of shoreline, elevated relative to the wetland sediments to the west, would have been an unsuitable location for human settlement because of its proximity to high water. Boring B9, just to the west, showed iron mottling marking the old waterline at nearly the same elevation as the buried soil. The land east of the project area may contain the old river terrace itself and should undergo subsurface survey if development extends east of the current project APE.

The wetland deposits transition conformably and gradually to the sandy floodplain sediment below (Unit 3). This increase of fines towards the surface is characteristic of an environment being cut off from a higher-energy water source like a river. The floodplain sands below the tidal mudflat deposit are tephra-rich and indicate accelerated sedimentation associated with volcanic eruptions. Prior to the 1980 eruption, major sediment flows have been documented at frequent intervals over the past 4,000 years. The deepest distinctive tephra in this sequence is the BGT marker tephra (Photos 22 and 23). The surges of volcanic sediment and fluvial sand indicate that the area was under water and not suitable for human settlement.

[2] "Unit" refers to "Lithostratigraphic Unit"

The BGT marker tephra(s) trace the surface of an old ridge-and-swale landform that broadly mirrors the historic one beneath the fill (Unit 2, Photo 23). A ridge of silt is present in boring B8, with apparent swales to the east and west (Figure 4). This buried wetland would have lain at the surface when the Kalama River delta was 3.6 m (11.8 ft) lower in elevation than it was in 1980. The wetland vegetation and fine-grained sediment suggest a period of relative stability in between eruptive periods. One such dormant period stretched from 10,500 to 4,000 years ago (Mullineaux 1996). This stable wetland may have been an important resource for Native people, but it would not have been suitable for settlement because of its waterlogged character. No soil development was noted in this sediment.

The older wetland caps a deep fluvial deposit (Unit 1) best represented in the deeper borings B7 and B11. A handful of other borings sampled the top of this deposit (B1, B4, and B6). The uppermost 1.5 m (4.9 ft) of this deposit are pumice-rich and suggest periodic surges of volcanic material (Photo 24). The portion of the deposit below this is dominated by well-sorted, homogeneous, massively bedded fine sand. The fluvial sands were laid down by flowing water when this area was part of the Columbia River channel. This deposit would not be a suitable setting for an archaeological site.

SUMMARY AND RECOMMENDATIONS

AINW conducted a cultural resource survey for a previous Port of Kalama project in 2013. The study was conducted for the Port of Kalama to meet, in part, the requirements of Section 106 of the NHPA in anticipation of a Corps permit, but was never submitted to the Corps. Cultural resource survey fieldwork conducted in 2012 (Ellwood et al.) and in 2013 described herein covers approximately 90 acres of the current project area. Archaeological shovel testing conducted for the previous projects was focused on areas outside of the current project as the current project area is dominated by thick modern dredge material deposits that could not be penetrated by manual shovel test/auger excavations to sample the underlying native soils. The two shovel tests that are within the current project area demonstrated this fact.

AINW conducted mechanical Geoprobe excavations to sample the native soils beneath an average of 4.9 m (16 ft) of dredge material in the project area. The borings were completed along a transect stretching 0.75 km (0.5 mi) from east to west across the project area. The buried landform beneath the fill is a broad tidal marsh that developed on top of older, river-laid sediments. The low-relief, waterlogged terrain would have been unsuitable for human settlement, and the area has a low probability of retaining deeply buried archaeological sites. **No additional archaeological work is recommended, and no monitoring is recommended** during construction within the project area.

One historic-period archaeological site represented by remnants of timber pier or dock pilings was identified and recorded as site 45CO372. Two other separate historic-period timber pier or dock pilings (45CO373 and 45CO374) are shown on the 1953 USGS *Kalama* 7.5-minute quadrangle map and have not been previously recorded (Figure 3). **These sites are recommended to be not eligible for listing in the NRHP.** Washington Archaeological Site Inventory Forms for these resources are appended to this report.

If the project will extend outside of the project area investigated in this report or if there will be ground disturbances within the portion of the project area not surveyed for this report, additional cultural resource studies may be needed. If archaeological resources are inadvertently encountered during construction, all ground-disturbing activity near the find should be halted and the DAHP should be promptly notified to ensure compliance with relevant

state and federal laws and regulations. If evidence of burials is encountered, all ground-disturbing activity in the vicinity should be halted immediately, and the Cowlitz County Coroner and law enforcement must be contacted. If the coroner determines the remains are non-forensic, then the DAHP will be contacted and will take jurisdiction over the remains.

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1953 *Kalama, Washington-Oregon.* 7.5-minute topographic map. Electronic document, http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&xcm=r3standardpitrex_prd&carea=%24ROOT&layout=6_1_61_48&uiarea=2)/.do, accessed November 15, 2013..
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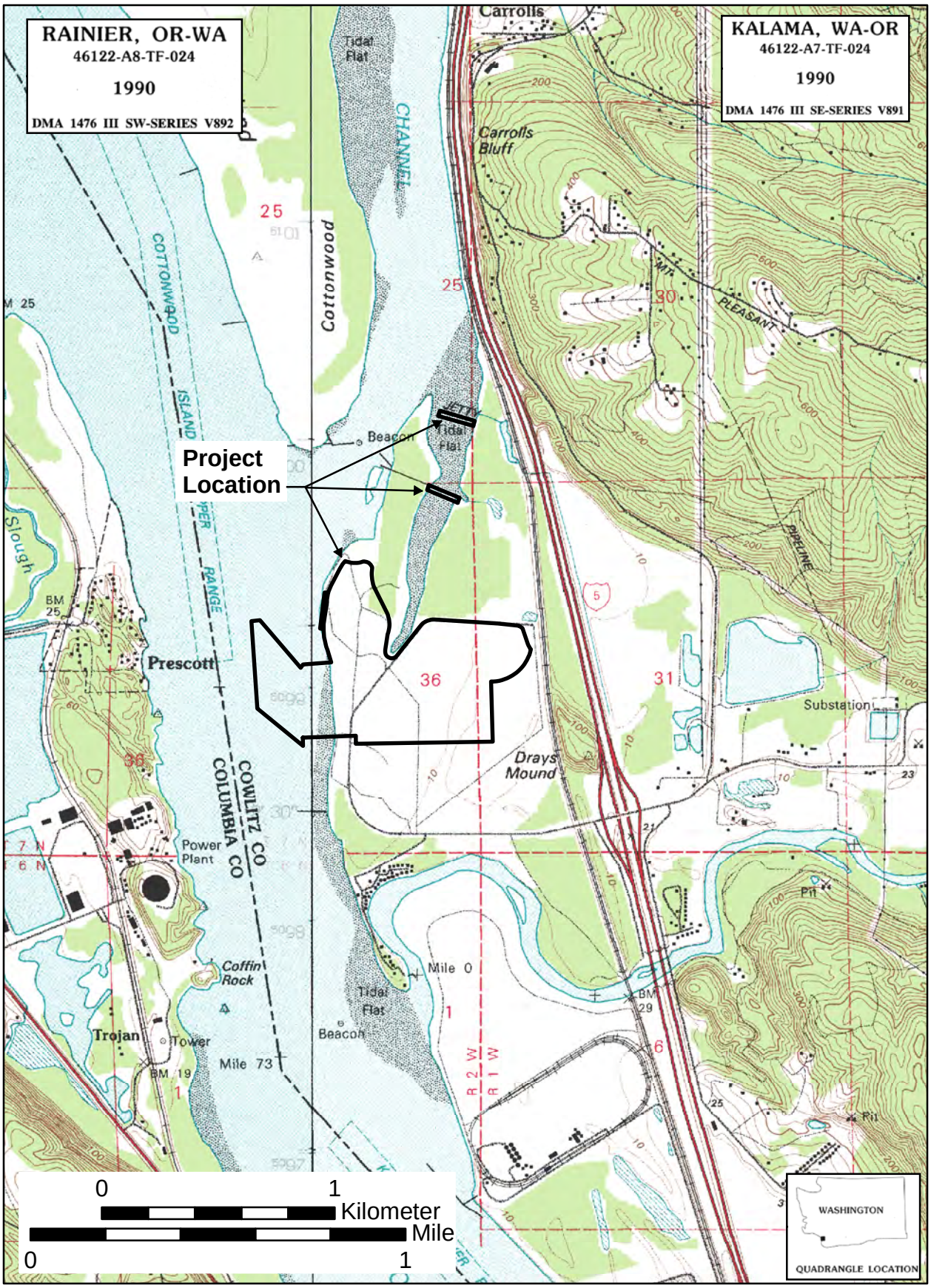


Figure 1. Location of the proposed Kalama Manufacturing and Marine Export Facility project.

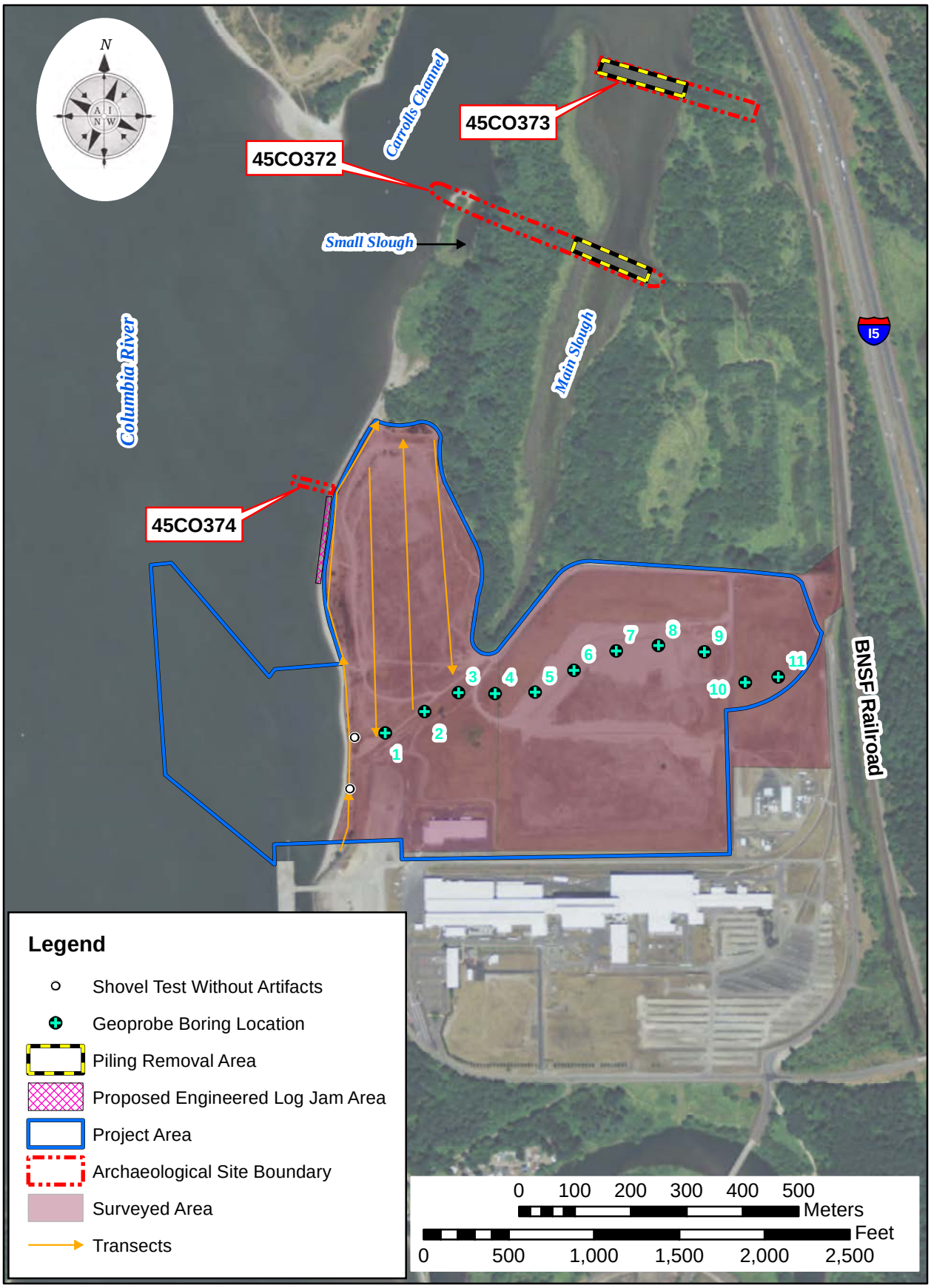
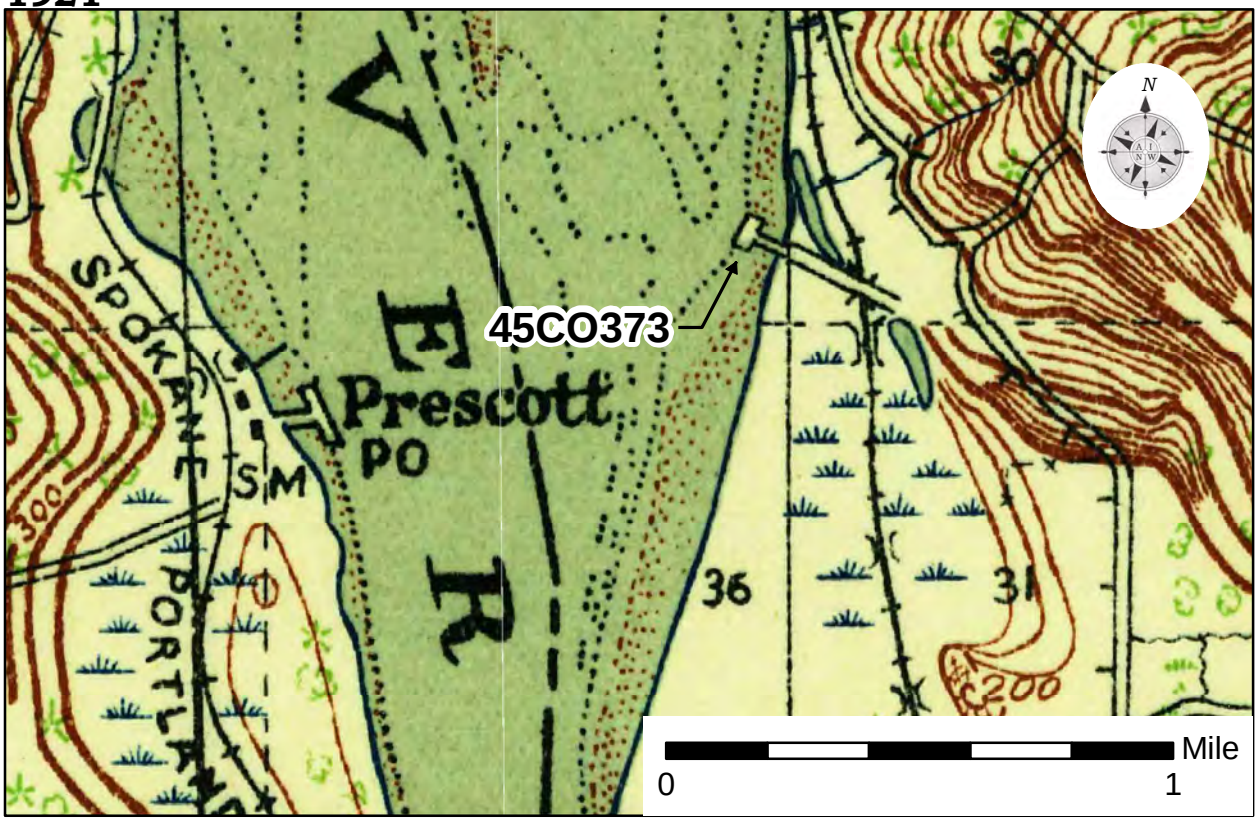


Figure 2. Project areas showing previous cultural resource surveys and identified archaeological resources. Each orange transect line on the map represents four individual transects.

1921



1953

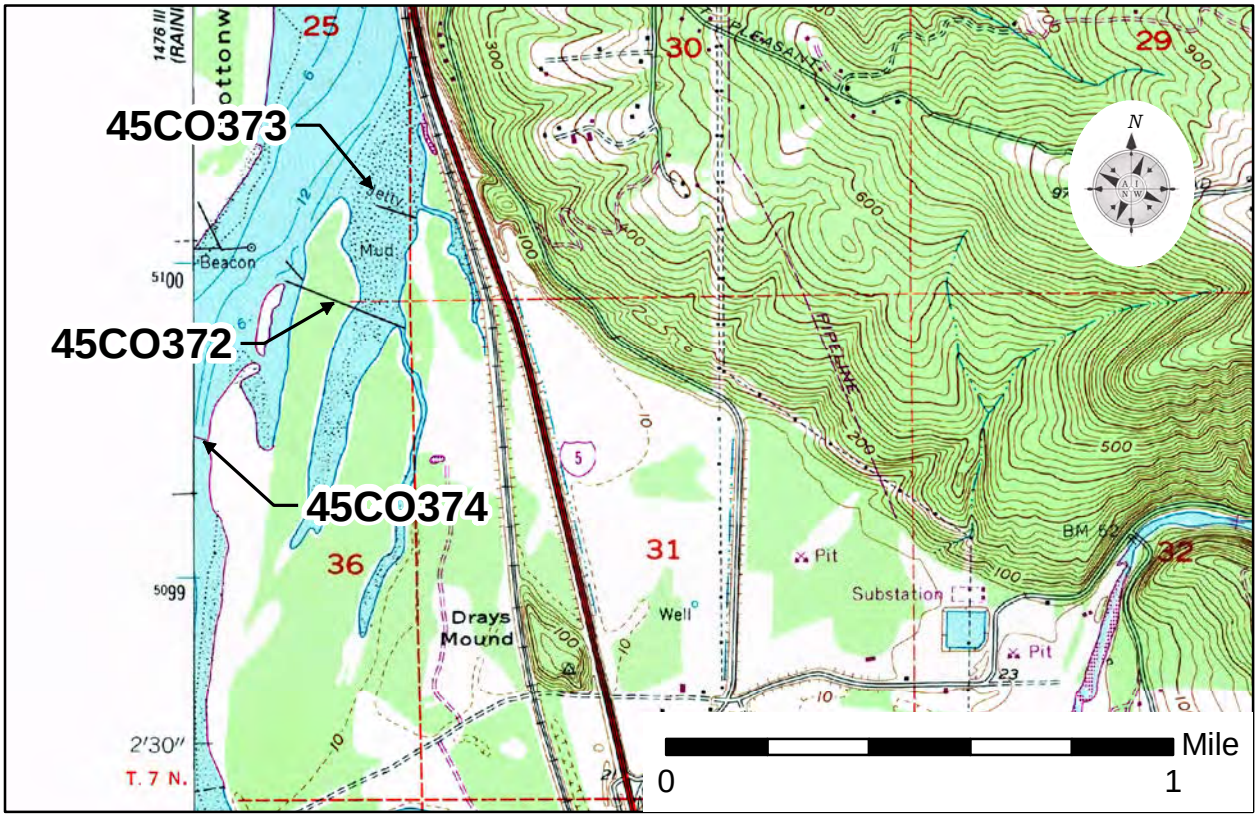


Figure 3. Archaeological site locations in relation to historic-period Kalama, Washington quadrangle maps (top 1921, 15-minute and bottom 1953, 7.5-minute).

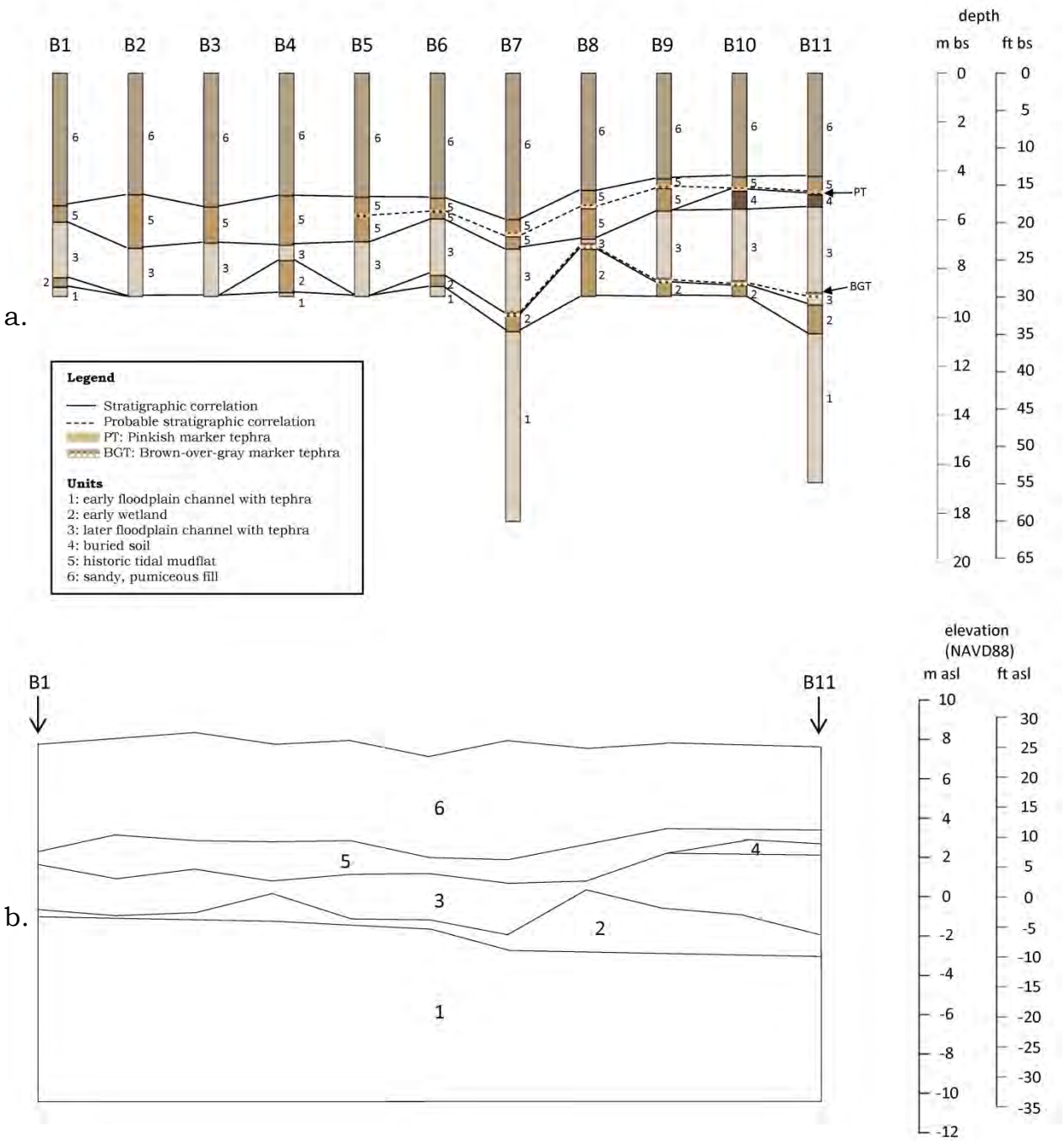


Figure 4. a) Fence diagram showing links between stratigraphic units for each boring, with absolute depths below surface (bs) in meters (m) and feet (ft), and b) Stratigraphic cross section of the project area, showing elevations above and below sea level (asl).

Photo 1. Overview of the project area, showing the fenced portion with dredge materials. The view is towards the southeast.

Photo 2. Overview of the project area, showing the developed portion and existing facilities to the south, and dredge materials. The view is towards the south.

Photo 3. Overview of the west side of the project area showing the dredge materials. The view is towards the north.

Photo 4. The project area looking towards the east, showing the dredge materials, with sparse vegetation. Heavier vegetation is visible to the east. The view is towards the east.

Photo 5. Overview of the project area showing vehicular tracks and mineral soil visibility in the western portion of the project area. The view is towards the southeast.

Photo 6. Overview of the project area taken from Kalama River Road, showing the existing facilities and previously (2012) surveyed area. The view is towards the northwest.

Photo 7. Shovel test ST-30 excavated in dredge materials to a depth of 200 cm (80 in) below the surface. The trowel in the photo points north.

Photo 8. Overview of the southwest corner of the project area, next to the existing facilities fence and location of shovel tests ST-29 and ST-30. The view is towards the southwest.

Photo 9. Timber pilings from pier or dock identified in the main slough, site 45CO372. The view is towards the east.

Photo 10. Timber pilings from pier or dock identified in the small slough, site 45CO372. The view is towards the southeast. The yellow arrow indicates the rocky structure.

Photo 11. Timber pilings from pier or dock extending into the Columbia River, site 45CO372. The view is towards the northwest.

Photo 12. Construction detail of site 45CO372, as seen at the riverbank location in Photo 3. West is towards the top of the photo.

Photo 13. Grouping of timber pilings in the small slough, south of site 45CO372. The view is towards the north.

Photo 14. Timber pilings from pier or dock identified in the far northern end of the main slough, site 45CO373. The view is towards the north.

Photo 15. Timber pilings from pier or dock identified in the Columbia River, site 45CO374. The view is towards the northwest.

Photo 16. Construction detail of site 45CO374. West is towards the top of the photo.

Photo 17. Geoprobe in action at Boring B3. The view is towards the south.

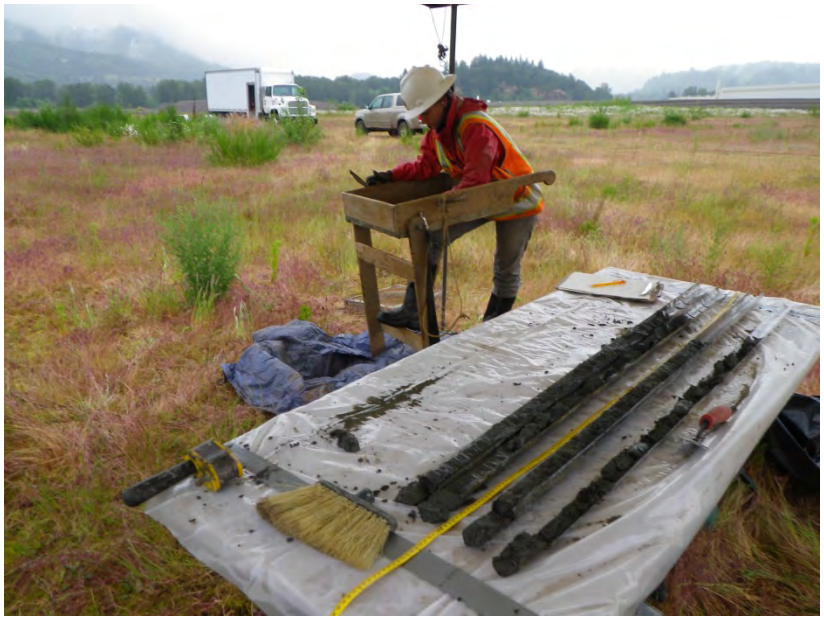


Photo 18. Screening sediments from split Geoprobe samples at Boring B2. The view is towards the east.

Photo 19. The yellow arrow marks the transition from pumiceous dredge fill (right) to rooted wetland sediment (left) in Boring B8 at 4.81 m (15.8 ft) bs.

Photo 20. Buried, granular silty soil with vertical rootlets as seen from 5.09 to 5.16 m (16.7 to 16.9 ft) bs in Boring B10.

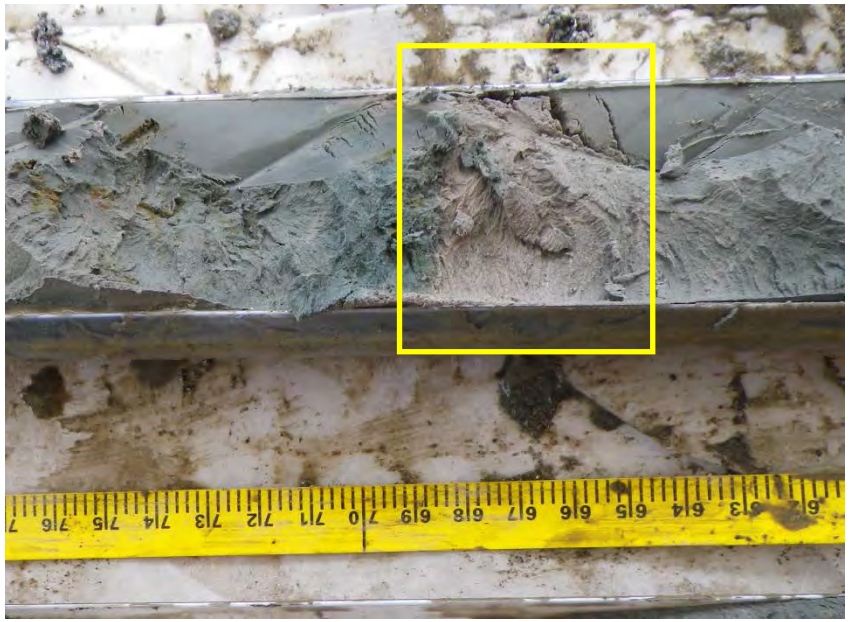


Photo 21. The yellow box delineates the pinkish tephra that post-dates the buried soil, as seen within wetland silt from 5.66 to 5.69 m (18.6 to 18.7 ft) bs in Boring B6.

Photo 22. The yellow box delineates the brown-over-gray tephra that post-dates the earliest wetland, as seen from 8.42 to 8.56 m (27.6 to 28.1 ft) bs in Boring B9.

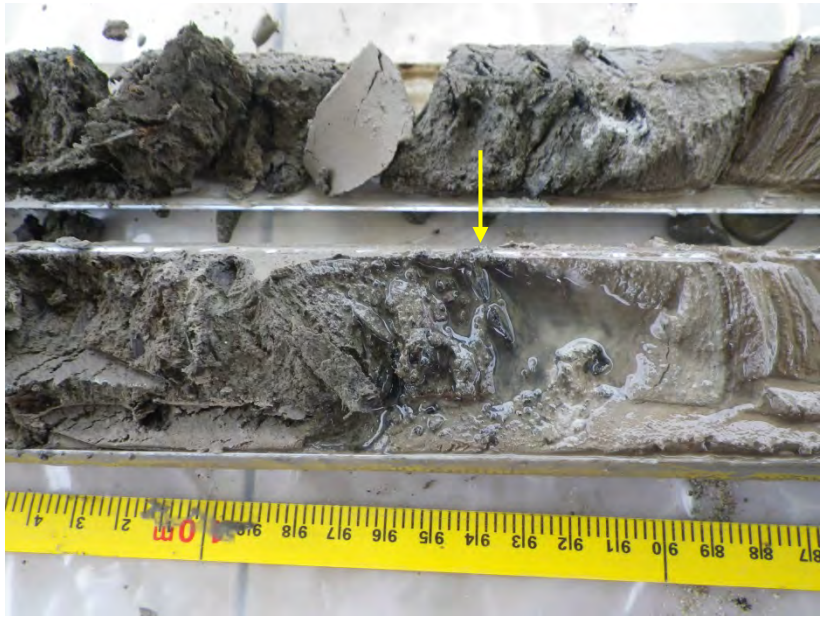


Photo 23. The yellow arrow marks the transition from brown-over-gray tephra (right) to the early rooted wetland silt (left) at 9.94 m (32.6 ft) bs in Boring B7.

Photo 24. Very poorly sorted fluvial sand and gravel as seen from 14.58 to 14.75 m (47.8 to 48.4 ft) bs in Boring B11.

APPENDIX

ARCHAEOLOGICAL RESOURCE FORMS

SITE 45CO372
SITE 45CO373
SITE 45CO374

STATE OF WASHINGTON
ARCHAEOLOGICAL SITE INVENTORY FORM

Smithsonian No.: 45CO372
***County:** Cowlitz

***Date:** 2/3/15 ***Compiler:** Sara J. Davis and Sarah L. Jenkins **Human Remains?** ☐
Location Information Restrictions *(Yes/No/Unknown)*: No **DAHP Case No.:**

SITE DESIGNATION

Site Name:
Field/ Temporary ID: 13/2150-1
***Site Type(s):** Historic Water Structures

SITE LOCATION

***USGS Quad Map Name(s):** *Kalama, WA-OR,* 7.5-minute, 1990
***Legal Description:** **Township** 7 North **Range** 2 West
Quarter Section(s): SE ¼ of the SE ¼ of the SE ¼ of Section 25
NE ¼ of the NE ¼ of the NE ¼ of Section 36
UTM: **Zone** 10 (NAD 83) **Easting** 510029 **Northing** 5100070
Latitude: **Longitude:** **Elevation (ft/m):** 10 ft/3 m
Other Maps: **Type:**
Scale: **Source:**
Drainage, Major: Columbia River **Drainage, Minor:** Carrolls Channel **River Mile:** 72
Aspect: Flat **Slope:** 0

***Location Description** *(General to Specific)*: The site is located in southwest Washington along the Columbia River between Kalama and Carrolls, Washington. The site is visible within a slough or inlet and where the southern end of Carrolls Channel enters the Columbia River.

***Directions** *(For Relocation Purposes)*: From Kalama, Washington, follow Interstate 5 north 3.7 kilometers (km) (2.3 miles [mi]) to Exit 32 for Kalama River Road. Turn left (west) on Kalama River Road and continue over the interstate and the railroad tracks to the first right turn which is Tradewinds Road. Turn right (north) and follow this road to its end, parking along the Columbia River in a sandy area. Follow the river shoreline north to the site, approximately 1 km (0.6 mi).

SITE DESCRIPTION

Narrative Description** *(Overall Site Observations):** The site consists of wood piling remnants in three locations. The piling locations were likely once connected to form a single pier or dock and are visible on maps as early as 1953.

Site Dimensions** *(Overall Site Dimensions):**

***Length:** 400 m ***Direction:** NW/SE x ***Width:** 1 m ***Direction:** NE/SW

***Method of Horizontal Measurement:** GPS

***Depth:** Unknown depth below the water however there is between 50 and 100 cm of wood above the water at low tide

* **Method of Vertical Measurement:** Tape

Vegetation** *(On Site):** Cottonwood, horsetail, vine maple, ferns

Local: Wetland on the Columbia River floodplain

Regional: *Tsuga heterophylla* (western hemlock) zone

Landforms *(On Site)***:** River terrace and tidal flat

Local: Columbia River valley

Water Resources *(Type)***:** Columbia River

Distance: Western site is within the river **Permanence:** Permanent

CULTURAL MATERIALS AND FEATURES

Narrative Description** *(Specific Inventory Details):** At each location, there are two parallel rows of pilings, many of which have rusted metal bolts in the wood. The pilings themselves were each approximately 30 centimeters (cm) (12 inches [in]) in diameter. There were some areas where a horizontal piece of timber remained between the two rows of pilings. At the eastern extent of the central pilings location, there are rocks partially in the water and partially on land that may be part of a former rock crib or other supporting rock structure.

***Method of Collection:** No artifacts were collected

Location of Artifacts** *(Temporary/Permanent):** N/A

SITE AGE

***Component:** Historic-period ***Dates:** pre-1953 ***Dating Method:** Historic maps

Phase: Unknown **Basis for Phase Designation:** N/A

SITE RECORDERS

Observed by: Sara J. Davis, Andrew Polta, Lea Loiselle, and Joey Veysey

Address: Archaeological Investigations Northwest, Inc., 3510 NE 122nd Avenue, Portland, OR 97230

***Date Recorded:** November 4, 2013

Recorded by** *(Professional Archaeologist):** Sara J. Davis

***Organization:** Archaeological Investigations Northwest, Inc.

***Organization Phone Number:** 503-761-6605

***Organization Address:** Same as above ***Organization E-mail:** sarah@ainw.com

Date Revisited: **Revisited By:**

SITE HISTORY

Current Archaeological Work** *(References):**

Jenkins, Sarah L., and Terry L. Ozbun
2015 *Cultural Resource Survey for the Proposed Kalama Manufacturing and Marine Export Facility Project, Cowlitz County, Washington*. Archaeological Investigations Northwest, Inc. Report No. 3417. Prepared for BergerABAM, Portland, Oregon.

Previous Archaeological Work** *(Done at Site):**

Davis, Sara J., and Terry L. Ozbun
2013 *Cultural Resource Survey for the Port of Kalama North Port Project, Cowlitz County, Washington*. Archaeological Investigations Northwest, Inc. Report No. 3176. Prepared for Port of Kalama, Kalama, Washington.

Ellwood, Emily, Andrea Blaser, and Terry Ozbun
2012 *Cultural Resource Survey of the Northwest Pipeline GP Kalama Lateral Pipeline Project, Cowlitz County, Washington*. Revised October 2012 (original September 2012). Archaeological Investigations Northwest, Inc. Report No. 2847. Prepared for Northwest Pipeline GP, Battleground, Washington.

LAND OWNERSHIP

***Owner:** Port of Kalama

***Address:** 380 West Marine Dr., Kalama, Washington 98625

***Tax Lot/ Parcel No:** 63305 and 63301

RESEARCH REFERENCES

Items/Documents Used In Research** *(Specify):**

U.S. Geological Survey (USGS)
1953 *Kalama, Wash.* 7.5-minute topographic map. Electronic document, http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&xcm=r3standardpitrex_prd&carea=%24ROOT&layout=6_1_61_48&uiarea=2)/.do, accessed November 15, 2013.

USGS MAP

*__Quad Name(s):__ *Kalama, WA-OR*

***Series:** 7.5-minute

***Date(s):** 1953, 1990

SEE ATTACHED

SKETCH MAP

***Sketch Map Description:**

SEE ATTACHED

***Legend:** **Known Boundary Symbology:**

Possible Boundary Symbology:

Other Symbols *(Other Than USGS)***:**

***INSERT LEGEND**

***Scale:**

North Arrow** *(Magnetic/True North):**

PHOTOGRAPH(S)

***Photograph Description(s)**

Westernmost pilings extending into the Columbia River. Prescott, Oregon, is visible in the background and there is a large driftwood log visible behind the pilings in the photo. The view is towards the west.

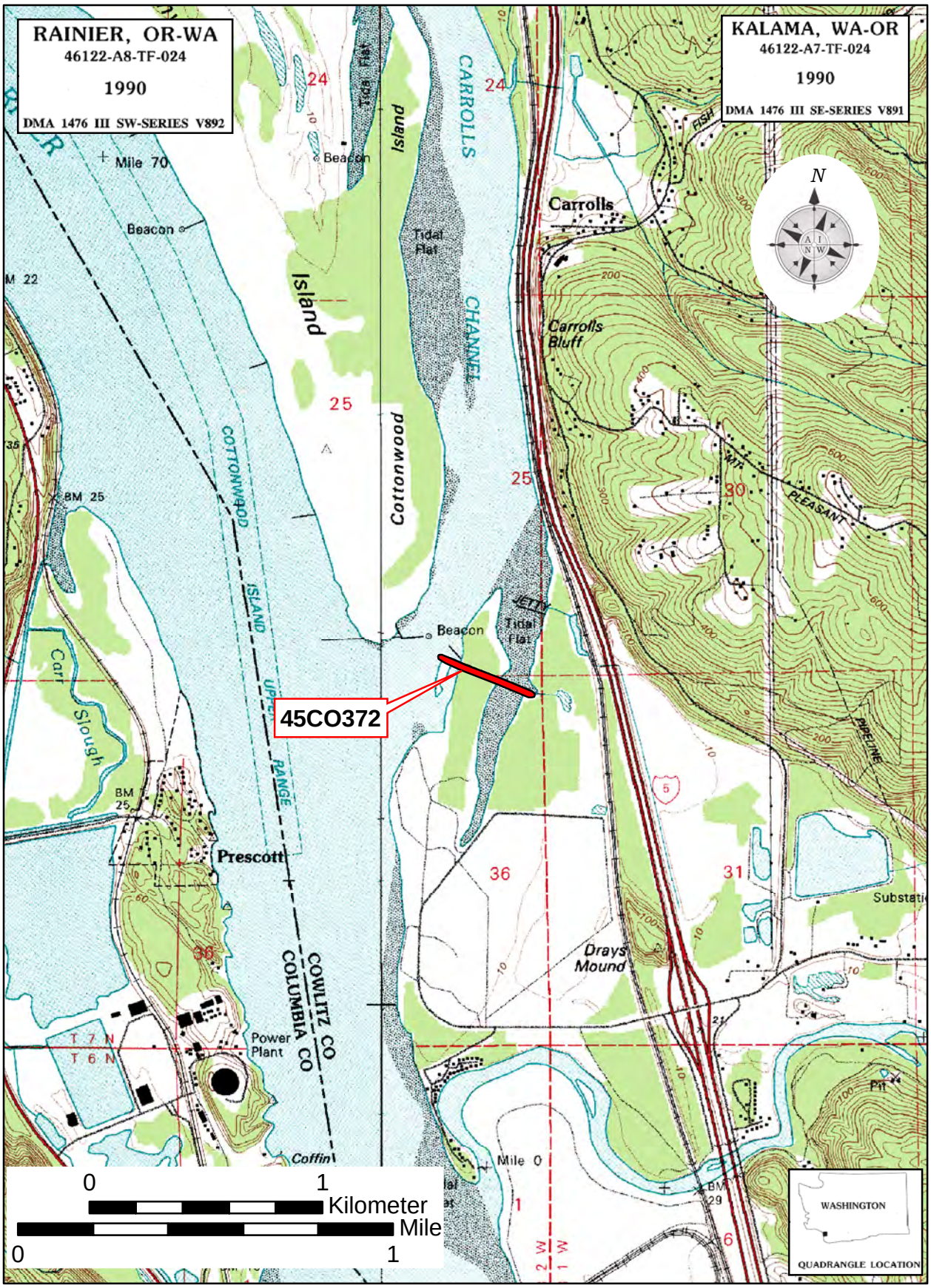
Central area of pilings with rock support structure at the left. The view is towards the south/southeast.

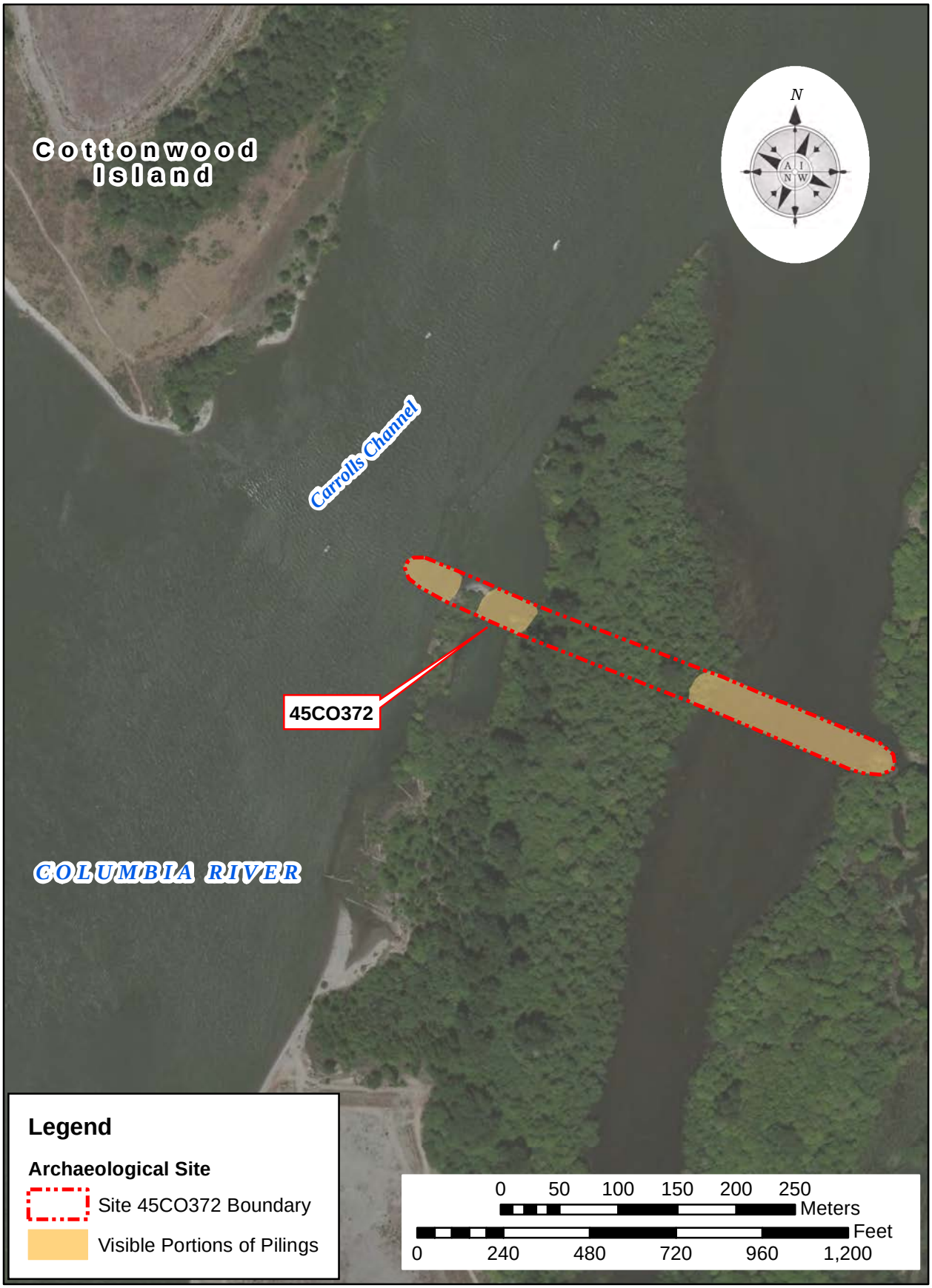
PHOTOGRAPH(S)

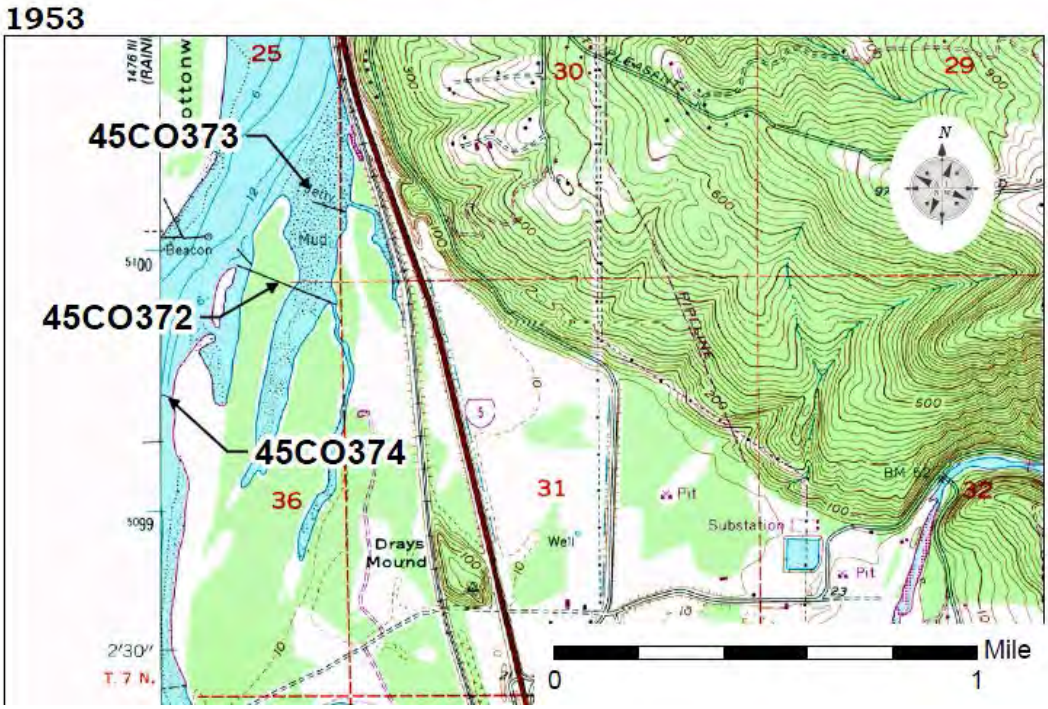
***Photograph Description(s)**

Easternmost pilings extending across the larger channel or main slough. The view is towards the southeast.

Close-up view of the pilings and metal bolts in the central piling area. The view is towards the south.


RAINIER, OR-WA
46122-A8-TF-024
1990
DMA 1476 III SW-SERIES V892
KALAMA, WA-OR
46122-A7-TF-024
1990
DMA 1476 III SE-SERIES V891
N
Mile 70
Beacon
Island
CARROLLS
CHANNEL
Tidal Flat
Carrolls
Carrolls Bluff
Cottonwood
COTTONWOOD ISLAND
UPPER RANGE
BM 25
Carr Slough
Prescott
Power Plant
COWLITZ CO
COLUMBIA CO
Coffin
JETTY
MT. PLEASANT
PIPELINE
Drays Mound
Substati
Pit
Mile 0
45CO372
0 1 Kilometer
0 1 Mile
WASHINGTON
QUADRANGLE LOCATION


Cottonwood Island
N
Carrolls Channel
45CO372
COLUMBIA RIVER
Legend
Archaeological Site
Site 45CO372 Boundary
Visible Portions of Pilings
0 50 100 150 200 250
Meters
Feet
0 240 480 720 960 1,200



Site 45CO372 (as well as sites 45CO373 and 45CO374) as shown on the 1953 USGS quadrangle map for Kalama, WA.

STATE OF WASHINGTON
ARCHAEOLOGICAL SITE INVENTORY FORM

Smithsonian No.: 45CO373
***County:** Cowlitz

***Date:** 2/9/15 ***Compiler:** Sarah L. Jenkins **Human Remains?** ☐
Location Information Restrictions *(Yes/No/Unknown)*: No **DAHP Case No.:**

SITE DESIGNATION

Site Name:
Field/ Temporary ID: 14/2245-1
***Site Type(s):** Historic Water Structures

SITE LOCATION

***USGS Quad Map Name(s):** *Kalama, WA-OR,* 7.5-minute, 1990

***Legal Description:** **Township** 7 North **Range** 1 West, 2 West
Quarter Section(s): NE ¼ of the SE ¼ of the SE ¼ of Section 25
NW ¼ of the SW ¼ of the SW ¼ of Section 30

UTM: **Zone** 10 (NAD 83) **Easting** 510266 **Northing** 5100329
Latitude: **Longitude:** **Elevation (ft/m):** 10 ft/3 m
Other Maps: **Type:**
Scale: **Source:**
Drainage, Major: Columbia River **Drainage, Minor:** Carrolls Channel **River Mile:** 72
Aspect: Flat **Slope:** 0

***Location Description** *(General to Specific)*: The site is located in southwest Washington along the Columbia River between Kalama and Carrolls, Washington. The site is visible within a slough or inlet and where the southern end of Carrolls Channel enters the Columbia River.

***Directions** *(For Relocation Purposes)*: From Kalama, Washington, follow Interstate 5 north 3.7 kilometers (km) (2.3 miles [mi]) to Exit 32 for Kalama River Road. Turn left (west) on Kalama River Road and continue over the interstate and the railroad tracks to the first right turn which is Tradewinds Road. Turn right (north) and follow this road to its end, parking along the Columbia River in a sandy area. Follow the river shoreline north to the site, approximately 1 km (0.6 mi).

SITE DESCRIPTION

Narrative Description** *(Overall Site Observations):** The site consists of wood piling remnants spanning most of the way across the slough, near its confluence with the Columbia River. The piling locations were likely once connected to form a single pier or dock and are visible on maps as early as 1921 where they show a facility connected to the nearby railroad.

Site Dimensions** *(Overall Site Dimensions):**

*__Length:__ 285 m *__Direction:__ NW/SE x *__Width:__ 2.7 m *__Direction:__ NE/SW

*__Method of Horizontal Measurement:__ Map

*__Depth:__ Unknown depth below the water

* __Method of Vertical Measurement:__ None

Vegetation** *(On Site):** Cottonwood, horsetail, vine maple, ferns

Local: Wetland on the Columbia River floodplain

Regional: *Tsuga heterophylla* (western hemlock) zone

Landforms *(On Site)***:** River terrace and tidal flat

Local: Columbia River valley

Water Resources *(Type)***:** Columbia River

Distance: Western site is within the river **Permanence:** Permanent

CULTURAL MATERIALS AND FEATURES

Narrative Description** *(Specific Inventory Details):** There are two main rows of pilings separated by a distance of approximately 2.7 meters (9 feet), each row has a pair of pilings located side by side. On the west end, the pilings form a square with approximately five pilings 3.2 m (10.5 ft) apart.

***Method of Collection:** No artifacts were collected

Location of Artifacts** *(Temporary/Permanent):** N/A

SITE AGE

***Component:** Historic-period *__Dates:__ post-1888 to 1921 ***Dating Method:** Historic maps

Phase: Unknown **Basis for Phase Designation:** N/A

SITE RECORDERS

Observed by: Sara J. Davis, Andrew Polta, Lea Loiselle, and Joey Veysey

Address: Archaeological Investigations Northwest, Inc., 3510 NE 122nd Avenue, Portland, OR 97230

***Date Recorded:** November 4, 2013

Recorded by** *(Professional Archaeologist):** Sara J. Davis and Sarah L. Jenkins

***Organization:** Archaeological Investigations Northwest, Inc.

***Organization Phone Number:** 503-761-6605

***Organization Address:** Same as above ***Organization E-mail:** sarah@ainw.com

Date Revisited: **Revisited By:**

SITE HISTORY

Current Archaeological Work** *(References):**

Jenkins, Sarah L., and Terry L. Ozbun
2015 *Cultural Resource Survey for the Proposed Kalama Manufacturing and Marine Export Facility Project, Cowlitz County, Washington*. Archaeological Investigations Northwest, Inc. Report No. 3417. Prepared for BergerABAM, Portland, Oregon.

Previous Archaeological Work** *(Done at Site):**

Davis, Sara J., and Terry L. Ozbun
2013 *Cultural Resource Survey for the Port of Kalama North Port Project, Cowlitz County, Washington*. Archaeological Investigations Northwest, Inc. Report No. 3176. Prepared for Port of Kalama, Kalama, Washington.

Ellwood, Emily, Andrea Blaser, and Terry Ozbun
2012 *Cultural Resource Survey of the Northwest Pipeline GP Kalama Lateral Pipeline Project, Cowlitz County, Washington*. Revised October 2012 (original September 2012). Archaeological Investigations Northwest, Inc. Report No. 2847. Prepared for Northwest Pipeline GP, Battleground, Washington.

LAND OWNERSHIP

***Owner:** Port of Kalama; State Department of Game

***Address:** 110 West Marine Dr., Kalama, Washington 98625; 600 N Capitol Way, Olympia, Washington 98504

***Tax Lot/ Parcel No:** WH2516001, WD3012003, and WH2500003

RESEARCH REFERENCES

Items/Documents Used In Research** *(Specify):**

U.S. Geological Survey (USGS)

1921 *Kalama, Wash.* 15-minute topographic map. Electronic document, http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&xcm=r3standardpitrex_prd&carea=%24ROOT&layout=6_1_61_48&uiarea=2)/.do, accessed November 15, 2013.

1953 *Kalama, Wash.* 7.5-minute topographic map. Electronic document, http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&xcm=r3standardpitrex_prd&carea=%24ROOT&layout=6_1_61_48&uiarea=2)/.do, accessed November 15, 2013.

USGS MAP

*__Quad Name(s):__ *Kalama, WA-OR*

***Series:** 7.5-minute

***Date(s):** 1921, 1953, 1990

SEE ATTACHED

SKETCH MAP

***Sketch Map Description:**

SEE ATTACHED

***Legend:** **Known Boundary Symbology:**

Possible Boundary Symbology:

Other Symbols *(Other Than USGS)***:**

***INSERT LEGEND**

***Scale:**

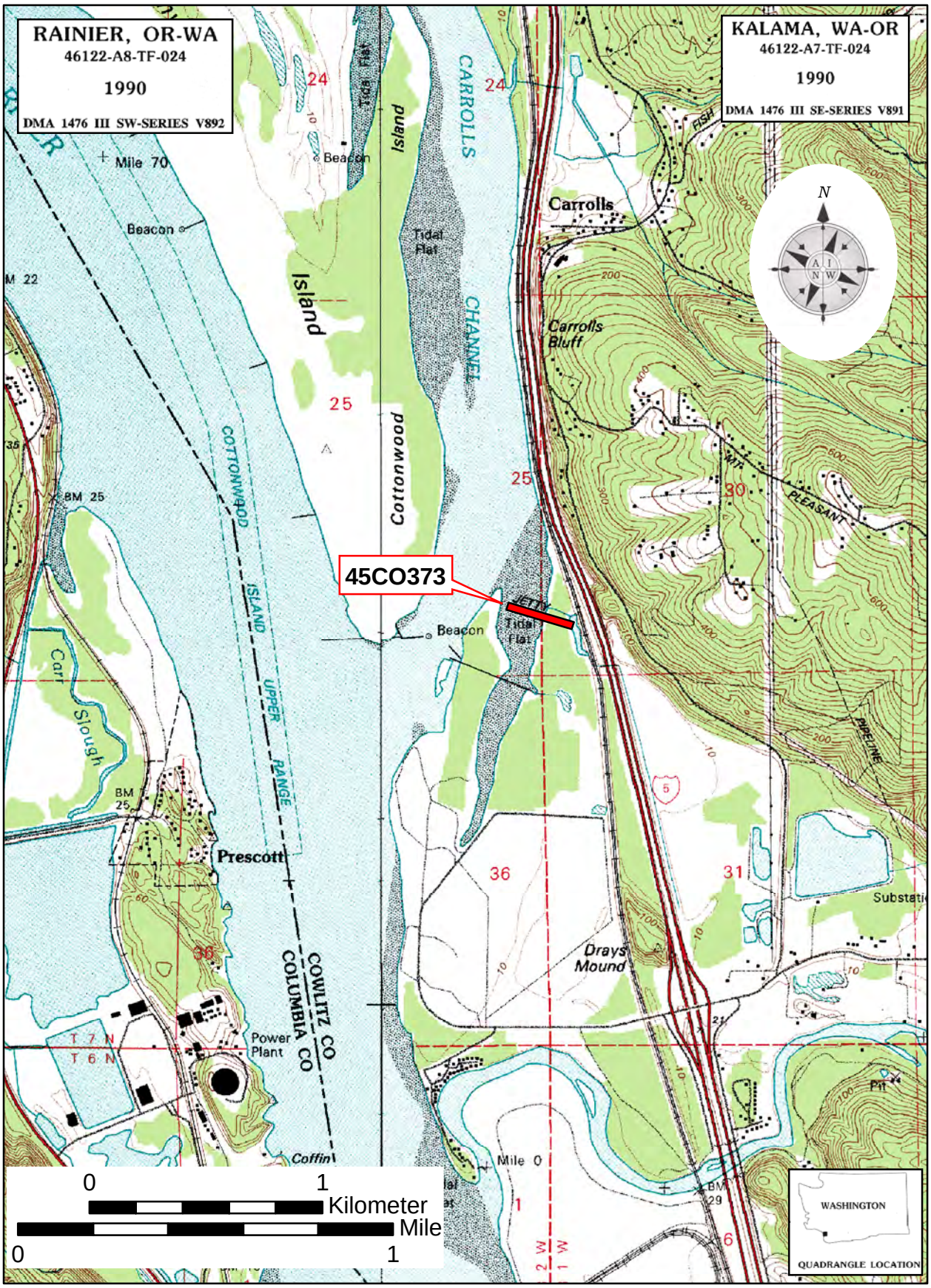
North Arrow** *(Magnetic/True North):**

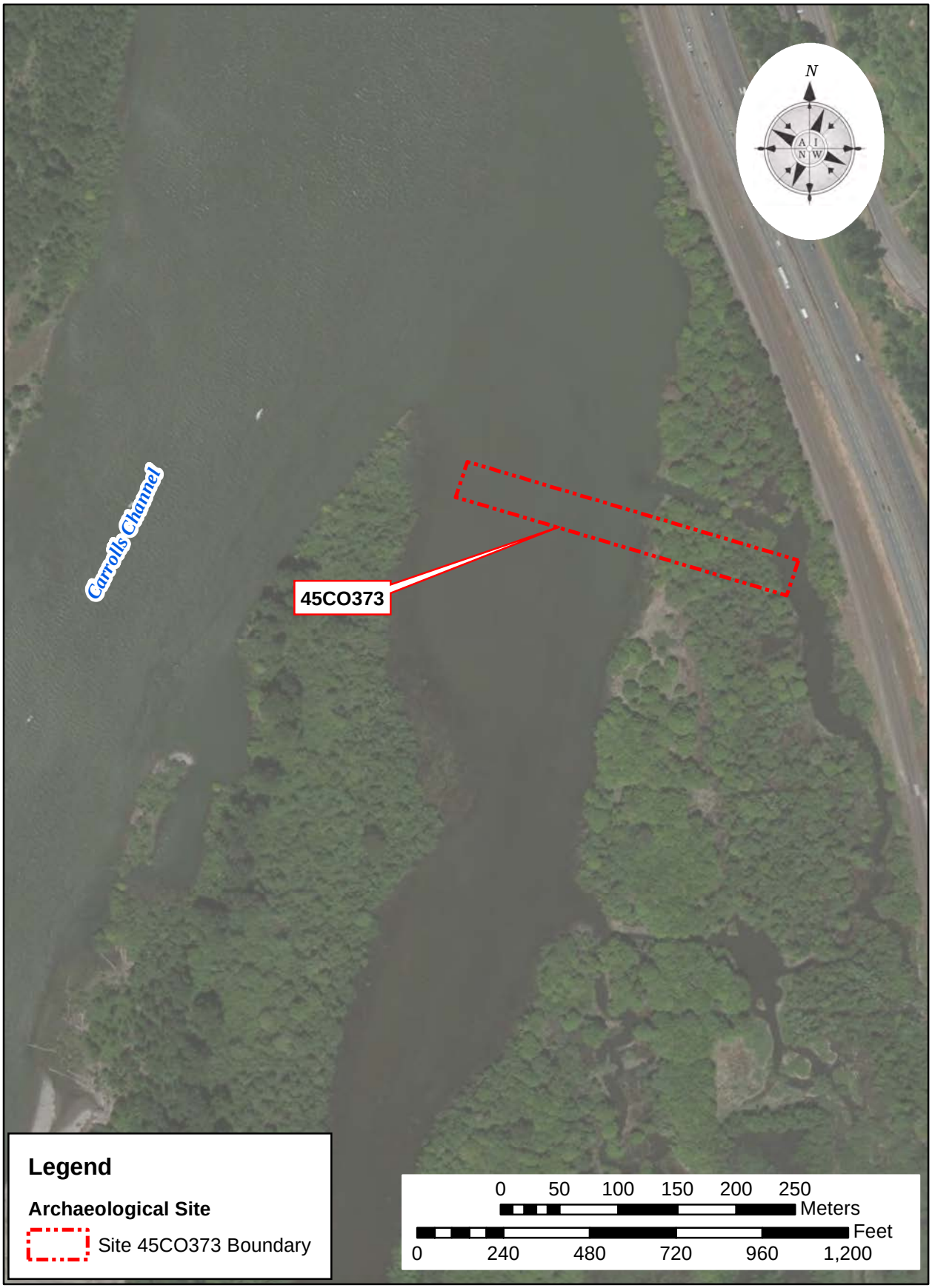
PHOTOGRAPH(S)

***Photograph Description(s)**

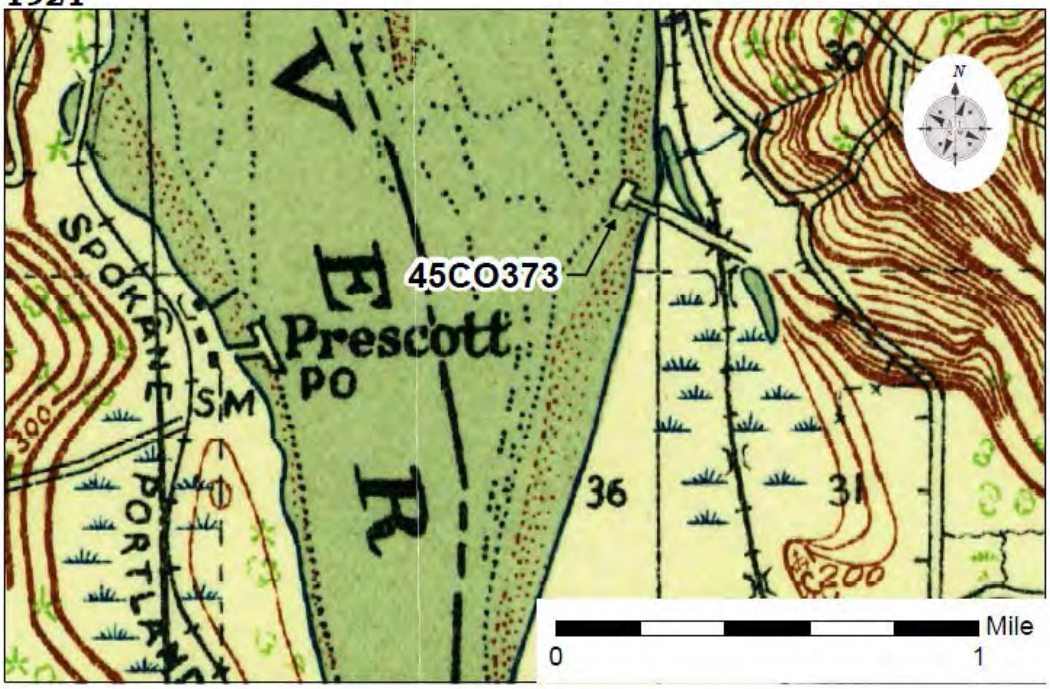
Overview of the pilings at the north end of the slough, with Interstate 5 in the background. The view is towards the north.

Satellite image of the pilings from Google Earth 2014.


RAINIER, OR-WA
46122-A8-TF-024
1990
DMA 1476 III SW-SERIES V892
KALAMA, WA-OR
46122-A7-TF-024
1990
DMA 1476 III SE-SERIES V891
45CO373
Carrolls
Carrolls Bluff
Cottonwood Island
CARROLLS CHANNEL
Tidal Flat
Beacon
Mile 70
Mile 0
Prescott
Power Plant
Drays Mound
COWLITZ CO
COLUMBIA CO
COTTONWOOD ISLAND UPPER RANGE
Carr Slough
JETTY
MT. PLEASANT
PIPELINE
Pit
Substati
Coffin
WASHINGTON
QUADRANGLE LOCATION
0 1 Kilometer
0 1 Mile

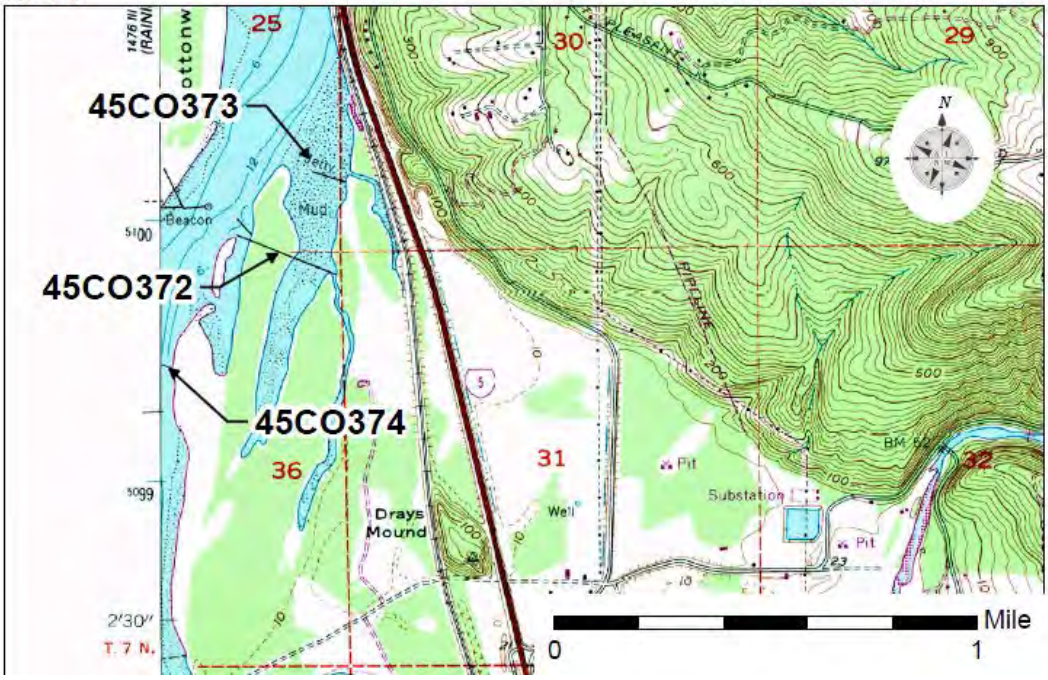

N
Carrolls Channel
45CO373
Legend
Archaeological Site
Site 45CO373 Boundary
0 50 100 150 200 250
Meters
Feet
0 240 480 720 960 1,200

1921



Site 45CO373 as shown on the 1921 USGS quadrangle map for Kalama, WA.

1953



Site 45CO373 (as well as sites 45CO374 and 45CO372) as shown on the 1953 USGS quadrangle map for Kalama, WA.

STATE OF WASHINGTON
ARCHAEOLOGICAL SITE INVENTORY FORM

Smithsonian No.: 45CO374
***County:** Cowlitz

***Date:** 2/9/15 ***Compiler:** Sarah L. Jenkins **Human Remains?** ☐
Location Information Restrictions *(Yes/No/Unknown)*: No **DAHP Case No.:**

SITE DESIGNATION

Site Name:
Field/ Temporary ID: 14/2245-2
***Site Type(s):** Historic Water Structures

SITE LOCATION

***USGS Quad Map Name(s):** *Kalama, WA-OR,* 7.5-minute, 1990
***Legal Description:** **Township** 7 North **Range** 2 West
Quarter Section(s): NW ¼ of the SW ¼ of the NE ¼ of Section 36
UTM: **Zone** 10 (NAD 83) **Easting** 509610 **Northing** 5099624
Latitude: **Longitude:** **Elevation (ft/m):** 10 ft/3 m
Other Maps: **Type:**
Scale: **Source:**
Drainage, Major: Columbia River **Drainage, Minor:** Carrolls Channel **River Mile:** 72
Aspect: Flat **Slope:** 0

***Location Description** *(General to Specific)*: The site is located in southwest Washington along the Columbia River between Kalama and Carrolls, Washington. The site is visible in the Columbia River, just north of the Port of Kalama – North Port Marine Terminal.

***Directions** *(For Relocation Purposes)*: From Kalama, Washington, follow Interstate 5 north 3.7 kilometers (km) (2.3 miles [mi]) to Exit 32 for Kalama River Road. Turn left (west) on Kalama River Road and continue over the interstate and the railroad tracks to the first right turn which is Tradewinds Road. Turn right (north) and follow this road to its end, parking along the Columbia River in a sandy area. Follow the river shoreline north to the site, approximately 0.31 km (0.19 mi).

SITE DESCRIPTION

Narrative Description** *(Overall Site Observations):** The site consists of wood piling remnants in the Columbia River. The pilings are visible on maps as early as 1953.

Site Dimensions** *(Overall Site Dimensions):**

*__Length:__ 67 m *__Direction:__ NW/SE x *__Width:__ 2.5 m *__Direction:__ NE/SW

*__Method of Horizontal Measurement:__ Map

*__Depth:__ Unknown depth below the water

* __Method of Vertical Measurement:__ None

Vegetation** *(On Site):** Shrub-scrub and weedy herbaceous plants

Local: Wetland on the Columbia River floodplain

Regional: *Tsuga heterophylla* (western hemlock) zone

Landforms *(On Site)***:** River terrace and tidal flat

Local: Columbia River valley

Water Resources *(Type)***:** Columbia River

Distance: Western site is within the river **Permanence:** Permanent

CULTURAL MATERIALS AND FEATURES

Narrative Description** *(Specific Inventory Details):** The pilings are located along the western edge of the project area, and extend from the shore into the Columbia River. There are two parallel rows of pilings separated by a distance of approximately 0.69 meter (2.25 feet). Each piling is staggered from the one opposite in a zigzag pattern.

***Method of Collection:** No artifacts were collected

Location of Artifacts** *(Temporary/Permanent):** N/A

SITE AGE

***Component:** Historic-period *__Dates:__ pre-1953 ***Dating Method:** Historic maps

Phase: Unknown **Basis for Phase Designation:** N/A

SITE RECORDERS

Observed by: Sara J. Davis, Andrew Polta, Lea Loiselle, and Joey Veysey

Address: Archaeological Investigations Northwest, Inc., 3510 NE 122nd Avenue, Portland, OR 97230

***Date Recorded:** November 4, 2013

Recorded by** *(Professional Archaeologist):** Sara J. Davis and Sarah L. Jenkins

***Organization:** Archaeological Investigations Northwest, Inc.

***Organization Phone Number:** 503-761-6605

***Organization Address:** Same as above ***Organization E-mail:** sarah@ainw.com

Date Revisited: **Revisited By:**

SITE HISTORY

Current Archaeological Work** *(References):**

Jenkins, Sarah L., and Terry L. Ozbun
2015 *Cultural Resource Survey for the Proposed Kalama Manufacturing and Marine Export Facility Project, Cowlitz County, Washington*. Archaeological Investigations Northwest, Inc. Report No. 3417. Prepared for BergerABAM, Portland, Oregon.

Previous Archaeological Work** *(Done at Site):**

Davis, Sara J., and Terry L. Ozbun
2013 *Cultural Resource Survey for the Port of Kalama North Port Project, Cowlitz County, Washington*. Archaeological Investigations Northwest, Inc. Report No. 3176. Prepared for Port of Kalama, Kalama, Washington.

Ellwood, Emily, Andrea Blaser, and Terry Ozbun
2012 *Cultural Resource Survey of the Northwest Pipeline GP Kalama Lateral Pipeline Project, Cowlitz County, Washington*. Revised October 2012 (original September 2012). Archaeological Investigations Northwest, Inc. Report No. 2847. Prepared for Northwest Pipeline GP, Battleground, Washington.

LAND OWNERSHIP

***Owner:** Port of Kalama; State Department of Game

***Address:** 110 West Marine Dr., Kalama, Washington 98625

***Tax Lot/ Parcel No:** 63304

RESEARCH REFERENCES

Items/Documents Used In Research** *(Specify):**

U.S. Geological Survey (USGS)
1953 *Kalama, Wash.* 7.5-minute topographic map. Electronic document, http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&xcm=r3standardpitrex_prd&carea=%24ROOT&layout=6_1_61_48&uiarea=2)/.do, accessed November 15, 2013.

USGS MAP

*__Quad Name(s):__ *Kalama, WA-OR*

***Series:** 7.5-minute

***Date(s):** 1953, 1990

SEE ATTACHED

SKETCH MAP

***Sketch Map Description:**

SEE ATTACHED

***Legend:** **Known Boundary Symbology:**

Possible Boundary Symbology:

Other Symbols *(Other Than USGS)***:**

***INSERT LEGEND**

***Scale:**

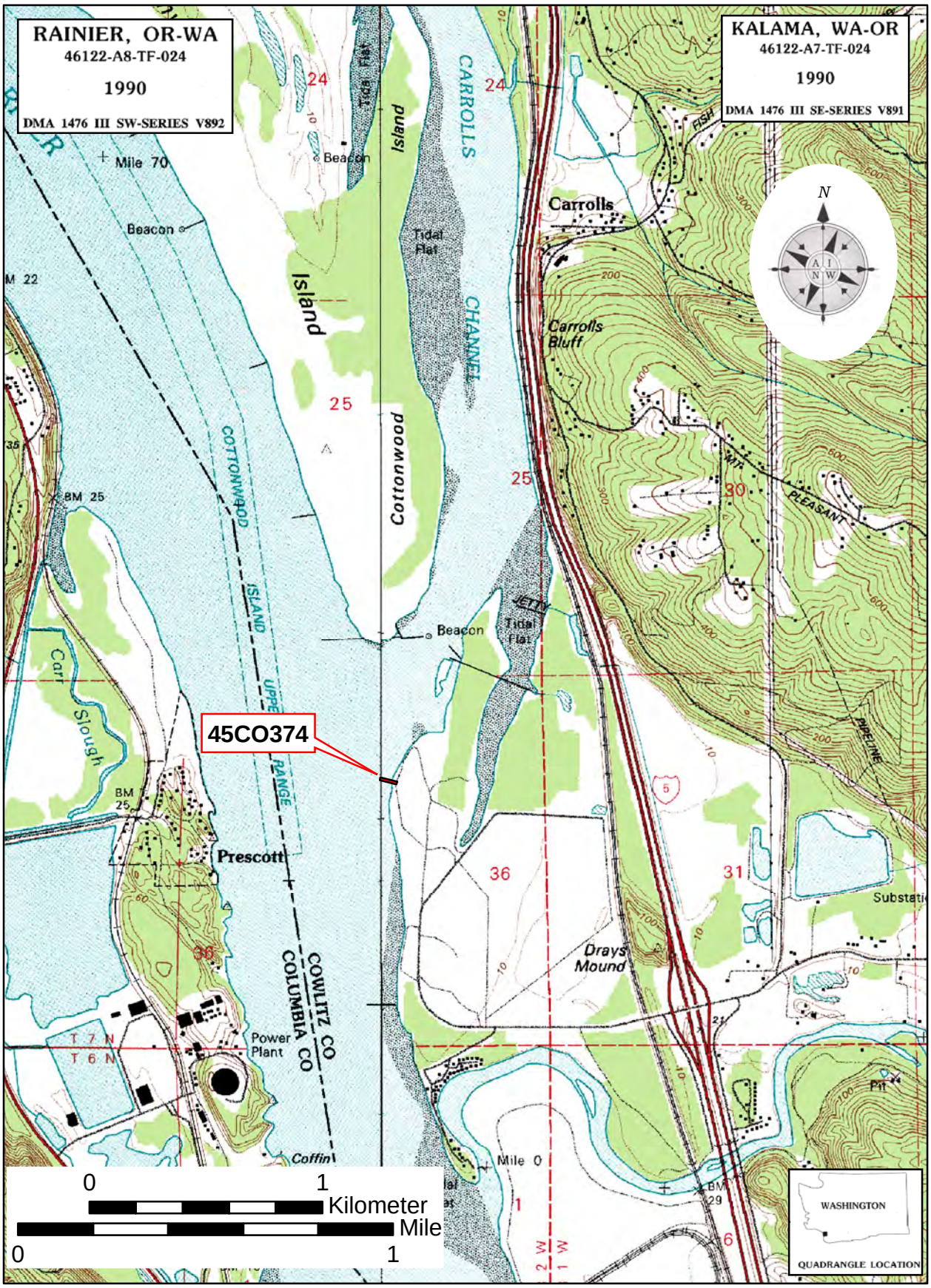
North Arrow** *(Magnetic/True North):**

PHOTOGRAPH(S)

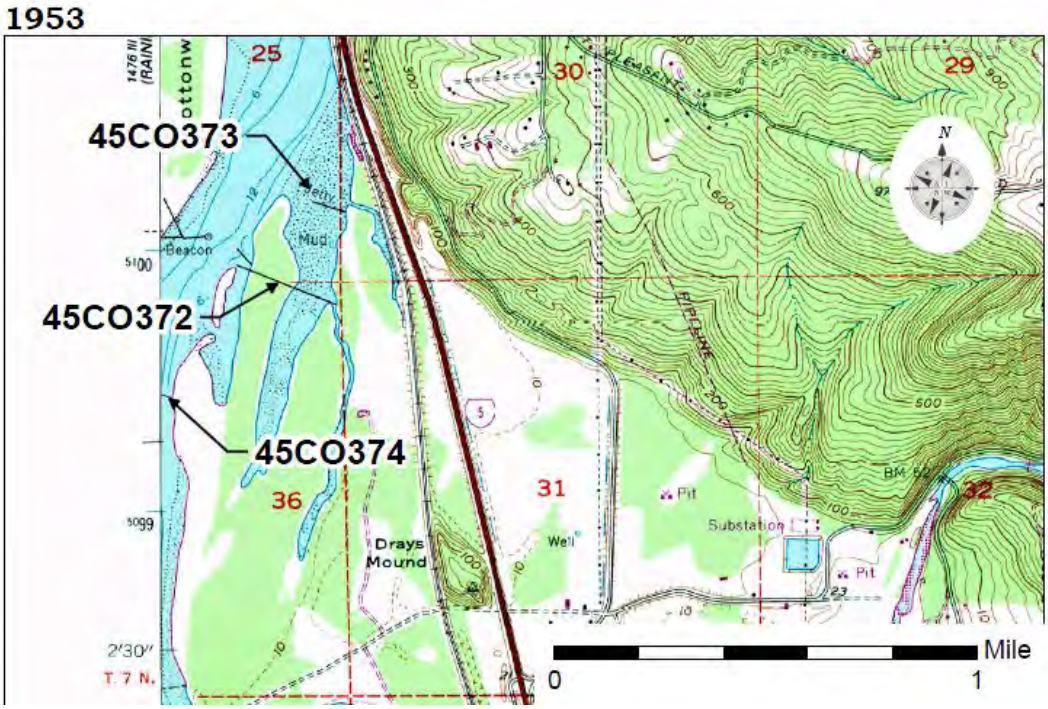
***Photograph Description(s)**

Overview of the pilings within the project area, on the Columbia River. The view is towards the north.

Satellite image of the pilings from Google Earth 2014.


RAINIER, OR-WA
46122-A8-TF-024
1990
DMA 1476 III SW-SERIES V892
KALAMA, WA-OR
46122-A7-TF-024
1990
DMA 1476 III SE-SERIES V891
45CO374
Mile 70
Beacon
Island
CARROLLS
CHANNEL
Tidal Flat
Carrolls
Carrolls Bluff
Cottonwood
COTTONWOOD ISLAND
UPPER RANGE
Carr Slough
BM 25
Prescott
Power Plant
COWLITZ CO
COLUMBIA CO
Coffin
Drays Mound
JETTY
MT. PLEASANT
PIPELINE
Substati
Pit
Mile 0
BM 29
T 7 N
T 6 N
2 W
1 W
N
WASHINGTON
QUADRANGLE LOCATION
0
1
Kilometer
Mile

N
COLUMBIA RIVER
45CO374
Legend
Archaeological Site
Site 45CO374 Boundary
0 30 60 90 120 150
Meters
Feet
0 150 300 450 600 750



Site 45CO374 (as well as sites 45CO373 and 45CO372) as shown on the 1953 USGS quadrangle map for Kalama, WA.

Appendix H
Section 408 Analysis

COAST & HARBOR ENGINEERING
A Division of Hatch Mott MacDonald

Technical Memorandum
Kalama Manufacturing and Marine Export Facility Possible Impacts on Federal Navigation Channel

1. Introduction

This technical memorandum presents the results of the study completed by Coast & Harbor Engineering (CHE) to evaluate possible impacts to the adjacent Federal Navigation Channel (FNC) due to construction and operation of the proposed Kalama Manufacturing and Marine Export Facility (Methanol Terminal) and due to possible removal of a pile dike and trestle immediately downstream of the proposed terminal. The proposed Methanol Terminal is located on the Washington side of the Columbia River, directly downstream from the Port's North Port Terminal, as shown in Figure 1. The figure also shows the dredge prism boundaries and the centerline of the FNC that neighbors the dredge area of the Methanol Terminal to the west.

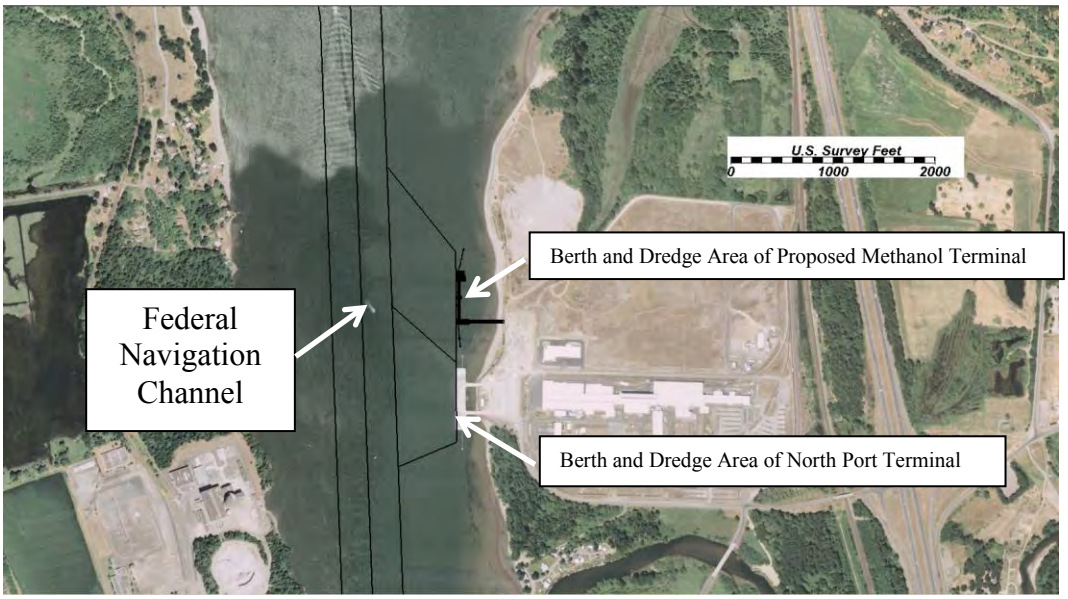


Figure 1. Location of project site

The locations of the pile dike and trestle proposed for removal are shown in Figure 2, provided by Berger/ABAM. It is our understanding that removal of these structures (pile dike and trestle) constitutes the project mitigation action and may or may not be executed at the time of terminal construction. It is also our understanding that only partial removal of the

center portion of the pile dike and partial removal of the western half of the trestle, as shown on the figure, is proposed under the mitigation action.

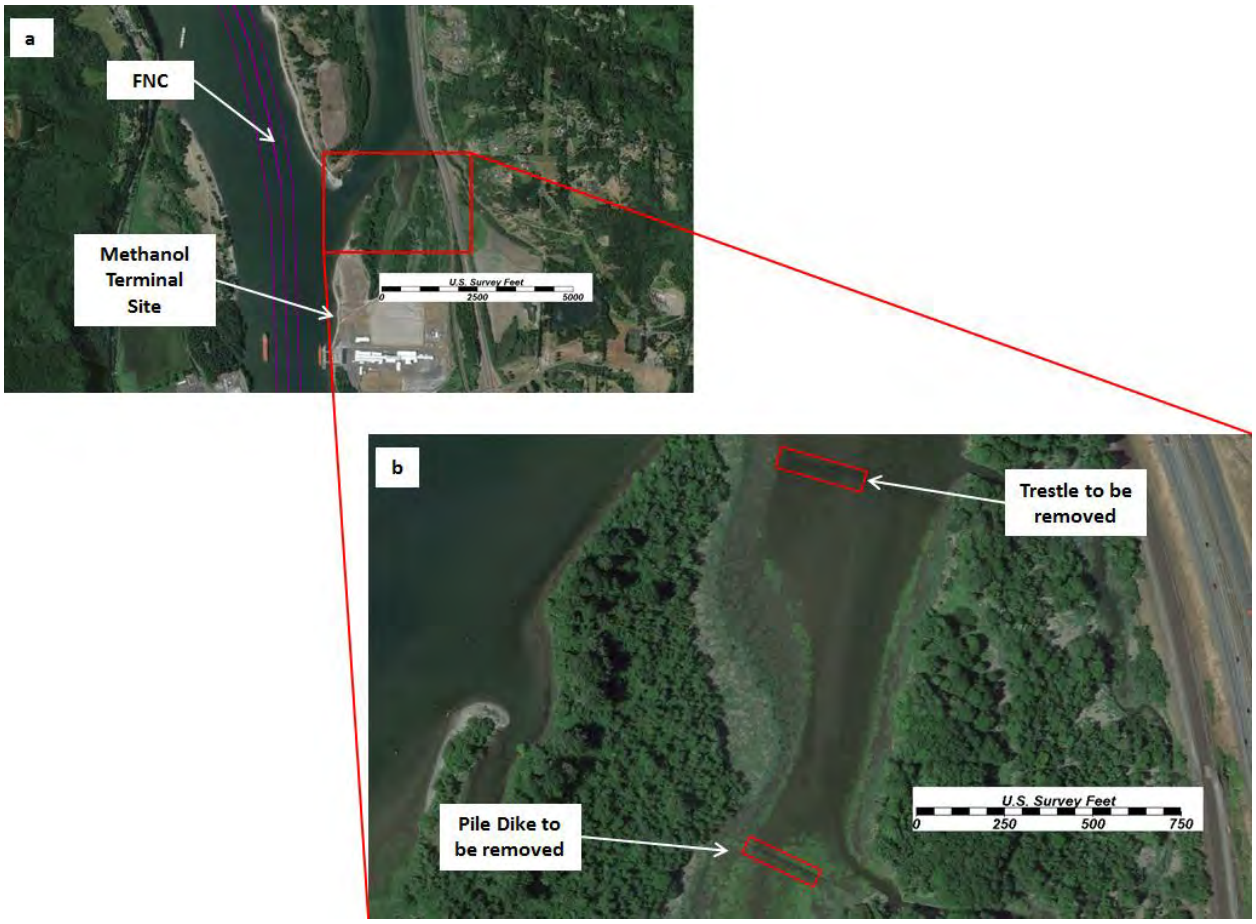


Figure 2. a) General location of the area of possible removal the pile dike and trestle and b) specific locations of pile dike and trestle to be removed (provided by Berger/ABAM)

As discussed in more detail below in Section 2, the U.S. Army Corps of Engineers (Corps) has conducted periodic maintenance dredging work in the FNC in the vicinity and downstream of the project area in order to maintain the authorized navigable dimensions in the channel. Maintenance dredging is mostly conducted due to formation and propagation of sand waves through the channel and deposition of suspended sediment from river flow. In the context of these Corps' activities, the specific objective of CHE's study was to determine if construction of the berth and dredging of the berthing area at the proposed Methanol Terminal and possible removal of a pile dike and trestle would alter (increase) the ongoing dredging requirements in the adjacent part of the FNC. The impact from the proposed actions was identified based on understanding the mechanics of channel sedimentation and assuming that an increase of dredging requirements in the FNC would occur due to the following major factors: 1) if placement of dredged material from the proposed Methanol Terminal at an in-water disposal site generates an additional source of sedimentation in the channel; 2) if dredging or berth construction alters the flow and hydrodynamics of the Columbia River in a

way that reduces current velocities along the channel[1]; and 3) if dike and trestle removal generates a new source of sediment and/or change the flow hydrodynamics in a way that results in additional sedimentation along the channel.

Currently, no final design (or decision) on dredging at the proposed terminal and location of a dredged material placement site has been made. However, it is appropriate to assume that selection of the dredged material placement site will be conducted using the criteria of no impact on the FNC. It is expected that the placement site designated for disposal of dredged material from the Methanol Terminal will have no impact on an increase in sedimentation and maintenance dredging requirements in the FNC. It should be noted that there are several designated flow lane disposal sites in the vicinity that potentially may be used for placement of dredged material. These sites will be subjected to a very thorough monitoring program capable of detecting any possible impact on the FNC and ensuring the termination of placement from the Methanol Terminal, if indeed an impact is detected. Keeping the above in mind, the first causation factor (in-water disposal of dredged material) has been excluded from the investigation, and the analysis of impact was focused on the second factor – impact of the project on flow velocities through the FNC. To investigate this impact, numerical modeling of flow hydrodynamics for existing and proposed project conditions was conducted and the results were compared (Section 2). Based on comparison of existing and post-project conditions, an opinion on impact of the Corps' maintenance dredging practice on the FNC from the proposed Methanol Terminal was formulated (Section 2). Further, this opinion was evaluated (Section 4) with regard to a hypothetical risk related to uncertainties of available data and results of numerical modeling. The methodology for impact on FNC due to possible removal of pile-dike and trestle was simplified to logistic analysis, engineering intuition, and practical experience with similar projects (Section 3).

2. Flow Hydrodynamics Impact Analysis

As discussed above, possible impacts from the Methanol Terminal on sediment deposition and maintenance dredging requirements in the FNC was conducted using numerical modeling of flow hydrodynamics for conditions before and after construction of the proposed project. Numerical modeling was conducted using a two-dimensional (2-D) hydrodynamic model. The numerical modeling domain was constructed, extending approximately 190 miles from the mouth of the Columbia River to open ocean and upstream to the Bonneville Dam. Figure 3 displays the modeling domain and grid, and examples of grid resolution at the areas of interest.

Numerical modeling was conducted for day-to-day river flow discharge, combined with a neap and spring tidal sequence. Day-to-day conditions were represented by 32 days of flow discharge observed at Bonneville Dam (Columbia River) and at Oregon City (Willamette River), combined with a neap and spring tide sequence.

Modeling was conducted for existing and post-project conditions. To model post-project conditions, configurations of the Methanol Terminal and associated dredged area were built into the modeling grid, based on the terminal configuration provided by BergerABAM and the dredging design developed by CHE. A total of two hydrodynamic modeling runs were

[1] It is anticipated that reduction of current velocities in the footprint of the FNC would result in deposition of additional volumes of sediment in the channel.

conducted: pre-project and post-project conditions. Each scenario ran for a four-week period of simulation. Modeling results were output for water surface elevation and depth-averaged velocities. Figure 4 shows examples of modeling results - snapshots of depth-averaged velocities for typical conditions for both existing and post-project conditions during ebb tide. Figure 5 shows the same modeling results but zoomed in at the project vicinity.

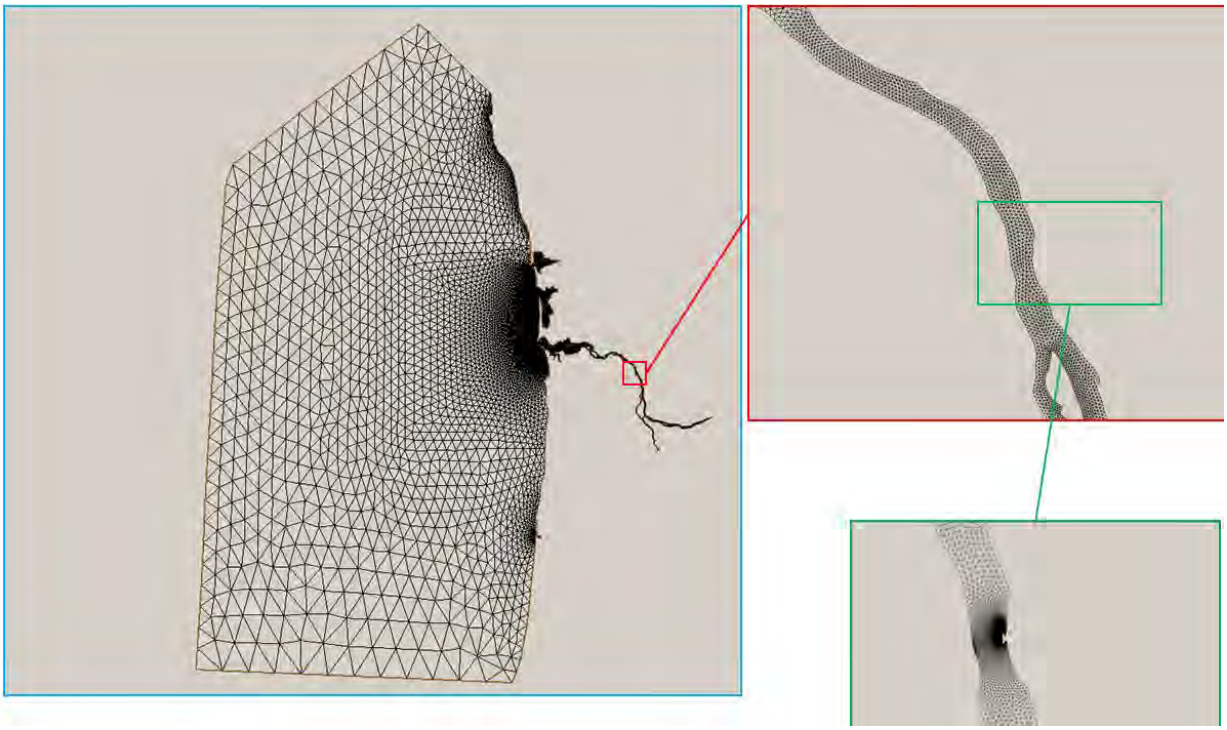


Figure 3. Numerical modeling grid

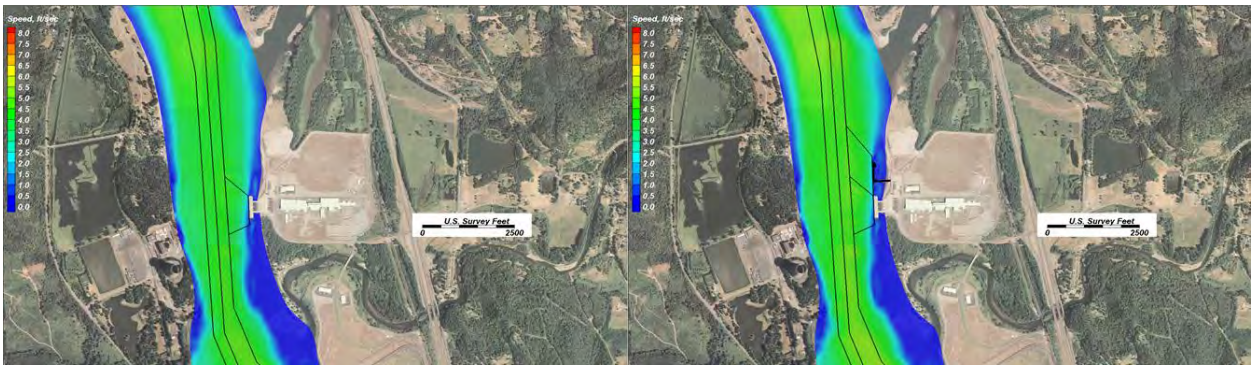


Figure 4. Simulated depth-averaged velocities for ebb tides for day-to-day conditions for existing conditions (a) and post-project conditions (b)

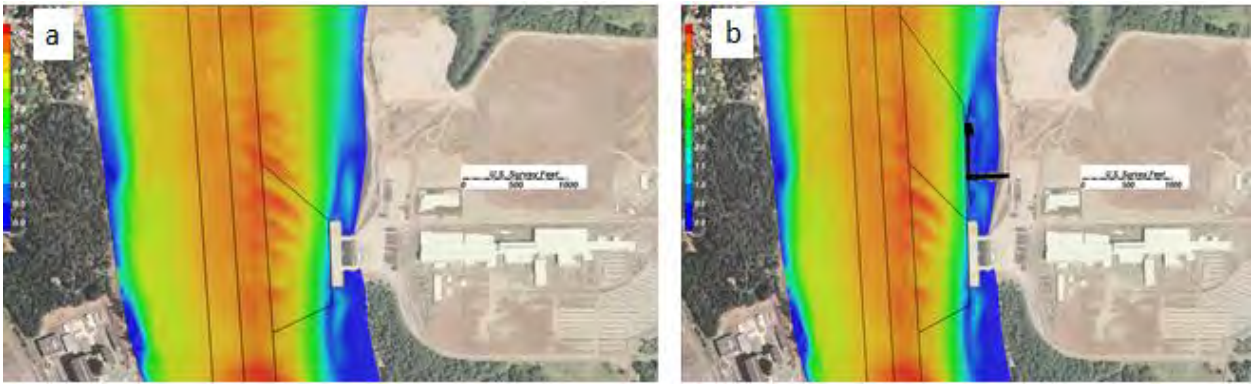


Figure 5. Simulated depth-averaged velocities for ebb tides for day-to-day river flow discharge for existing conditions (a) and post-project conditions (b)

The figure shows depth-averaged current speeds at the project site for existing conditions (without Methanol Terminal and dredging of prism) and post-project conditions (with Methanol Terminal and dredging of prism) in color format. Red and yellow colors indicate high velocities, while blue and green colors indicate low or zero velocities.

Two methods of analysis were applied to detect and evaluate possible changes in velocities due to the Methanol Terminal Project: spatial analysis and time domain analysis. The first method (spatial analysis) calculated post-project velocities relative to existing conditions (i.e., post-project conditions minus existing conditions) at every grid node in the model domain. The differences were then plotted and examined. Examples of difference plots for depth-averaged velocities at the project site for peak ebb and peak flood tides are shown in Figures 6 and 7, respectively. Red colors indicate an increase in velocities, blue colors indicate a reduction in velocities, and white color shows no change in velocities. The comparisons show little or no change in current velocities in the FNC. As expected, the velocities decrease in the proposed dredging area due to the increase in depth from pre- to post-project conditions.

As mentioned above, the change in velocities in the channel area typically corresponds to changes in patterns and rates of deposition of suspended sediment from river flow: a reduction in velocities corresponds to an increase in the rate of deposition; and vice versa, an increase in velocities corresponds to a possible reduction in the rate of deposition. Based on the results of the spatial analysis method, it appears that no change in deposition of suspended sediment would occur in the FNC upon construction and maintenance of the Methanol Terminal berthing area.

The second method (time domain analysis) involves evaluating time histories at several points to determine any change in patterns between existing conditions and post-project conditions. This method allows identifying even small and temporal effects on flow velocities that may result from construction of the Methanol Terminal berth. The time domain method consists of extracting a time series of current velocities from control points in the modeling domain during the simulation period and comparing them between existing and post-project conditions. Figure 8 shows the location of the control points (yellow-colored) that were used to extract current velocities.

Figure 6. Difference in depth-averaged speeds at project site for peak ebb tides between post-project and existing conditions (post-project relative to existing)

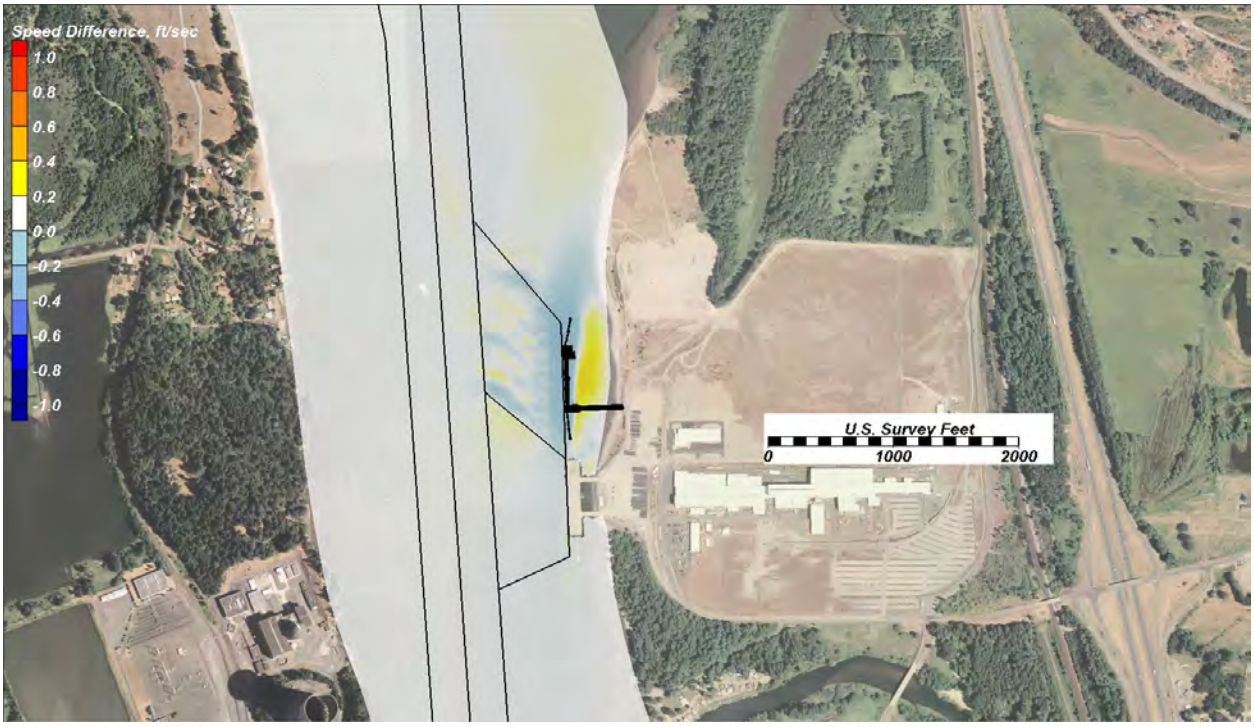


Figure 7. Difference in depth-averaged speeds at project site for peak flood tides between post-project and existing conditions (post-project relative to existing)

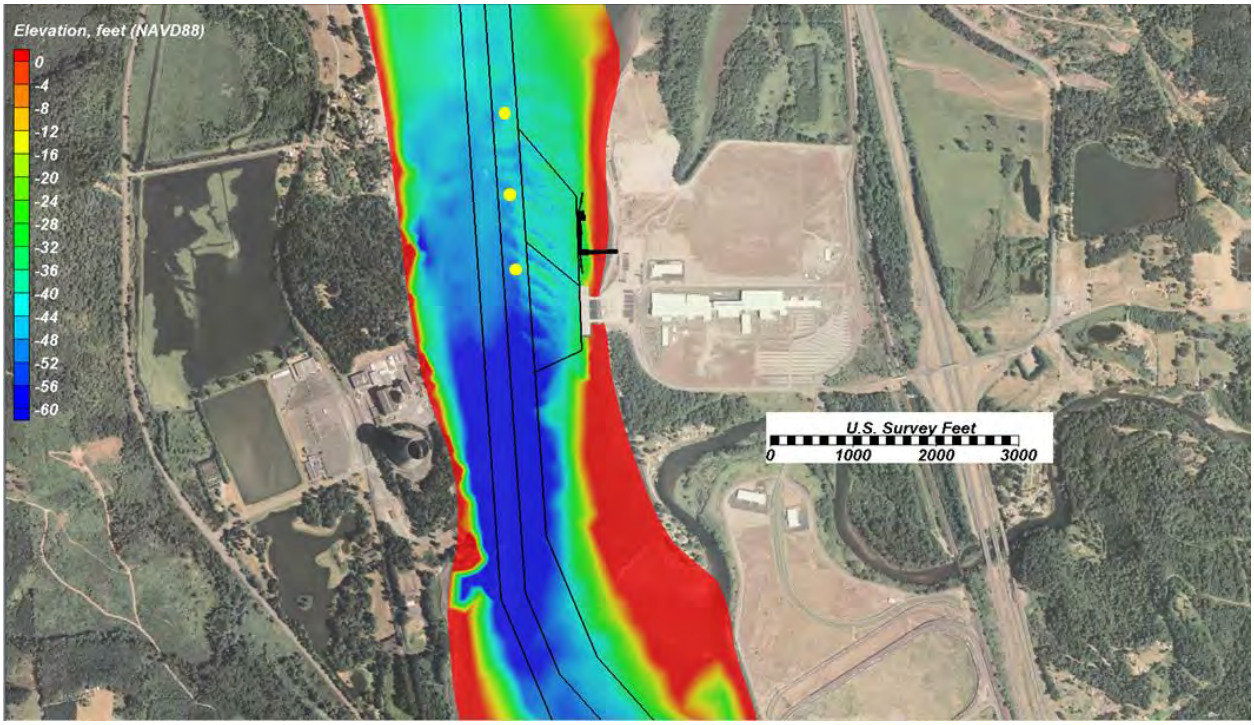


Figure 8. Location of control points used for extracting model velocities at areas of interest

Figure 9 plots an example time series of extracted velocities at Control Point 1 during existing and post-project conditions for a period of 32 days. Please note that the current velocities on the graph represent depth-averaged velocities during typical (day-to-day) river flow conditions. To determine possible impacts from the proposed project on velocities, existing and post-project conditions were subtracted from each other at each time step at each of the control points. The results of subtraction (velocity differences) are plotted in Figure 10. The velocity differences are shown in blue, and the averages of the velocity differences over time are shown in red.

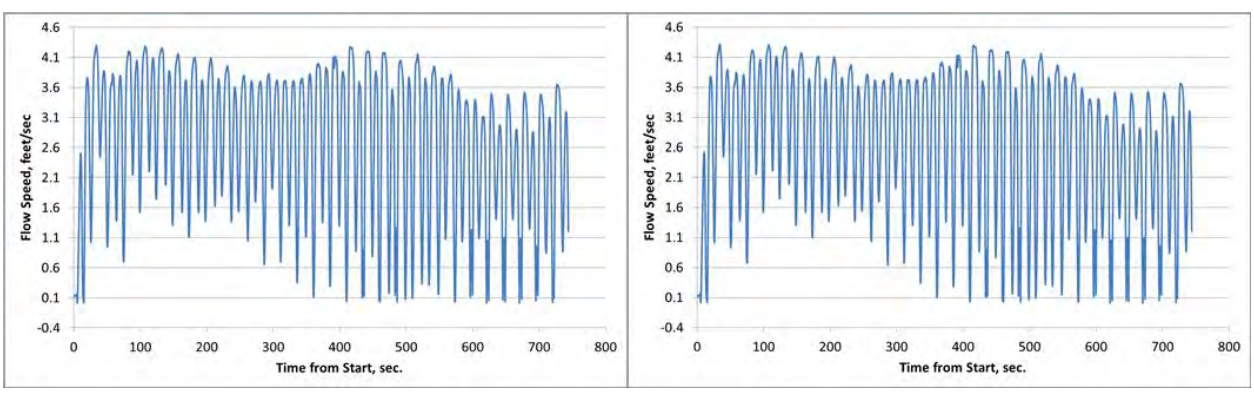


Figure 9. Example depth-averaged current velocity time series at Point 1 for existing and post-construction conditions

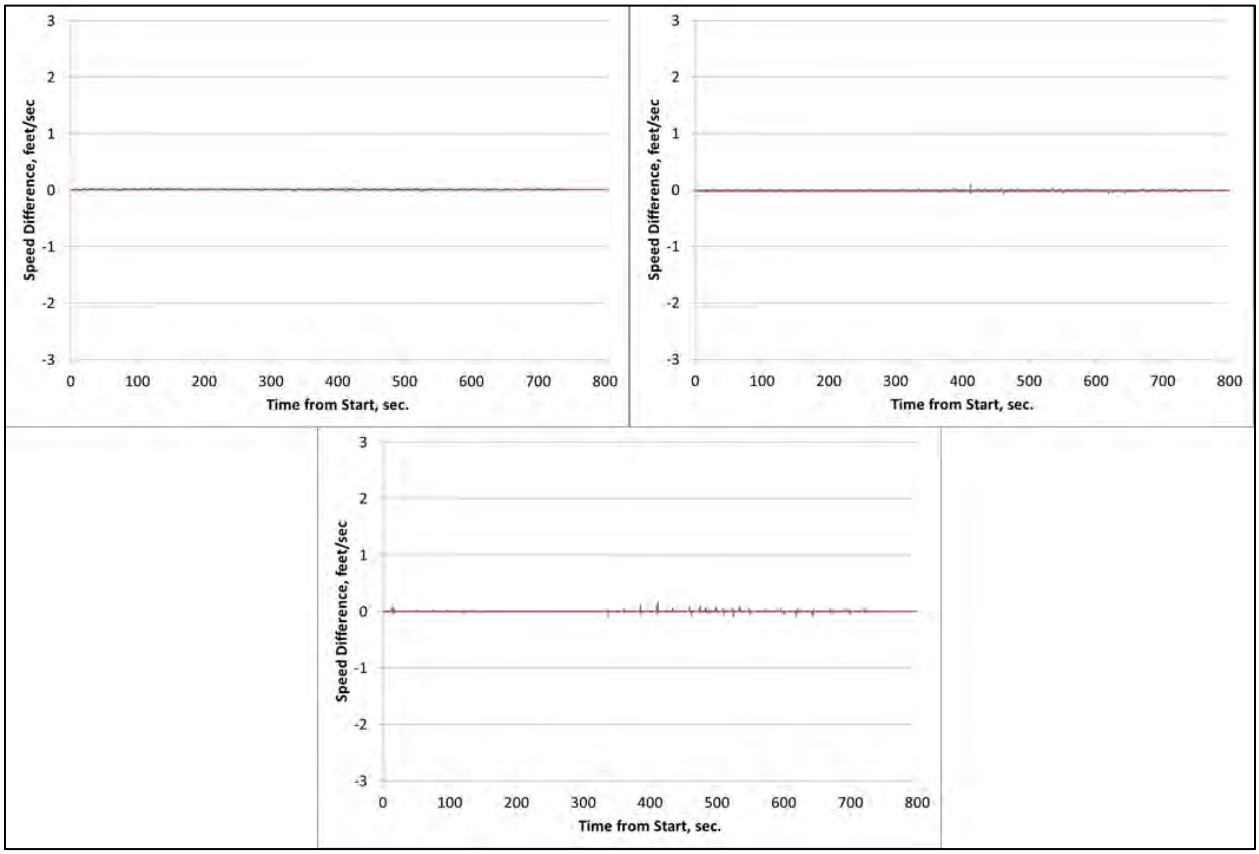


Figure 10. Differences between existing minus post-project conditions; depth-averaged current velocity time series at Points 1 through 3

In general, Figure 10 shows no change in velocities in the FNC area between existing and post-project conditions at any of the control points. Some increase/decrease of velocities, depicted in the figure in the range of 0.1 feet/second (ft/sec) and smaller, most likely can be attributed to artificial effects and the accuracy of the model, and should be disregarded. A short-term duration (spike) of increase in velocities (approximately 0.2 ft/sec) was observed at one of the control points. This increase, if it is genuine, may result in a reduction of deposition or even scour of the channel. However, it is likely that this increase is also exacerbated by the numerical model, and is not valid. Overall, the results of time domain analysis demonstrate that construction of the Methanol Terminal and associated dredging would have little or no effect on flow velocities in the vicinity of the FNC. Using the same logic as for the spatial analysis above, it appears no change in deposition of suspended sediment would occur in the FNC upon construction and maintenance of the berthing area at the Methanol Terminal.

In summary, analysis of numerical modeling results using the two methods demonstrates that dredging and maintenance of the berth area of the Methanol Terminal would not increase the Corps' maintenance dredging work along the FNC. It is likely that, due to deposition of some sediment in the proposed Methanol Terminal dredged area, the actual volume of dredging performed by the Corps may reduce. This conclusion, however, is based on in-field experience and intuition and requires additional analysis and confirmation.

In addition to numerical modeling and analysis, CHE requested and obtained the volumes of maintenance dredging work in the FNC for the last 10 years from the Corps. Table 1 shows the data:

Table 1. Maintenance Dredging in FNC Adjacent to Proposed Project River Mile 70 thriough 73

Year	Volume Dredged (cy)
2002	0
2003	88,756
2004	0
2005	178,190
2006	47,992
2007	0
2008	54,708
2009	0
2010	131,512
2011	0
Average per year	56,000

The table shows that maintenance dredging in this part of the channel has usually been conducted every other year (but sometimes every year), with an estimated average yearly maintenance dredging volume of 56,000 cubic yards (cy). The data in the table also show high variability of maintenance dredging volume conducted by the Corps in the part of the channel adjacent to the Methanol Terminal from year to year. The range of dredging volumes in the channel has varied from 47,000 to 130,000 cy.

As discussed above, based on numerical modeling and analysis, from the study it was concluded that construction of the Methanol Terminal would result in either no change or little reduction in sedimentation and maintenance dredging requirements. Any risks associated with hypothetical alteration of these conclusions, again, due to hypothetical uncertainties in the numerical modeling (input data, model validation, etc.) would be mitigated by the scale and variability of ongoing maintenance dredging work in the FNC. In other words, the maximum hypothetical impact from the Methanol Terminal project on sedimentation of the FNC would exist as a non-detectable noise in variability of the ongoing maintenance dredging work in the channel.

3. Dike Removal Impact Analysis

The pile dike proposed for removal is a part of a larger dike system, originally built between the southern tip of Cottonwood Island and the Washington mainland. It is appears that the pile dike, and specifically part of the pile dike proposed for removal (the center portion of the dike in the large embayment), has been deteriorated and does not properly perform the functions that it was designed and built for - sediment and channel management.

The trestle proposed for removal is located north of the pile dike and crosses the embayment that probably was partially formed due to manmade activities along the river, including

dredging of FNC. Similar to the pile dike, the trestle has significantly deteriorated and does not properly perform functions that it was designed and built for (whatever these functions were). Therefore, it is our first observation and opinion that if removal of the dike and trestle may somehow impact on FNC sedimentation it (this impact) at most has already occurred for a long time. The removal of these non-functional structures would likely not add any significance to the impact that has historically occurred (if any).

The other factor that should be accounted in the evaluation of possible impact of pile dike and trestle removal is that the embayment, where the dike and trestle are located, discharges into Carrols Channel, the location where the Columbia River bifurcates around the upstream end of Cottonwood Island. The main navigable channel (dredged channel) is located on the west side of Cottonwood Island. Carrols Channel on the east side of the Cottonwood apparently is not navigable by deep-draft vessels. It is a standard practice at bifurcations of navigable rivers to maintain and promote river flow in the main navigable channel by reducing river flow in the secondary (non-navigable) river channel. Keeping the main river flow in the navigable river branch increases the flushing effect and reduces sedimentation and maintenance dredging requirements, respectively. The same approach has been employed by the US Army Corps of Engineers (Corps) in maintenance of the Columbia River Navigation Channel. For this purpose, the Corps has built and maintained diversion dikes that provide reduction of river flow in non-navigable river branches along the navigation channel.

It is our opinion that removal of the above mentioned pile dike and trestle will increase hydraulic resistance of the Carrols Channel system and reduce flow in this branch of the river, respectively. Figure 11 shows the flows through the main channel, Carrols Channel, and from the embayment. The increase of hydraulic resistance would occur due to an intensification of circulation in the embayment and increased flow from the embayment to Carrols Channel.

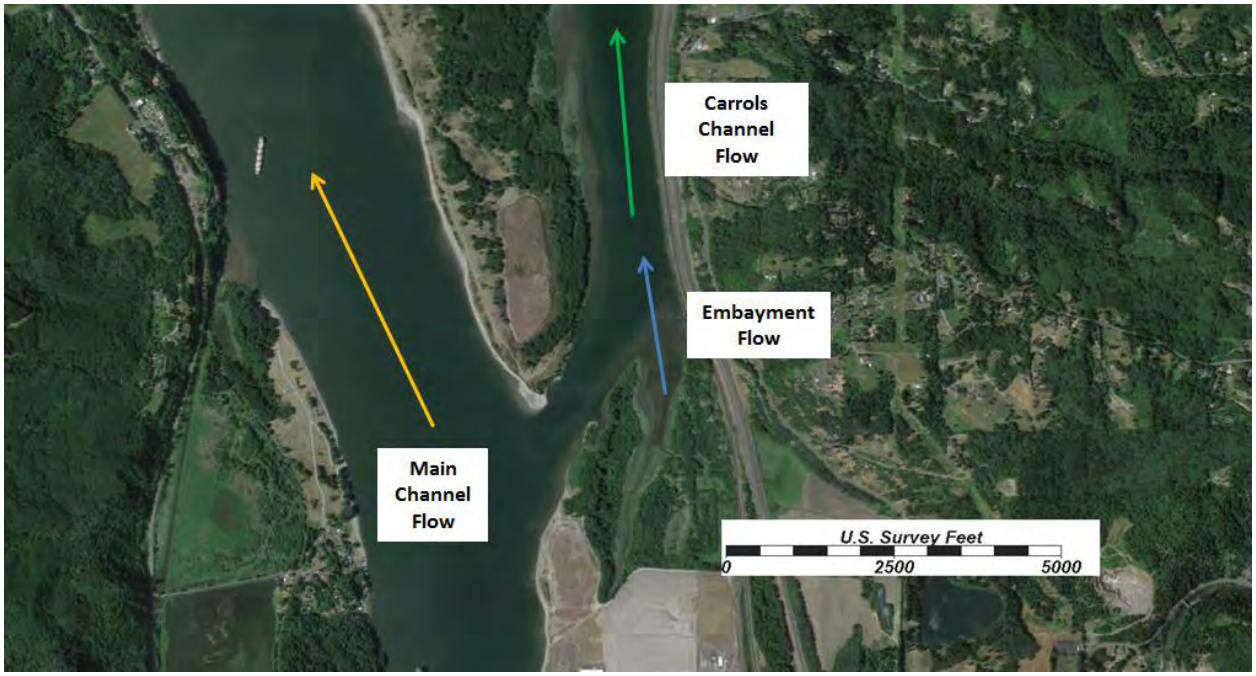


Figure 11. Increases in flow from the embayment would result in a decrease in flow from the main channel through Carrols Channel and an increase in flow and decrease in sedimentation in the main channel.

In simple terms, the increase of hydraulic resistance may be explained by fluid mechanics through the effect of sudden enlargement of river area. The coefficient of hydraulic loss (resistance) increases with the sudden increase of the flow area. After removal of pile dike and trestle, the flow area that passes through Carrols Channel will increase dramatically. An increase in flow area through the side channel will result in an increase in internal friction and a general reduction of the flow from the main channel in this river branch. With a decrease in flow through Carrols Channel from the main channel, flow in the main channel will increase and result in a reduction of maintenance dredging in the FNC.

4. Conclusions

Two-dimensional flow circulation modeling was conducted to investigate the potential impact of the proposed Methanol Terminal and the associated dredge areas on maintenance dredging requirements in the FNC.

The result of tidal and flow circulation modeling and analysis has determined that construction of the Methanol Terminal and dredging of the dredge prism would produce little to no impacts on tidal and river flow circulation near or in the FNC. As indicated in Section 1, the effects of in-water disposal of dredged material on sedimentation in the FNC was excluded from the investigation with the expectation that additional studies will be conducted to confirm that a proposed in-water placement site (if any) has no impact on an increase in sedimentation and maintenance dredging requirements in the FNC. As expected, the result of tidal and flow circulation modeling and analysis has determined there would be a localized reduction in velocities at the project site, and none or a small localized increase in velocities downstream and upstream of the project site and in the FNC.

Analysis of numerical modeling results using two methods demonstrated that dredging and maintenance of the berth area of the Methanol Terminal would not result in an increase in maintenance dredging requirements in the FNC by the Corps. It is likely that, due to a decrease in flows through and subsequent increase in deposition of sediment in the proposed Methanol Terminal dredged area, the actual Corps' volume of dredging may reduce. However, this last statement is largely predicated on intuition and in-field experience and requires additional analysis and confirmation.

Currently, a significant amount of maintenance dredging work is conducted along the FNC in the vicinity of the proposed project. The scale and variability of this work overshadows the possible risk associated with hypothetical alteration of the study conclusions. A maximum hypothetical impact from the Methanol Terminal project on sedimentation of the FNC (if any) would exist as a non-detectable noise in the variability of the ongoing maintenance dredging work in the channel.

Analysis of removal of a portion of a dike and a trestle immediately downstream of the proposed Methanol Terminal was conducted to determine if there would be any impacts to flow or sediment deposition in the FNC. Both the pile dike and the trestle are structurally compromised. The partially removal of them would have no more impact on dredging in FNC that it currently sees from the existing conditions of the pile dike and trestle. Furthermore, with the removal of the pile dike and trestle, the hydraulic resistance of Carrols

Channel would increase, flow through Carrols Channel from the main channel would decrease, and flow through the main channel would increase. Partial removal of the pile dike and trestle will have no deleterious impact on dredging in the FNC.

5. Reference

Kivva, S.L., P. Kolomiets, T. Shepeleva, and M. Zheleznyak. 2006. *CHEWPCE-MORPH. A Numerical Simulator for Depth-Averaged Surface Water Flow, Sediment Transport and Morphodynamics in Nearshore Zone. Version 2.0. User guide.* Developed under U.S. Civilian Research and Development Foundation grant from 2004-2008 in Ukraine, Russia.