

SECTION 7.1: HERITAGE RESOURCES

ENVIRONMENTAL ASSESSMENT CERTIFICATE APPLICATION

WesPac Tilbury Marine Jetty Project

7.1 HERITAGE RESOURCES EFFECTS ASSESSMENT

This section presents the existing conditions and results of the assessment of potential Project effects and cumulative effects on Heritage Resources. The rationale for the selection of Heritage Resources as a Valued Component (VC) and assessment boundaries are also described. Assessment findings, including identification of Project interactions and effects, proposed approaches to mitigation, characterization of residual Project and cumulative effects, and determination of significance are presented. Monitoring and follow-up programs to be conducted with respect to Heritage Resources are also described.

This effects assessment on Heritage Resources is linked to:

- Current Use of Lands and Resources for Traditional Purposes VC.
- River Processes Pathway Component (PC)

Results of the Heritage Resources assessment are incorporated into the following sections in the Environmental Assessment Certificate (EAC) Application:

- Current Use of Lands and Resources for Traditional Purposes VC.

Heritage Resources, with reference to the *Canadian Environmental Assessment Act, 2012* (Government of Canada, 2012a, 2012b), considers physical heritage, including any structure, site, or thing that is of paleontological, archaeological, historical, or architectural significance, but excludes non-physical (intangible) Aboriginal cultural heritage, which will be assessed in **Section 6.3, Current Use of Lands and Resources for Traditional Purposes**, or in **Part C: Aboriginal Consultation**.

Physical evidence for heritage resources may be determined through direct field assessment of a Project site, typically preceded by comprehensive background information review, to determine if there is potential for heritage resources to exist in the project site area. The Heritage Resources study for the Project comprised a desktop heritage resources overview assessment of readily available heritage data from the Local Assessment Area (LAA) and Regional Assessment Area (RAA) (Appendix 7.1-1). Baseline heritage studies did not include field testing because it was not considered necessary to conduct an inventory in the marine portions of the Project area, and given the understanding that Project-related subsurface impacts would be limited to the inter-tidal and subtidal areas. Subsurface impacts are now anticipated under current development plans in terrestrial areas, creating a data gap and a source of uncertainty for the effects assessment in the absence of a heritage resources inventory assessment. WesPac Midstream–Vancouver LLC (WesPac) commits to conducting a heritage resources inventory under terms of a *Heritage Conservation Act* (HCA; Government of BC, 1996) permit to address this data gap prior to, or concurrent with, Project construction (see **Section 7.1.5**).

7.1.1 Context and Boundaries

7.1.1.1 Context

Heritage Resources is one of the five key pillars referenced in the British Columbia *Environmental Assessment Act* (BCEAA; Government of BC, 2002). The three subcomponents of Heritage Resources are paleontological resources, archaeological resources, and historical resources (**Section 7.1.2.1**). Paleontological resources represent the fossil record of animals and plants that are minimally tens of thousands to many millions of years old, and in North America are usually presumed to predate human presence on the continent. Fossils are typically observed in sedimentary rock, often bedrock but also in shales and gravels (**Section 7.1.1.5**).

Archaeological resources are the physical remains of human activity. In British Columbia (BC), most archaeological resources predate 1846, a date selected to represent the beginning of settlement in what is now the province of BC under a colonial administration. Pre-contact archaeological material in BC predates 1846. The oldest archaeological material recorded in the Lower Mainland is about 8,000 years old.

Historical resources, which typically post-date 1846 in BC, may include archaeological sites such as shipwrecks, which are protected under provincial heritage legislation after two years, as well as built heritage, or standing structures deemed to have some historical significance (see **Sections 7.1.1.1 to 7.1.1.4**).

Regulation and government context relevant to Heritage Resources includes:

- CEEA 2012;
- *Heritage Conservation Act* (HCA);
- Local government bylaws;
- Aboriginal heritage policy; and
- The BC Fossil Management Framework.

7.1.1.1.1 Canadian Environmental Assessment Act, 2012

CEAA 2012 requires assessment of effects related to changes to the environment on “physical and cultural heritage” and “any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.” The Canadian Environmental Assessment Agency (CEA Agency) policies and procedures concerning heritage resources are described in *Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing that is of Historical, Archaeological, Paleontological or Architectural Significance under the Canadian Environmental Assessment Act, 2012* (CEA Agency, 2015). This guide provides federal guidance for assessments related to 5(1)(c)(ii) “physical and cultural heritage,” 5(1)(c)(iv) “any structure, site, or thing that is of historical, archaeological, paleontological or architectural significance,” 5(2)(b)(ii) “physical and cultural heritage,” and 5(2)(b)(iii) “any structure, site or thing that is of historical, archaeological, paleontological, or architectural significance.”

The CEA Agency further recommends that under CEAA 2012, heritage resources should be assessed in relation to the mandates, objectives, and intents of existing legislation and policies on heritage found at various government levels (i.e., federal, provincial, municipal, or territorial). Consequently, for the assessment of heritage resources in BC under CEAA 2012, the requirements of provincial legislation also need to be met.

7.1.1.1.2 Heritage Conservation Act

Heritage sites on non-federal lands in BC are administered by the Archaeology Branch and the Heritage Branch, in accordance with the HCA. The Archaeology Branch is the agency responsible for administering the HCA, for maintaining the Provincial Heritage Register, and for handling referrals from other provincial development agencies. The Heritage Branch exercises regulatory authority under the HCA regarding the protection and alteration of designated (i.e., protected) historical heritage sites. Section 13 of the HCA specifies that an individual (or corporation) must not “damage, excavate, dig in or alter, or remove any heritage object” from a heritage site, except in accordance with a permit issued by the Minister pursuant to Sections 12 and 14.

The HCA confers automatic protection upon heritage sites that pre-date AD 1846, or undated sites that could pre-date AD 1846, regardless of whether they are recorded in the Provincial Heritage Register, whether they are located on Crown land or private property, and whether they are in a disturbed or intact context. Heritage wrecks, consisting of the remains of vessels or aircraft after two or more years have passed since they sank, crashed, or were abandoned, are also protected under the HCA. Other post-AD 1846 historical heritage sites can be protected by Ministerial Order, Designation by an Order-in-Council, or a municipal bylaw. Section 9 (2)(c) of the HCA allows protection of historical heritage sites under the BC *Local Government Act* (Government of BC, 2015).

The requirements and procedures for heritage resource assessments undertaken for development projects are described in the *British Columbia Archaeological Impact Assessment Guidelines* (Archaeology Branch, 1998). The procedures for the respectful treatment and handling of found human remains that are protected under the HCA are provided in the Found Human Remains policy (Archaeology Branch, 1999).

Heritage resources assessment and management provisions in the HCA are compatible with the requirements of CEAA 2012.

7.1.1.1.3 Local Government Bylaws

Post-AD 1846 historical heritage sites that are not protected by the HCA may be protected by bylaw under the *Local Government Act* and be included on local government’s Community Heritage Register (CHR). These historical heritage sites may include buildings, industrial remains, trees, landscape features, properties, and heritage districts. A CHR generates a degree of recognition for these historical heritage sites; however, without local government legislation (such as a heritage designation bylaw, heritage revitalization agreement bylaw, or heritage restrictive covenant), inclusion on a CHR does not impose statutory prohibitions protecting these sites.

The City of Delta, within which the LAA and a portion of the RAA are situated, has enacted a bylaw to ensure long-term preservation and maintenance of Designated Heritage Properties. Any changes to Designated Heritage Properties must meet requirements set out in the protection bylaw and require Council approval. Further, on March 9, 1999, Council established the Delta Heritage Register, the official register of sites of heritage significance in the City of Delta. Properties listed in the register trigger a referral to the Heritage Advisory Commission during the review process for any type of application affecting the Designated Heritage Property (City of Delta, 2018).

The City of Delta has also developed a number of tools to protect heritage properties or heritage conservation areas that are receiving or are eligible to receive heritage incentives. These include the Heritage Conservation Covenant, Heritage Revitalization Agreement, Heritage Alteration Permit, and Temporary Protection Order.

The City of Richmond, within which a portion of the RAA is situated, has enacted two heritage bylaws over the past decade: the Richmond Heritage Commission (Bylaw No. 7906, 9 May 2005) and Heritage Procedures (Bylaw No. 8400, 4 May 2009). The Richmond Heritage Commission, which consists of nine members of the public, was enacted to advise Richmond City Council on heritage conservation and promotion matters as well as to undertake and provide support for activities that benefit and advance heritage in the City of Richmond. Heritage procedures was enacted to establish application procedures in respect of heritage conservation bylaws, agreements, and permits and to delegate Richmond City Council power to facilitate conservation. Heritage inventories for Richmond were completed in 1984 and 1989, with updates included up to 2002; this information is also referred to as the City's Heritage Register (City of Richmond, 2018).

Similar to the City of Delta, the City of Richmond has developed a Heritage Alteration Permit and Heritage Revitalization Agreement process to protect designated heritage properties. The Director of Development and Director, Building Approvals, work closely with the Richmond Heritage Commission to ensure that all development occurring within or near designated heritage properties has been approved.

The Canadian Register of Historic Places is Canada's definitive source of information on historic places. Federal, provincial, and territorial governments have worked together since 2001 to produce the register. The register is a work in progress and new listings are added continually.

7.1.1.1.4 Aboriginal Heritage Policy

Many BC Aboriginal groups have developed their own heritage policies and permitting systems. In general, the scope of these policies reflects a desire to have some measure of oversight with archaeological research in each respective Aboriginal group's territory so that particular cultural protocols are observed, particularly as they relate to human remains and spiritual locations. While aspects of these policies parallel the HCA, many diverge when it comes to the definition of what constitutes a "cultural resource"; most Aboriginal group heritage policies take a broader view of heritage resources than the HCA (Mason, 2011).

A review of the Consultative Areas Database (CAD) maintained by the Province of British Columbia identified 19 Aboriginal groups whose established or asserted traditional territories overlap the Project; these are listed in **Section 1.4** of this Application. Aboriginal groups/organizations that were listed and that have heritage policies and permitting systems in place include Musqueam Indian Band, Squamish Nation, Seyem' Qwantlen Business Group (Kwantlen First Nation), Stó:lō Research and Resource Management Centre, and Tsleil-Waututh Nation.

Golder Associates Ltd. (Golder) has applied for and received permits for archaeological assessments in support of the Project as follows:

- Musqueam Heritage Research/Investigation Permit MIB-2018-111-AOA;
- Squamish Nation Archaeological Investigation Permit 15-0134;

- Stó:lō Heritage Investigation Permit 2015-118; and
- Tsleil-Waututh Nation Cultural Heritage Investigation Permit 2015-050.

The Stó:lō Research and Resource Management Centre also provided Traditional Use Study (TUS) data which were incorporated into the Heritage Resources baseline study (Appendix 7.1-1). Reports provided through the concurrent Project assessment of the Current Use of Lands and Resources for Traditional Purposes VC including from the Kwantlen First Nation (Jones & McLaren, 2016), Métis Nation British Columbia (Gall, 2016), Musqueam Indian Band (Tam, Olson, & Firelight Research, 2018), and Tsleil-Waututh Nation (Morin, 2016) were also reviewed for relevance to Heritage Resources.

7.1.1.1.5 British Columbia Fossil Management Framework

The Province of BC recognizes that paleontological resources have heritage, scientific, and educational value as “fossils represent the historical record of the evolution and development of life on Earth” (Fossil Management Review Technical Working Group, 2004). While fossil collecting in BC has been unregulated and there has been no clear policy for fossil management, the Province recognizes the need to protect important fossil finds and the interests of stakeholders. Currently, the development of a Fossil Management Framework is being led by the Heritage Branch of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNR) based on the following principles (British Columbia Fossil Management Office, 2018):

- Fossils and fossil sites are important to BC as heritage resources.
- The order of priority for fossil management is science, natural heritage, education, and where appropriate, commercial use.
- The order of priority for extraction or excavation of fossils is science, natural heritage, education and, where appropriate, commercial use. Non-extractive commercial use has precedent over extractive commercial use.
- A fossil management framework that recognizes the heritage value of fossils, the need to protect significant fossil sites and the interests of stakeholders is necessary.

Regulatory protection for paleontological sites was limited until 1997, when they were included under the BC *Mineral Tenure Act* (Government of BC, 1996c). In 2005, a new regulation took effect that identifies fossils as “not a mineral” under the BC *Mineral Tenure Act*, effectively preventing the right to mine, extract, and sell fossils being obtained through new mineral claims. The Fossil Management Framework is designed to achieve the following outcomes (British Columbia Fossil Management Office, 2018):

- Raise awareness of the importance and the need to manage British Columbia’s fossil resource;
- Ensure that the stewardship of British Columbia’s fossil resource is consistent with the scientific, heritage, and educational value of fossils; and

- Encourage developers as well as commercial and industrial operators to apply responsible management practices that will allow for the recovery and preservation of important fossils.

While consultation regarding the Fossil Management Framework continues, some regulatory protection has been provided for fossils on Crown land under the BC *Land Act* (Government of BC, 1996b) and permits are required for the removal from Crown land of vertebrate skeletal fossils or fossil tracks. There are no explicit administrative controls or legal instruments that provide automatic protection and management of such resources on private land, although protection can be provided under certain conditions, for example through designation as a provincial heritage site or heritage object by issuing an Order-in-Council under Section 9 of the HCA.

In the absence of further legislative protection and resource management, ethical guidelines for paleontological sites found in Ludvigsen and Beard's *West Coast Fossils: A Guide to the Ancient Life of Vancouver Island* (Ludvigsen & Beard, 1994) and the British Columbia Paleontological Alliance *Policy on Fossil Collecting and Regulation* (British Columbia Paleontological Alliance, 2016) have been adopted for this assessment.

7.1.1.2 Identification of Heritage Resources a Valued Component

Heritage Resources was selected as a VC due to its importance to Aboriginal groups, the public, and other stakeholders, and due to its regulatory and conservation/scientific importance (Golder Associates Ltd., 2016b). Heritage Resources was selected based on the following rationale:

- Aboriginal importance:
 - Heritage sites are important to Aboriginal groups, and may be associated with the Current Use of Lands and Resources for Traditional Purposes VC or the exercise of Aboriginal rights.
 - Aboriginal groups have expressed interest in specific locations that are near or at the Project site, and that were used in the past.
- Regulatory importance:
 - CEAA 2012 requires assessment of an effect that may result in a change to Aboriginal physical and cultural heritage; and any structure, site or thing that is of archaeological, paleontological, or architectural significance per Sections 5(1)(c)(ii) and 5(1)(c)(iv).
 - The HCA is the provincial act related to heritage resources.
- Conservation/scientific importance:
 - The Project site could potentially contain heritage resources (paleontological, archaeological, and historical) that may be affected by construction, operation, and decommissioning activities.
- Other stakeholder importance:

- The Project site could potentially contain heritage resources (paleontological, archaeological, and historical) that are valued by the public.

7.1.1.2.1 Subcomponents

The subcomponents chosen for Heritage Resources and the rationale for their selection are presented in Table 7.1-1.

Table 7.1-1: Subcomponents for Heritage Resources

Subcomponent	Representative of	Rationale for Selection
Paleontological resources	Paleontological sites, features, and objects	<ul style="list-style-type: none"> • Considered under CEAA 2012 Subsections 5(1) and 5(2) • Conservation/scientific importance • Important to Aboriginal groups and stakeholders
Archaeological resources	Archaeological sites, features, and objects	<ul style="list-style-type: none"> • Considered under CEAA 2012 Subsections 5(1) and 5(2) • Automatically protected under HCA • Conservation/scientific importance • Important to Aboriginal groups and stakeholders
Historical resources	Historical sites	<ul style="list-style-type: none"> • Considered under CEAA 2012 Subsections 5(1) and 5(2) • Possibly protected under HCA • Conservation/scientific importance • Important to Aboriginal groups and stakeholders

CEAA 2012 = *Canadian Environmental Assessment Act, 2012*; HCA = Heritage Conservation Act.

7.1.1.2.2 Indicators

Indicators and measurable parameters provide a means of determining a Project-related change to a VC. The indicators and measurable parameters and the rationale for their selection are presented in Table 7.1-2.

Table 7.1-2: Indicators for Heritage Resources

Indicator	Subcomponent	Measurable Parameters	Rationale for Selection
Detectable, Project-induced disturbance of paleontological, archaeological, or historical sites, features, and objects	<ul style="list-style-type: none"> Paleontological resources Archaeological resources Historical resources 	<ul style="list-style-type: none"> Number of paleontological, archaeological or historical or sites, features and objects affected Volume of deposits bearing heritage resources that may be affected 	HCA requirement; CEAA 2012 requirement; Aboriginal groups' concern for heritage preservation; public interest
Changes in the level of accessibility to paleontological, archaeological, or historical sites, features, and objects	<ul style="list-style-type: none"> Paleontological resources Archaeological resources Historical resources 	<ul style="list-style-type: none"> Number of paleontological, archaeological or historical or sites, features and objects affected Volume of deposits bearing heritage resources that may be affected 	HCA requirement; CEAA 2012 requirement; Aboriginal groups' concern for heritage preservation; public interest

HCA = Heritage Conservation Act; CEAA 2012 = *Canadian Environmental Assessment Act, 2012*.

7.1.1.3 Assessment Boundaries

This section describes the methods used in identifying spatial, temporal, administrative and technical boundaries for the assessment of Heritage Resources.

7.1.1.3.1 Spatial Boundaries

The LAA and RAA for Heritage Resources are defined in Table 7.1-3 and shown in **Figure 7.1-1**.

The LAA was established to encompass the area within which the Project is expected to interact with, and potentially influence, Heritage Resources. In determining LAA boundaries, consideration was given to the nature and characteristics of heritage resources, its potential exposure to various influences, the direct effects and indirect effects of Project-related construction, operation, and decommissioning, and the maximum extent of potential adverse effects on heritage resources.

The RAA was established to provide a regional context for the assessment of Project effects. The RAA also encompasses the area within which the residual effects of the Project on Heritage Resources, if any, are likely to combine with the effects of other projects and activities to result in a cumulative effect. The larger geographic area of the RAA provides a broader context considered in the Heritage Resources baseline report (Appendix 7.1-1) for cultural background information in support of the Heritage Resources assessment.

Table 7.1-3: Spatial Boundary Definitions for Heritage Resources

Spatial Boundary	Description of Assessment Area
<i>Including Paleontological Resources, Archaeological Resources and Historical Resources</i>	
Local Assessment Area	The LAA consists of the Project site, including onshore and offshore components, and a 100 m buffer around the Project site.
Regional Assessment Area	The RAA consists of the LAA and the South Arm of the Fraser River from the Project site downstream to Sand Heads, and upstream to Annacis Island, and extending 1 km inland from the north and south shores of the river.
Cumulative effects Assessment Area	Same as RAA.

7.1.1.3.2 Temporal Boundaries

Temporal characteristics of the Project’s construction, operation and decommissioning phases are defined in **Part A, Section 1.0, Project Description**. In summary, the temporal boundaries established for the assessment of Project effects on Heritage Resources encompass these Project phases:

- Construction — 2019 to 2023 (just over three years);
- Operation — 2023 to 2053 (30 years minimum); and
- Decommissioning — 2053 or later (one year).

There are no temporal characteristics specific to Heritage Resources.

7.1.1.3.3 Administrative Boundaries

The key administrative boundaries for Heritage Resources are those which divide federally from provincially administered lands. Federal lands within the RAA include Vancouver Fraser Port Authority (VFPA) managed federal lands and waters, and a reserve, Musqueam IR 4. Lands within the city boundaries of Delta and Richmond fall under provincial legislation, except for the federal lands listed above.

There are no administrative boundaries within the LAA for Heritage Resources.

7.1.1.3.4 Technical Boundaries

The presence of deep, historical fill at the dike and nearshore portions of the Project area precludes assessment of those areas for archaeological and historical remains using conventional methods. Areas inland of the dike likely have shallower fill deposits and may be assessed prior to, or concurrent with, proposed future ground disturbance activities by WesPac.

7.1.2 Existing Conditions

7.1.2.1 Information Sources

In 2015, WesPac initiated a desktop study to support the assessment of effects on heritage resource (Appendix 7.1-1). The study was conducted with due regard for the *British Columbia Archaeological Impact Assessment Guidelines* (British Columbia Ministry of Forests, Lands and Natural Resource Operations, Archaeology Branch, 1998), and federal guidance for assessments provided in *Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing that is of Historical, Archaeological, Paleontological or Architectural Significance under CEAA 2012* (CEA Agency, 2015). The objectives of this and other relevant studies are summarized in Table 7.1-4.

The Heritage Resources baseline report (Appendix 7.1-1) consisted of a review of existing information conducted to support the characterization of existing conditions for Heritage Resources, including review of the following sources:

- Reports on the local and regional environment;
- Paleontological databases, maps, and scientific reports;
- Reports on the local and regional prehistory and history;
- Reports on traditional use of the regional environment by Aboriginal groups;
- Ethnographies on regional Aboriginal groups;
- Historical data, mapping, photographs, and aerial photographs;
- The Provincial Heritage Register;
- The British Columbia Archaeology Branch's Provincial Archaeological Report Library;
- Marine casualty lists; and
- Resources available in Golder's library.

The quality of these information sources is consistent with the standard of care for the period in which they were created, and they are considered reliable for the characterization of known heritage resources in the LAA and RAA. The complete list of references used in the desktop assessment is available in Appendix 7.1-1. Information for specific field conditions from concurrent studies or sources include:

- A site visit conducted on June 17, 2015, as part of an environmental study enabled the characterization of the intertidal area of the Project site with respect to historical resources and historical land use when the tide levels were estimated at between approximately 1.5 and 1.7 m above chart datum.
- The geotechnical evaluation of the proposed dike upgrade on the Project site, including the described conditions and borehole logs from the dike directly adjacent to the Project site (Golder Associates, Ltd., 2014).
- The geotechnical evaluation of the offshore area of the LAA, including the described conditions and borehole logs (Golder Associates Ltd., 2016a).

- The river processes evaluations of vessel wakes and morphological change modelling (Golder Associates Ltd., 2018; Tetra Tech EBA, 2018).

Section 7, Heritage Resources Assessment, of this Application considers Traditional Ecological Knowledge (TEK), and Aboriginal Traditional Knowledge as may be relevant to archaeology and provided in the following reports (see also **Section 6.3, Current Use of Lands and Resources for Traditional Purposes**) made available subsequent to the completion of the baseline report:

- *Kwantlen Land Use and Occupation in the Vicinity of Tilbury Island* (Jones & McLaren, 2016);
- Métis Nation British Columbia’s comment on the Draft Aboriginal Consultation Report 1 – WesPac Tilbury Marine Jetty Project (Gall, 2016);
- *Musqueam Indian Band Knowledge and Use Study for WesPac Midstream’s Proposed LNG Marine Jetty Project* (Tam et al., 2018); and,
- *Tsleil-Waututh Nation Traditional Use Study Review in Relation to the WesPac Tilbury Marine Jetty Project (14-211)* (Morin, 2016).

Table 7.1-4: Studies to Support the Heritage Resources Assessment

Study Name	Study Purpose	Study Available At
<i>Draft Heritage Resources Baseline, WesPac Tilbury Marine Jetty Project</i>	A desktop study to present existing conditions for paleontological, archaeological, and historical resources in the LAA and RAA, and to provide baseline information regarding the potential for Project-related impacts to heritage resources to occur	<i>Appendix 7.1-1</i>
<i>Kwantlen Land Use and Occupation in the Vicinity of Tilbury Island</i> (Jones & McLaren, 2016)	Traditional Land Use Report for the Kwantlen First Nation	Letter report submitted to WesPac
<i>Métis Nation British Columbia’s comment on the Draft Aboriginal Consultation Report 1 – WesPac Tilbury Marine Jetty Project</i> (Gall, 2016)	Traditional Land Use Report for the Métis Nation British Columbia	Letter report submitted to WesPac
<i>Tsleil-Waututh Nation Traditional Use Study Review in Relation to the WesPac Tilbury Marine Jetty Project (14-211)</i> (Morin, 2016)	Traditional Land Use Report for the Tsleil-Waututh Nation	Letter report submitted to WesPac
<i>Geotechnical Evaluation of Proposed Dike Upgrade, Tilbury Island</i> (Golder Associates, Ltd., 2014)	Geotechnical evaluation of dike located directly adjacent to the Project site	Final report submitted to FortisBC Energy Inc., Surrey, BC

Study Name	Study Purpose	Study Available At
<i>Interpretive Report – Offshore Geotechnical Investigation, Proposed LNG Terminal Tilbury Island, Delta, BC (Golder Associates Ltd., 2016a)</i>	Geotechnical evaluation of the riverbed located within the Project site	Letter report submitted to WesPac
<i>Permit 2013-0332: Archaeological Impact Assessment FortisBC Energy Inc.'s Tilbury 2 Project (Stantec, 2014)</i>	Archaeological Impact Assessment of land directly adjacent to the Project site	Final report submitted to FortisBC Energy Inc., Surrey, BC

LAA = Local Assessment Area; RAA = Regional Assessment Area; LNG = liquefied Natural Gas.

The baseline overview assessment (Appendix 7.1-1) identified some areas with potential for the presence of archaeological resources within the LAA (see **Section 7.1.3.2**). As the baseline assessment was completed with the understanding that Project subsurface construction impacts would be limited to the marine area of the LAA, it was anticipated that an overview would be sufficient for this assessment. Once it became clear that there would be subsurface construction impacts in terrestrial areas to depths where the untested potential for archaeological and historical resources had been identified, a heritage resources inventory was recommended to be conducted prior to, or concurrent with, construction (see **Sections 7.1.4 and 7.1.5**). The result of this study will provide data regarding the presence or absence of heritage resources and, therefore, whether there will be effects to heritage resources in the specific areas that are identified as having heritage resources potential in areas where heritage resources testing is also possible.

7.1.2.1.1 Traditional Use and Traditional Ecological Knowledge Incorporation

Information on traditional use and traditional ecological knowledge (TU/TEK) was gathered from a Project-specific studies undertaken by Aboriginal Groups and from publicly-available sources.

TU/TEK sources were reviewed for information that could contribute to an understanding of heritage. The main sources of this information included:

- An expert report produced on behalf of Tsleil-Waututh Nation, in relation to the Project (Morin, 2016)
- An expert report produced on behalf of Kwantlen First Nation, in relation to the Project (Jones & McLaren, 2016)
- Comments produced on behalf of Métis Nation British Columbia, in response to the Draft Aboriginal Consultation Report (Gall, 2016)
- An expert report produced on behalf of Musqueam Indian Band, in relation to the Project (Tam et al., 2018)

- Other documents and expert reports prepared for other projects in the vicinity of the Project site including the George Massey Tunnel replacement project (Charlie, 2015b; Kennedy, 2015b) and the Pattullo Bridge replacement project (Marshall, 2017b)

The Stó:lō Research and Resource Management Centre had provided information from its TUS Database, included in the baseline overview assessment (Appendix 7.1-1). No TU/TEK reports were received to review from the other Aboriginal Groups with established or asserted traditional territories overlapping the Project site, including: Cowichan Tribes; Halalt First Nation; the Hul'qumi'num Treaty Group; Lake Cowichan First Nation; Penelakut First Nation; Squamish Nation, and Stz'uminus First Nation. TU/TEK sources available at the time of writing provided extensive information regarding TU/TEK for archaeology in the RAA. On the other hand, TU/TEK sources available at the time of writing provided limited specific information regarding TU/TEK for archaeology in the LAA. There was no reference to traditional use specific to the Project work site, however, the LAA, including entire Fraser River and river bank areas including up to 250 m inland were identified as important for transportation and marine and terrestrial resource collection, as well as cultural and spiritual values. The Stó:lō Research and Resource Management Centre identified a speculated trail route along the south bank of the river which is mapped following the shoreline in the LAA (Appendix 7.1-1). Tilbury Island including the LAA would have provided plant resources, including berries traditionally harvested for food and medicine.

One terrestrial area located on the river bank directly opposite to the Project, was identified by the Cowichan Nation Alliance, Kwantlen First Nation, Musqueam Indian Band, and the Tseil-Waututh Nation as an important resource gathering (plant harvesting and fishing), habitation site, boat landing place, and also a place of spiritual and cultural value (Charlie, 2015a; Jones & McLaren, 2016; Kennedy, 2015a; Marshall, 2017a; Morin, 2016; Tam et al., 2018). This location, known as *Tl'uq̓tinus* or *Á̓q̓tinəs*, is thought to generally correspond with the location of archaeological site DgRs-17.

A general summary of information from available resources is presented below. A full summary of Aboriginal use and occupancy of the Project study area may be found in Section 6.3 Current Use of Lands and Resources for Traditional Purposes of this application.

Kwantlen First Nation reports Tilbury Island falls within their traditional territory, and Project-related activities will potentially affect traditional activities and cultural heritage sites (Jones & McLaren, 2016). Tilbury Island was not exclusively used by the Kwantlen First Nation. The portion of the south arm of the Fraser river where the Project site is located was traditionally used for hunting, fishing, village sites and as a transportation corridor. Further south of the Project site, exist cultural areas within the Kwantlen First Nation traditional territory, once used for plant and berry gathering. Significant heritage sites for the Kwantlen First Nation within 4,000 m of the Project site were identified. This included Lulu Island, Deas Island Slough (representing the western historical boundary of their traditional territory), the Fraser River, a village area on south end of Lulu Island (used mostly by Tsawwassen and Cowichan), berry gathering locations at Burns Bog and north east Lulu Island. Additionally, 10 pre- and post-contact archaeological sites were identified, including two sites across the river from the Project site where there remains of pre-contact fishing weirs have been reported.

Musqueam Indian Band reports extensive use of the Fraser River throughout the RAA. Locations important to "Sense of Place and Identity" for the Musqueam Indian Band include: "historic habitation sites, including old village sites, float homes, and camping areas utilised prior to the establishment of reserves; sites with rich archaeological evidence; harvesting camps for plants and salmon; burial sites for Musqueam members, including a mass grave

established during the smallpox epidemic; old canneries where many Musqueam members worked and lived during its operation and which were formerly village sites; areas of spiritual and ceremonial importance; place names; water routes utilised by members to travel throughout Musqueam territory; and locations with current importance as docking and camping areas” (Tam, J. et al., 2018). Within or adjacent to the LAA, the Musqueam Indian Band reports the importance of Cultural Continuity based in part on locations of spiritual importance, fishing and camping sites (presumed to be represented by *łəq̓tinəs*), and “the water route [river] used to access Musqueam territory” (Tam, J. et al., 2018). Fishing values specific to the river in and adjacent to the LAA include key fishing areas (for salmon, steelhead, sturgeon and eulachon), and fish habitat areas (for spawning and migration) (Tam, J. et al., 2018).

Tsleil-Waututh people traditionally used the Fraser River, including the area around the Project site for fishing activities (Morin, 2016). Tsleil-Waututh Nation records ten sites within the Project study area that were traditionally used for plant gathering, and one for bird hunting. Temporary settlements and gathering sites are also recorded. A traditional canoe route was recorded on the North Arm of the Fraser River, within the Project study area. Three petitions dated 1860 through 1870 indicate that Tsleil-Waututh Nation used the river and land resources along the lower Fraser River, as well as recognition of that use by other First Nations. The Project study area covers a major place of congregation for the Coast Salish people, including the Tsleil-Waututh. In particular, the *łəq̓tinəs* (also referred to as Cowichan, *Tl'uq̓tinus*) village site, across the river from the Project site, was one of the largest seasonally occupied Coast Salish villages (Morin, 2016).

Records indicate Métis presence in the northeastern part of the study area, who played important roles in the fur-trade in the late 18th and 19th centuries (Gall, 2016). Mixed Aboriginal families at Fort Langley relied on resources in and around the Fraser River, including salmon and timber. Métis Nation British Columbia identifies 56 sites of contemporary use within 5 km of the Project site and 84 within 1 km of the proposed shipping routes. This includes harvest areas for berries, fish, birds and other animals, as well as sites of cultural significance.

The Cowichan Nation Alliance claim Aboriginal title in the lower Fraser River, making special mention of the *Tl'uq̓tinus* village site, located across the river from the Project site (Marshall, 2017b). This village was a long term occupied site for members of the Cowichan Nation (Brealey, 2010; Charlie, 2015b; Kennedy, 2015b). A site of traditional activities including hunting, fishing, gathering and cultural activities, this location was consistently noted as Cowichan villages on HBC expedition maps, Admiralty Charts and journals in the 19th century (Brealey, 2010). Occupation on the South Arm of the Fraser River and traditional fishing activities continued into the 20th century (Brealey, 2010; Kennedy, 2015b). Cowichan presence on the Fraser River and occupation of the village site throughout the year was closely linked with the timing of salmon, sturgeon and eulachon in the river. Resources traditionally available to the Cowichan due to their occupation of the lower Fraser River included horsetail, wapato, cattail, bog cranberry, bog blueberry, wild clover, silverweed, crabapple, Indian hemp, Labrador tea and thule. Fish resources included sockeye and pink salmon, eulachon, sturgeon and flounder. Many other plant and animal species common to the area were harvested for food and material resources (detailed in Kennedy 2015).

7.1.2.2 Description of Existing Conditions

This section describes the existing conditions of each of the Heritage Resources subcomponents, as well as the surrounding environment and factors influencing Heritage Resources. The resources located in the RAA are

summarized below, and detailed if located within 5 km of the LAA. The potential for the presence in the LAA of paleontological resources, pre-contact archaeological resources, and heritage wrecks is also assessed.

7.1.2.2.1 Paleontological Resources

The LAA and RAA are situated within the Fraser River delta, a geomorphic formation resulting from sediments accumulating at the mouth of the Fraser River. The Fraser River Delta is underlain by Tertiary period (i.e., 66 to 2.6 million years ago) sedimentary rocks that can reach a thickness of 2,500 to 4,000 m in the Lower Mainland. These sedimentary rocks are dominated by Paleocene-Eocene epoch (i.e., 66 to 33.9 million years ago) sandstone, conglomerate, shale and partly cemented sandy gravels, clay, or clay shale deposits within which there is potential for fossils (e.g., shells, plant imprints, fish skeletons) (Clague, 1998).

Quaternary period (i.e., 2.6 million years ago to the present) sediments reaching a maximum of several hundred metres in thickness overlie the bedrock, with depths to the top of the bedrock ranging from 200 to 1,000 m with an average of 500 m (Clague et al., 1998). The surficial geology within 5 km of the LAA consists of sediments which are described as overbank silty to silt clay loam overlying deltaic and distributary channel fill (Figure 7.1-2). The remaining Fraser River sediments within the RAA vary from sandy silt to clay loam, with bog, swamp, and shallow Lake Salish sediments being minimally present within the RAA.

No Important Fossil Areas (defined by FLNR – Heritage, as polygons based on density of known fossil sites and known fossil-bearing geological layers) are mapped within 75 km of the RAA (DataBC, 2018). Given the depth of the bedrock (i.e., 200 to 1,000 m) below existing sediments, and absence of any gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, exist at depths that will be encountered during Project-related construction, operation, and decommissioning activities.

7.1.2.2.2 Archaeological Resources

The Fraser River delta developed rapidly following withdrawal of the glaciers. Around 5,000 years ago, sediment deposition began to form the islands situated within the RAA, including Tilbury. Sea levels were formerly lower, but by 5,000 years ago were within 2 m of current levels. Three thousand years later, the environment was developed and stabilized with sea level near current levels as well, enabling the maintenance of the overall shape and extent of the delta and the islands it contains, although the natural delta processes continued with periodic flooding and alternating cycles of erosion and sedimentation along the channel banks (Clague et al., 1998).

Some river banks and banks of slough channels became natural dikes, slightly raised above the surrounding poorly drained land, and these were preferentially selected as settlement and activity sites during the pre-contact and historic periods. Humans are known to have occupied the region for longer than the delta has existed in the RAA, and for the past 5,000 years the river has linked people and resources from the coast to the interior. Throughout this period, the Fraser River has also been a source for salmon, likely of regional significance, as reported ethnographically. Aboriginal groups from surrounding areas fished for sockeye in the RAA beginning in July using trawl and dip nets from canoes, before moving upriver as the season progressed (Suttles, 1990a). In the lower reaches of the Fraser River, shallow edges of river channels and sloughs were often locations for tidal ponds and weirs to catch salmon and sturgeon (Suttles, 1990b). Other fish species such as flounder and eulachon

were also caught, seals were commonly hunted in the lower river, and various animals and migratory birds were hunted in the RAA (see Appendix 7.1-1). Plant resources that were formerly gathered in the RAA, and on Tilbury Island specifically, included berries, reeds, cattails, and rushes (Brealey, 2010; Gall, 2016; Morin, 2016).

Aboriginal groups with interests in or near the Project site are all speakers of Coast Salish languages: Halq'eméylem / Hul'q'umi'num' / həh'qəmiñəh, SENĆOŦEN, and Skwxwú7mesh sníchim. These groups are related culturally and linguistically, and, collectively, their culture is known as Central Coast Salish (Barnett, 1955; Suttles, 1990a).

Regardless of the language spoken, these groups followed similar settlement and subsistence patterns during the pre-contact and historic periods. Activities such as the round of moving from winter village to various seasonal food procurement sites, canoe travel, plant gathering, bivalve collecting, gardening, hunting, fishing, and aspects of their material culture (i.e., dwellings) are detailed in Appendix 7.1-1. Some traditionally known locations have been recorded along the shores of the Fraser and the slough channels, and those located within 5 km of the LAA are shown in Figure 7.1-3. The village site located directly across the main river channel from the Project site, *Tl'uqtinus*, was reported to be the largest pre-contact settlement on the South Arm of the Fraser River, possibly occupied year-round, and reportedly occupied by the Cowichan, Musqueam, Tsleil-Waututh and Tsawwassen (Brealey, 2010; Morin, 2016; Tam, J. et al., 2018).

Previous archaeological research conducted within the RAA is summarized in Appendix 7.1-1. Despite the documented lateral and downstream migration of the river channel bends with alternately eroded and deposited sediments along the Fraser River banks, archaeological sites still exist in portions of the RAA where lateral migration and erosion of sediments has been limited. Previously recorded pre-contact archaeological sites located within 5 km of the Project site are shown in Figure 7.1-3 and are summarized as follows:

- **DgRr-023**—pre-contact, fish weir (structure and design of weir could not be ascertained), surface lithics (including ground slate knife).
- **DgRr-039**—pre-contact, surface lithics and shell midden (imported archaeological materials, origin unknown).
- **DgRs-017**—pre-contact, surface fire broken rock, subsurface lithics, fishing weir (one set of at least 10 wooden stakes are aligned nearly in a straight row, miscellaneous stakes including from milled stock observed along entire frontage of site), site is 2 km in length and is thought to be *Tl'uqtinus* village site (most of site has either been destroyed, or is covered by 2 to 3 m of fill and possibly set back from existing river bank).
- **DgRs-039**—pre-contact, fishing weir (weir stakes aligned with a right-angle bend), surface lithics.

There is potential for archaeological resources to exist anywhere along the banks of the river or sloughs. Throughout the related intertidal areas and based on an analysis of known archaeological sites within the Metro Vancouver region, 90% of the known sites occur within 100 m of the shoreline. The baseline report (Appendix 7.1-1) highlights facts which may influence the integrity of, and the capacity to investigate for, archaeological deposits potentially located in the LAA. These include:

- Historically documented sediment migration and erosion within the South Arm of the Fraser River; these processes have increased because of vessel traffic during the past half century;
- Previous land use and development activities on the Project site, including construction, operation, and decommissioning of a lumber mill and marine jetty from the early 1960s until the mid-to-late 2000s on the Project site;
- Additional land use activities in the LAA, including farming from the late 19th century to the 1980s and periodic dredging of the South Arm of the Fraser River throughout the 20th century; and
- The addition of overburden throughout the 20th century, including imported fill added in at least two events to build the dike, and channel fill accumulating in the intertidal areas.

There is potential for archaeological materials or features, including fish weirs, to exist in the intertidal area of the LAA. However, because of the sediments accumulated in recent history, as evident in historical aerial photographs and confirmed with geotechnical results to likely represent up to 7 m of channel fill (Golder Associates Ltd., 2016a), it is not practicable to conduct archaeological testing in this area (Figure 7.1-4).

The bank location has not changed based on historical charts and historical aerial photographs; as such, the potential for an archaeological site to exist on the former natural dike that may exist under the modern dike location has not changed through the recorded period (Figure 7.1-4). Geotechnical results show that historical dike building has added 3 to 4 m of imported fill to the dike core (Golder Associates, Ltd., 2014). This indicates that the natural dike may have been relatively low and uninviting for use at this location, and also that the former surface is now deep enough to present a challenge to archaeological testing.

Based on an analysis of known archaeological sites within the Metro Vancouver region, there is potential for archaeological resources to be present inland, with 90% of the known sites occurring within 100 m of the shoreline (Figure 7.1-4). Archaeological tests conducted in the adjacent ForistBC Energy Inc. (FortisBC) property at distances of greater than 100 m from both the Fraser River and Tilbury Slough were all negative but showed a plough zone from agricultural use about 30 cm deep (Stantec, 2014) (Figure 7.1-4). Although the LAA has been subject to previous agricultural and industrial land uses, and has likely seen the import of fill, the depths of the related disturbances and fill overburden have not been quantified by any form of testing.

Archaeological site DgRs-017 is located directly across the river from the LAA. If any archaeological material was eroded from the bank at this site, due to river currents it is unlikely to remain displaced in a directly downslope position where it might be situated within the proposed dredge footprint. The navigation channel is subject to regular dredging, and it is further documented that there are considerable changes in water depths, reported on a seasonal and yearly basis, underscoring the high level of mobility of sediments and any associated cultural materials (see Chapter 4.1).

7.1.2.2.3 Historical Resources

The historical resources considered include sites listed in heritage registers (i.e., sites of architectural significance), and archaeological sites with historical components and heritage wrecks protected under the HCA.

The historical period began, in terms of the potential for historical archaeological sites on the lower Fraser River, in 1827, when the Hudson's Bay Company established its first outpost on the Fraser River at Fort Langley. From the late 18th to the early 19th century, emphasis was placed on exploiting fur resources, mostly in the northern portion of the province, and not on settlement, apart from Hudson's Bay Company farmland in Langley.

Appendix 7.1-1 summarizes settlement of the lower Fraser River for agricultural purposes supported by episodic improvements of the dike system beginning in the mid-19th century, as well as the development of the salmon fishery and canneries on the Lower Fraser River. The Fraser River remains an important source of transportation, with ferry crossings active until the mid-20th century. This period also saw modern industrial facilities for production, processing, and transport of lumber, liquefied natural gas (LNG), steel, and cement become established on former agricultural lands by the river. In the LAA, Weyerhaeuser Company Ltd.'s Northwest Hardwood Mill was active from prior to 1974 (based on review of historical aerial photographs) until the 2000s.

Seventy-six historical heritage properties and landscapes were identified within the RAA during the desktop study (Appendix 7.1-1). Five of these were located downstream within 5 km of the Project site (Figure 7.1-3), but no historical heritage sites were identified within the LAA.

A review of historical wrecking events revealed 12 events reported between the dates of 1894 and 1996 that might have led to a heritage wreck in the RAA. No vessel or aircraft losses were reported between Annacis Island and Garry Point in recent history (i.e., after 1991, when one of repeated channel dredging operations occurred).

Previously recorded heritage wrecks and archaeological sites with historical components located within 5 km of the Project site are shown in Figure 7.1-3 and are summarized as follows:

- **DgRr-023**—historic building, Japanese domestic ceramics (possibly 90 years old) recovered.
- **DgRs-113**—post-contact, marine shipwreck, partially exposed intertidal water, with wooden hull and decks extant but no superstructure. Thought to be a former naval auxiliary vessel, 31 m in length, abandoned sometime before 1963 based on historical aerial photographs.
- **DgRs-114**—post-contact, marine shipwreck, scow-ended barge located in shallow intertidal water, and largely overgrown. Abandoned after 1963 and before 1974, based on historical aerial photographs.
- **DgRr-025**—post-contact, subsurface refuse, scatter of early 20th century Japanese crockery, glass, and butter clam fragments. Wooden pilings and earthen dike observed. Don Island was home to a community of Japanese fisher families between 1901 and the beginning of World War II.
- **DgRr-041**—post-contact, building, surface refuse, subsurface refuse. Home to the Ewen Cannery between 1885 and 1930. Remains of the Ewen Cannery / Lion Island canning complex and Chinese bunkhouse at the eastern end of the island and the Japanese fishing camp at the western end.

Another wreck was observed in historical aerial photographs off Tilbury Island approximately 1.9 km upstream of the LAA (Figure 7.1-3). This wreck, apparently an abandoned scow-form barge, was abandoned in place sometime between 1984 and 1991.

Given that the dike at the LAA seems to have remained in place without substantial imported filling extending into the river, and based on the negative evidence in historical charts and historical aerial photographs, a heritage wreck is not likely to be located in the terrestrial fill of the LAA, including the dike.

Results of the review of historical aerial photographs and the site visit does not suggest a likelihood for any heritage wrecks located in the intertidal portion of the LAA.

As assessed in the baseline report (Appendix 7.1-1), the presence of unrecorded heritage wrecks in the subtidal portions of the LAA is also unlikely due to the lack of developed river access to this foreshore prior to the early 1960s; the absence of any protected shoreline inviting to vessel abandonment (at least prior to jetty construction occurring between 1963 and 1974); the lack of historical (including visual) evidence for the presence of wrecks; the anticipated strength and effects of river currents on non-imbedded structure; and the effects of periodic dredging activities in the navigation channel and adjacent to jetties. Following a review of the current dredge plan and related bathymetry, there is a suggestion, however, that part of the proposed Dredge Area lies in an area that may have escaped historical dredging activities. While the presence of unrecorded heritage wrecks in the subtidal portions of the LAA remains unlikely, the review of any recent marine remote sensing data (i.e., bathymetry, magnetometry), if available for review prior to Project-related dredging, would enable an assessment for the presence of heritage wrecks potentially exposed on the riverbed (see Table 7.1-6, Section 7.1.5).

7.1.2.2.4 Heritage Resources in the Local Assessment Area

Desktop review indicates there are no known heritage resources located within the LAA (Appendix 7.1-1) (Figure 7.1-4). The review suggests that there is some potential for unrecorded heritage resources to exist in the LAA, depending on the subcomponent and location within the LAA as follows:

- Owing to depth of bedrock and lack of bedrock, shale or gravels it is unlikely that paleontological resources are present within the depth of possible project effects.
- There is potential for buried archaeological resources to exist within 100 m of the river edge in both the marine and terrestrial parts of the Project, and within the depths of possible project effects (i.e., densification).
- Owing to river current and cycles of sediment erosion and deposition, it is unlikely that archaeological resources are present in offshore portion of the Project.
- Although their presence is unlikely, a historical resources (i.e., heritage wrecks) could potentially exist within the offshore portion of the Project.

7.1.3 Methodology for Assessment of Potential Project Effects

The methodology used to assess the potential adverse effects of the Project has been outlined in **Part A, Section 1.0, Project Description**. A summary of this assessment methodology as it relates to Heritage Resources is provided below.

Background information regarding known and potential heritage resources was assessed in a desktop study, the Heritage Resources baseline report (Appendix 7.1-1), which is summarized in section 7.1.2. The assessment for potential project effects is therefore based on the on the potential presence of heritage resources. No sub-surface investigations have been conducted, and no HCA permits have been applied for at this time.

7.1.3.1 Potential Project Interactions

Construction, operation, and decommissioning of the Project may lead to changes to Heritage Resources. Potential interactions between Project components and activities during these phases on heritage resources have been identified and are rated in **Section 7.1.4.1**. To focus the assessment on those interactions of greatest importance, interactions resulting in no effect or a negligible (undetectable or unmeasurable) effect have not been carried forward for assessment.

The following interaction as follows have been applied:

- **Potential interaction**—may result in a potential effect on Heritage Resources; these interactions have been carried forward in the assessment.
- **Negligible interaction**—neither detectable nor measurable and not anticipated to influence the short- or long-term viability of the VC or subcomponent; these interactions have not been carried forward in the assessment.
- **No interaction**—these interactions have been justified but are not carried forward in the assessment.

For those Project interactions carried forward in the assessment, the potential effects, both adverse and beneficial (if any) arising from those interactions, are described.

7.1.3.2 Mitigation Measures

Mitigation measures that are expected to reduce or eliminate an adverse effect on Heritage Resources, or enhance a beneficial effect, were identified. Mitigation measures may include monitoring to verify results and standard mitigation measures such as Best Management Practices (BMPs), including changes to the means in which the Project will be designed, constructed, operated, or decommissioned. Mitigation also considered the views of Aboriginal groups and key stakeholders, where available.

Effectiveness of mitigation measures to reduce or eliminate potential adverse effects are characterized using the following criteria:

- **High effectiveness:** the mitigation measure is expected, once implemented, to significantly improve or eliminate the effect or improve the condition of Heritage Resources.
- **Moderate effectiveness:** the mitigation measure is expected, once implemented, to moderately improve the effect on a VC or moderately improve the condition of Heritage Resources.
- **Low effectiveness:** the mitigation measure may provide no or little change in the effect on a VC, the effectiveness of the mitigation measure is unknown or untested, or no improvement to the condition of Heritage Resources.

7.1.3.3 Characterization of Potential Residual Project Effects

Residual effects are characterized using specific criteria for each VC as defined in the British Columbia Environmental Assessment Office’s (BCEAO’s) *Guideline for the Selection of Valued Components and Assessment of Potential Effects* (BCEAO 2013). Definitions for residual effects criteria, developed with specific reference to Heritage Resources, are presented in Table 7.1-5. Effects that are negligible prior to mitigation measures are not carried forward to the assessment of residual Project effects or cumulative effects.

Table 7.1-5: Criteria Used to Characterize Residual Effects on Heritage Resources

Criteria	Description	Definition
Magnitude	Expected size or severity of the residual effect	<p>Negligible—effects which are so small that they are neither detectable nor measurable and are not anticipated to influence the short- or long-term viability of the VC or a subcomponent</p> <p>Low—magnitude of effects are anticipated to be within the range of natural variability and therefore cannot be qualified</p> <p>Moderate—magnitude of effects exceed natural variability and could be quantified within a well-designed monitoring program (e.g., erosion over a number of years)</p> <p>High—magnitude of effects are obvious and can be easily observed and described (e.g., excavation for a utility)</p>
Geographic Extent	Spatial scale over which the residual effect is expected to occur	<p>Site-specific—effects limited to the Project site</p> <p>LAA—effects limited to the LAA</p> <p>RAA—effects extend to the RAA</p> <p>Beyond the RAA—effects extend to areas beyond the RAA</p>
Duration	Length of time over which the residual effect is expected to persist	<p>Short-term—effects present for less than one year</p> <p>Medium-term—effects present for one year to the life of the Project</p> <p>Long-term—effects present for greater than the life of the Project</p> <p>Permanent—effects present indefinitely</p>

Criteria	Description	Definition
Frequency	How often the residual effect is expected to occur	Infrequent —effect occurs once or rarely over the specified duration Frequent —effect occurs repeatedly over the specified duration, but without any predictable pattern during the life of the Project Continuous —effect occurs continuously over the specified duration
Timing	Whether the period in which the residual effect occurs coincides with sensitive timing, periods, or windows for the VC	There are no temporal characteristics specific to Heritage Resources
Reversibility	Whether or not the residual effect can be reversed once the physical work or activity causing the effect ceases	Reversible —effect can be reversed Partially reversible —effect can be reversed partially Irreversible —effect is permanent
Context	Whether the VC is sensitive or resilient to Project-related stressors	Low resilience —highly sensitive to Project-related stressors Moderate resilience —able to withstand or absorb some Project-related stressors High resilience —able to resist most Project-related stressors

VC = Valued Component; LAA = Local Assessment Area; RAA = Regional Assessment Area.

The Application assesses the likelihood for all residual adverse effects using appropriate quantitative or qualitative terms and sufficient description to understand how the conclusions were reached. Likelihood refers to whether or not a residual effect is likely to occur (BCEAO 2013). The analysis to determine the likelihood of a residual effect occurring is based on a review of available information and professional judgement. When assessing likelihood, the following criteria have been applied and are defined to clarify interpretations:

- **Unlikely**—Past experience and professional judgement indicates that a residual effect is unlikely to occur, based on the low or untested potential for the presence of a heritage resource where it may be impacted by the Project.
- **Likely**—Past experience and professional judgement indicates that there is a likelihood that a residual effect could occur, based on the known presence of a heritage resource where it may be impacted by the Project.

7.1.3.4 Determination of Significance

The determination of significance of potential residual effects for Heritage Resources was based on the residual effects rating assigned, a review of background information, consultation with government agencies and other experts, and professional judgement. Each residual Project effect and cumulative effect has been rated as not significant, or significant, as follows:

- **Not significant**—potential residual effects determined to be not significant are those that do not meet the definition of significant.
- **Significant**—permanent adverse effects to intact Heritage Resources.

The process of determining the significance of effects to Heritage Resources is through a combined evaluation of heritage site value, Project-related effects on those sites, the application of mitigation strategies to offset the effects, and evaluation of the success of follow-up mitigation on any residual effects. This process begins with individual site evaluation using methods prescribed by various guidelines and frameworks as described below. The checks and balances established by this process should result in residual effects that are not significant. Significant residual effects should only occur if processes are not followed or if unforeseen effects occur to heritage resources of value which are not mitigated to applicable regulatory standards.

7.1.3.4.1 Effects Significance Determination for Paleontological Resources

Paleontological site values are determined using a checklist which includes the following four categories of evaluative criteria: scientific, educational, heritage, and commercial. These criteria are described in the following documents: *Fossil Management Framework Consultation Summary Report* (British Columbia Ministry of Forests, Lands and Natural Resource Operations, Land Tenures Branch, 2010) and *Fossil Management for British Columbia* (Fossil Management Review Technical Working Group, 2004). Additional guidance was taken from criteria used in other North American jurisdictions for the protection of paleontological resources.

The significance of the potential effect is first determined by evaluating the heritage value (typically referred to as “site significance”) of the area of paleontological sensitivity area according to the criteria noted above. The second step is to evaluate the magnitude of the effect of the proposed alteration on the area of paleontological sensitivity. As a result, equal levels of alteration to areas of paleontological sensitivity with different heritage value ratings will result in a different significance determination for the potential effect. Using this approach, alterations to areas of paleontological sensitivity determined to be high (Class I), moderate (Class II), and low (Class III) heritage value can occur, provided that acceptable mitigation is implemented to offset the adverse effect or create a beneficial effect. In the absence of explicit paleontological legislation in BC, mitigation would be to a level equivalent to recognized “good practices.” As such, the residual effect might not be significant, and classified as a “negligible” residual effect.

7.1.3.4.2 Effects Significance Determination for Archaeological and Historical Resources

For archaeological and historical resources, heritage value is determined by applying the Checklist for Criteria for Pre-contact Site Evaluation and Checklist for Criteria for Post-Contact Site Evaluation in the *British Columbia Archaeological Impact Assessment Guidelines*, Appendices D and E (British Columbia Ministry of Forests, Lands and Natural Resource Operations, Archaeology Branch, 1998). The checklists include up to five evaluative categories: scientific, historic, public, ethnic, and economic significance, where the term “significance” refers to

values assigned to each category. This use of the term “significance” in this context is distinct from its use in determining the significance of an effect.

The significance of the potential effect is first determined by evaluating the heritage value (typically referred to “site significance”) of the archaeological or historical site in question according to the criteria noted above. The second step is to evaluate the magnitude of the effect of the proposed alteration on the archaeological or historical site. As a result, equal levels of alteration to archaeological or historical sites with different heritage value ratings will result in a different significance determination for the potential effect. Using this approach, alterations to archaeological and historical sites determined to be of high heritage value can occur, provided that acceptable, site-specific mitigation is implemented to offset the adverse effect. The degree to which planned alterations and mitigation strategies are acceptable is a decision that rests with the Archaeology Branch based on information gathered by archaeologists, input from Aboriginal groups, and other sources. If it is determined that the Project will affect an archaeological or historical site, a mitigation plan must be developed and implemented that includes methods to reduce the adverse effects of the alteration to a level that is acceptable to the Archaeology Branch. As such, the residual effect would not be significant. An impact to an archaeological or an historical resource will be permanent and irreversible, and therefore significant, if not offset.

7.1.3.5 Confidence and Risk

The level of confidence for each predicted residual Project effect has been discussed to characterize the level of uncertainty associated with both the significance and likelihood determinations. The level of confidence for each predicted residual effect is related to the factors discussed below to characterize the level of uncertainty associated with both the significance and likelihood determinations. Level of confidence is typically based on gathered background information, field study results, knowledge of types of effects potentially resulting from various activities, professional judgement, and effectiveness of mitigation. All assumptions have been made clear in the text and are based on the following criteria:

- **Low**—judgement hampered by incomplete understanding of cause-effect relationships or lack of data.
- **Moderate**—reasonable understanding of cause-effect relationships and adequate data.
- **High**—good understanding of cause-effect relationships and ample data.

7.1.4 Assessment of Potential Project Effects

7.1.4.1 Project Interactions

This section considers potential Project effects on Heritage Resources in relation to the indicators and measurable parameters listed in Table 7.1-2.

Potential interactions between Project components and activities and Heritage Resources during the construction, operation, and decommissioning phases of the Project are identified in Table 7.1-6. No interactions are likely due to the absence of known heritage resources; however, possible interactions are identified where the untested potential for heritage resources has been identified.

Table 7.1-6: Potential Project Interactions with Heritage Resources

Project Phase and Activities	Interaction	Nature of Interaction and Rationale for Interaction Rating
<i>Paleontological Resources</i>		
CONSTRUCTION		
Site preparation and removal of existing abandoned marine infrastructure	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related construction activities
Dredging of Dredge Area	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related construction activities
In-river ground stabilization and pile works	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related construction activities
Land-based ground stabilization and pile works	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related construction activities
Construction of associated Offshore Facilities	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related construction, operation or decommissioning activities
Construction of associated Onshore Facilities	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related construction activities
Marine transportation of construction materials and equipment	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related construction activities
Road transportation of construction materials and equipment	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related construction activities

Project Phase and Activities	Interaction	Nature of Interaction and Rationale for Interaction Rating
Enhancement of the previously disturbed foreshore	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related construction activities
OPERATION		
LNG carrier/barge loading	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related operation activities
Berthing/Departure of vessels	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related operation activities
Marine shipping from the Project site to Sand Heads	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related operation activities
Maintenance dredging	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related operation activities
Maintaining marine security zone	No interaction	n/a
Accidents and malfunctions during operation	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related operation activities
DECOMMISSIONING		
Removal of associated Offshore Facilities	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related decommissioning activities
Removal of associated Onshore Facilities	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related decommissioning activities
Marine transportation of decommissioning materials and equipment	No interaction	Given the depth of bedrock below existing sediments, and absence of gravels or shale, it is unlikely that paleontological resources, if they exist within the LAA, will be encountered during Project-related decommissioning activities

Project Phase and Activities	Interaction	Nature of Interaction and Rationale for Interaction Rating
Archaeological Resources		
CONSTRUCTION		
Site preparation and removal of existing marine infrastructure	No interaction	Encountering archaeological remains during abandoned marine infrastructure removal is unlikely, given the minimal area of disturbance
Dredging of Dredge Area	No interaction	Encountering archaeological remains in the dredge area is unlikely, given the location in an active, regularly dredged, river channel, seasonal cycles of sediment erosion and deposition due to river currents, and depths of recent deposits in areas not previously dredged
In-river ground stabilization and pile works	Potential interaction	Encountering deeply buried archaeological remains in the river near shore is considered unlikely and not archaeologically testable given depths of recent deposits
Land-based ground stabilization and pile works	Potential interaction	Encountering archaeological resources in the vicinity of ground stabilization and pile works is considered unlikely but archaeologically testable.
Construction of associated Offshore Facilities	No interaction	Encountering archaeological remains during construction of associated Offshore Facilities is unlikely, given no subsurface disturbance
Construction of associated Onshore Facilities	No interaction	Encountering archaeological remains during Onshore Facilities construction is unlikely, given minimal subsurface disturbance
Marine transportation of construction materials and equipment	Negligible	Effects of wake and propellor wash on archaeological remains (in recorded sites on the river bank within the RAA and adjacent to the South Arm navigation channel) will be negligible, given the minimal change to existing wake effects anticipated due to Project vessel traffic (see Chapter 4.1)
Road transportation of construction materials and equipment	No interaction	Encountering archaeological remains on road networks is unlikely, given no subsurface disturbance
Enhancement of the previously disturbed foreshore	No interaction	Encountering archaeological remains during foreshore enhancement is unlikely given depths of recent deposits
OPERATION		
LNG carrier/barge loading	No interaction	Encountering archaeological remains as a result of LNG carrier/barge loading is unlikely
Berthing/Departure of vessels	Negligible	Effects of vessel wakes and propeller wash on archaeological site DgRs-17 will be negligible, given the minimal change to existing wake and propeller wash effects anticipated due to Project vessel traffic (see Chapter 4.1)

Project Phase and Activities	Interaction	Nature of Interaction and Rationale for Interaction Rating
Marine shipping from the Project site to Sand Heads	Negligible	Effects of vessel wakes on archaeological remains (in recorded sites on the river bank within the RAA and adjacent to the South Arm navigation channel) will be negligible, given the minimal change to existing wake effects anticipated due to Project vessel traffic (see Chapter 4.1)
Maintenance dredging	No interaction	Encountering archaeological remains in the river channel/dredge area is unlikely, given seasonal cycles of sediment erosion and deposition due to river currents
Maintaining marine security zone	No interaction	n/a
Accidents and malfunctions during operation	Potential interaction	Potential adverse effects to buried archaeological materials in vicinity of accidents and malfunctions during operations (e.g., fuel spill) is considered unlikely, but the terrestrial area of the LAA is archaeologically testable
DECOMMISSIONING		
Removal of associated Offshore Facilities	No interaction	Encountering archaeological remains during removal of associated Offshore Facilities is unlikely
Removal of associated Onshore Facilities	No interaction	Encountering archaeological remains during removal of Onshore Facilities is unlikely
Marine transportation of decommissioning materials and equipment	Negligible	Effects of wake and propellor wash on archaeological remains (in recorded sites on the river bank within the RAA and adjacent to the South Arm navigation channel) will be negligible, given the minimal change to existing wake effects anticipated due to Project vessel traffic (see Chapter 4.1)
Historical Resources		
CONSTRUCTION		
Site preparation and removal of existing abandoned marine infrastructure	No interaction	Encountering historical remains in the vicinity of existing abandoned marine infrastructure is unlikely
Dredging of Dredge Area	Potential interaction	Encountering historical remains in the dredge area is considered unlikely, but presence/absence of heritage wrecks may be further determined with review of remote sensing data, if available
In-river ground stabilization and pile works	No interaction	Encountering historical remains in the near shore river channel is unlikely
Land-based ground stabilization and pile works	No interaction	Encountering historical remains on the land is unlikely
Construction of associated Offshore Facilities	No interaction	Encountering historical remains during construction of associated Offshore Facilities is unlikely
Construction of associated Onshore Facilities	No interaction	Encountering historical remains during construction of associated Onshore Facilities is unlikely

Project Phase and Activities	Interaction	Nature of Interaction and Rationale for Interaction Rating
Marine transportation of construction materials and equipment	No interaction	Encountering historical remains during marine transportation of construction materials and equipment is unlikely
Road transportation of construction materials and equipment	No interaction	Encountering historical remains on road networks is unlikely
Enhancement of the previously disturbed foreshore	No interaction	Encountering historical remains along the previously disturbed foreshore is unlikely
OPERATION		
LNG carrier/barge loading	No interaction	Encountering historical remains during LNG carrier/barge loading is unlikely
Berthing/Departure of vessels	No interaction	Encountering historical remains during berthing/departure of vessels is unlikely
Marine shipping from the Project site to Sand Heads	No interaction	Encountering historical remains during marine shipping from the Project site to Sand Heads is unlikely
Maintenance dredging	No interaction	Encountering historical remains in the river channel/dredge area is unlikely
Maintaining marine security zone	No interaction	n/a
Accidents and malfunctions during operation	No interaction	Encountering historical remains as a result of accidents and malfunctions during operations is unlikely
DECOMMISSIONING		
Removal of associated Offshore Facilities	No interaction	Encountering historical remains during removal of associated Offshore Facilities is unlikely
Removal of associated Onshore Facilities	No interaction	Encountering historical remains during removal of Onshore Facilities is unlikely
Marine transportation of decommissioning materials and equipment	No interaction	Encountering historical remains in the river channel/dredge area unlikely

Potential Project Interaction ratings: no interaction; negligible interaction; potential interaction
 LAA = Local Assessment Area; n/a = not applicable; LNG = liquefied natural gas.

7.1.4.2 Potential Project Effects

7.1.4.2.1 Archaeological or Historical Site Alteration

Construction

Ground-altering activities associated with construction have the potential to alter archaeological or historical sites, features, and objects (Figure 7.1-5). These potential alterations are both adverse and potentially beneficial. Beneficial effects include the discovery of sites, features, and objects and the associated gain in archaeological and historical knowledge. Discovery of sites is more likely to occur during construction than during operation or decommissioning. Adverse effects would include damage and changes in the integrity of archaeological and historical sites and objects.

HCA permit applications for archaeological investigations or alterations to known heritage sites, features, and objects that are HCA-protected would be referred to Aboriginal groups for review and comment, and they would also have an opportunity to comment on the cultural significance of sites, features, and objects that are encountered. Aboriginal groups' comments may contribute, along with mitigation strategies (**Section 7.1.4.3**), to the reduction of significant adverse effects, and add to beneficial effects, if possible.

Operation

Accidents and malfunctions during operation have the potential to alter archaeological or historical sites, features, and objects. These potential alterations are both adverse and potentially beneficial. Beneficial effects include the discovery of sites, features, and objects and the associated gain in archaeological and historical knowledge. Adverse effects would include damage and changes in the integrity of archaeological and historical sites and objects.

Decommissioning

Ground-altering activities associated with decommissioning have the potential to alter archaeological or historical sites, features, and objects. Although site alteration is less likely to occur during decommissioning than in construction or operation, potential alterations are again both adverse and potentially beneficial. Beneficial effects include the discovery of sites, features, and objects and the associated gain in archaeological and historical knowledge. Adverse effects would include damage and changes in the integrity of archaeological and historical sites and objects.

7.1.4.2.2 Changes in the Level of Accessibility

Construction and Operation

Proposed construction activities have the potential to change the level of accessibility to archaeological and historical sites, features, and objects, if present. Archaeological and historical sites, features, and objects may be buried by construction fill or placed behind a security fence, effectively precluding scientific investigations for the foreseeable future. In some cases, intentional burial or fencing can be a positive Project effect, particularly in locations prone to unauthorized (illicit) artifact collecting. Construction also has the potential to expose archaeological sites, features, and objects in publicly accessible areas such as the riverbank, thereby increasing the likelihood of illicit collecting activities by members of the public.

Decommissioning

Proposed decommissioning activities have the potential to change the level of accessibility to archaeological and historical sites, features, and objects, if present. Archaeological and historical sites, features, and objects, if present, may no longer be protected by a security fence, thereby increasing the likelihood of illicit collecting activities by members of the public.

7.1.4.3 Mitigation Measures

Mitigation measures that are expected to reduce or eliminate an adverse effect, or enhance a positive effect, are described below and summarized in Table 7.1-7. Mitigation measures include mitigation integrated into Project design and specific mitigation identified for Heritage Resources.

Selection of mitigation measures for heritage resources was informed by:

- A review of mitigation measures and follow-up programs undertaken for similar developments;
- Regulator, public, and Aboriginal group input; and
- Internal evaluation of technical and economic feasibility.

There is a risk with carrying out a desktop-based assessment that has not been ground-truthed with an archaeological impact assessment (AIA), given that detectable heritage resources may be present and be potentially affected by Project-related activities. While the desk-based assessment (Appendix 7.1-1) provides confidence with respect to the absence of paleontological resources where they might be impacted by Project activities, archaeological and historical resources may be buried beneath the ground or sediment surface, or be located underwater, and therefore are not visible, but could be encountered at any time over the life of the Project.

Completion of an AIA increases the level of confidence associated with residual effects characterization by enhancing the accuracy of likelihood determinations. Subsurface visibility for the archaeological resources may be achieved through subsurface testing and examination of fortuitous subsurface exposures (e.g., cutbanks), or geophysical survey. As such, WesPac commits to further field study of the LAA prior to, or concurrent with, Project construction activities. The results of further field study may change the results of the effects assessment for Heritage Resources.

Where confidence is not high that there is an absence of undetected heritage resources, the remaining risk of potential effects may be effectively managed through the implementation of Heritage Resource Chance Find Management Procedures, as may be included in the Construction Environmental Management Plan developed for the Project, if heritage resources are encountered during Project construction, operation, or decommissioning phases.

7.1.4.3.1 Project Design Mitigation

Based on current knowledge, the Project is located in an area without heritage resources, and therefore avoids effects to Heritage Resources.

7.1.4.3.2 Specific Mitigation for Heritage Resources

As noted in **Sections 7.1.2.2.2 and 7.1.4.3**, an AIA has not been completed for areas of heritage resource potential that may be subject to ground-altering activities. To address the possibility for ground-altering activities to alter as-yet undiscovered, buried archaeological and historical sites, WesPac commits to undertake field investigations in areas with archaeological or historical potential prior to, or concurrent with, Project construction activities. Field investigations are consistent with the recommendation in the report prepared for the Kwantlen First Nation and Seyem' Qwantlen by Jones and McLaren (Jones & McLaren, 2016). Heritage field investigations will further provide a basis for the conduct of appropriate mitigation measures, if any are required.

The following sections describe mitigation measures specific to avoiding, reducing, or otherwise mitigating the potential effects to heritage resources, summarized in Table.7.1-7.

Should archaeological or historical resources be encountered in the Project area, adoption of the mitigation hierarchy is recommended (see **Section 7.1.3.4.2**).

7.1.4.3.2.1 Mitigation Measure M7.1-1 Realign or Redesign Project Components to Avoid Heritage Resources

If heritage resources are encountered during subsequent studies or during construction, realignment or redesign of components may be considered to reduce potential loss or destruction of these resources. Avoidance of heritage resources is the preferred mitigation option, when feasible, from a cultural resource management perspective. Residual effects are not expected where heritage resources are avoided, and the effectiveness of avoidance is, therefore, high.

7.1.4.3.2.2 Mitigation Measure M7.1-2 Alternative Measures to Reduce Project Effects to Archaeological and Historical Sites

Archaeological and historical site preservation can also be achieved through measures that minimize or reduce adverse project effects. If heritage resources are encountered during subsequent studies or during construction and realignment or redesign is not feasible; alternative protection measures will be implemented to reduce potential effects to the archaeological and historical site. Alternative protection measures may include protective covering, stabilization, and physical barriers that aim to minimize or reduce Project effects (see Archaeology Branch [British Columbia Ministry of Forests, Lands and Natural Resource Operations, Archaeology Branch, 1998]; see also Davis et al. [Davis, Gdaniec, Brice, & White, 2004] and English Heritage [English Heritage, 2007]). The mitigation methods listed above represent standard archaeological BMPs, and the effectiveness of each method at minimizing direct effects is high.

7.1.4.3.2.3 Mitigation Measure M7.1-3 Heritage Offsetting

If effects to archaeological and historical sites cannot be avoided or minimized, effects to Heritage Resources will be reduced by “heritage offsetting” to achieve “no net loss” of heritage (i.e., gain in knowledge commensurate with severity of the adverse effect). Offsets may include surface artifact collection, additional inventory studies, or systematic data recovery (e.g., excavation, detailed recording and documentation, construction surveillance or monitoring). These are archaeological BMPs providing mitigation effectiveness that may be characterized as moderate to high, depending on the archaeological or historical resource.

7.1.4.3.2.4 Mitigation Measure M7.1-4 Chance Find Management Procedure

A Heritage Resources Chance Find Management Procedure will be prepared for implementation by WesPac. The objectives of this procedure include the preservation and proper management of heritage resources that are unexpectedly encountered during Project activities and minimizing disruption to construction activities and scheduling. The document will include both general guidelines and detailed steps to follow for the appropriate response to the discovery of known or suspected heritage materials during the course of Project activities. In addition to providing instructions for crews, it will include a list of important contacts, a description of the most likely types of heritage feature or object to be encountered by crews, and a copy of the Archaeology Branch’s Found Human Remains Policy for reference.

In their report for the Kwantlen First Nation and Seyem’ Qwantlen, Jones and McLaren (Jones & McLaren, 2016) recommended a Chance Find Management Plan for dredging activities.

The implementation of a Heritage Resources Chance Find Management Procedure is an archaeological BMP providing mitigation effectiveness that may be characterized as moderate to high, depending on the archaeological or historical resource.

7.1.4.3.2.5 Summary of Mitigation Measures

A summary of mitigation to address adverse Project effects on Heritage Resources is provided in Table 7.1-7. No effects to the paleontological resources subcomponent are anticipated.

Table 7.1-7: Summary of Mitigation Measures to Address Adverse Project Effects on Heritage Resources

Potential Effect	Mitigation Measure	Mitigation ID #	Effectiveness
Archaeological Resources			
Construction			
Alteration	Realign or redesign Project components to avoid heritage resources	M7.1-1	High
	Alternative measures to reduce Project effects to archaeological and historical sites	M7.1-2	High
	Heritage offsetting	M7.1-3	Moderate to High
	Chance Find Management Procedure	M7.1-4	Moderate to High
Changes in the level of accessibility	Alternative measures to reduce Project effects to archaeological and historical sites	M7.1-2	High
Operation			
Alteration	Realign or redesign Project components to avoid heritage resources	M7.1-1	High
	Alternative measures to reduce Project effects to archaeological and historical sites	M7.1-2	High
	Heritage offsetting	M7.1-3	Moderate to High
	Chance Find Management Procedure	M7.1-4	Moderate to High
Changes in the level of accessibility	Alternative measures to reduce Project effects to archaeological and historical sites	M7.1-2	High
Decommissioning			
Alteration	Realign or redesign Project components to avoid heritage resources	M7.1-1	High
	Alternative measures to reduce Project effects to archaeological and historical sites	M7.1-2	High
	Heritage offsetting	M7.1-3	Moderate to High
	Chance Find Management Procedure	M7.1-4	Moderate to High
Changes in the level of accessibility	Alternative measures to reduce Project effects to archaeological and historical sites	M7.1-2	High

Potential Effect	Mitigation Measure	Mitigation ID #	Effectiveness
Historical Resources			
Construction			
Alteration	Realign or redesign Project components to avoid heritage resources	M7.1-1	High
	Alternative measures to reduce Project effects to archaeological and historical sites	M7.1-2	High
	Heritage offsetting	M7.1-3	Moderate to High
	Chance Find Management Procedure	M7.1-4	Moderate to High
Changes in the level of accessibility	Alternative measures to reduce Project effects to archaeological and historical sites	M7.1-2	High
Operation			
Alteration	Realign or redesign Project components to avoid heritage resources	M7.1-1	High
	Alternative measures to reduce Project effects to archaeological and historical sites	M7.1-2	High
	Heritage offsetting	M7.1-3	Moderate to High
	Chance Find Management Procedure	M7.1-4	Moderate to High
Changes in the level of accessibility	Alternative measures to reduce Project effects to archaeological and historical sites	M7.1-2	High
Decommissioning			
Alteration	Realign or redesign Project components to avoid heritage resources	M7.1-1	High
	Alternative measures to reduce Project effects to archaeological and historical sites	M7.1-2	High
	Heritage offsetting	M7.1-3	Moderate to High
	Chance Find Management Procedure	M7.1-4	Moderate to High
Changes in the level of accessibility	Alternative measures to reduce Project effects to archaeological and historical sites	M7.1-2	High

7.1.4.4 Residual Project Effects

There are no known heritage resources in the LAA and, consequently, no residual effects to heritage resources are anticipated.

If heritage resources are encountered in the LAA during future archaeological testing or Project construction, and mitigation measures including avoidance have not been applied or do not meet the acceptable threshold for residual effects determined by the Archaeology Branch, the adverse effects to archaeological or historical resources would be permanent, irreversible, and not offset. The residual effects would therefore be significant.

Based on past experience and professional judgement, the likelihood of residual effects is considered low, considering the assessed potential for the presence of heritage resources in the LAA and the effectiveness of the mitigation measures. The following sections provide a characterization of residual effects carried forward in the assessment following the determination of the presence of archaeological and historical resources in the LAA, and application of mitigation measures during construction, operation and decommissioning (see Table 7.1-8).

7.1.4.4.1 Alteration of Heritage Resources

Where heritage resources have been located (e.g., buried archaeological resources in the pipeline densification footprint, or heritage wrecks in the dredge footprint) and can be avoided (M7.1-1) through project design/redesign, residual effects are not expected.

Effects to Heritage Resources may be minimized or reduced by providing direct protection and/or restricting access (M7.1-2). If these protections meet the acceptable threshold for residual effects determined by the Archaeology Branch, the direction of effects could be positive (site identification followed by protection), or the magnitude of effects could be negligible, infrequent (due to protection), and partially reversible (access for scientific purposes might be restored at a future date) (Table 7.1-8), and the potential residual effects to archaeological and historical sites protected by the HCA if present, are considered to be negligible (Table 7.1-8).

If effects to archaeological and historical sites cannot be avoided or minimized, effects to Heritage Resources may be reduced by heritage offsetting (M7.1-3) including surface artifact collection, additional inventory studies or systematic data recovery (e.g., excavation, detailed recording, and documentation) to an acceptable level before construction proceeds, and/or monitoring of construction. As effects to Heritage Resources could be offset, even when effects are permanent and irreversible, provided the heritage offsetting meets the acceptable threshold for residual effects determined by the Archaeology Branch, the direction of effects could be positive (i.e., a gain in knowledge commensurate with severity of the adverse effect) (Table 7.1-8), and the potential residual effects to archaeological and historical sites, if present, are considered to be negligible (Table 7.1-8).

In the event that heritage resources are unexpectedly encountered during Project activities, the proper implementation of the Heritage Resources Chance Find Management Procedure (M7.1-4) will allow the professional recording of any unanticipated impacts, and if documentation is commensurate with severity of the adverse effect as determined by the Archaeology Branch, the direction of the effect could again be positive (Table 7.1-8), and the potential residual effects to archaeological and historical sites, if present, are considered to be negligible (Table 7.1-8).

7.1.4.4.2 Changes to Accessibility to Heritage Resources

Effects to Heritage Resources may be minimized or reduced by providing direct protection and/or restricting access (M7.1-2). If these protections meet the acceptable threshold for residual effects determined by the Archaeology Branch, the direction of effects could be positive. Note that site access is currently limited by fencing from the road, but is open to public access from the beach side. Additional fencing could be erected around archaeologically sensitive areas, or buried archaeological material could be “capped” with the application of pavement or other hard surfaces. Access restrictions could be in place during construction and operation, but might be removed with decommissioning. The magnitude of effects could be negligible, infrequent (due to protection), and partially reversible (access for scientific purposes might be restored at a future date) (Table 7.1-8), and the potential residual effects to archaeological and historical sites, if present, are considered to be negligible (Table 7.1-8).

7.1.4.4.3 Summary of Residual Effects

7.1.4.4.3.1 Residual Effects to Paleontological Resources

The baseline assessment (Appendix 7.1-1) indicates that paleontological resources are unlikely to be present where Project impacts can occur, so no residual adverse effects or cumulative effects to paleontological resources are anticipated.

7.1.4.4.3.2 Residual Effects to Archaeological Resources

The baseline assessment (Appendix 7.1-1) indicates that no known archaeological resources are present where Project impacts can occur, so no residual adverse effects to archaeological resources are anticipated.

Any impact to an intact archaeological resource that may be present, however, is likely permanent and irreversible, and therefore a significant residual effect. If the resources cannot be avoided, it will be necessary to mitigate by offsetting the adverse effects. Consistent with Archaeology Branch guidance, the mitigation measures for addressing potential effects to archaeological resources, if present, will be adequate to render residual adverse effects negligible (see **Sections 7.1.4.4.1 and 7.1.4.4.2**). The determination of a threshold for residual effects on archaeological resources that are protected under the HCA is under the jurisdiction of the Archaeology Branch. It is, therefore, understood that residual effects would need to be mitigated to an acceptable level before the proposed Project activities could proceed and significant adverse residual effects be avoided, should intact archaeological materials be present in the Project area.

Residual effects to archaeological resources with the implementation of mitigation measures are summarized in Table 7.1-8. As all resulting residual effects are negligible, this assessment concludes that there is no cumulative effects for archaeological resources.

7.1.4.4.3.3 Residual Effects to Historical Resources

The baseline assessment (Appendix 7.1-1) indicates that no known HCA-protected historical resources are present where Project impacts can occur, so that no residual adverse effects to historical resources are anticipated.

Any impact to an intact HCA-protected historical resource that may be present, however, is likely permanent and irreversible, and therefore a significant residual effect. If the resources cannot be avoided, it will be necessary to mitigate by offsetting the adverse effects. Consistent with Archaeology Branch guidance, the mitigation measures for addressing potential effects to historical resources, if present, will be adequate to render residual adverse effects negligible (see **Sections 7.1. 4.4.1 and 7.1.4.4.2**). The determination of a threshold for residual effects on historical resources that are protected under the HCA is the jurisdiction of the Archaeology Branch. It is, therefore, understood that residual effects would need to be mitigated to an acceptable level before the proposed Project activities could proceed and significant adverse residual effects be avoided, should intact historical materials protected under the HCA be present in the Project area.

Residual effects to historical materials protected under the HCA with the implementation of mitigation measures are summarized in Table 7.1-8. As all resulting residual effects are negligible, this assessment concludes that there is no cumulative effects for Historical Resources.

Table 7.1-8: Summary of Residual Effects Characterization for Archaeological and Historical Resources

Subcomponent	Potential Adverse Residual Effect	Contributing Project Activity or Physical Works	Mitigation #	Direction of Effect	Residual Effects Characterization							
					Magnitude	Geographic Extent	Duration/Frequency	Timing	Reversibility	Context	Residual Effect (Y/N)	
Construction												
Archaeological resources	Damage or destruction of sites, features, or objects	Ground disturbance	M7.1-1 M7.1-2 M7.1-3 M7.1-4	P, N	N	LAA	P/I	n/a	I	LR	N	
Archaeological resources	Changes in the level of accessibility	Site burial, fencing, or other barriers to access	M7.1-2	P, N	N	LAA	LT	n/a	PRV	LR	N	
Historical resources	Damage or destruction of sites, features, or objects	Ground disturbance	M7.1-1 M7.1-2 M7.1-3 M7.1-4	P, N	N	LAA	P/I	n/a	I	LR	N	
Historical resources	Changes in the level of accessibility	Site burial, fencing, or other barriers to access	M7.1-2	P, N	N	LAA	LT	n/a	PRV	LR	N	
Operation												
Archaeological resources	Damage or destruction of sites, features, or objects	Accidents and malfunctions (e.g., spills)	M7.1-1 M7.1-2 M7.1-3 M7.1-4	P, N	N	LAA	P/I	n/a	I	LR	N	
Historical resources	Damage or destruction of sites, features, or objects	Accidents and malfunctions (e.g., spills)	M7.1-1 M7.1-2 M7.1-3 M7.1-4	P, N	N	LAA	P/I	n/a	I	LR	N	

Subcomponent	Potential Adverse Residual Effect	Contributing Project Activity or Physical Works	Mitigation #	Direction of Effect	Residual Effects Characterization						
					Magnitude	Geographic Extent	Duration/Frequency	Timing	Reversibility	Context	Residual Effect (Y/N)
Decommissioning											
Archaeological resources	Damage or destruction of sites, features, or objects	Ground disturbance	M7.1-1 M7.1-2 M7.1-3 M7.1-4	P, N	N	LAA	P/I	n/a	I	LR	N
Archaeological resources	Changes in the level of accessibility	Site burial, fencing, or other barriers to access	M7.1-2	P, N	N	LAA	LT	n/a	PRV	LR	N
Historical resources	Damage or destruction of sites, features, or objects	Ground disturbance	M7.1-1 M7.1-2 M7.1-3 M7.1-4	P, N	N	LAA	P/I	n/a	I	LR	N
Historical resources	Changes in the level of accessibility	Site burial, fencing, or other barriers to access	M7.1-2	P, N	N	LAA	LT	n/a	PRV	LR	N

Notes:

Direction: P = positive; N = negative

Magnitude: N = negligible; L = low; M = moderate; H = High

Geographic Extent: LAA = Local Assessment Area; RAA = Regional Assessment Area; B= Beyond the RAA

Duration: ST = short-term; MT = medium-term; LT = long-term; P = permanent

Frequency: I = infrequent; F = frequent; CT = continuous

Timing: n/a (there are no temporal characteristics specific to the Heritage Resources VC)

Reversibility: RV = reversible; PRV = partially reversible; I = irreversible

Context: LR = low resilience; MR = moderate resilience; HR = high resilience

7.1.4.4 Determination of Significance of Residual Adverse Effects

After the implementation of mitigation measures, the Project is not predicted to result in residual effects on archaeological and historical resources. Where no residual effects, or negligible potential residual effects are predicted, the significance of those effects is also none or negligible and therefore no further evaluation is required. Proposed project mitigation measures, predicted effectiveness of mitigation measures, and overall residual effects determination are summarized below (Table 7.1-9).

Each potential residual Project effect and potential cumulative effect has been rated as either “not significant”, or “significant”.

Table 7.1-9: Summary of Effects Characteristics for Archaeological and Historical Resources

Subcomponent	Potential Effect Before Mitigation	Contributing Project Activity or Physical Works	Mitigation #	Effectiveness	Level of Confidence	Potential Residual Effect
Archaeological resources	Damage or destruction of sites, features, or objects	Ground disturbance	M7.1-1 M7.1-2 M7.1-3 M7.1-4	Moderate to High	High	N
Archaeological resources	Changes in the level of accessibility	Site burial, fencing, or other barriers to access	M7.1-2	High	High	N
Historical resources	Damage or destruction of sites, features, or objects	Ground disturbance	M7.1-1 M7.1-2 M7.1-3 M7.1-4	Moderate to High	High	N
Historical resources	Changes in the level of accessibility	Site burial, fencing, or other barriers to access	M7.1-2	High	High	N
Archaeological resources	Damage or destruction of sites, features, or objects	Accidents and malfunctions (e.g., spills)	M7.1-1 M7.1-2 M7.1-3 M7.1-4	Moderate to High	High	N

Subcomponent	Potential Effect Before Mitigation	Contributing Project Activity or Physical Works	Mitigation #	Effectiveness	Level of Confidence	Potential Residual Effect
Historical resources	Damage or destruction of sites, features, or objects	Accidents and malfunctions (e.g., spills)	M7.1-1 M7.1-2 M7.1-3 M7.1-4	Moderate to High	High	N
Archaeological resources	Damage or destruction of sites, features, or objects	Ground disturbance	M7.1-1 M7.1-2 M7.1-3 M7.1-4	Moderate to High	High	N
Archaeological resources	Changes in the level of accessibility	Site burial, fencing, or other barriers to access	M7.1-2	High	High	N
Historical resources	Damage or destruction of sites, features, or objects	Ground disturbance	M7.1-1 M7.1-2 M7.1-3 M7.1-4	Moderate to High	High	N
Historical resources	Changes in the level of accessibility	Site burial, fencing, or other barriers to access	M7.1-2	High	High	N

7.1.5 Monitoring and Follow-Up Programs

Given that areas with heritage resource potential have not been subject to field inspection (e.g., archaeological inventory), this remains a data gap and a source of uncertainty for the effects assessment. The areas that have heritage resource potential (and therefore provide a potential Project interaction) and are testable include terrestrial portions of the LAA (minimally located within 100 m of a water course, or inland of the dyke) that will be subject to land-based ground stabilization and pile works during construction, and which may be subject to accidents and malfunctions (i.e., spills) during operation (see Table 7.1-6; Figure 7.1-5). These areas will be assessed prior to, or concurrent with, proposed future ground disturbance activities by WesPac. If suitable remote sensing data (i.e., bathymetry, magnetometry) are available, the review of these data would address the unlikely possibility that heritage wrecks are present and have not been removed by historical dredging in the subtidal portions of the Dredge Area (see **Section 7.1.2.2.3**, Table 7.1-6). Should heritage resources be encountered, the mitigation measures described in **Section 7.1.4.3** will be implemented to eliminate the potential for residual project effects on Heritage Resources.

A Heritage Resources Chance Find Management Procedure will be prepared for implementation by WesPac. This will be a stand-alone document, and will be appended to the comprehensive Environmental Management Plan (EMP; see **Section 14.0, Management Plans**). The objectives of this Procedure include the preservation and proper management of heritage resources that are unexpectedly encountered during Project activities and to minimize disruption to construction activities and scheduling. The document will include both general guidelines and detailed steps to follow for the appropriate response to the discovery of known or suspected heritage materials during the course of Project activities. In addition to providing instructions for crews, it will include a list of important contacts and telephone numbers, a description of the most likely types of heritage feature or object to be encountered by crews and a copy of the Archaeology Branch's Found Human Remains Policy for reference.

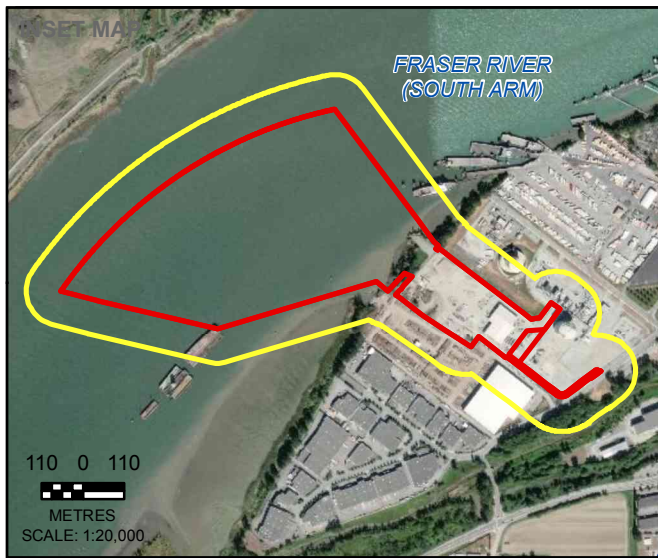
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7.1.6 References for Heritage Resources Effects assessment

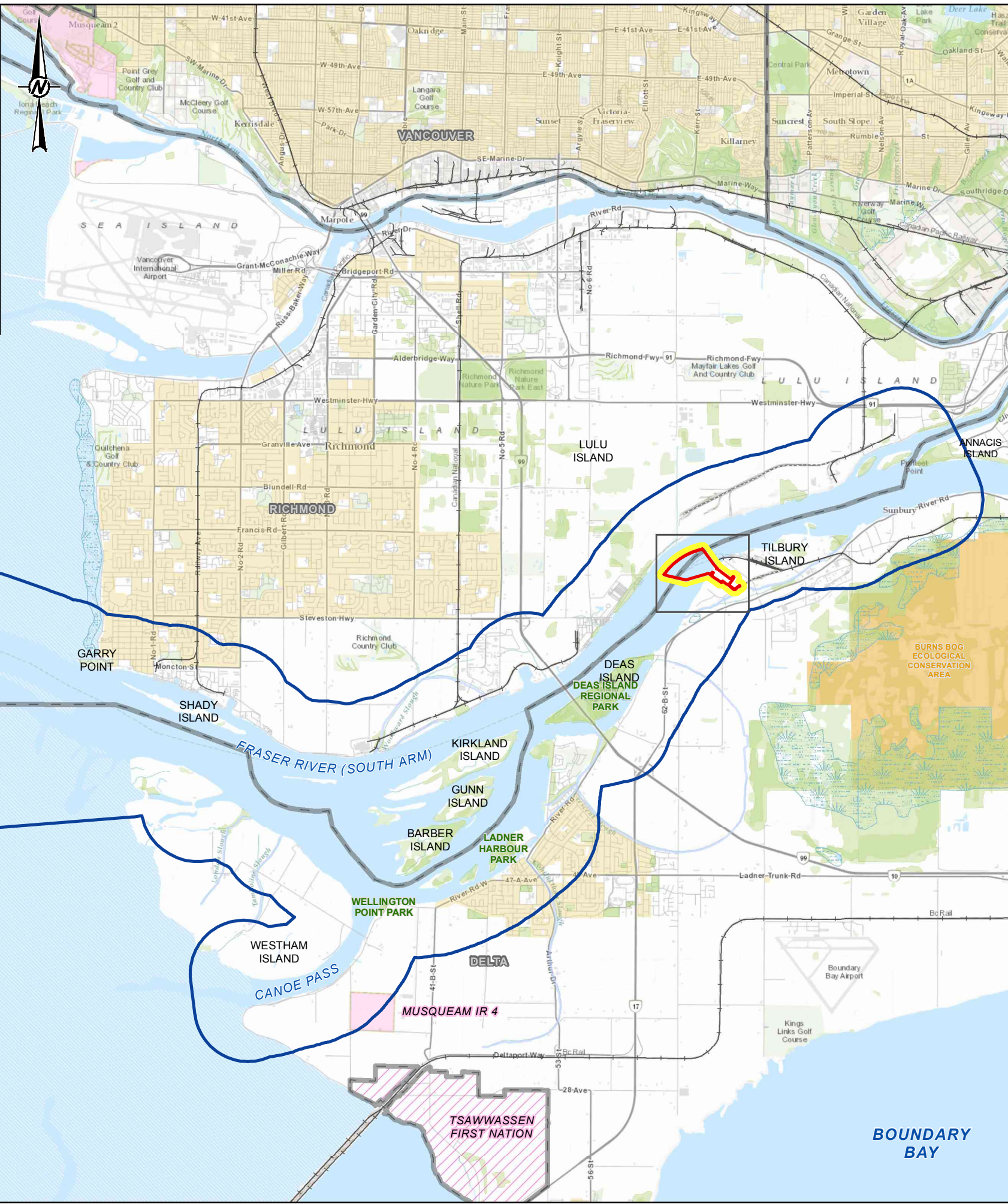
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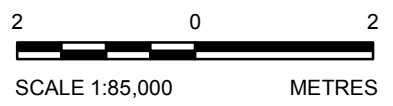


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METRES
SCALE: 1:20,000



LEGEND

- PROJECT BOUNDARY
- HERITAGE RESOURCES LAA
- HERITAGE RESOURCES RAA
- MUNICIPAL BOUNDARY
- INDIAN RESERVE
- TSAWWASSEN FIRST NATION LANDS
- RESIDENTIAL AREA
- PARK / FOREST AREA
- BURNS BOG ECOLOGICAL CONSERVATION AREA
- WETLAND
- WATER
- WATERCOURSE
- ROAD
- RAILWAY
- SAND HEADS LIGHTHOUSE



REFERENCE

1. INDIAN RESERVES, TSAWWASSEN FIRST NATION LANDS AND MUNICIPAL BOUNDARIES OBTAINED BY B.C. MINISTRY OF FORESTS, LANDS AND NATURAL RESOURCE OPERATIONS.
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CLIENT

WESPAC MIDSTREAM - VANCOUVER LLC

PROJECT

TILBURY MARINE JETTY
DELTA, B.C.

TITLE

**HERITAGE RESOURCES LOCAL ASSESSMENT AREA
AND REGIONAL ASSESSMENT AREA**

CONSULTANT



YYYY-MM-DD	2019-03-14
PREPARED	JP
DESIGN	CM
REVIEW	ARM
APPROVED	CM

PROJECT NO.
13-1422-0049

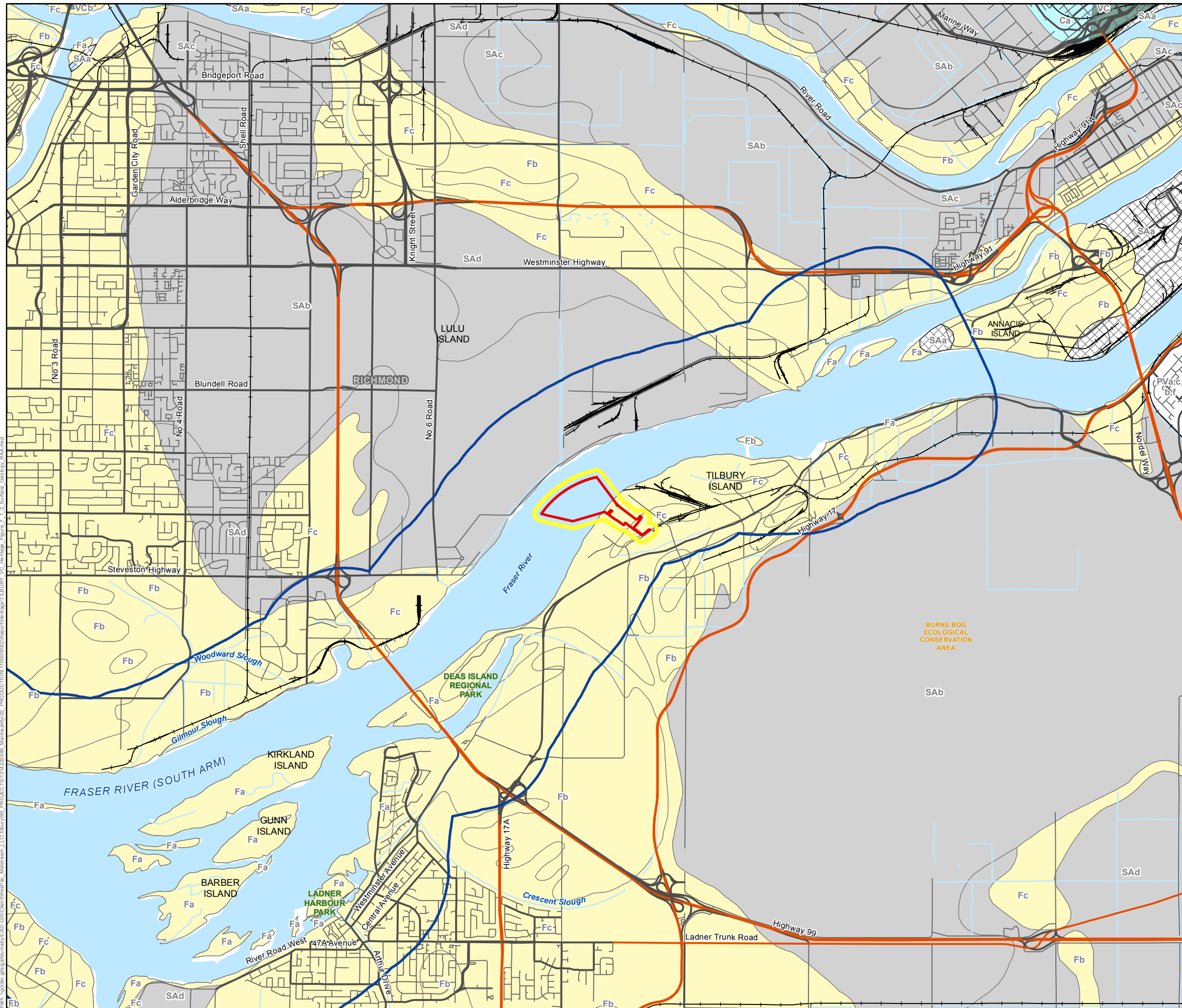
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Rev.
2

FIGURE
7.1-1

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LEGEND

- PROJECT BOUNDARY
- HERITAGE RESOURCES LAA
- HERITAGE RESOURCES RAA
- WATERBODY
- HIGHWAY
- MAJOR ROAD
- ROAD
- RAILWAY
- WATERCOURSE

SURFICIAL GEOLOGY LEGEND

QUATERNARY

POSTGLACIAL

SALISH SEDIMENTS

- Landfill including sand, gravel, till, crushed stone, and refuse
- Bog, swamp, and shallow lake deposits: SAb, lowland peat up to 14 m thick, in part overlying Fb, c; SAc, lowland peat up to 1 m thick underlying Fb (up to 2 m thick); SAd, lowland organic sandy loam to clay loam 15 to 45 cm thick overlying SAg and Fd; SAe, upland peat up to 8 m or more thick

FRASER RIVER SEDIMENTS

- Deltic and distributary channel fill sediments overlying and cutting estuarine sediments and overlain in part of the area by overbank sediments: Fa, channel deposits, fine to medium sand and minor silt occurring along present day river channels; Fb, overbank sandy to silt loam up to 2 m thick overlying 15 m or more of Fd; Fc, overbank silty to silt clay loam normally up to 2 m thick overlying 15 m or more of Fd; Fd*, deltic and distributary channel fill (includes tidal flat deposits) sandy to silt loam, 10 to 40 m thick interbedded fine to medium sand and minor silt beds; may also contain organic and fossiliferous material; Fe*, estuarine fine sand to clayey silt, in places fossiliferous; probably underlies extensive areas in Sumas and Matsqui valleys; thickness may vary from 10 to 150 m; Ff*, channel and floodplain sand and gravel, up to 60 m thick, underlying Fd,g,h; may be in part Sumas outwash (Sa,j); Fg, channelled deposits (expressed at surface by ridges and swales), silty clay loam, silt loam, silty clay, and minor organic sediments, up to 10 m thick, overlies Ff and Fe, Fh, channelled deposits similar to Fg but coarser textured, sandy loam and loamy sand

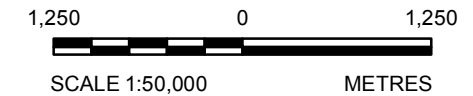
PLEISTOCENE

CAPILANO SEDIMENTS

- Raised marine, deltic, and fluvial deposits: Ca, raised marine beach, spit, bar, and lag veneer, poorly sorted sand to gravel (except in bar deposits) normally less than 1 m thick but up to 8 m thick, mantling older sediments and containing fossil marine shell casts up to 175 m above sea level; Cb, raised beach medium to coarse sand 1 to 5 m thick containing fossil marine shell casts; Cc, raised deltic and channel fill medium sand to cobble gravel up to 15 m thick deposited by proglacial streams and commonly underlain by silty to silty clay loam; Cd, marine and glaciomarine stony (including till-like deposits) to stoneless silt loam to clay loam with minor sand and silt normally less than 3 m thick but up to 30 m thick, containing marine shells. These deposits thicken from west to east. Ce, mainly marine silt loam to clay loam with minor sand, silt, and stony glaciomarine material (see Cd), up to 60+ m thick. In many of the upland areas sediments mapped as Cc and Cd are mantled by a thin veneer (less than 1 m) of Ca

VASHON DRIFT AND CAPILANO SEDIMENTS

- Glacial drift including: lodgment and minor flow till, lenses and interbeds of stratified glaciofluvial sand to gravel, and lenses and interbeds of glaciolacustrine laminated stony silt; up to 25 m thick but in most places less than 8 m thick (correlates with Va,b); overlain by glaciomarine and marine deposits similar to Cd normally less than 3 m but in places up to 10 m thick. Marine derived lag gravel normally less than 1 m thick containing marine shell casts has been found mantling till and glaciomarine deposits up to 175 m above sea level; above 175 m till is mantled by bouldery gravel that may be in part ablation till, in part colluvium, and in part marine shore in origin



REFERENCE

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CLIENT

WESPAC MIDSTREAM - VANCOUVER LLC

PROJECT

TILBURY MARINE JETTY
DELTA, B.C.

TITLE

**SURFICIAL GEOLOGY OF THE LAA AND WITHIN 5
KILOMETRES OF THE PROJECT**

CONSULTANT



YYYY-MM-DD	2019-03-14
PREPARED	JP
DESIGN	CM
REVIEW	ARM
APPROVED	CM

PROJECT NO.
13-1422-0049

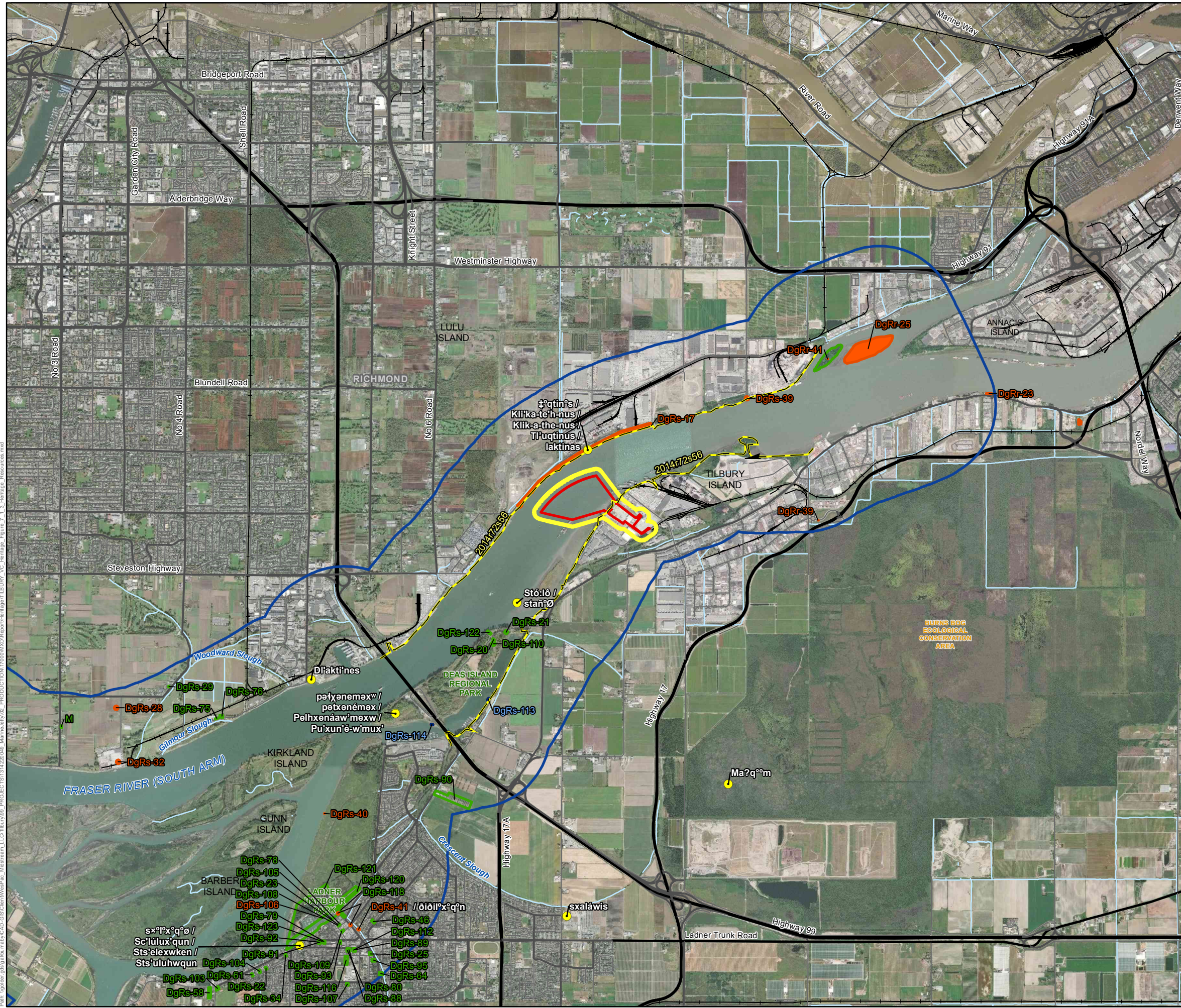
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Rev.
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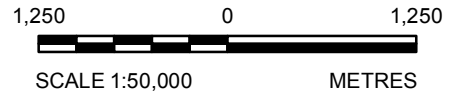
FIGURE
7.1-2

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ANSI B 24mm



- LEGEND**
- PROJECT BOUNDARY
 - HERITAGE RESOURCES LAA
 - HERITAGE RESOURCES RAA
 - ARCHAEOLOGICAL SITE
 - HISTORICAL HERITAGE SITE
 - HERITAGE WRECK SITE
 - APPROXIMATE OF TRADITIONAL PLACE NAME LOCATION
 - WRECK OBSERVED IN HISTORICAL AERIAL IMAGERY
 - TRAIL ROUTE (MODEL)
 - HIGHWAY
 - MAJOR ROAD
 - ROAD
 - RAILWAY
 - WATERCOURSE



REFERENCE

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3. HISTORICAL SITE M DIGITIZED FROM IMAGERY.
4. REFER TO THE REPORT FOR TRADITIONAL LOCATIONS.
5. GIS MODELLED TRAIL ROUTES OBTAINED FROM THE STÓ:LŌ RESEARCH AND RESOURCE MANAGEMENT CENTRE, SHIP 2015-118 (NOVEMBER 24, 2015).
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CLIENT
WESPAC MIDSTREAM - VANCOUVER LLC

PROJECT
TILBURY MARINE JETTY
DELTA, B.C.

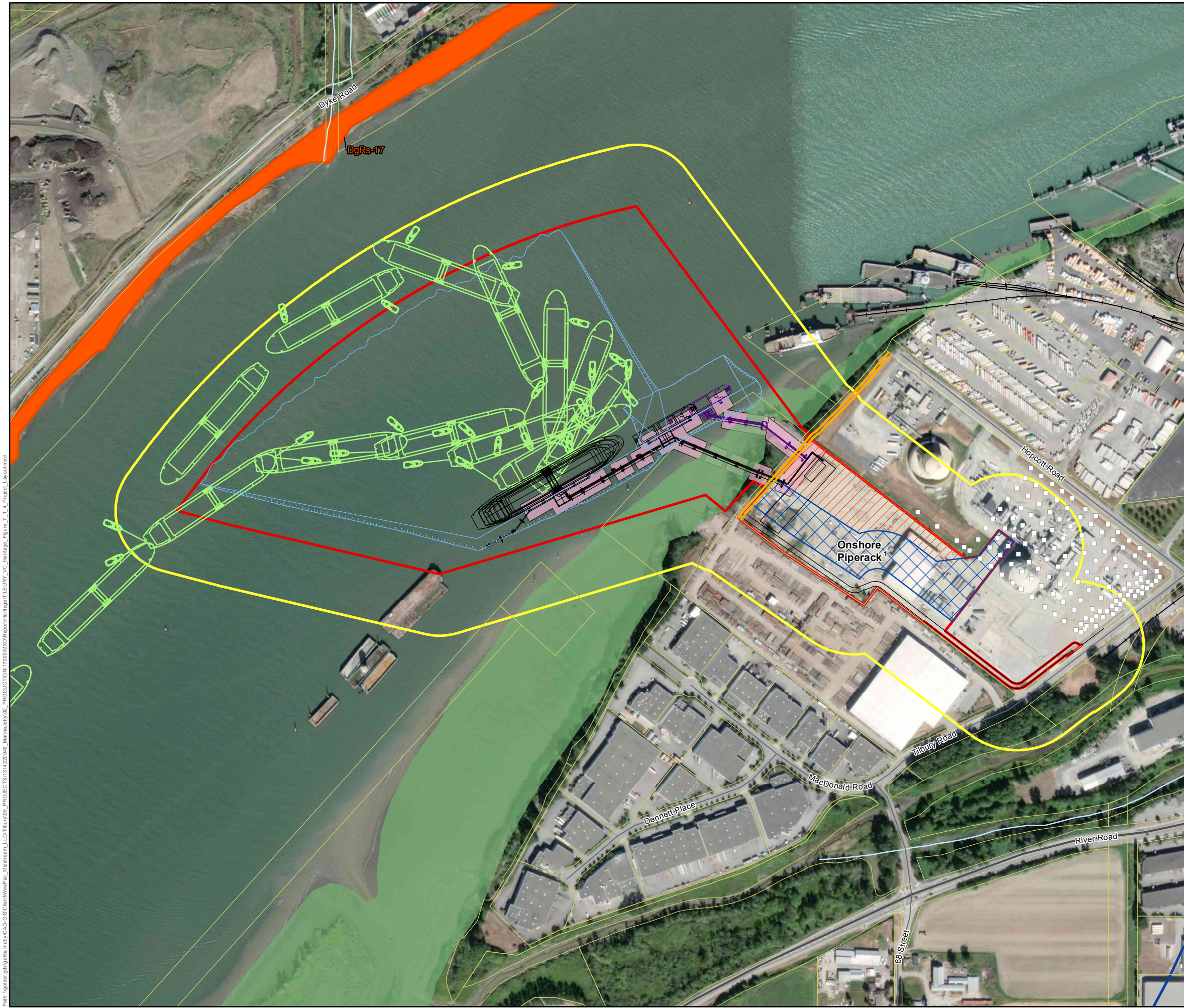
TITLE
ARCHAEOLOGICAL AND HISTORICAL RESOURCES, AND TRADITIONALLY KNOWN LOCATIONS WITHIN THE RAA AND 5 KILOMETRES OF THE PROJECT

CONSULTANT	YYYY-MM-DD	2019-03-14
	PREPARED	JP
	DESIGN	CM
	REVIEW	ARM
	APPROVED	CM

PROJECT NO. 13-1422-0049 CONTROL 18110 Rev. 2 **FIGURE 7.1-3**

Path: \\golder\gdr\p\m\mby\CAD_GIS\Clean\MapDocs_Midstream_LLC\Tilbury\99_PROJECT\311314\2019\03_PROD\FIGURE 7.1-3_Heritage_Resources.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ANSI B 24mm

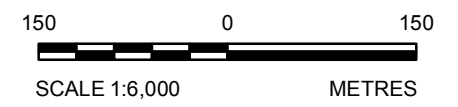


LEGEND

- PROJECT BOUNDARY
- HERITAGE RESOURCES LAA
- HERITAGE RESOURCES RAA
- CADASTRE
- INTERTIDAL ZONE
- ARCHAEOLOGICAL SITE
- STANTEC TEST LOCATION (2014)
- MAJOR ROAD
- ROAD
- RAILWAY
- WATERCOURSE

PROPOSED PROJECT LAYOUT

- DREDGE POCKET
- PROPOSED LAYOUT
- PROPOSED TEMPORARY BUNKER BERTH LAYOUT
- 90,000M³ VESSEL MOVEMENT
- DIKE/BERM
- PROPOSED DENSIFICATION AREA
- PIPE RACK - LIKELY ROUTING CORRIDOR
- PIPE RACK - POSSIBLE ROUTING CORRIDOR



NOTES

1. THE ONSHORE PIPERACK WILL HAVE A 30 METRE WIDE DENSIFICATION CORRIDOR.

REFERENCE

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CLIENT
WESPAC MIDSTREAM - VANCOUVER LLC

PROJECT
TILBURY MARINE JETTY
DELTA, B.C.

TITLE
PROJECT LAYOUT

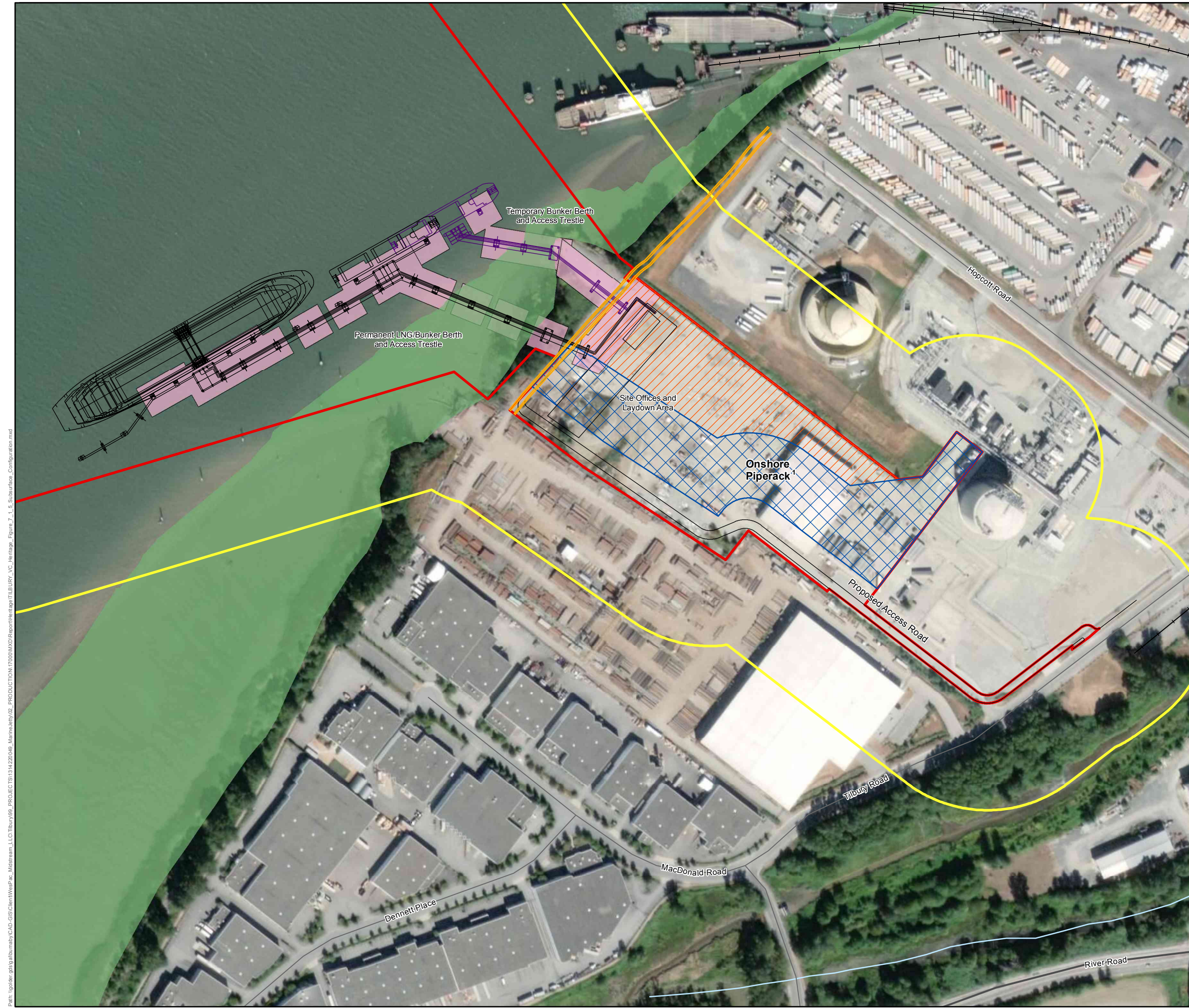
CONSULTANT	YYYY-MM-DD	2019-03-14
Golder Associates	PREPARED	JP
	DESIGN	CM
	REVIEW	ARM
	APPROVED	CM

PROJECT NO. 13-1422-0049	CONTROL 18110	Rev. 2
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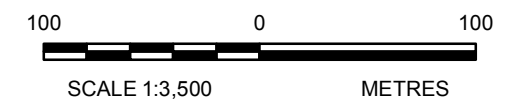
FIGURE 7.1-4

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ANSI B



- LEGEND**
- PROJECT BOUNDARY
 - HERITAGE RESOURCES LAA
 - INTERTIDAL ZONE
 - MAJOR ROAD
 - ROAD
 - RAILWAY
 - WATERCOURSE
- PROPOSED PROJECT LAYOUT**
- PROPOSED LAYOUT
 - PROPOSED TEMPORARY BUNKER BERTH LAYOUT
 - DIKE/BERM
 - PROPOSED DENSIFICATION AREA
 - PIPE RACK - LIKELY ROUTING CORRIDOR
 - PIPE RACK - POSSIBLE ROUTING CORRIDOR



NOTES

1. THE ONSHORE PIPERACK WILL HAVE A 30 METRE WIDE DENSIFICATION CORRIDOR.

REFERENCE

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3. STANTEC. 2014. FORTISBC ENERGY INC.'S TILBURY 2 PROJECT ARCHAEOLOGICAL IMPACT ASSESSMENT (2013-0332). FINAL REPORT PREPARED FOR FORTISBC ENERGY INC., MARCH 5, 2014.
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PROJECTION: UTM ZONE 10; DATUM: NAD 83

CLIENT
WESPAC MIDSTREAM - VANCOUVER LLC

PROJECT
TILBURY MARINE JETTY
DELTA, B.C.

TITLE
SUBSURFACE CONFIGURATION

CONSULTANT	YYYY-MM-DD	2019-03-14
Golder Associates	PREPARED	JP
	DESIGN	CM
	REVIEW	ARM
	APPROVED	CM

PROJECT NO. 13-1422-0049 CONTROL 18110 Rev. 2 **FIGURE 7.1-5**

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ANSI B