

8.0 ASSESSMENT OF POTENTIAL HERITAGE EFFECTS

8.1 Heritage Resources

8.1.1 Introduction

This section of the Environmental Assessment Certificate (EAC) Application/Environmental Impact Statement (EIS) (hereafter referred to as the EA) has been prepared by Golder Associates Ltd. (Golder). It addresses the effects of the Proposed BURNCO Aggregate Project (hereafter referred to as the 'Proposed Project' or the 'Project') identified in the construction, operation, reclamation and closure phases on Valued Components (VCs) related to heritage resources. For the purpose of this report the term heritage resources includes: archaeological sites and materials, historic features and habitations, and palaeontological resources. A heritage resource overview assessment (HROA) was conducted and consists of an archaeological impact assessment (AIA), a historical overview assessment, and a palaeontological overview assessment for the Proposed Project. Consideration has been given to mitigation measures proposed to offset any identified effects to acceptable levels and any residual effects have been characterized. Additionally, consideration has also been given to cumulative effects of other reasonable foreseeable future projects in combination with the residual effects of the Proposed Project.

This section should be read in conjunction with the following technical baseline report(s) provided in Volume 4, Part G – Section 22.0: Appendices:

- Appendix 8.1-1 - Final Report on Archaeological Impact Assessment of Proposed Aggregate Project at McNab Creek, Howe Sound, BC.
- Appendix 8.1-2 - Heritage Resource Overview Assessment of Proposed Aggregate Project at McNab Creek, Howe Sound, BC.
- Appendix 8.1-3 - Palaeontological Resource Desktop Assessment BURNCO Rock Product Ltd.'s Proposed BURNCO Aggregate Project Howe Sound, BC.

8.1.2 Regulatory and Policy Setting

This section summarizes the regulatory and policy setting of the Proposed Project as it relates to heritage resources.

Three pieces of legislation have bearing on the Proposed Project: the *Heritage Conservation Act* (HCA), the former *Canadian Environmental Assessment Act* (CEAA), and the *BC Environmental Assessment Act* (BCEAA). The role and scope of these three pieces of legislation are outlined in the following sections. Complementary First Nations heritage policies, the *BC Fossil Management Framework*, and the *Local Government Act* also have relevance to the Proposed Project and are summarized below.

8.1.2.1 Heritage Conservation Act

All archaeological sites on provincial Crown or private land predating 1846 are automatically protected under 1996 amendments to the HCA. Certain sites, including burials and rock art sites, that have historical or archaeological value, are protected regardless of age. 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.

Site protection under the HCA does not necessarily negate impact; in some cases, development proceeds following an impact assessment or other mitigation actions. Subsurface investigation of an archaeological site or investigation with the intent to locate a site requires a permit under Section 14 of the HCA. In addition, with the exception of impacts occurring under a Section 14 Permit, any alteration to a known archaeological site must be permitted under Section 12 of the HCA. A Section 12 Site Alteration Permit (SAP) is held by the individual responsible for the site alteration and may include data recovery or mitigation requirements such as monitoring or data sampling.

The Archaeology Branch (Ministry of Forests, Lands and Natural Resource Operations) is the provincial government agency responsible for administering the HCA, issuing permits, maintaining a database of recorded archaeological sites, and handling referrals from various development agencies. All applications for Section 12 or Section 14 HCA Permits are forwarded by the Archaeology Branch to appropriate First Nations for review. A 30-day review period is provided for comments regarding the proposed methodology.

8.1.2.2 Local Government Act

Significant historical sites that are not protected by the HCA may be protected by municipal by-law, per the *Local Government Act*, and/or included on municipally-administered Community Heritage Registers (CHRs). A CHR provides a degree of recognition for these sites; however, without municipal legislation (such as a heritage designation by-law, heritage revitalization agreement by-law, and/or heritage restrictive covenant), inclusion on a CHR does not provide protection for these sites.

8.1.2.3 First Nations Heritage Policy and Permitting Systems

Many British Columbia First Nations have developed their own heritage policies with permitting systems. While not legally binding, the archaeological community has largely respected these requirements. Both of the First Nations groups with interests in the Proposed Project, (the *Skwxwú7mesh* (Squamish) First Nation and Tsleil-Waututh Nation), have heritage policies and permitting systems.

In general, the scope of these heritage policies reflects a desire to have some measure of control over archaeological research in each respective First Nations' territory so that particular cultural protocols are observed, particularly as they relate to human remains. While aspects of these policies parallel the HCA, many diverge when it comes to the definition of what constitutes a "cultural resource". Most First Nations heritage policies take a broader view of heritage resources that warrant management, compared to the HCA (Mason 2011).

8.1.2.4 BC Fossil Management Framework

The Province of British Columbia recognizes that palaeontological remains have a 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). As such, the Province recognizes the need to protect significant fossil finds and the interests of stakeholders. Undermining this recognition is the absence of administrative controls and legal instruments designed to protect and manage such resources. Currently, fossil collecting is largely unregulated and there is no clear policy for fossil management (Fossil Management Review Technical Working Group 2004). As such, conflicts have arisen between scientific, recreational and commercial interests due to the lack of programs to manage palaeontological sites. For projects that trigger the former CEAA in BC, best practices from other Canadian jurisdictions (such as Alberta) are generally followed for assessing, documenting, and mitigating impacts to identified palaeontological resources.

8.1.3 Assessment Methodology

This section provides a description of the assessment methodology used in preparing the EA related to heritage resources.

Please refer to Volume 2, Part B - Section 4.0: Assessment Methods of this EA for full description of the assessment methodology and scope including: selection value components, establishing boundaries, describing existing conditions, identification of Proposed Project VC interactions, identifying mitigation measures, evaluating residual effects and assessing cumulative effects.

8.1.3.1 Valued Component (VC) Selection and Rationale

The heritage resources VC comprise of palaeontological, archaeological, and historical resources. While archaeological resources and certain historical resources are protected by the HCA, all three resource types are subject to existing management frameworks or legislation, warranting consideration under the former CEAA. Further, all three resource types have the potential to interact with activities associated with the construction,

operation and maintenance, and closure and reclamation phases of the Proposed Project. Key indicators of heritage resources are palaeontological, archaeological, and historical sites, whether known or unknown. Palaeontological sites or localities are specific locations where evidence of extinct life forms has been recorded within the geological record. Similarly, archaeological sites are specific locations associated with past cultural activities where the primary information source is gathered via scientific methods. Such archaeological sites could include, but are not limited to: stone artifact scatters, culturally modified trees, cultural depressions, rock shelters, burials, rock art, and/or trail beds. Archaeological sites primarily date to the Pre-Contact Period, but may also include HCA-protected Post-Contact (historical) sites, including forts, burials, marine wrecks, and aviation wrecks. Other historical sites which may or may not be protected by the HCA include places or things of historical or architectural significance, and/or structures.

Heritage resources may occur in subsurface deposits or as surface expressions. Therefore, heritage resources may remain undetected through even the most rigorous studies. Heritage resource potential models are used to identify areas with a greater likelihood of encountering resources than would be encountered by random sampling. Areas with archaeological potential could include: level or near level terrain adjacent to distinct breaks-in-slope, freshwater shorelines and other features associated with watercourses (such as terraces, stream banks, or palaeo-shorelines), previously recorded archaeological sites, known pre-contact resource procurement places (including stone quarries), obvious transportation corridors, karst or rock shelter features, good vantage points, and/or older tree stands. Palaeontological sensitivity mapping, which is generated through a review of known resources, surface and subsurface geology, and geomorphology, provides a similar level of information.

A simplified presence/absence criteria is used for determining effects predictions relating to the Key Indicators of the heritage resources VC as provided below.

Table 8.1-1 summarizes the identified VC, rationale for their inclusion in the assessment, and Measurable Indicators that will be considered. The candidate heritage resource VC was carried forward in the effects assessment (e.g. no heritage resource VCs were excluded from the assessment). Additional details regarding the methods used to select VCs is provided in Part B, Volume 2 – Section 4.2.4.

Table 8.1-1: Valued Components and Measurable Indicators: Heritage Resources

Valued Component	Rationale	Measurable Indicators
Heritage Resources	Construction and operation of the Proposed Project could directly or indirectly affect heritage resources in the Proposed Project Area.	Presence or absence of heritage resources.

8.1.3.2 Assessment Boundaries

8.1.3.2.1 Spatial Boundaries

The spatial boundaries for the EA have been selected to take into account the physical extent of the Proposed Project, physical extent of Proposed Project-related effects, and the physical extent of any key environmental systems. The spatial boundaries for heritage resources are provided in Table 8.1-2.

For a full description of the temporal boundaries of the Proposed Project please refer to Part A.

Table 8.1-2: Spatial Boundaries: Heritage Resources

Study Area	Description
Local Study Area (LSA)	The heritage resources Local Study Area (LSA) measures 117.678 hectares (ha) and includes a buffer due to potential locations for related habitat compensation works (Figure 8.1-1).
Regional Study Area (RSA)	The RSA includes the inter-tidal and shallow sub-tidal areas of Howe Sound located within 4 km on both sides of and perpendicular to the proposed barge centrelines routes (Figure 8.1-2).

8.1.3.2.2 Temporal Boundaries

Based on the Proposed Project schedule, the temporal boundaries for the effects assessment for heritage resources are as follows:

- Project construction – up to 2 years;
- Project operations and maintenance – 16 years; and
- Project reclamation and closure – on-going and one year beyond operations.

Proposed Project construction conditions – Includes all pre-construction activities such as site preparation, ancillary work, and constructions activities. The construction phase is estimated to commence in 2014 and be completed in 2015, with heritage resource assessment (including an AIA) occurring during pre-construction activities. The proposed aggregate pit represents the largest single part of the Proposed Project and will include timber and brush clearing in advance of excavation. Additional potential impacts from construction may occur from geotechnical testing, the addition of fill, heavy equipment traffic, road construction, berm and dyke construction, and from infrastructure. Infrastructure may include but is not limited to: aggregate processing facilities, an office and welfare building, an electrical substation, underground tunnels and above-ground conveyors, the barge load out jetty with mooring appurtenances, and habitat compensation areas.

Proposed Project operation and maintenance conditions – The operational phase will last through the expected economic and design life of the equipment, which is expected to last 16 years. Aggregate extraction from the main source during operations has the potential to affect heritage resources, if present. Additional potential impacts to heritage resources may occur as a result of wave action along the proposed barge routes. While unlikely, effects from accidental fuel releases or tug and barge stranding could impact heritage resources (including heritage wrecks) that are located in the intertidal area of the RSA, (which includes a 4 km direct line from the centrelines of the proposed barge shipping routes). Impacts occurring due to barge or tug stranding may be anticipated to archaeological resources located within the shallow sub-tidal areas (to a depth of 15 m bsl¹), as well as inter-tidal areas.

¹ Below sea level (bsl), represents a measure below the elevation of hydrographic chart datum at lowest normal tide.

Proposed Project remediation and closure - The remediation and closure of the Proposed Project will be ongoing and last approximately one year beyond operations. The scope for interaction during remediation and closure phase is considered limited.

8.1.3.2.3 Administrative Boundaries

The Administrative Boundaries for the heritage resource study of the Proposed Project can be defined as those presented in the HCA Permit 2010-0031 (Volume 4, Part B – Section 22.0: Appendix 8.1-1) which includes the 117.678 ha of the LSA.

8.1.3.2.4 Technical Boundaries

The Technical Boundaries for the heritage resource study of the Proposed Project include the RSA and LSA as well as surrounding areas with existing information on heritage site locations that could be used in the identification of heritage resource potential assessment. Uncertainties with the exact location of archaeological sites and existing palaeontological resources exist, as does their current condition. Monitoring effects on these resources may prove to be difficult.

8.1.3.3 Assessment Methods

The heritage resources VC includes unique, non-renewable resources which are susceptible to changes to their integrity, context and accessibility. Heritage resource integrity and context can be affected, not only by physical impacts such as displacement or removal through excavation, but also by factors such as compaction or chemical alteration which can change the nature of the resource while remaining in situ. Indirect effects can include changes to the environment which create greater or less accessibility to heritage resources, essentially exposing resources to higher risk of vandalism, unpermitted collection or, conversely, by rendering them inaccessible and effectively precluding them from further scientific study. For the heritage resources VC, Proposed Project-induced effects are those that may alter natural processes, which in turn, affect the resources.

Preservation of heritage resource sites can be affected by geological processes. Certain factors, such as unusually dry or wet soil conditions, can enhance preservation of organic heritage materials, while other processes such as flooding can destroy evidence. Certain heritage sites may be covered with sediments or subject to erosion and redeposition. The context of a heritage resource, including its state of preservation, is instrumental in evaluating the sites heritage value.

As stated previously, heritage resources occur as surface expressions or buried subsurface deposits, with the result that even the most rigorous field studies may not identify all heritage resources present. Therefore, Proposed Project-related activities which have the potential to affect heritage resources integrity, context, and accessibility must be reviewed relative to both known and unknown heritage resources. Further, heritage resources that occur as surface expressions may be more vulnerable to the effects of low impact Proposed Project-related activities such as barge and water taxi traffic in comparison to subsurface heritage resources. Once a potential effect has been identified, the assessment of the adverse nature of the effect is measured against the

value and sensitivity of the heritage resource being affected. For example, the same level of disturbance to two archaeological sites of differing heritage values, or sensitivity ratings, may have widely differing levels of impact if left unmitigated.

For the purposes of this effects assessment, both indirect and direct effects may occur within the LSA, while the RSA is generally susceptible to indirect Proposed Project-induced effects.

8.1.3.3.1 Existing Conditions

A heritage resources overview assessment (HROA) was prepared to characterize archaeological and historical baseline conditions for the RSA. The HROA included desktop studies to assess the potential for the existence of archaeological and historical sites within the RSA, as described in Volume 4, Part G – Section 22.0: Appendix 8.1-2 (Section 1.1). The HROA also included a background review and field study program to assess for the presence of heritage resources within the LSA. The HROA incorporated the AIA field component and associated results, which was conducted under HCA Permit 2010-0031 (Volume 4, Part B – Section 22.0: Appendix 8.1-1) in accordance with *British Columbia Archaeological Impact Assessment Guidelines* (BC Archaeology Branch 1998), Tsleil-Waututh Nation Cultural Heritage Investigation Permit 2013-06, and *Skwxwú7mesh* (Squamish) Nation Archaeological Investigation Permit 12-0124. The HROA was conducted as a baseline study of potential heritage resources for reference in the Proposed Project EAC Application, and for the completion of the EA. In addition, a desktop palaeontological overview assessment (POA) was completed for the LSA and RSA drawing on geological records and palaeontological site locations from within and beyond the RSA, in order to develop a palaeontological sensitivity model for the Proposed Project.

Information used for the heritage resources desktop and field level studies baseline data included the following data sources:

- Provincial Heritage Register;
- Available ethnographic, archaeological, historical and palaeontological reports;
- Available local and shipwreck histories;
- Surficial geological maps;
- Shipwreck records, including a shipwreck database (Northern Maritime Research 2002);
- Google Earth, including historic imagery which may have been acquired during lower tides;
- Select historical aerial photos (where the historical context may be provided for locations identified through other sources); and
- Reports from remotely operated vehicle and seismic survey including multibeam bathymetric, sonar, and sub-bottom acoustic profiling previously conducted within the underwater portion of the LSA (Frontier Geoscientists 2009, Wright 2006).

An AIA was recommended for the LSA which included a field component and is further discussed in Section 3 of the resulting AIA report (Volume 4, Part G – Section 22.0: Appendix 8.1-1). The AIA included a desktop data review of relevant data (discussed above), as well as an archaeological potential assessment, and field investigation. The field methods included a systematic ground surface inspection by pedestrian traverse and a subsurface testing program intended to locate and assess archaeological materials that may be present within the LSA.

An archaeological potential assessment was conducted for the RSA and included the following data: known archaeological resource locations, the likelihood for the presence of historical resources, evaluation of relevant background materials, and review of readily available imagery (Volume 4, Part G – Section 22.0: Appendix 8.1-2, Section 4.0). To facilitate the archaeological and historical potential assessment in the RSA, the area was subdivided into the following sectors:

- Thornbrough Channel (west barge route), approximately 17 km in transit length;
- Howe Sound Basin², (west barge route), approximately 12 km in transit length;
- Ramillies Channel (east barge route), approximately 13.5 km in transit length; and
- Queen Charlotte Sound (shared portion of barge route), approximately 15.5 km in transit length.

The palaeontological methods, as discussed in Volume 4, Part G – Section 22.0: Appendix 8.1-3 (Section 3.0) included a background literature review of relevant geological, surficial geology, and palaeontological maps. All nearby and regional palaeontological site locations and their assemblage composition, if available, were recorded to form a baseline level of palaeontological knowledge in which the Proposed Project is set. From this baseline an inventory of known palaeontological sites was compiled for the LSA and RSA. Palaeontological assessments were dependent on locally available sources to aid in the evaluation of the probability for finding palaeontological resources (both surface and subsurface). Palaeontological sensitivity zones were created from the available data. The sensitivity zones indicate the interpreted potential to find palaeontological resources when conducting surface inspections. These zones are divided into four levels of sensitivity to disturbance and are discussed in Volume 4, Part G – Section 22.0: Appendix 8.1-3 (Section 3.4.2).

Where present, archaeological site value is determined using a checklist that includes the following four evaluative criteria: scientific, public, ethnic, and economic significance as per the *British Columbia Archaeological Impact Assessment Guidelines* (BC Archaeology Branch 1998), while historical site value is determined using scientific, public, ethnic, economic and historic significance evaluation criteria as found in *British Columbia Archaeological Impact Assessment Guidelines* (BC Archaeology Branch 1998). Palaeontological sites are evaluated using scientific, educational, heritage and commercial value criteria as described in the *Fossil Management Framework Consultation Summary Report* (British Columbia Ministry of Agriculture and Lands 2010) and the *Fossil Management Plan for British Columbia* (Fossil Management Review Technical Working Group 2004).

² Howe Sound Basin is a term fabricated for this report as there seems to be no distinct name for the body of water corresponding to this sector.

8.1.3.3.2 Identifying Project Interactions

A preliminary evaluation of identified interactions between the various physical works and activities and the selected VCs across all spatial and temporal phases of the Proposed Project was undertaken to characterize interactions as either:

- a) Positive, none or negligible, requiring no further consideration; or
- b) Potential effect requiring further consideration and possibly additional mitigation.

This evaluation is presented in Section 8.1.5. Rationale is provided for determinations of no or negligible interaction and that no further consideration is required. For those Proposed Project-VC interactions that may result in a potential effects requiring further consideration, the nature of the effects (both adverse and positive) arising from those interactions is described. Potential effects include direct, indirect, and induced effects.

Potential Proposed Project interactions with heritage resources result from activities which may cause planned or unplanned effects on heritage resources within the LSA and RSA, throughout the life of the Proposed Project, including closure and reclamation. These interactions relate to Proposed Project activities with the potential to cause changes to the context, integrity and accessibility of heritage resources. Because of the stationary nature of heritage resources, as defined for this application, Proposed Project interactions under consideration are those which occur within the LSA and RSA and are temporally limited to the period during which the Proposed Project is active. Proposed Project related changes to heritage resource integrity, context and accessibility may result directly from activities involving compaction, chemical alteration, physical alteration or surface and subsurface disturbance, or indirectly through increased or decreased resource access. Similarly, Proposed Project-induced effects with heritage resources could include increased erosion due to wave action from Proposed Project vessel traffic. Accidents and malfunctions such as fuel spills or barge groundings may also directly affect heritage resources, if present. When no heritage resources are present, then no interaction occurs. However, because not all heritage resources are known, possible interactions must still be considered, largely based on archaeological potential and palaeontological sensitivity models. Effects that cannot be fully mitigated through design changes, operational changes or other measures, can still interact with heritage resources, and produce residual effects.

8.1.3.3.3 Evaluating Residual Effects

Potential Proposed Project-related residual effects were characterized as the basis for determining the significance of potential residual adverse effects for each VC. The characterization of effects was undertaken following application of appropriate mitigation measures.

Potential residual effects were characterized using the following standard residual effects criteria:

- **Context** – the current and future sensitivity and resilience of the VC to change caused by the Proposed Project;
- **Magnitude** – the expected size or severity of the residual effect;
- **Extent** – the spatial scale over which the residual physical, biological and/or social effect is expected to occur;
- **Duration** – the length of time the residual effect persists;
- **Reversibility** - indicating whether the effect is fully reversible, partially reversible, or irreversible; and
- **Frequency** – how often the residual effect occurs.

The criteria defined in Table 8.1-3 have been used to characterize and determine the significance of potential effects on Heritage Resource VCs.

The likelihood of potential residual effects (after mitigation) occurring was also characterized for each VC using the following qualitative terms:

- Low - likelihood of occurrence (0 to 40%) – Residual effect is possible but unlikely;
- Medium - likelihood of occurrence (41 to 80%) - Residual effect may occur, but is not certain to occur; and
- High - Likelihood of occurrence (81% to 100%) - Residual effect is likely to occur or is certain to occur.

Characterization of likelihood was based on professional judgement taking into consideration the available qualitative and quantitative data for each potential residual effect.

Where possible, definitions have taken into account the technical guidance that has been produced. The following documents are considered to be relevant to heritage resources:

- *Heritage Conservation Act*;
- Draft Application Information Requirements/Environmental Impact Statement Guidelines (Rev 3.0);
- *BC Environmental Assessment Act*, and
- Former *Canadian Environmental Assessment Act*.

Please refer to Volume 2, Part B - Section 4.0 of this EA for a description of the criteria used to characterize potential effects for all disciplines.

The likelihood of potential residual effects occurring was also characterized for each VC using appropriate quantitative or qualitative terms.

Table 8.1-3: Criteria for Characterizing Potential Residual Effects: Heritage Resources

VC	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Heritage Resources	Heritage resources are considered non-resilient, unable to tolerate stresses without being damaged. Context is measured by level of previous disturbance, simplified to Resilient (Disturbed), Moderately Resilient (Partially Disturbed), or Sensitive (Undisturbed).	The amount of physical alteration or destruction which can be expected. The resultant loss to heritage value is measured either in amount or degree of disturbance (Adapted from BC Archaeology Branch 1998). Negligible, Low; Medium; or High.	Local Effects occur within the LSA; Regional Effects occur within the RSA; or Beyond Regional Effects occur outside the RSA.	Short-term – The activity or activities causing the effect occurs during the construction phase of the Proposed Project only; Medium-term – The activity or activities causing the effects occur through the operations phase of the Proposed Project; or Long-term – The activity or activities causing the effects occur through the operations and into the closure phase.	Fully Reversible – Effects that can be reversed at the Proposed Project end; Partially Reversible – Effects that can be reversed partially, or that take time to be reversed; or Irreversible Effects that cannot be reversed.	Low - Occurs rarely or during a specific period; Medium - Occurs intermittently; or High - Occurs continuously.

8.1.3.3.4 Evaluating Significance of Residual Effects

The significance of potential residual adverse effects will be determined for each VC based on the residual effects criteria and the likelihood of a potential residual effect occurring, a review of background information and available field study results, consultation with government agencies, First Nations, and other experts, and professional judgement.

The determination of significance of residual adverse effects is rated as negligible-not-significant, not significant, or significant, which are generally defined as follows:

- Negligible-Not Significant: The basis for determining that effects are negligible will be provided in the Application for each VC. Negligible effects will not be carried forward to the cumulative effects assessment
- Not significant: Effects determined to be not significant are residual effects greater than negligible that do not meet the definition of significant. Residual effects that are not significant will be carried forward to the cumulative effects assessment.
- Significant: The basis for determining that a residual effect is significant will be provided in the Application for each VC. Significant residual effects will be carried forward to the cumulative effects assessment.

Rationale and determination of the significance of potential residual effects on VCs are provided in Section 8.1.5.

8.1.3.3.5 Level of Confidence

The level of confidence for each predicted effect is discussed to characterize the level of uncertainty associated with both the significance and likelihood determinations. Level of confidence is typically based on expert judgement and is characterized as:

- Low: Limited evidence is available, models and calculations are highly uncertain, and/or evidence about potential effects is contradictory.
- Moderate: Sufficient evidence is available and generally supports the prediction.
- High: Sufficient evidence is available and most or all available evidence supports the prediction.

The prediction confidence of the assessment on each VC is based on gathered background information, field study results, knowledge of types of effects potentially resulting from various activities, professional judgement, and effectiveness of mitigation.

The buried nature of many heritage resources and resulting lack of visibility means that undetected resources may be encountered at any time over the life of the Proposed Project. While desktop and field studies were undertaken, methods used for identifying and confirming the presence of heritage resources during the impact assessment necessarily relied on surface and subsurface visibility at the time of the assessment. Subsurface visibility for the archaeological resources was achieved through shovel testing and examination of fortuitous subsurface exposures. The combined use of an archaeological potential model with ground-truthing provides a higher level

of confidence in the results than either method on its own. Palaeontological and historical studies were limited to desktop analysis, without the benefit of ground-truthing. Pre-development verification of palaeontological potential through ground-truthing would offer a higher level confidence in the assessment and has been recommended (Volume 4, Part B – Section 22.0: Appendix 8.1-3). However, effects on undetected heritage resources can be effectively managed through the use of a heritage resource chance find management plan, which outlines the procedure to be taken in the event that heritage resources are encountered over the course of the Proposed Project. The use of an archaeological potential model and palaeontological sensitivity mapping further increase the level of confidence associated with residual effects characterization by greatly enhancing the accuracy of likelihood determinations.

8.1.4 Baseline Conditions

8.1.4.1 Traditional Ecological and Community Knowledge Incorporation

TEK/CK information was sought from publicly-available sources in the process of conducting a heritage resources overview assessment (HROA) to characterize archaeological and historical baseline conditions for the Heritage Resources VC, and to plan for the archaeological impact assessment (AIA). These sources included the Provincial Heritage Register and available ethnographic, archaeological, and historical reports. The HROA and the results of the AIA informed this effects assessment on heritage resources.

Additional information was obtained subsequent to writing the Heritage Resources effects assessment, including:

- Occupation and Use Study (OUS) undertaken by *Skwxwú7mesh* (Squamish Nation) (Traditions 2015 a,b);
- An expert report produced on behalf of Tsleil-Waututh Nation for another project (Morin 2015); and
- Regulatory documents for other projects in close proximity to the Proposed Project Area (e.g., Eagle Mountain – WGP 2015 a,b; PMV 2015; WLNG 2015).

These TEK/CK sources did not provide any additional specific information that would affect the existing conditions or effects assessment for the Heritage Resources VC. A summary of the general information related to cultural heritage follows.

Skwxwú7mesh report hundreds of place names, habitation sites and resource areas in the region, many with associated histories including origin and ancestral stories (Traditions 2015b). *Skwxwú7mesh* ancestral village sites are located throughout the west side of Howe Sound, including *tsitsusm* (Potlatch Creek), *k'ik'elxn* (Port Mellon), *ch'kw'elhp* and *schenk* (Gibsons) and *kw'ech'tenm* (Kwitctenem/McNab Creek) (Kennedy and Bouchard 1976a in WLNG 2014; Kennedy and Bouchard 1976a in Millennia Research Ltd. 1997; Millennia Research Ltd. 1997; Reimer 2011). Several of these locations are included in Figure 8.1-2 Regional Study Area for Heritage Resources in this Application.

Skwxwú7mesh reports that there are 107 dwelling sites within Howe Sound, and five within a 3 km radius of the Project Area, although *Skwxwú7mesh* has not provided specific locations for these sites. These sites include archaeological sites, villages, campsites and bases for resource gathering, economic activities and cultural events, which provides evidence of long term, intense occupation by *Skwxwú7mesh* people and their ancestors. Sites related to traditional *Skwxwú7mesh* culture and history where one or more of the following site “activities” is

recorded: named place, traditional history, burial, ceremonial/sacred site, legendary being, conflict, medical/therapeutic site or archaeological site. Of the cultural history sites in Howe Sound, there are over 200 named places, and countless history sites, illustrating the high cultural and historical value of the region to the *Skwxwú7mesh* (Traditions 2015b).

Tsleil-Waututh Nation has previously reported that Howe Sound holds substantial meaning and significance to them. They describe multiple settlement and overnight campsites along the shores of Howe Sound, used for harvesting. Culturally significant landscapes and the features associated with them include, but are not limited to, named places, village sites, transformer sites, rock art locations, wild spirit places, and travel routes (WLNG 2015).

Tsleil-Waututh Nation reports that it maintains confidential records of traditional activities within their territory that relate to cultural heritage, as well as the seasonality and procurement of culturally important marine species. (WLNG 2015). Tsleil-Waututh Nation also reports that several landforms in Howe Sound are linked with powerful spirit beings, and many landscape features are used in traditional ceremonial practices (WLNG 2015). The Proponent has not received information on these culturally significant locations.

For a full summary of Aboriginal Group use and occupancy of Howe Sound refer to Part C.

8.1.4.2 Introduction

Desktop and field-level studies were conducted to assess the potential for archaeological and historical resources within the LSA. The study included a comprehensive background literature review and a field-level AIA. A HROA was also conducted to summarize the heritage resources present within the RSA. The RSA was identified for the purpose of this heritage resource study to include a large portion of shallow sub-tidal and inter-tidal zones of the lower Howe Sound shoreline. In addition, a POA was completed to identify the palaeontological sensitivity of the LSA and RSA.

8.1.4.3 Results

No heritage resources were identified or observed in the LSA during the course of field work for the archaeological program conducted on January 22 and 23, 2013. Two areas of archaeological potential identified within the LSA were subject to subsurface testing. Twenty-eight shovel tests were excavated, with negative results.

The palaeontological overview assessment identified a total of 35 polygons demarking the palaeontological sensitivity zones across the LSA. Six areas with high sensitivity have been identified that are the most prospective areas for fossils and a further 27 larger areas with medium palaeontological sensitivity are regarded as secondary prospective areas. The background area across the Proposed Project Area is considered to be of low sensitivity at the surface; however, wherever excavation is expected to occur, fossiliferous strata could be encountered. No palaeontological field component has been undertaken to date, to verify the potential ratings.

The desktop review of heritage resources in the RSA resulted in the identification of 89 recorded heritage sites: 78 archaeological sites, six heritage wrecks (both possible and reported), and five properties included in community heritage registers (but not protected under the HCA). Six locations with known palaeontological

resources (F008, F030, F031, F032, F033, and F037) have been documented within the RSA (Volume 4, Part G – Section 22.0: Appendix 8.1-3, Figure 3). One site (F008) is located in the Thornbrough Channel on Bowen Island. Five sites (F030, F031, F032, F033, and F037) are located in the Ramillies Channel. Table 8.1-4 below provides a summary of identified HCA-protected heritage resources within the RSA.

Table 8.1-4: HCA-Protected Heritage Resources by Site Type in the RSA

Barge Route	Location	Archaeological Sites	Site Type
Thornbrough Channel	Bowen Island	DiRu-47	Subsurface, Shell Midden
		DiRt-10	Subsurface, Shell Midden
		DiRt-15	Subsurface, Shell Midden
		DiRu-65	Subsurface, Lithics
	Woolridge Island	DjRu-6	Subsurface, Charcoal
	Pasley Island	DiRu-22	Subsurface, Shell Midden
	Port Mellon	DjRu-5	Human Remains, Cemetery
		DjRu-7	Surface, Lithics
		DjRu-9	Marine, Shipwreck
	Hopkins Landing	DiRu-11	Subsurface, Shell Midden
		DiRu-12	Subsurface, Shell Midden
		DiRu-2	Surface, Subsurface, Shell Midden, Fish Trap, Lithics
		DiRu-14	Subsurface, Shell Midden
		DiRu-50	Precontact, Cultural Material,
		DiRu-53	Culturally Modified Tree, aboriginally-logged, flat-topped stump
		DiRu-67	Subsurface, Lithics
		DiRu-15	Subsurface, Shell Midden
	Granthams Landing	DiRu-17	Subsurface, Shell Midden
		DiRu-1	Subsurface, Shell Midden
		DiRu-16	Subsurface, Shell Midden
		DiRv-8	Subsurface, Shell Midden, Surface, Lithics
		DiRv-1	Subsurface, Shell Midden, Surface, Lithics
	Keats Island	DiRu-19	Subsurface, Shell Midden
		DiRu-27	Subsurface, Shell Midden
		DiRu-79	Surface, Lithics
		DiRu-80	Surface, Lithics
		DiRu-41	Surface, Lithics, Subsurface, Shell Midden
		DiRu-63	Subsurface, Surface, Lithics
DiRu-76		Surface, Lithics	
DiRu-77		Surface, Lithics	

Barge Route	Location	Archaeological Sites	Site Type
		DiRu-75	Surface, Lithics
		DiRu-74	Surface, Lithics
		DiRu-20	Subsurface, Shell Midden, Fish Trap, Surface, Subsurface, Lithics
		DiRu-72	Surface, Lithics
	Gambier Island	DiRu-8	Subsurface, Shell Midden
		DiRu-10	Subsurface, Shell Midden, Transportation, Marine, Shipwreck
		DiRu-61	Historic, Transportation, Marine, Precontact, Human Remains, Cemetery
		DiRu-18	Subsurface, Shell Midden
		DiRu-48	Subsurface, Shell Midden
		DiRu-6	Subsurface, Surface, Lithics
		DiRu-5	Subsurface, Shell Midden
		DiRu-68	Subsurface, Shell Midden
		DiRu-4	Subsurface, Lithics
		DiRu-3	Subsurface, Shell Midden, Human Remains, Burial
		DiRu-34	Subsurface, Shell Midden
		DiRu-28	Surface, Lithics
		DiRu-29	Subsurface, Shell Midden, Surface, Lithics
		DiRu-31	Subsurface, Shell Midden
		DiRu-32	Subsurface, Shell Midden
		DiRu-58	Subsurface, Surface, Lithics
		DiRu-57	Surface, Lithics
		DiRu-33	Surface, Lithics
		DiRu-56	Subsurface, Surface, Lithics
		DiRu-69	Transportation, Marine, Shipwreck
		DiRu-57	Surface, Lithics
		DiRu-58	Subsurface, Surface, Lithics
		DiRu-55	Subsurface, Shell Midden
		DiRu-66	Transportation, Marine, Shipwreck
		DiRu-60	Subsurface, Surface, Lithics
		DiRu-13	Surface, Lithics
DiRu-7	Subsurface, Shell Midden		
DiRu-9	Precontact, Cultural Material, Subsurface, Shell Midden		

Barge Route	Location	Archaeological Sites	Site Type
Ramillies Channel	Lions Bay	DiRt-3	Subsurface, Shell Midden, Surface, Lithics
		DiRt-13	Ceremonial/Religious Feature, Rock Art, Petroglyph
		DiRt-2	Subsurface, Lithics
	Anvil Island	DjRt-4	Surface, Lithics
	Gambier Island	DjRu-4	Subsurface, Shell Midden, Surface, Lithics
		DjRu-1	Subsurface, Shell Midden
		DjRu-2	Subsurface, Firebroken Rock
		DiRt-21	Surface, Lithics
		DiRt-22	Surface, Lithics
		DiRt-20	Surface, Lithics
		DiRu-54	Surface, Lithics, Historic, Building, Habitation, Cabin
		DiRt-16	Subsurface, Shell Midden, Transportation Feature, Petroform, Canoe Skid, Cultural Material, Surface, Lithics, Historic, Building, Habitation, Cabin
		DiRt-12	Subsurface, Shell Midden
	Port Mellon	DjRu-3	Ceremonial/Religious Feature, Rock Art, Pictograph
		DjRt-6	Subsurface, Shell Midden, Surface, Lithics
Bowyer Island	DiRt-14	Subsurface, Shell Midden	
Queen Charlotte Channel	Bowen Island	DiRt-9	Subsurface, Shell Midden
		DiRu-51	Historic, Other Structure, Marine, Causeway, Transportation, Marine
		DiRt-23	Surface, Lithics
		DiRu-46	Traditional Use Site
		DiRu-45	Subsurface, Shell Midden
	Horseshoe Bay	DiRt-7	Subsurface, Shell Midden
		DiRt-6	Subsurface, Lithics
		DiRt-25	Post contact, Transportation, Marine, Shipwreck
		DiRt-1	Subsurface, Shell Midden
	Lions Bay	DiRt-8	Subsurface, Shell Midden

8.1.4.4 Discussion/Concluding Remarks

Although no heritage resources were identified within the LSA during the AIA or as a result of the ROA and POA, the potential to encounter undetected heritage resources warrants further consideration. Of particular note, the HCA makes no distinction with respect to the protected status of archaeological materials between documented and undocumented locations. As such, precautionary measures should be taken throughout the life of the Proposed Project, such as the implementation of Heritage Resources Chance Find Management Plan (Volume 3, Part E - Section 16.0), in the event that undetected heritage resources are encountered.

With the RSA, 89 archaeological and historical sites are located along the shorelines of the 3 proposed barge routes: 62 in Thornbrough Channel; 17 in Ramillies Channel; and 10 in Queen Charlotte Channel. The sites are located within the intertidal or near shore environment. Table 8.1-5 summarizes the heritage resources site types associated with the shoreline of the three proposed barge routes located within the RSA. Table 8.1-5 also includes 6 palaeontological identified in associate with two of the proposed barge routes. The locations of recorded palaeontological sites are approximate.

Table 8.1-5: Heritage Resource Site Types along the Three Proposed Barge Routes

Site Type	Thornbrough Channel	Ramillies Channel	Queen Charlotte Channel
Subsurface Midden	24	3	5
Lithics	24	5	2
CMT/Traditional Use	1	-	1
Marine/Transportation	3	-	2
Human Remains/Burial	2	-	-
Petroglyph	-	2	-
Midden/Lithics	4	4	-
Midden/Marine	1	-	-
Midden/Burial	1	-	-
Charcoal	1	-	-
Lithics/Historic	-	1	-
Midden/Lithic/Marine Transportation/Historic	-	1	-
Other Cultural	-	1	-
Palaeontological	1	5	-

In addition to the recorded heritage sites presented in Table 8.1-5 above, seventeen additional wrecked vessels are potentially located in shallow waters of the Thornbrough (n=3), Ramillies (n=8) and Queen Charlotte (n=6) channels, while five additional wrecks may be encountered in shallow waters of the Howe Sound Basin.

Please refer to Volume 4, Part G – Section 22.0: Appendix 8.1-1 to 8.1-3 of this EA for the heritage resource technical baseline reports of the Proposed Project site.

8.1.5 Effects Assessment

8.1.5.1 Project-VC Interactions

A preliminary evaluation of identified interactions between the various physical works and activities and the heritage resources VC across all spatial and temporal phases of the Proposed Project is presented in Table 8.1-6. Potential Project-VC interactions are characterized as positive, none or negligible (requiring no further consideration) or potential effect requiring further consideration and possibly additional mitigation.

Rationale is provided for determinations of no or negligible interaction and that no further consideration is required.

For those Proposed Project-VC interactions that may result in potential direct, indirect or induced effects requiring further consideration, the nature of the effects (both adverse and positive) arising from those interactions is described in Section 8.1.5.2 below.

Table 8.1-6: Project-VC Interaction: Heritage Resources VC – Heritage Resources

Project Activities	Description	VC: Heritage Resources	
		Potential Interaction ^(a)	Potential Effect / Rationale for Exclusion
Construction			
1. Crew and equipment transport	<ul style="list-style-type: none"> ▪ Daily water taxi movements ▪ Tug and barge transport of machinery/materials ▪ Barge household and industrial solid waste barged off-site 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
2. Site preparation, including berm and dyke construction	<ul style="list-style-type: none"> ▪ Logging, clearing and grubbing ▪ Grading ▪ Construction of the berms and dyke ▪ Compaction and laying of gravel base ▪ Limited improvements to existing on-site road infrastructure 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
3. Processing area installation, including conveyors and materials handling system)	<ul style="list-style-type: none"> ▪ Installation and use of portable concrete batch plant for construction ▪ Installation of concrete foundations ▪ Installation of screens, crushers, wash plant, conveyor system and automated materials-handling system (i.e., reclaim tunnels) ▪ Installation of groundwater well as a source of make-up water for the wash plant 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
4. Substation construction and connection	<ul style="list-style-type: none"> ▪ Construct electrical substation adjacent to existing BC Hydro transmission line ▪ Construct outdoor switchyard, electric building, and 100 m transmission line 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
5. Marine loading facility installation	<ul style="list-style-type: none"> ▪ Remove existing mooring dolphins ▪ Steel pile installation ▪ Installation of conveyor, barge movement winch and mooring dolphins 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.

Project Activities	Description	VC: Heritage Resources	
		Potential Interaction ^(a)	Potential Effect / Rationale for Exclusion
6. Pit development	<ul style="list-style-type: none"> ▪ Dry excavation to remove overburden/topsoil ▪ Installation of clamshell and floating conveyor 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
7. Other ancillary land-based construction works	<ul style="list-style-type: none"> ▪ Temporary construction infrastructure set up (trailers, temporary power, etc.) ▪ Upgrades to the existing heavy equipment maintenance shop and warehouse ▪ Upgrades to the existing fuelling facility for the storage of diesel and gasoline for on-site equipment ▪ Construct site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility and helipad ▪ Install contained washroom facilities ▪ Construct pump room for well/stream intake water distribution and fire-fighting 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
8. Other ancillary marine construction works	<ul style="list-style-type: none"> ▪ Removal of existing small craft dock; install temporary dock for worker access ▪ Construct new floating small craft dock, the with tie-up area for a float plane, serviced with 30 amp (A) 125 volt (V) shore power ▪ Barge household and industrial solid waste off-site 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
Operations			
9. Crew transport	<ul style="list-style-type: none"> ▪ Daily water taxi 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present ▪ Changes to heritage resources context, if present ▪ Changes to heritage resources accessibility, if present

Project Activities	Description	VC: Heritage Resources	
		Potential Interaction ^(a)	Potential Effect / Rationale for Exclusion
10. Aggregate mining	<ul style="list-style-type: none"> ▪ Use of electric powered floating clamshell dredge ▪ Primary screening and conveyance of extracted material to processing area ▪ Install channel plug in WC 2 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
11. Processing (screening, crushing, washing)	<ul style="list-style-type: none"> ▪ Screening to separate aggregate sizes ▪ Oversized gravels crushed ▪ Operation of wash plant fed using recycled water from two large storage tanks, supplemented with make-up water by a groundwater well. ▪ Drying and storage of fines and silt 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
12. Progressive reclamation	<ul style="list-style-type: none"> ▪ Ongoing earth works (including site clearing, surface material removal) ▪ Fines and silt mixed with organic overburden material and used for infilling, re-vegetation and landscaping 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
13. Stockpile storage	<ul style="list-style-type: none"> ▪ Processed sand and gravel conveyed to stockpile area ▪ Storage of processed materials in stockpiles 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
14. Marine loading	<ul style="list-style-type: none"> ▪ Transfer of stored material using marine conveyor system ▪ Barge loading ▪ Site and navigational lighting 	○	<ul style="list-style-type: none"> ▪ No temporal or spatial overlap between Proposed Project activity and heritage resources.
15. Shipping	<ul style="list-style-type: none"> ▪ Barge traffic (delivery/collection) in Howe Sound, Ramillies Channel, Thornbrough Channel, and Queen Charlotte Channel ▪ Tug and barge transport of fuel and consumables ▪ Navigational lighting 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
16. Refueling and maintenance	<ul style="list-style-type: none"> ▪ Refueling and maintenance of on-site equipment 	○	<ul style="list-style-type: none"> ▪ No temporal or spatial overlap between project activity and heritage resources.

Project Activities	Description	VC: Heritage Resources	
		Potential Interaction ^(a)	Potential Effect / Rationale for Exclusion
Reclamation and Closure			
17. Crew and equipment transport	<ul style="list-style-type: none"> ▪ Daily water taxi movements ▪ Tug and barge transport of machinery/materials ▪ Barge household and industrial solid waste barged off-site 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
18. Removal of land-based infrastructure	<ul style="list-style-type: none"> ▪ Remove surface facilities, including clamshell dredge, conveyor system, screens, crushers, wash plant, automated materials-handling system, heavy equipment maintenance shop and warehouse, fuelling facility, site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility, helipad and contained washroom facilities 	●	<ul style="list-style-type: none"> ▪ Changes to heritage resource integrity, if present. ▪ Changes to heritage resources context, if present. ▪ Changes to heritage resources accessibility, if present.
19. Removal of marine infrastructure	<ul style="list-style-type: none"> ▪ Remove marine facilities, in marine load out facility, jetty, conveyors and piles 	○	<ul style="list-style-type: none"> ▪ Low impact activity, No temporal or spatial overlap between Proposed Project activity and heritage resources.
20. Site reclamation	<ul style="list-style-type: none"> ▪ Ongoing earth works (including site clearing, surface material removal) ▪ Fines and silt mixed with organic overburden material and used for infilling, re-vegetation and landscaping 	○	<ul style="list-style-type: none"> ▪ No temporal or spatial overlap between Proposed Project activity and heritage resources.

Notes:

○ = Potential effect of Proposed Project activity on VC is positive, none or negligible; no further consideration warranted.

● = Potential effect of Proposed Project activity on VC may require mitigation; warrants further consideration including the creation of and reference to a Heritage Resource Chance Find Management Plan

8.1.5.2 Potential Project-Related Effects

8.1.5.2.1 Heritage Resources

All heritage resource VCs are susceptible to similar types of Proposed Project-related effects. Therefore, this section presents the potential Proposed Project-related effects as comparable for palaeontological, archaeological and historical resources, including known and unknown resources. Potential Proposed Project-related effects on heritage resources can further be generalized to any activities during construction, operation or closure and reclamation that result in changes to resource integrity, context and accessibility. Typically, direct effects relate to activities, such as excavation and other ground disturbing activities during construction, aggregate extraction, processing, product storage (compaction), and earthworks activities associated with reclamation. These have the potential to cause change to resource integrity or context, if present. Indirect effects can result from activities that cause changes to resource accessibility or through indirect, Proposed Project-induced changes to the context or integrity of resources through increased wave-generated erosion along shorelines containing heritage resources. In addition, consideration is given to potential effects cause by accidents and malfunctions during each Proposed Project phase.

There is potential for wave action erosion and possible spills along the shoreline of the three proposed barge routes to affect archaeological and palaeontological resources. The impacts could result from certain Proposed Project activities such as crew and equipment transport during the construction, operation and maintenance, and reclamation and transport phases of the Proposed Project. These activities and phases were previously discussed in Table 8.1-6.

8.1.5.2.1.1 Construction

No heritage resources were identified within the LSA during the AIA, HROA or POA. Site clearing and preparation activities have the potential to affect undetected heritage resources through surface and subsurface disturbance which may result in changes to heritage site context and integrity through displacement or destruction of heritage material or cause compaction of the location.

During construction, heritage resources within the RSA are likely to be affected by Proposed Project activities in the form of wave action created by crew and equipment transport, and the potential for a spill which could affect intertidal and near shore archaeological and palaeontological sites.

8.1.5.2.1.2 Operations

No heritage resources were identified within the LSA during the AIA, HROA or POA. However, aggregate extraction activities have the potential to affect undetected heritage resources through surface and subsurface disturbance which may result in changes to heritage site context and integrity through displacement or destruction of heritage material or cause compaction of the location.

Crew transport and shipping during operations have the potential to affect heritage resources within the RSA, through low level increases in wave action created by crew and equipment transport, and the potential for a spill which could affect intertidal and near shore palaeontological and archaeological sites, including heritage wrecks.

Six locations with known palaeontological resources are located within the RSA: F008, F030, F031, F032, F033, and F037 (Volume 4, Part G – Section 22.0: Appendix 8.1-3, Figure 3) that could be affected during crew transport and operations activities. One site (F008) is located in Thornbrough Channel on Bowen Island. Five sites (F030, F031, F032, F033, and F037) are located in Ramillies Channel. There are also several locations within the RSA where potentially fossiliferous sedimentary units could be impacted by water taxi and barge transportation and the resulting wave action which would create very slight increases in rates of erosion. Much of the shoreline north and south of Lions Bay, the shoreline around Bowen Island, and several sections of shoreline associated with Gambier Island, Anvil Island, Port Melon, Langdale, and Keats Island (Volume 4, Part G – Section 22.0: Appendix 8.1-3, Figure 4), are also susceptible.

8.1.5.2.1.3 Reclamation and Closure

Reclamation and closure is unlikely to affect heritage resources although, as with construction and operation, any activities involving new ground disturbance does have the potential to affect heritage resources, if present. Activities such as foundation and pier removal may result in additional ground disturbance beyond initial construction phases.

8.1.5.3 Mitigation

This section provides a description of the proposed mitigation measures specifically related to Proposed Project effects on VCs for heritage resources. The following mitigation is presented to mitigate potential Proposed Project-related effects to Heritage Resources. The suite of measures proposed to mitigation potential heritage resources effects is presented in Table 8.1-7.

The mitigation strategy outlined below forms the basis for the commitments that the Proposed Project is making with respect to heritage resources. A detailed list of all commitments of the Proposed Project are provided in Volume 3, Part F – Section 19.

While the potential to impact heritage resources within the LSA has been examined through desktop and field level studies that resulted in no newly identified heritage resources, undetected heritage resources could still be encountered once ground-disturbing activities begin. In order to provide a cost effect method of managing heritage resources throughout the life of the Proposed Project, BURNCO should have in place a Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) that would consider the following management options, if unforeseen heritage resources are encountered:

- **Option 1:** Avoidance through partial Proposed Project redesign or relocation. This results in minimal impact to the heritage site and is the preferred option from a cultural resource management perspective. It can also be the least expensive option from a construction or operations perspective. A site investigation may be required to define the heritage site limits.

- **Option 2:** Systematic data recovery (salvage or emergency excavation), if necessary. This option can delay construction or operations by up to several weeks. Consequently, salvage or emergency excavation is not a preferred option.
- **Option 3:** Monitoring of activities. This option may require a Site Alteration permit from the Archaeology Branch if an archaeological site is present. Monitoring is appropriate where Proposed Project impacts cannot be predicted or evaluated before construction or operations, especially near the margins of a heritage site, or in cases where deeply buried deposits are expected that cannot be accessed without the assistance of heavy machinery. Monitoring may also be appropriate where systematic data recovery has been undertaken, but where significant heritage deposits (potentially archaeological or palaeontological) remain.

8.1.5.3.1 Construction

In the event that unidentified heritage resources are encountered during construction the use of a Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) could be consulted, and a qualified archaeologist and/or palaeontologist contacted to determine acceptable management strategy for heritage resources within the LSA and RSA.

8.1.5.3.2 Operations

In the event that unidentified heritage resources are encountered during operations the creation and use of a Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) could be consulted, and a qualified archaeologist contacted to determine acceptable management strategies as outlined above.

Due to the greater number of recorded heritage sites (including archaeological, palaeontological, and historical) that may be potentially impacted by wave erosion, groundings or spills during the operational period of the development in the RSA, Golder recommends making the eastern barge route (through Ramillies Channel and Queen Charlotte Channel) the preferred route as these contain fewer known heritage sites and are less susceptible to erosion.

Should a future accident occur resulting in potential impacts to inter-tidal or sub-tidal areas of the RSA where heritage sites (including archaeological, palaeontological, and historical) are present, Golder recommends that an appropriate management strategy be implemented in consultation with the Archaeology Branch, the *Skwxwú7mesh* (Squamish) First Nation, and the Tsleil-Waututh Nation.

8.1.5.3.3 Reclamation and Closure

As with other earlier phases of development, mitigation of adverse effects on heritage resources during reclamation and closure would be achieved through the implementation of a Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0). However, it is anticipated that there would likely be no temporal or spatial overlap between heritage resources and this phase of the Proposed Project as any heritage resources encountered would have been managed at an earlier phase.

Table 8.1-7 summarizes the mitigation approaches associated with each phase of the Proposed Project.

Table 8.1-7: Identified Mitigation Measures: Heritage Resources

Potential Effect	Mitigation	Anticipated effectiveness
Construction		
Changes to heritage resource integrity, if present, through compaction, crushing and chemical alteration.	Implement Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) that provides management recommendations for avoidance, systematic data recovery or monitoring, in the event that undetected heritage resources are encountered during project activities.	Mitigation measures will minimize potential residual effects to acceptable levels.
Changes to heritage resources context, if present, through surface and subsurface disturbance.	Implement Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) that provides management recommendations for avoidance, systematic data recovery or monitoring, in the event that undetected heritage resources are encountered during Proposed Project activities.	Mitigation measures will minimize potential residual effects to acceptable levels.
Changes to heritage resources accessibility, if present (increased or decreased access)	Implement Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) that provides management recommendations for avoidance, systematic data recovery or monitoring, in the event that undetected heritage resources are encountered during Proposed Project activities.	Mitigation measures will minimize potential residual effects to acceptable levels.
Operations		
Same as for construction		
Reclamation and Closure		
Same as for construction		

8.1.5.4 Residual Effects Assessment

Potential Proposed Project-related residual effects have been characterized using the criteria for each VC identified in Section 8.1.3.3.3. The characterization of potential residual effects (following application of appropriate mitigation measures) is described below and presented in Table 8.1-8. The characterization of likelihood of the residual effects occurring is presented in Table 8.1-9.

Residual effects occur when changes to the integrity, context and accessibility the heritage resources have not been or cannot be fully mitigated through avoidance. Loss of context and integrity are changes which are permanent and irreversible. Despite mitigation of effects on heritage resources, Proposed Project-related residual effects could occur during construction, operation and maintenance as well as reclamation, and closure phases of the Proposed Project because the mitigation activities also result in changes to the context, integrity and accessibility of the heritage resource in question.

Residual effects assessment is an evaluation of the level of the remaining adverse effects on heritage resources following mitigation. The significance of the effect varies with the amount of Proposed Project-induced change to a heritage resource relative to the value (referred to as “site significance”) of the resource in question and the effectiveness of applied mitigation procedures. Heritage resources protected under the HCA are evaluated using checklists that include the following evaluative criteria: scientific, public, ethnic, historical and economic significance as per the *British Columbia Archaeological Impact Assessment Guidelines* (Archaeology Branch 1998).

As no heritage resources were identified with the LSA, Proposed Project activities have a greatly reduced risk of interacting with heritage resources within the LSA. However, as undetected heritage resources may still occur in the LSA, interaction is unlikely but still possible. In the rare event that undetected heritage resources are encountered during the life of the Proposed Project, implementation of a Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate appropriate mitigation.

While heritage resources are documented in the RSA, the results of the marine transportation assessment (Volume 2, Part B - Section 7.2) indicate that the wave generated erosion will not be noticeably higher than existing conditions. Further, while accidents and malfunctions such as barge groundings and fuel spills could potentially occur the unpredictable nature of the locations or timing of such events renders residual effects assessment on heritage resources highly speculative. Nonetheless, at risk heritage resources in the RSA include those located on shorelines on shallows and intertidal areas.

8.1.5.4.1 Construction

The potential for residual effects to occur to heritage resources are considered to be low during Proposed Project construction. No heritage resources were identified within the LSA and effects to heritage sites within the RSA can be limited by using a more favourable barge route which limits use of the Thornbrough Channel.

Heritage sites located within the RSA have the potential of being impacted in the occurrence of a fuel spill, by a vessel running aground, or from wave erosion due to increased boat traffic. To limit these impacts the preferred route through Ramillies Channel and Queen Charlotte Channel should be considered. Furthermore, while not in direct conflict with areas of palaeontological interest, the proposed barge routes include known palaeontological sites and areas of high potential for palaeontological resources that could be impacted if there was a fuel spill, if a vessel ran a ground, or by increased wave action due to increased traffic.

8.1.5.4.2 Operations

No heritage resources were identified within the LSA. However, as the volume of Proposed Project activity causing ground disturbance is greatly increased during operations, there is higher risk of encountering previously undetected heritage resources, which could result in minimal residual effects prior to the initiation of mitigation procedures as prescribed in a Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0). Effects to heritage sites within the RSA during operations can be limited by using a more favourable barge and water taxi route which restricts use of the Thornbrough Channel.

Heritage sites located within the RSA have the potential to be impacted in the occurrence of a fuel spill, by a vessel running aground, or from wave erosion due to increased boat traffic. To limit these impacts, the preferred route through Ramillies Channel and Queen Charlotte Channel should be considered during operations. Furthermore, while not in direct conflict with areas of palaeontological interest, the proposed barge routes include known palaeontological sites and areas of high potential for palaeontological resources that could be impacted if there was a fuel spill, if a vessel ran aground, or by increased wave action due to increased traffic.

8.1.5.4.3 Reclamation and Closure

The magnitude of residual effects to occur to heritage resources during reclamation and closure is considered to nil to negligible. The effects on heritage resources are considered extremely unlikely at this stage as any conflicts with heritage resources would be addressed during prior activities.

Table 8.1-8: Characterization of Potential Project-Related Residual Effects: Heritage Resources VC – Heritage Resources

Project-Related Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Construction						
Changes to heritage resource integrity, if present	S - LSA has been previously affected by forestry operations, but may contain undetected heritage resources. LSA has only limited potential contain undetected archaeological and historical resources, but slightly higher potential to contain palaeontological material. RSA is known to contain sensitive heritage resources in proximity to shorelines, shallows and inter-tidal zones.	L	L and R	ST	FR	L
Changes to heritage resources context, if present	S - LSA has been previously affected by forestry operations, but may contain undetected heritage resources. LSA has only limited potential contain undetected archaeological and historical resources, but slightly higher potential to contain palaeontological material. RSA is known to contain sensitive heritage resources in proximity to shorelines, shallows and inter-tidal zones.	L	L and R	ST	FR	L
Changes to heritage resources accessibility, if present	S - LSA has been previously affected by forestry operations, but may contain undetected heritage resources. LSA has only limited potential contain undetected archaeological and historical resources, but slightly higher potential to contain palaeontological material. RSA is known to contain sensitive heritage resources in proximity to shorelines, shallows and inter-tidal zones.	L	L and R	ST	PR	L

Project-Related Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Operations						
Changes to heritage resource integrity, if present	S - LSA has been previously affected by forestry operations, but may contain undetected heritage resources. LSA has only limited potential contain undetected archaeological and historical resources, but slightly higher potential to contain palaeontological material. Greatest risk to palaeontological resources is during the operations phase. RSA is known to contain sensitive heritage resources in proximity to shorelines, shallows and inter-tidal zones.	M	L and R	MT	IR	H
Changes to heritage resources context, if present	S - LSA has been previously affected by forestry operations, but may contain undetected heritage resources. LSA has only limited potential contain undetected archaeological and historical resources, but slightly higher potential to contain palaeontological material. Greatest risk to palaeontological resources is during the operations phase. RSA is known to contain sensitive heritage resources in proximity to shorelines, shallows and inter-tidal zones.	M	L and R	MT	IR	H
Changes to heritage resources accessibility, if present.	S - LSA has been previously affected by forestry operations, but may contain undetected heritage resources. LSA has only limited potential contain undetected archaeological and historical resources, but slightly higher potential to contain palaeontological material. Greatest risk to palaeontological resources in the LSA is during the operations phase. RSA is known to contain sensitive heritage resources in proximity to shorelines, shallows and inter-tidal zones.	L	L and R	MT	IR	H
Reclamation and Closure						
Changes to heritage resource integrity, if present.	R - At the reclamation and closure phase, heritage resources are unlikely to be present, as management of such resources would occur at an earlier phase.	N	L and R	ST	IR	L

Project-Related Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Changes to heritage resources context, if present.	R - At the reclamation and closure phase, heritage resources are unlikely to be present, as management of such resources would occur at an earlier phase.	N	L and R	ST	IR	L
Changes to heritage resources accessibility, if present.	R - At the reclamation and closure phase, heritage resources are unlikely to be present, as management of such resources would occur at an earlier phase.	N	L and R	ST	IR	L

Assessment Criteria:

Context: R (Resilient) -Disturbed, MR Moderately Resilient) – Partially Disturbed; S (Sensitive)-Undisturbed

Magnitude: N- Negligible, L – Low, M – Medium, H – High;

Geographic Extent: L – Local, R – Regional, BR – Beyond Regional;

Duration: ST – Short-term, MT – Medium-term, LT – Long-term;

Reversibility: FR – Fully Reversible, PR - Partially Reversible, IR - Irreversible;

Frequency: L – Low, M – Medium, H – High.

Table 8.1-9: Likelihood of Occurrence of Potential Residual Effects: Heritage Resources

VC	Residual Effect	Likelihood	Rationale
Construction			
Heritage Resources	Changes to integrity of heritage resources, if present.	Low	No heritage resources identified in LSA, but may be present and heritage sites in RSA are at minimal risk of increased erosion rates due to barging.
	Changes to context of heritage resources, if present.	Low	No heritage resources identified in LSA, but may be present and heritage sites in RSA are at minimal risk of increased erosion rates due to barging.
	Changes to accessibility of heritage resources, if present.	Low	No heritage resources identified in LSA, but may be present and heritage sites in RSA are at minimal risk of increased erosion rates due to barging.
Operations			
Heritage Resources	Changes to integrity of heritage resources, if present.	Low to Medium	Increased level of ground-disturbing activities in LSA may affect undetected heritage resources, if present. Heritage sites in RSA are at minimal risk of increased erosion rates due to barging and water taxi transport.
	Changes to context of heritage resources, if present.	Low to Medium	Increased level of ground-disturbing activities in LSA may affect undetected heritage resources, if present. Heritage sites in RSA are at minimal risk of increased erosion rates due to barging and water taxi transport.
	Changes to accessibility of heritage resources, if present.	Low	Increased level of ground-disturbing activities in LSA may expose undetected heritage resources to risk of unauthorized collection, if present. Heritage sites in RSA are at minimal risk of increased erosion rates due to barging and water taxi transport.
Reclamation and Closure			
Heritage Resources	Changes to integrity of heritage resources, if present.	Low	Any effects on heritage resources would have been addressed at prior phases of development.
	Changes to context of heritage resources, if present.	Low	Any effects on heritage resources would have been addressed at prior phases of development.
	Changes to accessibility of heritage resources, if present.	Low	Any effects on heritage resources would have been addressed at prior phases of development.

8.1.5.5 Significance of Residual Effects

The significance of potential residual adverse effects will be determined for each VC based on the residual effects criteria and the likelihood of a potential residual effect occurring, a review of background information and available field study results, consultation with government agencies, First Nations, and other experts, and professional judgement. A summary of significance determinations is presented in Table 8.1-10. Detailed rationale for significance determinations is provided below.

The implementation of a Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) for addressing undetected heritage resources is considered the most efficient means to reduce adverse effects to acceptable levels. The potential residual effects to palaeontological, archaeological, and

historical resources are considered to be not significant. Acceptable levels for residual effects on archaeological and historical resources that are protected under the HCA are determined by the Archaeology Branch of the Ministry of Forests, Lands and Natural Resource Operations. As these resources must be managed in a manner compliant with the HCA, any management strategies implemented through the Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) would, by necessity, be conducted to a level acceptable to the Archaeology Branch.

8.1.5.5.1 Construction

The significance of residual effects to heritage resources during construction are considered not significant. No heritage resources have been identified within the LSA. If heritage resources are encountered, adverse effects mitigation would be facilitated through the implementation of a Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) to determine appropriate actions.

8.1.5.5.2 Operations

The significance of residual effects to heritage resources during operations are considered not significant. No heritage resources have been identified within the LSA; however, areas of palaeontological sensitivity have been identified within the LSA that have not been verified through ground-truthing. A higher degree of confidence with respect to potential effects on palaeontological resources may be achieved through field-level verification of palaeontological sensitivity. Further, while archaeological field studies have been completed and no archaeological sites were recorded within the LSA, the area does retain potential to contain buried archaeological materials. If heritage resources are encountered during operations, adverse effects mitigation would be facilitated through the implementation of a Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) to determine appropriate actions.

Heritage resources within the RSA could be negatively impacted in the event of a spill during operations resulting in a change in the integrity of the resource, or through erosion causing a change to the integrity and to the context of the resources. However, as wave-generated erosion is not expected to increase significantly above current levels, the effects of Proposed Project-induced erosion are considered to be not significant.

8.1.5.5.3 Reclamation and Closure

Significance of residual effects to heritage resources during reclamation and closure is considered to not significant. The effects on heritage resources are considered extremely unlikely at this stage as any conflicts with heritage resources would be addressed during prior activities.

Table 8.1-10: Significance of Potential Residual Effects: Heritage Resources

VC	Residual Effect	Significance	Rationale
Construction			
Heritage Resources	Changes to heritage resources integrity, if present.	Not Significant	No heritage resources identified within LSA, and heritage sites within the RSA would be subject to low risk of erosion beyond current conditions. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.
	Changes to heritage resources context, if present.	Not Significant	No heritage resources identified within LSA, and heritage sites within the RSA would be subject to low risk of erosion beyond current conditions. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.
	Changes to heritage resources accessibility, if present.	Not Significant	No heritage resources identified within LSA, and heritage sites within the RSA would be subject to low risk of erosion beyond current conditions. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.
Operations			
Heritage Resources	Changes to heritage resources integrity, if present.	Not Significant	No heritage resources currently identified within LSA. However, increased activity associated with surface and subsurface disturbance, including erosion and compaction and exposure to spill risks have corresponding increase in chance of unmitigated effect of heritage resources in the LSA and RSA. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.
	Changes to heritage resources context, if present.	Not Significant	No heritage resources currently identified within LSA. However, increased activity associated with surface and subsurface disturbance, including erosion and compaction and exposure to spill risks have corresponding increase in chance of unmitigated effect of heritage resources in the LSA and RSA. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.
	Changes to heritage resources accessibility, if present.	Not Significant	No heritage resources currently identified within LSA. However, increased activity associated with surface and subsurface disturbance, including erosion and compaction and exposure to spill risks have corresponding increase in chance of unmitigated effect of heritage resources in the LSA and RSA. Implementation of Heritage Resource Chance Find Management Plan

VC	Residual Effect	Significance	Rationale
			(Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.
Reclamation and Closure			
Heritage Resources	Changes to heritage resources integrity, if present.	Not Significant	The effects on heritage resources are considered extremely unlikely at this stage as any conflicts with heritage resources would be addressed during prior activities
	Changes to heritage resources context, if present.	Not Significant	The effects on heritage resources are considered extremely unlikely at this stage as any conflicts with heritage resources would be addressed during prior activities
	Changes to heritage resources accessibility, if present	Not Significant	The effects on heritage resources are considered extremely unlikely at this stage as any conflicts with heritage resources would be addressed during prior activities

8.1.5.6 Level of Confidence

The level of confidence for predicted residual effects is provided in Table 8.1-11. The prediction confidence of the assessment on each VC is based on scientific information and statistical analysis, professional judgement, and effectiveness of mitigation (rated as high, moderate, and low).

Table 8.1-11: Level of Confidence in Potential Residual Effect Predictions: Heritage Resources

Residual Effect	Level of Confidence (LOC) in Residual Effect Prediction	LOC Rationale
Construction		
Changes to heritage resources integrity, if present.	High	No heritage resources currently identified in LSA, heritage sites avoided in the RSA. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.
Changes to heritage resources context, if present.	High	No heritage resources currently identified in LSA, heritage sites avoided in the RSA. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.
Changes to heritage resources accessibility, if present.	High	No heritage resources currently identified in LSA, heritage sites avoided in the RSA. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.

Residual Effect	Level of Confidence (LOC) in Residual Effect Prediction	LOC Rationale
Operations		
Changes to heritage resources integrity, if present.	High	No heritage resources currently identified in LSA, heritage sites avoided in the RSA. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.
Changes to heritage resources context, if present.	High	No heritage resources currently identified in LSA, heritage sites avoided in the RSA. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.
Changes to heritage resources accessibility, if present	High	No heritage resources currently identified in LSA, heritage sites avoided in the RSA. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.
Reclamation and Closure		
Changes to heritage resources integrity, if present	High	No heritage resources currently identified in LSA, heritage sites avoided in the RSA. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.
Changes to heritage resources context, if present	High	No heritage resources currently identified in LSA, heritage sites avoided in the RSA. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.
Changes to heritage resources accessibility, if present	High	No heritage resources currently identified in LSA, heritage sites avoided in the RSA. Implementation of Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) will facilitate the effective management of resources to meet <i>Heritage Conservation Act</i> objectives for site protection.

8.1.5.7 Cumulative Effects Assessment

Cumulative effects result from interactions between Proposed Project-related residual effects and incremental effects of past, present and reasonably foreseeable projects and activities. Potential effects from past and present projects were assessed as part of the baseline conditions. Cumulative effects assessment methodology is described in Volume 2, Part B - Section 4.6.

8.1.5.7.1 Cumulative Effects Assessment Boundaries

As described in Section 8.1.3.2, the spatial boundary of the cumulative effects assessment for Heritage Resources is defined as the inter-tidal and shallow sub-tidal areas of Howe Sound located within 4 km on both sides and perpendicular to the proposed barge centreline routes (Figure 8.1-2).

Projects that overlap with the cumulative effects assessment boundary are shown on Figure 4-4.

8.1.5.7.2 Residual Effects Considered in Cumulative Effects Assessment

Proposed Project-related residual effects that were considered for the cumulative effects assessment are provided in Table 8.1-12. If residual effects were excluded from the cumulative effects assessment rationale is provided. Negligible residual effects were not carried through to the cumulative effects assessment as they are not considered measureable or are within a natural variability of the system are therefore unlikely to interact cumulatively with other past, present and reasonably foreseeable projects.

Table 8.1-12: Residual Effects Considered in Cumulative Effects Assessment

VC	Residual Effect	Considered in Cumulative Effects Assessment	Rationale
Heritage Resources	Changes to heritage resource integrity, context and accessibility, if present.	Yes	Potential for cumulative effect.

8.1.5.7.3 Effects of Other Projects and Activities

A list of past, present and reasonably foreseeable projects and activities with potential effects that could interact temporally and/or spatially with Proposed Project-related residual effect are provided in Table 4-5 in Volume 2, Part B - Section 4.5.5. Those that have potential to result in cumulative effects to Heritage Resources are provided in Table 8.1-13. All other projects were not considered to interact with this residual effect because:

- They will not interact temporally and/or spatially with those Heritage Resources with the potential to be affected by the BURNCO Aggregate Project.

Table 8.1-13: Potential Incremental Effects of Other Project and Activities on Heritage Resources

Project	Timeline	Phase of the project overlaps with the Proposed Project ³	Project Description	Rationale
Past, Present and Reasonably Foreseeable Future Projects				
Retired and Active Forest Tenures (Various)	Ongoing	Operations	Harvested logs dropped, bundled, and stored prior to barging.	Forestry activities have the potential to impact the same set of heritage resources as those which may be at risk to erosion due to barge and water taxi transport associated with the Proposed Project in the RSA.
Log dump and storage	Ongoing	Operations		
Active and Pending Forest Tenures (Various)	Several. Exact timelines for tenures are unknown.	Construction and operations	Crown component of Timber Harvesting Forestry Land Base in Howe LU is 11,285 of 52,209 total gross hectares.	Forestry activities have the potential to impact the same set of heritage resources as those which may be at risk to erosion due to barge and water taxi transport associated with the Proposed Project in the RSA.

³ When timelines are uncertain it was assumed that the Proposed Project would overlap with both construction and operations.

8.1.5.7.4 Potential Interactions with Other Projects

Interactions between adverse effects from certain or reasonably foreseeable project activities and Proposed Project residual adverse effects that could result in cumulative adverse effects to Heritage Resources are summarized in Table 8.1-14.

Table 8.1-14: Activities Considered in the Cumulative Effects Assessment for Heritage Resources

Activities	Potential Effect	Potential for Interaction of Effects	Rationale
Log handling / storage	Changes to heritage resource integrity, context and accessibility, if present	Y	Logs within the intertidal could impact heritage resources from the tenure located within the RSA.

No interaction or not likely to interact cumulatively (N), Yes, Potential cumulative effect (Y).

8.1.5.7.5 Cumulative Effects Related to Heritage Resources

Log handling and storage could affect heritage resources (if present) on the shoreline and within the intertidal zone along active vessel transportation corridors within the RSA during the lifespan of the BURNCO Aggregate Project. Temporal and spatial overlap exists between Forest Tenure activity areas associated with log handling and storage and the intertidal vessel corridors associated with the Proposed Project. Both sources will contribute to shoreline and intertidal erosion with the potential to impact heritage resources.

8.1.5.7.6 Mitigation of Cumulative Effects

Mitigation measures that will assist in minimizing interactions between Proposed Project effects and similar environmental effects from other reasonably foreseeable project activities are described in Table 8.1-15. In the event that unidentified heritage resources are encountered during development, the creation and use of a Heritage Resource Chance Find Management Plan should be consulted and a qualified archaeologist contacted to determine acceptable management strategies to offset negative impacts.

Table 8.1-15: Identified Mitigation Measures for Cumulative Effects: Heritage Resources

Potential Cumulative Effect	Mitigation	Responsibility for Implementation	Anticipated Effectiveness
Construction			
Changes to heritage resource integrity, context and accessibility, if present.	Implement Heritage Resource Chance Find Management Plan that provides management recommendations for avoidance, systematic data recovery or monitoring, in the event that undetected heritage resources are encountered during Proposed Project activities.	BURNCO	Mitigation measures will minimize potential cumulative effects to acceptable levels.
Operations			
Changes to heritage resource integrity, context and accessibility, if present.	Implement Heritage Resource Chance Find Management Plan that provides management recommendations for avoidance, systematic data recovery or monitoring, in the event that undetected heritage resources are encountered during Proposed Project activities.	BURNCO	Mitigation measures will minimize potential cumulative effects to acceptable levels.
Reclamation and Closure			
Changes to heritage resource integrity, context and accessibility, if present.	Implement Heritage Resource Chance Find Management Plan that provides management recommendations for avoidance, systematic data recovery or monitoring, in the event that undetected heritage resources are encountered during Proposed Project activities.	BURNCO	Mitigation measures will minimize potential cumulative effects to acceptable levels.

8.1.5.7.7 Residual Cumulative Effects and their Significance

Potential residual cumulative effects and their significance were characterized using the same methods that were used to characterize residual effects (see Table 8.1-3) and summarized in Table 8.1-16.

The residual Proposed Project -related cumulative effects are considered to be not significant and will be minimized through the implementation of a Heritage Resource Change Find Management Plan. Predicted levels of Proposed Project-induced erosion are low.

The RSA is known to contain sensitive heritage resources (disturbed and undisturbed) in proximity to shorelines, shallows, and inter-tidal zones; therefore, the context of heritage resources in the RSA for the cumulative effects assessment is considered sensitive. The magnitude of Proposed Project-related residual cumulative effects on Heritage Resources is expected to be low because Proposed Project-induced erosion levels are predicted to be low and changes to heritage resource integrity, context, and accessibility, will be minimized through the implementation of a Heritage Resource Change Find Management Plan. The extent of Proposed Project-related residual cumulative effects will be regional (e.g., confined to the RSA). The duration of Proposed Project-related residual cumulative effects will occur throughout the lifespan of the Proposed Project through to closure phases (log-dumping is assumed to occur continuously and vessel movements are expected through to closure) and are, therefore, considered long-term. Any impacts to the context and integrity of heritage resources are generally considered irreversible. The overall frequency of residual effects on heritage resources generated as a result of erosion of intertidal and near shore areas in combination with impacts as a result of log-dumping activities are considered high during the operations phase of the Proposed Project when vessel traffic will be highest. During construction and closure phases, the residual effects are expected to be low as vessel traffic will be less frequent.

The likelihood for cumulative residual effects to cause impact to heritage resources is considered low to medium because Proposed Project-induced erosion levels are predicted to be low. The level of confidence is high, largely based on the effectiveness of mitigation through the implementation of the Heritage Resources Change Find Management Plan and because the increased level of erosion with potential to affect heritage resources (if present) is expected to be low.

Table 8.1-16: Summary of Residual Cumulative Effects Characterization for Heritage Resources

Project-Related Residual Effect	Residual Cumulative Effect Assessment Criteria						Significance	Likelihood	Level of Confidence
	Context	Magnitude	Extent	Duration	Reversibility	Frequency			
Construction									
Changes to heritage resource integrity, context and accessibility, if present.	S	L	R	LT	IR	L	N	L	H
Operations									
Changes to heritage resource integrity, context and accessibility, if present.	S	L	R	LT	IR	H	NS	L to M	H
Reclamation and Closure									
Changes to heritage resource integrity, context and accessibility, if present.	S	L	R	LT	IR	L	N	L	H

Assessment Criteria:
 Context: R (Resilient) -Disturbed, MR (Moderately Resilient) – Partially Disturbed; S (Sensitive)-Undisturbed
 Magnitude: N – Negligible, L – Low, M – Medium, H – High;
 Geographic Extent: L – Local, R – Regional, BR – Beyond Regional;
 Duration: ST – Short-term, MT – Medium-term, LT – Long-term;
 Reversibility: FR – Fully Reversible, PR - Partially Reversible, IR - Irreversible;
 Frequency: L – Low, M – Medium, H – High
 Significance: N – Negligible- Not Significance, NS – Not Significant, S – Significant
 Likelihood: L- Low, M - Medium, H – High
 Level of Confidence: L- Low, M - Moderate, H – High

8.1.6 Conclusions

Heritage studies of the RSA resulted in the identification of 89 recorded archaeological and historical sites including 78 archaeological sites, six heritage wrecks (both possible and reported) and five properties included in community heritage registers (not protected under the HCA). No heritage resources were observed or identified in the LSA during the course of field work conducted on January 22 and 23, 2013. Two areas of archaeological potential were identified within the LSA and were subjected to subsurface testing. Twenty-eight shovel tests were excavated, with negative results.

Palaeontological desktop studies resulted in the development of palaeontological sensitivity ratings for the LSA and RSA, which have not been verified through field studies. Areas of high palaeontological sensitivity are noted within the LSA, which may be verified through pre-development palaeontological field studies, as recommended by Branta (2014). However, any undetected heritage resources could be addressed through the implementation of a Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0) to facilitate the development of effective and timely mitigation procedures should interactions occur.

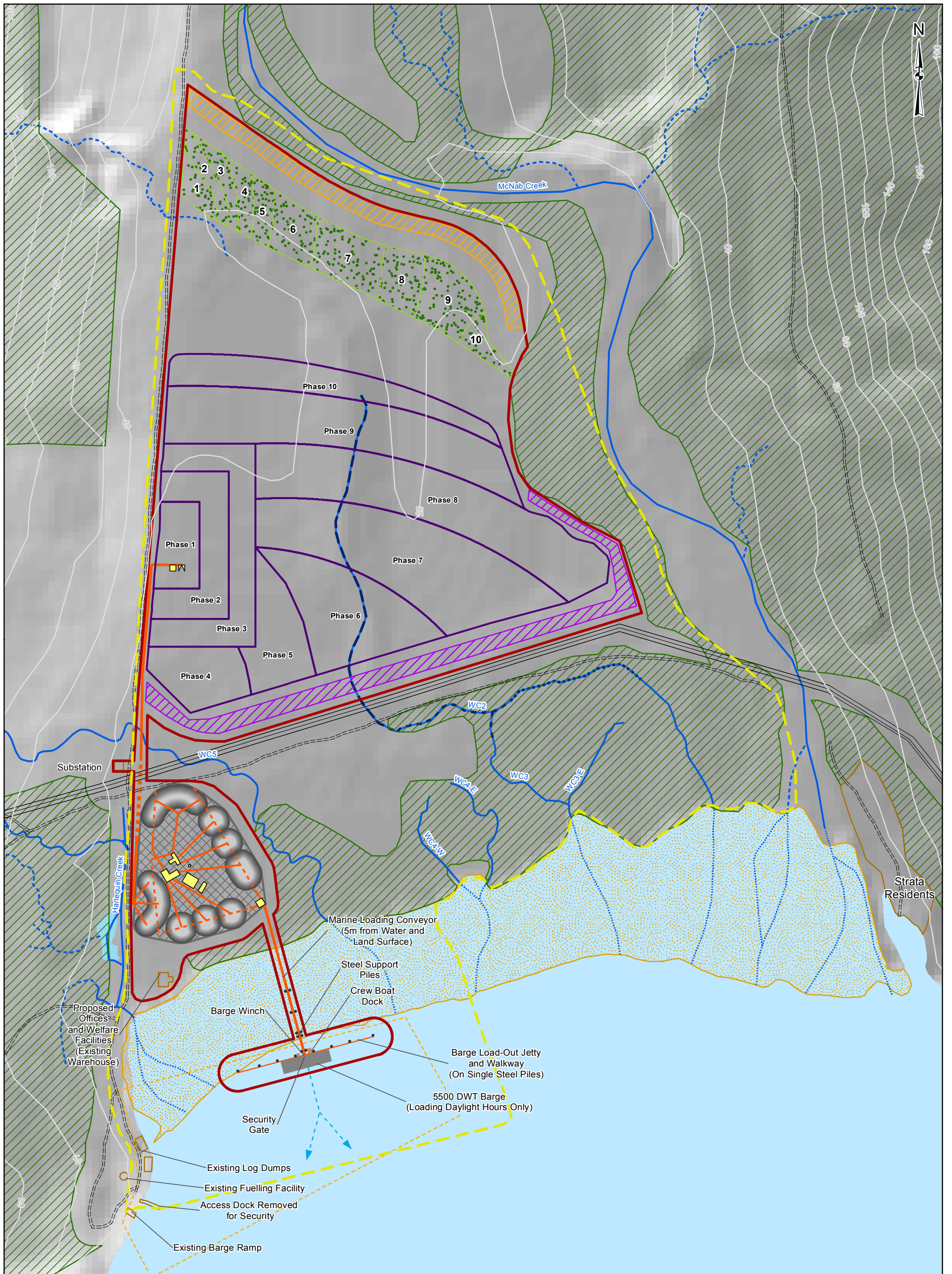
Due to the greater number of recorded heritage resources that may potentially be impacted by slight increases in wave erosion, vessel grounding, or fuel spills during the operational phase of the development in the RSA, Golder recommends making the eastern barge route (Ramillies and Queen Charlotte Channels) the preferred route.

Should a future accident occur resulting in potential impacts to inter-tidal or sub-tidal areas of the RSA where heritage resources may be present, it is recommended that an appropriate management strategy be developed in consultation with the Archaeology Branch, the *Skwxwú7mesh* (Squamish) First Nation, and the Tsleil-Waututh Nation. In the event that unidentified heritage resources (including archaeological or palaeontological) are encountered the proponent should create and refer to a Heritage Resource Chance Find Management Plan (Volume 3, Part E - Section 16.0).

Consistent with the intent of the HCA, BURNCO is advised that should any heritage resources be encountered during development of the LSA, the following measures should be undertaken:

- Modify or stop any land-altering activities in the immediate vicinity of the previously unidentified heritage site such that it will not be adversely impacted;
- Notify the Archaeology Branch, the *Skwxwú7mesh* (Squamish) First Nation, and the Tsleil-Waututh Nation. If the resources are archaeological, a qualified archaeologist should also be notified, and if the resources are palaeontological, a qualified palaeontologist should be notified; and
- Determine in consultation with the Archaeology Branch, the *Skwxwú7mesh* (Squamish) First Nation, and the Tsleil-Waututh Nation an acceptable management strategy.

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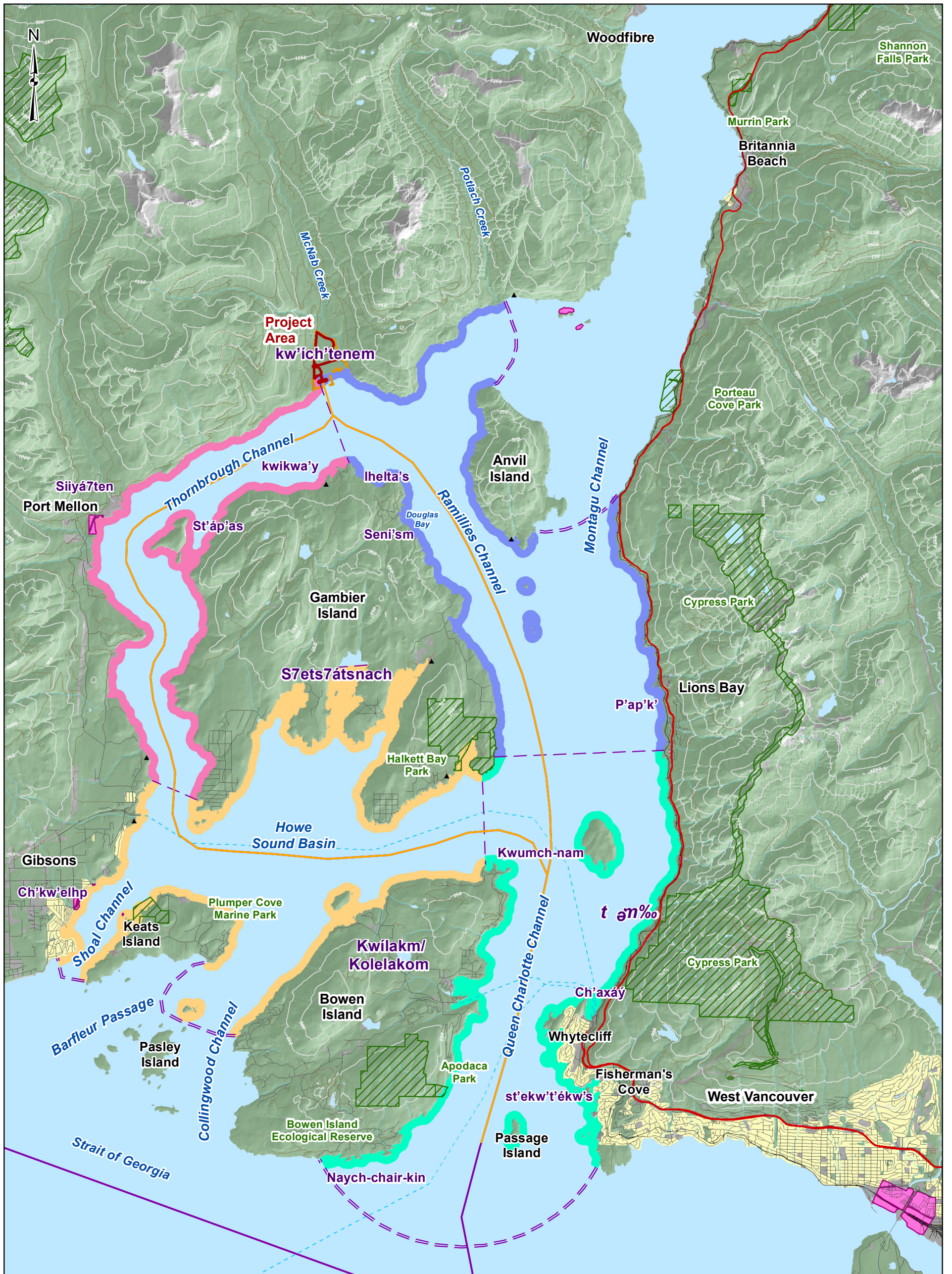
LEGEND			
	Archaeology LSA		Permanent / Perennial Watercourse
	Project Area		Intermittent Watercourse
	Proposed Aggregate Pit Phase		Intertidal Watercourse
	Fines Storage Area		Constructed Watercourse
	McNab Creek Flood Protection Dyke		Phase 1 (1985)
	Pit Lake Containment Berm		Phase 2 (1998)
	Product Stockpiles		Phase 3 (2001 - 2003)
	Processing Area		Waterbody
	Existing Feature		Intertidal Zone
	Existing Log Tenure Area		Mature Forest
	Possible Processing Plant Configuration		Elevated Conveyor
	Elevated Conveyor		Underground Conveyor
	Underground Conveyor		Barge Load-out
	Barge Load-out		Transmission Line
	Transmission Line		Barge Route
	Barge Route		Pile
	Pile		Road (Existing)
	Road (Existing)		Contour (20m)
	Contour (20m)		

REFERENCE
 DEM from Geobase. Base data from the Province of British Columbia. Contours from TRIM positional data. Additional detailed site features provided by McElhanney. Projection: UTM Zone 10 Datum: NAD 83



PROJECT		BURNCO ROCK PRODUCTS LTD. BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.	
TITLE		PROPOSED CONCEPTUAL SITE LAYOUT AND LSA FOR HERITAGE RESOURCES	
PROJECT NO. 11-1422-0046		PHASE No.	
DESIGN	MD	2 Nov. 2012	SCALE AS SHOWN
GIS	DL	05 Apr. 2016	REV. 1
CHECK	AC	30 Sep. 2014	FIGURE 8.1-1
REVIEW	DG	30 Sep. 2014	



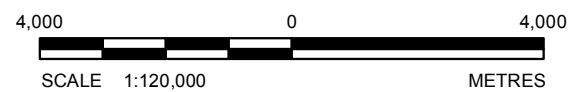


LEGEND

- Limit to Heritage Resources RSA
- Sectors within Heritage Resources RSA
- Howe Sound Basin RSA Sector
- Queen Charlotte Channel RSA Sector
- Ramillies Channel RSA Sector
- Thornbrough Channel RSA Sector
- Proposed Barging Route
- Existing Barging Route
- Project Area
- Park / Protected Area
- Vegetation
- Residential Area
- Indian Reserve
- ▲ Camp
- Highway
- Road
- Resource Road
- Railway
- Ferry
- Contour (250m)

REFERENCE

Parks/protected areas and sensitive areas from the Province of British Columbia. Elevation and Indian reserves from Geobase. Base data from CanVec. Projection: UTM Zone 10 Datum: NAD 83



PROJECT		BURNCO ROCK PRODUCTS LTD. BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.	
TITLE		REGIONAL STUDY AREA FOR HERITAGE RESOURCES	
PROJECT NO. 11-1422-0046		PHASE No.	
DESIGN	CB	21 Jan. 2013	SCALE AS SHOWN
GIS	DL	5 Apr. 2016	REV. 1
CHECK	AL	7 Feb. 2013	FIGURE 8.1-2
REVIEW	CM	7 Feb. 2013	

