October 1, 2014

HCA PERMIT 2010-0031

Heritage Resource Overview Assessment of Proposed Aggregate Project at McNab Creek, Howe Sound, BC

First Nation Heritage Permit No.: Tsleil-Waututh Nation 2013-006 and Squamish Nation 2012-0124

Submitted to:

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REPORT

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Executive Summary

On behalf of BURNCO Rock Products, Ltd. (BURNCO), Golder Associates, Ltd. conducted a heritage resource impact assessment (HRIA) and archaeological impact assessment (AIA) of the proposed aggregate facility at McNab Creek, located approximately 8 km north-east of Port Mellon and 22 km north-west of West Vancouver, in southwestern British Columbia.

The proposed Project consists of an aggregate extraction area, aggregate extraction system, processing plant, a barge loading facility, and associated habitat compensation areas, within a development footprint of approximately 118 ha, identified as the Local Study Area (LSA). It is anticipated that extensive impacts to portions of the LSA will occur during the course of construction, through excavation, tree felling, access road and ancillary component construction, and aggregate extraction.

The LSA was subject both to a heritage resource impact assessment (HRIA) and an AIA under the terms and conditions of *Heritage Conservation Act* (HCA) Permit 2010-0031, Tsleil-Waututh Nation Permit 2013-006 and Squamish Nation Permit 12-0124. The HRIA was conducted as a baseline study of potential heritage resources for reference in the Project Environmental Assessment Certificate Application, and for the completion of the Environmental Assessment, based on conditions within the *BC Environmental Assessment Act* and *Canadian Environmental Assessment Act* to be supported in the Application.

An area identified as the Regional Study Area (RSA) for the purposes of this heritage resource study consisted of much of the lower Howe Sound shoreline, including the shallow sub-tidal and inter-tidal zones, where the potential exists for impact by tug and/or barge groundings, or fuel releases, during the operation of the proposed facilities. This study further consisted of a heritage overview assessment (HROA), comprising of a desktop study to assess the potential for archaeological and historical sites to exist within the RSA, as well as a background review to assess for the potential presence of heritage resources within the LSA.

The objectives of the HRIA/HROA were to:

- Conduct a cultural heritage resource (archaeological, historical, and paleontological) overview of the Project LSA to identify known resources and areas of archaeological and paleontological potential;
- Conduct a cultural heritage resource (archaeological and historical) overview of the Project RSA to identify known resources and areas of archaeological potential;
- Identify and describe heritage resources within the LSA through field investigations;
- Identify and evaluate potential impacts to heritage resources that might result from construction and operation of the Project;
- Assess significance of the identified heritage resources; and
- Develop recommendations for measures to avoid, limit or otherwise mitigate potential adverse effects of the proposed Project to identified heritage resources.

The HROA of the RSA resulted in the identification of a total of 100 recorded sites, including archaeological sites, Heritage wrecks (n=6) and five properties included in community heritage registers (not protected under the HCA.

No heritage resources were identified in the LSA during the course of fieldwork conducted 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 for archaeological remains. No archaeological materials or features, or paleontological materials were observed within the LSA.

Recommendations for the management of heritage resources within the LSA and RSA were formulated from the results of the HROA and HRIA and are outlined below.

- No further archaeological work is recommended for the remainder of the LSA or RSA, provided the proposed development is not altered to include areas not assessed during the HRIA;
- Should further construction be proposed outside of the LSA, Golder recommends an archaeologist or paleontologist be contacted to evaluate the need for further heritage investigation;
- Due to the greater number of recorded archaeological and historical resources that may potentially be impacted by grounding or spill during the operational period of the development, Golder recommends making the eastern barge route (through Ramillies Channel and Queen Charlotte Channel) the preferred route; and
- Should a future accident occur resulting in potential impacts inter-tidal or sub-tidal impacts areas of the RSA where archaeological and historical resources may be present, determine in consultation with the Archaeology Branch, Squamish First Nation and Tsleil-waututh Nation an appropriate management strategy.

It should be noted that even the most thorough investigation may not reveal the presence of all archaeological materials, including human remains protected by the Heritage Conservation Act. Therefore, consistent with the intent of the Act, the proponent is advised that should any archaeological sites or paleontological materials 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 site such that it will not be adversely impacted;
- Notify the Archaeology Branch, Squamish First Nation, Tsleil-waututh Nation and a Golder archaeologist of the discovery, or notify a paleontologist; and
- Determine in consultation with the Archaeology Branch, Squamish First Nation and Tsleil-waututh Nation of an acceptable management strategy.

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1.0 INTRODUCTION

On behalf of BURNCO Rock Products, Ltd. (BURNCO), Golder Associates, Ltd. (Golder) conducted a heritage resource impact assessment (HRIA) and archaeological impact assessment (AIA) of the proposed aggregate facility at McNab Creek (the Project). The Project is located within the asserted traditional territories of the Squamish Nation and Tsleil-Waututh Nation.

The AIA was conducted under *Heritage Conservation Act* (*HCA*) Permit 2010-0031, Tsleil-Waututh Nation Cultural Heritage Investigation Permit 2013-06, and Squamish Nation Archaeological Investigation Permit 12-0124. The HRIA was conducted as a baseline study of potential heritage resources for reference in the Project Environmental Assessment Certificate (EAC) Application, and for the completion of the Environmental Assessment (EA), based on conditions within the *BC Environmental Assessment Act* (*BCEAA*) and *Canadian Environmental Assessment Act* (*CEAA*) to be supported in the Application.

The study further consisted of a heritage overview assessment (HROA), consisting of a desktop study to assess the potential for archaeological and historical sites to exist within the Regional Study Area (RSA, described in Section 1.1), and a background review and field study program to assess for the presence of heritage resources within the Local Study Area (LSA, described in Section 1.1).

This report summarizes the results of the assessments, and provides recommendations for the management of heritage resources, where warranted. Section 1 provides the Project description and location, and reviews relevant provincial and federal legislation, and local policies protecting heritage resources. Section 2 summarizes the objectives of the assessment. A review of the physical, archaeological, ethnographic, and historical setting for the region is found in Section 3. Section 4 describes the methods used in the study, while Section 5 summarizes the results of the study. Results include the background review for the overview of the RSA in Section 5.1, results of the overview for the LSA in Section 5.2, and the results of the field study in the LSA in Section 5.3. Section 6 describes the heritage resource potential and significance of any known heritage sites in the RSA and LSA, while Section 7 describes potential impacts known sites. Section 8 provides an evaluation of the assessments, and Section 9 offers recommendations for heritage resource management. Photographs of the LSA are contained in Appendix A.

1.1 Project Description and Location

BURNCO proposes the development and operation of an aggregate facility at McNab Creek on Thornbrough Channel on the Sunshine Coast of Howe Sound, British Columbia, approximately 8 km north-east of Port Mellon and 22 km north-west of West Vancouver, BC (Figure 1). The proposed Project consists of the aggregate extraction area, aggregate extraction system, processing plant, and barge loading facility, within a development footprint of 61.24 ha identified as the Project Area. The Local Study Area (LSA) for heritage resources measures 117.678 ha and includes the Project Area with the addition of a buffer to include potential locations for related habitat compensation works (Figure 2). The LSA is subject both to an HRIA and an AIA.

The terrestrial part of Project Area is located within land described as DL 677 LD 37 New Westminster Group (PID: 002-969-645); DL 677A LD 37 New Westminster Group (PID: 002-970-171); DL 6778 LD 37 New Westminster Group (PID: 002-969-378) and is divided by a BC Hydro right-of-way, 50 m wide. The Project Area located north of the right-of-way is within a 70 ha clear cut and will contain the pit from which a projected 20 million tons of sand and gravel may be extracted over an operational life span of 15 to 20 years. The

processing plant will be located on a parcel of less than 1 ha located south of the BC Hydro right-of-way (Figure 2).

The barge loading component of the LSA includes marine structures and a loading system located within a water lot described as Foreshore Tenure #240515. Barges of 15,000 deadweight tonnage (DWT, representing the maximum weight of load safely carried) with 6.03 m draught will be loaded from a conveyor while berthed approximately 130 m from the shoreline. The conveying system and other marine structures, *e.g*. barge loader foundation, berthing dolphins and connecting catwalks, will be supported by piles across the intertidal area to deeper water. A mooring buoy for an awaiting barge will be anchored east of the berth. The inter- and sub-tidal portion of the LSA surrounding the barge load out structure and a fish compensation area represents approximately 22 ha (Figure 2).

Barges will transit between the McNab Creek loading facilities and unloading/transhipment points on the lower Fraser River throughout the proposed life of the Project. South-bound (loaded) barges will use either Thornbrough or Ramillies Channels, and then Queen Charlotte Channel to access the Georgia Straight and entrance to the Fraser River (see Figure 1). The HROA conducted in this report includes the inter-tidal and shallow sub-tidal areas located within Howe Sound and within 4 km to either side and perpendicular to the proposed centrelines of the proposed barge routes. This area includes much of the Howe Sound shoreline, where the potential exists for impact by tug and/or barge groundings, or fuel releases, during the operation of the proposed facilities, and is identified as the Regional Study Area (RSA) for the purposes of this heritage resource study (Figure 3).

1.2 Potential Project Impacts

A number of proposed project-related activities have the potential to impact archaeological materials or other heritage resources located in the surface and sub-surface areas of the Project Area sites by disturbing cultural deposits and features, damaging artifacts, hindering or increasing access to paleontological and archaeological deposits, and destroying contextual information that is essential for interpreting archaeological site function and age (Davis *et al.* 2004; Williams and Corfield 2003). Historical resources may also be destroyed or damaged by these activities. The proposed aggregate pit represents the largest single part of the Project and will include the clearing of timber and brush in advance of excavation. Additional potential impacts from construction may occur from geotechnical testing, the addition of fill, heavy equipment traffic, the construction of roads, a berm, and of infrastructure including 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.

Additional potential impacts to archaeological and historical resources[1] may occur during the operation of the facilities if fuel oil is released from a tug towing a barge, or if the tug and/or barge accidently run aground. Impacts from fuel are anticipated to archaeological and historical (including heritage wrecks) resources that are located in the intertidal area of the RSA, (i.e., within a 4 km direct line from the centrelines of the proposed barge shipping routes). Impacts occurring as a result of barge or tug stranding may be anticipated to archaeological resources located within the shallow sub-tidal areas (i.e., to a depth of 15 m bsl[2]), as well as inter-tidal areas.

[1] Paleontological resources are not considered in the RSA because fuel spills and vessel groundings should not impact these heritage resources.

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

1.3 Relevant Legislation

Two pieces of legislation have bearing on the Project; the *HCA* the *CEAA*. The role and scope of these pieces of legislation are outlined in the following sections. Complementary First Nations heritage policies, the *Local Government Act*, and the BC Fossil Management Framework also have relevance to the current study and are summarized below.

1.3.1 *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.

1.3.2 *Canadian Environmental Assessment Act*

The results of this study may form a component of an environmental assessment report that will be submitted under the terms of *CEAA* for environmental regulatory review and approval purposes. Heritage resources are defined within the Canadian Environmental Assessment Agency guidelines as “physical and cultural heritage… [including] any structure, site or thing that is of historical, archaeological, paleontological or architectural significance” (Canadian Environmental Assessment Agency 2012). For the purposes of this study, heritage resources represent archaeological sites, historical sites, and paleontological sites.

1.3.3 BC Environmental Assessment Act

The Project is subject to review under the (*BCEAA),* which came into effect in 2002 (S.B.C. 2002, c. 43). With respect to heritage resources, one of the purposes of the *Act* is “to provide for the thorough, timely and integrated assessment of the environmental, economic, social, cultural, heritage and health effects of reviewable projects.” Heritage resource assessment and management provisions in the *HCA* are compatible with the requirements of the *BCEAA*.

1.3.4 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.

1.3.5 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 Project, the Squamish Nation and Tsleil-Waututh Nation, are known to have heritage policies and permitting systems.

In general, the scope of these 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).

1.3.6 BC Fossil Management Framework

The Province of British Columbia recognizes that paleontological 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 paleontological sites. For projects that trigger *CEAA* in BC, best practices from other Canadian jurisdictions (e.g., Alberta) are generally followed for assessing, documenting, and mitigating impacts to identified paleontological resources.

2.0 OBJECTIVES

The HRIA was conducted in accordance with the *British Columbia Archaeological Impact Assessment Guidelines* (Archaeology Branch 1998). The objectives of the HRIA were to:

- Conduct a cultural heritage resource (archaeological, historical, and paleontological) overview of the Project LSA and RSA to identify known resources and areas of archaeological and paleontological potential;
- Identify and describe heritage resources within the LSA through field investigations;
- Identify and evaluate potential impacts to heritage resources that might result from construction and operation of the Project;
- Assess significance of the identified heritage resources; and
- Develop recommendations for measures to avoid, limit or otherwise mitigate potential adverse effects of the proposed Project to identified heritage resources.

3.0 BACKGROUND

This section summarizes readily available information regarding the paleoenvironment, marine environment, local and regional prehistory, history, and ethnography of the Project Area.

3.1 Physical Setting

An understanding of the physical setting of the Project Area is important to heritage research. Land uses, settlement patterns, and subsistence practices of First Nations and non-native peoples are often adaptations to specific environments; physical factors, such as terrain, climate, proximity to water and vegetation, can influence the location, preservation, and visibility of archaeological sites. In addition, traditional land use practices are frequently related to the location, accessibility and quantity of culturally-valued animal and plant species.

Preservation of archaeological and paleontological sites can be affected by geological processes. Certain factors, such as unusually dry or wet soil conditions, can enhance preservation of organic archaeological materials, while other processes such as flooding can destroy archaeological evidence. Paleontological sites can be covered with sediments or subject to erosion.

3.1.1 Glacial History and Paleoenvironment

During the height of the Late Wisconsin glaciations, the Lower Mainland (including islands within Howe Sound) was covered by up to 2 km of ice (Clague et al. 1982). Following the retreat of the Wisconsin glaciers, sea levels changed dramatically due to glacio-eustatic effects. Reimer (n.d.) has compiled archaeological paleoenvironmental 14C dates for the Howe Sound and Burrard Inlet areas. Reimer's (n.d.) data show that at 12,000 BP[3], relative sea levels were 85 m above their current location. By 10,200 BP, de-glaciation of Howe Sound and the Squamish valley was complete and sea levels had fallen to 33.5 m above their current level. Sea levels continued to fall until 7500 BP, when they reached a low of 10 to 15 m below their current level. Following 6500 BP sea levels rose to a late Holocene (approx. 3000 BP) high of 3 m above current levels, and have since gradually fallen to present levels.

These relative sea level changes may have dramatic implications for the location and visibility of archaeological sites. Many coastal and riverside sites are being eroded by waves and currents, a situation which suggests they were occupied at a time when relative sea levels were lower. Some coastal sites have been uncovered beneath deposits of sand and gravel, also indicative of lower sea levels. Numerous sites are likely submerged beneath the ocean waters (Fedje and Christensen 1999; Fedje and Josenhans 2000).

Due to sea level change, the inter- and sub-tidal areas (to a depth of about 10 m) in both the Project LSA and RSA were potentially exposed to human occupation between the dates of approximately 9000 and 4200 BP (Reimer n.d.). Furthermore, occupation sites once located on the shoreline, where archaeological sites are located with greatest density might be located up to 3 m above modern sea level, corresponding with the highest relative sea levels occurring approximately 3000 BP.

[3] BP – Before Present, with present defined as AD 1950 by convention.

3.1.2 Geological and Marine Setting

Howe Sound is a long, steep-sided valley carved by a glacier and flooded to become a fjord. The extent of level ground is very limited except where streams such as McNab Creek have created small deltas, or a few areas of lower relief such as near Gibsons.

The deep waters of Howe Sound provide far better mobility for human travel than the surrounding land, given the availability of watercraft. There are relatively few reefs or areas of foul ground except near the entrance to the sound where a shallow glacial still exists in places. The waters of the Sound are protected, however, the inversion of polar continental air can cause the rapid acceleration of a gale force wind, known here and elsewhere on the B.C. coast as a "Squamish". These winds are common, especially between October and March. Despite the short fetches, strong winds in the sound can quickly generate "short, steep, choppy seas that are particularly hazardous to small craft" (Thomson 1981).

The mean tidal range in Howe Sound is about 3.1 m. Because of the steep shores, horizontal exposures of inter-tidal areas are limited. This reduces the likelihood for pre-Contact archaeological sites to exist in the inter-tidal areas, and vessels stranding on shore will not infrequently sink and slip off into deeper water before settling, making both contemporary salvage and subsequent location difficult. The average depth of upper Howe Sound is 275 m (Thomson 1981).

Unconsolidated glaciofluvial and glacial sediments make up the surficial geology of the LSA, although post-glacial fluvial deposits occur in the valley, particularly at the creek mouth and near shore. The sand-and-gravel delta extends from the valley into Howe Sound, with a sudden steep drop a few hundred meters offshore. The valley fan was likely created as glacial ice receded and decayed ten thousand years ago, after the present Howe Sound fjord was formed. Glacial decay would have produced significant sediment deposition due to high water volumes (Golder 2011).

The bedrock surface that the fan has accumulated on is likely undulating and irregular, with deposits ranging between 50 to 100 m (Golder 2011). Three main bedrock units make up the McNab Creek drainage.

- Intermediate felsic volcanic flows, breccia and tuff, with a mix of conglomerate, calcareous sandstone, siltstone and shale;
- Mixture of hornblende, biotite hornblende, and quartz diorite; and
- Intermediate felsic flows, volcanic clastic sandstones, minor carbonate and conglomerates.

Of these bedrock units, sandstone, siltstone and shale could have been useful for traditional tool manufacture (Reimer 2004), and these same units potentially contain paleontological resources.

3.1.3 Modern Biophysical Setting

The RSA is situated within Coastal Western Hemlock (CWH) biogeoclimatic zone with subzones ranging from the Western Hemlock Very Dry Maritime (CWHxm) to Very Wet Maritime (CWHvm). The CWH biogeoclimatic zone covers low- to mid-elevations and is the most productive zone in British Columbia in terms of overall biomass (Jones and Annas 1978). On average, the CWH biogeoclimatic zone is the rainiest zone in

British Columbia, and features cool summers and mild winters. The mean annual temperature is about 8°C, while annual precipitation for the zone ranges between 100 and 440 cm (Pojar *et al*. 1991). In general, the forests of the CMHxm subzone are dominated by western hemlock, Douglas-fir and western redcedar. All of these tree species, most notably cedar, were traditionally used by Coast Salish peoples and as valued components of technology, subsistence, medicine, and ceremonialism/spirituality.

The understory in the CWH zone is generally lush and contains a number of food species important in traditional First Nations' subsistence, including blueberry, salmonberry, bunchberry, soopolallie (soapberry), sword fern and lady fern. Red huckleberry, stink currant, Nootka rose and prickly rose are also characteristic of CWH. Plants such as stinging nettle were also gathered for medicinal purposes. Nettles also provided raw materials for basketry, mats and other uses.

Economically-important animal species within the lower elevations of the CWH zone include marten, mule deer, grouse, and various species of waterfowl. Throughout the CWH zone, streams and rivers provide spawning grounds for salmon and other fish, which in turn attract predators such as black bears and raptors, and further provide habitat for otters, other smaller animals, and various resident bird species. Important marine species include in-shore fish such as smelt and herring; off-shore fish such as lingcod and rockfish; resident populations of coho and chinook salmon; and sea mammals such as seals, sea lions, and porpoises. Among shellfish, mussels are common in Howe Sound, although clams are not, except in a couple of locations. The Strait of Georgia area, Howe Sound included, is the largest overwintering location for waterfowl in Canada (Thomson 1981). For First Nations, these fauna provided (and still provide) food, while the hides, feathers, bones, shells, and antlers or horns supplied raw materials for clothing, tools and other items.

3.2 Cultural Summary

3.2.1 Ethnographic Information

The Project Area is located within the asserted traditional territories of the Squamish Nation and the Tsleil-Waututh Nation. Detailed ethnographic information for these groups may be found in Barnett (1938, 1955), Boas (1886), Bouchard and Turner (1976), Drucker (1965), Gustafson (1980), Harris (1994), Hill Tout (1897, 1905), Kennedy (1976), Kennedy and Bouchard (1976), Matthews (1955), Maud (1978), Peterson (1962), Rozen (1979), Stewart (1977, 1984, 1996), Suttles (1987, 1990, 2004), and Turner (1975, 1979, 1991, 1995).

Members of these two groups practiced a lifeway typical of the Northwest Coast culture area (Suttles 1990). Common cultural traits included: a coastal or riverine settlement pattern; diverse subsistence base with a focus on anadromous fish, but also including game and plant/root resources; complex fishing and storage economy; bilateral kinship; social/political organization with families, households, local groups and winter villages as the basic elements; and regionally similar myth system including vision quests, shamanism, life-cycle and subsistence cycle celebrations and rituals (Suttles 1990).

Typical activities associated with Northwest Coast peoples that may be reflected within the archaeological record of the Project Area include: resource procurement (e.g., fishing, hunting – especially waterfowl, plant/root gathering); food storage or preparation (e.g., use of drying racks, hearths or roasting pits); habitation; transportation and trade (e.g., use of trails and waterways); and mortuary practices (e.g., burials).

3.2.2 First Nations Place Names

A review of available ethnographic sources of the surrounding area resulted in the identification of First Nations place names within the RSA (described below). Both the *skxwúmish* (Squamish people) and Tsleil-Waututh speak languages placed by linguists within the Coast Salish division of the Salishan Language family. First Nations place names and their locations are important as they demonstrate use of a particular area and, in some cases, provide some indication of the range of activities that may have taken place. Both the named locations and the activities they imply are important to archaeologists as they assist with the identification and interpretation of archaeological sites (Figure 3).

kw'ích'tenem

McNab Creek, or "Fish cutting place" (Kennedy 1976). The creek and estuary were traditionally used by the *skxwúmish* for fishing spring, coho and pink salmon with basket traps and nets. Slate found at the creek was used to make knives for fish processing (Reimer 2004).

kwikwa'y

Land and water west of Ekins Point, Gambier Island. Translated as "lots of second growth", the area was used for camping and trolling salmon (Reimer 2004).

St'áp'as

Latona Beach (Kennedy 1976).

Siiyá7ten

Translated as "widows" and located near mouth of Rainy River, Port Mellon, and I.R. 25, Kaikalahun (Kennedy 1976).

Ch'kw'elhp

Skxwúmish village site at Gibson's. Currently I.R. 26, Chekwelp (Kennedy 1976).

S7ets7átsnach

Translated as "bunch of bays", also Gambier Island as a whole (Kennedy 1976; Reimer 2004).

seni'sm

Camp site at Douglas Bay, reputed to be one of the best places in Howe Sound for both hunting and fishing (Reimer 2004).

lhelta's

Navigation point at northeastern point of Gambier Island (Reimer 2004).

P'ap'k'

Translated as "white", this term refers to the shoreline and a coho spawning stream in the vicinity of Lion's Bay (Kennedy and Bouchard 1976; Rozen 1979).

təmλ

Refers to “red paint”, a source for red ochre found in a rock formation located about “two and one-half miles” north of Horseshoe Bay (Matthews 1955; Rozen 1979).

ch’ax̱áy̓

Horseshoe Bay, location of village and fishing camp, named after the “sizzling noise” made by the smelt schooling in shallow waters (Kennedy and Bouchard 1976; Rozen 1979).

st’ek̲w’t’ék̲w’s

The Whytecliff Park area, including Fisherman’s Cove. Translated as Copper Point (Kennedy and Bouchard 1976) or “Rocks all cut up” (Matthews 1955); this was the location where two “sea serpents” collided resulting in one serpent’s head breaking off, according to *skxwúm̓ish* mythology (Rozen 1979).

Eagle Island

Located outside of Fisherman’s Cove, this island was used for burials by the *skxwúm̓ish* (Rozen 1979). The Grebe Islands, located about 1 km further south, were also used for burials, according to Matthews (1955).

Kwumch-nam

Roughly translated, *Kwumch-nam* means “thumping feet” or “noise as when stamping heel”, and refers to the Hood Point on the northern tip of Bowen Island (Matthews 1955; Rozen 1979).

Kwílakm/Kolelakom

Bowen Island as a whole, or the productive clam harvesting location at Tunstall Bay (west side of the island). *Kwílakm* was also regarded as an important location for deer and marine mammal hunting (Matthews 1955; Rozen 1979).

Naych-chair-kin

Translated as “outside of the islands”, *Naych-chair-kin* refers to the south-facing coastline of Bowen Island, from Cowan Point to Cape Roger Curtis (Matthews 1955; Rozen 1979).

3.2.3 Archaeological Sequence of the Strait of Georgia region

A great deal of archaeological research has taken place in the southern Strait of Georgia region, particularly in the Lower Mainland area around Vancouver and in the Gulf Islands. Research undertaken in the Vancouver area and the Gulf Islands has helped to build a regional chronology spanning at least 8,500 years (Matson 1976, 1992). The early development of this sequence can be traced back to Borden (1950, 1968, 1970), Carlson (1960), Mitchell (1971) and Matson (1974).

The following provides a general summary of the archaeological sequence for the southern Strait of Georgia region.

3.2.3.1 Pebble Tool Tradition

The earliest culture type identified in the archaeological record of the coast is variously referred to as Old Cordilleran (Matson 1976, 1992), the Lithic Culture Type (Mitchell 1971), the Pebble Tool Tradition (Carlson 1990, 1996), or the Protowestern Tradition (Ham, 1982). This little-known period, which extends from about 8500 to 5500 BP, is associated with generally lower sea levels. The culture type is characterized by an artifact assemblage dominated by chipped stone artifacts, including cobble tools and leaf-shaped bifaces, along with other bone and antler tools (Carlson 1990; Matson 1992).

Faunal remains from the Pebble Tool Tradition components, including from a site such as the Glenrose Cannery Site (DgRr-006) which was located adjacent to marine resources, reflect an economic pattern directed toward the hunting of land mammals, with deer and wapiti the two most important animals that were observed archaeologically. Seals, salmon, sticklebacks, eulachon, flatfish, and bay mussel, however, have also been identified in early midden deposits (Matson 1976, 1992).

3.2.3.2 Charles/St. Mungo Culture Type

The Charles Culture Type (5500 to 3300 BP) may be the earliest archaeological phase directly ancestral to the ethnographically documented Northwest Coast pattern and has well-described components from three sites in the Fraser delta: St. Mungo (DgRr-002), Glenrose Cannery (DgRr-006), and Crescent Beach (DgRr-001) (Matson and Coupland 1995). This period saw a continuation of some tool types from the previous culture type and the introduction of new types, including chipped stone scrapers, drills, stemmed bifaces, as well as ground slate, bone, and antler implements (Ham et al. 1986).

A well-developed woodworking technology is inferred from the presence of adzes and wedges and the remains of several large residential structures located along the Fraser River at Agassiz and Hatzic (LeClair 1976; Mason 1994).

Pratt (1992) suggested Charles Culture faunal remains are indicative of a mixed economy where both land and sea mammals were exploited. Although salmon were exploited to some extent, specialization had not yet begun (Matson 1992). Mason (1994) has argued that the presence of several large residential structures at sites located along the Fraser River suggests specialized salmon exploitation had occurred by this period. It is doubtful that a hunter-gatherer population would have required, or invested, the time and energy necessary to construct the large structures found at the Hatzic Rock (DgRn-023) and Maurer (DhRk-008) sites.

Eldridge (1991) argues for intensive salmon harvesting, processing, and storage at the mouth of the Fraser River by 4600 BP, based on the presence of intertidal stakes, thought to represent the remains of fish weirs, at the Glenrose Cannery Site (DgRr-006). Test excavations also revealed basketry, cordage, carved wood, and cedar bark clothing (Eldridge 1991). Eldridge further suggests that the Northwest Coast pattern was likely well established during the Charles Culture, and elements such as massive architecture, wealth accumulation, hereditary status, and social ranking were in place at this time. Cannon (1993) has argued for the presence of salmon specialization and storage technology at Namu, on the central coast prior to 6000 BP, suggesting similar data are waiting to be uncovered in the Lower Mainland area.

Ham et al. (1984) suggest a broader economic base may have led to stratification in social status as evidenced by burial practices, use of labrets, and possibly human cranial deformation. In contrast, Pratt (1992) suggests an egalitarian society existed despite the possible presence of status differentiation as reflected in burial remains at Tsawwassen and possibly Pender Canal.

3.2.3.3 Locarno Beach Culture Type

The Locarno Beach Culture Type, (ca. 3500/3300 to 2500 BP) is typified by a predominantly chipped stone technology with a relatively small proportion of large, thick ground stone tools. A variety of tool types is found in Locarno Beach assemblages, including flaked shouldered and lanceolate stone points, microblades and cores, bilaterally and unilaterally barbed points, one-piece and composite toggling harpoon heads, woodworking tools such as abraders, grinding slabs, and wedges, large, faceted ground slate points, and thick ground slate knives (Mitchell 1990). Evidence of cordage, basketry, and other wood items has been recovered from water saturated sites in the Lower Mainland (Archer and Bernick 1990; Bernick 1991; Borden 1976; Patenaude 1983).

The small and carefully made steatite, coal, and bone artifacts characteristic of the Gulf Island complex also appear to be associated with the Locarno Beach Culture Type, although these items are not found in all components of this period (Mitchell 1990).

Faunal remains demonstrate that people of this period utilized a varied resource base, showing a great reliance on shellfish, birds, and sea mammals; however, land mammals and fish were still of prime importance.

Evidence of large residential structures is lacking; nonetheless, the existence of these dwellings is inferred based on the nature of tools found in artifact assemblages and the presence of large Charles Culture (ca. 5500 to 3000 BP) dwellings (see Mason 1994).

3.2.3.4 Marpole Culture Type

The Marpole Culture spans the period between 2,500 and 1,400 BP (Burley 1980). Mitchell (1971) provides a synthesis of diagnostic archaeological features found within the Marpole Culture Type and has produced a list of twenty defining criteria. These criteria were later re-examined and further refined by Burley (1980).

Artifact assemblages typical of Marpole period deposits tend to be quite varied. While many artifact types from the Locarno Beach Culture Type are found in Marpole period assemblages, technology from the latter period can be characterized by a decrease in proportion of chipped stone tools with a concomitant increase by proportion and refinement of ground stone tools. Exclusive to the Marpole period, the non-toggling, barbed harpoon point is considered a diagnostic artifact (Mitchell 1990). Among items associated with the development of ranked society, native copper ornaments are prevalent, as are midden burials with grave inclusions such as shell or slate disc beads (Burley 1980).

Tools indicative of large-scale woodworking are typical of Marpole assemblages and, as Borden (1954, 1970) suggests, represent the type of woodworking recorded in ethnographic times. This is supported by identification of features such as large house outlines and post moulds (Burley 1980). Houses were likely composed of a heavy timber frame upon which cedar planks were lashed and assembled in the row-housing style or, in later Marpole times, as extremely large single structures. Generally, Marpole villages were large and composed of houses arranged facing the shore, with midden refuse deposits between and behind the houses (Mitchell 1990).

Distinctive stone sculpture is a defining trait of Marpole assemblages. Seated human figurine bowls, decorated stone bowls, and incised siltstone objects are a few examples of the Marpole artistic tradition. Typical motifs include “turtle-like animals with prominent eyes, snake or sea monster representations, herons and other birds, and seated emaciated humans” (Mitchell 1990).

Some archaeologists view Marpole assemblages as indicative of a major shift in subsistence practices and social organization on the Northwest Coast. For example, Burley (1980) suggests, as did others before him, that salmon were an integral component of Marpole era society; it was the ability to dry and preserve surplus salmon that stimulated cultural change. Indeed, it has been postulated that salmon are linked to the development of large-scale, ranked societies on the Northwest Coast as the surplus of salmon resources would have allowed for the development of economic and cultural traits normally associated with chiefdoms such as "semi-sedentism and population aggregation" (Burley 1980).

3.2.3.5 Developed Coast Salish Culture Type

The Developed Coast Salish Culture (1400 to 200 BP) is directly ancestral to present Coast Salish culture and contains a single culture type, though several regional variants have been proposed. These variants include Late (Fladmark 1982; Matson 1992), San Juan (Carlson 1960), Strait of Georgia Culture Type (Mitchell 1971, 1990), Gulf of Georgia Culture Type (Ham 1982), and Stselax (Borden 1954). Defining archaeological characteristics for the culture type include small, triangular flaked basalt points; thin, ground slate points and knives; unilaterally barbed bone points, usually with many enclosed barbs; composite toggling harpoon heads; and large, well-made ground stone adzes (Mitchell 1990).

Household and resource procurement technology typical of this period is characteristic of wide-ranging subsistence practices. Fishing, hunting, plant gathering, and shellfish harvesting implements are found throughout Developed Coast Salish sites. Nets were used for hunting, and collections of net weights may indicate their use in capturing ungulates or fowl. Collections of net weights and anchor stones are also indicative of net fishing technology (Easton 1985). Woodworking implements are consistent with those found in Marpole assemblages and differ only in minor detail (Mitchell 1990).

House styles typical of this period include both row and single dwellings. Structures were likely composed of a heavy timber frame upon which cedar planks were lashed (Mitchell 1990). Refuges formed by walls or ditches, surrounding a series of temporary structures, are sometimes found in nearby association with larger dwellings.

Developed Coast Salish Culture peoples are thought to have relied on a diet of salmon supplemented with other fish, animal, and plant resources. Most archaeological sites falling within the Developed Coast Salish Culture are seasonal in nature, consequently little is known regarding the overall diet (Mitchell 1990). Seasonal assemblages indicate that shellfish and herring were of considerable importance in the spring, while salmon constituted the most important fall food resource. Deer, Roosevelt elk, and dog remains are found in Developed Coast Salish assemblages. Dog bones are usually found intact and articulated indicating they were not typically used for food.

Seasonal assemblages of differing faunal and floral resources and structure types indicate that social organization mirrored that of the ethnographically known Coast Salish groups. Characteristics of the Developed Coast Salish groups seen in ethnographically recorded Coast Salish cultures include a resource economy based on a seasonal round and the presence of large winter villages. Seasonal patterns of settlement were typified by the large winter village, some large summer gathering areas, and smaller spring, summer, and fall camps (Mitchell 1990).

3.2.4 Post-Contact Period Regional History

The following summarizes some of the rapid changes following the arrival of the non-indigenous populations into to the Strait of Georgia region, with emphasis on patterns or phases of settlement and resource exploitation. The changes were typically marked by significant technological developments which impacted the landscape in ways which may remain visible, and may be evident in the archaeological record, particularly, for the purposes of this study, in maritime material culture manifest in heritage wrecks.

3.2.4.1 European Exploration and Fur Trade (1791-1857)

The first Europeans to explore the Georgia Strait did so with a brief burst of activity beginning in 1791 when Jose Maria Narvaez entered the Strait from the Juan de Fuca, followed the next year by an another Spanish expedition under Cayento Valdes and Dionisio Alcala Galiano, and a British expedition under George Vancouver (Newcombe 1923). The navigational challenges for sailing vessels were too great and the rewards too small for the maritime fur traders to brave the passes guarding this inland sea and follow in the explorers' wakes. Although isolated for a time from further contact with Europeans, the Coast Salish communities in the Georgia Strait basin had already suffered the first of several outbreaks of smallpox twenty years before the arrival of Narvaez, and these would continue to drastically reduce the Native population for over a century (Suttles 1990).

The Hudson's Bay Company (HBC) extended its influence into the Georgia Strait area slowly, beginning with the establishment of Fort Langley in 1827. The HBC pioneered a number of small–scale export operations including for salmon (salted), shingles and lumber (Barman 1996). The fort at Nanaimo was only established in 1853 in response to the HBC's new interests in acquiring coal to feed the boilers of steam ships (McKelvie 1952). The HBC was also instrumental in introducing the first vessels in the region which were provided with steam propulsion, starting with the first steam-powered vessel on the West Coast of North America, the *Beaver* in 1836, and followed by the first propeller-driven craft, the *Otter*, in 1853 (Galois and Ray 1993; Drushka 1981). The first iron-hulled vessel also made its appearance (albeit unsuccessful) on the coast before the end of this period in the form of the steamer *Major Tompkins* (Newell and Williamson 1958).

3.2.4.2 Colony to Province (1858-1885)

All of the settlement on the West Coast was initially dependent on water transportation for its existence. An influx of settlers to the Georgia Strait was brought by the word of gold found in the interior of New Caledonia in 1858. The path of the gold seekers was from Fort Victoria in the newly formed colony of Vancouver Island where they typically landed and then travelled by steamer across the southern part of the Georgia Strait to the Fraser River. From there, they continued by whatever means and route available into Thompson region of the interior.

As settlement gradually began in the wake of the Fraser and Caribou gold strikes, one of the first requirements for transportation was the charting of the water ways. The Georgia Strait area was extensively charted by Captain Richards of HMS *Plumper* beginning in 1858, with work continuing into the mid-1860's in the HMS *Hecate* and H.M.-hired *Beaver* under the successive commands of Captain Pender, and Lieutenants Mayne and Hand (Walbran 1971).

Commercial fisheries, including whaling and sealing, were being developed during this period with substantial contributions from Native hunters, fishers and boat builders. The (sockeye) salmon canning industry was also nascent, but export markets were rapidly developing and by 1880 every river and inlet with a salmon stream along the coast had a cannery (Barman 1996). The larger fishing vessels (such as those used for halibut and sealing) were not typically built locally at this time.

Settlement also created demand for lumber. In the 1860s and 1870s, mills were constructed in Burrard Inlet, the future site of New Westminster, and Vancouver Island to meet local lumber requirements as well as for export. Sailing ships were brought into the Georgia Strait by tugs to load coal and lumber for export. These big steam tugs were among the first substantial vessels built in the region, and further became general service vessels carrying passengers and freight to camps scattered along the coast. The side-wheeler *Isabel* was first to be built in BC (1866), and the *Etta White* (one of the first propeller-driven tugs, built in 1871), *Alexander* (the last side-wheeler tug, built 1875) and *Pilot* (1876) were other significant pioneer tugs operating in coastal British Columbia (Drushka 1981). After working as a survey vessel, *Beaver* (along with *Otter*) found further employment as a tug (Drushka 1981).

3.2.4.3 The Railway and Population Explosion (1886-1912)

The inside waters of British Columbia were transformed by the arrival of the Canadian Pacific Railway (CPR) to Burrard Inlet in 1886. Resource and industrial development rapidly expanded, primarily in forestry (spars and lumber), mining (coal), and fishing (primarily canned sockeye salmon). People flooded into the area to work and settle, while vessels remained the principal form of transport whether in the form of sailing ships, coastal steamers, oceangoing ships, or tugs towing barges, scows and booms (Drushka 1981; Rushton 1974). The CPR also came to dominate the coastal trade among the major Pacific coast ports and between BC and the Orient; the contract for the mail service to Japan and Hong Kong was secured in 1889, and in 1891 the first of the CPR empress liners was in service (Barman 1996).

The many smaller ports along the coast would be served by the Union Steamship Company, incorporated in 1889. Small sailing coastal schooners also provided transport of goods around the Strait. Small craft powered by oars and sail provided basic personal transport, and were also critical in various forms for the fishing industry, for which purpose they were produced locally in large numbers (Moore 1993).

Most of the navigational infrastructure of the coast, including marker lights, buoys, lighthouses and light ships were installed through this period, and the first lifesaving services were implemented. C.G.S *Quadra* under the command of Caption John Walbran from 1891-1908 was critical in establishing much of this infrastructure while continuing surveying work and functioning as a fisheries patrol vessel (Walbran 1971).

Logging throughout this period remained selective, with the trees cut by men with hand tools and the logs moved by oxen, then horses, water (flume), and donkey steam engines. Douglas-fir was the first species selected for cutting by the big timber companies; western redcedar was cut secondarily for shingle bolts; and finally hemlock for pulp, and alder for furniture (Peterson 1962). Mills were no longer limited to adjacent timber stands, but relied on logs delivered by tugs in booms, rafts, or on barges often converted from ocean-going vessels.

The fishing industry became well-established as export industry primarily with salmon processed at canneries. British capital was important for the development of the industry, and most of the exports would travel in sailing

ships around Cape Horn to Britain. The channels of the Fraser River were dredged to get the deep-draughted ships to the wharves of the canneries located along the river banks.

In addition to employing Native people, the salmon canning industry also employed Chinese and Japanese workers to fish and process salmon. The off-season found many Japanese fishermen establishing themselves as boat-builders, or pursuing new fisheries such as the salting of chum salmon and herring for Asian markets, beginning in 1897 (Yesaki 2003). The making of charcoal, particularly to supply the braziers for hand-soldering cans was also a popular off-season activity. Salteries and charcoal-making operations appeared around the Gulf of Georgia (Haig-Brown 1993).

Other mining resources were developed in this period, besides coal. The copper seam at Britannia Mine, for example was discovered in 1890, and subsequently developed (Armitage 1997). Many small operations were set up around the coast to quarry stone and extract clay for bricks to supply the growing need for building materials.

3.2.4.1 Technological Change and Socio-Economic Turbulence (1913-1939)

The second decade of the century saw massive changes as a result of technological innovation. Mechanization was the order of the day in the fishing industry, for example. Gas engines were introduced (mostly slow-turning Easthope engines made in Vancouver) and by 1915 the sailing gillnetters on the Fraser River had generally been replaced. Gas and diesel engines spurred the invention of new vernacular types of fishing vessels including powered trollers, seiners, and halibut “schooners” (Bell 1970; Haig-Brown 1993; Moore 1992). On the cannery lines, in addition to fish-butchering machines, mechanical canning machines replaced hand-soldering, and, as a result, ended the need for charcoal production. More mobile fleets of fishing boats, along with refrigerating capacity expanded fishing activities to new catches, broader geographic areas, and extended seasons. Fish were also delivered more easily to the European market because the opening of the Panama Canal in 1914 cut the distance to less than half and made transport by modern steam ships practical.

At the same time seemingly archaic methods persisted throughout this period. Some fishermen, for example, could and did still make a marginal living around the Georgia basin, often moving between previously abandoned aboriginal seasonal camps, maintaining ancient canoe runs, and fishing for salmon with hand lines from row boats or dugout canoes (Moore 2013).

On the other hand, the gas engine also made air travel possible, and this period saw the first “bush” planes come into use along the coast. Many early aircraft were flying boats while others employed floats. The Vancouver Civic Airport and Seaplane Harbour opened on Sea Island in 1931 (Hayes 2012). On the water, new speeds were made possible by the introduction of high-powered engines, like the “liberty” aircraft engines, available as surplus after World War One. One economic activity which benefitted from high speed vessels was smuggling, with some rum-running boats specially built to evade capture through speed.

The emergence of gas and oil as preferred fuels contributed to the Vancouver Island coal mines being phased out in the 1930s. Reciprocating steam engines were, however, still the preferred power source for larger vessels active through this period, including, for example, tugs like the *Lorne*, built in 1889 for towing sailing vessels, but active until 1936 towing log barges (Drushka 1981; Stone 2007). Diesel engines were first successfully installed in smaller tugs beginning about 1921 with the *Radio*, built by John A. Cates in Vancouver (Drushka 1981). The

newer tugs were no longer multipurpose vessels, but specialized in towing. Sailing coasters were no longer used, having been replaced by moderately-sized powered coasters, some imported with steel hulls.

The standard building material on the West Coast continued to be wood, although the larger ocean-going craft and some moderately-sized coasters were constructed of steel, and these were generally still built abroad. Large ocean-going vessels also continued to be built of wood on the West Coast, most notably during World War One when large numbers of wooden freighters were manufactured. Some of these vessels were abandoned after the war, while others were reused as log barges along the BC coast.

While vessels have always been vulnerable fire, the introduction of motorized propulsion, particularly the early gas engines, made fire and/or explosion a very common form of loss. These losses could occur anywhere and not infrequently did occur at or near docks. Abandonment of older wooden vessels once their useful lives were over, due to accident-related damage, age, the end of war-time exigencies, or simply the ebb and flow of resource-based industries, also became common. Abandoned vessels might be beached near wharves or in back waters, or anchored out of the way where they might eventually sink through intention or neglect. Not infrequently vessels were abandoned in clusters sometimes referred to as ships' graveyards (Richards 2008).

3.2.4.2 Modern Era (1940-present)

Following World War Two, there was a general decline in the number and variety of water craft on the BC Coast used for transport. As after World War One, surplus vessels and engines were readily available and demand for local new construction fell off. Roads were built to many coastal areas and aircraft service became common. Union Steamships ceased operations in 1959 (Hayes 2012). Where roads could not be constructed, such as to the larger islands and across major inlets, regularized ferry service was instituted, first supplied privately, and then by the provincial service (BC Ferries) beginning in 1961.

The forestry industry became mechanized with the introduction of the chain saw and logging trucks. Clear-cut timber harvesting areas were linked by developed roads to log sorts where the logs would be dropped into the water to be taken by boom or barge to mills.

Steel construction in regional shipyards became common but materials varied according to type. Since the 1940s wooden barges have gradually been replaced, the largest sizes first, with barges of steel construction. These barges find employment with every resource sector on the coast from transporting raw materials to supplying equipment and specialized cargo such as fuel oil. New tugs have typically been built of steel.

Large numbers of locally built craft continued to be built locally of wood for fishing, although newer boats were generally larger with more powerful diesel engines. Although wooden fishing vessels are still occasionally built and many remain in use, beginning in the 1960s fibreglass and aluminum become the most common hull materials for new fishing vessels (Haig-Brown 1993).

Numerous safety measures on board vessels including electronic aids to navigation, inexpensive radios, as well as better education and training around vessel and fuel management has made vessel operation generally much safer. However, the post-war years have also seen the emergence of recreational boating with large numbers of small craft used in the Georgia Strait area. Many of these craft have contributed to the number of lost vessels over the past 60 years due to the inexperience of some operators, the unsuitability of some recreational craft to the environment in which they are used, and the sheer number of recreational craft currently in use.

3.2.5 Previous Heritage Resource Studies

The first inventory of archaeological sites in Howe Sound was conducted at the direction of the provincial Heritage Branch in 1974 (Winram 1975). This study assessed the McNab Creek outlet area with similar archaeological potential as the Potlatch Creek and Rainy River outlets[4], although with potential use limited to "resource" rather than a "general use" site type (Winram 1975). No archaeological sites were identified then or subsequently within the deltaic fans of any of the three streams.

Subsequent archaeological studies in and around Howe Sound have typically been in response to industrial and residential development (*e.g.*, Apland 1980; Arcas 1995, Arcas 1998, Bussey 1990, Friensen 1980, Golder 2003, Howe 1981, Howe 1982; May and Lucas 1976, Merchant and Rousseau 1994; Quirolo and Ham 1990; Reimer 2004; Simonsen and Reimer 2002; and Sneed and Smith 1977). Overall, the Howe Sound area has not been investigated intensively. A mitigative excavation project was conducted on Gambier Island, where two sites (DiRu-56 and DiRu-60) were the focus of the study (Pratt and Howe 1998).

Successive field surveys by the Underwater Archaeological Society of British Columbia have resulted in the publication of Historic Shipwrecks of the Lower Mainland (Stone 2007). This report includes the description of six heritage wrecks located in Howe Sound, in West Bay, Gambier Island, and Plowden Bay (sites DiRu-066, DiRu-069 and DjRu-009; Figure 4), and a discussion about the possible location of the *Lorne* also in West bay.

A previous investigation of the McNab Creek area was completed by Rudy Reimer under Heritage Inspection Permit 2004-145 (Reimer 2004). The AIA was conducted on June 7, 2004 and consisted of a systematic survey of the proposed timber harvesting area, with traverses space at 5-10 m, with both prehistoric and historic activities noted and recorded. Seven areas of archaeological potential were identified that were associated with intact landforms. In total 55 subsurface shovel tests were excavated (Figure 5). All subsurface tests were negative and no archaeological sites were identified (Reimer 2004).

No previous paleontological studies specific to the Howe Sound area were identified.

4.0 METHODS

4.1 First Nation Communications

Consistent with Provincial policy, a copy of Golder's *HCA* Permit application was forwarded by the Archaeology Branch to the Squamish Nation and Tseil-Waututh Nation. The Archaeology Branch determined which groups and organizations were to receive the application based on documentation on file with the Archaeology Branch. Each group or organization was given an opportunity to review and comment on the application.

In keeping with industry practice, Golder applied for permits from the Squamish Nation and Tsleil-Waututh Nation and obtained Squamish Nation Archaeological Investigations Permit 12-0124 and Tsleil-Waututh Nation Cultural Heritage Investigation Permit 2013-006.

Golder contacted the Squamish First Nation and Tsleil-waututh Nation by telephone, fax, and email to notify each community of the proposed development and to invite a member of each community to participate in the

[4] Rainy River and Potlatch Creek are the next major drainages southwest and northeast of McNab Creek, respectively.

fieldwork. Louise Williams, representative of Squamish First Nation participated in the fieldwork component of the AIA. A Participant from Tsleil-waututh Nation was not available to participate in the fieldwork due to previous commitments. A copy of this report will be provided to the Squamish First Nation and Tsleil-waututh Nation.

4.2 Background Research

To provide an overview survey of the heritage resources within the LSA and RSA, the following sources were reviewed:

- Provincial Heritage Register;
- Available ethnographic, archaeological, historical and paleontological 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 of ROV and seismic survey including multibeam bathymetric, sonar, and sub-bottom acoustic profiling previously conducted within the underwater portion of the LSA (Frontier 2009; Wright 2006).

4.3 Heritage Resource Potential Assessment

Heritage Resource potential refers to an assessed likelihood that heritage resources are, or were at one time, present in a given area. It is based on an evaluation of ethnographic, historic, environmental, geological and archaeological data relating to past land use patterns and known archaeological, historical, and paleontological site locations. With respect to archaeology, this report is consistent with provincial guidelines (Ministry of Tourism Culture and the Arts 2008) resulting in determinations to identify areas of potential within the LSA and RSA.

Within the LSA, archaeological and paleontological potential were further refined through observation of landforms, surface inspection, and subsurface testing during the AIA field assessment.

Potential assessment within the RSA was limited to the assessment of known archaeological resources and the likelihood for the presence of historical resources, identified through evaluation of relevant background materials and review of readily available imagery. To facilitate the potential assessment in the RSA, the area was subdivided into sectors as follows (Figures 3 and 4):

- Thornborough Channel (west barge route), approximately 17 km in transit length;

- Howe Sound Basin[5], (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.

4.4 Field Methods

4.4.1 Archaeological Potential Assessment

Generally, areas of archaeological potential are considered to include level or near level terrain adjacent to water features and/or previously recorded archaeological sites; areas of known pre-contact resource procurement (e.g., a lithic quarry area); areas with associated ethnographic information or place names; terrain with favourable aspect or drainage; certain forest cover types; and, the presence of micro-environmental features such as terraces, small rises in local topography (e.g., hillocks or knolls), and breaks in slope. Culturally modified trees (CMTs) are also possible when suitable forest cover exists. Typically, old growth forests containing Sitka spruce, Douglas-fir or Western redcedar are considered areas where CMTs are likely. Factors considered to constrain archaeological potential include: steep or rough terrain (~30% and higher), particularly if it is more than 50 m away from a water feature; poorly drained terrain; massively disturbed areas; unbroken slope; and/or tree stands younger than 1846 A.D.

Additionally, areas of archaeological potential associated with intertidal zones (e.g., for features such as canoe runs and fishing weirs or traps, as well as anaerobically preserved organic materials) are considered to include shoreline settings with gradual beach slopes; protected settings relative to dominant weather/wave systems; areas adjacent to terrestrial fresh water features and/or previously recorded archaeological sites; areas of known pre-contact resource procurement; and, areas with associated ethnographic information or place names.

Potential for heritage wrecks may be determined by historical or visual records indicating the presence of a wreck or the occurrence of a wrecking event. Local hydrographic characteristics may create areas hazardous to navigation resulting in multiple historical wrecking events and an area of high potential for the presence of wrecks. Vessel abandonments are events less likely to be recorded, however, the potential for abandoned wrecks to be located in an area may be established through geography (i.e., little-used but protected anchorages, or proximity to wharves or shipyards) as well as historic records of ship's graveyards, places where vessels were "moth-balled" (Richards 2008).

Archaeological potential within the LSA was assessed during the visual inspection and areas were categorized as having either high or low potential. Those areas considered to have high archaeological potential were subject to subsurface testing (Section 5.3.3).

[5] 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.

4.4.2 Pedestrian Survey

A surface reconnaissance conducted on foot is the most common method utilized to rapidly identify sites within a project area. However, results can be affected by several factors including transect widths, artifact and feature visibility, land use, and individual experience (Shott 1995).

The pedestrian survey consisted of visual survey and surface inspection of the LSA employing parallel traverses spaced at varying intervals depending on terrain, ground cover and assessed site potential. Locations assessed as having archaeological potential, such as the shoreline, level terraces above the shoreline, and stream margins were most intensively inspected and were traversed by a crew of 2 to 3 people spaced at 5 m to 10 m intervals. Areas considered to have low archaeological or paleontological potential were traversed at wider (20 to 30 m) intervals.

Traverses were used to examine the proposed LSA for both surficial archaeological and paleontological evidence and to identify areas of potential. The surface geology was examined for evidence of potential for paleontological resources. Surface evidence of cultural material was also sought, including, but not limited to, stone, bone, antler, shell or other artifacts, fire-altered rock, rock art, cultural features (e.g., hearths, cultural depressions), anthropogenic soils, historic cultural remains and debris. When present, existing trails, tree throws, berms, cutbanks and other exposures were inspected for archaeological materials. Additionally, the shore line within the LSA was examined by boat to further identify areas of archaeological potential, and to identify any surficial archaeological or paleontological evidence.

4.4.3 Subsurface Testing

Judgementally-placed shovel tests, averaging 30 cm by 30 cm and placed at 5 m to 10 m intervals, were used to search for buried cultural deposits at locations considered to have archaeological site potential. Subsurface tests extended to sterile stratum, subject to subsurface constraints. Excavated material was screened through 6 mm metal mesh or manually sorted. All excavated material was replaced in the test hole upon completion of the test. A hand held global positioning system (GPS) was used to determine the location of each test area for plotting on development plans.

4.4.4 Complementary Studies

Because field studies related to the Project are being conducted concurrently with this heritage resource study, it has been possible to examine additional data sets from a heritage perspective as part of this assessment. These data include review of recorded video from a diver-held camera within the sub-tidal seabed the LSA. Participants in marine biophysical surveys were also advised to report the presence of worked wood, machinery, or other indications for the presence of shipwrecks while conducting dive transects and while towing an underwater video camera (Figure 5) in the sub-tidal LSA. Divers followed three transects perpendicular to the beach to a depth of about 20 m, and the towed video data was gathered between depths of 3 and 25 m below chart datum. Additional observations and still images were available from participants in pedestrian surveys for marine and habitat assessments conducted within the LSA during favourable low tide conditions.

4.5 Resource Evaluation

The significance of archaeological sites in BC is evaluated using the Checklist of Criteria for either Pre-Contact Site Evaluation or Post-Contact Site Evaluation (Appendix E) of the British Columbia Archaeological Impact Assessment Guidelines (Archaeology Branch 1998). Categories include scientific, public, economic, and ethnic significance.

We will assess scientific, public, and, where applicable, historic and economic significance for sites recorded during the AIA that are conflict with proposed development activities. We will use criteria established in the British Columbia Archaeological Impact Assessment Guidelines to make such assessments. Ethnic or cultural significance will be assessed and provided by the First Nation group(s) with ties to the archaeological site(s) in question. Within the RSA significance of recorded sites will be generally indicated.

We will further evaluate historic resources that may or not be protected under terms of the *HCA* to assess the potential for meeting the criteria for national historic significance (Historic Sites and Monument Board of Canada 2000).

Paleontological resources were not assessed for significance.

4.6 Impact Assessment

The assessment of potential impacts to heritage resources reflects the anticipated net change between the condition of the resource or site with and without development. Anticipated Project-related impacts are provided in accordance with Appendix F of the BC Archaeological Impact Assessment Guidelines. Categories include magnitude, severity, duration, range, frequency, diversity, and cumulative effect.

We will evaluate potential direct and indirect adverse impacts to identified archaeological sites resulting from proposed development activities.

4.7 Recommendations

Recommendations for the management of potential impacts to recorded sites were made. Recommendations may include avoidance through project re-design, excavation, or other mitigative actions.

5.0 RESULTS

5.1 Regional Study Area Overview

5.1.1 McNab Creek and Development History of Howe Sound

The following sections summarize results of background historical research specific to the development of Howe Sound, focussing on McNab Creek and development sector activities influencing the potential for heritage resources within the RSA.

5.1.1.1 Charting and Navigation

The European naming of what would become Howe Sound occurred slowly. The name applied to the sound by Galiano and Valdes, *Boca del Carmelo*, did not endure. Vancouver dispatched Peter Puget in a launch to explore the Sound, but only two islands, Anvil and Passage, were named as a result (Newcombe 1923). Many of the features within the Howe Sound were named by Captain Richards in 1859, after Royal Navy participants and vessels in the "Glorious First of June", a significant British naval battle in the eastern Atlantic over a French fleet in 1794[6].

McNab Creek appears to have been named after John McNab, a recent arrival from Ottawa, who along with John Robinson disappeared on an excursion by boat "to hunt and trade guns with natives" in the spring of 1886 (British Colonist, October 26, 1886). Their camp was apparently located at McNab Creek. It speaks to the lack of navigation in the area that it was some months before it was determined they were missing. No one was ever charged, however the disappearance of the men was variously described in newspaper accounts as "mysterious", "foulplay suspected" or "undoubted murders" (British Colonist, October 26, and December 9, 1886).

Navigation was assisted by the installation of the Point Atkinson lighthouse in 1876. A pilot's station was established nearby at Caulfield Cove by 1899. The installation of smaller navigation beacons through Howe Sound continued through the 20th century. Aids to navigation did not stop the loss of coastal vessels of every description in the Howe Sound. Over 60 wrecking events are reported within Howe Sound up to the 1990s. The first recorded loss may be *Nellie Taylor*, a steamer that drifted from its Port Graves anchorage and foundered in 1891 (Northern Maritime Research 2002; Rogers 1973). Known wrecks and reported wrecking events potentially leaving wreck remains in shallow water (in the RSA) are reported in sections 5.1.2 and 5.1.3. A selection of deep water wrecks with a representative range of accident causes, and limited to Queen Charlotte Channel, includes the following:

- A Royal Norwegian Air Force Northrup N-3PB crashed into the sea off Point Aktinson on a training mission, February 21, 1941, with the loss of both crew members (Victoria Times Colonist 2006).

[6] Notable names in the RSA which commemorate the 18th century battle include: Howe Sound, named after Lord Admiral Howe, commander of the British fleet; Queen Charlotte Channel named after Admiral Howe's flagship HMS *Queen Charlotte* (110 guns); Ramillies Channel named after HMS *Ramillies* (74 guns); Thornbrough Channel named after (Admiral) Edward Thornbrough, captain of the frigate HMS *Latona*; and, Gambier Island, named after (Admiral) James Gambier, captain of HMS *Defence* (74 gins) (Walbran 1971).

- The *Dola*, a 109 ft. (33 m) wooden steam tug built 1907 at Wallace Shipyards, North Vancouver, was sunk following a collision with the *Lady Cynthia* (Union Steamships Co.) off Whytecliff, October 29, 1953 (*Dola* was towing a barge with railroad cars which was not lost) (Rogers 1973).
- The tug *Hercules*, with scow in tow, sank after off Passage Island with the loss of one life (Rogers 1973).
- The M.V. *Triggerfish*, a freighter converted from a World War Two sub-chaser, capsized north-east of Passage Island, October 5, 1958, with the loss of three lives (Rogers 1973).
- The tug *Rex* sank after striking deadhead off Passage Island in December, 1958 (Rogers 1973).
- The steel tug *Emerald Straits* towing an empty barge, sank April 19, 1969, with the loss of two lives; subsequently located in a depth of 670 ft. (205 m) by a locally-built *Pisces* submersible, and then salvaged (Rogers 1973).
- The tug *Pacific Racer* burned in November of 1976 (Rogers 1973).
- Yacht *Kimberly* run down by ferry *Queen of Cowichan*, August 12, 1985 (Northern Maritime Research 2002).

5.1.1.2 Mineral Exploration and Development

There was a brief Squamish River "Gold rush" 1858. In that year, HBC chief trader Joseph McKay explored a route from the interior, Fort Pemberton, down to Squamish. Neither event led to further development of the Squamish area (Armitage 1997).

There was an early attempt at mining copper in 1865 when Howe Sound Copper Mines Ltd. was formed to mine at Whytecliff (Armitage 1997). 1890 marked the year that Britannia Mountain was staked by Oliver Furry, a prospector who lived at McNab Creek (Armitage 1997). The Britannia Copper Syndicate was formed that same year and, by the 1920s, Britannia Mines was producing largest amount of copper in British Empire (Hayes 2012).

Meanwhile, clay for bricks was being mined in a few locations around the Sound including on Bowen, Gambier, and Anvil islands (Armitage 1997). In 1894, slate was being quarried at McNab Creek; according to a pamphlet account of boat excursion, there was a "Slate Quarry belonging to Mr. Rowland…. whence McNabb [sic] and Robinson so mysteriously disappeared in 1886" (cited in Armitage 1997:77).

5.1.1.3 Forestry

As early as 1865, Hastings Mill (Burrard Inlet) leased timber rights in Howe Sound (Armitage 1997). Twenty-two years later Howe Sound's (non-aboriginal) residents numbered only nine, all of them described as "lumbermen" (Armitage 1997). In the next century shingle bolt camps of various sizes were set up around the Sound, some "Japanese" and "Chinese camps" among them, and some with charcoal-making operations included (Van Den Wyngaert 1980). Logging operations began to leave a permanent mark on the landscape as complex systems of dams and flumes were introduced to move the logs into logging camp sites built by companies employing significant numbers of men such as Stolz Shingle Bolt Co. Large operations were noted in the 1920's at McNab, Potlatch, and McNair creeks (Van Den Wyngaert 1980). Captain H.A. Mellon chose the Port Mellon site to build

a mill in 1908, based on water, timber, and the harbor he found there (Sunshine Coast Museum and Archives 2013).

McNab Creek was again the site of major logging operations when Burns and Jackson Logging moved their operations from Bowen Island to McNab Creek in 1931. They operated there until 1935 (or 1937) when they moved their camp to Wilson Creek (Petersen 1962; Van Den Wyngaert 1980). H.R. McMillan later acquired holdings from Burns and Jackson Logging, including McNab Cr. It is estimated that the log dump at McNab Creek was in on-and-off operation for approximately 80 years (dating to the Burns and Jackson period); Canfor operated a log dump with dry-land sort and two push-off locations for approximately 20 years beginning in the early 1980s (Wright 2006).

5.1.1.4 Commercial Fishing

The commercial fishing history in the Sound goes back to 1868 when a whaling camp was established on Pasley Island (Armitage 1997). Fisherman's Cove got its name from a Newfoundlander named Alcock who, in 1888, began to operate the first sealing schooner based in the Vancouver area, the *C.R. Rand*, from that cove (Armitage 1997).

Unlike rivers in other inlets up the coast, the Squamish River has never seen a significant salmon gill net fishery. However, one salmon cannery was built in the RSA, at Eagle Harbour in 1897 which operated for about 20 years. A larger cannery, the Great Northern Cannery built in 1891, was built in Sandy Cove, a short distance to the west of the RSA. This plant would later rely on seine boats, some working the Sound, to deliver its catch. Commercial trolling for salmon became popular in the 1920s with handliners, and later with locally-built powered trolling boats based in Howe Sound (Moore 1992).

5.1.1.5 Settlement

William Challenger may have been the settler in Howe Sound when he pre-empted land on Anvil Island in 1872; he cleared land and was listed as "farmer" by 1874 (Armitage 1997). The 1887, the opening of the CPR terminus in Vancouver saw a great increase in pre-emptors. Among them was George Gibson, who in 1888 received lumber for the first settler's house in West Howe Sound from the tug *Etta White* (Peterson 1962). The same year saw first successful settlement in Squamish area, where hop farming subsequently developed (Squamish Centennial Committee 1967). Gibson, among other early settlers, was more of a market gardener than a farmer who had to get his relatively small quantities of fruit and vegetables to city markets by small craft or steamer. In 1892, Chek-welp village (located near Gibson's Landing and possibly the last First Nations village occupied to that time within the RSA) was abandoned as the result of small pox epidemic (Peterson 1962).

5.1.1.6 Marine Transportation

Critical to early navigation and first settlement in the RSA were tugs. Even before the construction of a wharf, construction materials would be delivered by barge with a tug pushing the barge into the beach on rising tide (Petersen 1962). Some tug boats important to the development in Howe Sound, and all built prior to 1878, include the *Etta White* (destroyed by fire near Ocean Falls in 1920); *Bart*; *Eva* (sank on the Skeena River in

1892); *Sunbury*; and *Alice* (Petersen 1962, Rogers 1973, 1992). None of these pioneering tugs appear to have sunk within the RSA, however, the big steam tug *Lorne*, built in 1889, may be located in West Bay, Gambier Island (Drushka 1981; Stone 2007). *Adam*, a pioneer gas tug built 1907, sank in deep water off Bowen Island 1934 (Drushka 1981; Northern Maritime Research 2002). Tugs with barges continue to provide the primary mode of transport for industrial equipment and raw materials.

A range of steamers serviced the communities in the RSA, particularly once the wharves were built and until the advent of ferries and highways. The pioneer sternwheeler *Ritchet*, renamed *Paramba*, was one of them (Van Den Wyngaert 1980). Regular service to Squamish, twice weekly beginning in 1891, was supplied by the steamer *Saturna* (before it sank in False Creek in 1911) (Rogers 1992, Squamish Centennial Committee 1967). After World War One, the Squamish service was provided by Cates and then Union Steamships (Squamish Centennial Committee 1967). Some of Jack Cates' Terminal Steam Navigation Company boats included *Britannia*, *Defiance*, and *Lois* (lost off Eagle Harbour in 1904, see Figure 4) (Van Den Wyngaert 1980). McNab Creek was connected first by a fish boat making somewhat scheduled trips to and from Gibson's Landing, and then, in 1926, by *Nalaco*, a 36 ft. (11 m) passenger vessel making a half dozen stops between McNab Creek and Gibson's Landing (Van Den Wyngaert 1980).

The Union Steamship Co., founded in 1898, came to absorb virtually all of the smaller steamship lines in supplying regular service and excursions with vessels such as the *Comox*, *Capilano* (wrecked 1915 near Savary Island), and *Capilano II* (now breakwater in Land Bay, near Stillwater Bay) (Rogers 1973). A number of Union Steamship vessels were purchased and modified for use on the West Coast, including: former yachts built 1883 in the United Kingdom, *Santa Maria* (later *Chilco* and *Lady Pam*), and *Selma*; former minesweepers built in 1919, *Swinden* (renamed *Lady Cecilia*), and *Barnstaple* (renamed *Lady Cynthia*); a tug and rumrunner, *Trucilla* (renamed *Lady Alexandra*); and *Deerhound* (renamed *Lady Evelyn*), a vessel which had played a role in the rescue of survivors from the RMS *Empress of Ireland* in 1914 (Petersen 1962, Van Den Wyngaert 1980).

A Union Steamship pamphlet from the 1920s lists McNab Creek as one of 16 stops within the RSA (Hayes 2012).

The importance of steamers was eclipsed by the introduction of ferry service and the construction of roads. In the RSA, this first occurred when the Blackball Line inaugurated a ferry service between West Vancouver and the Sunshine Coast in 1951, with BC Ferries taking over the route in 1961 (Petersen 1962). Important road developments included the completion of a road across West Vancouver around 1906, the road to Port Mellon, finished in 1954, and the opening of the Squamish Highway in 1958 (Armitage 1997, Petersen 1962).

5.1.1.7 Boatbuilding and Maintenance

Small oar and sail-powered boats provided personal transportation for the first 50 years of coastal settlement. For example, George Gibson built his sailing vessel, *Swamp Angel*, before sailing it to where he eventually settled (Van Den Wyngaert 1980). The closest Post Office to McNab Creek in the 1930s and 1940s was on Anvil Island, and residents at McNab Creek like Bill Baines rowed there to collect their mail (Armitage 1997). These small craft might have been built by the owners, but were also built by boat-building specialists in the community. One early builder was E.J. Byfield, active in Gibson's Landing about 1909 (Van Den Wyngaert 1980). Later builders of fishing boats in Gibsons included Jim and Roy Malyea, and the Corletts (Moore 2013, Van Den Wyngaert 1980).

A noted building project was the construction of the 72 ft. (23 m) tug, S.S. *Hopkins.* This vessel was built by Vancouver-based shipwright Arthur Moscrop at Hopkins' Landing in 1910 (Van Den Wyngaert 1980). The *Hopkins* was built on the beach without benefit of a shipyard or other infrastructure, but close to the timber supply. Shipbuilding did not become an industry within the RSA. However, the Malcolm and Hicks Boat Works, later Charlie Malcolm Boat Works, was established in 1947 in Gibsons and produced custom vessels for fishing and beachcombing, with continued use for marine repairs until the first years of the twenty-first century (Town of Gibsons 2006).

5.1.2 Previously Recorded Archaeological Sites (RSA)

Archaeological sites listed in the Provincial Heritage Register with components extending into the intertidal areas within the RSA (including "surface lithics", which in Howe Sound frequently indicates an inter-tidal lithic scatter), or with locations directly adjacent to the high tide line, are listed in the following sections according to RSA sector[7].

5.1.2.1 Thornbrough Channel

There are 12 previously recorded archaeological sites in the Thornbrough Channel sector (Table 1). Of these, seven are shell midden sites, and three have surface lithics. Two heritage wrecks are listed, including the *Chieftain*, a steam tug abandoned on the beach in north of New Brighton (Gambier Island), a location (DiRu-010) which is also a midden site, coincidentally. The wooden remains of the lower hull and some metal components are still visible at low tide. The other heritage wreck (DjRu-009) is completely submerged in Plowden Bay (Stone 2007). The hull, which is wood with steel bulkheads and thought to be a Yard-class (YMS) minesweeper (World War Two), is located, stern down, on a steep slope with the bow at 12 m bsl (Stone 2007) (Figure 4).

Two postcontact cemeteries are also listed. One of these, DiRu-061 is an unusual designation as it is a location recognized for its current use; "Mariner's Rest" is where the ashes of deceased mariners may be released.

Table 1: Previously Identified Archaeological Sites Located Along the Littoral of Thornbrough Channel

Site (Borden) Number	Site Type
DjRu-004	Precontact: Subsurface, Shell Midden; Surface, Lithics
DjRu-009	Historic: Marine, Shipwreck (Submerged, 12 m min depth)
DjRu-005	Postcontact: Human Remains, Cemetery
DjRu-007	Precontact: Surface, Lithics
DjRu-006	Precontact: Subsurface, Charcoal
DjRu-018	Precontact: Subsurface, Shell Midden
DiRu-061	Postcontact: Human Remains, Cemetery, Marine "Mariner's Rest" (memorial reserve)
DiRu-010	Precontact: Subsurface, Shell Midden Historic: Marine, Shipwreck, *Chieftain* (Intertidal)

[7] Sites are listed in "loaded", or outbound sequence, generally from north to south from the Project Area.

Site (Borden) Number	Site Type
DiRu-011	Precontact: Subsurface, Shell Midden
DiRu-012	Precontact: Subsurface, Shell Midden
DiRu-002	Precontact: Surface and Subsurface; Shell Midden; Fish Trap; Lithics
DiRu-008	Precontact: Subsurface, Shell Midden
Total Number of Sites	**12**

5.1.2.2 "Howe Sound Basin"

There are 45 previously recorded archaeological sites in the Howe Sound Basin sector (Table 2). Of these, 28 are shell midden sites, and 15 have surface lithics. There are no precontact sites with noted inter-tidal features. There are two historic period sites, both located in West Bay, Gambier Island, containing five heritage wrecks. Site DiRu-066 is the wreck of the *Thomas J, Lipton*, a four-masted lumber schooner of about 210 ft. (64 m) length, 1205 net tons, built in 1919 in Georgia, Alabama, and converted for use on this coast as wood chip barge (Stone 2007). The wooden hull was driven ashore and abandoned sometime after 1940, and remains a conspicuous, partially submerged, structure lying along the shore in West Bay. Site DiRu-069 consists of four unidentified wooden wrecks some of which are exposed at low tide, down to 7 m bsl to the shallowest wreck component. The wrecks are described as two scows, a vessel (62 m by 15 m) once mistakenly thought to be the *Lorne*, but now thought to be a deep-sea barge, and a smaller vessel (Stone 2007; Figure 4).

Table 2: Previously Identified Archaeological Sites Located Along the Littoral of "Howe Sound Basin".

Site (Borden) Number	Site Type
DiRu-014	Precontact: Subsurface, Shell Midden
DiRu-050	Precontact: Surface, Lithics
DiRu-067	Precontact: Subsurface, Lithics
DiRu-015	Precontact: Subsurface, Shell Midden
DiRu-017	Precontact: Subsurface, Shell Midden
DiRu-001	Precontact: Subsurface, Shell Midden
DiRu-016	Precontact: Subsurface, Shell Midden
DiRv-001	Precontact: Subsurface, Shell Midden; Surface, Lithics
DiRv-008	Precontact: Subsurface, Shell Midden; Surface, Lithics
DiRu-019	Precontact: Subsurface, Shell Midden
DiRu-027	Precontact: Subsurface, Shell Midden
DiRu-079	Precontact: Surface, Lithics
DiRu-080	Precontact: Surface, Lithics
DiRu-063	Precontact: Surface and Subsurface, Lithics
DiRu-076	Precontact: Surface, Lithics
DiRu-075	Precontact: Surface, Lithics
DiRu-074	Precontact: Surface, Lithics
DiRu-020	Precontact: Subsurface, Fish Trap, Shell Midden, Lithics; Surface, Lithics

Site (Borden) Number	Site Type
DiRu-022	Precontact: Subsurface, Shell Midden
DiRu-041	Precontact: Subsurface, Shell Midden; Surface, Lithics
DiRu-065	Precontact: Subsurface, Lithics
DiRu-009	Precontact: Subsurface, Shell Midden
DiRu-007	Precontact: Subsurface, Shell Midden
DiRu-013	Precontact: Surface, Shell Midden
DiRu-060	Precontact: Subsurface, Shell Midden; Surface, Lithics
DiRu-066	Historic: Marine, Shipwreck, *Sir Thomas J Lipton* (inter-tidal)
DiRu-055	Precontact: Subsurface, Shell Midden
DiRu-069	Historic: Marine, Shipwreck, "West Bay Mystery Wrecks" A Ship and Barge and two scows (inter-tidal to submerged -7 m)
DiRu-033	Precontact: Surface, Lithics
DiRu-057	Precontact: Surface, Lithics
DiRu-058	Precontact: Surface and Subsurface, Lithics
DiRu-032	Precontact: Subsurface, Shell Midden
DiRu-031	Precontact: Subsurface, Shell Midden
DiRu-029	Precontact: Subsurface, Shell Midden; Surface, Lithics
DiRu-028	Precontact: Surface, Lithics
DiRu-034	Precontact: Subsurface, Shell Midden
DiRu-003	Precontact: Subsurface, Shell Midden
DiRu-004	Precontact: Subsurface, Lithics
DiRu-068	Precontact: Subsurface, Shell Midden, Lithics
DiRu-005	Precontact: Subsurface, Shell Midden
DiRu-006	Precontact: Subsurface, Shell Midden
DiRu-047	Precontact: Subsurface, Shell Midden
DiRu-048	Precontact: Subsurface, Shell Midden
DiRt-011	Precontact: Subsurface, Shell Midden; Surface, Lithics
DiRt-012	Precontact: Subsurface, Shell Midden
Total Number of Sites	45

5.1.2.3 Ramillies Channel

There are 9 previously recorded archaeological sites in the Ramillies Channel sector (Table 3). Of these, 6 have surface lithics, and 4 are shell midden sites. A canoe skid is mentioned as a inter-tidal component of site DiRt-016, but the site form suggests that this may be an historic feature. The Pictograph (DjRu-003) is in a shoreline location, but not inter-tidal (see section 5.2.1 for discussion). There are no heritage wrecks listed in this sector (Figure 4).

Table 3: Previously Identified Archaeological Sites Located Along the Littoral of Ramillies Channel.

Site (Borden) Number	Site Type
DjRt-006	Precontact: Subsurface, Shell Midden; Surface Lithics
DjRu-003	Precontact: Rock Art, Pictograph
DjRu-001	Precontact: Subsurface, Shell Midden
DjRu-002	Precontact: Subsurface, Fire Broken Rock
DjRt-004	Precontact: Surface, Lithics
DiRt-020	Precontact: Surface, Lithics
DiRu-054	Precontact: Surface, Lithics Historic: Habitation, Cabin
DiRt-016	Precontact: Petroform, Canoe Skid; Subsurface, Shell Midden; Surface, Lithics Historic: Habitation, Cabin
DiRt-003	Precontact: Subsurface, Shell Midden; Surface, Lithics
Total Number of Sites	**9**

5.1.2.4 Queen Charlotte Channel

There are 14 previously recorded archaeological sites in the Queen Charlotte Channel sector (Table 4). Of these, 8 are shell midden sites, and one site has surface lithics. The Petroglyph (DjRu-003) is in a shoreline location, but not inter-tidal. There are no archaeological remains at DiRu-046, but oral tradition identifies the beach in Alder Bay near the southwestern tip of Bowen Island as a First Nations “meeting place”. The historic site identified as a causeway (DiRu-051) is part of the resort infrastructure built by the Union Steamship Co. for its resort in Deep Bay, Bowen Island. One heritage wreck site (DiRt-025) recorded at the entrance to Eagle Harbour is not included in the table because at 19 m bsl it is too deep for consideration.

Table 4: Previously Identified Archaeological Sites Located Along the Littoral of Queen Charlotte Channel

Site (Borden) Number	Site Type
DiRt-013	Precontact: Rock Art, Petroglyph
DiRt-002	Precontact: Subsurface, Lithics
DiRt-014	Precontact: Subsurface, Shell Midden
DiRt-010	Precontact: Subsurface, Shell Midden
DiRt-015	Precontact: Subsurface, Shell Midden
DiRt-008	Precontact: Subsurface, Shell Midden
DiRt-009	Precontact: Subsurface, Shell Midden
DiRt-023	Precontact: Surface, Lithics
DiRu-051	Historic: Structure, Marine, Causeway
DiRt-001	Precontact: Subsurface, Shell Midden
DiRt-007	Precontact: Subsurface, Shell Midden
DiRt-006	Precontact: Subsurface, Lithics
DiRu-046	Precontact: Traditional Use Site
DiRu-045	Precontact: Subsurface, Shell Midden
Total Number of Sites	**14**

5.1.2.5 Community Heritage Register Sites

A review of the communities in the RSA indicated that there no properties designated under the *Local Government Act*. However, a list of properties in the RSA (*i.e.*, sites extending into the inter-tidal zones of the identified sectors) which are registered in community heritage registers[8] are as follows:

Howe Sound Basin

- Granthams' Landing Wharf (Sunshine Coast Regional District Board 2011)
- Gibson's Government Wharf (Town of Gibsons 2006)
- Smitty's Marina House and Chandlery (Town of Gibsons 2006)
- Malcolm & Hicks Boat Works (Town of Gibsons 2006)

Queen Charlotte Channel

- Whytecliff Park (District of West Vancouver 2013)

5.1.2.6 Recorded Sites Summary

There are currently two routes proposed for tugs to take loaded barges away from the Project Area. The western route down Thornbrough Channel and crossing Howe Sound Basin before leaving the Sound by way of Queen Charlotte Channel includes a littoral with over 76 recorded sites, including community heritage register sites. In contrast, the shorter, eastern route down Ramillies and Queen Charlotte channels includes 24, or less than one-third of the number of sites.

5.1.3 Historic Shipwreck Data (RSA)

Many more shipwrecks are reported to have occurred than are typically found and identified on the seabed. A review of ship casualty events reported in Howe Sound area indicates that over 155 events have occurred between 1871 and 1996. Many of these were in the vicinity of Howe Sound, but actually located in the Georgia Strait outside of the RSA. Others were a partial loss, meaning the vessels were damaged but not sunk, or were salvaged.

Vessel casualty descriptions of "lost", "foundered" or "sunk" are considered to be deep water wrecks, with no identified potential to be located in the shallow sub- and inter-tidal areas of the RSA. A sample of the deep water wrecks were reviewed in section 5.1.1.1.

Criteria for the selection of reported wrecking events which have a potential for leaving a heritage wreck site within the inter-tidal or shallow sub-tidal areas are: 1) provision of fairly specific location; and 2) listed as total loss; and 3) listed as "stranding" or "grounding"; or described as "stripped", "beached", "grounded", "hulk", etc.; or

[8] Local governments within the RSA which apparently do not have a heritage properties listed in a community heritage register include Islands Trust (for Gambier and Keats Islands), the Municipality of the Village of Lions Bay, and the Municipality of Bowen Island.

4) listed as suffering fire or explosion within a short distance of shore. In the latter condition, it is recognized that the position reported in a casualty report is often where the fire or explosion occurred, or where the crew was forced to abandon the vessel. Burning wooden vessels often stay afloat for some time becoming more buoyant as upper structural weight is consumed by the fire, potentially drifting ashore or into shallow water with the wind.

None of the 22 vessels included in this section are represented by recorded wreck sites. The locations of the vessels listed in tables in the following sections are recorded on Figure 4 as "reported wreck location from archival sources" if the location reported is relatively specific (n=14). All of the information is recorded in Fred Rogers' book (1973) or the Northern Shipwreck Database (Northern Maritime Research 2002) which, in any case, relies heavily on Rogers for shipwrecks in this region. The wrecking events are listed in chronological order.

5.1.3.1 Thornbrough Channel

There are three vessels reported wrecked between 1913 and 1986, and potentially resting in the shallow waters of Thornbrough Channel (Table 5). Based on the limited information available none of these has any particular historical significance, although it is not clear if the barge *Gog* (Gulf of Georgia?) was converted and renamed from a previous function.

Table 5: Summary of Vessels Lost and Potentially Located in the Intertidal and Shallow Coastal Waters of Thornbrough Channel

Name, Registry	Date of Loss Y/M/D	Nature of Loss	Place of Loss	Size of Vessel in gross tons	Hull Material	Type of Vessel, Official Number
Gog	1913/06/07	Strandedtotal loss	near Rainy River (Port Mellon) total loss	172	Wood	Barge, Unknown
Rowdy (The), Vancouver, B.C.	1986/06/23	Fire	East Side of Gambier Island (not mapped)	4.9	unknown	Tender, 13K93386Li
Sea Comet, Vancouver, B.C.	1987/11/12	Fire	49°22'21" N 123°24'34" W (West of Ekins Pt).	51.3	unknown	Tug, 177994

5.1.3.2 "Howe Sound Basin"

There are five vessels reported wrecked between 1959 and 1987, and potentially resting in the shallow waters of Howe Sound Basin (Table 6). All were the victims of fire. Based on the limited information available, none of these has any particular historical significance. Two vessels not listed in the table for Howe Sound Basin are the *Peerless* and *Lorne*[9]. Both vessels are historically significant as pioneering steam tugs dating to the nineteenth century. Both are rumoured to have been abandoned and sunk in the West Bay ship's graveyard, but as extensive survey work by the UASBC has failed to locate them in shallow water, they are not included on this table (Drushka 1981, Rogers 1973, Stone 2007).

[9] The *Lorne* was built in Victoria in 1889, was 288 gross tons and 151 ft. (46 m) in length.

Table 6: Summary of Vessels Lost and Potentially Located in the Intertidal and Shallow Coastal Waters of "Howe Sound Basin".

Name, Registry	Date of Loss Y/M/D	Nature of Loss	Place of Loss	Size of Vessel in gross tons	Hull Material	Type of Vessel, Official Number Year Built (if known)
Holland Rock, Unknown	1959/02/23	Fire	Gambier Island (not mapped)	Unknown	Wood	Fishing, Unknown
Mr. Chips, Vancouver, B.C.	1962/11/14	Fire, Beached	"Cotton Bay" assumed to be located S. of Cotton Pt., Keats Island	32.3	Unknown	Unknown, 319395
Unknown, Unknown	1962/05/29	Fire	Gambier Island (not mapped)	Unknown	Unknown	Log Salvage Boat, Unknown
Debbie Kathleen K., Vancouver, B.C.	1967/01/07	Fire, Sank at anchor	Gambier Island (not mapped)	84.8 (Net ton)	Unknown	Unknown, 150649
Tee En, Vancouver, B.C.	1987/10/15	Fire	West Bay	6.9	Unknown	Fishing, 13K18385Li

5.1.3.3 Ramillies Channel

There are eight vessels reported wrecked between 1918 and 1964, and potentially resting in the shallow waters of Ramillies Channel (Table 7). All but two were the victims of fire or explosion. The hull and machinery of the steam tug *Freno* was removed during salvage, but some pieces of the wreck were recovered from off Bowyer Island in 1968 although it is not clear that anything remains now (Rogers 1973). Based on the limited information available, none of the vessels listed has any particular historical significance. The *Piltan #2* and *Shelmerdene* are discussed further in section 5.3.4.

Table 7: Summary of Vessels Lost and Potentially Located in the Intertidal and Shallow Coastal Waters of Ramillies Channel

Name, Registry	Date of Loss Y/M/D	Nature of Loss	Place of Loss	Size of Vessel in gross tons	Hull Material	Type of Vessel, Official Number. Year Built (if known)
Freno,	1918/10/08	fire and grounding	South end of Bowyer Island (salvaged, but divers observed remains in shallow water in 1968)	Unknown	Unknown	Steam tug
Lavita, Vancouver, B.C.	1920/02/27	Stranded, Total Loss	Anvil Island (not mapped)	7.9 (Net ton)	Wood	Sloop, 130549, 1909?
Tex, Vancouver, B.C.	1930/02/09	Fire	Potlach Creek	14. (Net tons)	Wood	Unknown, 150764
Rover, Vancouver, B.C.	1931/09/03	Fire	Anvil Island (not mapped)	12.2 (Net ton)	Wood	Unknown, 122518

Name, Registry	Date of Loss Y/M/D	Nature of Loss	Place of Loss	Size of Vessel in gross tons	Hull Material	Type of Vessel, Official Number. Year Built (if known)
Shelmerdene, Vancouver, B.C.	1932/07/10	Explosion	McNab Creek	4.5 (Net ton)	Wood	Unknown, 154635
Piltan #2, Vancouver, B.C.	1946/03/09	Explosion. Fire.	McNab Creek	3.3 (Net ton)	Wood	Unknown, 175147
Island Flyer, Vancouver, B.C.	1948/02/17	Stranded	Douglas Bay	3.3 (Net ton)	Wood	Unknown, 176878
Taboo, Vancouver, B.C.	1964/07/24	Fire	Between Gambier Island and Anvil Island (not mapped)	11.5	Unknown	Sail-boat, 310416

5.1.3.4 Queen Charlotte Channel

There are six vessels reported wrecked between 1904 and 1962, and potentially resting in the shallow waters of Queen Charlotte Channel (Table 8). All but one were the victims of fire or explosion. The *Lois* was a small tug but a locally significant vessel as it was one of the first bought by Capt. John Cates and used for towing logs in the Sound. Rogers (1973) reports that the vessel was salvaged but as the history of the *Freno* demonstrated, there is potential for wreck material to remain at a grounding site.

Table 8: Summary of Vessels Lost and Potentially Located in the Intertidal and Shallow Coastal Waters of Queen Charlotte Channel

Name, Registry	Date of Loss Y/M/D	Nature of Loss	Place of Loss	Size of Vessel in gross tons	Hull Material	Type of Vessel, Official Number, Year Built (if known)
Lois, Vancouver, B.C.	1904/06/20	Stranded, Total Loss	Fisherman's Cove (off Eagle Island)	25.5	Wood	Steam-tug, 100200, 1891
Emma R., Vancouver, B.C.	1923/10/02	Fire	0.5 m N. of Whytecliff	654 (net)	Wood	Unknown, 150581
Quinnat, Vancouver, B.C.	1925/07/12	Fire	1 m N. of Whytecliff Point	13	Wood	Steam-tug, 126437, 1919
Laurel Point, Unknown	1930/ 10/28	Fire	hulk towed to beach in Snug Cove	Unknown	Wood	Fishing
Dianna II, Unknown	1954/09/27	Fire. Beached	Bowen Island (not mapped)	Unknown	Wood	Fishing, Unknown
Silvertip II, Unknown	1962/05/11	Explosion	Horseshoe Bay	Unknown	Unknown	Unknown

5.1.3.5 Historical Shipwreck Data Summary

The distribution of reported wrecking events considered for the RSA sectors is far more even than for recorded archaeological sites. There are 14 reported wrecking events for both the western and eastern barge routes. This may reflect the heavier use historically of Ramillies Channel as well as Queen Charlotte Channel.

5.1.4 Orthographic Photo Review (RSA)

Google Earth, including available historical imagery, was reviewed for images of possible heritage wrecks (2013). The ideal timing of data collection corresponding with low tide in flat water conditions to facilitate maximum exposure of inter-tidal and sub-tidal areas was not achieved. However, five wrecks or possible wrecks were observed that were not recorded elsewhere. As a gauge, the wreck of the *Thomas J. Lipton* (DiRu-066) was clearly visible in Google Earth, while other wreck sites known to exist in the inter-tidal {DiRu-010 (*Chieftain*) and DiRu-069} were not.

The location of each wreck or possible wreck observed in Google Earth is recorded in Figure 4 as a "possible heritage wreck observed in intertidal". The lengths of the observed features were measured in Google Earth (2013). There was no opportunity to ground-truth the possible wrecks during this study.

Thornbrough Channel

- A barge, measuring 25 m in length, made of steel and partially submerged in 2010, is located approximately 5 km south-west of the Project Area.
- A vessel-shaped object, possibly a wreck, partially obscured by tree canopy in the upper intertidal area of Seaside Park beach just east of Port Mellon, light in colour and measuring perhaps 9 m in length, located approximately 7.25 km south-west of the Project Area.
- A barge, measuring 11 m in length, partially obscured by the tree canopy in the upper intertidal area, visible in 2005 2009 and 2010, is located approximately 9.75 km south-west of the Project Area.
- A vessel-shaped discolouration, possibly outlining a wreck in the shallow sub-tidal area, but only visible in 2009, measuring perhaps 18 m in length, located approximately 7.25 km south-west of the Project Area.

Ramillies Channel

- A vessel-shaped object on a rock outcrop, and possibly only rock, in the upper-tidal area, measuring 25 m in length, located approximately 11 km south-east of the Project Area.

Within the LSA, three rectangular objects were observed. Two of these objects were noted in the lower inter-tidal part of the LSA, resting side by side and generally aligned N-S and measuring approximately 7 m by 23 m. These appear to be open metal-framed structures. The third rectangular object lies in the upper intertidal about half way between the proposed wharf location and the outlet of McNab Creek. This object is somewhat smaller, measuring about 6 m by 21 m and aligned SW-NE. The object is solid, perhaps indicating a deck with a grey and light grey colouring suggestive of bleached wood. These objects within the LSA were ground-truthed by pedestrian surveys conducted within the LSA (section 5.3.4; Figure 5)

5.1.5 Paleontological Review (RSA)

The RSA is located within the Coast Mountains adjoining Howe Sound. The surrounding mountain peaks are dominantly formed of granodiorite plutonic rock (Golder 2011). This is typical of the Coast Belt, an area characterized by intrusive rocks of various types that do not contain any fossils (Haggart and Richstad 1998). The Howe Sound region is cut into plutonic rocks of complex origin that formed over an extended period of time. Rocks from the Late Cretaceous consist largely of quartz diorite, granodiorite, and quartz monzonite. These rocks are associated with older metasediments, younger metavolcanics and Pleistocene volcanics (Hickin 1989).

Fossils are present in the Coast Belt including in the sandstones and shales of the Relay Mountain Group (Haggart and Richstad 1998). The Howe Sound area is not proximal to any of the six designated fossil sites in British Columbia (Fossil Management Review Technical Working Group 2004, Haggart and Richstad 1998). Macro fossils identified in the Howe Sound area include ammonites found in roof pendant shales (fossilsites.com 2008) and bivalves *(Buchia sp.)* of the family *Buchiidae* (Royal British Columbia Museum 2010) which are found along the Sunshine Coast Regional District. Ammonite imprints have also been identified in Mesozoic black slates at the north end of Gambier island (Geological Survey Canada 1963).

Bivalves of the family *Buchiidae* are widely distributed from the Late Triassic to the Early Cretaceous marine environments on most continents of the earth (Zakharov 1987). The genus *Buchia* is known from Late Jurassic to Early Cretaceous strata, and is restricted to the Northern Hemisphere, with over thirty species recognised (Zakharov 1987). Fossil *Buchia* is particularly abundant north of latitude 50”N at all stratigraphic levels in the Late Jurassic and Early Cretaceous periods (Zakharov 1987).

The origin, growth and evolution of the genus *Buchia* took place in the circum-boreal region, where species of *Buchia* are biogeographically distributed. Differences in the assemblages are observed for paleo-seas with different regimes (*i.e.*, shallow platform and deeper basinal areas). *Buchia* is characterised by a high rate of evolution, and the biostratigraphic value of *Buchia* is based on this, as well as its wide geographic distribution, the limited influence of local facies, the abundance in different types of facies and the ease of taxonomic determination (Zakharov 1987).

Metasedimentary rocks such as phyllite and slate exist in outcrops locally on the west side of the Project Area, although granodiorite bedrock dominates the area and volcanic units are reported within McNab Creek valley (Golder 2011). For additional information on palaeontological resources of the area, please see Branta (2014).

5.2 Local Study Area Overview

5.2.1 Previously Recorded Archaeological Sites (LSA)

There are no previously recorded archaeological sites within the LSA, but five previously recorded archaeological sites are located within 5 km of the LSA. The closest archaeological site (DjRu-3) is approximately 800 m southeast of the LSA, along the shore to the east of McNab Creek. Two archaeological sites (DjRu-001 and DjRu-004) are located approximately 3.5 km south of the LSA, along the north shore of nearby Gambier Island; and two archaeological sites are located 5 km from the LSA boundary; DjRu-002 is approximately 5 km to the southeast, and DjRt-006 is approximately 5 km to the east. The archaeological sites are described as follows:

- Archaeological site DjRu-003 measures 1 m by 1 m and consists of a Pictograph rock art of a human, a stick like fish, and a rounded fish on a rock face located on the shore. The site was recorded as part of the Howe Sound Survey on August 14, 1975 by John Brinson (Winram 1975).
- Archaeological site DjRu-001 measures 5 m by 2 m and consists of approximately 1.25 cm of subsurface shell midden. The site was recorded as part of the Howe Sound Survey on July 19, 1975 by Patricia Winram (Winram 1975).
- Archaeological site DjRu-004 measures 15 m by 4 m and consists of surface lithics, along with approximately 1.20 cm of subsurface shell midden. The site was recorded as part of the Howe Sound Survey on August 13, 1975, by Sherrill Kautz (Winram 1975).
- Archaeological site DjRt-006 measures 125 m by 50 m and consists of subsurface shell midden, and surface lithics. The site was recorded as part of the Howe Sound Survey on August 13, 1975, by Mary Quirolo; with a subsequent visit by Arcas Consulting in 1990 for the Archaeological Inventory of Traditional Squamish Territory (Winram 1975, Stryd 1996, Simonsen 1990).
- Archaeological site DjRu-002 measures 50 m by 14 m and consists of subsurface firebroken rock. The site was recorded as part of the Howe Sound Survey on August 6, 1976 by Sherill Kautz (Winram 1975).

5.2.2 Review of Historic Aerial Photos

Historic aerial photos from the Geography Department of the UBC Library were reviewed including the following dates, 2005, 2003, 1996, 1995, 1990, 1987, 1971, 1967, 1966, 1953, 1952, and 1947. These photos were examined for visual indications of structures, activities, and possible archaeological features visible in the intertidal area of the LSA, as well as to provide a general time sequence of major impacts visible on land.

Some features of the site were already in place in 1947 (Photo # BC399/115), including a float in the same general area as it is today and the road heading straight north from the dry sort area, which currently forms the western edge of the LSA. While extensive clear-cutting of higher ground surrounding the LSA is already evident in 1947 (Photo # BC399/115), there is no evidence of forestry clear-cutting within the LSA until 2005. The cut for the power line right-of-way was made by 1966.

Booming activities in the water were evident from 1947 (Photo # BC399/115), although the site was being used for booming when consecutive aerial photos were taken in 1952 (Photo # BC1634/90), 1953 (Photo # BC1634/89), and 1966 (Photo # BC5175/082). At times these booming activities were located in the intertidal area, including apparent log ramps near the existing warehouse or farther north than the existing ramps (Figure 4). These activities may be expected to have destroyed any archaeological surface features in the area.

No inter-tidal features of possible archaeological origin were observed. The metal frames in the lower inter-tidal area are first visible in 2005 (Photo #s 30BCC05026/0144-5).

5.2.3 Historic Shipwreck Data (LSA)

A review of shipwreck records indicates that two vessels became total losses at McNab Creek (Figure 4). The *Shelmerdene* (official number 154635) was a small (4.5 net ton) vessel which suffered an explosion June 10, 1932 (Northern Maritime Research 2002; Rogers 1973). There is no indication as to vessel type, but given that Burns and Jackson Logging operations at McNab Creek (Section 5.1.1.3) were well underway at this time, the *Shelmerdene* was probably one of the early gas-powered tugs engaged in the transport of log booms. The *Piltan #2* (or II; official number 175147) was also a small (3.3 net ton) vessel which suffered an explosion and fire March 9, 1946, at McNab Creek (Northern Maritime Research 2002; Rogers 1973). Again, there is no indication as to vessel type, but it was likely another gas or diesel tug engaged in the logging industry.

Other vessel casualties were noted with locations generally ascribed to the waters between McNab Creek and the north end of Gambier Island. These are listed below as reported losses with some (if limited) potential to have left wreck remains in the sub-tidal LSA (Northern Maritime Research 2002; Rogers 1973):

- *Weaver Lake* (or *Weaver Bay*), a 37 ft. (11.25 m) tug sank after striking a deadhead "off the NW end of Gambier Island" December 7, 1958.
- *Tamarlane* (official number 193518), 10.6 net tons, sank "N. of Gambier Island", March 3, 1959.
- *Rothesay* "lost with three men on trip to Port Mellon" (from Squamish?), May 4, 1959.
- *Taboo* (official number 310416) an 11.5 net ton sailboat burned at the "E. ent., Ramilles [sic] Channel, btwn Anvil I. and Gambier Island", July 24, 1964.

Further research was not conducted into the description or history of any of the vessels listed here. However, should a shipwreck be encountered during Project development, it will be possible to get more details from the vessel registry records for the four vessels with known official numbers (all in the Vancouver registry records) to assist in identification.

5.2.4 Underwater Survey Reports

Past records of the LSA at low tide characterize the intertidal zone as sandy, with gravels and river cobbles, and scattered log debris (Frontier 2009, Wright, 2006).

Wright (2006), with survey coverage of the western sub-tidal portion of the LSA, reported the presence of a dense fiber mat consisting of bark and woody debris (*i.e.*, sticks or branches, as well as more significant logs) covering 100% of the sub-tidal seabed with some exposure of cobble and boulders at water depths below +/- 3 m dbs. Sub-bottom acoustic profiling survey shows sediments up to 15 m thick in some areas with water depths less than 20 m below chart datum; a very thin cover of sediment covers bedrock between about 30 m and 40 m in water depth; while the sediments thicken significantly with depths greater than 40 m (Frontier 2009).

With loosely consolidated sediments there exists the potential for wreck remains to be buried. However, Wright (2006) indicates the presence of industrial debris including an old tire, and miscellaneous metal items including cables, an engine block and a cat track, without sign of significant burial. Neither the Wright (2006) nor Frontier

(2009) reports give any sign of the presence of any structure or debris suggesting the presence of a potential heritage wreck.

The sediments collected above the bedrock sill at 20 m water depth are assumed to be recent alluvial deposits, therefore the surface of the seabed in this area is not an inundated surface potentially occupied by humans.

5.2.5 Expected Site Types

Based on the local regional background, the sites types expected in the terrestrial portion of the LSA includes CMTs where veteran trees, particularly western redcedar, remain standing, shell midden, or other buried archaeological features. Bedrock shale deposits may be associated with a quarry site, or with paleontological resources.

In the intertidal area, the site types expected include shell midden, lithic scatter, canoe run, fish trap or weir features, and heritage wrecks present as a result of accident (i.e., fire followed by grounding) or abandonment. There is potential as well for sunken wrecks in the sub-tidal area.

5.3 Field Study

5.3.1 LSA Description

The terrestrial parts of the LSA, including the Project Area most recently, have been historically logged. There are existing access roads, power lines, log sorting area and abandoned buildings all related to past forestry operations. The LSA is located on hummocky terrain, with a gentle slope (1%), generally to the southeast (Appendix A: Photograph 1). A linear knoll and a ridge form the banks of a seasonal drainage and dry creek channel located towards the southeast boundary of the Project Area, west of McNab Creek (Figure 2). Soils within the LSA were well drained, and consisted on sands, with rounded and subrounded gravels and cobbles. Vegetation consists of willow, red alder, various fern, huckleberry and various grasses. Forest cover is predominantly a mixture of second growth conifers and deciduous trees including the occasional veteran. Observed tree species consist of: western redcedar, Douglas-fir, western hemlock, Sitka spruce, red alder, and big-leaf maple.

Aquatic features include a man-made channel running north-south through the centre of the LSA, which is used as fish habitat, a small tidal channel adjacent to the northern and eastern boundary of the processing area, a tidal channel adjacent to the southern boundary of the LSA, south of the power lines, a dry channel within 50 m of the eastern boundary of the LSA, and McNab Creek adjacent to the eastern boundary of the LSA. The intertidal zone of Howe Sound within the LSA is typically sandy with gravels and river cobbles, and scattered log debris.

Disturbances include a large rock push resulting from the man-made channel, historically logged tree stumps and debris, existing cut-lines, existing access roads, power line right-of-way, log sorting area and abandoned buildings.

5.3.2 Pedestrian Survey and Surface Inspection

Observed tree species consist of western redcedar, Douglas-fir, western hemlock, Sitka spruce, red alder, and big-leaf maple. Existing stumps of western redcedar and Douglas fir from historic logging activities were observed throughout the LSA and most of the standing trees were second growth (Appendix A: Photograph 2). Veteran western redcedar trees were examined for any indications of cultural modification, none was observed. Tree throws were examined for cultural materials and none were observed (Appendix A: Photograph 3). Two areas of archaeological potential were identified along the edge of a ridge and along a knoll overlooking low-lying terrain and a dry creek channel. Ground disturbances included undergrowth and slash from past harvesting, a large rock push resulting from the man-made creek channel, existing cut trails, a power line right-of-way, access roads, an abandoned building and log sorting areas.

Visual inspection of the terrestrial portion of the LSA resulted in the identification of two areas of moderate to high archaeological potential. These areas were subject to a surface inspection following the methods described above. No archaeological remains or surface features were observed at these locations. These areas of potential were then subject to subsurface testing. The remainder of the terrestrial portion of the LSA is considered to have low archaeological potential due to the hummocky, undifferentiated terrain, with no defined topographic features, rocky soils and past disturbances (Appendix A: Photograph 4).

Visual inspection of the upper inter-tidal portion of revealed no shell midden, lithic artifacts, or intertidal features. The inter-tidal portion of the LSA is considered to have low archaeological potential due to the beach consisting of coarse sands, gravels and cobbles, lack of crushed shell, and past disturbances (Appendix A: Photograph 5).

No bedrock shale or other evidence of fossils was identified within the LSA. The abundance of granodiorite in and around the Project Area means fossil potential is limited. Evidence of sedimentary rocks was limited to small quantities of shale observed within gravel and small outcrops of metasedimentary rock. The presence of shale in gravel form suggests some limited potential for the presence of microfossils, but not the macrofossil bivalves and ammonite expected in the sedimentary rocks of the region. While bedrock fossils are possible metasedimentary rock, they would likely be heavily deformed and poorly preserved.

5.3.3 Subsurface Investigation

Twenty-eight (28) subsurface tests were excavated within two areas. Test Area 1 was located along a well-defined linear knoll, and Test Area 2 was situated along the edge of a ridge (Figure 5). Both test areas are described below.

5.3.3.1 Test Area 1

Test Area 1 measures approximately 7 m by 45 m and is located along a linear knoll overlooking a dry drainage channel to the west and a low lying area to the east (Appendix A: Photographs 6 and 7). Test Area 1 is located in an old cut-block, along the eastern boundary of the LSA. Vegetation consists of salmon berry, fern, grasses, and a forest cover of recently planted and mature hemlock, Douglas fir and western redcedar. Soils were well drained. Fourteen shovel tests were excavated along the edge of the knoll spaced 5-10 m apart, surface constraints permitting. Shovel tests were terminated at the end of the feature, where terrain became undifferentiated. The stratigraphy at Test Area 1 consisted of approximately 2 cm of organic duff overlying

approximately 18 cm of dark brown silty loam, a thin lens of approximately 2 cm light grey silts, and ≥18 cm medium brown sands. No inclusions were observed, and the stratigraphy was consistent throughout Test Area 1 (Appendix B). Disturbances included tree stumps and debris from past timber harvesting. No archaeological sites were identified at this location.

5.3.3.2 Test Area 2

Test Area 2 measures approximately 3 m by 100 m and is located along a ridge overlooking a dry drainage channel to the east (Appendix A: Photograph 8). Test Area 2 is situated within the harvested area, along the eastern boundary of the LSA. Vegetation consists of salmon berry, fern, grasses, and a forest cover of recently planted hemlock, Douglas fir and western redcedar. Soils are well drained. Fourteen shovel tests were excavated along the ridge edge spaced 5-10 m apart, surface constraints permitting. Shovel tests were terminated at the end of the feature, where terrain became undifferentiated. The stratigraphy at Test Area 2 consisted of approximately 4 cm of organic duff over approximately 4 cm of dark brown silty loam and approximately ≥7 cm medium brown/grey sands. No inclusions were observed, and the stratigraphy was consistent throughout Test Area 2 (Appendix B). Disturbances included trees stumps and log debris from past timber harvesting. No archaeological sites were identified at this location.

5.3.4 Complementary Studies

Observations by archaeologists within the intertidal LSA during mid- to high-tides were supplemented by observations and visual recordings by other Golder personnel at the site. Outside of the LSA to the east is the sandy estuary of the current McNab Creek outlet (Appendix A: Photograph 9). The LSA inter- and sub-tidal areas consist primarily of cobble and gravel alternating at some places with boulders or sand and silt with some fragmented shell (Golder 2013) (Appendix A: Photographs 10 and 11). Of shellfish species potentially used by First Nations people as a food resource, only mussels (*Mytilus sp*.) were observed in “abundance” (Golder 2013). These were observed throughout the intertidal areas surveyed except for upper 20-40 m. Some oysters were also present.

Any irregularities in cobble distribution appear fluvial in origin or due to historic disturbance. There were no signs of rock alignments that might be cultural in origin, and no stakes were reported (sections 5.1.4 and 5.2.2).

The structures which were observed in the aerial and satellite imagery in the intertidal LSA were examined more closely. The function of the two rectangular structures located in the lower intertidal area (Figure 5; Appendix A, Photographs 11 and 12) is still not known. However, the frames, consisting of metal pipe (approximately 1.5 m in diameter), appear to have been decked at one time and may have functioned as a floats or ramps. The structures do not represent a barge or other vessel, and therefore not a wreck protected under the *HCA*. Similarly, the single rectangular structure observed in the upper intertidal area (Figure 5) is an abandoned float with a wooden deck built on logs (Appendix A, Photograph 13).

A boat was observed in the upper intertidal area of the LSA (Appendix A, Photograph 14; Figure 5). This small fibreglass vessel may have been abandoned for more than two years, but is apparently still mobile and of no heritage significance.

The seabed visible in diver and towed video revealed is a continuation of the intertidal area, gradually shelving with soft sediments and patches of cobles. The beach extends with a flat gradual slope to between 150 m and 200 m offshore and drops quickly to greater depths in the sub-tidal portions (Golder 2013). Light woody debris, presumably the result of use of the area for log booming appears in the shallow sub-tidal area (Appendix A, Photograph 15). The debris observed becomes larger and more diverse with depth, including sunken logs, fragments of cable and other miscellaneous metal debris. No debris was observed that was indicative of the presence of a wreck.

6.0 RESOURCE EVALUATION

No heritage resources were identified during the course of the impact assessment within the LSA, and a resource evaluation was not completed.

7.0 IMPACT ASSESSMENT

No heritage resources were identified during the AIA. The probability of finding unidentified archaeological sites or significant paleontological resources within the LSA is considered to be low. As a result, no impacts to heritage resources are expected from the proposed land-altering activities associated with this development.

Numerous archaeological resources, including subsurface and historical (including heritage wrecks and potential wreck sites) were identified during the course of the RSA overview. Site-specific assessments were not conducted, however, the majority of these sites (n=95) are protected under the *HCA*. No impacts to these heritage resources are expected from the proposed land-altering activities associated with this Project, however, because of the location of these resources in the inter-tidal portions of the RSA, the potent exists for impacts related to accident during the transport of materials over the operating life of the Project.

8.0 EVALUATION OF THE ASSESSMENT

The methods and procedures utilized during this AIA are considered appropriate for addressing the objectives outlined for this project. The visual methods employed were effective in identifying areas with the highest archaeological potential and the subsurface methods were effective in assessing subsurface conditions.

Prior to fieldwork, archaeological potential of the LSA was discussed as follows:

1) The LSA is located in close proximity to aquatic sources such as McNab Creek and other minor tributary drainages, as well the shores of Howe Sound.

2) While CMTs are possible within the LSA due to a forest cover of western redcedar, Douglas fir and Sitka spruce, historic logging has removed most of the old growth forest, making CMTs unlikely.

3) It was anticipated that the LSA would feature well-drained soils.

4) Photographs, previous documentation and disturbances of the LSA determined that it was unlikely for intact archaeological deposits to exist within the intertidal zone.

5) Archaeological site types expected within the LSA included: lithic scatters, shell midden, CMTs and buried archaeological features. As such, the fieldwork included pedestrian survey as well as subsurface testing to search for these types of archaeological sites.

For the two areas of archaeological potential identified within the LSA, subsurface testing was conducted as outlined in Table 1. Shovel tests were excavated so that every 100 m^2 area of high archaeological potential, 14 shovel tests would be excavated.

Field observations identified no old growth forests, and homogenous terrain with poorly defined features, supporting documentation of the intertidal area at low tide shows a rocky intertidal area, already impacted by previous development (log sort, abandoned buildings) resulting in the LSA being determined to have low archaeological potential.

Table 9: Test Locations

Test Area	Test Area Dimensions (m^2)	# Shovel Tests
1	315	14
2	300	14

9.0 RECOMMENDATIONS

Recommendations for the management of heritage resources within the LSA and RSA were formulated from the results of the HROA and HRIA and are outlined below.

- No further archaeological work is recommended for the remainder of the LSA or RSA, provided the proposed development is not altered to include areas not assessed during the HRIA.
- Should further construction be proposed outside of the LSA, Golder recommends an archaeologist and paleontologist be contacted to evaluate the need for further heritage investigation.
- Due to the greater number of recorded archaeological and historical resources that may potentially be impacted by grounding or spill during the operational period of the development, Golder recommends making the eastern barge route (through Ramillies Channel and Queen Charlotte Channel) the preferred route.
- Should a future accident occur resulting in potential impacts inter-tidal or sub-tidal impacts areas of the RSA where archaeological and historical resources may be present, determine in consultation with the Archaeology Branch, Squamish First Nation and Tsleil-waututh Nation an appropriate management strategy.

It should be noted that even the most thorough investigation may not reveal the presence of all archaeological materials, including human remains protected by the Heritage Conservation Act. Therefore, consistent with the intent of the Act, the proponent is advised that should any archaeological sites or paleontological materials 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 site such that it will not be adversely impacted;
- Notify the Archaeology Branch, Squamish First Nation, Tsleil-waututh Nation and a Golder archaeologist of the discovery, or notify a paleontologist; and
- Determine in consultation with the Archaeology Branch, Squamish First Nation and Tsleil-waututh Nation of an acceptable management strategy.

10.0 STUDY LIMITATIONS

This report was prepared for the exclusive use of the BURNCO Rock Products, Ltd and the Archaeology Branch. Any use, reliance, or decisions made by third parties on the basis of this report are the responsibility of such third parties.

Even the most thorough investigation may fail to reveal the presence of all heritage resources, including archaeological materials protected under the *Heritage Conservation Act*. Subsurface conditions observed during development activity may differ from those on which this study is based. Therefore, consistent with the intent of the *Heritage Conservation Act*, BURNCO Rock Products, Ltd. is advised that if unanticipated paleontological or cultural materials or features including, but not limited to, stone artifacts, protected historical materials and features, or human remains are encountered during construction, all work in the immediate area should cease, and the Archaeology Branch, a professional paleontologist, or a professional archaeologist and First Nations should be contacted immediately for direction.

11.0 CLOSURE

We trust the information in the document is satisfactory for your present needs. Should you require additional information or clarification, please do not hesitate to contact the undersigned at your earliest convenience.

GOLDER ASSOCIATES LTD.

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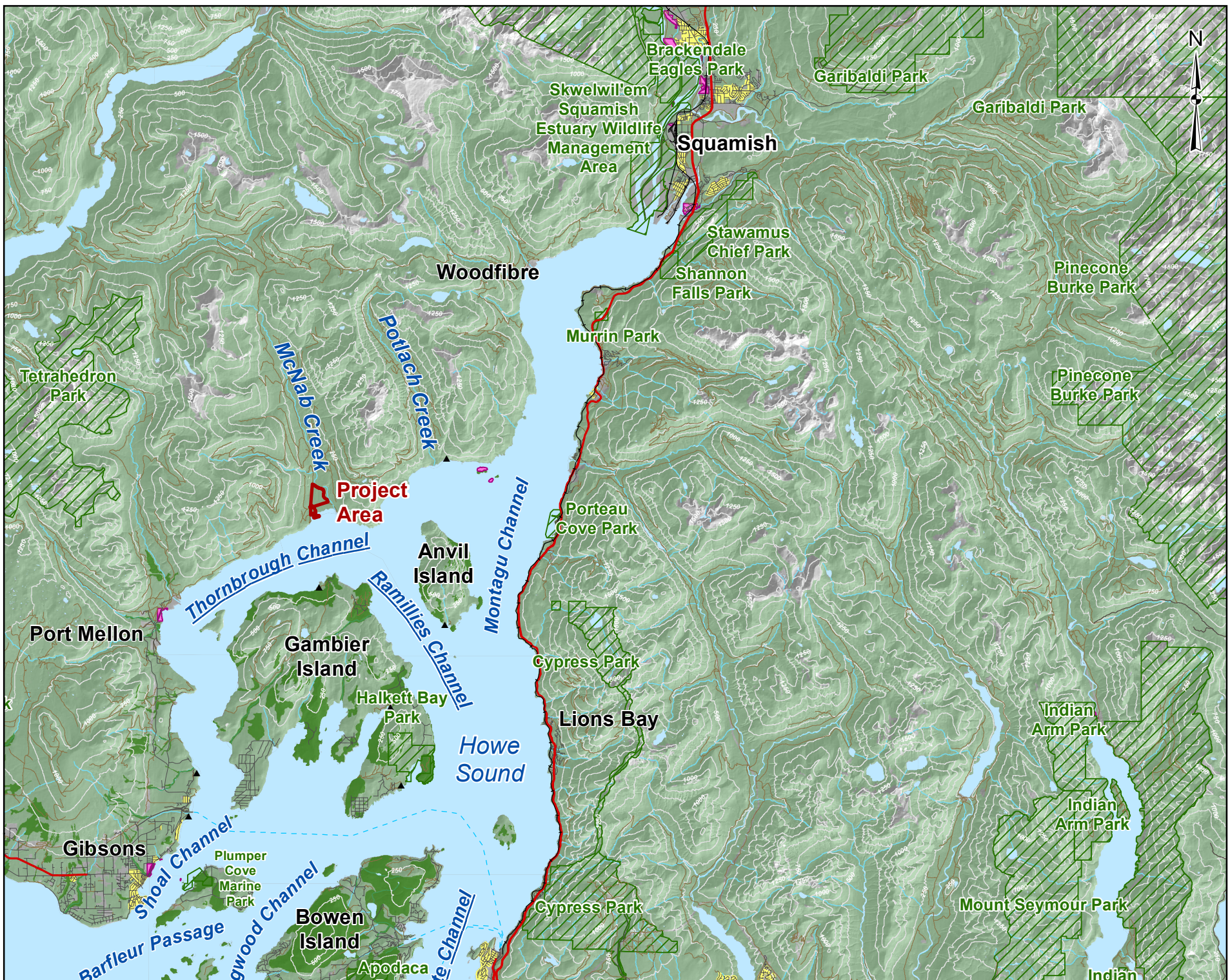

LEGEND

- Project Boundary
- Parks / Protected Areas
- Sensitive Environmental Area
- Vegetation
- Indian Reserve
- Residential Area
- Camp
- Highway
- Road
- Resource Road
- Railway
- Ferry
- Contour (250m)

5,000 0 5,000

SCALE 1:230,000 METRES

REFERENCE

Parks/protected areas and sensitive areas from BC LRDW, elevation and aboriginal lands from Geobase, base data from CanVec10.
Projection: UTM Zone 10 Datum: NAD 83

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

LOCATION OF BURNCO AGGREGATE PROJECT

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	2 Nov. 2012	SCALE AS SHOWN	REV. 3
GIS	AL	8 Nov. 2012		
CHECK	AC	30 Sep. 2014		
REVIEW	DG	30 Sep. 2014		

FIGURE 1

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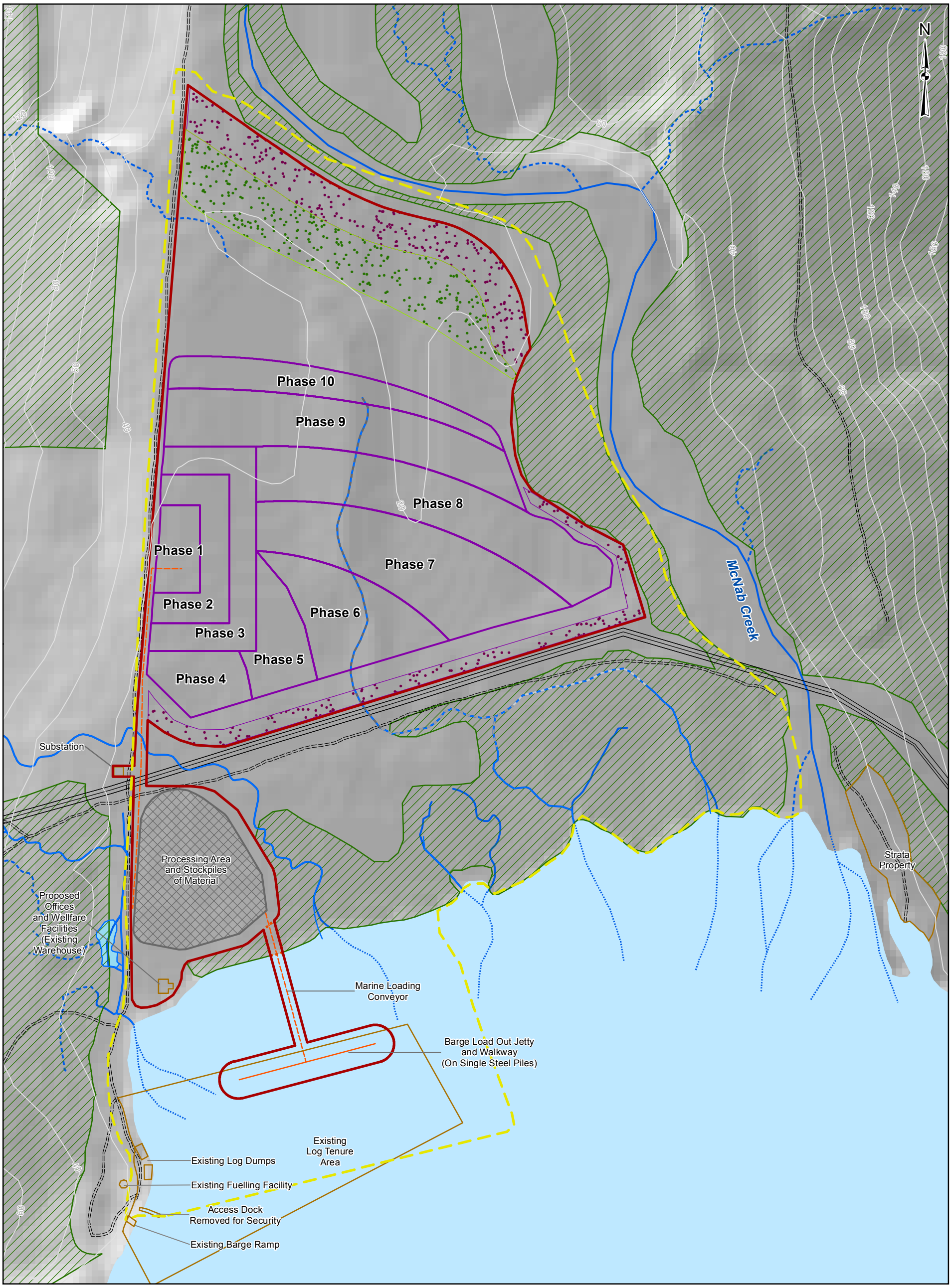

LEGEND

- Archaeology LSA
- Project Boundary
- Mature 2nd Growth Forest
- Processing Plant and Product Stockpile
- Berm (Organic + Wash Sediment Mixed and Planted)
- Planted forest (organics and washed fines)
- Proposed Aggregate Pit Area
- Waterbody
- Road (existing)
- Transmission Line
- Barge Load-out
- Conveyor
- Conveyor Buffer
- Permanent / Perennial Channel
- Intermittent Channel
- Intertidal Channel
- Contour - 20m Interval

Constructed Channel

- Phase 1
- Phase 2
- Phase 3

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

200 0 200

SCALE 1:6,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

PROPOSED CONCEPTUAL SITE LAYOUT AND LSA FOR HERITAGE RESOURCES

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	2 Nov. 2012	SCALE AS SHOWN	REV. 6
GIS	AL	21 Nov. 2012	FIGURE 2	
CHECK	AC	30 Sep. 2014		
REVIEW	DG	30 Sep. 2014		

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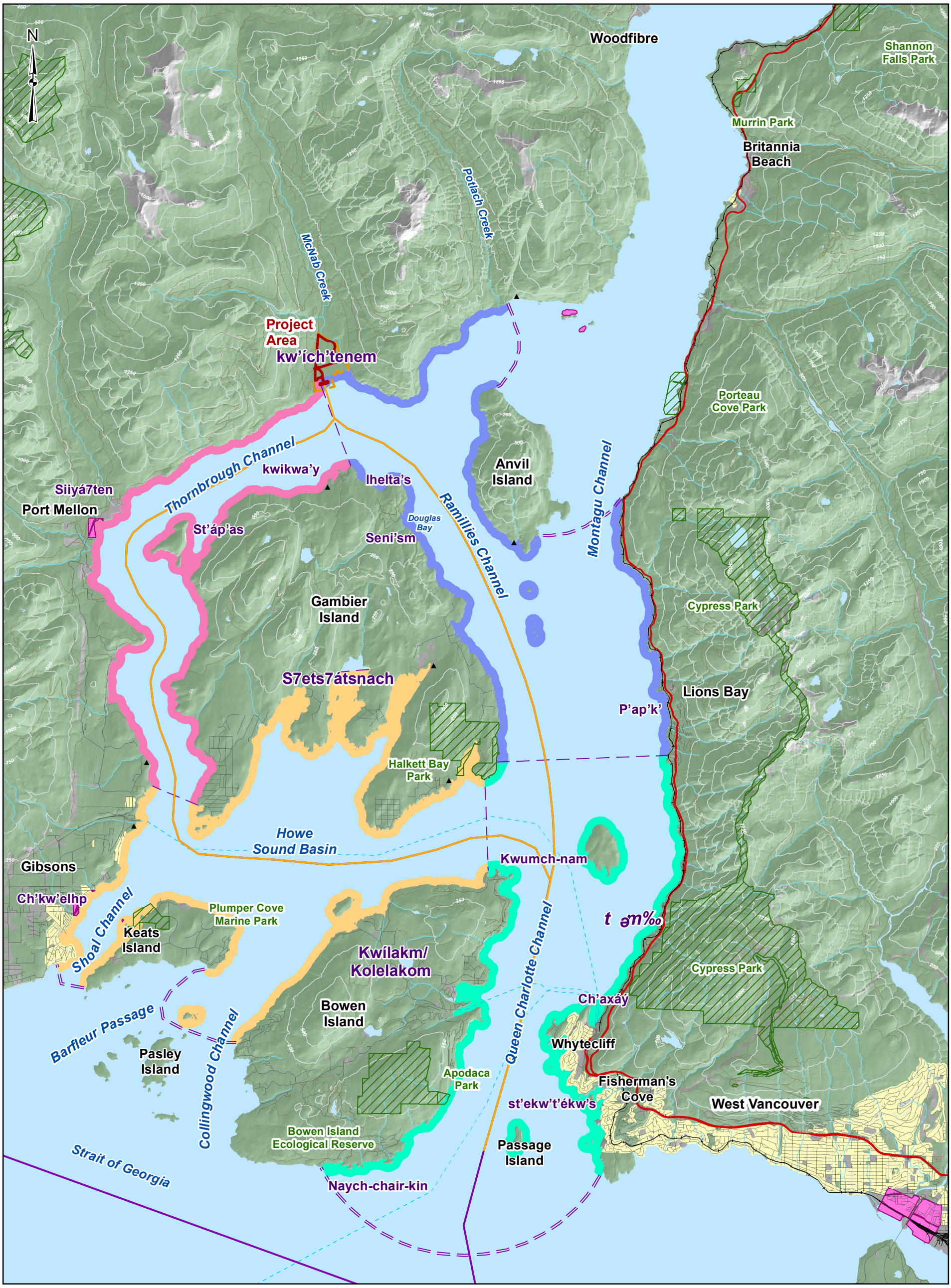

LEGEND

- 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 Boundary
- Parks / Protected Areas
- Vegetation
- Residential Area
- Indian Reserve
- Camp
- Highway
- Road
- Resource Road
- Railway
- Ferry
- Contour (250m)

4,000 0 4,000

SCALE 1:120,000 METRES

REFERENCE

Parks/protected areas and sensitive areas from BC LRDW, elevation and aboriginal lands from Geobase, base data from CanVec10.
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

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	CB	21 Jan. 2013	SCALE AS SHOWN	REV. 3
GIS	AS	31 Jan. 2013		
CHECK	AL	7 Feb. 2013		
REVIEW	CM	7 Feb. 2013		

FIGURE 3

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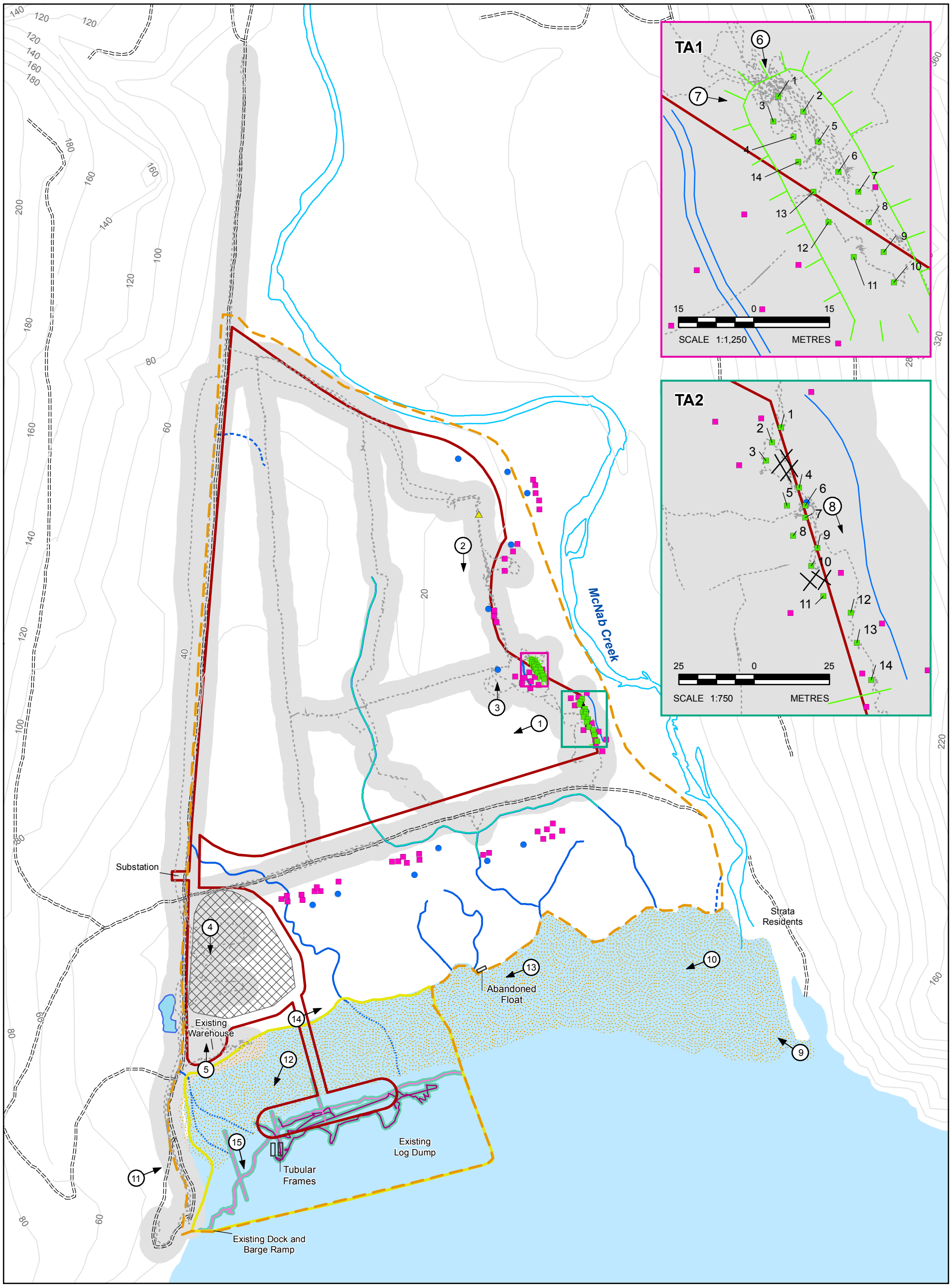


LEGEND

- Negative Shovel Test
- Negative Shovel Test (2004)
- Tree Throw (2004)
- Soil Exposure
- Transet Line
- Transect Area (30m Buffer)
- Diver Track with Video Reviewed
- Sub-Tidal Transect and Towed Video
- Transect Area (5m Buffer)
- Dead Fall
- PRF Channel
- Undifferentiated
- Road (existing)
- Permanent / Perennial Channel
- Intermittent Channel
- Intertidal Channel
- Constructed Channel
- Contour - 20m Interval
- Project Boundary
- Archaeology LSA
- Waterlot
- Processing Plant and Product Stockpile
- Intertidal Zone
- Photo Location

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

LOCAL STUDY AREA
RESULTS OF FIELD STUDY

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	CB	21 Jan. 2013	SCALE AS SHOWN	REV. 2
GIS	AS	31 Jan. 2013		
CHECK	AC	30 Sep. 2014	**FIGURE 5**	
REVIEW	DG	30 Sep. 2014		

Path: X:\Project Data\BC\McNab\Figures\MXD\Archaeology\BURNCO_ARCHAEOLOGY_Figure_05_Local_Study_Area_Results_of_Field_Study.mxd

APPENDIX A

Photographs

Photograph 1: View west along cut-line from southeast corner of Project Area.

Photograph 2: View south at a historically logged western redcedar stump.

Photograph 3: View north at tree throw.

Photograph 4: View south through processing plant area from northwest corner.

Photograph 5: View north along rock banks of the shoreline.

Photograph 6: View south at Test Area 1 located on top of a linear knoll.

Photograph 7: Cross-cut of ridge at Test Area 1 showing sandy stratigraphy.

Photograph 8: View south at Test Area 2, along the edge of a ridge.

Photograph 9: View north from outside LSA near McNab Creek outlet.

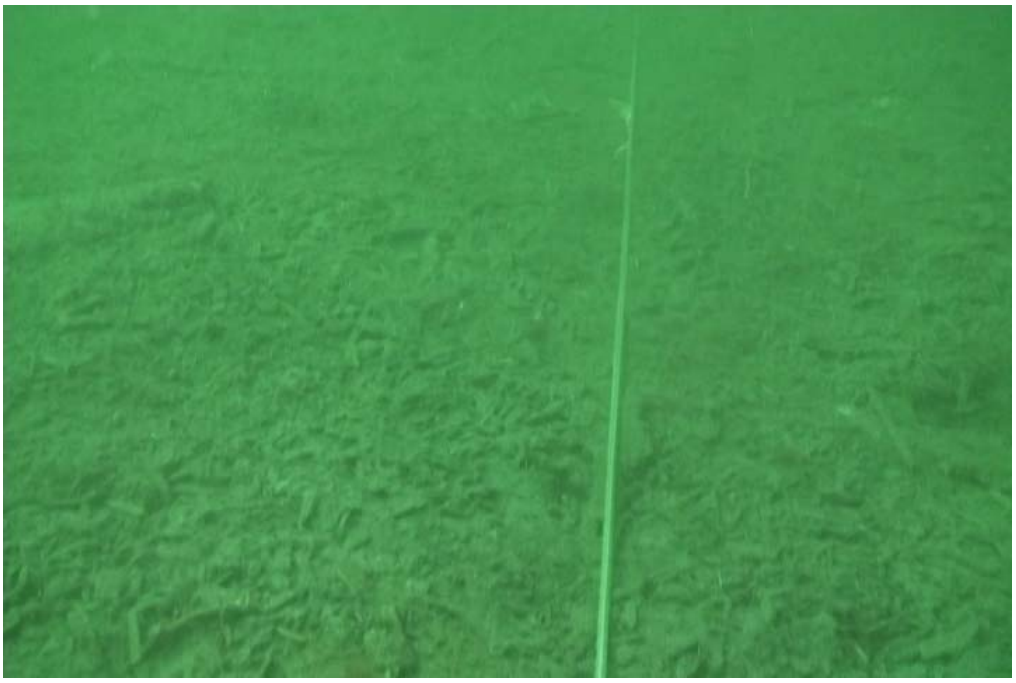
Photograph 10: View east along inter-tidal zone around McNab Creek.

Photograph 11: View of intertidal area of LSA with possible flot structure.

Photograph 12: View southwest of tubular frames with log and barge ramps over rip rap fill behind.

Photograph 13: View of abandoned log-based float.

Photograph 14: View of abandoned fibreglass dingy in upper intertidal area.



Photograph 15: View from diver video (August 17, 2012) of sub-tidal LSA illustrating visibility and woody debris (bark chips, sticks and small logs) with 12 mm braided lead line for scale.

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APPENDIX B

Shovel Test Log

Table 1: Subsurface Conditions Observed During Shovel Testing

Test Area	Shovel Test #	Results	Depth Below Surface (cm)	Matrix Descriptions
1	1	Negative	0-2	Organic duff
			2-20	Dark brown silty loam
			20-24	Light grey silty granular sand
			24-40	Medium brown sand with cobbles, old creek bed
1	2	Negative	0-4	Organic duff
			4-20	Dark brown silty loam
			20-23	Light grey silty sand
			23-50	Medium brown sand with cobbles, old creek bed
1	3	Negative	0-2	Organic duff
			2-22	Dark brown silty loam
			22-25	Light grey silty sand
			25-40	Medium brown sand with cobbles, old creek bed
1	4	Negative	0-2	Organic duff
			2-22	Dark brown silty loam
			22-24	Light grey silty sand
			24-35	Medium brown sand with cobbles, old creek bed
1	5	Negative	0-2	Organic duff
			2-22	Dark brown silty loam
			22-25	Light grey silty sand
			25-37	Medium brown sand with cobbles, old creek bed
1	6	Negative	0-3	Organic duff
			3-23	Dark brown silty loam
			23-26	Light grey silty sand
			26-39	Medium brown sand with cobbles, old creek bed
1	7	Negative	0-2	Organic duff
			2-24	Dark brown silty loam
			24-27	Light grey silty sand
			27-40	Medium brown sand with cobbles, old creek bed

Test Area	Shovel Test #	Results	Depth Below Surface (cm)	Matrix Descriptions
1	8	Negative	0-3	Organic duff
			3-22	Dark brown silty loam
			22-24	Light grey silty sand
			24-45	Medium brown sand with cobbles, old creek bed
1	9	Negative	0-2	Organic duff
			2-20	Dark brown silty loam
			20-23	Light grey silty sand
			23-43	Medium brown sand with cobbles, old creek bed
1	10	Negative	0-2	Organic duff
			2-22	Dark brown silty loam
			22-25	Light grey silty sand
			25-47	Medium brown sand with cobbles, old creek bed
1	11	Negative	0-3	Organic duff
			3-23	Dark brown silty loam
			23-25	Light grey silty sand
			25-50	Medium brown sand with cobbles, old creek bed
1	12	Negative	0-2	Organic duff
			2-22	Dark brown silty loam
			22-26	Light grey silty sand
			26-52	Medium brown sand with cobbles, old creek bed
1	13	Negative	0-3	Organic duff
			3-22	Dark brown silty loam
			22-24	Light grey silty sand
			24-50	Medium brown sand with cobbles, old creek bed
1	14	Negative	0-2	Organic duff
			2-22	Dark brown silty loam
			22-24	Light grey silty sand
			24-48	Medium brown sand with cobbles, old creek bed
2	1	Negative	0-2	Organic duff
			2-8	Black silty sand with trace clay
			8-15	Brown/grey sand with cobbles, old creek bed

Test Area	Shovel Test #	Results	Depth Below Surface (cm)	Matrix Descriptions
2	2	Negative	0-1	Organic duff
			1-6	Black silty sand with trace clay
			6-17	Brown/grey sand with cobbles, old creek bed
2	3	Negative	0-2	Organic duff
			2-5	Black silty sand with trace clay
			5-20	Brown/grey sand with cobbles, old creek bed
2	4	Negative	0-4	Organic duff
			4-7	Black silty sand with trace clay
			7-15	Brown/grey sand with cobbles, old creek bed
2	5	Negative	0-3	Organic duff
			3-8	Black silty sand with trace clay
			8-20	Brown/grey sand with cobbles, old creek bed
2	6	Negative	0-4	Organic duff
			4-8	Black silty sand with trace clay
			8-25	Brown/grey sand with cobbles, old creek bed
2	7	Negative	0-2	Organic duff
			2-8	Black silty sand with trace clay
			8-14	Brown/grey sand with cobbles, old creek bed
2	8	Negative	0-4	Organic duff
			4-8	Black silty sand with trace clay
			8-15	Brown/grey sand with cobbles, old creek bed
2	9	Negative	0-4	Organic duff
			4-8	Black silty sand with trace clay
			8-18	Brown/grey sand with cobbles, old creek bed
2	10	Negative	0-4	Organic duff
			4-8	Black silty sand with trace clay
			8-20	Brown/grey sand with cobbles, old creek bed
2	11	Negative	0-3	Organic duff
			3-7	Black silty sand with trace clay
			7-22	Brown/grey sand with cobbles, old creek bed

APPENDIX B
Shovel Test Log

Test Area	Shovel Test #	Results	Depth Below Surface (cm)	Matrix Descriptions
2	12	Negative	0-3	Organic duff
			3-9	Black silty sand with trace clay
			9-21	Brown/grey sand with cobbles, old creek bed
2	13	Negative	0-4	Organic duff
			4-8	Black silty sand with trace clay
			8-18	Brown/grey sand with cobbles, old creek bed
2	14	Negative	0-3	Organic duff
			3-8	Black silty sand with trace clay
			8-18	Brown/grey sand with cobbles, old creek bed

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