January 23, 2014

HCA PERMIT 2010-0031

Final Report on Archaeological Impact Assessment of Proposed Aggregate Project at McNab Creek, Howe Sound, BC

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 an archaeological impact assessment (AIA) of the proposed aggregate facility at McNab Creek (the Project), 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 an area of approximately 118 ha including inter- and sub-tidal portions, identified as the Local Study Area (LSA). Much of the area was previously impacted by clear-cut forestry, road building, and log sorting activities. Anticipated impacts which may occur within the development footprint during the course construction include excavation, tree felling, access road and ancillary component construction, and, during the Project operation, aggregate extraction.

The AIA was conducted 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 objectives of the AIA were to:

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

No archaeological 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 subject to subsurface testing. Twenty-eight shovel tests were excavated, with negative results for archaeological remains. No further archaeological work is recommended for the Project, as currently proposed.

Credits

Project Director	Mark Johannes, Ph.D.
Project Coordinator	Heather Pratt, M.A., RPCA
Permit Holder	Chris Dodd, B.A., RPCA
Field Director	Heather Pratt
Field Supervisor[1]	Chris Baker, M.Sc., RPCA
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[1] Chris Baker performed 2 days as a Field Supervisor on this Project towards qualification as Coastal Field Director.

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1.0 INTRODUCTION

On behalf of BURNCO Rock Products, Ltd. (BURNCO), Golder Associates, Ltd. (Golder) conducted an archaeological impact assessment (AIA) of the proposed aggregate facility (the Project) at McNab Creek, located approximately 8 km north-east of Port Mellon and 22 km north-west of West Vancouver, in southwestern British Columbia (Figure 1). The Project is located within the asserted traditional territories of the Squamish Nation and Tsleil-Waututh Nation.

The AIA was conducted under the term and conditions of *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 fieldwork was carried out by Heather Pratt and Chris Baker (Golder) and Louise Williams (Squamish Nation).

The results of the AIA are discussed below in fulfilment of the terms and conditions of HCA Permit 2010-0031.

1.1 Objectives

The objectives of the AIA included:

- Conduct an archaeological overview assessment to identify known resources and areas of archaeological potential;
- Identify and describe archaeological resources through field investigations;
- Identify and evaluate potential impacts to archaeological resources that might result from construction and operation of the Project;
- Assess significance of the identified archaeological resources; and
- Develop recommendations for measures to avoid, limit or otherwise mitigate potential adverse effects of the proposed Project to identified archaeological resources.

1.2 Relevant Legislation

All archaeological sites located on Provincial Crown or private land that predate or are assumed to predate AD 1846 are automatically protected under the HCA. Specific sites, including burials, and rock art sites are protected regardless of age, if they have heritage value. 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. Inspection, investigation or alterations to archaeological sites require a permit issued by the Archaeology Branch, Ministry of Forests, Lands and Resource Operations.

A broader assessment for heritage resources for the proposed BURNCO aggregate facility at McNab Creek has also been produced by Golder (2013a) in partial fulfillment of conditions for the proposed Project development under terms of the *Canadian Environmental Assessment Act* and the *BC Environmental Assessment Act*.

1.3 Report Organization

This final report includes the results of the fieldwork conducted on January 22 and 23, 2013. The report follows the Guidelines for Report Content as outlined in the BC Archaeological Impact Assessment Guidelines (Archaeology Branch 1998). Copies of this report will be forwarded to the Squamish Nation and Tsleil-Waututh Nation.

2.0 BACKGROUND OVERVIEW

2.1 Description of the Project Area

BURNCO proposes the development and operation of an aggregate facility at McNab Creek on Thornbrough Channel in Howe Sound, British Columbia. 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) 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).[2]

The terrestrial portion of the 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 50 m wide BC Hydro right-of-way. The Project Area located north of the right-of-way is within a 70 ha forestry clear-cut and will contain the aggregate extraction area (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.

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 inter-tidal 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.

2.2 Proposed Development

A number of proposed project-related activities have the potential to impact archaeological resources in the LSA by disturbing cultural deposits and features, damaging artifacts, hindering or increasing access to archaeological deposits, and destroying contextual information that is essential for interpreting archaeological site function and age (Davis *et al.* 2004; Williams and Corfield 2003). The proposed aggregate extraction area represents the largest single component of the Project and will include the clearing of brush in advance of excavation. Additional potential impacts from construction may occur from geotechnical testing, the clearing of timber, 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.

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[2] The terms Project Area (development footprint), Local Study Area (Project Area plus buffer with habitat compensation works), and Regional Study Area (the inter-tidal and shallow sub-tidal areas located within Howe Sound and within 4 km to either side of the proposed barge routes) are terms developed for use within the framework of the EIS Technical Report for Heritage Resources (Golder 2013a). Project Area and Local Study Area (LSA) are used in this report to provide consistency across Project reports.

2.3 Physical Setting

An understanding of the physical setting of the Project Area is important to archaeological 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 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. Sea level change may leave sites formerly located near the shore above or below or the current sea levels. Rising sea levels may erode and destroy archaeological sites, however, episodic sea level "stands" within an extended period of generally rapid sea level change may leave recognizably intact relict beach lines and other littoral features, possibly including archaeological sites, from the intervals of relative stability.

2.3.1 Glacial History and Palaeo-environment

During the height of the Late Wisconsin glaciation, 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 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. Numerous sites are likely submerged beneath the ocean waters of the British Columbia coast (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 the LSA 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 recorded archaeological sites exist in the greatest density, might be located up to 3 m above modern sea level, corresponding with the highest relative sea levels occurring approximately 3000 BP.

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

2.3.2 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 sill or shoal 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 and shallow sub-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 metres 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).

2.3.3 Modern Biophysical Setting

The LSA is situated within Coastal Western Hemlock (CWH) biogeoclimatic zone. 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 CWH 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, including Howe Sound, 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.

2.4 Cultural Summary

2.4.1 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).

2.4.2 First Nations Place Names

A review of available ethnographic sources of the surrounding area resulted in the identification of First Nations place names which are described below. Both the *skxwú÷ish* (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 *skxwú÷ish* 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).

S7ets7átsnach

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

Ihelta's

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

St'áp'as

Latona Beach (Kennedy 1976).

2.4.3 Cultural 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), Matson (1974), and Mitchell (1971).

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

2.4.3.1 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).

2.4.3.2 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 inter-tidal 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.* (1986) 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.

2.4.3.3 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).

2.4.3.4 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).

2.4.3.5 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).

2.4.4 Post-Contact Period Regional History Overview

The following sections thematically summarize some of the rapid historical developments following the arrival of the non-indigenous populations into to the Strait of Georgia region, with emphasis on research specific to the development of Howe Sound, focussing on McNab Creek. Historical transitions 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 heritage wrecks.

2.4.4.1 Charting and Navigation

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). 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 (Walbran 1971).

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 (Armitage 1997; Thomson 1981).

McNab Creek appears to have been named after John McNab, an 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 at this time that it was some months before it was determined they were missing.

2.4.4.2 Settlement

Sailing ships of the maritime fur trade avoided the navigationally challenging inside waters of the Georgia Strait, and the Hudson’s Bay Company (HBC) extended its influence into the 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 established in 1853 in response to the HBC’s new interests in acquiring coal to feed the boilers of steam ships (McKelvie 1951). 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).

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. A route by way of Howe Sound and the Squamish River Valley was explored at this time, but was not used and did not lead to settlement in the area (Armitage 1997).

Settlement also created demand for lumber. 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 (Drushka 1981).

The inside waters of British Columbia were transformed by the arrival of the Canadian Pacific Railway (CPR) to Burrard Inlet in 1886. The 1887 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).

2.4.4.3 Mineral Exploration

There was a very brief Squamish River "gold rush" in 1858, and 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 the largest amount of copper in the 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).

2.4.4.4 Forestry

Early logging activities were 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.

As early as 1865, Hastings Mill (Burrard Inlet) leased timber rights in Howe Sound (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.

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 Creek. 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).

2.4.4.5 Commercial Fishing

The fishing industry became well-established in the last decades of the 19th century, exporting primarily 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.

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).

Commercial fisheries, including whaling and sealing, were being developed 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). One small cannery was built in Howe Sound; it operated in Eagle Harbour between 1897 and 1917.

Commercial trolling for salmon became popular in the 1920s with handliners, and later with locally-built powered trolling boats based in Howe Sound (Moore 1993). The introduction of gas engines led to the general replacement of the sailing gillnetters on the Fraser River by 1915, while 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 1993). At the same time, seemingly archaic methods persisted at least through the 1930's in some areas. 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).

2.4.4.6 Marine Transportation

Vessels remained the principal form of transport whether in the form of sailing ships, coastal steamers, ocean-going ships, or tugs towing barges, scows and booms (Drushka 1981; Rushton 1974). The Union Steamship company served many smaller ports along the coast, and small craft powered by oars and sail, provided basic personal and goods transport in addition to being critical to the fishing industry (Moore 1993).

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). This big steam tug may be located in West Bay, Gambier Island (Drushka 1981; Stone 2007). 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).

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 gas engine also made air travel possible and the first “bush” planes come into use along the coast following World War One. Many early aircraft were flying boats while others employed floats. New speeds for vessels were also made possible by the introduction of high-powered engines, like the “liberty” aircraft engines that became available as military surplus.

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).

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. The post-war years have 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.

The importance of steamers was eclipsed by the introduction of ferry service and the construction of roads. 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).

2.4.4.7 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), and residents at McNab Creek like Bill Baines rowed to collect their mail at the post office on Anvil Island (Armitage 1997). These small craft might have been built by the owners, but were also crafted by boat-building specialists in the community. One early builder in Howe Sound 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).

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).

2.5 Previous Archaeological Research

The first inventory of archaeological sites in Howe Sound was conducted at the direction of the provincial Archaeological 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 that are located 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, the one located closest to the Project Area being located in Plowden Bay (site DjRu-009; Figure 3).

A previous investigation of a portion of the McNab Creek area was completed by Rudy Reimer under Heritage Conservation Act 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 spaced at 5 to10 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. All subsurface tests were negative and no archaeological sites were identified (Reimer 2004).

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, adjacent to Potlatch Creek (Figure 3). 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 subsurface shell midden. The site was recorded as part of the Howe Sound Survey on July 19, 1975 by Patricia Winram (Winram 1975);

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

- Archaeological site DjRu-004 measures 15 m by 4 m and consists of surface lithics and 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); and
- 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).

2.6 Expected Site Type Summary Based on Overview

Based on the background overview, the sites types which may be present in the terrestrial portion of the LSA include culturally modified trees (CMTs) where veteran trees, particularly western redcedar, remain standing, lithic artifact scatter, shell midden, or other buried archaeological features. A quarry site may be associated with bedrock shale deposits, and rock art may be present where boulders or near vertical bedrock faces are observed.

In the inter- and sub-tidal areas, the site types which may be present include shell midden, lithic artifact scatter, as well as canoe skids, fish traps, weir features, and heritage wrecks present as a result of accident to vessels (i.e., fire followed by grounding) or abandonment. There is potential as well for sunken heritage wrecks in the sub-tidal area.

3.0 AIA METHODS

3.1 First Nations Involvement

A copy of Golder's HCA permit application was forwarded by the Archaeology Branch to the Squamish Nation and Tsleil-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 methodology outlined in the application.

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

Golder contacted the Squamish Nation and Tsleil-Waututh Nation by telephone and email to notify each community of the proposed development and to invite a member of each community to participate in the fieldwork. Louise Williams, representating Squamish 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 Nation and Tsleil-Waututh Nation.

3.2 Desktop Data Review of LSA

3.2.1 Review of Historic Aerial Photos and Satellite Imagery

Historic aerial photographs from the Geography Department of the UBC Library were reviewed and included 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 inter-tidal area of the LSA, as well as to provide a general time sequence of major impacts visible on land. Imagery available on Google Earth from 2009 and 2012 (2013) was also examined.

3.2.2 Historic Ship and Aircraft Wreck Data

A review of historic shipwreck and vessel and aircraft casualty records (Northern Maritime Research 2002; Rogers 1973, 1992; Transportation Safety Board of Canada 2013a, 2013b, Transport Canada 1970-1983, 1981) was conducted to determine what vessels or aircraft might have been lost in the Project vicinity with the potential for heritage wreck being located within the LSA.

3.2.3 Underwater Survey Reports

Underwater survey reports based on camera records and sub-bottom acoustic profiling (Frontier 2009, Wright 2006) were reviewed for archaeological information relevant to the sub-tidal portions of the LSA.

3.3 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. 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 inter-tidal zones (e.g., for features such as canoe runs and fishing weirs or traps, as well as anaerobically preserved organic materials), areas 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 4.2.3).

3.4 Field Investigations

Field investigations were consistent with the research design outlined in the HCA Heritage Inspection Permit 2010-0031 application and consisted of a systematic ground surface inspection (i.e., pedestrian reconnaissance) and a subsurface testing program intended to locate and assess cultural deposits or features that may be present within the Project Area.

Sections 3.4.1 and 3.4.2 summarize the methods employed for the AIA field program.

3.4.1 Pedestrian Survey

During pedestrian survey of the terrestrial portion of the LSA, a surface inspection was conducted in judgementally selected areas, depending on terrain, ground cover, previous AIA survey coverage (Reimer 2004), the absence/presence of fill, and assessed site potential. Tree species and age were observed. Exposures of bedrock shale were sought. All areas identified as having archaeological potential were traversed by crews spaced at 5 - 15 m intervals. Areas that have been previously assessed by Reimer (2004) and for which "no further archaeological work" was recommended were not be resurveyed unless, based on observed field conditions and at the judgment of the field director, a field survey was considered appropriate. During the surface inspection, exposures, e.g., those associated with tree throws and at stream margins, were examined. The locations of all survey transects were mapped, and recorded using had-held GPS devices.

Surface evidence of cultural material were sought, including but not limited to stone, bone, antler, shell, or other artifacts; fire-cracked rock; anthropogenic soils; cultural features (e.g., cultural depressions, post-moulds, hearths, CMTs, trails, burials, pictographs or petroglyphs); terraces or other features possibly indicated a relict beach; and historic cultural remains and debris.

During pedestrian survey of the marine portion of the LSA, a surface inspection of the inter-tidal area was conducted to the limit of tidal exposure available during the pedestrian survey.[5] Surface evidence of cultural material was sought, including but not limited to stone, bone, antler, shell, or other artifacts; fire-cracked rock; cultural features (e.g., canoe runs, fish traps; and shipwrecks or other historic cultural remains).

3.4.2 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.

3.4.3 Concurrent Field Study Review

Observations by archaeologists within the inter-tidal LSA during relatively high tide levels were supplemented by observations and visual recordings by other Golder personnel who were present in the LSA during lower tides. Golder personnel also conducted dive surveys and collected video data with diver held cameras as well as drop video cameras within the sub-tidal portions of the LSA (August 17 and August 18, 2012). These videos were reviewed for data relevant to the archaeological assessment.

3.5 Reporting

As required under the terms and conditions of Golder's HCA Permit, this final report has been completed for submission to the Archaeology Branch and First Nations. This report documents the employed methodologies, details the results of the field assessment. A description of the anticipated impacts from the proposed Project is provided, along with recommendations for appropriate management of these findings.

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[5] Lowest tide levels available during the pedestrian survey were 3.3 m (January 22) and 3.7 m (January 23) above chart datum (Fisheries and Oceans Canada 2012).

4.0 RESOURCE INVENTORY RESULTS

4.1 Desk Top Study

4.1.1 Historic Aerial Photos and Satellite Imagery

Some features in and near the LSA 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 inter-tidal 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. However, metal frames in the lower inter-tidal area are first visible in 2005 (Photo #s 30BCC05026/0144-5). These frames are more clearly visible in Google Earth (2013), and may be described as two rectangular objects located in the lower inter-tidal part of the LSA, resting side by side with a generally aligned N-S, and measuring approximately 7 m by 23 m. These appear to be open, metal-framed structures.

A third rectangular object was observed lying in the upper inter-tidal about half way between the proposed wharf location and the outlet of McNab Creek (Google Earth 2013). 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 (sections 4.2.2 and 4.2.4; Figure 4).

4.1.2 Data Related to Heritage Wrecks

A review of aircraft casualty records (Transportation Safety Board of Canada 2013b; Transport Canada 1970-1983) indicates no loss of aircraft in the Project vicinity.

A review of shipwreck records indicates that two vessels became total losses at McNab Creek, although no precise locations are provided (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 2.4.4.4) 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; and
- *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.

Three vessels (*Sea Comet*, 1987; *Island Flyer*, 1948; *Tex*, 1930) suffering wrecking events with locations recorded within 6 km of the Project but which may with some confidence be said to be located outside the LSA are indicated in Figure 3.

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.

4.1.3 Previous Underwater Surveys

Past records of the LSA at low tide characterize the inter-tidal 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 (Frontier 2009), therefore the surface of the seabed in this area is not an inundated surface potentially occupied by humans.

4.2 Field Investigations

4.2.1 Terrain Description

The terrestrial parts of the LSA, including the Project Area, 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). The portion of the LSA closest to the sea, and south of the transmission line, is swampy with extensive standing water with second growth forest cover.

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. Soils within the LSA are well drained, and consist of 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 inter-tidal 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, historical logging, existing cut-lines, existing access roads, power line right-of-way, log sorting area and abandoned buildings.

4.2.2 Pedestrian Survey and Potential Assessment

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). Ground disturbances including a large rock push resulting from the man-made creek channel, existing cut trails, a power line right-of-way, access roads, and log sorting areas, were examined and no cultural material was observed. No bedrock shale was identified within the LSA.

Visual inspection of the terrestrial portion of the LSA resulted in the identification of two areas of archaeological potential along a knoll overlooking low-lying terrain and the edge of a ridge and a dry creek channel (Figure 4). 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 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 inter-tidal 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).

4.2.3 Subsurface Inspection

4.2.3.1 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 salmonberry, fern, grasses, and an overstory 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 to 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 materials or features were identified at this location.

4.2.3.2 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 an old cut-block, along the eastern boundary of the LSA. Vegetation consists of salmonberry, fern, grasses, and an overstory of recently planted hemlock, Douglas-fir and western redcedar. Soils are well drained. Fourteen shovel tests were excavated along the ridge edge spaced 5 to 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 overlying 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 materials or features were identified at this location.

4.2.4 Concurrent Field Studies

Observations by archaeologists within the inter-tidal LSA during mid- to high-tides were supplemented by observations and visual recordings by other Golder personnel working in or near the LSA. 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 2013b) (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 2013b). These were observed throughout the inter-tidal areas surveyed except for the upper 20 to 40 m. Oysters were also present, but in smaller quantities.

Irregularities in cobble distribution appear fluvial in origin or due to historic disturbance. No signs (evidence) of rock alignments that might be cultural in origin, and no stakes were observed.

As noted in Section 4.1.1, two rectangular metal-framed structures were observed in 2005 aerial and satellite imagery in the inter-tidal LSA. The structures which were examined more closely in the field. The function of the two rectangular structures located in the lower inter-tidal area (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 inter-tidal area is an abandoned float with a wooden deck built on logs (Appendix A, Photograph 13).

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

The seabed visible in diver and towed video revealed a continuation of the inter-tidal area, gradually shelving with soft sediments and patches of cobles (Figure 4). 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 2013b). 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.

5.0 RESOURCE EVALUATION

As no archaeological sites were identified during the course of the AIA, a resource evaluation was not completed.

6.0 IMPACT ASSESSMENT

No archaeological sites were identified during the AIA. The probability of finding unidentified archaeological sites within the Project Area is considered to be low. As a result, no impacts to archaeological sites are expected from the proposed land-altering activities associated with this development, as currently proposed.

7.0 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, reducing the presence of CMTs;

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 inter-tidal zone; and

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, 4 shovel tests would be excavated.

Field observations identified no old growth forest (although isolated veteran western redcedars were observed and examined), and homogenous terrain with poorly defined features over a substrate largely consisting of gravels. The terrestrial portion of the LSA closest to the water, and south of the transmission line was swampy with extensive standing water.

Supporting documentation of the inter-tidal area indicates that it is comprised largely of cobble and gravel through the areas of low slope, which then drops steeply into the sub-tidal area.

The LSA has also been extensively impacted by previous development, including by clear-cut forestry, road building, and log sorting activities. As such, the LSA is determined to have low archaeological potential.

Table 1: Test Locations

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

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 Nation, Tsleil-Waututh Nation and a Golder archaeologist of the discovery, or notify a paleontologist; and
- Determine in consultation with the Archaeology Branch, Squamish Nation and Tsleil-Waututh Nation of an acceptable management strategy.

8.0 RECOMMENDATIONS

Recommendations for the management of archaeological resources within the LSA were formulated from the results of the AIA and are outlined below.

- No further archaeological work is recommended for the remainder of the LSA, provided the proposed development is not altered to include areas not assessed during the AIA; and
- Should further construction be proposed outside of the LSA, Golder recommends an archaeologist be contacted to evaluate the need for further heritage investigation.

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 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; and
- Determine in consultation with the Archaeology Branch, Squamish First Nation and Tsleil-Waututh Nation of an acceptable management strategy.

9.0 LIMITATIONS AND CLOSURE

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 sole responsibility of such third parties.

We trust the information contained in this report is sufficient for your present needs. Should you have any questions regarding the project, please do not hesitate to contact Christopher Baker at 250-754-5651.

GOLDER ASSOCIATES LTD.

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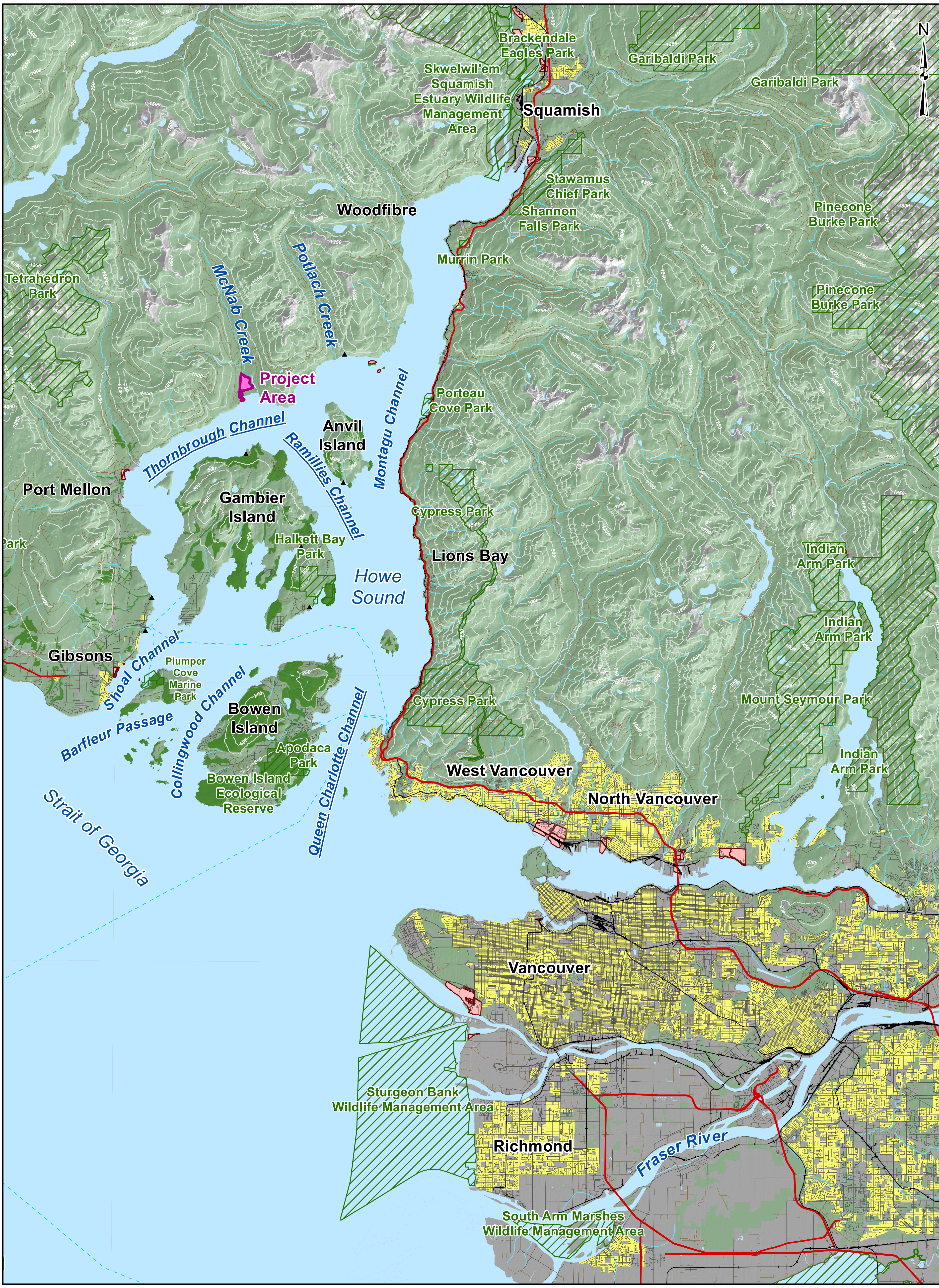


LEGEND

- Project Area (Approximate)
- Parks / Protected Areas
- Sensitive Environmental Area
- Vegetation
- Aboriginal Land
- Residential Area
- ▲ Camp
- Highway
- Road
- Resource Road
- Railway
- Ferry

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.
AGGREGATE PROJECT, HOWE SOUND, B.C.

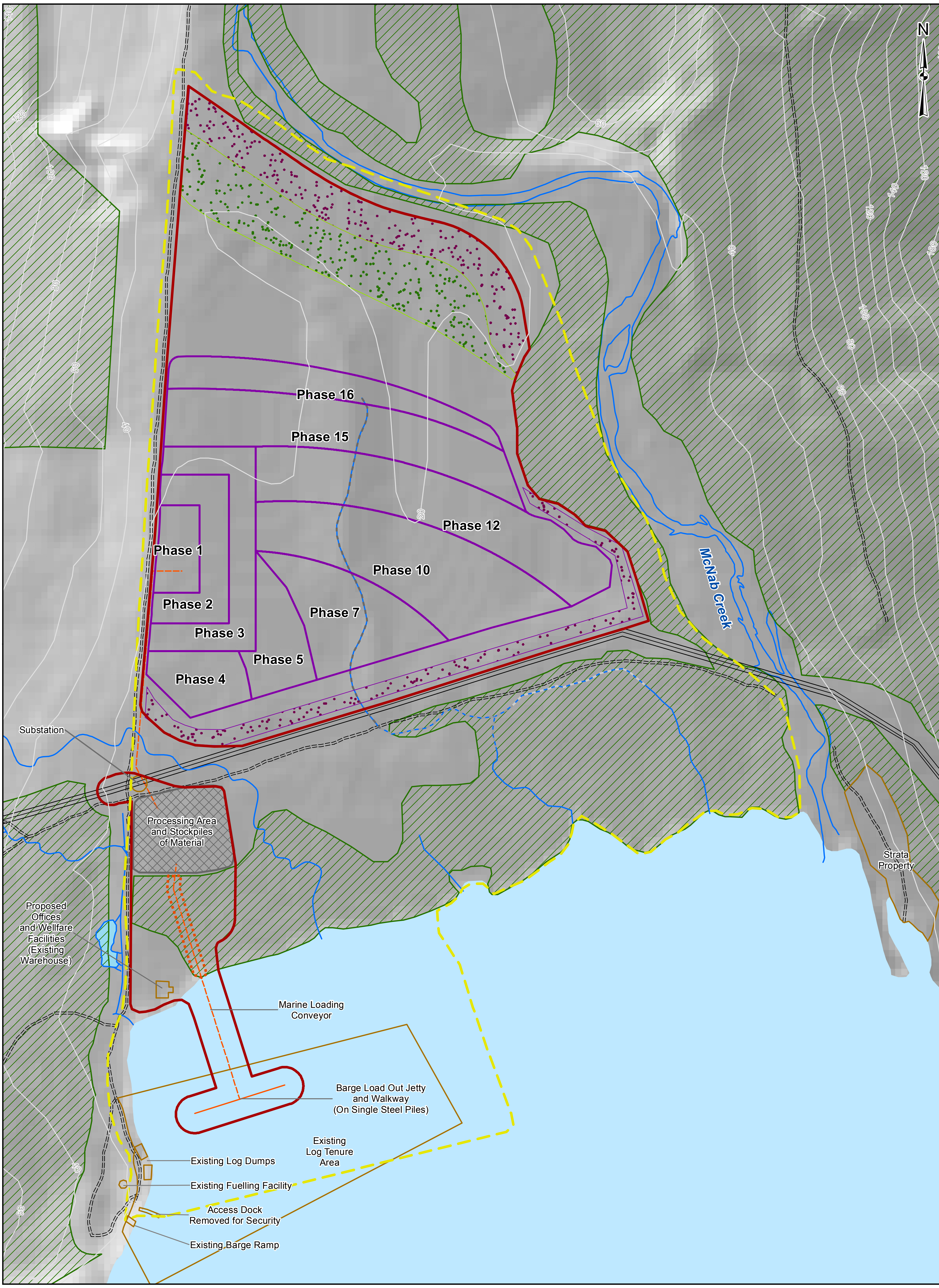
TITLE

LOCATION OF BURNCO AGGREGATE PROJECT

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.
DESIGN	MD	2 Nov. 2012	SCALE AS SHOWN REV. 2
GIS	AL	8 Nov. 2012	**FIGURE 1**
CHECK			
REVIEW			

Path: X:\Project Data\BC\McNab\Figures\MXD\Archeology\BURNCO_ARCHAEOLOGY_Vr2_Figure_01_Location_of_Burnco_Aggregate_Project - Copy.mxd



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_UpdatedDec4
- Waterbody
- Road (existing)
- Transmission Line
- Barge Load-out
- Conveyor
- Conveyor Buffer
- Watercourses
- Contour - 20m Interval

Constructed Channel

- Phase 1
- Phase 2

200 0 200

SCALE 1:6,000 METRES

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.
AGGREGATE PROJECT, HOWE SOUND, B.C.

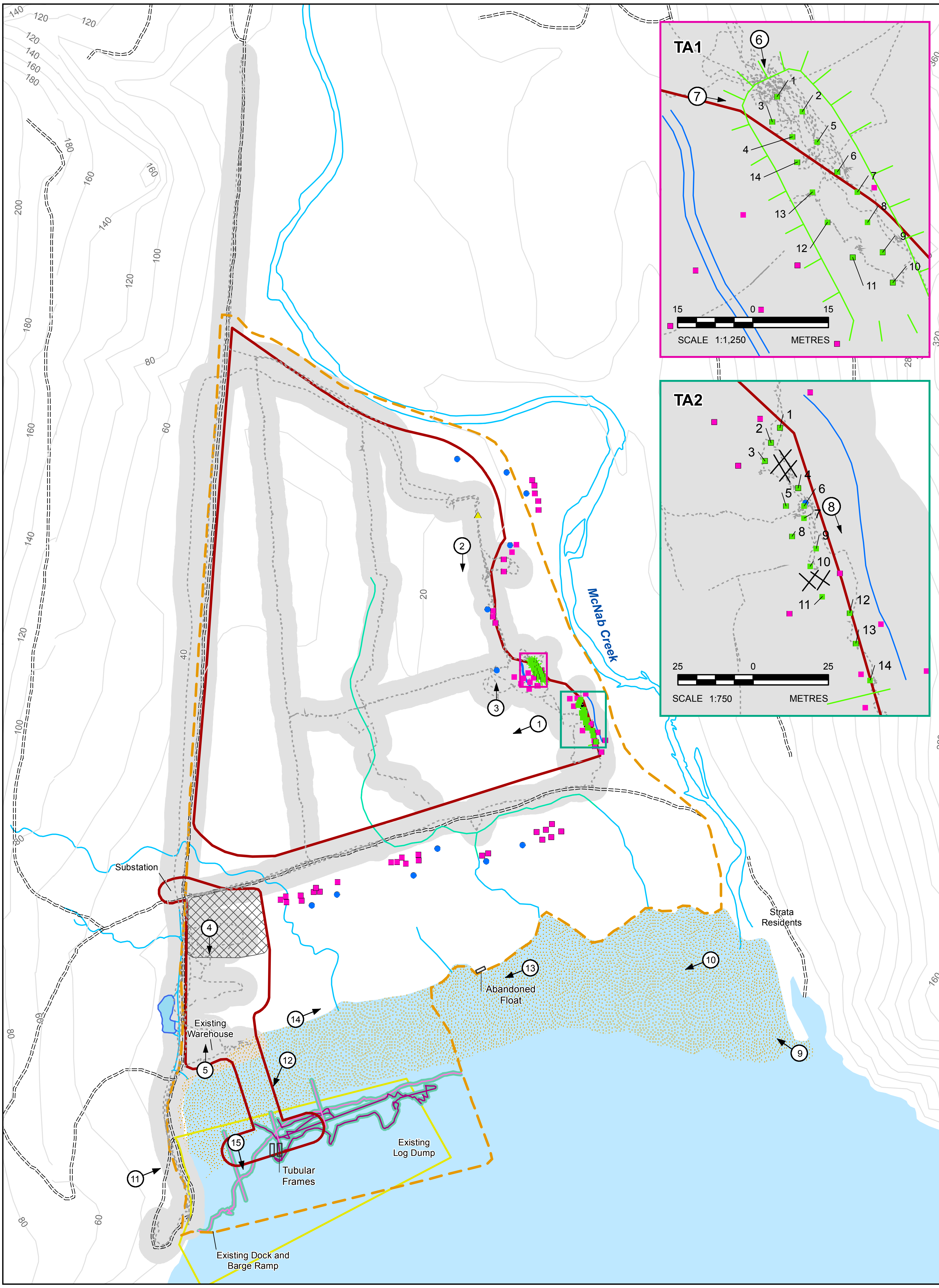
TITLE

PROPOSED CONCEPTUAL SITE LAYOUT AND LSA FOR ARCHAEOLOGICAL IMPACT ASSESSMENT

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	2 Nov. 2012	SCALE AS SHOWN	REV. 6
GIS	AL	21 Nov. 2012		
CHECK	AL	21 Jan. 2013	**FIGURE 2**	
REVIEW	MJ	21 Jan. 2013		

Path: Y:\Vancouver\Spatial Data\Project Data\BC\McNab\Figures\MXD\Archaeology\BURNCO_ARCHAEOLOGY_Vr2_Figure_02_Proposed_Conceptual_Site_Layout_and_LSA_For_Heritage_Resources.mxd



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)
- Watercourse
- Constructed Channel
- Contour - 20m Interval
- Project Boundary
- Archaeology LSA
- Waterlot
- Processing Plant and Product Stockpile
- Photo Location

250 0 250
SCALE 1:7,500 METRES

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.
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. 3
GIS	AS	31 Jan. 2013		
CHECK	AL	7 Feb. 2013	FIGURE 4	
REVIEW	CM	7 Feb. 2013		

Path: Y:\Vancouver\Spatial Data\Project Data\BC\McNab\Figures\MXD\Archeology\BURNCO_ARCHAEOLOGY_Vr2_Figure_04_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 of proposed 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 or 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 looking into LSA from mouth of McNab Creek.

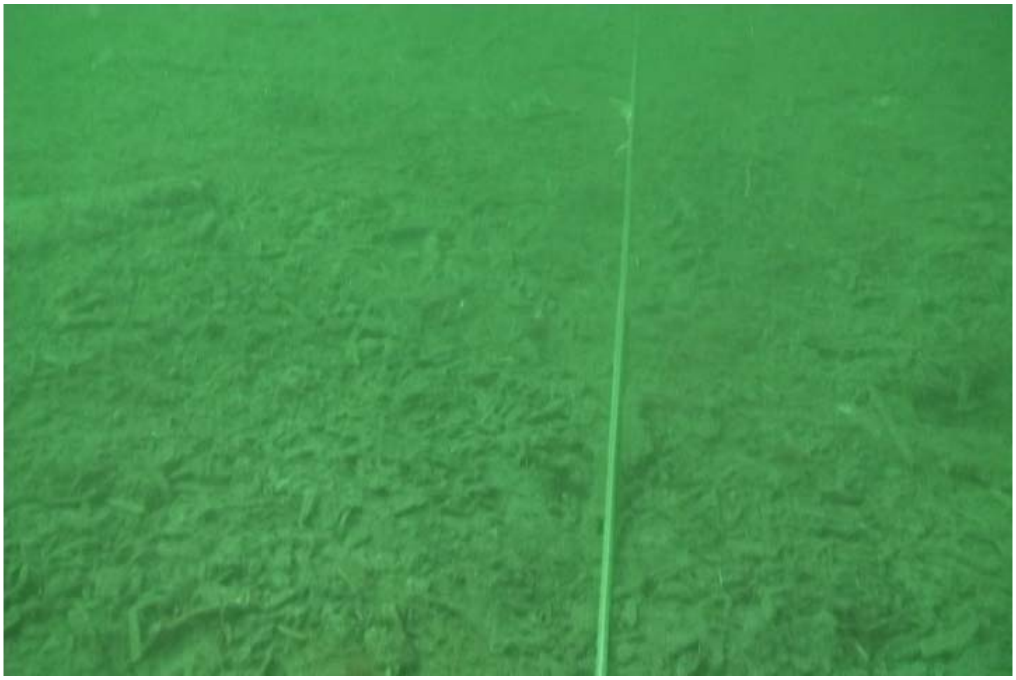
Photograph 10: View east along inter-tidal zone around McNab Creek.

Photograph 11: View of intertidal area of LSA with tubular frame structures.

Photograph 12: View southwest to 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

Subsurface 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

Test Area	Shovel Test #	Results	Depth Below Surface (cm)	Matrix Descriptions
			24-27	Light grey silty sand
			27-40	Medium brown sand with cobbles, old creek bed
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

Test Area	Shovel Test #	Results	Depth Below Surface (cm)	Matrix Descriptions
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
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

Test Area	Shovel Test #	Results	Depth Below Surface (cm)	Matrix Descriptions
			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
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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