Application for an Environmental Assessment Certificate

Appendix L-3
Shallow Subtidal

L.1 INTRODUCTION

Prince Rupert Gas Transmission Ltd. proposes to install a gas pipeline up to 900 km in length to transport natural gas from a point near Hudson Hope, northeast BC, to Lelu Island, near Prince Rupert, BC (the 'Project'). The proposed routes for this pipeline all include a marine component. Since the installation of this project has the potential to affect marine species and habitats, surveys were carried out to provide a baseline characterization of the subtidal environment to inform the environmental assessment process and subsequent permitting and monitoring requirements. The main aims were to identify substrate types, as well as an indication of the dominant biota associated with them, at all proposed pipeline landfall locations. Wherever possible, these surveys were planned to overlap with the lowest point of the intertidal surveys (Appendix L-2) and the shallowest point of the benthic habitat mapping (Appendix L-4) to provide a continuous characterization of the marine environment within the Project local assessment area (LAA).

L.2 METHODS

Remotely operated vehicle (ROV) surveys were carried out from 18 September, 2013, through October 3, 2013, by International Underwater Surveyors Inc. using a Deep Ocean Phantom DHD2 ROV. Three sites were surveyed based on a suite of proposed pipeline routes (Figure L-3-1), namely: Lelu Marine, Nass Bay, and Nasoga Gulf. Four additional sites were surveyed to ensure representative coverage of coastal subtidal habitat in case of proposed route changes. These additional sites were Lelu North, Work Channel Head, Work Channel North, and Work Channel South (Attachment L-3-1).

The ROV operator manipulated the speed, lighting and elevation of the ROV above the seafloor to capture the most informative footage possible. Video from each transect flight was recorded and each video frame was stamped with a depth, date and time. The geographic position of the ROV was also tracked and time-stamped in synchrony with the video. As a result, the location of stills could be obtained by comparing the timestamps on the video with the tracking data. The ROV was fitted with a high intensity white LED and a tungsten-halogen light to provide illumination. Parallel scaling lasers were mounted on the ROV, spaced 15 cm apart, to allow size estimation of substrate and organisms from the video footage to help with habitat characterization and species identification.

Survey design (transect number, length, and distribution) was based on site area, topography and accessibility. Nasoga Gulf and the three Work Channel sites were all surveyed using 15 transects. Transects were oriented perpendicular to the shore, navigated from deep to shallow, and were spread across a 500 m zone on either side of

the proposed pipeline routes. The depth at which transects were started varied by site but, where possible, started at the depth where benthic habitat mapping (Appendix L-4) ended.

Several route options are being considered for Nass Bay, which comprises an expansive shallow mudflat, fringed by areas of rocky/bedrock substrate. Collectively, these options span near-shore and mid-bay subtidal areas of Nass Bay (including Iceberg Bay, which forms the southern extent of Nass Bay). To obtain data on the types of habitats in these areas, two 250 m transects were flown with the ROV to the south of Nass Bay, adjacent to the proposed shoreline stretch of a land-based route option and just south of the landfall of the marine options (Figure L-3-2). These transects were navigated from deep to shallow water, and included sections running both parallel with, and perpendicular to, the shoreline.

Due to sediment deposition from the Skeena River, the seafloor around Lelu Island is relatively shallow and the benthic habitat mapping only reached ~4 – 5 km from the island (Appendix L-4). The survey area at this site was, therefore, much larger than at the other sites; consequently an alternative survey methodology was used at both the north and south Lelu Island sites to sample these expansive areas. A total of 30, 100 m transects were flown at each of the Lelu sites with 20 focused on the proposed pipeline route and 10 spread across the 500 m buffer area on either side of the proposed route in a stratified random design (Figure L-3-3, Figure L-3-4, and Figure L-3-5).

Video footage from each transect was reviewed by trained biologists and relevant data were recorded. Specifically, they recorded substrate type, flora, and fauna. Substrate classes were divided into soft bottom, soft bottom with cobble, soft bottom with boulders, soft bottom with shell, cobble, boulders, bedrock, bedrock with boulders, and mixed substrate (Table L-3-1). Organism data were then divided into four groups, flora, fish, crabs and shrimp, and other invertebrates. All flora observed below 30 m were assumed to be pieces that had been ripped from shallower depths as coastal algae in British Columbia rarely occur deeper than this due to the lack of light (Lucas et al. 2007). These types of algae were categorized as “drift algae” and were not assumed to be growing where observed.

Community composition was expected to vary by substrate type and depth. Therefore, information on the dominance of different taxa at each site was summarized for all substrate types separately in four depth zones, the range of which was specific to the site. Specifically, for each depth zone within each site, the number of individuals observed of a taxon on a particular substrate was divided by the total number of all other taxa observed on that substrate type and depth zone. Data recorded as percent cover, were treated similarly by calculating a mean percent cover for each taxon on each substrate for each depth zone. For each substrate type, the relative abundance of taxa at a particular depth is indicated by the size of the point on the figure; large points indicate that the taxon was highly abundant (> 66 % of observations) at that depth relative to everything else seen on the same substrate; small points indicate that although the taxon was seen on

that substrate, it was relatively uncommon (< 33 % of observations) at that depth compared to other taxa. Because of the taxonomic level to which taxa could be most readily identified, crustacean and fish data were summarized by family while algae and other invertebrate data were summarized by phylum. These data are represented in figures for each site.

Attachment L-3-2 shows the frequency at which taxa were seen (number of individuals seen per 100 m of transect) for all the count data at each transect at each site. It also shows the frequency (number of individuals seen per 100 m of transect) of that taxon over the whole site. This attachment also provides the lowest taxonomic unit to which individuals were identified. Some data were recorded as percent cover rather than number of individuals. These data are also recorded in the attachment tables. Note: these lists show the species that were seen; absence of a species on these lists merely indicates that it was not seen at a particular site and not that it was necessarily absent from the site. Throughout, particular reference is made to species known to be of importance to commercial, recreational, or Aboriginal (CRA) fisheries, and species at risk.

Table L-3-1: Substrate Classifications

Substrate Type	Description	Picture
Anthropogenic	Substrate consisting of anthropogenic debris or structures (e.g. discarded crab traps)	
Bedrock	Large areas of solid rock substrate	
Boulder	Large pieces of rock (size >30 cm)	

Table L-3-1: Substrate Classifications (cont'd)

Substrate Type	Description	Picture
Cobble	Hard substrate of small rocks (10 cm < size < 30 cm)	
Gravel	Hard substrate of small stones (0.2 cm < size < 10 cm)	
Mixed	Consisting of multiple hard and soft substrates	
Soft bottom	Soft substrate (size <2.0 mm) >60%	
Soft bottom with boulder	Soft (size <2.0 mm) and hard (size >30 cm) substrate	

Table L-3-1: Substrate Classifications (cont'd)

Substrate Type	Description	Picture
Soft bottom with cobble	Soft (size <2.0 mm) and hard (10 cm < size < 30 cm) substrate	
Soft bottom with shell	Soft (size <2.0 mm) and shell (>60%)	

L.3 RESULTS

L.3.1 Lelu Marine

L.3.1.1 Substrate

Three substrate types were observed at Lelu Marine, soft bottom, soft bottom with boulder and soft bottom with shell (Figure L-3-4 and Figure L-3-5). Soft bottom was the most widespread and found at all depths while 'soft bottom with shell' was only found shallower than 27 m. Only a very small amount of 'soft bottom with boulder' was observed at this site. The soft substrates are likely due to the large volumes of sediment-laden outflow from the Skeena River, which also resulted in poor visibility throughout.

L.3.1.2 Flora

Algae were seen on all three substrate types present at this site. Green algae (*Chlorophyta*), including *Ulva* spp., dominated soft substrates with shell between 18 m and 27 m but were absent or less dominant at other depths and substrates (Figure L-3-6). Brown algae were only observed at depths shallower than 27 m on soft bottom and soft bottom with shell with the most common species being sea felt (*Pylaiella littoralis*) and spaghetti kelp (*Chorda filum*) (Attachment L-3-2, Table 2-6 to Table 2-9).

Unidentified crustose coralline red algae (*Rhodophyta*) were the only algae seen on soft bottom with boulder. Other substrates at depths shallower than 37 m had medium to low relative abundance of other red algae, including Turkish washcloth (*Mastocarpus papillatus*), although much of this may have been drift algae. Other unidentified algae were predominantly found at medium abundance on soft bottom substrate at depths less than 27 m; although these algae appeared to dominate substrates at depths greater than 38 m, these observations were assumed to be drift algae.

L.3.1.3 Fish

Fish were only observed at relatively low abundances on soft bottom and soft bottom with shell substrates at Lelu Marine (Figure L-3-6). Only sculpins (*Cottidae*), righteye flounders, and eelpouts were observed on soft bottom with shell while ronquils, pricklebacks, and unidentified fish were also seen on plain soft bottom substrates.

The snake prickleback and the northern ronquil (*Ronquilus jordani*) were the most frequently observed fish species (Attachment L-3-2, Table 2-6 to Table 2-9).

L.3.1.4 Crabs and Shrimps

Crabs were seen on all substrates and at all depths with hermit crabs (*Paguroidea*) and Dungeness crab showing the greatest total abundance across this site (Attachment L-3-2, Table 2-6 to Table 2-9). Hermit crabs dominated the few areas that had soft substrate with boulders but appeared relatively scarce on other substrates and at other depths (Figure L-3-6).

Unlike crabs, shrimp at Lelu Marine were only seen on soft bottom substrates at moderate depths (between 18 m and 27 m). They were not identified to species, because of poor visibility and limitations in video quality, but were seen at high abundance relative to other taxa on this substrate at that depth. This high relative abundance, however, is due to a large number of individuals seen on only one transect.

L.3.1.5 Other Invertebrates

Invertebrates were observed on all substrate types at all depth bins at Lelu Marine. All Phyla, except for Cnidaria, were observed at low abundance relative to other taxa (Figure L-3-6). On soft bottom substrates, Cnidaria were of medium abundance relative to other taxa seen on that substrate at all depths except for those between 18 m and 27 m where Cnidaria were at low relative abundance. The most abundant cnidarians observed were orange sea pens (Attachment L-3-2, Table 2-6 to Table 2-9).

Species of mollusc were observed at all depths and on all substrates apart from soft substrate with boulder. The most common molluscs observed were striped nudibranchs, presumably supported by the abundance of their prey, orange sea pens.

Echinoderms, including at least three species of sea star, and annelids worms were only observed at low abundances with only one individual of each echinoderm and annelid species observed throughout the site. Sponges were only observed at depths less than 27 m and were of low relative abundance.

L.3.2 Nass Bay

L.3.2.1 Substrate

Only two substrate types were identified during subtidal ROV surveys of Nass Bay, soft bottom and soft bottom with boulder although only a small proportion of the latter was found (Figure L-3-2).

L.3.2.2 Flora

Brown algae, including narrow winged kelp (*Alaria nana*) and dark brown wrack kelp (*Laminaria bongardiana*) were relatively widespread throughout the site (Figure L-3-7). Red algae were also observed at this site. Algae seen on soft substrate were likely drift algae from nearby areas with hard substrate since they cannot grow on unconsolidated soft substrates.

L.3.2.3 Fish

Only one sculpin was seen at Nass Bay.

L.3.2.4 Crabs and Shrimps

Dungeness crab was the most common species of crab seen across the site. Relative to other species observed, they were found at medium to high abundance (Figure L-3-7). Nine individuals were seen across both transects, resulting in a mean frequency of 1.5 Dungeness crabs/100 m of transect, the highest seen at any site (Attachment L-3-2, Table 2-10 and Table 2-11). A single hermit crab (*Paguroidea* spp.) and a single crab that could not be identified were also observed. No shrimp were observed at Nass Bay.

L.3.2.5 Other Invertebrates

No other invertebrates were seen in Nass Bay (Figure L-3-7).

L.3.3 Nasoga Gulf

L.3.3.1 Substrate

A range of substrates were present at Nasoga Gulf (Figure L-3-8); substrates farther from shore were dominated by soft sediments while those close to shore contained bedrock, boulder and cobble. A similar trend was seen latitudinally, with northern transect having a higher proportion of soft sediments. One transect (NG01) crossed two abandoned crab traps, noted as anthropogenic on Figure L-3-8.

L.3.3.2 Flora

Red algae dominated hard, shallow (0 m to 22 m) substrates, including bedrock, boulder and cobble. Although green algae were present on these substrates in relatively low abundance (Figure L-3-9), they dominated shallow soft substrates with shell. Other soft substrates had relatively low abundances of algae and eelgrass (only a few shoots seen) at depths less than 22 m. Several algae could not be identified; these were relatively abundant on shallow (0 m to 22 m) soft bottom substrates and at medium to low relative abundance on harder substrates at these depths. Green, red, and brown algae were seen on soft substrates below 23 m (soft bottom, soft bottom with cobble, and soft bottom with shell); however, it is likely that much of this was drift algae.

L.3.3.3 Fish

Fish diversity on Nasoga Gulf was relatively high compared to other sites surveyed with at least 18 species in 13 families observed. Most notably, a number of rockfish species (*Sebastidae*) were seen at this site, including black, blue, copper and quillback rockfish (Attachment L-3-2, Table 2-12 to Table 2-15), and several that could not be identified to species. Cumulatively, 0.39 rockfish were seen per 100 m of transect across the site. Rockfish were seen on a variety of substrates at depths between 0 m and 66 m including bedrock, boulder, cobble, and soft bottom with boulder, cobble or shell.

Relative abundance of other fish species varied by depth and substrate. Shiner perch (*Cymatogaster aggregate*) were abundant over shallow soft-bottom substrates, while in deeper areas pricklebacks and northern ronquil were abundant (observed at frequencies of 1.65 and 1.08 individuals/100 m, respectively). Flatfish, including rock sole and English sole (*Parophrys vetulus*) were also observed throughout the site on soft substrates. Eelpouts, gobies, greenlings, gunnels, poacher, pollock, and sculpins were also all observed at this site but at low relative abundances and frequencies.

L.3.3.4 Crabs and Shrimps

Galatheid crabs were the most abundant crustacean seen at Nasoga Gulf (Figure L-3-9) with mean frequency of 4.3 individuals/100 m of transect (Attachment L-3-2, Table 2-12 to Table 2-15). These species most frequently occurred at depths exceeding 45 m and on soft bottom substrates with or without shell. The majority of other crabs seen were also observed on soft substrates with or without shell including (hermit crabs: 0.85 individuals/100 m; the northern kelp crab [*Pugettia producta*]: 0.47 individuals/100 m; Dungeness crab: 0.11 individuals/100 m; longhorn decorator crabs [*Chorilia longipes*]: 0.06 individuals/100 m and grooved tanner crabs [*Chionoecetes tanneri*]: 0.03 individuals/100 m).

Shrimp were seen in waters deeper than 23 m. They were relative scarce on soft-bottom substrate, but their overall relative abundance was increased by the presence of a large group seen on deep-water bedrock. Overall, an average of 3.27 shrimp were seen per 100 m of transect.

L.3.3.5 Other Invertebrates

Invertebrate communities were highly speciose and ubiquitous at Nasoga Gulf (n = 47 species, other than crabs and shrimp), including observations of reef-forming glass sponges, (e.g., *Aphrocallistes vastus*) (Figure L-3-9). A biogenic sponge reef, dominated by *A. vastus*, was observed approximately 1 km from shore and 200 m south of the marine pipeline route, at a depth of 60 m. Nasoga Gulf is the only site at which such ecologically important structures were identified using shallow-water ROV surveys. The reef included areas of white sponge, indicating active growth (Conway et al. 2005). Other sponges were observed throughout the site, predominantly on bedrock and boulder. However, these were solitary individuals and not reef-forming.

Echinoderms were the most well-represented invertebrate phylum at Nasoga Gulf with at least 21 species observed and occurring on all substrates, especially boulder and cobbles between 22 m and 66 m and soft substrates with cobble from 0 to 66 m (Figure L-3-9). The giant sea cucumber and sunflower star were particularly common (4.38 and 3.8 individuals/100 m of transect, respectively; Attachment L-3-2, Table 2-12 to Table 2-15). Additionally, 14 species of sea star and four urchin species were also observed at this site.

Other invertebrate taxa included annelid worms, arthropods, bryozoans, cnidarians, gastropods and tunicates. Annelids were common in waters deeper than 22 m on a variety of hard substrate types. In particular, clusters of serpulid tube-worms were seen attached to the underside of large rocks and boulders, while other species, such us feather-duster worms, were seen at low relative abundance on soft bottom and soft bottom with shell. Arthropods, bryozoans, cnidarians, gastropods and tunicates were also seen but were relatively uncommon compared to other species. The abandoned crab traps supported bryozoans, echinoderms and tunicates.

L.3.4 Additional Sites

L.3.4.1 Work Channel Head

Substrate

A number of substrate types were present at the head of Work Channel, but were dominated by soft bottom types (Figure L-3-10). Substrate diversity declined with increasing depth from eight substrate types in the shallows, including a mix of hard and soft substrates, to only soft bottom with or without shell at depth.

Flora

Brown algae dominated all substrates in the shallows (< 26 m; Figure L-3-11), especially on bedrock, cobble and soft substrate with cobble. Species observed include a number of kelps, such as fringed sea colander kelp (*Agarum fimbriatum*), sieve kelp (*Agarum clathratum*), ribbon kelp (*Alaria marginata*), and split kelp (*Saccharina groenlandica*) as well as rockweeds (*Fucus* spp.). Red algae were scarce relative to other taxa especially on shallow bedrock, cobble and soft substrates, though they became more dominant on soft substrates with boulder between 14 m and 26 m. On hard substrates, most of the red algae observed were crustose coralline algae (*Corallinales* spp.) but frilly red ribbon (*Palmaria callophylloides*) and narrow iodine seaweed (*Grateloupia americana*) were also observed. Green algae were also present in shallow waters but could not be identified beyond phylum due to the quality of video footage. Finally, eelgrass was seen at several shallow locations on soft substrates with or without shell. These beds were patchy, being scarce in some areas and abundant in others.

Fish

At least 17 fish species from eight families were identified at the head of Work Channel, of which the most frequently seen was the rock sole (mean frequency: 8.6 individuals/ 100 m; Attachment L3.2, Table 2-16 to Table 2-19). Five other species of righteye flounders were also observed at this site but at much lower frequencies. Though often seen on soft-substrate types across a range of depths, flounders were only dominant over soft-bottom with cobble in shallow waters (Figure L-3-11). Snake pricklebacks were also seen frequently (7.5 individuals/100 m across the site) but only comprised a major component for communities on soft substrates with cobble at depths below 40 m. Several rockfish species were observed, including copper and quillback. In particular, high aggregations of rockfish were seen at the edges of the bay (transects WH02 and WH15: 12.2 and 10 fish/100 m, respectively; Figure L-3-10; Attachment L-3-2, Table 2-16 and Table 2-17). Eelpouts, greenlings, poachers, ronquils, and sculpins were also occasionally seen at this site.

Crabs and Shrimps

Crabs and shrimp were rare at Work Channel head. Galatheid and Dungeness crabs were the species most often seen although less than five individuals of each were observed and only a single shrimp was observed throughout the site.

Other Invertebrates

Numerous invertebrates other than crabs and shrimp were also seen at Work Channel head. Echinoderms were found at medium to high abundance relative to other taxa on most shallow (<13 m) substrates, especially cobble and soft substrate with cobble (Figure L-3-11), but comprised a smaller component of communities in deeper waters. The most frequently seen echinoderm was the giant sea cucumber (mean frequency:

2.6 individuals/100 m; Attachment L-3-2, Table 2-16 and Table 2-17). Additionally, eight sea star species and a single species of sea urchin were also observed. The crimson anemone (*Cribrinopsis fernaldi*) was ubiquitous and often found in dense clusters; on average, 8.9 anemones were seen per 100 m. Molluscs, including nudibranchs, mussels, scallops, and chitons were present at depths shallower than 40 m, while cnidarians and annelids, including feather duster and tube worms, comprised a relatively minor component of invertebrate communities across all depths. Finally, gastropods and sponges dominated communities on bedrock, but were scarcer elsewhere.

L.3.4.2 Central Work Channel: North Shore

Substrate

A wide range of substrate types occurred along the northern shore of central Work Channel. In contrast to most sites surveyed, this site was dominated by hard substrates including bedrock, boulder and soft substrates with boulder (Figure L-3-12). Steep walls of bedrock and boulders characterised all transects down to depths of >200 m.

Flora

Flora was largely restricted to shallow waters (0 to 52 m); any seen below this depth were considered drift algae due low light levels. Of particular note, eelgrass was dominant on gravel substrates at shallow depths in one transect (WN06), which straddled a large eelgrass bed near a freshwater outflow (Figure L-3-13). Similar beds likely occur along Work Channel in similar substrates. Brown algae formed an important part of community assemblages on cobble, mixed and soft bottom substrates (Figure L-3-13). These species included several kelp species, such as ribbon, split, and sugar-wrack kelps, while some sparse, diminutive stands of bull kelp were also seen. Fucus spp. were also common in the shallows (Attachment L-3-2, Table 2-20 to Table 2-23). Red algae were found at medium relative abundance on bedrock and boulder and mainly consisted of crustose coralline algae found in deeper waters covering rock. Turkish washcloth was also present. Green algae were not common at this site with only few Ulva spp. and some unidentified green algae seen.

Fish

Likely a consequence of the pervasive hard substrate, this site had the highest diversity of fish species of any site surveyed with at least 39 species from 13 families (Attachment L-3-2, Table 2-20 to Table 2-23). Rockfish were particularly prevalent and diverse with at least 14 species identified. Cumulatively, 3.5 rockfish were seen per 100 m of transect—the highest of any site. Quillback rockfish was the most common (mean frequency: 1.2 individuals/100 m). Rockfish were observed across all depths and substrates (Figure L-3-13). Righteye flounders were seen across all depths and on a range of substrates, but were particularly ubiquitous in shallower waters. Species observed included English, flathead, rock, sand and slender soles. The northern ronquil was also

widespread in shallow waters, but relatively uncommon throughout (Figure L-3-13). Ratfish (*Chimaeridae*) were seen on a range of substrates in waters deeper than 52 m (mean frequency: 0.37 individuals/100 m; Attachment L-3-2, Table 2-20 to Table 2-23). Other species seen include cod, eelpouts, greenlings, gobies, gunnels, poachers, sculpins, skates and surfperch.

Crabs and Shrimps

Crabs were uncommon at this site with the most abundant taxon being squat lobster (*Munida quadrispina*; mean frequency: 0.43 individuals/100 m; Attachment L-3-2: Table 2-20 to Table 2-23). Hermit crabs (*Paguroidea* spp.), a king crab and a Dungeness crab were also seen. Pandalus shrimp dominated invertebrate communities on soft bottom substrates in waters deeper than 53 m, (Figure L-3-13). Cumulatively, over 50 shrimp were seen per 100 m, and were found across a wide range of substrates.

Other Invertebrates

Echinoderms were the most speciose phylum of invertebrates seen at Work Channel North. Within this group, the sea stars were the best represented; at least 20 species were identified. Of these, the most frequently observed was the vermillion star (*Mediaster aequalis*; 3.8 individuals/100 m; Attachment L-3-2, Table 2-20 to Table 2-23). The feather star (*Florometra serratissima*) was also relatively common (1 individual/ 100 m). The giant sea cucumber was the most common invertebrate, excluding crabs and shrimp, seen (4.3 individuals/100 m). Echinoderms were found at high abundance relative to other taxa on cobble and soft bottom with shell substrates at depths shallower than 53 m and on soft bottom with shell or cobble at depths below 157 m, but were less dominant elsewhere (Figure L-3-13).

Serpulid tubeworms were the most common annelid, often seen as dense accumulations of calcareous tubes on the underside of overhanging rocks and boulders. Due to the density and ubiquity of these dense accumulations, annelids dominate the relative abundance measures on most substrates at most depths.

Several sponge and cnidarian species were seen throughout the site across most substrates and depths. Boot sponges, including the round lipped (*Staurocalyptus dowlingi*) and sharp lipped (*Rhabdocalyptus dawsoni*) boot sponge, were most common (mean: 1.7 individuals/100 m). Peach ball sponges (*Suberites montiniger*) and cloud sponges were also relatively common. Most of the cnidarian species identified were anemones with giant plumose anemones and crimson anemones being seen at the highest frequency (Attachment L-3-2, Table 2-20 to Table 2-23).

L.3.4.3 Central Work Channel: South Shore

Substrate

Substrates on the southern shore of Work Channel echoed those on the north. The site was characterised by steep rocky walls and ledges featuring bedrock, boulder, cobble and soft bottom with boulder (Figure L-3-14). Deep areas had slightly fewer substrate types than shallow waters.

Flora

Due to the wide depth range surveyed (0 – 216 m), the shallowest depth considered at this site included all taxa seen between 0 and 54 m (Figure L-3-15). Consequently, the majority of algae observed fell into this depth bin. All descriptions below are for this depth range, since any algae seen at greater depths were assumed to be drift algae.

Brown algae were ubiquitous and the most dominant algal group seen (Figure L-3-15). They were particularly prolific on gravel and soft bottom with or without cobble. Of these algae the most abundant were *Fucus* spp., *Laminaria* spp. and *Agarum* spp. while sparse bull kelp was also observed. Red and green algae were also widespread, but far less common than brown algae. Crustose coralline algae were the most common red algal species, while *Ulva* spp. were the most commonly identified green algae. Finally a small patch of eelgrass was also observed in the shallows on one transect.

Fish

As with the north shore, a wide diversity of fish was seen at this site, including at least 28 species from 11 families. Most notably, at least nine species of rockfish were observed across the site, including brown, canary, copper, quillback, rosethorn, rosy, shortspine, vermillion, and yelloweye rockfish. Cumulatively, they were seen at a frequency of 2.6 individuals/100 m (Attachment L-3-2, Table 2-24 to Table 2-27). They were found within all depth bins and on a variety of substrates, including bedrock, boulder, cobble and soft bottom with or without boulder or shell (Figure L-3-15).

Righteye flounders and sculpins were also fairly common. The flounders were seen at all depth ranges and showed wide substrate preferences in shallower waters. Species observed included Dover, English, rex, rock, and slender soles. At least four sculpin species were observed, but only in waters shallower than 108 m and on bedrock, cobble, gravel and soft bottom with shell substrates. Other fish observed at this site, but in low relative abundances and frequencies include cod, eelpouts, gobies, greenlings, poachers, ratfish, ronquils and tubesnouts.

Crabs and Shrimps

A wide variety of crab and shrimp were observed at this site. By far the most abundant were Pandalus shrimps (mean frequency: 146 individuals/100 m; Attachment L-3-2, Table 2-24 to Table 2-27). These shrimps dominated communities on soft bottom substrates either with or without boulder or cobble at depths between 55 and 108 m and on bedrock and soft bottom with boulder at depths exceeding 163 m (Figure L-3-15). One transect had a high abundance of mysid shrimp (Order Mysida) in deep waters (below 163 m). Squat lobster were seen at depths shallower than 163 m on bedrock, boulder, gravel and soft bottom substrates. Other sightings included hairy spined crab (*Acantholithodes hispidus*), a large Puget Sound king crab (*Lopholithodes mandtii*) and graceful kelp crab (*Pugettia richii*).

Other Invertebrates

This site showed a very high diversity of invertebrates with representatives from 30 families and 11 phyla. The echinoderms were the most speciose with at least 20 species of sea star, three species of urchin and two species of sea cucumber identified. Vermillion stars and giant sea cucumbers were the most common echinoderms at this site. Echinoderms were particularly prevalent in shallower waters (0 – 54 m) on various hard substrates (Figure L-3-15).

Sponges were observed throughout the site with the most notable observations being of numerous solitary cloud sponges primarily on bedrock and boulder. Cloud sponges were observed across all depths. Boot sponges (*Rossellidae* spp.), encrusting sponges, leather bag sponges (*Sycandra utriculus*), funnel sponges (*Phakelia* spp.) and vase sponges (*Polymastiidae* spp.) were also observed.

Annelid worms, including tubeworms (*Serpulidae* spp.) and feather duster worms (*Sabellidae* spp.) were observed throughout the site but were particularly dominant at depths exceeding 55 m on bedrock and boulder substrates, and soft-bottom substrates with boulder or cobble deeper than 163 m (Figure L-3-15). On hard substrates, annelids were most often present as dense mats of calcareous tubeworms. Other invertebrate taxa that were present include arthropods (primarily *Balanus* spp.), bryozoans, cnidarians (including a high frequency of giant plumose anemones), gastropods, molluscs and tunicates.

L.3.4.4 Lelu North

Substrate

Substrates in Lelu North were relatively uniform and were dominated by soft bottom and soft bottom with shell (Figure L-3-3). These soft substrates are likely due to the large volumes of sediment-laden outflow from the Skeena River (Thomson 1981). In waters shallower than 15 m, soft substrates were occasionally punctuated by boulders.

Visibility was generally poor at Lelu Island North due to the high turbidity of the water and relatively strong currents around Lelu Island.

Flora

Algae were observed on all substrate types found at this site with the greatest diversity found on shallow soft bottom substrates (Figure L-3-16). Brown algae (*Heterokontophyta*), including *Fucus* and *Agarum* spp., had a high relative abundance compared to other taxa on 'soft-bottom substrates with boulders' shallower than 15 m and soft bottom substrates deeper than 40 m, although algae in water deeper than 40 m was assumed to be drift algae. Unidentified algae were particularly abundant on boulders in shallow waters, and on soft-bottom substrates between 28 m and 39 m, where they were assumed to be drift. Few, loose, drifting eelgrass fronds were seen in the shallowest portions of the survey area.

Fish

Six families of fish were observed at this site encompassing at least nine species (Attachment L-3-2, Table 2-1 to Table 2-5). There was a relatively high abundance of fish in shallow waters that could not be identified due to poor visibility, with a medium to low abundance of these unidentified fish in waters deeper than 15 m. All other fish taxa were seen at relatively low abundance compared to other species seen at the same depth and substrate (Figure L-3-16).

Pricklebacks (*Stichaeidae*) were the most commonly seen fish in Lelu North with the only species identified being the snake prickleback (*Lumpenus sagittal*), which was observed at a mean frequency of 4.67 individuals/100 m (Attachment L-3-2, Table 2-1 to Table 2-5). Righteye flounders (*Pleuronectidae*), represented by at least four different species, were observed across all depths, with rock sole (*Lepidopsetta bilineata*) being the most commonly seen species. Ronquils (*Bathymasteridae*), eelpouts (*Zoarcidae*), gobies (*Gobiidae*), and sculpins (*Cottidae*) were also seen at this site but only in very low numbers.

Crabs and Shrimp

Six families of crabs and shrimp were found at all depths at Lelu North, all of them at low relative abundance and only on soft substrates (Figure L-3-16). The Family Cancridae is solely represented by Dungeness crab (*Metacarcinus magister*) which was observed in waters shallower than 39 m with a mean frequency of 0.57 individuals/100 m (Attachment L-3-2, Table 2-1 to Table 2-5). Shrimps, including *Pandalus* spp., were only seen in waters deeper than 28 m. Tanner crabs (*Oregoniidae*) were observed between 16 m and 39 m. Finally, squat lobsters (*Galatheidea*) were seen in waters deeper than 40 m.

Other Invertebrates

Invertebrate fauna, other than crabs and shrimp, were observed at all depths within the site and on all substrates except 'soft bottom with boulder', where no invertebrates were seen (Figure L-3-16). A total of eight phyla, represented by over 20 species, were observed at Lelu Island North.

Echinoderms were of relatively high abundance on the small amount of boulder substrate found at this site but were relatively scarce elsewhere. The most common echinoderm at this site was the sunflower star (*Pycnopodia helianthoides*) with other sea stars making up the majority of the other echinoderms seen. Sea cucumbers, including the giant sea cucumber (*Parastichopus californicus*) were also observed at this site (Attachment L-3-2, Table 2-1 to Table 2-5).

Cnidaria were present at medium to high relative abundance in shallower waters and at low relative abundance in waters deeper than 27 m. By far the most abundant Cnidarian observed was the orange sea pen (*Ptilosarcus gurneyi*) with a mean of 7.85 individuals/100 m across the site (Attachment L-3-2, Table 2-1 to Table 2-5). Other notable species observed were the giant and short plumose anemones (*Metridium farcimen* and *M. senile*, respectively).

Molluscs dominated 'soft substrates with shell' at depths of between 16 m and 27 m, but occurred at low relative abundance at other depths and substrates. The three most commonly seen molluscs were rough piddock (*Zirfaea pilsbryi*), unidentified bivalves and the striped nudibranch (*Armina californica*).

Ascidians, bryozoans, and sponges (*Porifera*) were seen at medium to low relative abundance throughout the site. Arthropods, represented solely by *Balanus* spp., dominated 'soft bottom with shell' between 28 m and 39 m, and were at low abundance on other substrates at depths exceeding 15 m (Figure L-3-16).

L.4 DISCUSSION

The two sites around Lelu Island shared much of the same characteristics, dominated by soft substrates with little floral or faunal diversity. Both Dungeness crabs and Pandalus were present in high numbers, both of which are important CRA species. These taxa were more abundant at Lelu South than Lelu North, possibly due to increased nutrient outflow from the Skeena. In spite of no Pacific salmon being observed (possibly a result of survey timing and/or visibility), this site is known to be an important route for salmon migrating to and from the Skeena River (DFO 1985).

Although both floral, faunal and substrate diversity was low in the two transects surveyed in Nass Bay, the site did display the highest frequency of Dungeness crab sightings from any site. However, this apparent abundance could be a consequence of a small sample size.

Nasoga Gulf had a diversity of substrate types with a clear pattern of harder substrates being present closer to shore and softer substrates occurring towards the center and the north of the gulf. Unique to this site was the observation of a biogenic sponge reef. These sponge reefs are an important habitat for many benthic invertebrates and fish, and are particularly sensitive to disturbance, including sedimentation (Conway et al. 2001; Jamieson and Chew 2002).

Crab and shrimp diversity and richness were low at Nasoga Gulf, but squat lobster and shrimp were relatively abundant in deeper waters and on soft substrates. Due to the range of substrates present, a diversity of fish species was observed, including several rockfish species, flounders, pricklebacks and ronquils.

Various rockfish were the only fish species of conservation concern noted through ROV surveys (Table L-3-2). The documentation of other habitat-forming species of cultural and ecological importance (Table L-3-2) will help to inform the environmental assessment and route planning processes.

Table L-3-2: Species at Risk and Habitat-Forming Species Seen at Each Site

Site	Species at Risk	Habitat-forming Species of Cultural or Ecological Importance[1]
Lelu Marine	None observed	None observed
Nass Bay	None observed	None observed
Nasoga Gulf	Quillback rockfish (*Sebastes maliger*)[2]	Boot sponge Cloud sponge (*Aphrocallistes vastus*) Eelgrass (*Zostera* spp.) Rockweed (*Fucus* spp.)
Work Channel Head	Quillback rockfish (*Sebastes maliger*)[2]	Boot sponge Eelgrass (*Zostera* spp.) Rockweed (*Fucus* spp.)
Work Channel North	Canary rockfish (*Sebastes pinniger*)[2] Darkblotched rockfish (*Sebastes crameri*)[2] Quillback rockfish (*Sebastes maliger*)[2] Yelloweye rockfish (*Sebastes ruberrimus*)[2,3]	Boot sponges Bull kelp (*Nereocystis leutkeana*) Cloud sponge (*Aphrocallistes vastus*) Eelgrass (*Zostera* spp.) Rockweed (*Fucus* spp.)

Table L-3-2: Species at Risk and Habitat-Forming Species Seen at Each Site (cont'd)

Site	Species at Risk	Habitat-forming Species of Cultural or Ecological Importance1
Work Channel South	Canary rockfish (*Sebastes pinniger*)[2] Quillback rockfish (*Sebastes maliger*)[2] Yelloweye rockfish (*Sebastes ruberrimus*)[2,3]	Boot sponges Bull kelp (*Nereocystis leutkeana*) Cloud sponge (*Aphrocallistes vastus*) Eelgrass (*Zostera* spp.) Rockweed (*Fucus* spp.)
Lelu Island North	None observed	Boot sponge Rockweed (*Fucus* spp.)

Note:

[1] Species noted here were selected to highlight those to be used as indicators in the environmental assessment (EA) of the Project and includes those habitat-forming species known to be of great cultural or ecological importance.

Sources:

[2] Status assigned by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)

[3] Status assigned under the Species at Risk Act (SARA)

L.5 REFERENCES

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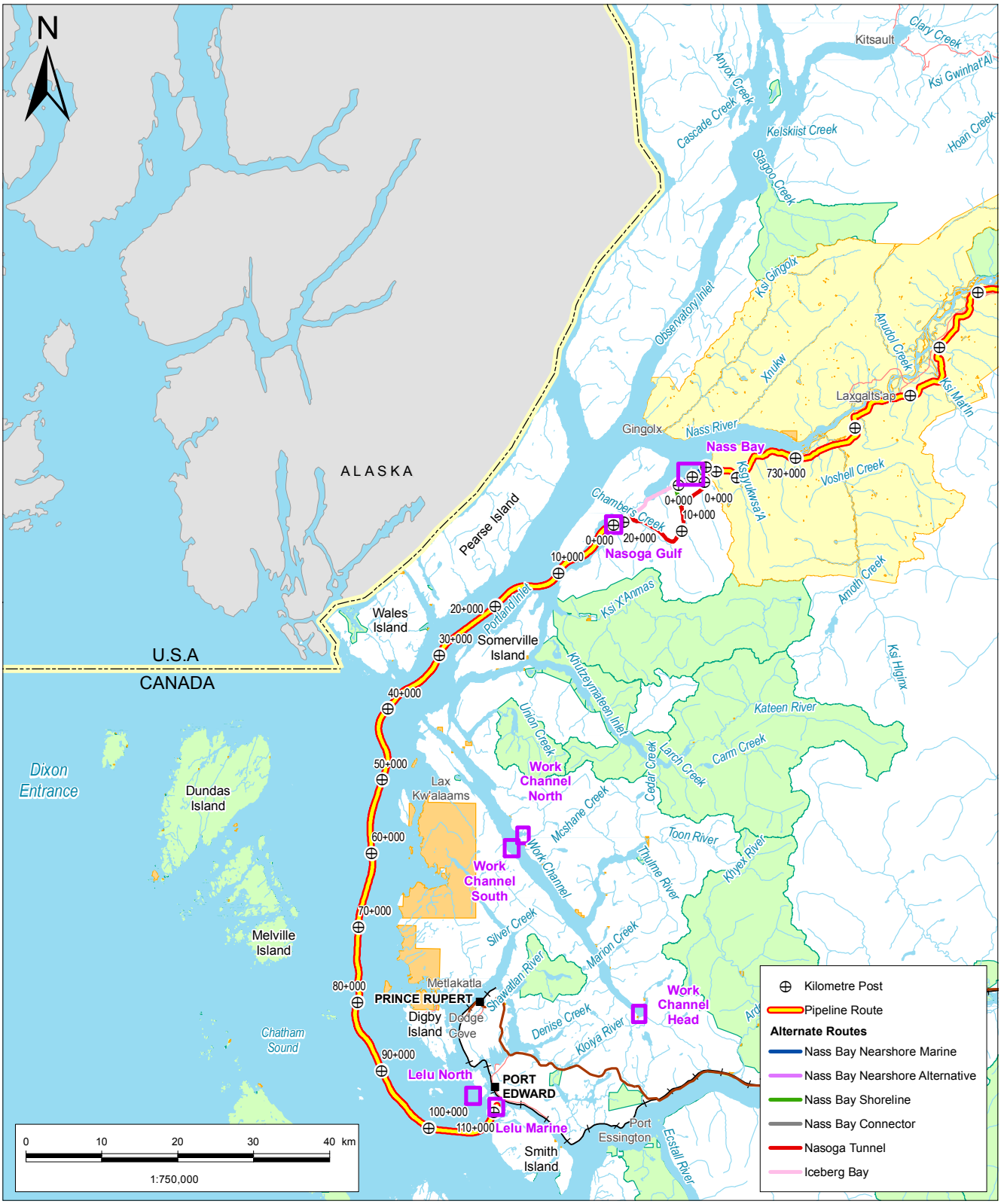

City, Town, Village, or District Municipality
Railway
Highway
Road
Watercourse
International Boundary
Indian Reserves
Nisga'a Lands
Parks, Protected Areas, Ecological Reserves, and Conservancies
Waterbody
Subtidal Survey Area

Data Sources: DataBC, Government of British Columbia (GovBC); Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; IntecSea; Focus Corporation

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Prince Rupert Gas Transmission Project

SUBTIDAL SURVEY OVERVIEW

ENVIRONMENTAL ASSESSMENT APPENDIX
MARINE RESOURCES

Prince Rupert
Gas Transmission Project

DATE: 21-MAR-14
FIGURE ID: 123110628
DRAWN BY: A. BOONE

PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: S. WISWEDEL

FIGURE NO: **L-3-1**

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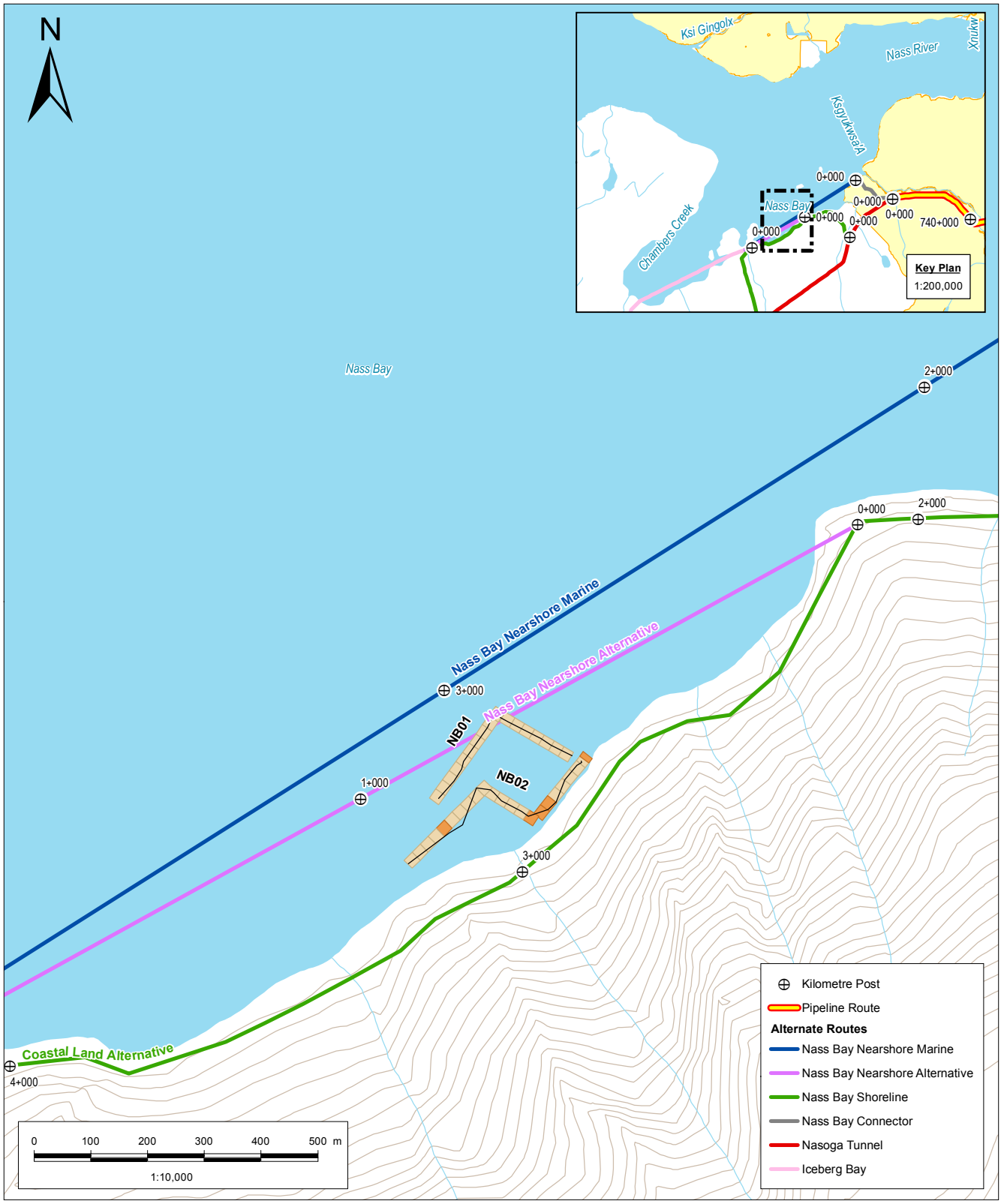

City, Town, Village, or District Municipality
Road
Railway
Contour
Watercourse
Waterbody
Remotely Operated Vehicle Transect

Substrate Class
Soft bottom
Soft bottom with boulder

Data Sources: DataBC, Government of British Columbia (GovBC); Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; IntecSea; Focus Corporation
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Prince Rupert Gas Transmission Project

NASS BAY REMOTELY OPERATED VEHICLE SURVEYS

ENVIRONMENTAL ASSESSMENT APPENDIX
MARINE RESOURCES

Prince Rupert
Gas Transmission Project

DATE: 21-MAR-14	PROJECTION: UTM - ZONE 9	FIGURE NO:
FIGURE ID: 123110628	DATUM: NAD 83	**L-3-2**
DRAWN BY: A. BOONE	CHECKED BY: S. WISWEDEL	

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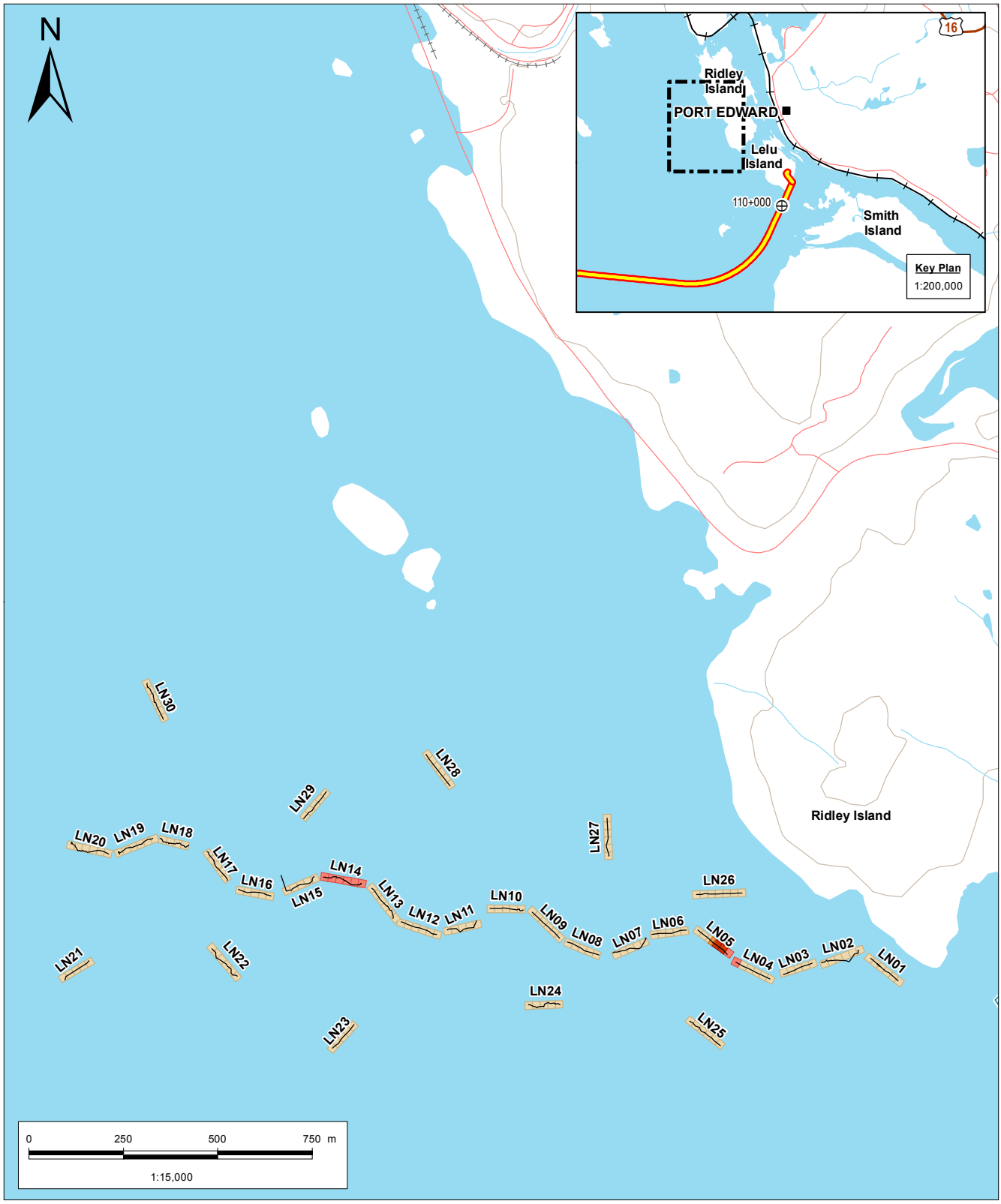

City, Town, Village, or District Municipality
Road
Railway
Contour
Watercourse
Waterbody
Remotely Operated Vehicle Transect
Kilometre Post
Pipeline Route

Substrate Class
Boulder
Soft bottom
Soft bottom with boulder
Soft bottom with shell

Prince Rupert Gas Transmission Project

LELU NORTH REMOTELY OPERATED VEHICLE SURVEYS

ENVIRONMENTAL ASSESSMENT APPENDIX
MARINE RESOURCES

Prince Rupert
Gas Transmission Project

Data Sources: DataBC, Government of British Columbia (GovBC); Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; IntecSea; Focus Corporation
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DATE: 25-MAR-14
FIGURE ID: 123110628
DRAWN BY: A. BOONE

PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: S. WISWEDEL

FIGURE NO: **L-3-3**

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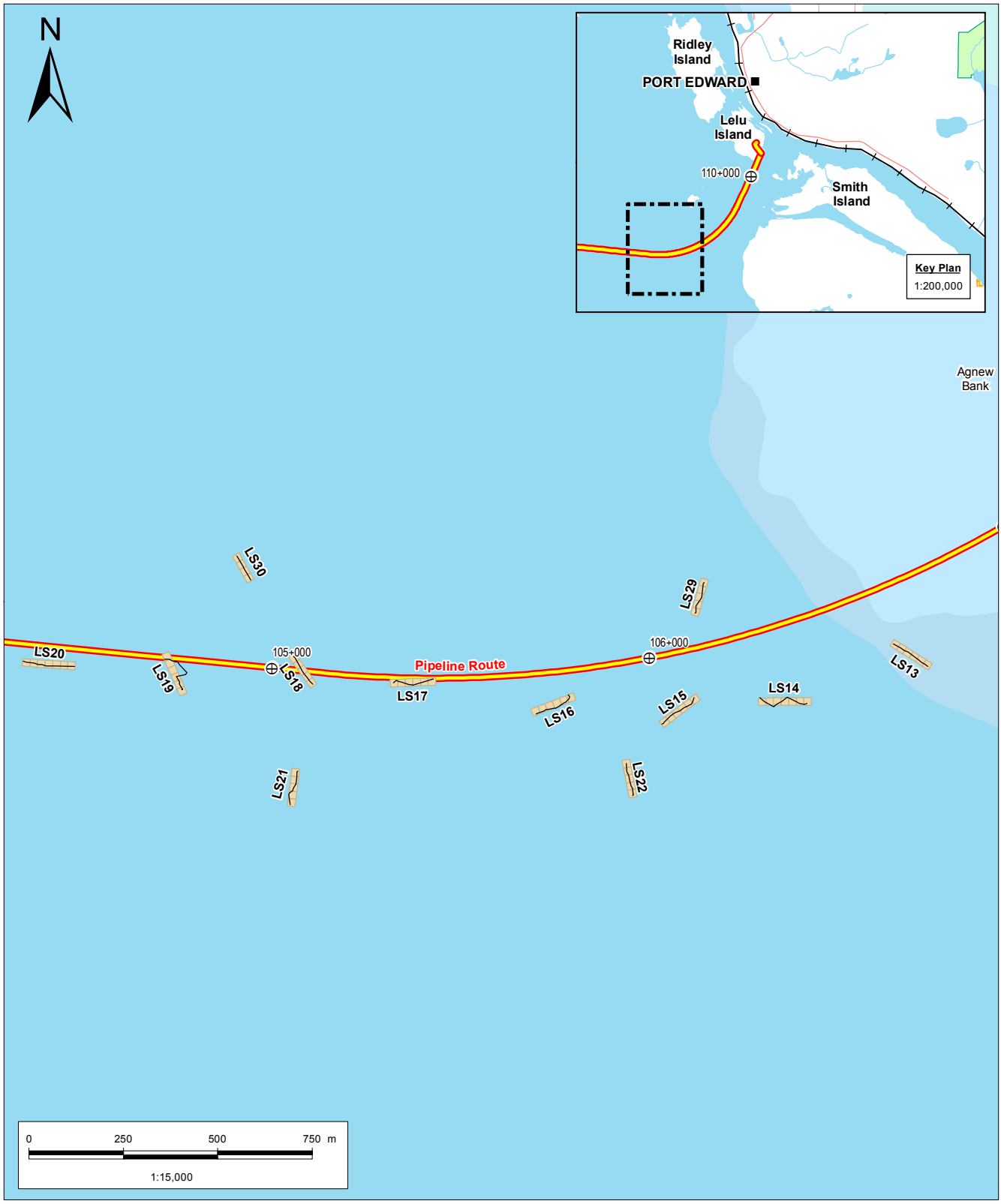

City, Town, Village, or District Municipality
Road
Railway
Contour
Watercourse
Waterbody
Agnew Bank
Flora Bank
Horsey Bank
Remotely Operated Vehicle Transect
Kilometre Post
Pipeline Route
Substrate Class
Soft bottom

Data Sources: DataBC, Government of British Columbia (GovBC); Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; IntecSea; Focus Corporation

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Prince Rupert Gas Transmission Project

LELU MARINE REMOTELY OPERATED VEHICLE SURVEYS

ENVIRONMENTAL ASSESSMENT APPENDIX
MARINE RESOURCES

Prince Rupert
Gas Transmission Project

DATE:	25-MAR-14	PROJECTION:	UTM - ZONE 9
FIGURE ID:	123110628	DATUM:	NAD 83
DRAWN BY:	A. BOONE	CHECKED BY:	S. WISWEDEL

FIGURE NO: **L-3-4**

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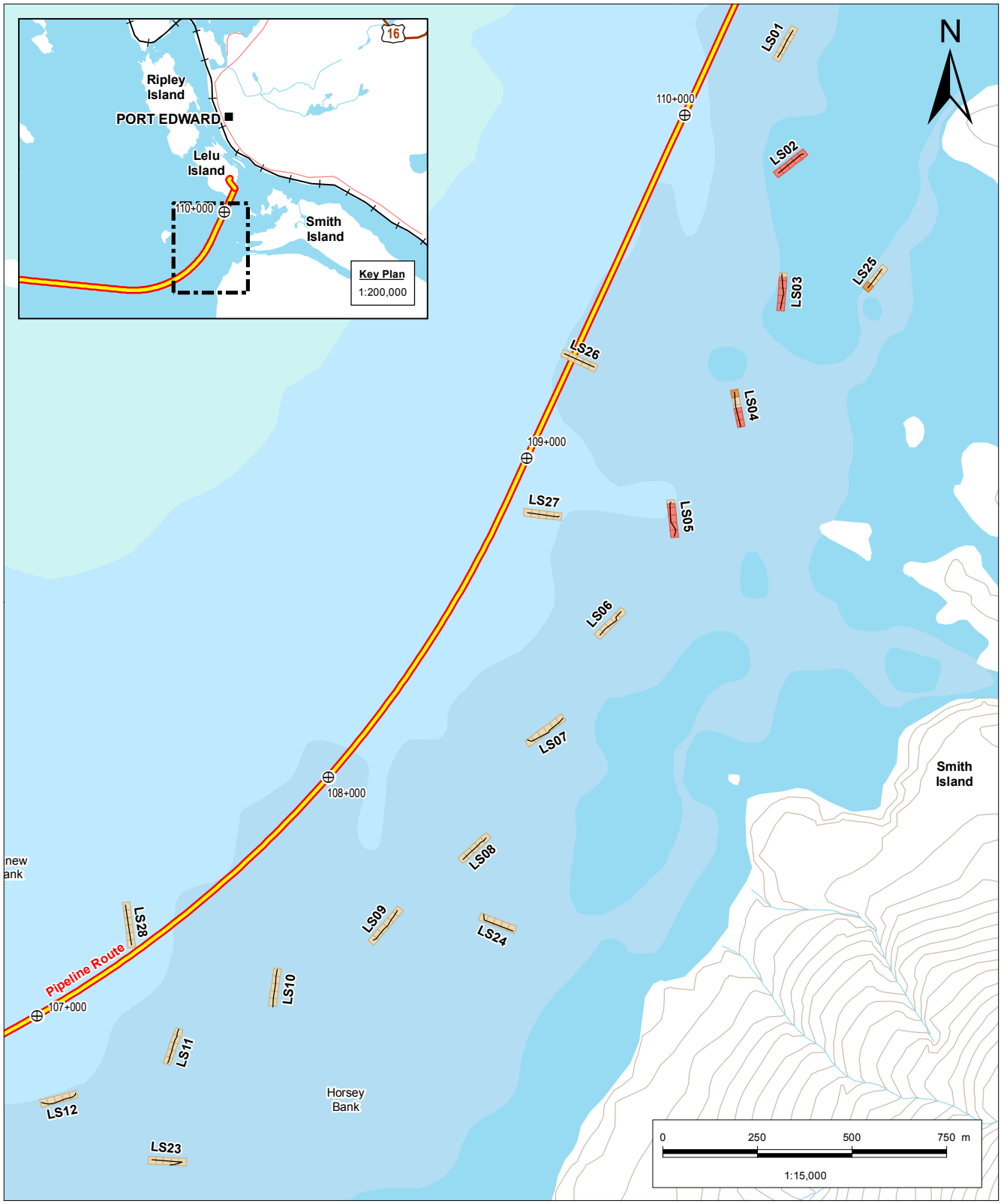

City, Town, Village, or District Municipality
Road
Railway
Contour
Watercourse
Waterbody
Agnew Bank
Flora Bank
Horsey Bank
Remotely Operated Vehicle Transect
Kilometre Post
Pipeline Route

Substrate Class

Soft bottom
Soft bottom with boulder
Soft bottom with shell

Data Sources: DataBC, Government of British Columbia (GovBC); Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; IntecSea; Focus Corporation

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Prince Rupert Gas Transmission Project

LELU MARINE REMOTELY OPERATED VEHICLE SURVEYS

ENVIRONMENTAL ASSESSMENT APPENDIX
MARINE RESOURCES

Prince Rupert
Gas Transmission Project

DATE:	25-MAR-14	PROJECTION:	UTM - ZONE 9
FIGURE ID:	123110628	DATUM:	NAD 83
DRAWN BY:	A. BOONE	CHECKED BY:	S. WISWEDEL

FIGURE NO: **L-3-5**

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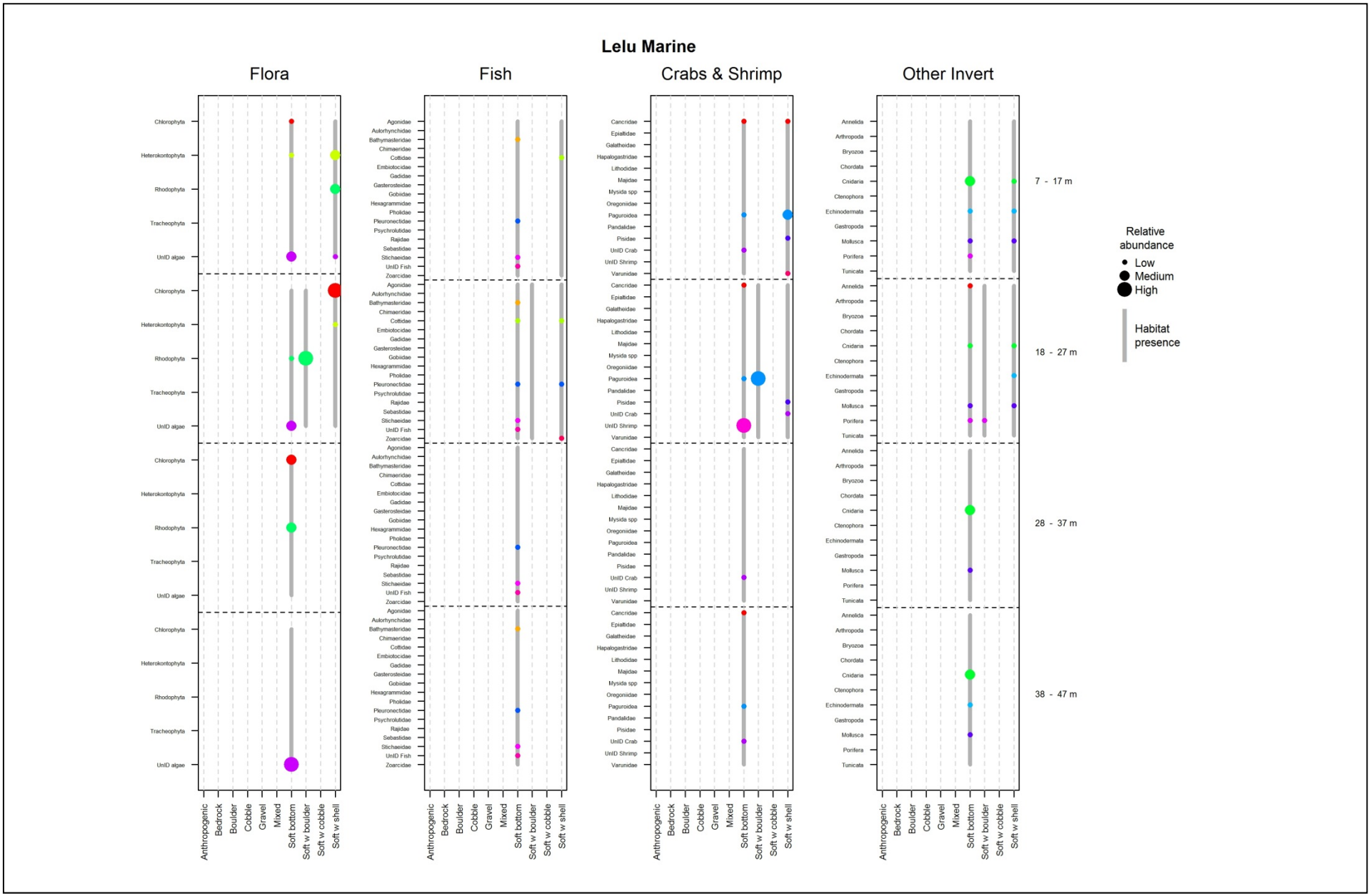


Prince Rupert Gas Transmission Project

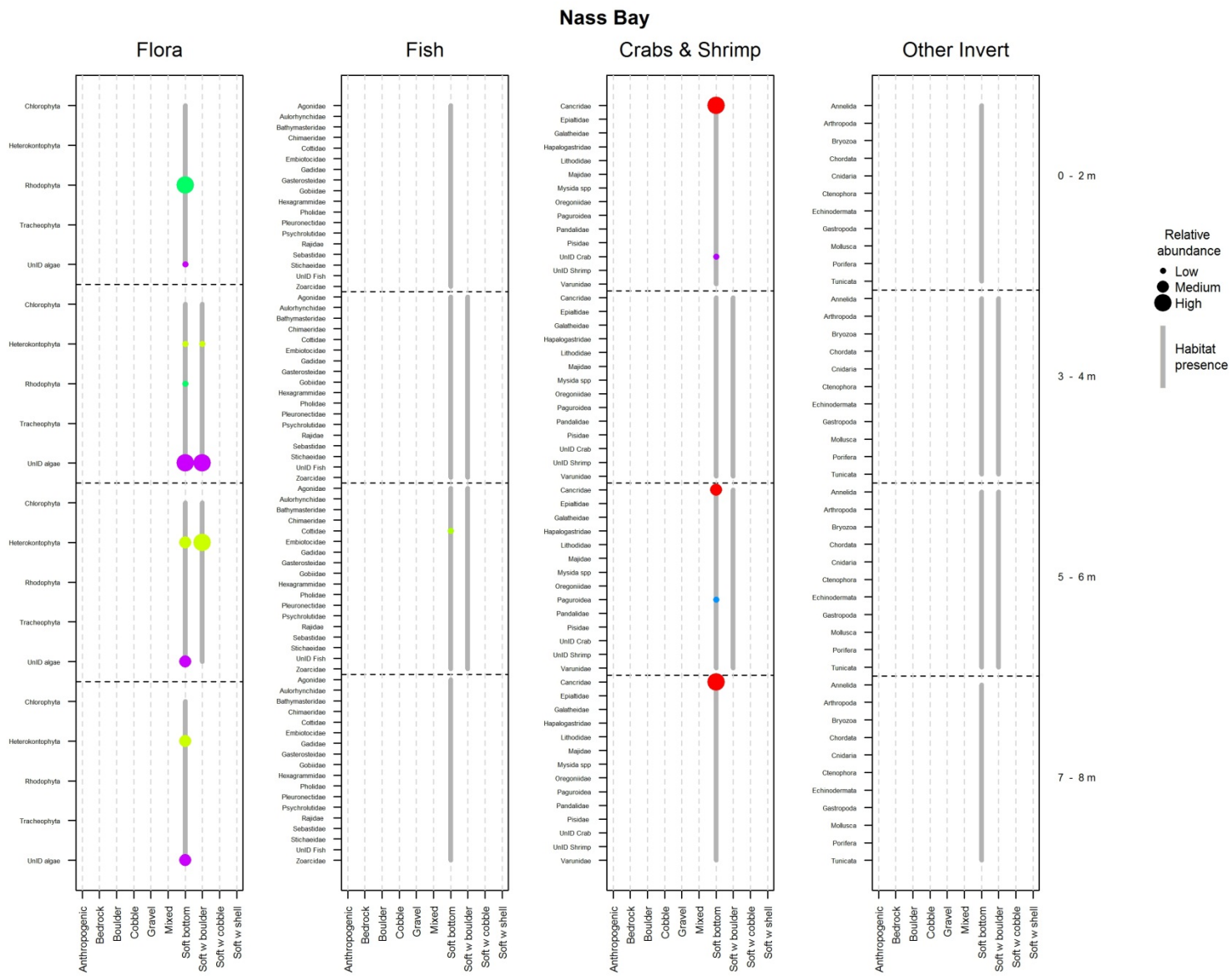
LELU MARINE: SUBSTRATE AND RELATIVE SPECIES ABUNDANCE

ENVIRONMENTAL ASSESSMENT APPENDIX – MARINE RESOURCES

Abundance of taxa relative to all taxa seen at Lelu Marine at the same depth and on the same substrate during subtidal ROV surveys. Depth bins calculated as equal quadrants between the minimum and maximum depths surveyed at this site. Gray bars denote the presence of a particular substrate type at that depth.

Prince Rupert
Gas Transmission Project

FIGURE NO:
L-3-6



Prince Rupert Gas Transmission Project

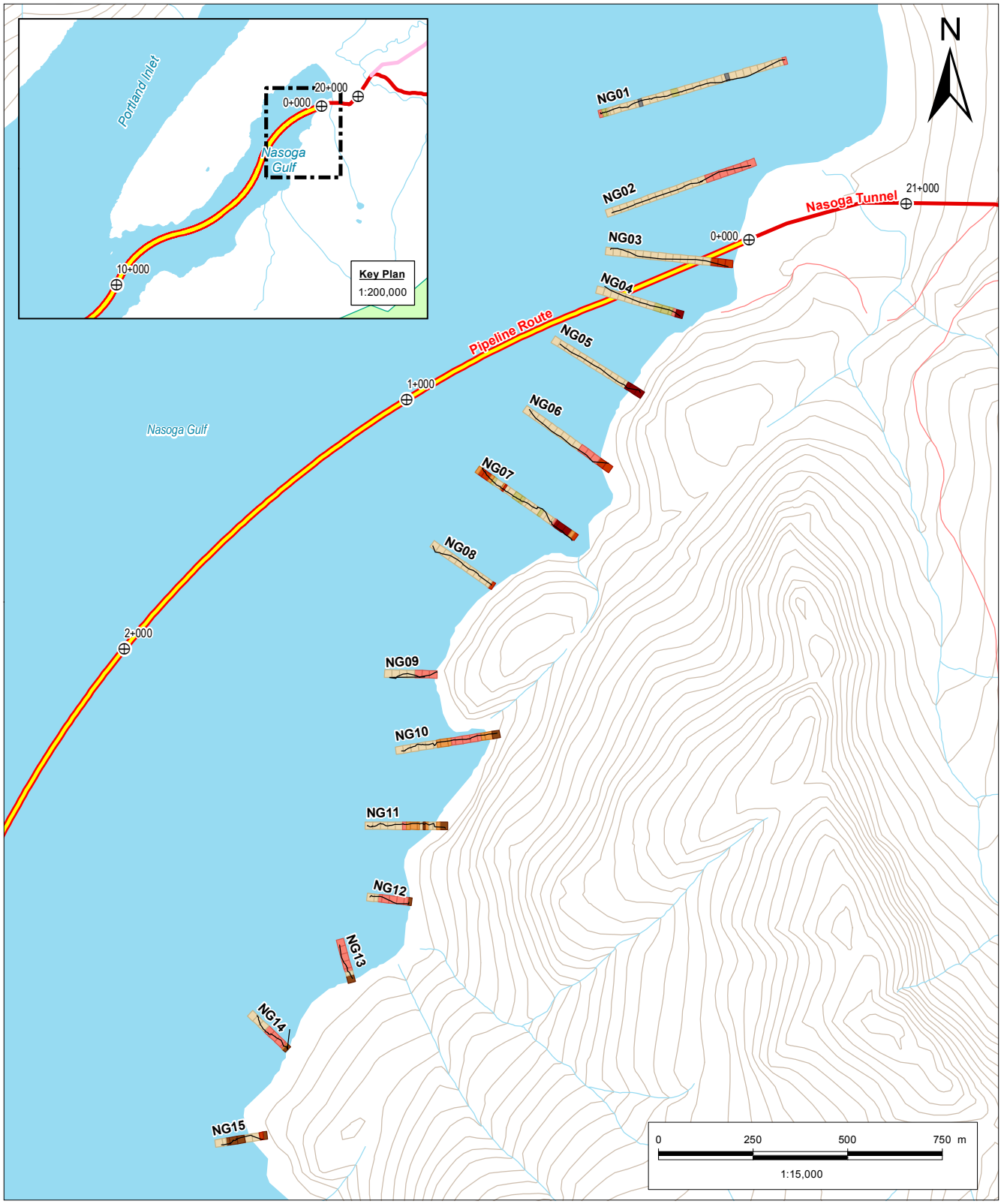
NASS BAY: SUBSTRATE AND RELATIVE SPECIES ABUNDANCE

ENVIRONMENTAL ASSESSMENT APPENDIX – MARINE RESOURCES

Abundance of taxa relative to all taxa seen at Nass Bay at the same depth and on the same substrate during subtidal ROV surveys. Depth bins calculated as equal quadrants between the minimum and maximum depths surveyed at this site. Gray bars denote the presence of a particular substrate type at that depth.

Prince Rupert
Gas Transmission Project

FIGURE NO: **L-3-7**



City, Town, Village, or District Municipality
Road
Railway
Contour
Watercourse
Waterbody
Remotely Operated Vehicle Transect
Kilometre Post
Pipeline Route
Alternate Routes
Nasoga Tunnel
Iceberg Bay
Substrate Class
Anthropogenic
Bedrock
Boulder
Cobble
Soft bottom
Soft bottom with boulder
Soft bottom with cobble
Soft bottom with shell

Data Sources: DataBC, Government of British Columbia (GovBC); Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; IntecSea; Focus Corporation

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Prince Rupert Gas Transmission Project

NASOGA GULF REMOTELY OPERATED VEHICLE SURVEYS

ENVIRONMENTAL ASSESSMENT APPENDIX
MARINE RESOURCES

Prince Rupert
Gas Transmission Project

DATE:	21-MAR-14	PROJECTION:	UTM - ZONE 9
FIGURE ID:	123110628	DATUM:	NAD 83
DRAWN BY:	A. BOONE	CHECKED BY:	S. WISWEDEL

FIGURE NO: **L-3-8**

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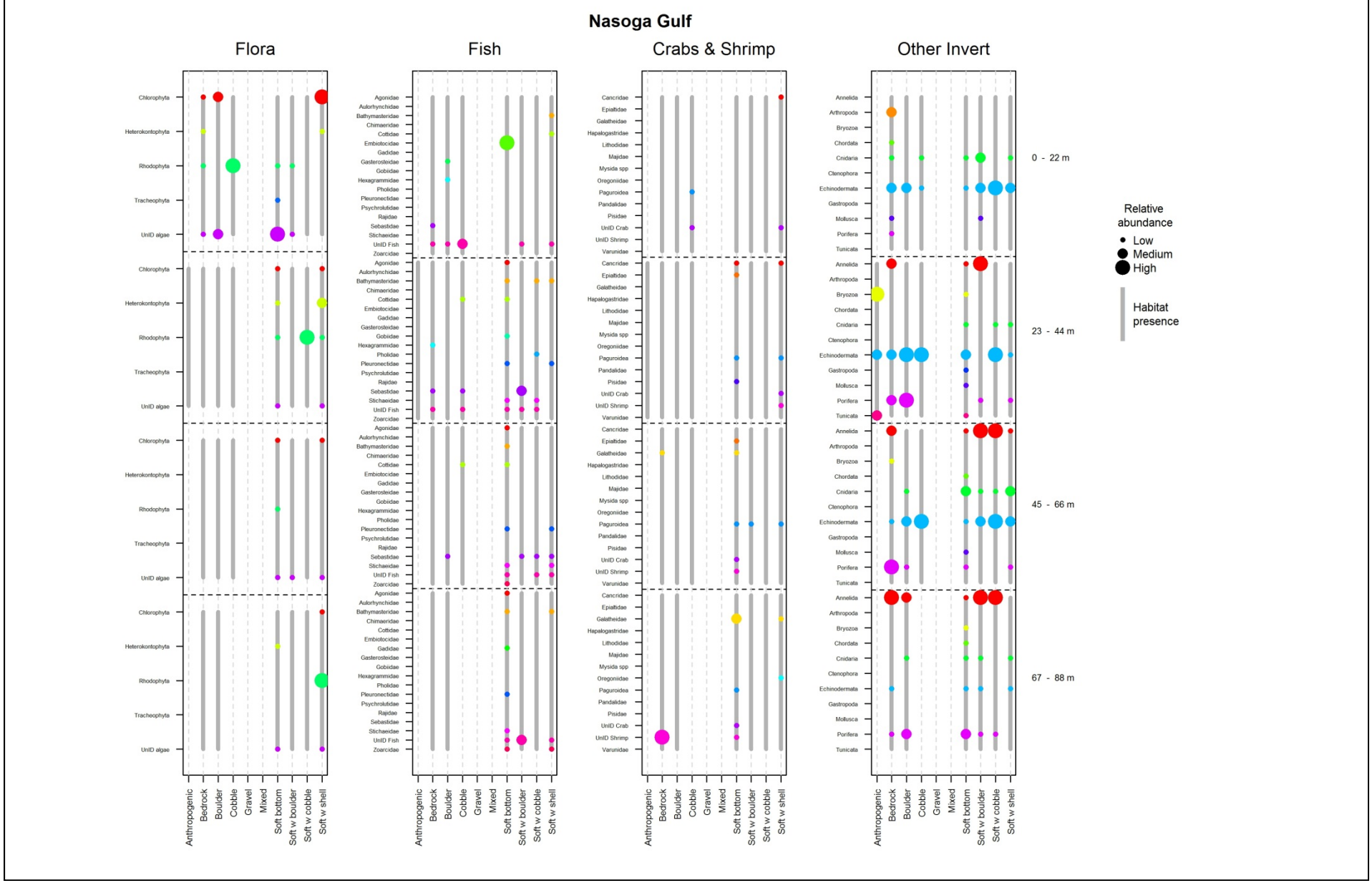


Prince Rupert Gas Transmission Project

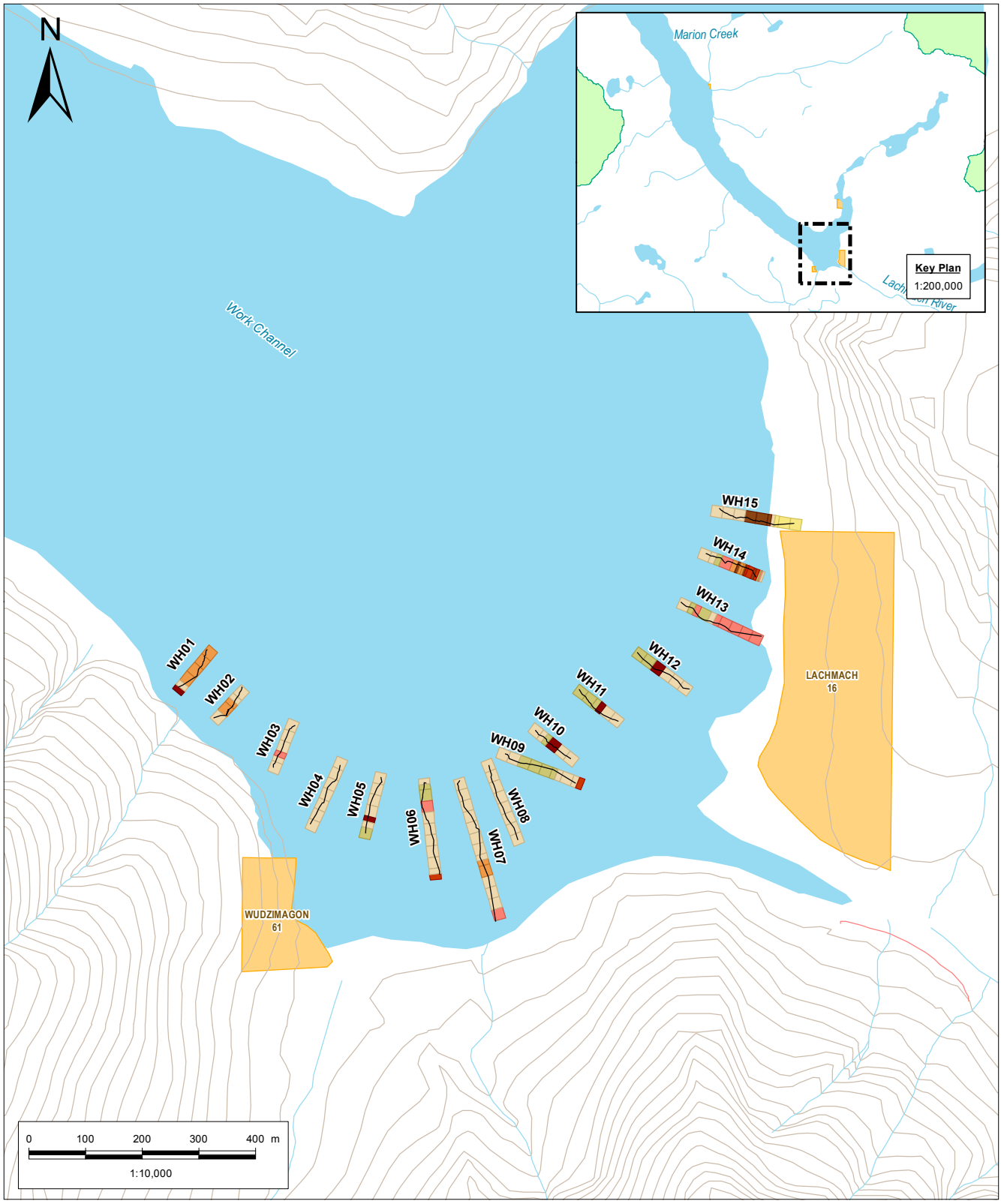
NASOGA GULF: SUBSTRATE AND RELATIVE SPECIES ABUNDANCE

ENVIRONMENTAL ASSESSMENT APPENDIX – MARINE RESOURCES

Abundance of taxa relative to all taxa seen at Nasoga Gulf at the same depth and on the same substrate during subtidal ROV surveys. Depth bins calculated as equal quadrants between the minimum and maximum depths surveyed at this site. Gray bars denote the presence of a particular substrate type at that depth.

Prince Rupert
Gas Transmission Project

FIGURE NO: **L-3-9**



City, Town, Village, or District Municipality
Road
Railway
Contour
Watercourse
Waterbody
Indian Reserves
Remotely Operated Vehicle Transect

Substrate Class

Bedrock
Boulder
Cobble
Mixed bottom
Soft bottom
Soft bottom with boulder
Soft bottom with cobble
Soft bottom with shell

Data Sources: DataBC, Government of British Columbia (GovBC); Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; IntecSea; Focus Corporation

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Prince Rupert Gas Transmission Project

WORK CHANNEL HEAD REMOTELY OPERATED VEHICLE SURVEYS

ENVIRONMENTAL ASSESSMENT APPENDIX
MARINE RESOURCES

Prince Rupert
Gas Transmission Project

DATE: 21-MAR-14
FIGURE ID: 123110628
DRAWN BY: A. BOONE

PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: S. WISWEDEL

FIGURE NO:
L-3-10

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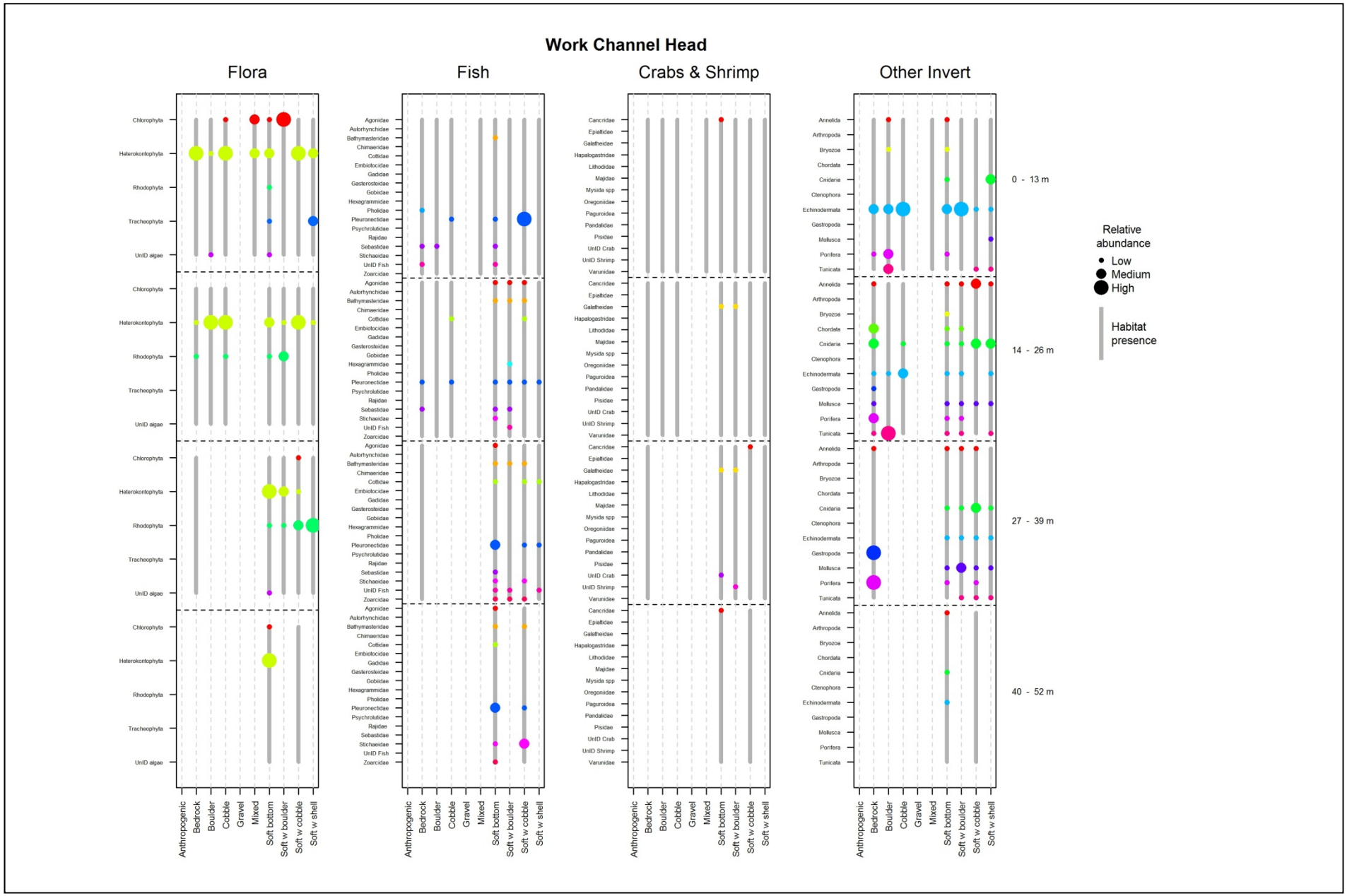


Prince Rupert Gas Transmission Project

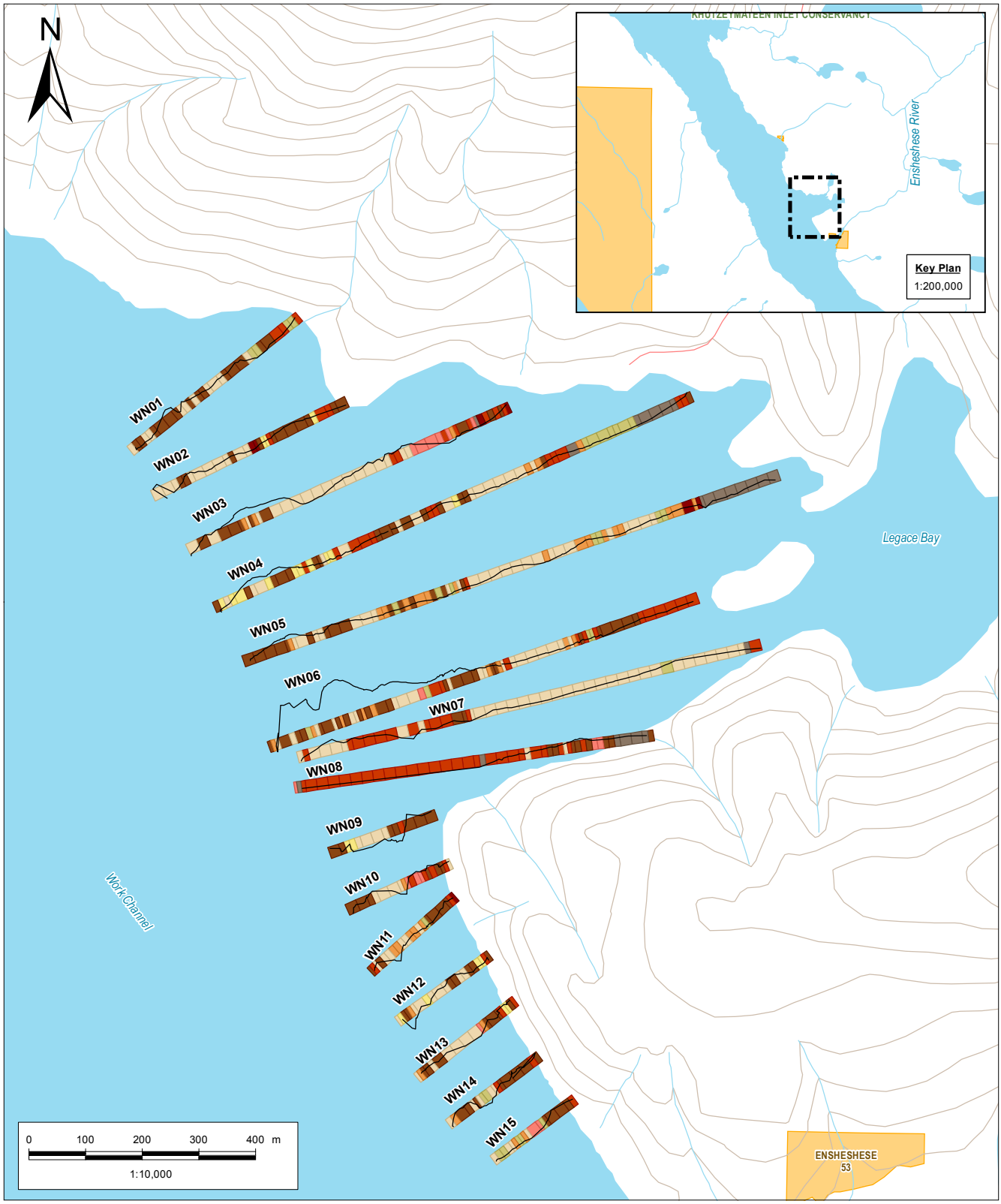
WORK CHANNEL HEAD: SUBSTRATE AND RELATIVE SPECIES ABUNDANCE

ENVIRONMENTAL ASSESSMENT APPENDIX – MARINE RESOURCES

Abundance of taxa relative to all taxa seen at Work Channel head at the same depth and on the same substrate during subtidal ROV surveys. Depth bins calculated as equal quadrants between the minimum and maximum depths surveyed at this site. Gray bars denote the presence of a particular substrate type at that depth

Prince Rupert
Gas Transmission Project

FIGURE NO:
L-3-11



City, Town, Village, or District Municipality
Road
Railway
Contour
Watercourse
Waterbody
Indian Reserves
Remotely Operated Vehicle Transect

Substrate Class

Bedrock
Boulder
Cobble
Gravel
Mixed bottom
Soft bottom
Soft bottom with boulder
Soft bottom with cobble
Soft bottom with shell

Prince Rupert Gas Transmission Project

CENTRAL WORK CHANNEL: NORTH SHORE REMOTELY OPERATED VEHICLE SURVEYS

ENVIRONMENTAL ASSESSMENT APPENDIX
MARINE RESOURCES

Prince Rupert
Gas Transmission Project

Data Sources: DataBC, Government of British Columbia (GovBC); Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; IntecSea; Focus Corporation

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DATE: 21-MAR-14
FIGURE ID: 123110628
DRAWN BY: A. BOONE

PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: S. WISWEDEL

FIGURE NO: **L-3-12**

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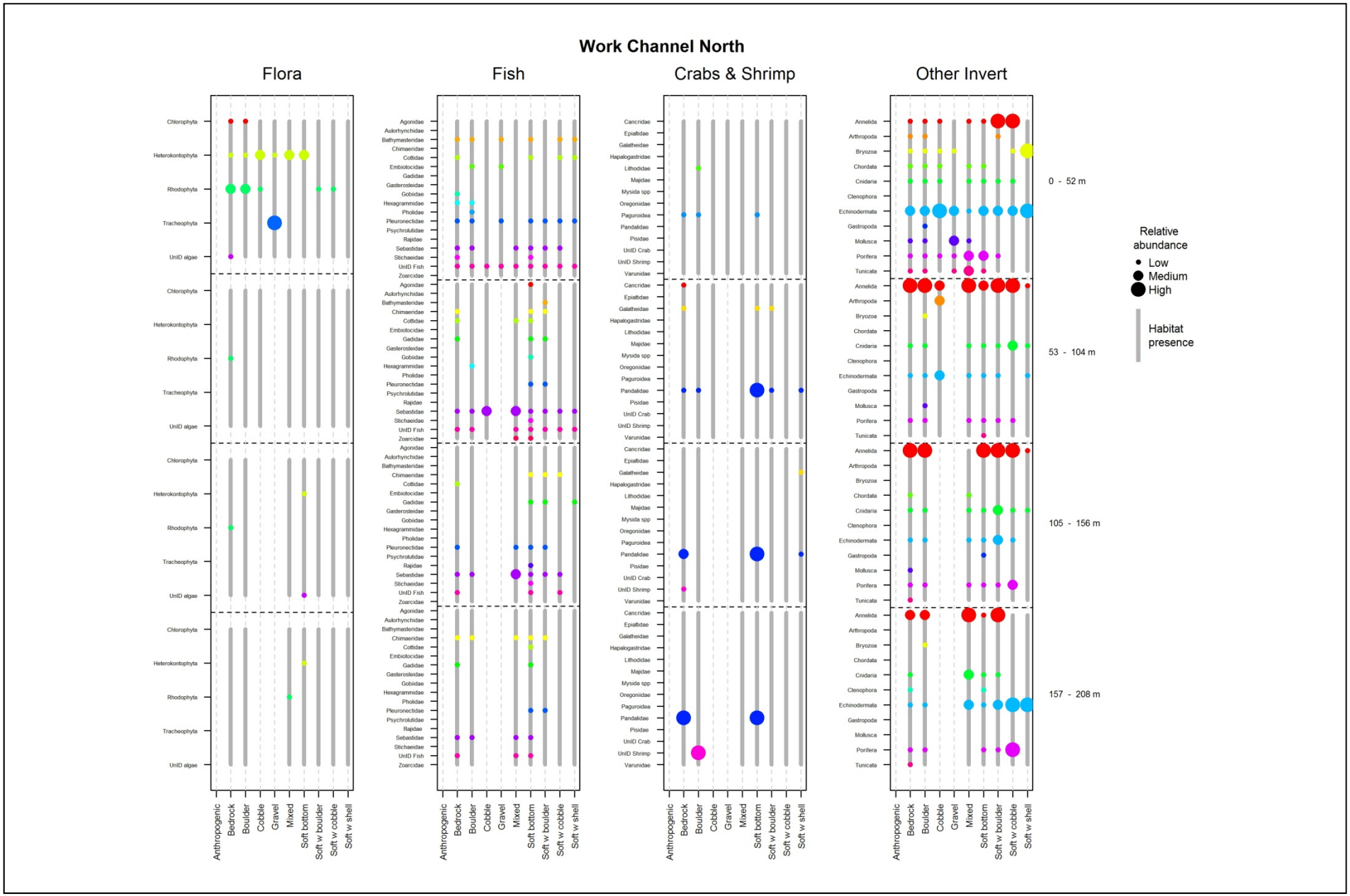

Prince Rupert Gas Transmission Project

CENTRAL WORK CHANNEL: NORTH SHORE - SUBSTRATE AND RELATIVE SPECIES ABUNDANCE

ENVIRONMENTAL ASSESSMENT APPENDIX – MARINE RESOURCES

Abundance of taxa relative to all taxa seen at Work Channel north at the same depth and on the same substrate during subtidal ROV surveys. Depth bins calculated as equal quadrants between the minimum and maximum depths surveyed at this site. Gray bars denote the presence of a particular substrate type at that depth.

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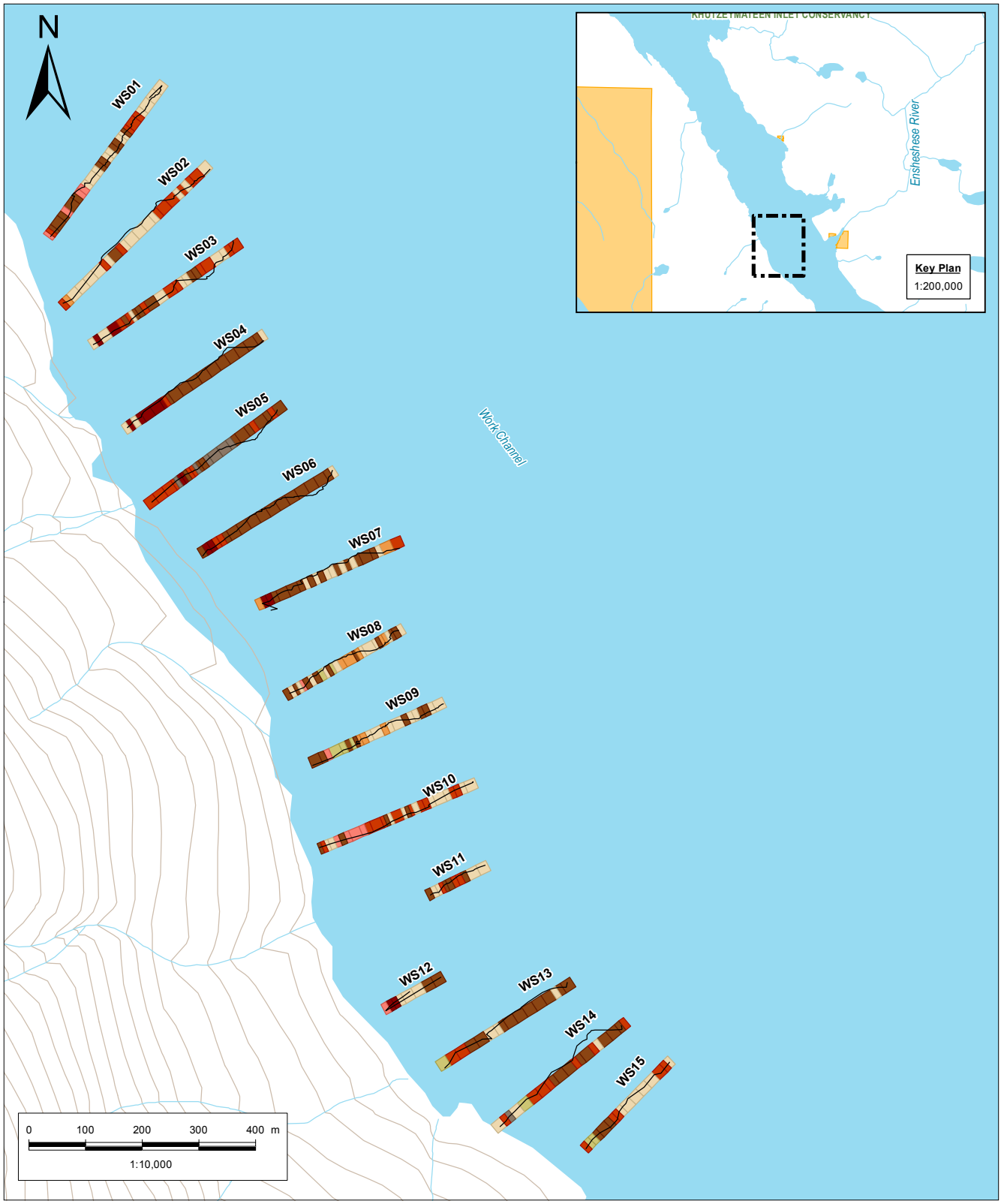
Gas Transmission Project

FIGURE N

L-3-13



City, Town, Village, or District Municipality
Road
Railway
Watercourse
Contour
Waterbody
Remotely Operated Vehicle Transect

Substrate Class

Bedrock
Boulder
Cobble
Gravel
Soft bottom
Soft bottom with boulder
Soft bottom with cobble
Soft bottom with shell

Prince Rupert Gas Transmission Project

CENTRAL WORK CHANNEL: SOUTH SHORE REMOTELY OPERATED VEHICLE SURVEYS

ENVIRONMENTAL ASSESSMENT APPENDIX
MARINE RESOURCES

Prince Rupert
Gas Transmission Project

Data Sources: DataBC, Government of British Columbia (GovBC); Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; IntecSea; Focus Corporation
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DATE: 21-MAR-14
FIGURE ID: 123110628
DRAWN BY: A. BOONE

PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: S. WISWEDEL

FIGURE NO: **L-3-14**

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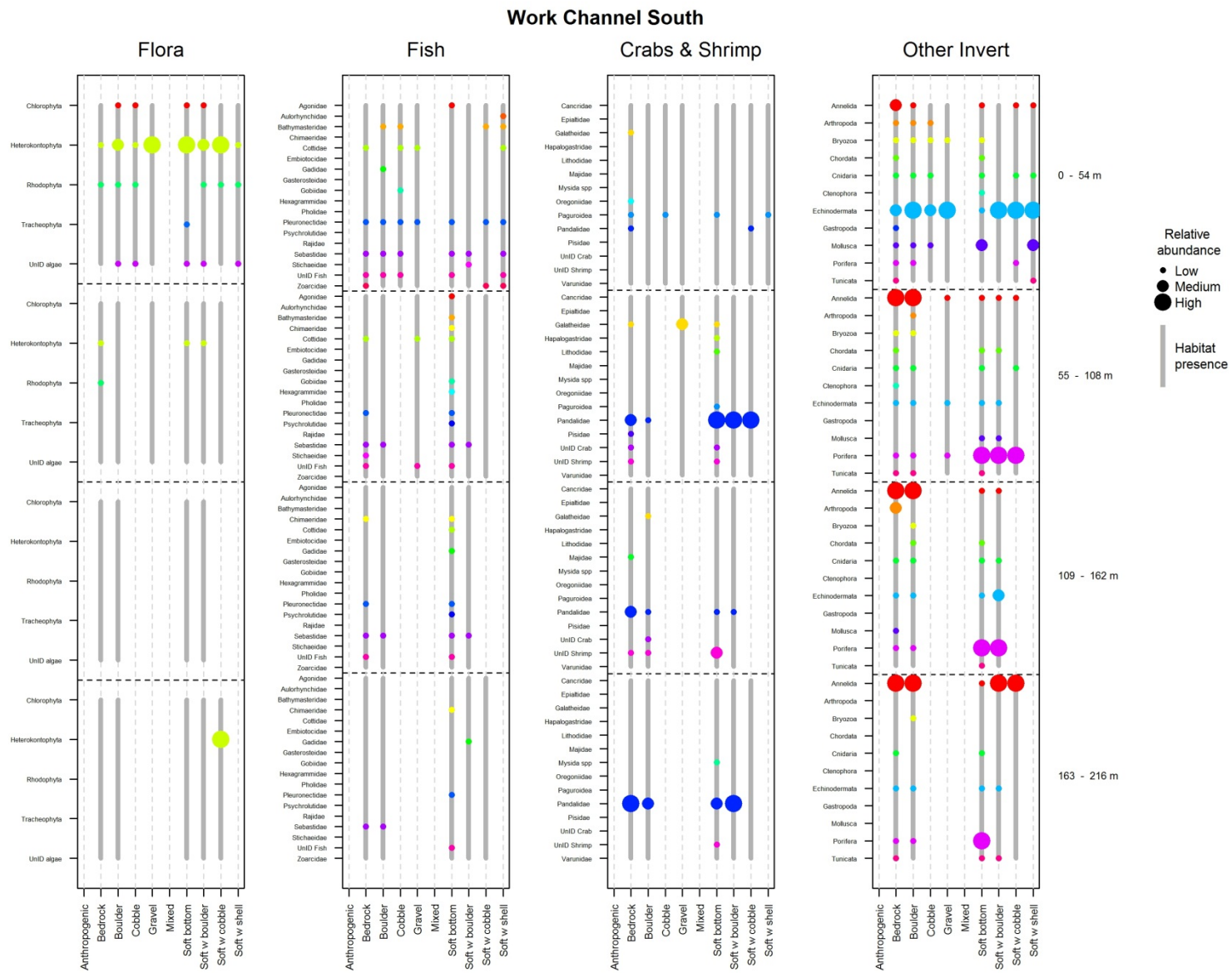

Prince Rupert Gas Transmission Project

CENTRAL WORK CHANNEL: SOUTH SHORE - SUBSTRATE AND RELATIVE SPECIES ABUNDANCE

ENVIRONMENTAL ASSESSMENT APPENDIX – MARINE RESOURCES

Abundance of taxa relative to all taxa seen at Work Channel south at the same depth and on the same substrate during subtidal ROV surveys. Depth bins calculated as equal quadrants between the minimum and maximum depths surveyed at this site. Gray bars denote the presence of a particular substrate type at that depth.

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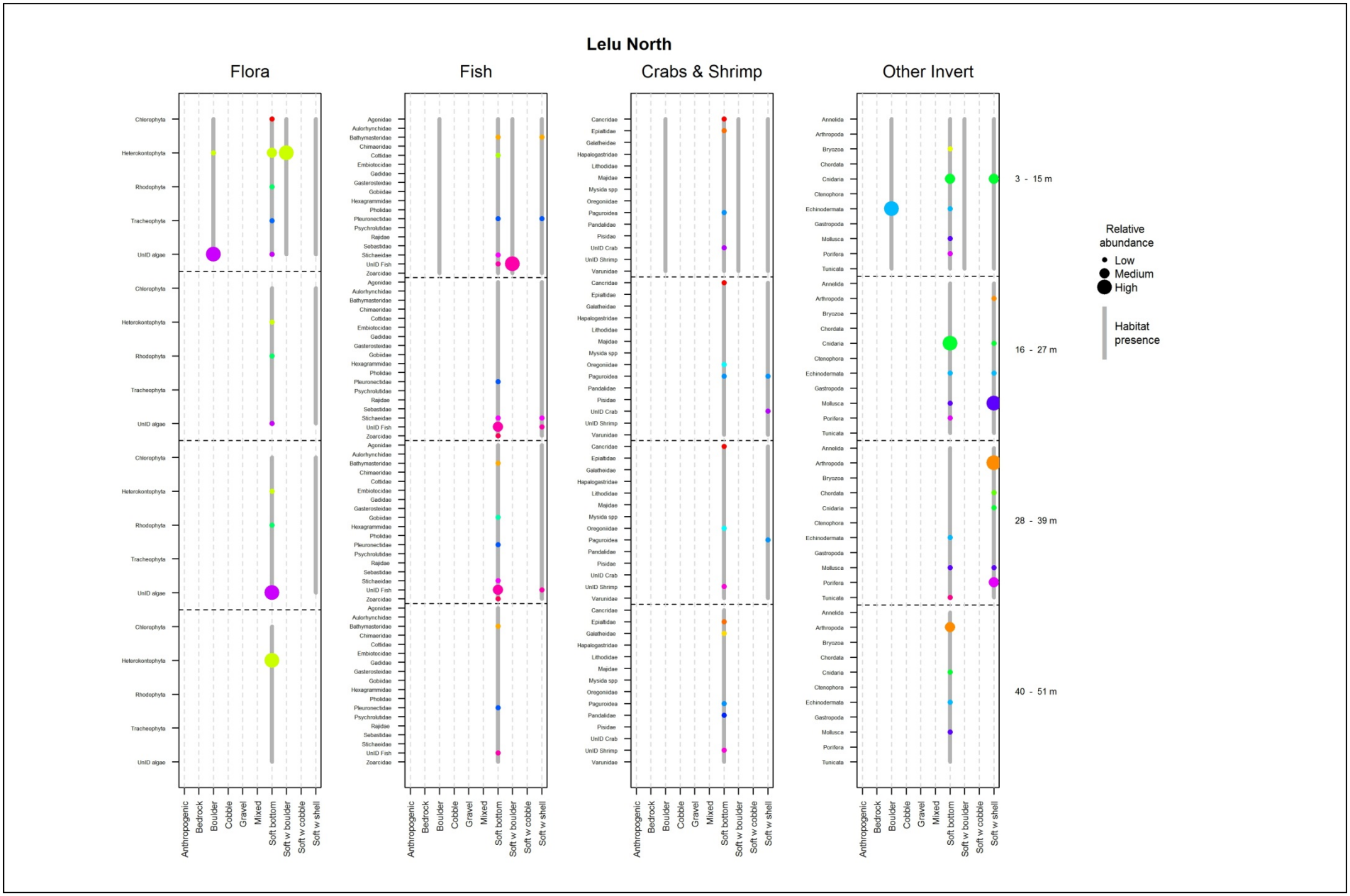
FIGURE NO:
L-3-15



Prince Rupert Gas Transmission Project

LELU NORTH: SUBSTRATE AND RELATIVE SPECIES ABUNDANCE

ENVIRONMENTAL ASSESSMENT APPENDIX – MARINE RESOURCES

Abundance of taxa relative to all taxa seen at Lelu North at the same depth and on the same substrate during subtidal ROV surveys. Depth bins calculated as equal quadrants between the minimum and maximum depths surveyed at this site. Gray bars denote the presence of a particular substrate type at that depth.

Prince Rupert
Gas Transmission Project

FIGURE NO:
L-3-16

Application for an Environmental Assessment Certificate

Attachment L-3-1
Location and Length of Subtidal ROV Transects

Table 1-1: Location and Length of Subtidal ROV Transects

Transect[a]	Start Point		End Point		Transect Depth (m)		Transect Length (m)
	Longitude	Latitude	Longitude	Latitude	Max	Min	
LN01	-130.3110	54.2027	-130.3099	54.2022	10	7	94
LN02	-130.3130	54.2026	-130.3115	54.2029	17	7	102
LN03	-130.3145	54.2023	-130.3134	54.2026	16	11	81
LN04	-130.3165	54.2026	-130.3151	54.2022	11	10	100
LN05	-130.3180	54.2033	-130.3168	54.2028	11	7	101
LN06	-130.3199	54.2032	-130.3185	54.2033	9	7	92
LN07	-130.3214	54.2028	-130.3202	54.2031	10	8	94
LN08	-130.3233	54.2030	-130.3220	54.2027	9	7	91
LN09	-130.3248	54.2037	-130.3236	54.2031	11	7	100
LN10	-130.3265	54.2038	-130.3251	54.2037	11	8	88
LN11	-130.3282	54.2032	-130.3270	54.2035	48	11	89
LN12	-130.3301	54.2034	-130.3286	54.2031	51	41	100
LN13	-130.3313	54.2042	-130.3304	54.2035	41	26	99
LN14	-130.3332	54.2044	-130.3317	54.2043	30	18	102
LN15	-130.3350	54.2045	-130.3336	54.2044	20	17	83
LN16	-130.3367	54.2041	-130.3353	54.2040	22	19	88
LN17	-130.3380	54.2050	-130.3371	54.2043	23	21	93
LN18	-130.3399	54.2053	-130.3387	54.2051	34	22	77
LN19	-130.3415	54.2049	-130.3402	54.2053	37	32	97
LN20	-130.3435	54.2051	-130.3420	54.2049	39	35	102
LN21	-130.3427	54.2023	-130.3436	54.2019	30	22	81
LN22	-130.3377	54.2027	-130.3366	54.2020	21	17	99
LN23	-130.3319	54.2009	-130.3327	54.2004	11	7	62
LN24	-130.3248	54.2015	-130.3236	54.2015	29	3	88
LN25	-130.3183	54.2012	-130.3170	54.2006	8	4	104
LN26	-130.3181	54.2042	-130.3163	54.2042	16	7	121
LN27	-130.3217	54.2051	-130.3218	54.2060	8	7	100
LN28	-130.3282	54.2067	-130.3292	54.2074	10	9	105
LN29	-130.3341	54.2058	-130.3332	54.2065	15	12	93
LN30	-130.3398	54.2081	-130.3405	54.2090	29	23	105
LS01	-130.2807	54.1881	-130.2801	54.1887	12	11	82
LS02	-130.2806	54.1853	-130.2796	54.1858	19	16	83
LS03	-130.2804	54.1821	-130.2804	54.1829	15	15	94
LS04	-130.2820	54.1793	-130.2823	54.1801	22	17	93

Table 1-1: Location and Length of Subtidal ROV Transects (cont'd)

Transect[a]	Start Point		End Point		Transect Depth (m)		Transect Length (m)
	Longitude	Latitude	Longitude	Latitude	Max	Min	
LS05	-130.2846	54.1766	-130.2847	54.1775	18	17	91
LS06	-130.2875	54.1743	-130.2867	54.1748	20	19	84
LS07	-130.2904	54.1718	-130.2890	54.1723	11	10	110
LS08	-130.2929	54.1689	-130.2920	54.1694	12	10	83
LS09	-130.2965	54.1669	-130.2955	54.1676	20	15	102
LS10	-130.3005	54.1653	-130.3003	54.1662	13	7	99
LS11	-130.3047	54.1639	-130.3043	54.1647	13	7	95
LS12	-130.3098	54.1629	-130.3084	54.1632	14	12	93
LS13	-130.3144	54.1622	-130.3130	54.1616	14	8	109
LS14	-130.3197	54.1608	-130.3178	54.1607	26	23	126
LS15	-130.3237	54.1601	-130.3224	54.1608	36	30	110
LS16	-130.3288	54.1603	-130.3275	54.1608	38	35	99
LS17	-130.3346	54.1610	-130.3330	54.1611	25	21	106
LS18	-130.3387	54.1616	-130.3379	54.1609	27	22	92
LS19	-130.3439	54.1615	-130.3431	54.1608	40	31	95
LS20	-130.3496	54.1614	-130.3475	54.1613	47	41	136
LS21	-130.3384	54.1589	-130.3387	54.1581	43	40	91
LS22	-130.3251	54.1592	-130.3248	54.1584	41	40	87
LS23	-130.3053	54.1616	-130.3045	54.1615	12	9	80
LS24	-130.2920	54.1676	-130.2908	54.1672	16	14	89
LS25	-130.2769	54.1826	-130.2764	54.1831	11	10	62
LS26	-130.2880	54.1806	-130.2892	54.1809	15	12	86
LS27	-130.2893	54.1771	-130.2905	54.1772	20	17	83
LS28	-130.3062	54.1667	-130.3065	54.1677	18	14	107
LS29	-130.3224	54.1628	-130.3221	54.1635	22	19	85
LS30	-130.3404	54.1634	-130.3410	54.1640	18	15	74
NB01	-129.9120	54.9382	-129.9084	54.9389	5	0	246
NB02	-129.9128	54.9371	-129.9081	54.9388	7	0	353
NG01	-130.0672	54.8874	-130.0596	54.8887	43	0	508
NG02	-130.0666	54.8850	-130.0609	54.8862	47	3	390
NG03	-130.0667	54.8841	-130.0618	54.8838	49	0	318
NG04	-130.0669	54.8832	-130.0638	54.8826	50	18	217
NG05	-130.0687	54.8819	-130.0654	54.8807	56	2	254
NG06	-130.0699	54.8803	-130.0666	54.8790	61	11	258

Table 1-1: Location and Length of Subtidal ROV Transects (cont'd)

Transecta	Start Point		End Point		Transect Depth (m)		Transect Length (m)
	Longitude	Latitude	Longitude	Latitude	Max	Min	
NG07	-130.0718	54.8789	-130.0681	54.8772	64	1	310
NG08	-130.0738	54.8770	-130.0714	54.8761	69	0	200
NG09	-130.0741	54.8739	-130.0736	54.8740	76	9	144
NG10	-130.0750	54.8721	-130.0710	54.8726	72	0	266
NG11	-130.0763	54.8704	-130.0731	54.8703	80	2	219
NG12	-130.0762	54.8687	-130.0746	54.8685	65	3	121
NG13	-130.0774	54.8675	-130.0769	54.8667	59	1	112
NG14	-130.0808	54.8658	-130.0794	54.8655	89	3	147
NG15	-130.0821	54.8627	-130.0804	54.8629	89	0	142
WH01	-129.9994	54.3060	-130.0002	54.3054	38	3	91
WH02	-129.9985	54.3054	-129.9992	54.3049	38	1	82
WH03	-129.9970	54.3048	-129.9976	54.3041	39	3	91
WH04	-129.9958	54.3042	-129.9965	54.3032	36	0	121
WH05	-129.9946	54.3040	-129.9950	54.3031	40	1	109
WH06	-129.9934	54.3039	-129.9930	54.3024	45	2	168
WH07	-129.9925	54.3039	-129.9915	54.3017	52	0	262
WH08	-129.9917	54.3042	-129.9909	54.3030	45	1	148
WH09	-129.9913	54.3044	-129.9894	54.3039	40	3	59
WH10	-129.9905	54.3048	-129.9895	54.3043	36	0	87
WH11	-129.9893	54.3054	-129.9882	54.3049	37	0	123
WH12	-129.9877	54.3060	-129.9863	54.3054	41	0	110
WH13	-129.9866	54.3068	-129.9844	54.3063	42	1	158
WH14	-129.9859	54.3076	-129.9846	54.3072	44	0	107
WH15	-129.9856	54.3083	-129.9836	54.3081	42	0	140
WN01	-130.2536	54.5173	-130.2493	54.5194	180	0	405
WN02	-130.2527	54.5165	-130.2479	54.5181	180	15	392
WN03	-130.2520	54.5156	-130.2435	54.5181	194	0	645
WN04	-130.2512	54.5147	-130.2386	54.5183	208	1	923
WN05	-130.2504	54.5140	-130.2362	54.5170	200	2	997
WN06	-130.2496	54.5128	-130.2383	54.5150	186	0	797
WN07	-130.2489	54.5124	-130.2365	54.5143	181	4	851
WN08	-130.2489	54.5120	-130.2395	54.5129	187	0	641
WN09	-130.2481	54.5110	-130.2454	54.5116	188	7	262
WN10	-130.2474	54.5100	-130.2449	54.5109	180	1	262

Table 1-1: Location and Length of Subtidal ROV Transects (cont'd)

Transecta	Start Point		End Point		Transect Depth (m)		Transect Length (m)
	Longitude	Latitude	Longitude	Latitude	Max	Min	
WN11	-130.2468	54.5091	-130.2447	54.5103	192	4	266
WN12	-130.2460	54.5083	-130.2437	54.5093	183	3	257
WN13	-130.2455	54.5075	-130.2431	54.5087	200	3	282
WN14	-130.2446	54.5067	-130.2430	54.5074	196	2	274
WN15	-130.2434	54.5061	-130.2414	54.5071	160	1	235
WS01	-130.2727	54.5104	-130.2753	54.5082	184	0	379
WS02	-130.2710	54.5093	-130.2749	54.5072	217	0	412
WS03	-130.2703	54.5082	-130.2741	54.5065	179	2	356
WS04	-130.2694	54.5066	-130.2731	54.5052	171	1	331
WS05	-130.2690	54.5055	-130.2724	54.5040	135	0	306
WS06	-130.2675	54.5046	-130.2710	54.5032	169	0	322
WS07	-130.2656	54.5034	-130.2691	54.5024	183	0	311
WS08	-130.2656	54.5021	-130.2685	54.5010	173	0	281
WS09	-130.2644	54.5009	-130.2679	54.4999	171	0	306
WS10	-130.2635	54.4997	-130.2677	54.4986	164	1	335
WS11	-130.2631	54.4984	-130.2646	54.4979	135	69	128
WS12	-130.2643	54.4966	-130.2651	54.4964	141	0	194
WS13	-130.2608	54.4965	-130.2641	54.4952	118	0	289
WS14	-130.2594	54.4959	-130.2626	54.4942	148	1	315
WS15	-130.2580	54.4953	-130.2602	54.4939	146	2	256

Note:

[a] Transect names follow convention of site and transect number where LN = Lelu North, LS = Lelu South, NB = Nass Bay, NG = Nasoga Gulf, WH = Work Channel head, WN = Work Channel north, WS = Work Channel south

Application for an Environmental Assessment Certificate

Attachment L-3-2
Species Tables

Table 2-1: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu North (part 1)

Taxon	Species Name	Common Name	LN01	LN02	LN03	LN04	LN05	LN06	LN07	LN08	LN09	LN10
Flora												
Heterokontophyta	*Fucus* spp.	UnID Fucus										
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae										
Rhodophyta	*Fryeella gardneri*	Arched red seaweed										
Rhodophyta	*Sparlingia pertusa*	Red eyelet silk										
Tracheophyta	*Zostera marina*	Eelgrass			1.23							
UnID Algae	UnID Algae	UnID Algae		0.98								
Crabs & Shrimp												
Cancridae	*Metacarcinus magister*	Dungeness crab			3.69			1.09				1.14
Epialtidae	*Pugettia producta*	Northern kelp crab		1.96								
Galatheidae	*Munida quadrispina*	Squat lobster										
Oregoniidae	*Chionoecetes bairdi*	Tanner crab		0.98								
Paguroidea	*Pagurus armatus*	Blackeyed hermit							1.07			
Paguroidea	UnID Paguroidea	UnID Hermit crab				1.00	0.99		1.07		1.00	
Pandalidae	*Pandalus hypsinotus*	Humpback shrimp										
UnID Crab	UnID Crab	UnID Crab		1.96			0.99					
UnID Shrimp	UnID Shrimp	UnID Shrimp										
Fish												
Bathymasteridae	*Ronquilus jordani*	Northern ronquil	1.07	1.96			0.99		2.14			1.14
Cottidae	*Hemilepidotus hemilepidotus*	Red Irish lord		0.98								
Gobiidae	*Lepidogobius lepidus*	Bay goby										
Pleuronectidae	*Lepidopsetta bilineata*	Rock sole	1.07									
Pleuronectidae	*Microstomus Pacificus*	Dover sole										
Pleuronectidae	*Parophrys vetulus*	English sole								1.10		1.14

Table 2-1: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu North (part 1) (cont'd)

Taxon	Species Name	Common Name	LN01	LN02	LN03	LN04	LN05	LN06	LN07	LN08	LN09	LN10
Pleuronectidae	*Psettichthys melanostictus*	Sand sole									1.00	
Pleuronectidae	UnID Pleuronectidae	UnID Righteye flounders				1.00		1.09	2.14	1.10		
Stichaeidae	*Lumpenus sagitta*	Snake prickleback							1.07	23.18	11.03	4.55
Stichaeidae	UnID Stichaeidae	UnID prickleback										
UnID Fish	UnID Fish	UnID Fish		0.98			0.99		1.07			
Zoarcidae	*Lycodes Pacificus*	Blackbelly eelpout										
Other Invertebrates												
Arthropoda	*Balanus* spp.	UnID Barnacle										
Bryozoa	UnID Bryozoa	UnID Bryozoa										
Chordata	UnID Ascidiidae	UnID Ascidiidae										
Cnidaria	*Metridium farcimen*	Giant plumose anemone										
Cnidaria	*Metridium senile*	Short plumose anemone							1.07			
Cnidaria	*Ptilosarcus gurneyi*	Orange sea pen	1.07	0.98	6.14	5.02	6.96	27.13	25.67	18.76	28.08	25.03
Cnidaria	UnID Anthozoa	UnID Anemones										1.14
Cnidaria	UnID Hydrozoa	UnID Hydroid										
Echinodermata	*Pisaster brevispinus*	Spiny pink star					0.99					
Echinodermata	*Pycnopodia helianthoides*	Sunflower star	2.14	2.94								
Echinodermata	*Mediaster aequalis*	Vermillion star										
Echinodermata	*Ophiura lutkena*	Grey brittle star										
Echinodermata	*Parastichopus californicus*	Giant california sea cucumber		0.98			0.99					
Echinodermata	UnID Holothuroidea	UnID Sea cucumbers	1.07					1.09				
Mollusca	*Armina californica*	Striped nudibranch				1.00			4.28	1.10		4.55
Mollusca	*Clinocardium blandum*	Smooth cockle	0.00		0.98							
Mollusca	*Zirfaea pilsbryi*	Rough piddock										

Table 2-1: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu North (part 1) (cont'd)

Taxon	Species Name	Common Name	LN01	LN02	LN03	LN04	LN05	LN06	LN07	LN08	LN09	LN10
Mollusca	*Tritonia festiva*	Diamondback nudibranch										
Mollusca	UnID Bivalvia	UnID Bivalvia										
Mollusca	UnID Nudibranch	UnID Nudibranch										
Mollusca	UnID Nudibranchia	UnID Nudibranchia										
Mollusca	UnID Pectinidae	UnID Scallop										
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge										
Porifera	UnID Porifera	UnID Encrusting yellow sponge										
Tunicata	UnID Tunicata	UnID Tunicata										

Table 2-2: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu North (part 2)

Taxon	Species Name	Common Name	LN11	LN12	LN13	LN14	LN15	LN16	LN17	LN18	LN19	LN20
Flora												
Heterokontophyta	*Fucus* spp.	UnID Fucus										
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae										
Rhodophyta	*Fryeella gardneri*	Arched red seaweed										
Rhodophyta	*Sparlingia pertusa*	Red eyelet silk										
Tracheophyta	*Zostera marina*	Eelgrass										
UnID Algae	UnID Algae	UnID Algae							1.08			
Crabs & Shrimp												
Cancridae	*Metacarcinus magister*	Dungeness crab	1.12						2.16	1.31		0.98
Epialtidae	*Pugettia producta*	Northern kelp crab			1.01							
Galatheidae	*Munida quadrispina*	Squat lobster	1.12									
Oregoniidae	*Chionoecetes bairdi*	Tanner crab			2.01							
Paguroidea	*Pagurus armatus*	Blackeyed hermit										
Paguroidea	UnID Paguroidea	UnID Hermit crab		4.99	1.01	3.92						
Pandalidae	*Pandalus hypsinotus*	Humpback shrimp	3.37	2.99								
UnID Crab	UnID Crab	UnID Crab				0.98						
UnID Shrimp	UnID Shrimp	UnID Shrimp		5.99								1.95
Fish												
Bathymasteridae	*Ronquilus jordani*	Northern ronquil	3.37	6.98	4.03							
Cottidae	*Hemilepidotus hemilepidotus*	Red Irish lord										
Gobiidae	*Lepidogobius lepidus*	Bay goby								2.61		
Pleuronectidae	*Lepidopsetta bilineata*	Rock sole										
Pleuronectidae	*Microstomus Pacificus*	Dover sole						1.13				
Pleuronectidae	*Parophrys vetulus*	English sole	1.12		1.01						1.03	

Table 2-2: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu North (part 2) (cont'd)

Taxon	Species Name	Common Name	LN11	LN12	LN13	LN14	LN15	LN16	LN17	LN18	LN19	LN20
Pleuronectidae	*Psettichthys melanostictus*	Sand sole										
Pleuronectidae	UnID Pleuronectidae	UnID Righteye flounders		2.00			1.21	1.13		5.22		
Stichaeidae	*Lumpenus sagitta*	Snake prickleback	7.87		1.01	0.98	1.21	6.81	9.71	1.31	11.34	16.59
Stichaeidae	UnID Stichaeidae	UnID prickleback										
UnID Fish	UnID Fish	UnID Fish		1.00		4.90	3.63		3.24	52.25	42.25	28.30
Zoarcidae	*Lycodes Pacificus*	Blackbelly eelpout								1.31		
Other Invertebrates												
Arthropoda	*Balanus* spp.	UnID Barnacle			30.20	1.96						
Bryozoa	UnID Bryozoa	UnID Bryozoa										
Chordata	UnID Ascidiidae	UnID Ascidiidae				1.96						
Cnidaria	*Metridium farcimen*	Giant plumose anemone	2.25	1.00								
Cnidaria	*Metridium senile*	Short plumose anemone										
Cnidaria	*Ptilosarcus gurneyi*	Orange sea pen	5.62			0.98	4.84	3.40				
Cnidaria	UnID Anthozoa	UnID Anemones	4.50			0.98	1.21					
Cnidaria	UnID Hydrozoa	UnID Hydroid					7.26		1.08			
Echinodermata	*Pisaster brevispinus*	Spiny pink star										
Echinodermata	*Pycnopodia helianthoides*	Sunflower star	1.12	2.99								0.98
Echinodermata	*Mediaster aequalis*	Vermillion star	1.12		2.01							
Echinodermata	*Ophiura lutkena*	Grey brittle star				4.90						
Echinodermata	*Parastichopus californicus*	Giant california sea cucumber										
Echinodermata	UnID Holothuroidea	UnID Sea cucumbers										

Table 2-2: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu North (part 2) (cont'd)

Taxon	Species Name	Common Name	LN11	LN12	LN13	LN14	LN15	LN16	LN17	LN18	LN19	LN20
Mollusca	*Armina californica*	Striped nudibranch	2.25									
Mollusca	*Clinocardium blandum*	Smooth cockle			1.00							
Mollusca	*Zirfaea pilsbryi*	Rough piddock				24.48	14.51					
Mollusca	*Tritonia festiva*	Diamondback nudibranch	1.12									
Mollusca	UnID Bivalvia	UnID Bivalvia				32.31	2.42	1.13		1.31	3.09	3.90
Mollusca	UnID Nudibranch	UnID Nudibranch					1.21		1.08			
Mollusca	UnID Nudibranchia	UnID Nudibranchia										0.98
Mollusca	UnID Pectinidae	UnID Scallop	1.12									
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge				9.79						
Porifera	UnID Porifera	UnID Encrusting yellow sponge										
Tunicata	UnID Tunicata	UnID Tunicata										0.98

Table 2-3: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu North (part 3)

Taxon	Species Name	Common Name	LN21	LN22	LN23	LN24	LN25	LN26	LN27	LN28	LN29	LN30	Whole Site
Flora													
Heterokontophyta	*Fucus* spp.	UnID Fucus					0.96	4.96					0.25
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae						2.48					0.11
Rhodophyta	*Fryeella gardneri*	Arched red seaweed				1.14							0.04
Rhodophyta	*Sparlingia pertusa*	Red eyelet silk				1.14							0.04
Tracheophyta	*Zostera marina*	Eelgrass											0.04
UnID Algae	UnID Algae	UnID Algae											0.07
Crabs & Shrimp													
Cancridae	*Metacarcinus magister*	Dungeness crab		2.02	1.62	1.14		1.65					0.57
Epialtidae	*Pugettia producta*	Northern kelp crab											0.11
Galatheidae	*Munida quadrispina*	Squat lobster											0.04
Oregoniidae	*Chionoecetes bairdi*	Tanner crab											0.11
Paguroidea	*Pagurus armatus*	Blackeyed hermit											0.04
Paguroidea	UnID Paguroidea	UnID Hermit crab				2.28	0.96						0.60
Pandalidae	*Pandalus hypsinotus*	Humpback shrimp											0.21
UnID Crab	UnID Crab	UnID Crab											0.14
UnID Shrimp	UnID Shrimp	UnID Shrimp											0.28
Fish													
Bathymasteridae	*Ronquilus jordani*	Northern ronquil											0.74
Cottidae	*Hemilepidotus hemilepidotus*	Red Irish lord											0.04
Gobiidae	*Lepidogobius lepidus*	Bay goby											0.07

Table 2-3: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu North (part 3) (cont'd)

Taxon	Species Name	Common Name	LN21	LN22	LN23	LN24	LN25	LN26	LN27	LN28	LN29	LN30	Whole Site
Pleuronectidae	*Lepidopsetta bilineata*	Rock sole											0.04
Pleuronectidae	*Microstomus Pacificus*	Dover sole				1.14		0.83					0.11
Pleuronectidae	*Parophrys vetulus*	English sole		1.01									0.21
Pleuronectidae	*Psettichthys melanostictus*	Sand sole											0.04
Pleuronectidae	UnID Pleuronectidae	UnID Righteye flounders			1.62			0.83		0.96	1.07	1.91	0.67
Stichaeidae	*Lumpenus sagitta*	Snake prickleback	28.26	3.03						0.96	6.43	7.62	4.67
Stichaeidae	UnID Stichaeidae	UnID prickleback					1.92	3.31			2.14	15.25	0.85
UnID Fish	UnID Fish	UnID Fish	2.46	87.81									7.56
Zoarcidae	*Lycodes Pacificus*	Blackbelly eelpout				1.14							0.07
Other Invertebrates													
Arthropoda	*Balanus* spp.	UnID Barnacle											1.13
Bryozoa	UnID Bryozoa	UnID Bryozoa						0.83					0.04
Chordata	UnID Ascidiidae	UnID Ascidiidae											0.07
Cnidaria	*Metridium farcimen*	Giant plumose anemone				2.28							0.18
Cnidaria	*Metridium senile*	Short plumose anemone											0.04
Cnidaria	*Ptilosarcus gurneyi*	Orange sea pen			17.85	36.50	14.43	7.45	4.99		2.14		7.85
Cnidaria	UnID Anthozoa	UnID Anemones											0.25
Cnidaria	UnID Hydrozoa	UnID Hydroid											0.25
Echinodermata	*Pisaster brevispinus*	Spiny pink star											0.04

Table 2-3: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu North (part 3) (cont'd)

Taxon	Species Name	Common Name	LN21	LN22	LN23	LN24	LN25	LN26	LN27	LN28	LN29	LN30	Whole Site
Echinodermata	*Pycnopodia helianthoides*	Sunflower star											0.35
Echinodermata	*Mediaster aequalis*	Vermillion star											0.11
Echinodermata	*Ophiura lutkena*	Grey brittle star											0.18
Echinodermata	*Parastichopus californicus*	Giant california sea cucumber				1.14							0.11
Echinodermata	UnID Holothuroidea	UnID Sea cucumbers											0.07
Mollusca	*Armina californica*	Striped nudibranch			1.62	2.28	1.92						0.60
Mollusca	*Clinocardium blandum*	Smooth cockle											0.07
Mollusca	*Zirfaea pilsbryi*	Rough piddock											1.31
Mollusca	*Tritonia festiva*	Diamondback nudibranch											0.04
Mollusca	UnID Bivalvia	UnID Bivalvia											1.56
Mollusca	UnID Nudibranch	UnID Nudibranch											0.07
Mollusca	UnID Nudibranchia	UnID Nudibranchia											0.04
Mollusca	UnID Pectinidae	UnID Scallop											0.04
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge											0.35
Porifera	UnID Porifera	UnID Encrusting yellow sponge				1.14							0.04
Tunicata	UnID Tunicata	UnID Tunicata											0.04

Table 2-4: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Surveys for Lelu North (part 1)

Taxon	Species Name	Common Name	LN01	LN02	LN03	LN04	LN05	LN06	LN07
Flora									
Chlorophyta	UnID Chlorophyta	UnID Chlorophyta	P						
Heterokontophyta	*Agarum clathratum*	Sieve kelp					A		
Heterokontophyta	*Agarum fimbriatum*	Frigned sea colander kelp							
Heterokontophyta	*Fucus* spp.	UnID Fucus		P	A				
Heterokontophyta	*Saccharina groenlandica*	Split kelp	C	P					
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae							
Rhodophyta	UnID Rhodophyta	UnID Red algae	C						
Tracheophyta	*Zostera marina*	Eelgrass				P			
UnID Algae	UnID Algae	UnID Algae	P	P			C		
Other Invertebrates									
Arthropoda	*Balanus* spp.	UnID Barnacle							
Cnidaria	UnID Hydrozoa	UnID Hydroid							
Mollusca	UnID Bivalvia	UnID Bivalvia							
Porifera	*Suberites montiniger*	Peach ball sponge						P	P
Porifera	UnID Porifera	UnID Encrusting yellow sponge				P			

Legend:
P – Present <25%
C – Common 25–75%
A – Abundant >76%

Table 2-5: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Surveys for Lelu North (part 2)

Taxon	Species Name	Common Name	LN09	LN11	LN14	LN15	LN18	LN22	LN26
Flora									
Chlorophyta	UnID Chlorophyta	UnID Chlorophyta							
Heterokontophyta	*Agarum clathratum*	Sieve kelp							
Heterokontophyta	*Agarum fimbriatum*	Frigned sea colander kelp		P					
Heterokontophyta	*Fucus* spp.	UnID Fucus							P
Heterokontophyta	*Saccharina groenlandica*	Split kelp							
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae		P					
Rhodophyta	UnID Rhodophyta	UnID Red algae							
Tracheophyta	*Zostera marina*	Eelgrass							
UnID Algae	UnID Algae	UnID Algae					P		
Other Invertebrates									
Arthropoda	*Balanus* spp.	UnID Barnacle			C				
Cnidaria	UnID Hydrozoa	UnID Hydroid			P	P		P	
Mollusca	UnID Bivalvia	UnID Bivalvia			P				
Porifera	*Suberites montiniger*	Peach ball sponge	P						
Porifera	UnID Porifera	UnID Encrusting yellow sponge							

Legend:
P – Present <25%
C – Common 26–75%
A – Abundant >76%

Table 2-6: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu South (part 1)

Taxon	Species Name	Common Name	LS01	LS02	LS03	LS04	LS05	LS06	LS07	LS08	LS09	LS10
Crabs & Shrimp												
Cancridae	*Metacarcinus magister*	Dungeness crab		1.20	2.14			2.38	0.91	1.20	0.98	
Paguroidea	*Pagurus armatus*	Blackeyed hermit crab					1.09				1.97	
Paguroidea	*Pagurus ochotensis*	Alaskan hermit		1.20	3.21	1.07						
Paguroidea	UnID Paguroidea	UnID Hermit crab					1.09	1.19		1.20	0.98	
Pisidae	*Chorilia longipes*	Longhorn decorator crab			1.07		1.09					
UnID Crab	UnID Crab	UnID Crab			1.07		1.09		0.91			
UnID Shrimp	UnID Shrimp	UnID Shrimp										
Varunidae	*Hemigrapsus oregonensis*	Bay shore crab			2.14							
Fish												
Bathymasteridae	*Ronquilus jordani*	Northern ronquil						2.38	0.91			
Cottidae	*Artedius fenestralis*	Padded sculpin				3.22						
Cottidae	UnID Cottidae	UnID Sculpin			1.07	2.15						
Pleuronectidae	*Isopsetta isolepis*	Butter sole									0.98	
Pleuronectidae	*Lepidopsetta bilineata*	Rock sole										
Pleuronectidae	*Platichthys stellatus*	Starry flounder	2.43			1.07						
Pleuronectidae	UnID Pleuronectidae	UnID Righteye flounders		1.20								1.01
Stichaeidae	*Lumpenus sagitta*	Snake prickleback						2.38	1.82	4.82	0.98	1.01
UnID Fish	UnID Fish	UnID Fish						1.19	1.82	2.41	0.98	
Zoarcidae	*Lycodes Pacificus*	Blackbelly eelpout				1.07						
Other Invertebrates												
Annelida	UnID Sabellidae	UnID Feather duster worm					1.09					
Cnidaria	*Halianthella annularis*	Brooding anemone			1.07	1.07						
Cnidaria	*Metridium farcimen*	Giant plumose anemone									0.98	3.02
Cnidaria	*Metridium senile*	Short plumose anemone		1.20								

Table 2-6: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu South (part 1) (cont'd)

Taxon	Species Name	Common Name	LS01	LS02	LS03	LS04	LS05	LS06	LS07	LS08	LS09	LS10
Cnidaria	*Ptilosarcus gurneyi*	Orange sea pen		1.20								3.02
Cnidaria	UnID Anthozoa	UnID Anemones										
Echinodermata	*Pycnopodia helianthoides*	Sunflower star										
Echinodermata	*Dermasterias imbricata*	Leather star					1.09					
Echinodermata	*Henricia leviuscula*	Blood star					1.09					
Echinodermata	UnID Asteroidea	UnID Sea star										
Mollusca	*Armina californica*	Striped nudibranch										
Mollusca	*Panomya ampla*	False geoduck	1.21			5.37						
Mollusca	*Panopea generosa*	Pacific geoduck				1.07						
Mollusca	*Rossia Pacifica*	Stubby squid										
Mollusca	UnID Bivalvia	UnID Bivalvia					2.19					
Mollusca	UnID Cephalopoda	UnID Cephalopoda										
Mollusca	UnID Nudibranchia	UnID Nudibranchia										

Table 2-7: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu South (part 2)

Taxon	Species Name	Common Name	LS11	LS12	LS13	LS14	LS15	LS16	LS17	LS18	LS19	LS20
Crabs & Shrimp												
Cancridae	*Metacarcinus magister*	Dungeness crab	2.10	2.15	1.84	0.80				1.09		0.73
Paguroidea	*Pagurus armatus*	Blackeyed hermit crab										
Paguroidea	*Pagurus ochotensis*	Alaskan hermit										
Paguroidea	UnID Paguroidea	UnID Hermit crab										0.73
Pisidae	*Chorilia longipes*	Longhorn decorator crab										
UnID Crab	UnID Crab	UnID Crab					0.91					0.73
UnID Shrimp	UnID Shrimp	UnID Shrimp										
Varunidae	*Hemigrapsus oregonensis*	Bay shore crab										
Fish												
Bathymasteridae	*Ronquilus jordani*	Northern ronquil										7.34
Cottidae	*Artedius fenestralis*	Padded sculpin										
Cottidae	UnID Cottidae	UnID Sculpin										
Pleuronectidae	*Isopsetta isolepis*	Butter sole										
Pleuronectidae	*Lepidopsetta bilineata*	Rock sole				1.59			0.94			
Pleuronectidae	*Platichthys stellatus*	Starry flounder										
Pleuronectidae	UnID Pleuronectidae	UnID Righteye flounders	2.10		1.84	1.59		2.03	0.94	1.09	2.10	0.73
Stichaeidae	*Lumpenus sagitta*	Snake prickleback				1.59	3.65	3.04			7.36	1.47
UnID Fish	UnID Fish	UnID Fish			0.92		0.91	2.03		1.09	19.97	2.93
Zoarcidae	*Lycodes Pacificus*	Blackbelly eelpout										
Other Invertebrates												
Annelida	UnID Sabellidae	UnID Feather duster worm										
Cnidaria	*Halianthella annularis*	Brooding anemone										
Cnidaria	*Metridium farcimen*	Giant plumose anemone						1.01				0.73
Cnidaria	*Metridium senile*	Short plumose anemone										

Table 2-7: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu South (part 2) (cont'd)

Taxon	Species Name	Common Name	LS11	LS12	LS13	LS14	LS15	LS16	LS17	LS18	LS19	LS20
Cnidaria	*Ptilosarcus gurneyi*	Orange sea pen	9.44	3.22	3.67	0.80	2.74	20.26	9.44	6.55	13.66	10.27
Cnidaria	UnID Anthozoa	UnID Anemones										
Echinodermata	*Pycnopodia helianthoides*	Sunflower star										
Echinodermata	*Dermasterias imbricata*	Leather star										
Echinodermata	*Henricia leviuscula*	Blood star										
Echinodermata	UnID Asteroidea	UnID Sea star									1.05	
Mollusca	*Armina californica*	Striped nudibranch	1.05	3.22				1.01	0.94		1.05	
Mollusca	*Panomya ampla*	False geoduck										
Mollusca	*Panopea generosa*	Pacific geoduck										
Mollusca	*Rossia Pacifica*	Stubby squid										
Mollusca	UnID Bivalvia	UnID Bivalvia										
Mollusca	UnID Cephalopoda	UnID Cephalopoda	1.05									
Mollusca	UnID Nudibranchia	UnID Nudibranchia						1.01				

Table 2-8: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu South (part 3)

Taxon	Species Name	Common Name	LS21	LS22	LS23	LS24	LS25	LS26	LS27	LS28	LS29	LS30	Whole Site
Crabs & Shrimp													
Cancridae	*Metacarcinus magister*	Dungeness crab	1.10					2.32	1.20	0.94	1.18	1.35	0.85
Paguroidea	*Pagurus armatus*	Blackeyed hermit crab											0.11
Paguroidea	*Pagurus ochotensis*	Alaskan hermit											0.18
Paguroidea	UnID Paguroidea	UnID Hermit crab					1.62						0.21
Pisidae	*Chorilia longipes*	Longhorn decorator crab											0.07
UnID Crab	UnID Crab	UnID Crab											0.18
UnID Shrimp	UnID Shrimp	UnID Shrimp									1175.78		35.39
Varunidae	*Hemigrapsus oregonensis*	Bay shore crab											0.07
Fish													
Bathymasteridae	*Ronquilus jordani*	Northern ronquil	5.51	1.14									0.67
Cottidae	*Artedius fenestralis*	Padded sculpin											0.11
Cottidae	UnID Cottidae	UnID Sculpin											0.11
Pleuronectidae	*Isopsetta isolepis*	Butter sole											0.04
Pleuronectidae	*Lepidopsetta bilineata*	Rock sole											0.11
Pleuronectidae	*Platichthys stellatus*	Starry flounder							1.20				0.07
Pleuronectidae	UnID Pleuronectidae	UnID Righteye flounders		3.43		1.12				0.94	1.18		0.81
Stichaeidae	*Lumpenus sagitta*	Snake prickleback		2.29							8.23		1.31
UnID Fish	UnID Fish	UnID Fish	2.21										1.27
Zoarcidae	*Lycodes Pacificus*	Blackbelly eelpout											0.04

Table 2-8: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Lelu South (part 3) (cont'd)

Taxon	Species Name	Common Name	LS21	LS22	LS23	LS24	LS25	LS26	LS27	LS28	LS29	LS30	Whole Site
Other Invert													
Annelida	UnID Sabellidae	UnID Feather duster worm											0.04
Cnidaria	*Halianthella annularis*	Brooding anemone											0.07
Cnidaria	*Metridium farcimen*	Giant plumose anemone											0.21
Cnidaria	*Metridium senile*	Short plumose anemone											0.04
Cnidaria	*Ptilosarcus gurneyi*	Orange sea pen		88.06	8.80	1.12				1.87		31.15	6.97
Cnidaria	UnID Anthozoa	UnID Anemones					1.62						0.04
Echinodermata	*Pycnopodia helianthoides*	Sunflower star										1.35	0.04
Echinodermata	*Dermasterias imbricata*	Leather star											0.04
Echinodermata	*Henricia leviuscula*	Blood star											0.04
Echinodermata	UnID Asteroidea	UnID Sea star											0.04
Mollusca	*Armina californica*	Striped nudibranch	1.10	1.14	1.26							1.35	0.39
Mollusca	*Panomya ampla*	False geoduck											0.18
Mollusca	*Panopea generosa*	Pacific geoduck											0.04
Mollusca	*Rossia Pacifica*	Stubby squid											0.04
Mollusca	UnID Bivalvia	UnID Bivalvia											0.07
Mollusca	UnID Cephalopoda	UnID Cephalopoda											0.04
Mollusca	UnID Nudibranchia	UnID Nudibranchia											0.04

Table 2-9: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Surveys for Lelu South

Taxon	Species Name	Common Name	LS02	LS03	LS04	LS05	LS06	LS08	LS09	LS12	LS13	LS14	LS15	LS27	LS29
Flora															
Chlorophyta	*Ulva lactuca*	Dark sea lettuce									P				
Chlorophyta	UnID Chlorophyta	UnID Chlorophyta				P						P			
Heterokontophyta	*Pylaiella littoralis*	Sea felt		P											
Heterokontophyta	*Chorda filum*	Spaghetti kelp	P								P				
Heterokontophyta	*Petalonia fascia*	False kelp	P												
Rhodophyta	*Mazzaella oregona*	Northern mazza weed										P			
Rhodophyta	*Mastocarpus papillatus*	Turkish washcloth		P											
Rhodophyta	UnID Corallinales	UnID Crustose corraline algae			C										
Rhodophyta	UnID Rhodophyta	UnID Red algae		P			P							P	
UnID Algae	UnID Algae	UnID Algae		P					P	P	P		A		P
Other Invertebrates															
Porifera	*Haliclona permollis*	Purple encrusting sponge			P										
Porifera	*Ophlitaspongia pennata*	Velvety red sponge			P										
Porifera	*Suberites montiniger*	Peach ball sponge						P							
Porifera	UnID Porifera	UnID Encrusting yellow sponge							P						

Legend:
P – Present <25%
C – Common 26–75%
A – Abundant >76%

Table 2-10: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Nass Bay

Taxon	Species Name	Common Name	NB01	NB02	Whole Site
Crabs & Shrimp					
Cancridae	Metacarcinus magister	Dungeness crab	2.03	1.13	1.50
Paguroidea	Paguroidea	UnID Hermit crab	0.41		0.17
UnID Crab	UnID Crab	UnID Crab		0.28	0.17
Fish					
Cottidae	UnID Cottidae	UnID Sculpin		0.28	0.17

Table 2-11: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Nass Bay

Taxon	Species Name	Common Name	NB01	NB02
Flora				
Heterokontophyta	Alaria nana	Narrow winged kelp		P
Heterokontophyta	Laminaria bongardiana	Dark brown wrack kelp		C
Heterokontophyta	Heterokontophyta	UnID Brown algae		P
Rhodophyta	Rhodophyta	UnID Red algae	A	
UnID Algae	UnID Algae	UnID Algae	A	A

Legend:
P – Present <25%
C – Common 26–75%
A – Abundant >76%

Table 2-12: Number of Individuals Observed per 100 m during Subtital ROV Survey for Nasoga Gulf (part 1)

Taxon	Species Name	Common Name	NG01	NG02	NG03	NG04	NG05	NG06	NG07	NG08
Flora										
Chlorophyta	Ulva spp.	Sea lettuce								
Chlorophyta	Chlorophyta	UnID Chlorophyta								
Heterokontophyta	Alaria marginata	Ribbon kelp		1.79						
Heterokontophyta	Fucus gardneri	Rock weed								
Heterokontophyta	Heterokontophyta	UnID Brown algae								
Rhodophyta	Rhodophyta	UnID Red algae	0.20							
UnID Algae	UnID Algae	UnID Algae								
Crabs & Shrimp										
Cancridae	Metacarcinus magister	Dungeness crab	0.39							
Epialtidae	Pugettia producta	Northern kelp crab			1.57	3.23		1.94		
Galatheidae	Munida quadrispina	Squat lobster				0.46				
Galatheidae	Munida spp.	UnID Galatheid crab								
Oregoniidae	Chionoecetes tanneri	Grooved tanner crab								
Paguroidea	Pagurus spp.	Hermit crab	0.39							
Paguroidea	Paguroidea	UnID Hermit crab			0.31	0.46	1.58			0.50
Paguroidea	Elassochirus tenuimanus	Widehand hermit crab								
Pisidae	Chorilia longipes	Longhorn decorator crab		0.51						
UnID Crab	UnID Crab	UnID Crab	0.39	0.26	0.31				0.32	0.50
UnID Shrimp	UnID Shrimp	UnID Shrimp	9.84						0.32	
Fish										
Agonidae	Agonus acipenserinus	Sturgeon poacher	0.20					1.16		
Agonidae	UnID Agonidae	UnID Poacher								
Bathymasteridae	Ronquilus jordani	Northern ronquil		1.03	1.89	0.92	3.94	3.11		0.50
Cottidae	Artedius fenestralis	Padded sculpin	0.20							
Cottidae	UnID Cottidae	UnID Sculpin					0.39		0.65	

Table 2-12: Number of Individuals Observed per 100 m during Subtital ROV Survey for Nasoga Gulf (part 1) (cont'd)

Taxon	Species Name	Common Name	NG01	NG02	NG03	NG04	NG05	NG06	NG07	NG08
Embiotocidae	Cymatogaster aggregata	Shiner perch								
Gadidae	Theragra chalcogramma	Walleye pollock								
Gasterosteidae	Gasterosteus aculeastus	Threespine stickleback							4.84	
Gobiidae	Lepidogobius lepidus	Bay goby	0.20							
Hexagrammidae	UnID Hexagrammidae	UnID Greenling								
Pholidae	Pholis spp.	UnID Gunnel	0.20							
Pleuronectidae	Parophrys vetulus	English sole		0.26					0.32	
Pleuronectidae	Lepidopsetta bilineata	Rock sole	0.79		0.31	0.46	1.18			
Pleuronectidae	UnID Pleuronectidae	UnID Righteye flounders	1.18	0.26	0.94	0.92	0.39	1.55	0.32	
Sebastidae	Sebastes melanops	Black rockfish								
Sebastidae	Sebastes mystinus	Blue rockfish								
Sebastidae	Sebastes caurinus	Copper rockfish								
Sebastidae	Sebastes maliger	Quillback rockfish					0.79			
Sebastidae	Sebastes spp.	UnID Rockfish							1.29	
Stichaeidae	Lumpenus sagitta	Snake prickleback	2.56	0.77			1.97		2.90	0.50
Stichaeidae	UnID Stichaedae	UnID prickleback								
Stichaeidae	Poroclinus rothrocki	Whitebarred prickleback								
UnID Fish	UnID Fish	UnID Fish	1.97	9.49		7.39	2.36		2.58	0.50
Zoarcidae	Lycodes spp.	UnID Eelpout								
Zoarcidae	UnID Zoarcidae	UnID Eelpout								
Other Invertebrates										
Annelida	Chone aurantiaca	Orange feather duster worm								
Annelida	UnID Sabellidae	UnID Feather duster worm					0.39			
Annelida	UnID Serpulidae	UnID Tubeworm								
Bryozoa	UnID Bryozoa	UnID Bryozoans								

Table 2-12: Number of Individuals Observed per 100 m during Subtital ROV Survey for Nasoga Gulf (part 1) (cont'd)

Taxon	Species Name	Common Name	NG01	NG02	NG03	NG04	NG05	NG06	NG07	NG08
Chordata	Ascidia paratropa	Glassy sea squirt								
Chordata	UnID Ascidiidae	UnID Ascidiidae								
Cnidaria	Cribrinopsis fernaldi	Crimson anemone				0.46	0.39		0.97	
Cnidaria	Stomphia didemon	Swimming anemone								
Cnidaria	Obelia spp.	UnID Obeliad								
Cnidaria	Cyanea capillata	Lion's mane	0.79							
Cnidaria	Halipteris willemoesi	Sea whip								0.50
Cnidaria	Ptilosarcus gurneyi	Orange sea pen	4.33		0.31					
Cnidaria	Aurelia labiata	Moon jellyfish							0.65	
Cnidaria	UnID Anthozoa	UnID Anemones	0.20		0.31					
Cnidaria	UnID Cnidaria	UnID Jelly		0.77	0.31		0.39			
Cnidaria	UnID Hydrozoa	UnID Hydroid								
Echinodermata	Orthasterias koehleri	Rainbow star	0.39			0.46	0.79	4.27	0.65	
Echinodermata	Pisaster brevispinus	Spiny pink star	0.20							
Echinodermata	Pycnopodia helianthoides	Sunflower star	1.77	3.08	10.06	0.92	5.91	1.94	0.97	8.02
Echinodermata	Stylasterias forreri	Velcro star								
Echinodermata	Asterina miniata	Bat star								
Echinodermata	Henricia leviuscula	Blood star	0.39							
Echinodermata	Henricia sanguinolenta	Fat blood star					0.39			
Echinodermata	Hippasteria spinosa	Spiny red star						0.39	0.97	
Echinodermata	Mediaster aequalis	Vermillion star	4.33	0.51	0.63	0.92	0.79	0.39	2.90	0.50
Echinodermata	Luidia foliolata	Sandstar				0.46		0.39		
Echinodermata	Ophiura lutkena	Grey brittle star								
Echinodermata	Pteraster tesselatus	Cushion star								
Echinodermata	Ceramaster patagonicus	Cookie star				0.46				
Echinodermata	Solaster paxillatus	Orange sunstar				0.46				

Table 2-12: Number of Individuals Observed per 100 m during Subtital ROV Survey for Nasoga Gulf (part 1) (cont'd)

Taxon	Species Name	Common Name	NG01	NG02	NG03	NG04	NG05	NG06	NG07	NG08
Echinodermata	Crossaster papposus	Rose star								
Echinodermata	Solaster stimpsoni	Striped sunstar							0.32	
Echinodermata	Parastichopus californicus	Giant california sea cucumber	0.98	4.10	2.52	3.70	3.94	2.33	6.45	5.51
Echinodermata	Strongylocentrotus droebachiensis	Green urchin	0.39							
Echinodermata	Strongylocentrotus purpuratus	Purple urchin								
Echinodermata	Strongylocentrotus franciscanus	Red urchin								
Echinodermata	Strongylocentrotus pallidus	White urchin								
Echinodermata	UnID Asteroidea	UnID Sea star	0.39	0.26	0.94	1.39	1.18		1.29	0.50
Echinodermata	UnID Holothuroidea	UnID Sea cucumbers	0.20							
Gastropoda	UnID Gastropoda	UnID Gastropoda	0.39							
Mollusca	Clione limacina	Sea angel								
Mollusca	UnID Nudibranch	UnID Nudibranch	0.20						0.65	
Porifera	Aphrocallistes vastus	Cloud sponge								
Porifera	Phakellia spp.	Funnel sponge								
Porifera	Latrunculia spp.	Chocolate puffball sponge								
Porifera	Polymastia pachymastia	Vase sponge								
Porifera	Staurocalyptus dowlingi	Round lipped boot sponge							0.32	
Porifera	Rhabdocalyptus dawsoni	Sharp lipped boot sponge							0.97	
Porifera	UnID Porifera	UnID Encrusting yellow sponge								
Tunicata	Halocynthia aurantium	Pacific sea peach		0.26						
Tunicata	UnID Tunicata	UnID Tunicata	1.18							

Table 2-13: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Nasoga Gulf (part 2)

Taxon	Species Name	Common Name	NG09	NG10	NG11	NG12	NG13	NG14	NG15	Whole Site
Flora										
Chlorophyta	Ulva spp.	Sea lettuce						0.68		0.03
Chlorophyta	Chlorophyta	UnID Chlorophyta				0.82		0.68		0.06
Heterokontophyta	*Alaria marginata*	Ribbon kelp								0.19
Heterokontophyta	*Fucus gardneri*	Rock weed							1.41	0.06
Heterokontophyta	Heterokontophyta	UnID Brown algae		3.38						0.25
Rhodophyta	Rhodophyta	UnID Red algae			2.28					0.17
UnID Algae	UnID Algae	UnID Algae		0.75	4.56	1.65	12.48	1.36		0.83
Crabs & Shrimp										
Cancridae	*Metacarcinus magister*	Dungeness crab				0.82	0.89			0.11
Epialtidae	*Pugettia producta*	Northern kelp crab								0.47
Galatheidae	*Munida quadrispina*	Squat lobster	2.09			0.82		37.42	12.67	2.16
Galatheidae	*Munida* spp.	UnID Galatheid crab		0.38	35.11					2.16
Oregoniidae	*Chionoecetes tanneri*	Grooved tanner crab						0.68		0.03
Paguroidea	*Pagurus* spp.	Hermit crab								0.06
Paguroidea	Paguroidea	UnID Hermit crab		7.51						0.75
Paguroidea	*Elassochirus tenuimanus*	Widehand hermit crab		0.38				0.68		0.06
Pisidae	*Chorilia longipes*	Longhorn decorator crab								0.06
UnID Crab	UnID Crab	UnID Crab		0.75		0.82				0.25
UnID Shrimp	UnID Shrimp	UnID Shrimp							47.16	3.27
Fish										
Agonidae	*Agonus acipenserinus*	Sturgeon poacher			0.91					0.17
Agonidae	UnID Agonidae	UnID Poacher		0.75	1.82					0.17

Table 2-13: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Nasoga Gulf (part 2) (cont'd)

Taxon	Species Name	Common Name	NG09	NG10	NG11	NG12	NG13	NG14	NG15	Whole Site
Bathymasteridae	*Ronquilus jordani*	Northern ronquil	4.18				1.78			1.08
Cottidae	*Artedius fenestralis*	Padded sculpin								0.03
Cottidae	UnID Cottidae	UnID Sculpin					0.89			0.11
Embiotocidae	*Cymatogaster aggregata*	Shiner perch					89.16			2.77
Gadidae	*Theragra chalcogramma*	Walleye pollock							0.70	0.03
Gasterosteidae	*Gasterosteus aculeastus*	Threespine stickleback								0.42
Gobiidae	*Lepidogobius lepidus*	Bay goby								0.03
Hexagrammidae	UnID Hexagrammidae	UnID Greenling						0.68	0.70	0.06
Pholidae	*Pholis* spp.	UnID Gunnel								0.03
Pleuronectidae	*Parophrys vetulus*	English sole				0.82				0.08
Pleuronectidae	*Lepidopsetta bilineata*	Rock sole	0.70			1.65				0.33
Pleuronectidae	UnID Pleuronectidae	UnID Righteye flounders			1.82					0.61
Sebastidae	*Sebastes melanops*	Black rockfish						1.36		0.06
Sebastidae	*Sebastes mystinus*	Blue rockfish		0.38						0.03
Sebastidae	*Sebastes caurinus*	Copper rockfish						1.36		0.06
Sebastidae	*Sebastes maliger*	Quillback rockfish			0.46					0.08
Sebastidae	*Sebastes* spp.	UnID Rockfish			0.46			0.68		0.17
Stichaeidae	*Lumpenus sagitta*	Snake prickleback	1.39			0.82				0.94
Stichaeidae	UnID Stichaedae	UnID prickleback		3.38	5.47					0.58
Stichaeidae	*Poroclinus rothrocki*	Whitebarred prickleback		0.38	1.82					0.14
UnID Fish	UnID Fish	UnID Fish				1.65		7.48	5.63	2.75
Zoarcidae	*Lycodes* spp.	UnID Eelpout			1.82					0.11
Zoarcidae	UnID Zoarcidae	UnID Eelpout				2.47		0.68	1.41	0.17

Table 2-13: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Nasoga Gulf (part 2) (cont'd)

Taxon	Species Name	Common Name	NG09	NG10	NG11	NG12	NG13	NG14	NG15	Whole Site
Other Invertebrates										
Annelida	*Chone aurantiaca*	Orange feather duster worm						0.68		0.03
Annelida	UnID Sabellidae	UnID Feather duster worm								0.03
Annelida	UnID Serpulidae	UnID Tubeworm			1.82					0.11
Bryozoa	UnID Bryozoa	UnID Bryozoans		18.02					0.70	1.36
Chordata	*Ascidia paratropa*	Glassy sea squirt				16.47				0.55
Chordata	UnID Ascidiidae	UnID Ascidiidae				0.82		0.68		0.06
Cnidaria	*Cribrinopsis fernaldi*	Crimson anemone		0.38						0.17
Cnidaria	*Stomphia didemon*	Swimming anemone						0.68		0.03
Cnidaria	*Obelia* spp.	UnID Obeliad		0.38						0.03
Cnidaria	*Cyanea capillata*	Lion's mane								0.11
Cnidaria	*Halipteris willemoesi*	Sea whip								0.03
Cnidaria	*Ptilosarcus gurneyi*	Orange sea pen								0.64
Cnidaria	*Aurelia labiata*	Moon jellyfish								0.06
Cnidaria	UnID Anthozoa	UnID Anemones					12.48			0.44
Cnidaria	UnID Cnidaria	UnID Jelly								0.14
Cnidaria	UnID Hydrozoa	UnID Hydroid			0.91	1.65		3.40		0.25
Echinodermata	*Orthasterias koehleri*	Rainbow star	3.48					1.36	0.70	0.72
Echinodermata	*Pisaster brevispinus*	Spiny pink star								0.03
Echinodermata	*Pycnopodia helianthoides*	Sunflower star	5.57	1.50	1.37	9.88	5.35	2.72	4.22	3.80
Echinodermata	*Stylasterias forreri*	Velcro star							3.52	0.14
Echinodermata	*Asterina miniata*	Bat star						0.68	1.41	0.08
Echinodermata	*Henricia leviuscula*	Blood star	0.70			0.82		0.68	0.70	0.17

Table 2-13: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Nasoga Gulf (part 2) (cont'd)

Taxon	Species Name	Common Name	NG09	NG10	NG11	NG12	NG13	NG14	NG15	Whole Site
Echinodermata	*Henricia sanguinolenta*	Fat blood star								0.03
Echinodermata	*Hippasteria spinosa*	Spiny red star		0.38						0.14
Echinodermata	*Mediaster aequalis*	Vermillion star		0.38	0.46		0.89		0.70	1.25
Echinodermata	*Luidia foliolata*	Sandstar		0.38					1.41	0.14
Echinodermata	*Ophiura lutkena*	Grey brittle star						0.68		0.03
Echinodermata	*Pteraster tesselatus*	Cushion star			0.46					0.03
Echinodermata	*Ceramaster patagonicus*	Cookie star								0.03
Echinodermata	*Solaster paxillatus*	Orange sunstar						0.68		0.06
Echinodermata	*Crossaster papposus*	Rose star						0.68		0.03
Echinodermata	*Solaster stimpsoni*	Striped sunstar								0.03
Echinodermata	*Parastichopus californicus*	Giant california sea cucumber	6.96	7.13	5.47	6.59	2.67	13.61	1.41	4.38
Echinodermata	*Strongylocentrotus droebachiensis*	Green urchin								0.06
Echinodermata	*Strongylocentrotus purpuratus*	Purple urchin						1.36		0.06
Echinodermata	*Strongylocentrotus franciscanus*	Red urchin		0.38				0.68		0.06
Echinodermata	*Strongylocentrotus pallidus*	White urchin							1.41	0.06
Echinodermata	UnID Asteroidea	UnID Sea star		0.38	1.37	0.82		0.68	2.82	0.75
Echinodermata	UnID Holothuroidea	UnID Sea cucumbers								0.03
Gastropoda	UnID Gastropoda	UnID Gastropoda								0.06
Mollusca	*Clione limacina*	Sea angel							5.63	0.22
Mollusca	UnID Nudibranch	UnID Nudibranch								0.08

Table 2-13: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Nasoga Gulf (part 2) (cont'd)

Taxon	Species Name	Common Name	NG09	NG10	NG11	NG12	NG13	NG14	NG15	Whole Site
Porifera	*Aphrocallistes vastus*	Cloud sponge						2.72	11.26	0.55
Porifera	*Phakellia* spp.	Funnel sponge							4.22	0.17
Porifera	*Latrunculia* spp.	Chocolate puffball sponge			0.46					0.03
Porifera	*Polymastia pachymastia*	Vase sponge							0.70	0.03
Porifera	*Staurocalyptus dowlingi*	Round lipped boot sponge								0.03
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge							7.04	0.36
Porifera	UnID Porifera	UnID Encrusting yellow sponge	20.89		0.46			0.68		0.89
Tunicata	*Halocynthia aurantium*	Pacific sea peach								0.03
Tunicata	UnID Tunicata	UnID Tunicata								0.17

Table 2-14: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Nasoga Gulf (part 1)

Taxon	Species Name	Common Name	NG01	NG02	NG03	NG04	NG05	NG06	NG07	NG08
Flora										
Chlorophyta	*Cladophora columbiana*	Green tuft								
Chlorophyta	Ulva spp.	UnID Ulva							P	
Chlorophyta	UnID Chlorophyta	UnID Chlorophyta		A		P	P			P
Heterokontophyta	*Agarum clathratum*	Sieve kelp		P						
Heterokontophyta	*Fucus* spp.	UnID Fucus								
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae								
Rhodophyta	*Grateloupia americana*	Narrow iodine seaweed		P	P	P		P		
Rhodophyta	UnID Corallinales	UnID Crustose corraline algae							C	
Rhodophyta	UnID Rhodophyta	UnID Red algae		P	P	C			C	
Tracheophyta	*Zostera* spp.	Eelgrass	P							
UnID Algae	UnID Algae	UnID Algae	P		C					C
Other Invertebrates										
Annelida	UnID Serpulidae	UnID Tubeworm							A	
Annelida	UnID Serpulidae	UnID Tubeworm	C							
Arthropoda	*Balanus glandula*	Common acorn barnacles								
Arthropoda	*Balanus* spp.	UnID Barnacle								
Bryozoa	UnID Bryozoa	UnID Bryozoans	A							
Cnidaria	*Obelia* spp.	UnID Obeliad								
Cnidaria	*Halecium densum*	Dense bushy hydroid								
Cnidaria	*Plumularia setacea*	Glassy plume hydroid		P	P		P	P		P
Cnidaria	UnID Hydrozoa	Unknown hydroid	P						C	
Mollusca	*Mytilus* spp.	UnID Mussel	C							

Table 2-14: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Nasoga Gulf (part 1) (cont'd)

Taxon	Species Name	Common Name	NG01	NG02	NG03	NG04	NG05	NG06	NG07	NG08
Porifera	*Aphrocallistes vastus*	Cloud sponge		P					A	P
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge								
Porifera	UnID Hexactinellida	UnID Glass sponges							C	
Porifera	UnID Porifera	UnID Encrusting yellow sponge	P						C	

Legend:
P – Present <25%
C – Common 26–75%
A – Abundant >76%

Table 2-15: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Nasoga Gulf (part 2)

Taxon	Species Name	Common Name	NG09	NG10	NG11	NG12	NG13	NG14	NG15
Flora									
Chlorophyta	*Cladophora columbiana*	Green tuft						P	P
Chlorophyta	Ulva spp.	UnID Ulva							
Chlorophyta	UnID Chlorophyta	UnID Chlorophyta							
Heterokontophyta	*Agarum clathratum*	Sieve kelp							
Heterokontophyta	*Fucus* spp.	UnID Fucus			P		A		
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae		P					
Rhodophyta	*Grateloupia americana*	Narrow iodine seaweed							
Rhodophyta	UnID Corallinales	UnID Crustose corraline algae							
Rhodophyta	UnID Rhodophyta	UnID Red algae	P		P				
Tracheophyta	*Zostera* spp.	Eelgrass							
UnID Algae	UnID Algae	UnID Algae		C	P	C	A	P	P
Other Invertebrates									
Annelida	UnID Serpulidae	UnID Tubeworm						A	A
Annelida	UnID Serpulidae	UnID Tubeworm							
Arthropoda	*Balanus glandula*	Common acorn barnacles				C		C	C
Arthropoda	*Balanus* spp.	UnID Barnacle		P	C		A		
Bryozoa	UnID Bryozoa	UnID Bryozoans							
Cnidaria	*Obelia* spp.	UnID Obeliad	P	C	C				
Cnidaria	*Halecium densum*	Dense bushy hydroid				P		P	A
Cnidaria	*Plumularia setacea*	Glassy plume hydroid							
Cnidaria	UnID Hydrozoa	Unknown hydroid							
Mollusca	*Mytilus* spp.	UnID Mussel		C	C	C	C	C	P

Table 2-15: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Nasoga Gulf (part 2) (cont'd)

Taxon	Species Name	Common Name	NG09	NG10	NG11	NG12	NG13	NG14	NG15
Porifera	*Aphrocallistes vastus*	Cloud sponge	P						C
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge							P
Porifera	UnID Hexactinellida	UnID Glass sponges							
Porifera	UnID Porifera	UnID Encrusting yellow sponge	P					A	A

Legend:
P – Present <25%
C – Common 26–75%
A – Abundant >76%

Table 2-16: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel Head (part 1)

Taxon	Species Name	Common Name	WH01	WH02	WH03	WH04	WH05	WH06	WH08	WH08
Flora										
Heterokontophyta	*Coilodesme bulligera*	Sea chip								
Heterokontophyta	UnID Laminariacea	UnID Laminariacea								
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae								
Rhodophyta	UnID Corallinales	UnID Crustose corraline algae								
Rhodophyta	UnID Rhodophyta	UnID Red algae								
Crabs & Shrimp										
Cancridae	*Metacarcinus magister*	Dungeness crab							0.38	
Galatheidae	*Munida quadrispina*	Squat lobster	2.20		1.10					
UnID Crab	UnID Crab	UnID Crab		1.22						
UnID Shrimp	UnID Shrimp	UnID Shrimp	1.10							
Fish										
Agonidae	*Agonus acipenserinus*	Sturgeon poacher				0.82			0.38	4.05
Bathymasteridae	*Ronquilus jordani*	Northern ronquil	2.20	2.45			5.50	1.78	0.76	
Cottidae	*Scorpaenichthys marmoratus*	Cabezon								
Cottidae	*Artedius fenestralis*	Padded sculpin						0.59		
Cottidae	*Hemilepidotus hemilepidotus*	Red Irish lord			1.10					
Cottidae	*Icelinus tenuis*	Spotfin sculpin			1.10				0.38	0.68
Hexagrammidae	*Hexagrammos decagrammus*	Kelp greenling		1.22						
Pholidae	*Pholis* spp.	UnID Gunnel								
Pleuronectidae	*Microstomus Pacificus*	Dover sole						0.59		
Pleuronectidae	*Parophrys vetulus*	English sole								
Pleuronectidae	*Lepidopsetta bilineata*	Rock sole	2.20	13.46	9.93	7.41	4.58	1.19	9.54	35.78
Pleuronectidae	*Psettichthys melanostictus*	Sand sole						2.97		0.68

Table 2-16: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel Head (part 1) (cont'd)

Taxon	Species Name	Common Name	WH01	WH02	WH03	WH04	WH05	WH06	WH08	WH08
Pleuronectidae	*Lyopsetta exilis*	Slender sole								
Pleuronectidae	*Platichthys stellatus*	Starry flounder						0.59		
Pleuronectidae	UnID Pleuronectidae	UnID Righteye flounders		4.89		2.47	0.92	1.19	1.91	
Sebastidae	*Sebastes caurinus*	Copper rockfish	1.10		1.10					
Sebastidae	*Sebastes maliger*	Quillback rockfish	2.20				1.83			
Sebastidae	*Sebastes* spp.	UnID Rockfish		12.24						
Stichaeidae	*Lumpenus sagitta*	Snake prickleback			1.10		8.24	4.75	9.16	45.23
UnID Fish	UnID Fish	UnID Fish	5.51	1.22		1.65		0.59		
Zoarcidae	*Lycodes Pacificus*	Blackbelly eelpout	1.10							
Zoarcidae	*Lycodes* spp.	UnID Eelpout								
Other Invertebrates										
Annelida	UnID Sabellidae	UnID Feather duster worm	4.40			0.82			7.63	
Annelida	UnID Serpulidae	UnID Tubeworm					27.48	0.59		
Annelida	UnID Serpulidae	UnID Tubeworm								
Chordata	*Ascidia intestinalis*	Transparent sea squirt	6.61				18.32		2.29	
Chordata	*Corella inflata*	Brooding transparent tunicate								
Chordata	*Corella willmeriana*	Transparent tunicate								
Chordata	*Eudistoma solidium*	Red Ascidian								
Chordata	UnID Ascidiacea	UnID Ascidiacea								
Cnidaria	*Cribrinopsis fernaldi*	Crimson anemone			18.76	7.41	2.75	5.94	1.53	1.35
Cnidaria	*Polyorchis* spp.	Polyorchis spp.								
Cnidaria	*Metridium senile*	Short plumose anemone								
Cnidaria	*Aurelia labiata*	Moon jellyfish								
Cnidaria	UnID Anthozoa	UnID Anemones	1.10		3.31		0.92	1.19	0.38	

Table 2-16: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel Head (part 1) (cont'd)

Taxon	Species Name	Common Name	WH01	WH02	WH03	WH04	WH05	WH06	WH08	WH08
Cnidaria	UnID Cnidaria	UnID Jelly								7.43
Cnidaria	UnID Hydrozoa	Unknown hydroid								
Echinodermata	*Evasterias troscheli*	Mottled star								2.70
Echinodermata	*Orthasterias koehleri*	Rainbow star								
Echinodermata	*Pycnopodia helianthoides*	Sunflower star	2.20	1.22	1.10	0.82	0.92			0.68
Echinodermata	*Dermasterias imbricata*	Leather star	2.20	1.22						
Echinodermata	*Dendraster excentricus*	Pacific sand dollar								
Echinodermata	*Henricia leviuscula*	Blood star					0.92		0.38	0.68
Echinodermata	*Ceramaster patagonicus*	Cookie star	1.10							
Echinodermata	*Mediaster aequalis*	Vermillion star	1.10	2.45						
Echinodermata	*Parastichopus californicus*	Giant california sea cucumber	9.91	7.34	2.21			0.59		
Echinodermata	*Strongylocentrotus pallidus*	White urchin								
Echinodermata	UnID Asteroidea	UnID Sea star		2.45				0.59	0.76	
Echinodermata	UnID Holothuroidea	UnID Sea cucumbers								
Gastropoda	UnID Gastropoda	UnID Gastropoda								
Mollusca	*Armina* spp.	*Armina* spp.								
Mollusca	*Aldisa albomarginata*	White-rimmed nudibranch								
Mollusca	*Ansidoris noibilis*	Sea lemon nudibranch								
Mollusca	*Panopea generosa*	Pacific geoduck							2.29	
Mollusca	*Mytilus* spp.	UnID Mussel								
Mollusca	*Chlamys rubida*	Smooth scallop								
Mollusca	*Chlamys hastata*	Spiny pink scallop								
Mollusca	*Tochuina gigantea*	Lemon peel nudibranch								
Mollusca	UnID Bivalvia	UnID Bivalvia	6.61	1.22						0.68

Table 2-16: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel Head (part 1) (cont'd)

Taxon	Species Name	Common Name	WH01	WH02	WH03	WH04	WH05	WH06	WH08	WH08
Mollusca	UnID Nudibranchia	UnID Nudibranchia								
Mollusca	UnID Pectinidae	UnID Scallop			1.10					
Mollusca	*Mopalia* spp.	UnID Chiton					27.48			
Porifera	*Geodia mesotriaena*	Armoured Ball sponge								
Porifera	*Polymastia pachymastia*	Vase sponge								
Porifera	UnID Porifera	UnID Encrusting yellow sponge								
Porifera	UnID Sponge	UnID Sponge								
Tunicata	*Ciona savignyi*	Sea Vase								
Tunicata	*Halocynthia igaboja*	Bristly Tunicate								
Tunicata	*Halocynthia aurantium*	Pacific sea peach							1.91	
Tunicata	*Cnemidocarpa finmarkiensis*	Broadbase Tunicate								
Tunicata	UnID Tunicata	UnID Tunicata	1.10	26.92			0.92			

Table 2-17: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel Head (part 2)

Taxon	Species Name	Common Name	WH09	WH10	WH11	WH12	WH13	WH14	WH15	Whole Site
Flora										
Heterokontophyta	*Coilodesme bulligera*	Sea chip							0.72	0.05
Heterokontophyta	UnID Laminariacea	UnID Laminariacea					1.90			0.16
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae						1.87	2.87	0.32
Rhodophyta	UnID Corallinales	UnID Crustose corraline algae					0.63			0.05
Rhodophyta	UnID Rhodophyta	UnID Red algae						1.87	0.72	0.16
Crabs & Shrimp										
Cancridae	*Metacarcinus magister*	Dungeness crab					1.26			0.16
Galatheidae	*Munida quadrispina*	Squat lobster		1.15						0.22
UnID Crab	UnID Crab	UnID Crab								0.05
UnID Shrimp	UnID Shrimp	UnID Shrimp								0.05
Fish										
Agonidae	*Agonus acipenserinus*	Sturgeon poacher	5.10					1.87		0.70
Bathymasteridae	*Ronquilus jordani*	Northern ronquil	1.70							0.86
Cottidae	*Scorpaenichthys marmoratus*	Cabezon			0.81					0.05
Cottidae	*Artedius fenestralis*	Padded sculpin			0.81		1.90		0.72	0.33
Cottidae	*Hemilepidotus hemilepidotus*	Red Irish lord								0.05
Cottidae	*Icelinus tenuis*	Spotfin sculpin		2.30						0.27
Hexagrammidae	*Hexagrammos decagrammus*	Kelp greenling								0.05
Pholidae	*Pholis* spp.	UnID Gunnel							0.72	0.05
Pleuronectidae	*Microstomus Pacificus*	Dover sole								0.05
Pleuronectidae	*Parophrys vetulus*	English sole							0.72	0.05
Pleuronectidae	*Lepidopsetta bilineata*	Rock sole	25.52	5.74	4.06	3.64	4.42	3.74	2.87	8.62

Table 2-17: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel Head (part 2) (cont'd)

Taxon	Species Name	Common Name	WH09	WH10	WH11	WH12	WH13	WH14	WH15	Whole Site
Pleuronectidae	*Psettichthys melanostictus*	Sand sole							0.72	0.38
Pleuronectidae	*Lyopsetta exilis*	Slender sole						0.94	0.72	0.11
Pleuronectidae	*Platichthys stellatus*	Starry flounder		1.15					0.72	0.16
Pleuronectidae	UnID Pleuronectidae	UnID Righteye flounders					2.53		1.43	1.13
Sebastidae	*Sebastes caurinus*	Copper rockfish						0.94		0.16
Sebastidae	*Sebastes maliger*	Quillback rockfish							9.31	0.92
Sebastidae	*Sebastes* spp.	UnID Rockfish						0.94	0.72	0.65
Stichaeidae	*Lumpenus sagitta*	Snake prickleback	34.02		0.81	1.82	1.26	0.94	3.58	7.54
UnID Fish	UnID Fish	UnID Fish						0.94	2.87	0.75
Zoarcidae	*Lycodes Pacificus*	Blackbelly eelpout								0.05
Zoarcidae	*Lycodes* spp.	UnID Eelpout					3.16			0.27
Other Invertebrates										
Annelida	UnID Sabellidae	UnID Feather duster worm		22.97	0.81					2.48
Annelida	UnID Serpulidae	UnID Tubeworm					1.26	10.29		2.37
Annelida	UnID Serpulidae	UnID Tubeworm						0.94		0.05
Chordata	*Ascidia intestinalis*	Transparent sea squirt								1.72
Chordata	*Corella inflata*	Brooding transparent tunicate						3.74		0.22
Chordata	*Corella willmeriana*	Transparent tunicate							1.43	0.11
Chordata	*Eudistoma solidium*	Red Ascidian							0.72	0.05
Chordata	UnID Ascidiacea	UnID Ascidiacea							12.18	0.92
Cnidaria	*Cribrinopsis fernaldi*	Crimson anemone	66.35	26.42	6.50	0.91	18.95	10.29	6.45	8.94
Cnidaria	*Polyorchis* spp.	*Polyorchis* spp.						2.81		0.16
Cnidaria	*Metridium senile*	Short plumose anemone	1.70		2.44	1.82				0.32

Table 2-17: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel Head (part 2) (cont'd)

Taxon	Species Name	Common Name	WH09	WH10	WH11	WH12	WH13	WH14	WH15	Whole Site
Cnidaria	*Aurelia labiata*	Moon jellyfish					9.48			0.81
Cnidaria	UnID Anthozoa	UnID Anemones					0.63	4.68	1.43	0.86
Cnidaria	UnID Cnidaria	UnID Jelly				3.64		1.87	2.87	1.13
Cnidaria	UnID Hydrozoa	UnID Hydroid							0.72	0.05
Echinodermata	*Evasterias troscheli*	Mottled star					0.63	0.94	0.72	0.38
Echinodermata	*Orthasterias koehleri*	Rainbow star				0.91				0.05
Echinodermata	*Pycnopodia helianthoides*	Sunflower star		1.15		1.82	1.26		1.43	0.75
Echinodermata	*Dermasterias imbricata*	Leather star								0.16
Echinodermata	*Dendraster excentricus*	Pacific sand dollar						1.87		0.11
Echinodermata	*Henricia leviuscula*	Blood star							0.72	0.22
Echinodermata	*Ceramaster patagonicus*	Cookie star								0.05
Echinodermata	*Mediaster aequalis*	Vermillion star			0.81		1.90	1.87		0.48
Echinodermata	*Parastichopus californicus*	Giant california sea cucumber		14.93	4.06			4.68	5.73	2.64
Echinodermata	*Strongylocentrotus pallidus*	White urchin							0.72	0.05
Echinodermata	UnID Asteroidea	UnID Sea star								0.27
Echinodermata	UnID Holothuroidea	UnID Sea cucumbers					1.26			0.11
Gastropoda	UnID Gastropoda	UnID Gastropoda							10.75	0.81
Mollusca	*Armina* spp.	*Armina* spp.					4.42			0.38
Mollusca	*Aldisa albomarginata*	White-rimmed nudibranch					0.63	1.87		0.16
Mollusca	*Ansidoris noibilis*	Sea lemon nudibranch					1.26			0.11
Mollusca	*Panopea generosa*	Pacific geoduck								0.32
Mollusca	*Mytilus* spp.	UnID Mussel					0.63			0.05
Mollusca	*Chlamys rubida*	Smooth scallop					1.26			0.11

Table 2-17: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel Head (part 2) (cont'd)

Taxon	Species Name	Common Name	WH09	WH10	WH11	WH12	WH13	WH14	WH15	Whole Site
Mollusca	*Chlamys hastata*	Spiny pink scallop						1.87		0.11
Mollusca	*Tochuina gigantea*	Lemon peel nudibranch					0.63			0.05
Mollusca	UnID Bivalvia	UnID Bivalvia								0.43
Mollusca	UnID Nudibranchia	UnID Nudibranchia					2.53	2.81		0.38
Mollusca	UnID Pectinidae	UnID Scallop								0.05
Mollusca	*Mopalia* spp.	UnID Chiton					0.63			1.67
Porifera	*Geodia mesotriaena*	Armoured Ball sponge							0.72	0.05
Porifera	*Polymastia pachymastia*	Vase sponge							2.87	0.22
Porifera	UnID Porifera	UnID Encrusting yellow sponge					0.63	1.87		0.16
Porifera	UnID Sponge	UnID Sponge							1.43	0.11
Tunicata	*Ciona savignyi*	Sea Vase						0.94		0.05
Tunicata	*Halocynthia igaboja*	Bristly Tunicate						0.94		0.05
Tunicata	*Halocynthia aurantium*	Pacific sea peach					0.63	1.87		0.43
Tunicata	*Cnemidocarpa finmarkiensis*	Broadbase Tunicate						5.61		0.32
Tunicata	UnID Tunicata	UnID Tunicata					3.79	8.42		2.10

Table 2-18: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel Head (part 1)

Taxon	Species Name	Common Name	WH01	WH02	WH03	WH04	WH05	WH06	WH07	WH08
Flora										
Chlorophyta	*Chaetomorpha* spp.	Curly sea hair	P							
Chlorophyta	UnID Chlorophyta	UnID Chlorophyta		A				A	A	
Heterokontophyta	*Alaria marginata*	Ribbon kelp			P	P	A			P
Heterokontophyta	*Agarum* spp.	*Agarum* spp.								
Heterokontophyta	*Agarum fimbriatum*	Frigned sea colander kelp			C		C	C	A	
Heterokontophyta	*Agarum clathratum*	Sieve kelp								P
Heterokontophyta	*Fucus gardneri*	Rock weed								
Heterokontophyta	*Fucus* spp.	UnID Fucus								
Heterokontophyta	*Saccharina* spp.	*Saccharina* spp.								
Heterokontophyta	*Saccharina groenlandica*	Split kelp								
Heterokontophyta	UnID Laminariacea	UnID Laminariacea	C				P			
Heterokontophyta	*Sphacelaria rigidula*	Brown sea moss						A	A	A
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae	C	P	P	A	A		P	
Rhodophyta	*Grateloupia americana*	Narrow iodine seaweed	P		P					
Rhodophyta	*Palmaria callophylloides*	Frilly red ribbon							P	
Rhodophyta	*Sparlingia pertusa*	Red eyelet silk		P						
Rhodophyta	UnID Corallinales	UnID Crustose corraline algae	P	A						
Rhodophyta	UnID Rhodophyta	UnID Red algae	P	A			P	A		
Tracheophyta	*Zostera* spp.	Eelgrass				A				
Tracheophyta	*Zostera marina*	Eelgrass								
UnID Algae	UnID Algae	UnID Algae						A		

Table 2-18: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel Head (part 1) (cont'd)

Taxon	Species Name	Common Name	WH01	WH02	WH03	WH04	WH05	WH06	WH07	WH08
Other Invertebrates										
Annelida	UnID Serpulidae	UnID Tubeworm								
Arthropoda	*Balanus* spp.	UnID Barnacle								
Bryozoa	*Membranipora serrilamella*	Kelp encrusting bryozoan								
Bryozoa	UnID Bryozoa	UnID Bryozoans								
Cnidaria	UnID Stylasteridae	Purple encrusting hydrocoral								
Gastropoda	UnID Gastropoda	UnID Gastropoda								
Mollusca	UnID Nudibranchia	UnID Nudibranchia	C				P		P	
Porifera	*Geodia mesotriaena*	Armoured ball sponge								P
Porifera	*Polymastia pachymastia*	Vase sponge								
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge								P
Porifera	UnID Porifera	UnID Encrusting yellow sponge				P				

Legend:
P – Present <25%
C – Common 25–76%
A – Abundant >76%

Table 2-19: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel Head (part 2)

Taxon	Species Name	Common Name	WH09	WH10	WH11	WH12	WH13	WH14	WH15
Flora									
Chlorophyta	*Chaetomorpha* spp.	Curly sea hair							
Chlorophyta	UnID Chlorophyta	UnID Chlorophyta							P
Heterokontophyta	*Alaria marginata*	Ribbon kelp		P					
Heterokontophyta	*Agarum* spp.	*Agarum* spp.					C	A	
Heterokontophyta	*Agarum fimbriatum*	Frigned sea colander kelp	P	C	P	P			
Heterokontophyta	*Agarum clathratum*	Sieve kelp	P	C	C				
Heterokontophyta	*Fucus gardneri*	Rock weed							C
Heterokontophyta	*Fucus* spp.	UnID Fucus			P	P			
Heterokontophyta	*Saccharina* spp.	*Saccharina* spp.						P	
Heterokontophyta	*Saccharina groenlandica*	Split kelp							C
Heterokontophyta	UnID Laminariacea	UnID Laminariacea					P		
Heterokontophyta	*Sphacelaria rigidula*	Brown sea moss		C	C	C			
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae			A			A	A
Rhodophyta	*Grateloupia americana*	Narrow iodine seaweed							
Rhodophyta	*Palmaria callophylloides*	Frilly red ribbon		P	P	P			
Rhodophyta	*Sparlingia pertusa*	Red eyelet silk							
Rhodophyta	UnID Corallinales	UnID Crustose corraline algae					A		
Rhodophyta	UnID Rhodophyta	UnID Red algae				P			
Tracheophyta	*Zostera* spp.	Eelgrass					A	A	
Tracheophyta	*Zostera marina*	Eelgrass	A	A	A	A			
UnID Algae	UnID Algae	UnID Algae							P

Table 2-19: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel Head (part 2) (cont'd)

Taxon	Species Name	Common Name	WH09	WH10	WH11	WH12	WH13	WH14	WH15
Other Invertebrates									
Annelida	UnID Serpulidae	UnID Tubeworm						P	P
Arthropoda	*Balanus* spp.	UnID Barnacle							C
Bryozoa	*Membranipora serrilamella*	Kelp encrusting bryozoan			P	P			
Bryozoa	UnID Bryozoa	UnID Bryozoans						A	
Cnidaria	UnID Stylasteridae	Purple encrusting hydrocoral							A
Gastropoda	UnID Gastropoda	UnID Gastropoda						P	
Mollusca	UnID Nudibranchia	UnID Nudibranchia							
Porifera	*Geodia mesotriaena*	Armoured ball sponge							
Porifera	*Polymastia pachymastia*	Vase sponge							P
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge							
Porifera	UnID Porifera	UnID Encrusting yellow sponge					P	A	A

Legend:
P – Present <25%
C – Common 26–75%
A – Abundant >76%

Table 2-20: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel North (part 1)

Taxon	Species Name	Common Name	WN01	WN02	WN03	WN04	WN05	WN06	WN07	WN08
Flora										
Heterokontophyta	*Nereocystis luetkeana*	Bull kelp	0.49		0.16	0.11	0.10	0.38		0.31
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae				0.11				
UnID Algae	UnID Algae	UnID Algae								
Crabs & Shrimp										
Cancridae	*Metacarcinus magister*	Dungeness crab						0.13		
Galatheidae	*Munida quadrispina*	Squat lobster			2.48		0.60	0.88	0.12	
Lithodidae	UnID Lithodidae	UnID Lithodidae						0.13		
Paguroidea	UnID Paguroidea	UnID Hermit crab					0.10	0.13		0.16
Pandalidae	*Pandalus platyceros*	Pacific prawn						0.25		
Pandalidae	*Pandalus eous*	Spiny pink shrimp								
Pandalidae	*Pandalus* spp.	UnID Pandalus shrimp	265.98	421.84	15.50		15.04	25.36		
UnID Shrimp	UnID Shrimp	UnID Shrimp							117.55	
Fish										
Agonidae	UnID Agonidae	UnID Poacher								
Bathymasteridae	*Ronquilus jordani*	Northern ronquil			0.16		0.20	1.00	1.53	1.25
Chimaeridae	*Hydrolagus colliei*	Ratfish			0.16	0.11	0.20	1.13	0.12	0.62
Cottidae	*Artedius fenestralis*	Cottidae							0.12	
Cottidae	*Myoxocephalus polyacanthocephalus*	Great sculpin				0.11				
Cottidae	*Icelinus borealis*	Northern sculpin			0.16					
Cottidae	*Triglops macellus*	Roughspine sculpin							0.12	
Cottidae	UnID Cottidae	UnID Sculpin	0.25		1.09	0.11	0.40	0.50		
Cottidae	*Radulinus asprellus*	Slim sculpin				0.11				
Cottidae	*Dasycottus setiger*	Spinyhead sculpin					0.10			

Table 2-20: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel North (part 1) (cont'd)

Taxon	Species Name	Common Name	WN01	WN02	WN03	WN04	WN05	WN06	WN07	WN08
Cottidae	*Icelinus tenuis*	Spotfin sculpin				0.11		0.25	0.12	
Embiotocidae	*Embiotocidae*	Embiotocidae					1.20			
Embiotocidae	UnID Embiotocidae	UnID Surfperch								
Gadidae	*Gadus macrocephalus*	Pacific cod		0.26		0.11			0.24	
Gadidae	*Microgadus proximus*	Pacific tomcod								
Gadidae	UnID Gadidae	UnID Cod			0.16					
Gobiidae	*Lepidogobius lepidus*	Bay goby			0.47			0.13		
Hexagrammidae	*Hexagrammos decagrammus*	Kelp greenling		0.77						
Hexagrammidae	*Ophiodon elongatus*	Lingcod				0.11				0.16
Pholidae	*Pholis clemensi*	Longfin gunnel								0.16
Pleuronectidae	*Parophrys vetulus*	English sole			0.47		0.90			
Pleuronectidae	*Hippoglossoides elassodon*	Flathead sole						0.25		
Pleuronectidae	*Lepidopsetta bilineata*	Rock sole			0.78	0.32	0.40	0.13	0.47	0.47
Pleuronectidae	*Psettichthys melanostictus*	Sand sole							0.24	
Pleuronectidae	*Lyopsetta exilis*	Slender Sole				0.97	0.20	0.13		
Pleuronectidae	UnID Pleuronectidae	UnID Righteye flounders	0.74	0.26	0.78	0.22	1.10	0.38	0.24	
Rajidae	*Raja rhina*	Longnose Skate								
Sebastidae	*Sebastes melanops*	Black rockfish						0.25		
Sebastidae	*Sebastes mystinus*	Blue rockfish								0.16
Sebastidae	*Sebastes auriculatus*	Brown rockfish							0.12	
Sebastidae	*Sebastes pinniger*	Canary rockfish							0.12	
Sebastidae	*Sebastes nebulosus*	China rockfish						0.13		
Sebastidae	*Sebastes caurinus*	Copper rockfish	0.74	0.51		0.22			0.82	0.16
Sebastidae	*Sebastes crameri*	Darkblotched rockfish								
Sebastidae	*Sebastes elongatus*	Greenstripe rockfish				0.11				

Table 2-20: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel North (part 1) (cont'd)

Taxon	Species Name	Common Name	WN01	WN02	WN03	WN04	WN05	WN06	WN07	WN08
Sebastidae	*Sebastes alutus*	Pacific ocean perch								
Sebastidae	*Sebastes maliger*	Quillback rockfish		1.02	1.40	1.52	2.21	2.89		0.94
Sebastidae	*Sebastes proriger*	Redstripe rockfish								
Sebastidae	*Sebastes spp.*	Rockfish	2.97	1.28	1.09	0.11	0.90	1.00		
Sebastidae	*Sebastes miniatus*	Rockfish (vermillion)	0.25	0.26						
Sebastidae	UnID rockfish	UnID rockfish		3.83		1.41				
Sebastidae	*Sebastes ruberrimus*	Yelloweye rockfish				0.32		0.25		
Sebastidae	*Sebastes flavidus*	Yellowtail rockfish		7.92					0.24	
Stichaeidae	*Lumpenus sagitta*	Snake prickleback			0.62	0.22	0.40	0.38		
Stichaeidae	*Poroclinus rothrocki*	Whitebarred prickleback				0.11	0.20			
UnID Fish	UnID Fish	UnID Fish	8.16	1.53	4.19	2.60	5.31	3.51	1.76	0.16
Zoarcidae	*Lycodes pacificus*	Blackbelly eelpout				0.11				
Zoarcidae	*Lycodes* spp	Eelpout	0.25							
Other Invertebrates										
Annelida	*Protula pacifica*	Slime Tubeworm							1.29	2.50
Annelida	UnID Serpulidae	UnID Tubeworm	0.25	0.77	1.71		2.11	2.13	1.18	
Annelida	UnID Polychaete	UnID Polychaete								
Chordata	UnID Ascidiidae	UnID Ascidiidae					0.10	0.13		
Chordata	*Corella inflata*	Brooding transparent tunicate								
Chordata	*Corella willmeriana*	Transparent tunicate								5.15
Cnidaria	*Cribrinopsis fernaldi*	Crimson anemone	1.24	0.26	1.71	0.43	0.40	1.13	0.12	1.09
Cnidaria	*Urticina columbiana*	Sand anemone				0.11				
Cnidaria	*Stomphia didemon*	Swimming anemone								
Cnidaria	*Stomphia* spp.	UnID Swimming anemone					0.10			
Cnidaria	*Aglaophenia struthionides*	Ostrich-plume hydroids								

Table 2-20: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel North (part 1) (cont'd)

Taxon	Species Name	Common Name	WN01	WN02	WN03	WN04	WN05	WN06	WN07	WN08
Cnidaria	*Balanophyllia elegans*	Orange cup coral					0.50	0.88		
Cnidaria	*Halipteris willemoesi*	Sea whip			0.31		0.30	2.01		
Cnidaria	*Metridium farcimen*	Giant plumose anemone	4.70	6.38	1.71	3.03	1.20	0.88		
Cnidaria	*Metridium senile*	Short plumose anemone	0.25	2.04					0.24	
Cnidaria	*Aurelia labiata*	Moon jellyfish								
Cnidaria	UnID Anthozoa	UnID Anemones	0.25			0.11				
Cnidaria	UnID Coral	UnID Coral								
Ctenophora	*Bolinopsis infundibulum*	Fragile Combjelly								
Ctenophora	UnID Ctenophora	UnID Ctenophora				0.11				
Echinodermata	*Florometra serratissima*	Feather star			1.09	0.11		8.66		0.62
Echinodermata	*Evasterias troscheli*	Mottled star		0.26		0.11				
Echinodermata	*Pisaster ochraceus*	Purple star						0.25	0.12	0.62
Echinodermata	*Orthasterias koehleri*	Rainbow star			0.16		0.60	0.50		0.47
Echinodermata	*Pisaster brevispinus*	Spiny pink star			0.16		0.10	0.25		0.16
Echinodermata	*Pycnopodia helianthoides*	Sunflower star	0.49	0.26	0.62	0.11	0.50	0.13	0.82	0.78
Echinodermata	*Stylasterias forreri*	Velcro star		0.26	0.47	0.22	0.50	0.38		
Echinodermata	*Asterina miniata*	Bat star								
Echinodermata	*Henricia leviuscula*	Blood star			0.31	0.11		0.25		0.16
Echinodermata	*Henricia sanguinolenta*	Fat blood star			0.16		0.40			
Echinodermata	*Henricia aspera*	Ridged blood star				0.22		0.38		
Echinodermata	*Henricia asthenactis*	Sea star	0.74	0.51						
Echinodermata	*Henricia* spp.	UnID blood star	1.48	1.28						
Echinodermata	*Ceramaster patagonicus*	Cookie star	0.25	0.77			0.50	1.38		0.16
Echinodermata	*Gephyreaster swifti*	Gunpowder sea star	0.74	0.51		1.19				
Echinodermata	*Hippasteria spinosa*	Spiny red star				0.11				0.16

Table 2-20: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel North (part 1) (cont'd)

Taxon	Species Name	Common Name	WN01	WN02	WN03	WN04	WN05	WN06	WN07	WN08
Echinodermata	*Mediaster aequalis*	Vermillion star	2.97	3.83	9.92	5.96	4.21	5.52	2.00	0.94
Echinodermata	*Luidia foliolata*	Sandstar				0.87			0.71	0.16
Echinodermata	*Ophiura lutkeni*	Grey brittle star					0.10	0.13		
Echinodermata	*Psolus chitinoides*	Creeping pedal sea cucumber				0.11				0.16
Echinodermata	*Pteraster tesselatus*	Cushion star		0.26			0.10			
Echinodermata	*Solaster dawsoni*	Morning sunstar	0.74	0.51			0.10	0.25		
Echinodermata	*Solaster endeca*	Northern sun star						0.13		
Echinodermata	*Crossaster papposus*	Rose star	1.24		0.78	0.43	0.70	1.38		1.09
Echinodermata	*Parastichopus californicus*	Giant california sea cucumber	1.24	7.41	4.65	2.82	3.61	5.27	2.35	9.36
Echinodermata	*Strongylocentrotus droebachiensis*	Green urchin						3.51		
Echinodermata	*Strongylocentrotus pallidus*	White urchin	1.48	0.26	0.93	0.22	0.40	1.13		0.16
Echinodermata	*Synallectes challangeri*	Long-spined sea cucumber					0.10			
Echinodermata	*Strongylocentrotus pallidus*	White urchin							0.12	
Echinodermata	UnID Asteroidea	UnID Sea star	0.25	1.28	0.78	1.30	0.40	0.63		
Echinodermata	UnID Holothuroidea	UnID Sea cucumbers					0.20			
Gastropoda	UnID Gastropoda	UnID Gastropoda						2.51		
Mollusca	*Neptunea* spp	UnID Whelk								0.16
Mollusca	*Dirona albolineata*	Frosted Dirona								0.31
Mollusca	*Doris odhneri*	Giant White Dorid								
Mollusca	*Nucella* spp.	Nucella spp.								
Mollusca	UnID Octopus	UnID Octopus								
Mollusca	*Chlamys rubida*	Smooth scallop								
Mollusca	*Melibe leonina*	Hooded nudibranch				0.54	2.51			9.68
Mollusca	UnID Cephalopoda	UnID Cephalopoda								

Table 2-20: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel North (part 1) (cont'd)

Taxon	Species Name	Common Name	WN01	WN02	WN03	WN04	WN05	WN06	WN07	WN08
Mollusca	UnID Nudibranch	UnID Nudibranch	0.25							0.16
Mollusca	UnID Nudibranchia	UnID Nudibranchia		0.26						
Mollusca	*Mopalia* spp.	UnID Chiton								0.16
Porifera	*Aphrocallistes vastus*	Cloud sponge		0.51						
Porifera	*Phakellia* spp.	Funnel sponge					0.10			
Porifera	*Polymastia pachymastia*	Vase sponge				0.11				
Porifera	*Staurocalyptus dowlingi*	Round lipped boot sponge		0.77				0.13		
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge		4.09	0.62	2.38	1.70	5.15		
Porifera	*Suberites montiniger*	Peach ball sponge				0.11				1.87
Porifera	*Scypha compacta*	Tubular vase sponge								
Porifera	UnID Hexactinellida	UnID Glass sponges	0.49	0.26						
Porifera	UnID Porifera	UnID Encrusting yellow sponge				0.54				
Porifera	UnID sponge	UnID Sponge		0.77	0.62	0.87	0.30	0.50		
Tunicata	*Halocynthia aurantium*	Pacific sea peach			0.31		0.10	0.38	3.53	0.47
Tunicata	UnID Tunicata	UnID Tunicata		1.02						

Table 2-21: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel North (part 2)

Taxon	Species Name	Common Name	WN09	WN10	WN11	WN12	WN13	WN14	WN15	Whole Site
Flora										
Heterokontophyta	*Nereocystis luetkeana*	Bull kelp						0.73	1.28	0.20
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae	0.38							0.03
UnID Algae	UnID Algae	UnID Algae				0.78				0.03
Crabs & Shrimp										
Cancridae	*Metacarcinus magister*	Dungeness crab								0.01
Galatheidae	*Munida quadrispina*	Squat lobster							0.85	0.43
Lithodidae	UnID Lithodidae	UnID Lithodidae								0.01
Paguroidea	UnID Paguroidea	UnID Hermit crab								0.04
Pandalidae	*Pandalus platyceros*	Pacific prawn		0.38	0.38			0.37	0.85	0.09
Pandalidae	*Pandalus eous*	Spiny pink shrimp					0.71			0.03
Pandalidae	*Pandalus* spp.	UnID Pandalus shrimp		38.20	37.56			109.93	42.60	50.49
UnID Shrimp	UnID Shrimp	UnID Shrimp								13.35
Fish										
Agonidae	UnID Agonidae	UnID Poacher				0.39				0.01
Bathymasteridae	*Ronquilus jordani*	Northern ronquil								0.43
Chimaeridae	*Hydrolagus colliei*	Ratfish	0.76		1.50	1.17		0.37		0.37
Cottidae	*Artedius fenestralis*	Cottidae								0.01
Cottidae	*Myoxocephalus polyacanthocephalus*	Great sculpin								0.01
Cottidae	*Icelinus borealis*	Northern sculpin								0.01
Cottidae	*Triglops macellus*	Roughspine sculpin								0.01
Cottidae	UnID Cottidae	UnID Sculpin			0.38			0.37		0.25
Cottidae	*Radulinus asprellus*	Slim sculpin								0.01

Table 2-21: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel North (part 2) (cont'd)

Taxon	Species Name	Common Name	WN09	WN10	WN11	WN12	WN13	WN14	WN15	Whole Site
Cottidae	*Dasycottus setiger*	Spinyhead sculpin								0.01
Cottidae	*Icelinus tenuis*	Spotfin sculpin								0.05
Embiotocidae	*Embiotocidae*	Embiotocidae								0.16
Embiotocidae	UnID Embiotocidae	UnID Surfperch							0.43	0.01
Gadidae	*Gadus macrocephalus*	Pacific cod	0.38	1.53	0.38				0.43	0.15
Gadidae	*Microgadus proximus*	Pacific tomcod					0.35			0.01
Gadidae	UnID *Gadidae*	UnID Cod								0.01
Gobiidae	*Lepidogobius lepidus*	Bay goby								0.05
Hexagrammidae	*Hexagrammos decagrammus*	Kelp greenling								0.04
Hexagrammidae	*Ophiodon elongatus*	Lingcod								0.03
Pholidae	*Pholis clemensi*	Longfin gunnel								0.01
Pleuronectidae	*Parophrys vetulus*	English sole								0.16
Pleuronectidae	*Hippoglossoides elassodon*	Flathead sole								0.03
Pleuronectidae	*Lepidopsetta bilineata*	Rock sole								0.27
Pleuronectidae	*Psettichthys melanostictus*	Sand sole								0.03
Pleuronectidae	*Lyopsetta exilis*	Slender sole	0.38	1.15	0.38	1.94				0.29
Pleuronectidae	UnID *Pleuronectidae*	UnID Righteye flounders		0.38				0.37		0.39
Rajidae	*Raja rhina*	Longnose Skate		0.38				0.37		0.03
Sebastidae	*Sebastes melanops*	Black rockfish								0.03
Sebastidae	*Sebastes mystinus*	Blue rockfish								0.01
Sebastidae	*Sebastes auriculatus*	Brown rockfish					0.35			0.03
Sebastidae	*Sebastes pinniger*	Canary rockfish								0.01
Sebastidae	*Sebastes nebulosus*	China rockfish								0.01

Table 2-21: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel North (part 2) (cont'd)

Taxon	Species Name	Common Name	WN09	WN10	WN11	WN12	WN13	WN14	WN15	Whole Site
Sebastidae	*Sebastes caurinus*	Copper rockfish								0.20
Sebastidae	*Sebastes crameri*	Darkblotched rockfish		0.38		0.39		0.37		0.04
Sebastidae	*Sebastes elongatus*	Greenstripe rockfish								0.01
Sebastidae	*Sebastes alutus*	Pacific ocean perch	0.38							0.01
Sebastidae	*Sebastes maliger*	Quillback rockfish		1.15	1.13	0.78	0.35			1.16
Sebastidae	*Sebastes proriger*	Redstripe rockfish	0.38							0.01
Sebastidae	*Sebastes* spp.	Rockfish		3.06	1.88			1.10	1.28	0.81
Sebastidae	*Sebastes miniatus*	Rockfish (vermillion)								0.03
Sebastidae	UnID *rockfish*	UnID rockfish	4.57				1.77			0.60
Sebastidae	*Sebastes ruberrimus*	Yelloweye rockfish	0.76	0.38	0.38		0.71			0.15
Sebastidae	*Sebastes flavidus*	Yellowtail rockfish					2.13			0.52
Stichaeidae	*Lumpenus sagitta*	Snake prickleback					0.35			0.19
Stichaeidae	*Poroclinus rothrocki*	Whitebarred prickleback								0.04
UnID Fish	UnID *Fish*	UnID Fish	0.76	0.76	1.50	1.94	1.42	1.46	1.28	2.82
Zoarcidae	*Lycodes pacificus*	Blackbelly eelpout								0.01
Zoarcidae	*Lycodes* spp.	Eelpout								0.01
Other Invertebrates										
Annelida	*Protula pacifica*	Slime Tubeworm								0.36
Annelida	UnID Serpulidae	UnID Tubeworm	0.38	3.82	4.51	0.78	3.19	5.48	22.15	2.19
Annelida	UnID Polychaete	UnID Polychaete						0.37		0.01
Chordata	UnID Ascidiidae	UnID Ascidiidae			0.38	1.94	0.35			0.12
Chordata	*Corella inflata*	Brooding transparent tunicate	1.52				1.06			0.09
Chordata	*Corella willmeriana*	Transparent tunicate								0.44

Table 2-21: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel North (part 2) (cont'd)

Taxon	Species Name	Common Name	WN09	WN10	WN11	WN12	WN13	WN14	WN15	Whole Site
Cnidaria	*Cribrinopsis fernaldi*	Crimson anemone	1.14	0.76	1.50	0.78	0.35	1.46	2.56	0.85
Cnidaria	*Urticina columbiana*	Sand anemone								0.01
Cnidaria	*Stomphia didemon*	Swimming anemone				0.39				0.01
Cnidaria	*Stomphia* spp.	UnID swimming anemone								0.01
Cnidaria	*Aglaophenia struthionides*	Ostrich-plume hydroids	0.76							0.03
Cnidaria	*Balanophyllia elegans*	Orange cup coral		3.82						0.29
Cnidaria	*Halipteris willemoesi*	Sea whip								0.28
Cnidaria	*Metridium farcimen*	Giant plumose anemone	8.76	0.38			0.35	2.56	2.98	1.88
Cnidaria	*Metridium senile*	Short plumose anemone							0.85	0.17
Cnidaria	*Aurelia labiata*	Moon jellyfish			0.38					0.01
Cnidaria	UnID Anthozoa	UnID Anemones	3.43	0.38		1.94	7.44	0.37		0.52
Cnidaria	UnID Coral	UnID Coral	0.76							0.03
Ctenophora	*Bolinopsis infundibulum*	Fragile combjelly					0.35			0.01
Ctenophora	UnID Ctenophora	UnID Ctenophora	0.38			1.17				0.07
Echinodermata	*Florometra serratissima*	Feather star								1.08
Echinodermata	*Evasterias troscheli*	Mottled star	0.76			0.39				0.07
Echinodermata	*Pisaster ochraceus*	Purple star								0.09
Echinodermata	*Orthasterias koehleri*	Rainbow star	0.38	0.38		0.39		0.37	0.43	0.25
Echinodermata	*Pisaster brevispinus*	Spiny pink star								0.07
Echinodermata	*Pycnopodia helianthoides*	Sunflower star	0.76		1.13	0.39	0.35			0.44
Echinodermata	*Stylasterias forreri*	Velcro star			0.38	2.33		0.37	0.43	0.31
Echinodermata	*Asterina miniata*	Bat star						0.37		0.01
Echinodermata	*Henricia leviuscula*	Blood star								0.08

Table 2-21: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel North (part 2) (cont'd)

Taxon	Species Name	Common Name	WN09	WN10	WN11	WN12	WN13	WN14	WN15	Whole Site
Echinodermata	*Henricia sanguinolenta*	Fat blood star							1.28	0.11
Echinodermata	*Henricia aspera*	Ridged blood star		0.76				0.37		0.11
Echinodermata	*Henricia asthenactis*	Sea star								0.07
Echinodermata	*Henricia* spp.	UnID Blood star								0.15
Echinodermata	*Ceramaster patagonicus*	Cookie star	0.38	2.29	1.13	0.39		1.10	0.85	0.49
Echinodermata	*Gephyreaster swifti*	Gunpowder sea star						0.37		0.23
Echinodermata	*Hippasteria spinosa*	Spiny red star								0.03
Echinodermata	*Mediaster aequalis*	Vermillion star		0.38	3.38	1.17	1.42	4.02	0.85	3.81
Echinodermata	*Luidia foliolata*	Sandstar								0.20
Echinodermata	*Ophiura lutkeni*	Grey brittle star								0.03
Echinodermata	*Psolus chitinoides*	Creeping pedal sea cucumber				0.39				0.04
Echinodermata	*Pteraster tesselatus*	Cushion star	0.38							0.04
Echinodermata	*Solaster dawsoni*	Morning sunstar					0.35			0.12
Echinodermata	*Solaster endeca*	Northern sunstar		0.76						0.04
Echinodermata	*Crossaster papposus*	Rose star	2.29	2.29	2.25	0.39	0.71	1.83		0.87
Echinodermata	*Parastichopus californicus*	Giant california sea cucumber	5.33	4.97	1.50	2.33	2.83	6.94	2.56	4.25
Echinodermata	*Strongylocentrotus droebachiensis*	Green urchin								0.37
Echinodermata	*Strongylocentrotus pallidus*	White urchin	1.91	1.15	3.38	1.17	2.48	2.56	1.28	0.88
Echinodermata	*Synallectes challangeri*	Long-spined Sea cucumber		0.38						0.03
Echinodermata	*Strongylocentrotus pallidus*	White urchin								0.01
Echinodermata	UnID *Asteroidea*	UnID Sea star	2.29			1.94	2.48	0.73		0.69
Echinodermata	UnID *Holothuroidea*	UnID Sea cucumbers		1.15						0.07
Gastropoda	UnID *Gastropoda*	UnID Gastropoda	0.38							0.28

Table 2-21: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel North (part 2) (cont'd)

Taxon	Species Name	Common Name	WN09	WN10	WN11	WN12	WN13	WN14	WN15	Whole Site
Mollusca	*Neptunea* spp.	UnID Whelk								0.01
Mollusca	*Dirona albolineata*	Frosted dirona								0.03
Mollusca	*Doris odhneri*	Giant white dorid	0.38							0.01
Mollusca	*Nucella* spp.	Nucella spp						3.65		0.13
Mollusca	UnID *Octopus*	UnID Octopus		0.38						0.01
Mollusca	*Chlamys rubida*	Smooth scallop						0.37		0.01
Mollusca	*Melibe leonina*	Hooded nudibranch				1.94		0.37		1.31
Mollusca	UnID *Cephalopoda*	UnID Cephalopoda					0.35			0.01
Mollusca	UnID *Nudibranch*	UnID Nudibranch								0.03
Mollusca	UnID *Nudibranchia*	UnID Nudibranchia								0.01
Mollusca	*Mopalia* spp.	UnID Chiton								0.01
Porifera	*Aphrocallistes vastus*	Cloud sponge	4.57			0.78	0.71			0.24
Porifera	*Phakellia* spp.	Funnel sponge			0.38					0.03
Porifera	*Polymastia pachymastia*	Vase sponge				0.39				0.03
Porifera	*Staurocalyptus dowlingi*	Round lipped boot sponge								0.05
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge	1.14	0.76	3.00	1.17	0.71	0.73		1.60
Porifera	*Suberites montiniger*	Peach ball sponge					3.90			0.32
Porifera	*Scypha compacta*	Tubular vase sponge	0.76							0.03
Porifera	UnID *Hexactinellida*	UnID Glass sponges	0.76							0.07
Porifera	UnID *Porifera*	UnID Encrusting yellow sponge				0.39				0.08
Porifera	UnID *Sponge*	UnID Sponge	2.67	0.38		0.39		0.37	0.85	0.45
Tunicata	*Halocynthia aurantium*	Pacific sea peach		1.15		0.78	11.69			1.03
Tunicata	UnID *Tunicata*	UnID Tunicata					0.35			0.07

Table 2-22: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel North (part 1)

Taxon	Species Name	Common Name	WN01	WN02	WN03	WN04	WN05	WN06	WN07	WN08
Flora										
Chlorophyta	*Ulva* spp.	UnID Ulva			C					
Chlorophyta	UnID Chlorophyta	UnID Chlorophyta							C	
Heterokontophyta	*Fucus gardneri*	Rock weed								
Heterokontophyta	*Fucus* spp.	UnID Fucus				A		A	C	A
Heterokontophyta	*Nereocystis luetkeana*	Bull kelp						P		
Heterokontophyta	*Laminaria* spp.	*Laminaria* spp.	C			A				A
Heterokontophyta	*Alaria marginata*	Ribbon kelp								
Heterokontophyta	*Saccharina groenlandica*	Split kelp								
Heterokontophyta	*Laminaria saccharina*	Sugar kelp				C		P	P	
Heterokontophyta	*Palmaria mollis*	Thin dulse							P	
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae				A				A
Rhodophyta	*Lithothamnion* spp.	Pink rock crust			A	A	A	A		A
Rhodophyta	*Hildenbrandia* spp.	Red rock crust			P			C		C
Rhodophyta	*Mastocarpus papillatus*	Turkish washcloth								
Rhodophyta	UnID Corallinales	UnID Crustose corraline algae		A		P				
Rhodophyta	UnID Rhodophyta	UnID Red algae					P	A		P
Tracheophyta	*Zostera* spp.	Eelgrass					A			
UnID Algae	UnID Algae	UnID Algae								
Other Invertebrates										
Annelida	*Spiochaetopterus costarum*	Jointed three-section tubeworm					P			
Annelida	*Protula Pacifica*	Slime tubeworm						P		
Annelida	UnID Serpulidae	UnID Tubeworm	P	C	A	A	A	A	A	P

Table 2-22: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel North (part 1) (cont'd)

Taxon	Species Name	Common Name	WN01	WN02	WN03	WN04	WN05	WN06	WN07	WN08
Arthropoda	*Balanus glandula*	Common acorn barnacles								
Arthropoda	*Balanus* spp.	UnID Barnacle		P			P			C
Bryozoa	*Alcyonidium pedunculatum*	Smooth leather bryozoan								P
Bryozoa	*Heteropora alaskensis*	Delicate staghorn bryozoan								C
Bryozoa	*Heteropora Pacifica*	Northern staghorn bryozoan								P
Bryozoa	*Membranipora serrilamella*	Kelp encrusting bryozoan				C				A
Bryozoa	*Schizoporella unicornis*	Orange-encrusting bryozoan								P
Bryozoa	UnID Bryozoa	UnID Bryozoans				P			P	P
Chordata	*Corella willmeriana*	Transparent tunicate	C							P
Cnidaria	*Metridium farcimen*	Giant plumose anemone	C							
Cnidaria	*Plumularia setacea*	Glassy plume hydroid								P
Cnidaria	*Abietinaria* spp.	Hydroid			P					
Cnidaria	UnID Hydrozoa	UnID Hydroid		C		P	C	P	P	P
Porifera	*Aphrocallistes vastus*	Cloud sponge					P	A	C	P
Porifera	*Semisuberites cribrosa*	Stalked funnel sponge								P
Porifera	*Plakina atka*	Brain sponge			C		C	P		
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge							C	C
Porifera	*Suberites montiniger*	Peach ball sponge								P
Porifera	UnID Encrusting sponge	UnID Encrusting sponge			C		A	A		C
Porifera	UnID Porifera	UnID Encrusting yellow sponge								P
Porifera	UnID Sponge	UnID Sponge	A	A			P	P		
Tunicata	UnID Tunicata	UnID Tunicata								P

Table 2-22: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel North (part 1) (cont'd)

Taxon	Species Name	Common Name	WN01	WN02	WN03	WN04	WN05	WN06	WN07	WN08
Flora										
Chlorophyta	*Ulva* spp.	UnID Ulva			C					
Chlorophyta	UnID Chlorophyta	UnID Chlorophyta							C	
Heterokontophyta	*Fucus gardneri*	Rock weed								
Heterokontophyta	*Fucus* spp.	UnID Fucus				A		A	C	A
Heterokontophyta	*Nereocystis luetkeana*	Bull kelp						P		
Heterokontophyta	*Laminaria* spp.	*Laminaria* spp.	C			A				A
Heterokontophyta	*Alaria marginata*	Ribbon kelp								
Heterokontophyta	*Saccharina groenlandica*	Split kelp								
Heterokontophyta	*Laminaria saccharina*	Sugar kelp				C		P	P	
Heterokontophyta	*Palmaria mollis*	Thin dulse							P	
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae				A				A
Rhodophyta	*Lithothamnion* spp.	Pink rock crust			A	A	A	A		A
Rhodophyta	*Hildenbrandia* spp.	Red rock crust			P			C		C
Rhodophyta	*Mastocarpus papillatus*	Turkish washcloth								
Rhodophyta	UnID *Corallinales*	UnID Crustose corraline algae		A		P				
Rhodophyta	UnID *Rhodophyta*	UnID Red algae					P	A		P
Tracheophyta	*Zostera* spp.	Eelgrass					A			
UnID Algae	UnID *Algae*	UnID Algae								
Other Invertebrates										
Annelida	*Spiochaetopterus costarum*	Jointed three-section tubeworm					P			
Annelida	*Protula Pacifica*	Slime tubeworm						P		
Annelida	UnID Serpulidae	UnID Tubeworm	P	C	A	A	A	A	A	P

Table 2-22: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel North (part 1) (cont'd)

Taxon	Species Name	Common Name	WN01	WN02	WN03	WN04	WN05	WN06	WN07	WN08
Arthropoda	*Balanus glandula*	Common acorn barnacles								
Arthropoda	*Balanus* spp.	UnID Barnacle		P			P			C
Bryozoa	*Alcyonidium pedunculatum*	Smooth leather bryozoan								P
Bryozoa	*Heteropora alaskensis*	Delicate staghorn bryozoan								C
Bryozoa	*Heteropora Pacifica*	Northern staghorn bryozoan								P
Bryozoa	*Membranipora serrilamella*	Kelp encrusting bryozoan				C				A
Bryozoa	*Schizoporella unicornis*	Orange-encrusting bryozoan								P
Bryozoa	UnID Bryozoa	UnID Bryozoans				P			P	P
Chordata	*Corella willmeriana*	Transparent tunicate	C							P
Cnidaria	*Metridium farcimen*	Giant plumose anemone	C							
Cnidaria	*Plumularia setacea*	Glassy plume hydroid								P
Cnidaria	*Abietinaria* spp.	Hydroid			P					
Cnidaria	UnID Hydrozoa	UnID Hydroid		C		P	C	P	P	P
Porifera	*Aphrocallistes vastus*	Cloud sponge					P	A	C	P
Porifera	*Semisuberites cribrosa*	Stalked funnel sponge								P
Porifera	*Plakina atka*	Brain sponge			C		C	P		
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge							C	C
Porifera	*Suberites montiniger*	Peach ball sponge								P
Porifera	UnID Encrusting sponge	UnID Encrusting sponge			C		A	A		C
Porifera	UnID Porifera	UnID Encrusting yellow sponge								P
Porifera	UnID Sponge	UnID Sponge	A	A			P	P		
Tunicata	UnID Tunicata	UnID Tunicata								P

Legend:
P – Present <25%
C – Common 26–75%
A – Abundant >76%

Table 2-23: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel North (part 2)

Taxon	Species Name	Common Name	WN09	WN10	WN11	WN12	WN13	WN14	WN15
Flora									
Chlorophyta	*Ulva* spp.	UnID Ulva							
Chlorophyta	UnID Chlorophyta	UnID Chlorophyta							
Heterokontophyta	*Fucus gardneri*	Rock weed				C			
Heterokontophyta	*Fucus* spp.	UnID Fucus		P	C			P	C
Heterokontophyta	*Nereocystis luetkeana*	Bull kelp							
Heterokontophyta	*Laminaria* spp.	*Laminaria* spp.		C					C
Heterokontophyta	*Alaria marginata*	Ribbon kelp	P						
Heterokontophyta	*Saccharina groenlandica*	Split kelp				C	C		
Heterokontophyta	*Laminaria saccharina*	Sugar kelp		P	A			C	
Heterokontophyta	*Palmaria mollis*	Thin dulse							
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae							
Rhodophyta	*Lithothamnion* spp.	Pink rock crust		A	A			A	A
Rhodophyta	*Hildenbrandia* spp.	Red rock crust		P					
Rhodophyta	*Mastocarpus papillatus*	Turkish washcloth			P				
Rhodophyta	UnID Corallinales	UnID Crustose corraline algae							
Rhodophyta	UnID Rhodophyta	UnID Red algae							P
Tracheophyta	*Zostera* spp.	Eelgrass							
UnID Algae	UnID Algae	UnID Algae				P	P		P
Other Invertebrates									
Annelida	*Spiochaetopterus costarum*	Jointed three-section tubeworm							
Annelida	*Protula Pacifica*	Slime tubeworm		P	P			P	
Annelida	UnID Serpulidae	UnID Tubeworm	A	A	A	C	A	A	A
Arthropoda	*Balanus glandula*	Common acorn barnacles				A	A		
Arthropoda	*Balanus* spp.	UnID Barnacle	A	A	A			A	A

Table 2-23: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel North (part 2) (cont'd)

Taxon	Species Name	Common Name	WN09	WN10	WN11	WN12	WN13	WN14	WN15
Bryozoa	*Alcyonidium pedunculatum*	Smooth leather bryozoan							
Bryozoa	*Heteropora alaskensis*	Delicate staghorn bryozoan							
Bryozoa	*Heteropora Pacifica*	Northern staghorn bryozoan							
Bryozoa	*Membranipora serrilamella*	Kelp encrusting bryozoan		P	C				P
Bryozoa	*Schizoporella unicornis*	Orange-encrusting bryozoan							
Bryozoa	UnID Bryozoa	UnID Bryozoans							
Chordata	*Corella willmeriana*	Transparent tunicate							
Cnidaria	*Metridium farcimen*	Giant plumose anemone							
Cnidaria	*Plumularia setacea*	Glassy plume hydroid							
Cnidaria	*Abietinaria* spp.	Hydroid							
Cnidaria	UnID Hydrozoa	UnID Hydroid	P			P			
Porifera	*Aphrocallistes vastus*	Cloud sponge		P	P				
Porifera	*Semisuberites cribrosa*	Stalked funnel sponge							
Porifera	*Plakina atka*	Brain sponge			P				P
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge							
Porifera	*Suberites montiniger*	Peach ball sponge							
Porifera	UnID Encrusting sponge	UnID Encrusting sponge		C	C			C	C
Porifera	UnID Porifera	UnID Encrusting yellow sponge							
Porifera	UnID Sponge	UnID Sponge	A			A	A		
Tunicata	UnID Tunicata	UnID Tunicata	P						

Legend:
P – Present <25%
C – Common 26–75%
A – Abundant >76%

Table 2-24: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel South (part 1)

Taxon	Species Name	Common Name	WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08
Flora										
Chlorophyta	UnID Chlorophyta	UnID Chlorophyta	0.26							
Heterokontophyta	*Agarum fimbriatum*	Frigned sea colander kelp								
Heterokontophyta	*Agarum clathratum*	Sieve kelp								
Heterokontophyta	*Fucus* spp.	UnID Fucus								
Heterokontophyta	*Nereocystis luetkeana*	Bull kelp				0.91				
Heterokontophyta	*Alaria marginata*	Ribbon kelp								
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae	1.06							
Rhodophyta	UnID Rhodophyta	UnID Red algae	0.53							
UnID Algae	UnID Algae	UnID Algae	0.26							
Crabs & Shrimp										
Galatheidae	*Munida quadrispina*	Squat lobster	0.26	0.97		2.11	3.60	0.31		
Hapalogastridae	*Acantholithodes hispidus*	Hairy-spined crab				0.30				
Lithodidae	*Lopholithodes mandtii*	Puget sound king crab			0.28					
Majidae	*Pugettia richii*	Graceful kelp crab					0.33			
Mysida spp.	*Mysida* spp.	*Mysida* spp.				30.17				
Oregoniidae	*Chionoecetes* spp.	UnID Tanner crab								
Paguroidea	*Pagurus* spp.	Hermit crab					0.65			0.36
Paguroidea	UnID Paguroidea	UnID Hermit crab	1.85							
Pandalidae	*Pandalus hypsinotus*	Humpback shrimp		0.24						
Pandalidae	*Pandalus platyceros*	Pacific prawn		0.24	0.56	0.60	0.98			
Pandalidae	*Pandalus eous*	Spiny pink shrimp	6.08							
Pandalidae	*Pandalus* spp.	UnID Pandalus shrimp		25.46		120.69	130.77	332.63	182.50	558.77
Pisidae	*Chorilia longipes*	Longhorn decorator crab	0.26							
UnID Crab	UnID Crab	UnID Crab	0.26	0.24		0.30				0.36
UnID Shrimp	UnID Shrimp	UnID Shrimp	212.68		28.37				0.32	

Table 2-24: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel South (part 1) (cont'd)

Taxon	Species Name	Common Name	WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08
Fish										
Agonidae	*Agonus acipenserinus*	Sturgeon poacher	0.26							
Aulorhynchidae	*Aulorhynchus flavidus*	Tubesnout	3.96							
Bathymasteridae	*Ronquilus jordani*	Northern ronquil				1.81				
Chimaeridae	*Hydrolagus colliei*	Ratfish						0.31		
Cottidae	*Artedius fenestralis*	Padded sculpin			0.28					
Cottidae	*Leptocottus armatus*	Pacific staghorn sculpin					0.33			
Cottidae	UnID *Cottidae*	UnID Sculpin				0.91	0.98	2.80	0.97	0.36
Cottidae	*Radulinus asprellus*	Slim sculpin	0.53							
Cottidae	*Icelinus tenuis*	Spotfin sculpin	0.26	0.48	0.56	0.30				
Gadidae	*Gadus macrocephalus*	Pacific cod		0.24	0.28				0.32	
Gobiidae	*Lepidogobius lepidus*	Bay goby	0.26							
Gobiidae	*Coryphopterus nicholsi*	Black-eyed goby				0.30				
Hexagrammidae	*Hexagrammos decagrammus*	Kelp greenling								
Pleuronectidae	*Microstomus Pacificus*	Dover sole								
Pleuronectidae	*Parophrys vetulus*	English sole				0.30		0.62	0.97	
Pleuronectidae	*Glyptocephalus zacharius*	Rex sole								0.36
Pleuronectidae	*Lepidopsetta bilineata*	Rock sole	0.79	0.24	0.28	0.30				
Pleuronectidae	*Lyopsetta exilis*	Slender sole	1.06							
Pleuronectidae	UnID *Pleuronectidae*	UnID Righteye flounders	0.53						0.32	0.71
Psychrolutidae	*Dasycottus setiger*	Spinyhead sculpin								0.36
Sebastidae	*Sebastes auriculatus*	Brown rockfish	0.26		0.28					
Sebastidae	*Sebastes pinniger*	Canary rockfish			0.28					
Sebastidae	*Sebastes caurinus*	Copper rockfish			1.40					0.71
Sebastidae	*Sebastes maliger*	Quillback rockfish	0.79		0.28	0.60	1.31	1.24		

Table 2-24: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel South (part 1) (cont'd)

Taxon	Species Name	Common Name	WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08
Sebastidae	*Sebastes* spp.	UnID Rockfish	0.53	0.48	2.53	0.60	0.65	4.97	1.29	0.71
Sebastidae	*Sebastes miniatus*	Vermillion rockfish	0.53							0.71
Sebastidae	*Sebastes helvomaculatus*	Rosethorn rockfish	0.26							
Sebastidae	*Sebastes rosaceus*	Rosy rockfish					0.33			
Sebastidae	*Sebastolobus alascanus*	Shortspine thornyhead	0.26							
Sebastidae	*Sebastes ruberrimus*	Yelloweye rockfish	0.26	1.21						
Stichaeidae	*Lumpenus sagitta*	Snake prickleback					0.33			
UnID Fish	UnID *Fish*	UnID Fish	1.85	0.24		1.81	2.62	0.93	1.61	1.42
Zoarcidae	*Lycodes Pacificus*	Blackbelly eelpout	0.26							
Zoarcidae	*Lycodes* spp.	UnID Eelpout								0.36
Other Invertebrates										
Annelida	UnID Sabellidae	UnID Feather duster worm	1.85		11.52					
Annelida	UnID Serpulidae	UnID Tubeworm	1.06	0.00	0.00	10.26	2.62	20.83	0.64	2.49
Annelida	UnID Polychaete	UnID Polychaete	0.26							
Arthropoda	*Balanus* spp.	UnID Barnacle								
Chordata	UnID Ascidiidae	UnID Ascidiidae								
Chordata	*Corella willmeriana*	Transparent tunicate								2.13
Chordata	UnID Ascidiacea	UnID Ascidiacea	1.59							
Cnidaria	*Epiactis prolifera*	Brooding anemone				0.30				
Cnidaria	*Cribrinopsis fernaldi*	Crimson anemone	0.26	0.24	0.28	0.30	0.33	0.62	0.32	0.71
Cnidaria	*Halipteris willemoesi*	Sea whip	0.26							
Cnidaria	*Metridium farcimen*	Giant plumose anemone	0.53	1.45	0.84			0.31	5.15	1.07
Cnidaria	*Metridium senile*	Short plumose anemone			0.84					1.07
Cnidaria	UnID Anthozoa	UnID Anemones	0.79			0.30	0.65			
Cnidaria	UnID Cnidaria	UnID Jelly								0.36

Table 2-24: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel South (part 1) (cont'd)

Taxon	Species Name	Common Name	WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08
Cnidaria	UnID Soft coral	UnID Soft coral	0.53							
Ctenophora	UnID Ctenophora	UnID Ctenophora	0.79							
Echinodermata	*Amphipholis squamata*	Dwarf brittle star		0.24						
Echinodermata	*Evasterias troscheli*	Mottled star								0.36
Echinodermata	*Pisaster ochraceus*	Purple star			0.28	0.30	0.65		0.32	
Echinodermata	*Orthasterias koehleri*	Rainbow star		0.24		0.30	0.98	0.62	0.64	
Echinodermata	*Pycnopodia helianthoides*	Sunflower star	1.59	1.45	1.69		1.63	0.62	0.64	2.13
Echinodermata	*Stylasterias forreri*	Velcro star	0.26			0.91	0.33	0.31		
Echinodermata	*Dermasterias imbricata*	Leather star	0.26	1.21				0.31		
Echinodermata	*Cucumaria pallida*	Pallid cucumber						0.31		
Echinodermata	*Henricia leviuscula*	Blood star							0.32	0.71
Echinodermata	*Henricia sanguinolenta*	Fat blood star			0.84				0.32	
Echinodermata	*Henricia asthenactis*	Sea star								
Echinodermata	*Henricia* spp.	UnID Blood star	0.26							
Echinodermata	*Ceramaster patagonicus*	Cookie star	0.79	0.73	1.12		1.31	1.87	0.97	
Echinodermata	*Gephyreaster swifti*	Gunpowder sea star								0.71
Echinodermata	*Mediaster aequalis*	Vermillion star	2.64	2.91	4.21	5.13	8.50	9.33	3.54	4.62
Echinodermata	*Luidia foliolata*	Sandstar								
Echinodermata	*Ophiopholis aculeata*	Daisy brittle star		0.24		0.30				
Echinodermata	*Ophiura lutkena*	Grey brittle star	5.28							
Echinodermata	*Psolus chitinoides*	Creeping pedal sea cucumber	0.53			0.60				
Echinodermata	*Pteraster tesselatus*	Cushion star	0.26							
Echinodermata	*Pteraster militaris*	Wrinkled star							0.32	
Echinodermata	*Solaster dawsoni*	Morning sunstar								
Echinodermata	*Solaster endeca*	Northern sunstar	0.26							

Table 2-24: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel South (part 1) (cont'd)

Taxon	Species Name	Common Name	WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08
Echinodermata	*Crossaster papposus*	Rose star	0.26	0.24		0.91	0.65	0.62	0.64	1.07
Echinodermata	*Parastichopus californicus*	Giant california sea cucumber	2.38	1.70	2.25	3.02	4.25	4.66	1.93	3.20
Echinodermata	*Strongylocentrotus droebachiensis*	Green urchin	0.26	0.97	28.09	0.30	0.33	0.31	0.97	
Echinodermata	*Strongylocentrotus purpuratus*	Purple urchin				0.30				
Echinodermata	*Strongylocentrotus* spp.	UnID Urchin					0.33		0.64	1.07
Echinodermata	*Strongylocentrotus pallidus*	White urchin	4.49	3.39	5.06	7.54	5.88	21.45	19.31	7.46
Echinodermata	*Synallectes challangeri*	Long-spined sea cucumber							0.64	
Echinodermata	UnID Asteroidea	UnID Sea star	2.38	0.97	0.00	0.30	0.00	0.00	0.97	0.00
Echinodermata	UnID Holothuroidea	UnID Sea cucumbers	0.26							
Echinodermata	UnID Ophiuroidea	UnID Brittle star	1.85				0.33	0.31		1.42
Gastropoda	UnID Limpet	UnID Limpet			14.04					
Mollusca	*Armina* spp.	Armina spp.								0.36
Mollusca	*Euspira* spp.	UnID Moon snail						0.31		
Mollusca	*Enteroctopus dofleini*	Giant Pacific octopus				0.30				
Mollusca	*Rossia Pacifica*	Stubby squid								
Mollusca	*Melibe leonina*	Hooded nudibranch				7.54	0.98	0.62		
Mollusca	UnID Mollusca	UnID Mollusca					0.98			
Mollusca	UnID Nudibranchia	UnID Nudibranchia								0.71
Mollusca	*Mopalia* spp.	UnID Chiton				0.30			0.32	
Porifera	*Aphrocallistes vastus*	Cloud sponge	4.49							
Porifera	*Phakellia* spp.	Funnel sponge	0.79							
Porifera	*Sycandra utriculus*	Leather bag sponge		0.24	1.12					
Porifera	*Polymastia pachymastia*	Vase sponge	0.53							
Porifera	*Staurocalyptus dowlingi*	Round lipped boot sponge								1.07

Table 2-24: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel South (part 1) (cont'd)

Taxon	Species Name	Common Name	WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge	2.11	0.24		1.21	2.29	4.66	0.32	
Porifera	UnID Encrusting sponge	UnID Encrusting sponge								19.55
Porifera	UnID Porifera	UnID Encrusting yellow sponge	0.26				0.98		0.32	0.36
Porifera	UnID Sponge	UnID Sponge	0.26					0.31	1.61	0.36
Tunicata	UnID Tunicata	UnID Tunicata	0.53						0.32	4.62

Table 2-25: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel South (part 2)

Taxon	Species Name	Common Name	WS09	WS10	WS11	WS12	WS13	WS14	WS15	Whole Site
Flora										
Chlorophyta	UnID Chlorophyta	UnID Chlorophyta								0.02
Heterokontophyta	*Agarum fimbriatum*	Frigned sea colander kelp				5.15				0.22
Heterokontophyta	*Agarum clathratum*	Sieve kelp				0.05				0.00
Heterokontophyta	*Fucus* spp.	UnID Fucus		0.89		4.63				0.27
Heterokontophyta	*Nereocystis luetkeana*	Bull kelp								0.07
Heterokontophyta	*Alaria marginata*	Ribbon kelp				0.51				0.02
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae								0.09
Rhodophyta	UnID Rhodophyta	UnID Red algae								0.04
UnID Algae	UnID Algae	UnID Algae								0.02
Crabs & Shrimp										
Galatheidae	*Munida quadrispina*	Squat lobster								0.53
Hapalogastridae	*Acantholithodes hispidus*	Hairy-spined crab								0.02
Lithodidae	*Lopholithodes mandtii*	Puget sound king crab								0.02
Majidae	*Pugettia richii*	Graceful kelp crab								0.02
Mysida spp.	*Mysida* spp.	*Mysida* spp.								2.21
Oregoniidae	*Chionoecetes* spp.	UnID Tanner crab	0.33							0.02
Paguroidea	*Pagurus* spp.	Hermit crab	0.33							0.09
Paguroidea	UnID Paguroidea	UnID Hermit crab								0.15
Pandalidae	*Pandalus hypsinotus*	Humpback shrimp							39.04	2.23
Pandalidae	*Pandalus platyceros*	Pacific prawn								0.18
Pandalidae	*Pandalus eous*	Spiny pink shrimp								0.51
Pandalidae	*Pandalus* spp.	UnID Pandalus shrimp	771.12							143.19
Pisidae	*Chorilia longipes*	Longhorn decorator crab								0.02

Table 2-25: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel South (part 2) (cont'd)

Taxon	Species Name	Common Name	WS09	WS10	WS11	WS12	WS13	WS14	WS15	Whole Site
UnID Crab	UnID Crab	UnID Crab								0.09
UnID Shrimp	UnID Shrimp	UnID Shrimp		614.14	781.10	51.49		32.11	39.04	94.43
Fish										
Agonidae	*Agonus acipenserinus*	Sturgeon poacher					0.35			0.04
Aulorhynchidae	*Aulorhynchus flavidus*	Tubesnout								0.33
Bathymasteridae	*Ronquilus jordani*	Northern ronquil				1.54	0.35		0.39	0.24
Chimaeridae	*Hydrolagus colliei*	Ratfish	0.33			1.03		0.32		0.11
Cottidae	*Artedius fenestralis*	Padded sculpin								0.02
Cottidae	*Leptocottus armatus*	Pacific staghorn sculpin								0.02
Cottidae	UnID *Cottidae*	UnID Sculpin								0.42
Cottidae	*Radulinus asprellus*	Slim sculpin								0.04
Cottidae	*Icelinus tenuis*	Spotfin sculpin		0.60						0.18
Gadidae	*Gadus macrocephalus*	Pacific cod								0.07
Gobiidae	*Lepidogobius lepidus*	Bay goby								0.02
Gobiidae	*Coryphopterus nicholsi*	Black-eyed goby								0.02
Hexagrammidae	*Hexagrammos decagrammus*	Kelp greenling							0.39	0.02
Pleuronectidae	*Microstomus Pacificus*	Dover sole		0.30	0.78					0.04
Pleuronectidae	*Parophrys vetulus*	English sole								0.13
Pleuronectidae	*Glyptocephalus zacharius*	Rex sole								0.02
Pleuronectidae	*Lepidopsetta bilineata*	Rock sole	0.33	0.30		0.51		0.64	0.78	0.29
Pleuronectidae	*Lyopsetta exilis*	Slender sole								0.09
Pleuronectidae	UnID *Pleuronectidae*	UnID Righteye flounders						0.32	0.39	0.15
Psychrolutidae	*Dasycottus setiger*	Spinyhead sculpin	0.33							0.04
Sebastidae	*Sebastes auriculatus*	Brown rockfish								0.04

Table 2-25: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel South (part 2) (cont'd)

Taxon	Species Name	Common Name	WS09	WS10	WS11	WS12	WS13	WS14	WS15	Whole Site
Sebastidae	*Sebastes pinniger*	Canary rockfish		0.30						0.04
Sebastidae	*Sebastes caurinus*	Copper rockfish	1.31			2.57	0.69	0.95	0.39	0.49
Sebastidae	*Sebastes maliger*	Quillback rockfish		1.79		0.51	0.35	2.54		0.66
Sebastidae	*Sebastes* spp.	UnID Rockfish	0.33	0.30					0.39	0.93
Sebastidae	*Sebastes miniatus*	Vermillion rockfish	0.98							0.15
Sebastidae	*Sebastes helvomaculatus*	Rosethorn rockfish								0.02
Sebastidae	*Sebastes rosaceus*	Rosy rockfish						0.32	0.39	0.07
Sebastidae	*Sebastolobus alascanus*	Shortspine thornyhead								0.02
Sebastidae	*Sebastes ruberrimus*	Yelloweye rockfish		0.60						0.18
Stichaeidae	*Lumpenus sagitta*	Snake prickleback				0.51				0.04
UnID Fish	UnID Fish	UnID Fish	1.63		2.34	2.06	1.38	0.32	0.39	1.15
Zoarcidae	*Lycodes Pacificus*	Blackbelly eelpout								0.02
Zoarcidae	*Lycodes* spp.	UnID Eelpout	0.33							0.04
Other Invertebrates										
Annelida	UnID Sabellidae	UnID Feather duster worm		18.19	15.59	154.47		15.89	42.16	12.98
Annelida	UnID Serpulidae	UnID Tubeworm	1.63	0.00	0.00	0.00	0.00	0.00	0.00	2.81
Annelida	UnID Polychaete	UnID Polychaete								0.02
Arthropoda	*Balanus* spp.	UnID Barnacle					346.24			22.11
Chordata	UnID Ascidiidae	UnID Ascidiidae		5.96						0.44
Chordata	*Corella willmeriana*	Transparent tunicate								0.13
Chordata	UnID Ascidiacea	UnID Ascidiacea								0.13
Cnidaria	*Epiactis prolifera*	Brooding anemone								0.02
Cnidaria	*Cribrinopsis fernaldi*	Crimson anemone	0.65			0.51			0.78	0.33
Cnidaria	*Halipteris willemoesi*	Sea whip								0.02

Table 2-25: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel South (part 2) (cont'd)

Taxon	Species Name	Common Name	WS09	WS10	WS11	WS12	WS13	WS14	WS15	Whole Site
Cnidaria	*Metridium farcimen*	Giant plumose anemone		5.66	0.78	7.21	0.35	1.91	1.95	1.70
Cnidaria	*Metridium senile*	Short plumose anemone	0.33	0.30	2.34	0.51	0.69	9.85		1.00
Cnidaria	UnID Anthozoa	UnID Anemones	0.98			0.51		0.32		0.24
Cnidaria	UnID Cnidaria	UnID Jelly								0.02
Cnidaria	UnID Soft coral	UnID Soft coral								0.04
Ctenophora	UnID Ctenophora	UnID Ctenophora								0.07
Echinodermata	*Amphipholis squamata*	Dwarf brittle star								0.02
Echinodermata	*Evasterias troscheli*	Mottled star								0.02
Echinodermata	*Pisaster ochraceus*	Purple star								0.11
Echinodermata	*Orthasterias koehleri*	Rainbow star		1.19		0.51	0.35	0.95		0.40
Echinodermata	*Pycnopodia helianthoides*	Sunflower star	3.92	0.30		4.63	1.73	0.32	1.56	1.44
Echinodermata	*Stylasterias forreri*	Velcro star								0.13
Echinodermata	*Dermasterias imbricata*	Leather star		1.19		1.03	0.35			0.31
Echinodermata	*Cucumaria pallida*	Pallid cucumber								0.02
Echinodermata	*Henricia leviuscula*	Blood star	1.31							0.15
Echinodermata	*Henricia sanguinolenta*	Fat blood star							0.39	0.11
Echinodermata	*Henricia asthenactis*	Sea star	1.31							0.09
Echinodermata	*Henricia* spp.	UnID Blood star					0.35		0.39	0.07
Echinodermata	*Ceramaster patagonicus*	Cookie star		0.30		0.51		0.64	1.17	0.66
Echinodermata	*Gephyreaster swifti*	Gunpowder sea star	0.98							0.11
Echinodermata	*Mediaster aequalis*	Vermillion star	0.65	1.19	3.12	0.51	1.04		8.59	3.76
Echinodermata	*Luidia foliolata*	Sandstar		0.89	0.78		0.69	0.64	3.51	0.38
Echinodermata	*Ophiopholis aculeata*	Daisy brittle star								0.04
Echinodermata	*Ophiura lutkena*	Grey brittle star								0.44

Table 2-25: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel South (part 2) (cont'd)

Taxon	Species Name	Common Name	WS09	WS10	WS11	WS12	WS13	WS14	WS15	Whole Site
Echinodermata	*Psolus chitinoides*	Creeping pedal sea cucumber								0.09
Echinodermata	*Pteraster tesselatus*	Cushion star								0.02
Echinodermata	*Pteraster militaris*	Wrinkled star								0.02
Echinodermata	*Solaster dawsoni*	Morning sunstar						0.32	0.39	0.04
Echinodermata	*Solaster endeca*	Northern sunstar								0.02
Echinodermata	*Crossaster papposus*	Rose star	1.63							0.42
Echinodermata	*Parastichopus californicus*	Giant california sea cucumber	2.61	2.68		4.12	2.08	0.95	1.95	2.57
Echinodermata	*Strongylocentrotus droebachiensis*	Green urchin								2.45
Echinodermata	*Strongylocentrotus purpuratus*	Purple urchin								0.02
Echinodermata	*Strongylocentrotus* spp.	UnID Urchin								0.13
Echinodermata	*Strongylocentrotus pallidus*	White urchin	7.84	5.66	7.80	8.24	0.00	0.00	0.00	6.88
Echinodermata	*Synallectes challangeri*	Long-spined sea cucumber								0.04
Echinodermata	UnID Asteroidea	UnID Sea star	0.00	0.00	0.00	1.03	0.69	0.64	1.95	0.62
Echinodermata	UnID Holothuroidea	UnID Sea cucumbers								0.02
Echinodermata	UnID Ophiuroidea	UnID Brittle star	2.61							0.46
Gastropoda	UnID Limpet	UnID Limpet								1.11
Mollusca	*Armina* spp.	Armina spp.								0.02
Mollusca	*Euspira* spp.	UnID Moon snail								0.02
Mollusca	*Enteroctopus dofleini*	Giant Pacific octopus								0.02
Mollusca	*Rossia Pacifica*	Stubby squid			0.78					0.02
Mollusca	*Melibe leonina*	Hooded nudibranch		17.89		25.74			1.56	3.18
Mollusca	UnID Mollusca	UnID Mollusca								0.07

Table 2-25: Number of Individuals Observed per 100 m during Subtidal ROV Survey for Work Channel South (part 2) (cont'd)

Taxon	Species Name	Common Name	WS09	WS10	WS11	WS12	WS13	WS14	WS15	Whole Site
Mollusca	UnID Nudibranchia	UnID Nudibranchia								0.04
Mollusca	*Mopalia* spp.	UnID Chiton								0.04
Porifera	*Aphrocallistes vastus*	Cloud sponge	0.65			2.57				0.53
Porifera	*Phakellia* spp.	Funnel sponge				0.51				0.09
Porifera	*Sycandra utriculus*	Leather bag sponge								0.11
Porifera	*Polymastia pachymastia*	Vase sponge								0.04
Porifera	*Staurocalyptus dowlingi*	Round lipped boot sponge	1.96							0.20
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge	1.63							0.91
Porifera	UnID Encrusting sponge	UnID Encrusting sponge								1.22
Porifera	UnID Porifera	UnID Encrusting yellow sponge				0.51				0.15
Porifera	UnID Sponge	UnID Sponge								0.18
Tunicata	UnID Tunicata	UnID Tunicata	1.31							0.44

Table 2-26: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel South (part 1)

Taxon	Species Name	Common Name	WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08
Flora										
Chlorophyta	*Ulva* spp.	UnID Ulva		C		P	P			
Heterokontophyta	*Pleurophycus gardneri*	Broad rib kelp		A						
Heterokontophyta	*Agarum* spp.	*Agarum* spp.								C
Heterokontophyta	*Agarum fimbriatum*	Frigned sea colander kelp								
Heterokontophyta	*Agarum clathratum*	Sieve kelp		C						
Heterokontophyta	*Fucus gardneri*	Rock weed	C							
Heterokontophyta	*Fucus* spp.	UnID Fucus		C	P	C	A	A	A	A
Heterokontophyta	*Nereocystis luetkeana*	Bull kelp					P		P	
Heterokontophyta	*Laminaria bongardiana*	Dark brown wrack kelp		P						
Heterokontophyta	*Laminaria* spp.	*Laminaria* spp.				A		A	P	
Heterokontophyta	*Alaria marginata*	Ribbon kelp								
Heterokontophyta	*Laminaria saccharina*	Sugar kelp					A			
Heterokontophyta	*Palmaria mollis*	Thin dulse								
Heterokontophyta	*Sphacelaria rigidula*	Brown sea moss								
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae			A				C	P
Rhodophyta	*Lithothamnion* spp.	Pink rock crust				A	A	A	A	
Rhodophyta	*Hildenbrandia* spp.	Red rock crust		A			C	C	A	
Rhodophyta	*Petrocelis* spp.	Tar spot seaweed							C	
Rhodophyta	UnID Corallinales	UnID Crustose corraline algae								P
Rhodophyta	UnID Rhodophyta	UnID Red algae			P			P	P	
Tracheophyta	*Zostera* spp.	Eelgrass								
UnID Algae	UnID Algae	UnID Algae	P			C	A		A	

Table 2-26: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel South (part 1) (cont'd)

Taxon	Species Name	Common Name	WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08
Other Invertebrates										
Annelida	UnID Sabellidae	UnID Feather duster worm								
Annelida	*Protula Pacifica*	Slime tubeworm			P		P			
Annelida	UnID Serpulidae	UnID Tubeworm	A	A	A	A	A	A	A	P
Arthropoda	*Balanus glandula*	Common acorn barnacles	P							
Arthropoda	*Balanus* spp.	UnID Barnacle				A	A	A	A	
Bryozoa	*Alcyonidium pedunculatum*	Smooth leather bryozoan								
Bryozoa	*Heteropora alaskensis*	Delicate staghorn bryozoan		P	P					
Bryozoa	*Membranipora serrilamella*	Kelp encrusting bryozoan				A	A	A	P	
Bryozoa	*Schizoporella unicornis*	Orange-encrusting bryozoan							P	
Bryozoa	UnID Bryozoa	UnID Bryozoans	C	P						
Chordata	*Corella willmeriana*	Transparent tunicate								
Cnidaria	*Abietinaria* spp.	Hydroid						P		
Cnidaria	UnID Stylasteridae	Purple encrusting hydrocoral	A							
Cnidaria	*Stylaster campylecus*	White branching hydrocoral			P					
Cnidaria	UnID Hydrozoa	UnID Hydroid	P					C	P	
Porifera	*Aphrocallistes vastus*	Cloud sponge	P	A	A	A	A	A	P	
Porifera	*Heterochone calyx*	Finger goblet sponge		C						
Porifera	*Phakellia* spp.	Funnel sponge		P						
Porifera	*Haliclona permollis*	Purple encrusting sponge	A							
Porifera	*Halichondria panicea*	Yellow-green encrusting sponge			C					
Porifera	*Plakina atka*	Brain sponge				C	C			
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge		P	P					
Porifera	*Scypha compacta*	Tubular vase sponge	P							

Table 2-26: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel South (part 1) (cont'd)

Taxon	Species Name	Common Name	WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08
Porifera	UnID Encrusting sponge	UnID Encrusting sponge	A		P	A	P			A
Porifera	UnID Porifera	UnID Encrusting yellow sponge	C							
Porifera	UnID Sponge	UnID Sponge	A	P	P	P	P		P	
Tunicata	UnID Tunicata	UnID Tunicata								

Legend:
P – Present <25%
C – Common 26–75%
A – Abundant >76%

Table 2-27: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel South (part 2)

Taxon	Species Name	Common Name	WS09	WS10	WS11	WS12	WS13	WS14	WS15
Flora									
Chlorophyta	Ulva spp.	UnID Ulva							
Heterokontophyta	*Pleurophycus gardneri*	Broad rib kelp							
Heterokontophyta	*Agarum* spp.	*Agarum* spp.	P						
Heterokontophyta	*Agarum fimbriatum*	Frigned sea colander kelp					C		
Heterokontophyta	*Agarum clathratum*	Sieve kelp						A	P
Heterokontophyta	*Fucus gardneri*	Rock weed							
Heterokontophyta	*Fucus* spp.	UnID Fucus	C	A	C	P		A	C
Heterokontophyta	*Nereocystis luetkeana*	Bull kelp							
Heterokontophyta	*Laminaria bongardiana*	Dark brown wrack kelp							
Heterokontophyta	*Laminaria* spp.	*Laminaria* spp.							
Heterokontophyta	*Alaria marginata*	Ribbon kelp				P		A	C
Heterokontophyta	*Laminaria saccharina*	Sugar kelp							
Heterokontophyta	*Palmaria mollis*	Thin dulse		P					
Heterokontophyta	*Sphacelaria rigidula*	Brown sea moss						C	
Heterokontophyta	UnID Heterokontophyta	UnID Brown algae		P					P
Rhodophyta	*Lithothamnion* spp.	Pink rock crust							
Rhodophyta	*Hildenbrandia* spp.	Red rock crust					C	C	P
Rhodophyta	*Petrocelis* spp.	Tar spot seaweed							
Rhodophyta	UnID Corallinales	UnID Crustose corraline algae							
Rhodophyta	UnID Rhodophyta	UnID Red algae				P			
Tracheophyta	*Zostera* spp.	Eelgrass		A					
UnID Algae	UnID Algae	UnID Algae				P			

Table 2-27: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel South (part 2) (cont'd)

Taxon	Species Name	Common Name	WS09	WS10	WS11	WS12	WS13	WS14	WS15
Other Invertebrates									
Annelida	UnID Sabellidae	UnID Feather duster worm			C			P	P
Annelida	*Protula Pacifica*	Slime tubeworm							
Annelida	UnID Serpulidae	UnID Tubeworm	P	A	A				
Arthropoda	*Balanus glandula*	Common acorn barnacles							
Arthropoda	*Balanus* spp.	UnID Barnacle						C	A
Bryozoa	*Alcyonidium pedunculatum*	Smooth leather bryozoan					P		
Bryozoa	*Heteropora alaskensis*	Delicate staghorn bryozoan		P			P		
Bryozoa	*Membranipora serrilamella*	Kelp encrusting bryozoan							
Bryozoa	*Schizoporella unicornis*	Orange-encrusting bryozoan				P			
Bryozoa	UnID Bryozoa	UnID Bryozoans			P		P		
Chordata	*Corella willmeriana*	Transparent tunicate						P	
Cnidaria	*Abietinaria* spp.	Hydroid							
Cnidaria	UnID Stylasteridae	Purple encrusting hydrocoral							
Cnidaria	*Stylaster campylecus*	White branching hydrocoral							
Cnidaria	UnID Hydrozoa	UnID Hydroid							
Porifera	*Aphrocallistes vastus*	Cloud sponge			P	P	C	P	A
Porifera	*Heterochone calyx*	Finger goblet sponge							
Porifera	*Phakellia* spp.	Funnel sponge							
Porifera	*Haliclona permollis*	Purple encrusting sponge							
Porifera	*Halichondria panicea*	Yellow-green encrusting sponge							
Porifera	*Plakina atka*	Brain sponge							
Porifera	*Rhabdocalyptus dawsoni*	Sharp lipped boot sponge		C	P	P	P	P	

Table 2-27: Summary of Species Recorded as Percent Cover, Observed during Subtidal ROV Survey for Work Channel South (part 2) (cont'd)

Taxon	Species Name	Common Name	WS09	WS10	WS11	WS12	WS13	WS14	WS15
Porifera	*Scypha compacta*	Tubular vase sponge							
Porifera	UnID Encrusting sponge	UnID Encrusting sponge	A	P				P	
Porifera	UnID Porifera	UnID Encrusting yellow sponge							
Porifera	UnID Sponge	UnID Sponge							
Tunicata	UnID Tunicata	UnID Tunicata		C					

Legend:
P – Present <25%
C – Common 26–75%
A – Abundant >76%

Application for an Environmental Assessment Certificate

Appendix L-4
Benthic Habitat Mapping Survey

ACRONYMS AND ABBREVIATIONS

BC	British Columbia
BHM	benthic habitat mapping
CRA	commercial, recreational and aboriginal
EA	Application for an Environmental Assessment Certificate
H_2S	hydrogen sulfide
km	kilometres
MBES	multibeam echosounder
m	metres
m^2	square meter
PRPA	Prince Rupert Port Authority
Project	the Prince Rupert Gas Transmission Project
RAA	regional assessment area
SSS	sidescan sonar
SBP	sub-buttom profiler

L.1 INTRODUCTION

Prince Rupert Gas Transmission Ltd. (PRGT) proposes to install a pipeline to transport natural gas from a point south of Peace River (near Hudson Hope), northeast BC, to Lelu Island, near Prince Rupert, BC (the 'Project'). The pipeline route includes up to 120 km of twin marine pipelines. Installation of the pipeline on the seafloor could potentially disrupt marine habitats and species. Surveys were conducted to characterize, and subsequently map, benthic substrate type and dominant fauna assemblages found within 0.5 to 1 km swathes around the centerline of the proposed route. This baseline characterization will be used to inform the environmental assessment (EA) and habitat offsetting strategy. Another key objective was to identify highly sensitive environmental features (i.e., sponge reefs, coral mounds, and rocky reefs) so that they could be avoided during route selection as a primary environmental mitigation method.

L.2 METHODS

A series of complementary methods were used to support benthic habitat mapping (BHM) across all of the routes surveyed (June-July, 2013). These surveys spanned nine areas: the main sites currently under consideration in Nass Bay, Nasoga Gulf, Chatham Sound, and Prince Rupert Port Authority (PRPA) area around Lelu Island, as well as additional sites in Observatory Inlet, Portland Inlet, Steamer Passage, Work Channel, and Emma Passage. These surveys extended from the deepest offshore area spanned by the routes to the shallowest accessible point of each proposed route (Attachment L-4-1). The benthic habitat mapping consisted of hydrographic surveys and deployment of underwater cameras. The surveys were carried out by McGregor GeoScience Limited on behalf of Stantec. Refer to Attachment L-4-1 for complete list of equipment systems and data processing software.

Since the completion of this BHM work, PRGT reduced the number of route options (in part due to the results presented herein). Nevertheless, since the area surveyed for BHM purposes spans a wide range of the ecological habitats that are present on BC's north coast, and captures several important ecological areas, all data collected for BHM purposes are retained and presented in the full report (Attachment L-4-1).

Hydrographic surveys were completed to characterize physical habitat. Specifically, acoustic data were collected using a multibeam echosounder (MBES), sidescan sonar (SSS), and sub-bottom profiler (SBP). Acoustic data were acquired over a total of 2,975 line km along the routes. Physical habitat information was complemented by underwater video and photography at 98 selected sites representing different physical habitat types, as inferred through interpretation of the MBES and SSS data. Underwater footage yielded information on organisms present on or above each habitat type and thereby facilitated the identification of the biological communities dominant on different

physical habitats. Further confirmation was achieved by the collection of eight benthic faunal grab samples around the Prince Rupert Port Authority area. Invertebrates within these sediment samples were identified to characterize communities living within the soft sediment of the PRPA area.

L.2.1 Hydrographic Surveys

Hydrographic surveys were conducted to map seabed features, depth, and topography including shallow seafloor geology in sites accessible by boat. The MBES data were collected to produce detailed bathymetric maps, while SSS, sonar backscatter analysis, and SBP data were used to infer seabed features, seafloor physical habitat type, and superficial geological formations. In addition SBP sampling, which involves sending strong, low frequency echo-sounding into the water column, provided information on the density of benthic features. Sonar data were corrected to account for tidal state, and vessel position and orientation.

Bathymetry maps and backscatter mosaics were assessed onboard by trained geoscientists to identify the potential presence of highly sensitive benthic habitats. All suspected biogenic reefs were inspected using a drop-camera and assessed by qualified biologists. Specifically, they evaluated the substrate type, relief, extent, and direction of the feature, combined with the presence of fish and invertebrates in contrast with surrounding waters. Wherever practicable, the camera operator maintained a 1 – 2 m distance with the observed benthic feature to minimize disturbance of the seafloor by the equipment. This approach optimized image quality, and positive identification of seafloor features and faunal composition.

If a biogenic reef was identified, additional areas were studied to investigate alternative routes. This process continued until a path was identified that would minimize any interaction between the proposed route and any sensitive benthic habitats.

L.2.2 Ground-truth Sampling

L.2.2.1 Visual Inspection of Habitat Types

Benthic environmental sampling, including seafloor photography, video, and sediment grabs, was also completed to further describe the diversity of benthic habitat and biota found along the proposed routes. Survey locations were selected based on the interpretation of the bathymetric maps and backscatter data for ground-truthing purposes. Seafloor photography and video were acquired using a drop-down Kongsberg digital stills camera, towed for at least 15 minutes, capturing photographs every 15 seconds for each transect. Ninety-eight locations were visually surveyed in this manner, including 13 sites where sensitive benthic habitat features were suspected. Benthic species from a random subset of 458 of 5,999 seafloor photographs were identified to the finest taxonomic level and relative abundance was assessed.

L.2.2.2 Sediment Grabs

Benthic sediment grabs were taken at eight locations in the PRPA area using a 0.1 m^2 Van Veen grab sampler. Sediment grain size, colour, layering, odour (indicative of H2S), and macrofauna were assessed and categorized on-site, while subsamples were washed and fixed in 10% buffered formalin solution for further laboratory analysis of epifaunal community composition. Substrate characteristics were evaluated based on the percent composition of each sediment type (i.e., gravel, sands, silts, and clays).

L.2.2.3 Creation of Benthic Habitat Maps

Benthic habitat maps were produced by first characterizing habitat types based on acoustic information and benthic ground-truthing results, and then extrapolating habitat classes across all seafloor types identified based on interpretation of acoustic maps along the route. Regions of similar texture, backscatter intensity, and geomorphic bottom type were clustered and compared with the benthic habitat data set obtained from ground-truthing surveys. Finally, underwater photographs were evaluated and classified into the broad benthic habitat classes identified.

L.3 DISCUSSION

Several sensitive benthic habitats were identified based on bathymetry, backscatter analysis, and subsequent ground-truthing using underwater cameras. These seafloor features were characterized by complex topography and low backscatter returns, and were sometimes associated with dense collections of glass sponge or reefs (*Porifera*: class *hexactinellida*), also referred to as bioherms.

All sensitive seafloor features, such as sponge reefs, were found within Chatham Sound in water depths ranging from 40 – 200 m, and were most common around east Melville Island, Dunira Island, and Baron Island. To avoid glass sponge bioherms, three north-south corridors were evaluated to identify an alternative pipeline route. Within the vicinity of the final corridor, live glass sponge reefs were only recorded in three areas occurring approximately 200-300 m from the proposed route centreline.

By combining acoustic data with ground-truthing surveys, 15 benthic habitat classes were identified. Of these, bioturbated mud (described as soft sediment with frequent faunal burrows), dominated the routes passing through Nass Bay, Portland Inlet, and Chatham Sound. The proposed route in Chatham Sound also crossed areas of muddy gravel with epifauna and low-relief reef structures with epifaunal turf, which were associated with lower epifaunal abundance, species richness, and species diversity than biogenic sponge reefs. In addition, the route passing through Nasoga Gulf spanned bioturbated muddy sand and muddy sand/gravelly muddy sand.

Underwater camera surveys documented a total of 177 taxa. Diversity of seafloor animals varied greatly among habitat classes, and showed no specific pattern. Notably, an area approximately 0.5 – 1.0 km outside the mouth of Work Channel featured the highest abundance of benthic fauna, notably of sea anemone (*Epizoanthus scotinus*). This area appeared to shelter highly diverse and unique composition of benthic species within the survey area.

Seafloor video and stills revealed many seafloor species of interest including cold-water coral (*Primnoa* spp; seen off the mouth of Work Channel), and numerous fish and invertebrates associated with CRA fisheries. Snow crab (*Chionoecetes bairdi*) and Pandalus shrimps were abundant on soft bottom types, reaching densities of up to 28 individuals/m^2. Other commonly observed species on soft bottoms included flatfish (*Pleuronectidae*) and prickleback fish (*Stichaeidae*) while rockfish (*Sebastes* spp.) were predominantly found around hard-bottom structures. The spotted ratfish (*Hydrolagus colliei*) and the longnose skate (*Raja rhina*) were also seen. In addition, Pacific cod (*Gadus* sp.) were notably abundant in Nasoga Gulf. Other dominant species found in the still images included brittle stars (*Ophiura sarsii* and *O. lutkeni*), brachiopod (*Terebratulina* sp.), polychaete worms (*Serpulidae* sp.), and the sea pen (*Virgularia* sp.).

Sediment grabs taken within the PRPA area contained a total of 5,344 burrowing animals from 170 taxa. Of these, bivalves were particularly abundant (50.6% of the total individuals collected) and reasonably diverse (14.7% of the total recorded taxa). Polychaetes were the most diverse group, accounting for 47.6% of all observed taxa, while gastropod diversity represented 9.4% of all species recorded. The variation in seafloor structures associated with sediment-dwelling animals outside of the PRPA area implies additional patterns in infaunal communities that would be confirmed by more extensive sediment sampling. All benthic habitat maps, showing the distribution of benthic habitat classes are presented in the original report by Lu et al. (Attachment L-4-1).

Application for an Environmental Assessment Certificate

Attachment L-4-1
Benthic Habitat Mapping Report

TRANSCANADA PRINCE RUPERT GAS TRANSMISSION PROJECT

BENTHIC HABITAT MAPPING SURVEY

Prince Rupert, British Columbia

Project # 123110628

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EXECUTIVE SUMMARY

Prince Rupert Gas Transmission (PRGT; a subsidiary of TransCanada Pipelines) proposes to construct and install a pipeline from a point south of the Peace River (near Hudson's Hope) to Prince Rupert, British Columbia. Stantec Consulting Limited has been contracted to undertake the environmental assessment of this project pursuant to the British Columbia Environmental Assessment Act and the Canadian Environmental Assessment Act, 2012.

McGregor GeoScience Limited (McGregor) was contracted by Stantec Consulting Ltd for the provision of benthic habitat surveys and mapping services for the TransCanada Prince Rupert Gas Pipeline Limited Partnership's proposed pipeline. Several routes were proposed for the pipeline, all of which include submarine portions which require mapping.

The scope of work included the following:

1. Identification of environmentally Highly Sensitive Seafloor Habitat Features (HSSHF) to allow selection of a final pipeline route. This task was undertaken during geophysical surveys to enable survey crews to find alternate routes as needed in the field.
2. Collection and analysis of underwater video survey data (seafloor video and photographs) to characterise benthic fauna/flora and surficial geology along the survey route.
3. Collection and analysis of benthic infaunal samples from the survey route (where substrate types permit) using sampling gear specially designed for the collection of samples from a range of substrata (*i.e.* soft sediments, mixed sediments, gravel, pebble and coarse sand etc.), allowing characterisation of infauna communities over a wide range of sediment types.
4. The production of benthic habitat maps using multibeam sonar and backscatter data sets collected as part of the planned geophysical surveys along the pipeline route, coupled with the underwater video and stills, and benthic infauna data.

Field operations took place between June - November 2013. The *RV Mystery Bay* was mobilized in Seattle, USA, between June 23 - July 21, 2013. Field operations from the *RV Mystery Bay* commenced August 02, 2013 through to September 18, 2013. A total of 2,975 line km of multibeam echosounder (MBES), sidescan sonar (SSS) and sub-bottom profiler (SBP) data, were collected along the route. Underwater camera deployments (seafloor video and photographs) were made at 98 stations, selected at representative locations along the route based on interpretation of the MBES and SSS data. Eight benthic infaunal grab samples were also collected inside the Prince Rupert Port Authority (PRPA) Area.

A number of potential Highly Sensitive Seafloor Habitat Features (HSSHF) were identified from the processed MBES and SSS data during field operations, which were subsequently ground-truthed using the underwater camera system. All of these features were located in Chatham Sound, and were characterised by distinctive seafloor geomorphology appearing as topographically-complex bathymetry with variable backscatter characteristics. Ground-truthing revealed that these features were sometimes associated with dense, biogenic sponge reefs. These features were deemed to constitute HSSHF, and alternative routing was investigated further east of the features, in real time in the field. Three potential north-south corridors were investigated before a suitable route was mapped without dense aggregations of sponge reefs.

Upon completion of all survey work, data analysis and map production were conducted to map the proposed pipeline route. MBES bathymetry and derived seafloor slope and curvature, along with MBES and SSS backscatter data layers were imported into Arc GIS for interpretation. The data sets were segmented using conventional expert interpretation, whereby the data layers were divided into regions of similar texture, backscatter strength and/or geomorphic bottom type “by eye”. The acoustic interpretation was then compared with the benthic habitat information derived from the underwater video, seafloor photographs and benthic grab sample data for the production of benthic habitat maps.

Visual inspection of the seafloor photographs from the camera stations was undertaken to classify the images into broad benthic habitat classes. A total of 15 benthic habitat

types were identified from the images based on broad substrate and faunal features visible in the photographs.

The seafloor video and stills revealed a diverse benthic environment over the area. Species of interest included the glass sponges *Heterochone calyx* and *Aphrocallistes vastus* as well as the soft coral *Primnoa*. Among species with commercial value, crustaceans and fish were found over the entire area. The crustaceans included the snow crab *Chionoecetes bairdi* and the shrimps *Pandalus* which were numerous on the soft bottom, reaching densities up to 28 individuals/m^2. Throughout the survey area, commonly observed were rockfish (*Sebastes* spp.) around hard bottom structures and flatfish (Pleuronectidae) and prickleback fish (Stichaeidae) on soft bottoms. The spotted ratfish (*Hydrolagus colliei*) and the longnose skate (*Raja rhina*) were found at several stations. In addition, large number of the cod *Gadus* sp. was observed at one station.

A total of 177 taxa were recorded over the camera stations. Calculation of Diversity measures on countable abundance data showed dramatic variation with no clear patterns among the benthic habitat classes. The highest abundance of benthic fauna was recorded at a camera station in the mouth of the Work Channel (the sea anemone *Epizoanthus scotinus* – at a density of 2012 individuals / m^2). This geographic location appeared highly diverse and unique within the survey corridor. Other dominant species found in the still images included the brittle stars *Ophiura sarsii* and *O. lutkeni*, the shrimp *Pandalus* sp., the brachiopod *Terebratulina* sp., the polychaete *Serpulidae* spp., and the sea pen *Virgularia* sp.

The majority of the seafloor within the survey area comprised of the Bioturbated mud habitat class, and this benthic habitat was extensive over flat regions of the seafloor throughout the survey corridor, and over a variety of water depths. The density of burrows visible from the seafloor photographs and video was high within this habitat class, suggesting that this habitat supports and extensive infaunal community. A total of 5,344 infaunal animals comprised of 170 taxa were recorded from the 8 samples collected from the PRPA area. Polychaetes were the most diversified group with 81 species recorded, accounting for 47.6% of the total taxa, while the most abundant group was bivalves (2706 individuals, accounting for 50.6% of the total individuals collected). Other diversified groups included bivalves (25 species accounting for 14.7%),

amphipods (18 species accounting for 10.6%), and gastropods (16 species accounting for 9.4%). Differences in infaunal community structure outside of the PRPA area along the remaining length of the survey corridor are also expected, and further infaunal sampling is needed to determine infaunal community patterns over the soft sediment benthic habitat classes.

Benthic habitat maps, spatially delineating the benthic habitat classes defined from the underwater video, stills and grab samples, are presented for the survey corridor.

GLOSSARY OF TERMS

AC	Acoustic Classes
AHRS	Attitude and Heading Reference System
ANOSIM	Analysis of Similarity
AVG	Angle Varying Gain
BASE	Bathymetry Associated with Statistical Error
BHC	Benthic Habitat Class
CEAA	Canadian Environmental Assessment Act
cm	Centimetre
CHIRP	Compressed High Intensity Radar Pulse
CRS	Coordinate Reference System
dB	Decibel
DGPS	Differential Global Positioning System
DpTPU	Depth Total Propagated Uncertainty
DTM	Digital Elevation Models
EOL	End of Line
GC	Gravity Core
GIS	Geographic Information System
GPS	Global Positioning System
HSSHF	Highly Sensitive Seafloor Habitat Features
HzTPU	Horizontal Total Propagated Uncertainty
H_2S	Hydrogen sulfide
kHz	Kilohertz
km	Kilometre
kts	Knots
LED	Light-emitting diode
LNT	Lowest Normal Tide
m	Metres
MBES	Multibeam Bathymetry Echo Sounder
mp	Megapixel
m/sec	Metres per second
MUX	Multiplexing unit
NMBAQC	National Marine Biological Analytical Quality Control

OSPAR	Oslo and Paris Convention for the protection of the marine environment in the North-East Atlantic
PRGT	Prince Rupert Gas Transmission
PRIMER	Plymouth Routines in Multivariate Ecological Research
PRPA	Prince Rupert Port Authority
PSA	Particle Size Analysis
QC	Quality Control
QINSy	Quality Integrated Navigation System (QPS software)
SACFOR	Super-abundant, Abundant, Frequent, Common, Occasional, Rare
SOL	Start of Line
SSS	Side Scan Sonar
SBP	Subbottom Profile
SVP	Sound Velocity Profile
TPU	Total Propagated Uncertainty
TVG	Time Varying Gain
µm	Micrometre
USBL	Ultra Short Baseline
UTC	Coordinated Universal Time
UTM	Universal Transverse Mercator
WGS84	World Geodetic System 1984

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1 SCOPE OF WORK

Prince Rupert Gas Transmission (PRGT; a subsidiary of TransCanada Pipelines) proposes to construct and install a pipeline from a point south of the Peace River (near Hudson's Hope) to Prince Rupert, British Columbia. Stantec Consulting Limited has been contracted to undertake the environmental assessment of this project pursuant to the British Columbia Environmental Assessment Act and the Canadian Environmental Assessment Act, 2012.

Several routes have been proposed for this pipeline, all of which include submarine portions. Marine fieldwork will be conducted to describe the marine habitats and species within the Project footprint. In addition, PRGT wish for particularly sensitive environmental features to be identified so that they can be avoided during the final routing (Highly Sensitive Seafloor Habitat Features - HSSHF).

McGregor GeoScience Limited (McGregor) was contracted by Stantec Consulting Ltd for the provision of benthic habitat surveys and mapping services for the TransCanada Prince Rupert Gas Pipeline Limited Partnership's proposed pipeline from a point south of the Peace River (near Hudson's Hope) to Prince Rupert, British Columbia. The scope of work (Project No. **123110628**) included the following:

1. Identification of environmentally sensitive seafloor (HSSHF) features to allow selection of a final pipeline route. This task is to be undertaken during geophysical surveys to enable survey crews to find alternate routes as needed in the field.
2. Collection and analysis of underwater video survey data (seafloor video and photographs) to characterise benthic fauna/flora and surficial geology along the survey route.
3. Collection and analysis of benthic infaunal samples from the survey route (where substrate types permit) using sampling gear specially designed for the collection of samples from a range of substrata (*i.e.* soft sediments, mixed sediments, gravel, pebble and coarse sand etc.), allowing characterisation of infauna communities over a wide range of sediment types.

4. The production of benthic habitat maps using multibeam sonar and backscatter data sets collected as part of the planned geophysical surveys along the pipeline route, coupled with the underwater video and stills, and benthic infauna data.

2 FIELD OPERATIONS

Field operations took place between June - November 2013. The *RV Mystery Bay* was mobilized in Seattle, USA, between June 23 - July 21, 2013.

Field operations from the *RV Mystery Bay* commenced August 02, 2013 through to September 18, 2013. A total of 2,975 line km of MBES/SSS/SBP data were collected along the route (**Figure 2.1**). Camera deployments were made at 98 stations (**Figure 2.2a-i)** selected at representative locations along the route based on interpretation of the MBES and SSS data. Eight benthic infaunal grab samples were also collected inside the Prince Rupert Port Authority Area (**Figure 2.2g)**.

2.1 ACOUSTIC DATA SETS

2.1.1 Acoustic data acquisition

The objectives of the hydrographic survey were to map the seabed depth, topography and features along with shallow seabed geology over the survey area. Multibeam data were collected to investigate the seabed bathymetry. Sidescan sonar and sub-bottom profiler data were acquired to identify seabed features and shallow geological layers. Surveys were conducted from three survey platforms: 1) the *RV Mystery Bay*; 2) The *RV Richardson Point* (near-shore landing surveys); 3) the *RV Sea Dog* (shallow water areas). Ground-truthing surveys (underwater imaging and grab sampling - see section 2.3 below) were undertaken in water depths accessible to the *RV Mystery Bay.* Geographical coverage of ground-truthing stations was therefore limited at the landing sites surveyed by the *RV Richardson Point* and *RV Seadog*. The benthic habitat maps generated for this report are therefore based on the acoustic data coverage from the *RV Mystery Bay*, which covers the vast majority of the proposed route and coincides with the coverage of the ground-truthing surveys. Geophysical, bathymetric and other sensors and associated software used to characterise and assess the seafloor from the *RV Mystery Bay* are summarized in **Table 2.1**.

Full details of all data acquisition from all three platforms are provided in the Survey Report (McGregor doc. Number 1311_SurveyReport_Rev0).

Table 2.1 - Equipment system and software summary

R/V MYSTERY BAY	
Primary Equipment Systems	**Purpose**
C-NAV 3050 DGPS	Vessel positioning
Hemisphere GPS Heading	
Sonardyne Ranger 2 USBL	Tracking of Towed Sensors
Coda Octopus F185+	Motion sensor for MBES
Reson 7111 100kHz Multibeam	Acquisition of site bathymetry and backscatter
AML Sound Velocity Sensor	Acquired sound velocities at MBES head for processing
Mark 21 Sippican	Acquired sound velocities for MBES processing
Reson SVP 20	Backup for sound velocity acquisition
Edgetech 2000	Towed Sidescan Sonar/Sub-bottom System
3m Gravity Core	Seabed Sampling
VanVeen Grab Sampler	Seabed Sampling
Hamon Grab	Seabed Sampling
MacArtney Camera System	Deep sea photographs and video acquisition
Primary Software	**Purpose**
QINSy	Vessel Integrated Navigation System
CARIS Multibeam Processing Software	Processing of site bathymetry, backscatter, and sidescan sonar
Edgetech Discover	Acquisition of Sidescan Sonar/Sub-bottom
SonarWiz	Processing of Sidescan Sonar/Sub-bottom
SMT Kingdom Suite	Interpretation software for Sub-bottom data
Autodesk	Route Charting
Blue Marble	Coordinate Conversion software
ArcMap 10	GIS Mapping
Global Mapper 11	GIS Mapping

2.1.2 Acoustic data processing

Onboard data acquisition was overseen by the onboard client representatives. All multibeam, backscatter, sidescan, and sub-bottom acquisition lines were approved by the client representative. For the purpose of the benthic habitat study (this report), MBES and SSS data sets were used for map production, in conjunction with benthic imaging and grab sample survey data (see section 2.3).

Multibeam sonar bathymetric data:

MBES data were processed to remove all outliers (data spikes) present in the data set. The data were converted and imported into CARIS HIPS/SIPS under the Project and day-of-year on which the data were collected. The conversion process creates new files used for processing, leaving a full archive of the raw multibeam files. Once imported and opened in CARIS, the attitude data, (*i.e.* heading, heave, pitch and roll) were examined to ensure motion and heading values were applied properly. Navigation data (Eastings/Northings) were also examined and cleaned for any outliers. Tide values used during acquisition were referenced to NAVD88 vertical datum, and data corrected to chart datum or lowest normal tide (LNT). Sound velocity casts were acquired approximately every 24 to 48 hours during acquisition. The results were compiled into a CARIS compatible .svp file, and all sound velocity casts were concatenated into a single file making it possible to apply the sound velocity correction based on the SVP cast nearest in time. The sound velocity correction process uses a ray-tracing algorithm to apply the velocity profiles to the data to correct for refraction. Data merging combined the information from all of the sensors resulting in a corrected, geo-referenced depth.

Total Propagated Uncertainty (TPU) was used to assign a horizontal uncertainty estimate (HzTPU) and a depth uncertainty estimate (DpTPU) to each sounding. TPU is essential for creating S-44 or S-57 compliant datasets. TPU is derived from a combination of all individual uncertainty sources. The following uncertainties (among others) contribute to TPU:

- nav/gyro/heave/pitch/roll/tide errors;
- latency error estimate;
- sensor offset error estimates; and,
- individual sonar model characteristics.

Finally, gridded surfaces (a means of combining all of the soundings from each line into a final file) were generated based on the corrected bathymetric data. The surface was examined and cleaned to remove any outliers. Data were exported from as ASCII xyz data for import into ArcGIS v10.

Multibeam sonar backscatter data:

The MBES backscatter data were processed using *QPS Fledermaus FMGT*. The data were imported into the software package using the appropriate settings for the multibeam system, ensuring that all raw data files were imported into the software (paired GSF/XTF files). Once imported, the backscatter data were processed using the *Geocoder* processing tools to correct the backscatter. The following settings were used within the *Geocoder* processing tools:

- Source Data Type: Beam Time Series;
- Auto Gain Correction;
- Auto TVG Correction;
- Anti-Aliasing;
- AVG Correction using flat method with an AVG window size of 30;
- Mosaic Resolution: 10 m; and,
- Mosaicing Style: No nadir if possible.

Backscatter mosaics were generated for the survey corridor. Where necessary, manual adjustment of backscatter intensities were undertaken on a line by line basis to level backscatter intensities between lines. Small adjustments in the range of +/- 1-4 dB were needed to level intensities on some adjacent lines to produce an aesthetically correct mosaic.

Data were exported from *QPS Fledermaus FMGT* as both grey-scale geotiff mosaics, and as ASCII xyz data for import into ArcGIS v10.

Sidescan sonar backscatter data:

Two Edgetech 2000 series systems were deployed from the *R/V MYSTERY BAY*. The 2000 Series combines Edgetech's highly successful line of side scan sonars and sub-bottom profilers into one fully integrated system. The first portion of the survey was conducted using the 2000-TVD which is outfitted with a low frequency 1-10kHZ sub-bottom profiler and a 100/400 kHz dual simultaneous frequency CHIRP side scan sonar. The remainder of the survey was completed using a 2000-DSS which comes with a higher frequency 2-16kHZ sub-bottom profiler and a 100/400 kHz dual simultaneous frequency CHIRP side scan sonar.

The Edgetech sidescan is a dual-frequency system, acquiring both 100-kHz and 400-kHz sonograms of the seabed at sub-metre resolution. Both the low- and high-resolution sonograms (100-kHz and 400-kHz respectively) were scrutinized for anomalous hard returns and acoustic shadows indicative of potentially hazardous debris. The data were processed using the software package, *SonarWiz*. The SSS backscatter data were corrected by applying Time Varying Gain (TVG) corrections and Angle Varying Gain (AVG) corrections. A mosaic of the corrected backscatter lines was then generated and exported as a geotiff image for subsequent interpretation in ArcGIS.

2.2 IDENTIFYING HIGHLY SENSITIVE SEAFLOOR HABITAT FEATURES

The acquired multibeam echo sounder (MBES) bathymetry and backscatter data, and sidescan sonar data processed in the field (*i.e.* production of bathymetric DTM, MBES backscatter mosaic and SSS backscatter mosaic), were evaluated by the onboard geoscientists to identify potential Highly Sensitive Seafloor Habitat Features (HSSHF) (*i.e.* biogenic reefs, sponge beds etc.). A comprehensive list of HSSHF was agreed by Stantec and McGregor prior to the survey work commencing.

Any potential HSSHF identified in the field from the acoustic data sets were ground-truthed using the drop-camera system to verify what they were, their extent, and whether or not they constituted a HSSHF. Geophysical survey operations were then suspended, and the camera system deployed. Onboard McGregor and Stantec biologists evaluated the live video footage from the drop camera system real-time to confirm the identity of the feature, and assess whether or not it was a HSSHF. The camera system was lowered to the seafloor, and the vessel was allowed to drift over the target station/feature. Camera altitude was adjusted real-time by the camera operator to maintain a height above the seafloor of 1-2 m, providing optimal image quality. A total of 13 stations were surveyed as potential HSSHF (**Table 2.2**).

If the feature was deemed not to constitute a HSSHF then geophysical surveys resumed along the planned route. If the feature was identified as a HSSHF, then an alternative route was evaluated in the field to avoid the feature, and geophysical surveys commenced along the amended route. This approach allowed rapid evaluation of

potential biological HSSHF to avoid and minimize unnecessary collection of geophysical data, and ensure the proposed pipeline route resulted in minimal impact to sensitive seafloor habitats. Data gathered while validating HSSHF features were also used with data collected for the planned benthic habitat mapping surveys (see section 2.3) conducted upon completion of the geophysical surveys.

2.3 BENTHIC ENVIRONMENTAL SAMPLING

Seabed sampling/video/photographic locations were selected based on the interpreted backscatter and bathymetric data sets with the intention of sampling and describing the full range of benthic habitats encountered along the length of the survey route. A 0.1 m^2 Van Veen grab was used to sample 8 stations inside the Prince Rupert Port Authority Area. Subsamples were taken from each grab sample for sediment grain size analysis and the remaining sample was washed over a 500 μm sieve using an auto-siever and the residue fixed in a 10 percent solution of buffered formal saline. Samples were shipped back to the McGregor Environmental Laboratory for full species identification and enumeration. Further infaunal grab samples are planned for collection in early 2014 along the remainder of the route subject to receiving necessary OGC sampling permit. Underwater video/photographic data were collected at 98 stations distributed along the survey route, and these data were analysed to characterise surficial sediment, epifaunal community composition, and benthic habitat characteristics.

2.3.1 Seafloor Photography and Video

Seabed photography and video acquisition were conducted at 98 stations (including 13 stations surveyed as potential HSSHF sites determined from the geophysical data sets) to provide ground-truthing of seafloor types interpreted from the earlier acoustic surveys (see Section 2.1), and to identify conspicuous flora, fauna and benthic habitat characteristics. Camera transect coordinates including start of line (SOL) and end of line (EOL) positions, are listed in **Table 2.2** and shown in **Figure 2.2**. All video data from each camera drop are located in **Digital Appendix 1 and 2**.

Table 2.2 - Camera station coordinates (Longitude/Latitude)

	Line Start		Line End	
Station:	**Longitude**	**Latitude**	**Longitude**	**Latitude**
benthic-cd-001C	-130.3614446	54.16122472	-130.3636398	54.16449622
benthic-cd-002	-130.4047263	54.15150875	-130.4098527	54.15534149
benthic-cd-003	-130.4484312	54.15917615	-130.4484001	54.1611559
benthic-cd-004	-130.4350298	54.1664996	-130.434609	54.16783349
benthic-cd-005	-130.4399102	54.16913234	-130.4418992	54.16912732
benthic-cd-006	-130.5529206	54.27107355	-130.5530552	54.26800339
benthic-cd-007-008	-130.5735083	54.35288455	-130.565577	54.34815551
benthic-cd-011	-130.5934363	54.44234385	-130.5903967	54.4488771
benthic-cd-012	-130.5904149	54.45023303	-130.5904313	54.45199813
benthic-cd-013	-130.5599001	54.46174977	-130.5641899	54.46523822
benthic-cd-014	-130.5527052	54.47774999	-130.5450211	54.48178424
benthic-cd-014B	-130.5475703	54.47717894	-130.5510683	54.48328926
benthic-cd-015	-130.5627436	54.37511011	-130.5682289	54.36189895
R13_BHM_007	-130.3428133	54.20523667	-130.3426317	54.20472667
R13_BHM_010	-130.37229	54.21819817	-130.3727167	54.21593333
R13_BHM_011	-130.4014	54.22946667	-130.4017348	54.22749
R13_BHM_016	-130.5729133	54.28876333	-130.5664483	54.28833167
R13_BHM_002	-130.38115	54.16191667	-130.3597093	54.1615132
R13_BHM_001	-130.3406467	54.16057167	-130.3356167	54.16070167
R13_BHM_003	-130.4435933	54.16484583	-130.4409753	54.16336542
R13_BHM_005	-130.4491833	54.18027333	-130.4465967	54.1789
R13_BHM_013	-130.43925	54.23847667	-130.4419717	54.23954667
R13_BHM_004	-130.4703617	54.17386	-130.4740117	54.17478667
R13_BHM_006	-130.4677508	54.19231333	-130.4722683	54.19271333
R13_BHM_008	-130.4987833	54.20305667	-130.5021833	54.20411333
R13_BHM_009	-130.50372	54.21571	-130.5073617	54.21584167
R13_BHM_012	-130.5238667	54.23468217	-130.52781	54.23625167
R13_BHM_014	-130.4708233	54.24599833	-130.4723667	54.24983667
R13_BHM_015	-130.5537468	54.27949	-130.554975	54.28178833
R13_BHM_017	-130.5697817	54.299325	-130.57226	54.30121333
R13_BHM_021	-130.563235	54.33110667	-130.5631333	54.33317
R13_BHM_023	-130.55187	54.34925667	-130.5563935	54.34756
R13_BHM_022	-130.5593283	54.34632333	-130.5636317	54.34479
R13_BHM_025	-130.5693983	54.35112578	-130.5695884	54.3488735
R13_BHM_029	-130.56141	54.43640667	-130.56095	54.4393
R13_BHM_031	-130.5571933	54.45986167	-130.5626867	54.46504833
R13_BHM_032	-130.5428033	54.4763	-130.5428033	54.4763
R13_BHM_033	-130.55196	54.48828833	-130.5486467	54.48810167
R13_BHM_035	-130.5445	54.52660833	-130.5460067	54.528295
R13_BHM_036	-130.5350367	54.53881167	-130.5350193	54.541095
R13_BHM_038	-130.514655	54.59427833	-130.5155383	54.59648
R13_BHM_041	-130.521065	54.60766167	-130.5214	54.60938
R13_BHM_040	-130.5083833	54.604825	-130.5083033	54.60286

	Line Start		Line End	
Station:	**Longitude**	**Latitude**	**Longitude**	**Latitude**
R13_BHM_040B	-130.5103333	54.60246167	-130.5098767	54.604993
R13_BHM_042	-130.52672	54.61465333	-130.5266117	54.617205
R13_BHM_044	-130.53035	54.62332167	-130.5302317	54.62541667
R13_BHM_045	-130.5330117	54.63314167	-130.5354067	54.63500667
R13_BHM_047	-130.535285	54.64581	-130.5388217	54.64306333
R13_BHM_049	-130.5213917	54.65864	-130.5182367	54.66091667
R13_BHM_052	-130.5261783	54.66396167	-130.5218967	54.66600833
R13_BHM_053	-130.4952017	54.674225	-130.4932133	54.67531667
R13_BHM_056	-130.4854433	54.68001167	-130.4812833	54.68288
R13_BHM_051	-130.4575517	54.66717	-130.4575617	54.66505
R13_BHM_055	-130.450255	54.67758667	-130.449465	54.679555
R13_BHM_057	-130.4616333	54.68804667	-130.4594983	54.68978667
R13_BHM_059	-130.458775	54.69319	-130.4576217	54.69397333
R13_BHM_058	-130.44062	54.691145	-130.4390517	54.69273333
R13_BHM_061	-130.434545	54.71270167	-130.435095	54.71538833
R13_BHM_062	-130.39944	54.74076667	-130.400585	54.74283
R13_BHM_063	-130.3886283	54.74806833	-130.3856633	54.7492
R13_BHM_064	-130.3689567	54.75922333	-130.3672483	54.76063333
R13_BHM_066	-130.304695	54.79435333	-130.3020833	54.79534833
R13_BHM_070	-130.2399433	54.82934333	-130.23919	54.83144
R13_BHM_075	-130.1121233	54.94221333	-130.1110517	54.94513833
R13_BHM_076	-130.0219083	54.99040667	-130.018405	54.99076833
R13_BHM_077	-130.0143533	55.00315	-130.0160717	55.03
R13_BHM_068	-130.231002	54.80614567	-130.2289117	54.807965
R13_BHM_071	-130.1503167	54.834665	-130.147081	54.84484653
R13_BHM_074	-130.0713333	54.87987333	-130.073339	54.87846807
R13_BHM_073	-130.1093617	54.85196167	-130.1123	54.850215
R13_BHM_072	-130.1368233	54.83979167	-130.13769	54.839315
R13_BHM_069	-130.1710517	54.82295333	-130.1733567	54.82015167
R13_BHM_067	-130.1865117	54.801355	-130.073339	54.87846807
R13_BHM_065	-130.1931133	54.78105	-130.1123	54.850215
R13_BHM_060	-130.2400433	54.71837117	-130.13769	54.839315
R13_BHM_078	-130.344845	54.69923333	-130.1733567	54.82015167
R13_BHM_079	-130.3879833	54.65630333	-130.3880183	54.65828833
R13_BHM_054	-130.3818033	54.67879	-130.385285	54.67985333
R13_BHM_046	-130.4250833	54.638275	-130.4219483	54.63739333
R13_BHM_043	-130.369215	54.61831167	-130.3785833	54.61831167
R13_BHM_039A	-130.3406733	54.59023833	-130.3372183	54.588195
R13_BHM_037	-130.310375	54.558855	-130.31259	54.56121667
R13_BHM_034	-130.2434533	54.49720833	-130.2484217	54.49955333
R13_BHM_030	-130.19724	54.46391667	-130.1947633	54.461505
R13_BHM_028	-130.118239	54.407345	-130.1163133	54.40401167
R13_BHM_027	-130.0901433	54.38077667	-130.0923683	54.38273167
R13_BHM_026	-130.0831283	54.37674833	-130.0855133	54.37891

	Line Start		Line End	
Station:	**Longitude**	**Latitude**	**Longitude**	**Latitude**
R13_BHM_024	-130.0643167	54.35401167	-130.0656983	54.35596
R13_BHM_020	-130.0439	54.33095	-130.0430017	54.32877667
R13_BHM_A	-130.0237433	54.32159333	-130.0276983	54.32368
R13_BHM_018	-129.9991467	54.30847	-130.0022017	54.31149333
R13_BHM_019	-130.00979	54.31353667	-130.0113283	54.314865
R13_BHM_B	-130.0231583	54.31798333	-130.0430017	54.32877667
R13_BHM_027B	-130.0918817	54.38150667	-130.0276983	54.32368
R13_BHM_SC0319A	-130.2721667	54.52122833	-130.0022017	54.31149333
R13_BHM_SC0319B	-130.281105	54.528555	-130.0113283	54.314865
R13_BHM_SC0319C	-130.2806967	54.52684167	-130.2801147	54.52832533
R13_BHM_039B	-130.349255	54.59028167	-130.338745	54.58920667
R13_BHM_059C	-130.4588517	54.69579	-130.45948	54.69309667

The deep-water drop camera system was used for acquisition of all photographic and video data. The system consisted of a Kongsberg digital stills camera with separate Kongsberg flash unit and a Deepsea Power & Light Multi-SeaCam colour video camera. A laser scaling system was also incorporated into the system. The key acquisition parameters of the camera system are listed in **Table 2.3**.

Table 2.3 - Camera acquisition parameters

Standard Features	Specifications
Still Camera Resolution	10 Megapixel (mp) Kongsberg OE14-408 Underwater Digital Stills Camera
Light source	2 x LED lights 1 x Kongsberg OE11-442 Flashgun
Video Camera	Deepsea Power & Light Multi-SeaCam
Data transmission	Multiplexing unit (MUX) for two-way data transmission and power to the subsea systems via single coax double-armoured cable
Other	Integrated Laser Scale - 16 cm separation between lasers Auxiliary subsea units including an Altimeter as well as an Attitude (*i.e.* pitch, roll) and Heading Reference System (AHRS).

The system was mounted on an aluminum drop-down frame which was towed at the seabed. The output from the camera was controlled from the surface using a video stream supplied from the camera and number of function controls operated through a co-axial armoured cable. Once on the seabed, the system was towed for at least 15

minutes and digital stills photographs were acquired at 15 second intervals throughout the duration of each transect.

The camera captured 10 mp still photographs of the sea bottom to determine sediment composition and to allow for faunal identification. The camera was deployed at pre-determined locations picked from the backscatter and bathymetric data along the corridor (**Table 2.2** above).

The system was deployed from the stern A-frame of the vessel using the vertical drop-down frame technique and lowered to the seabed using the cable counter and the online video to control the frames height and attitude once at the seabed. Positioning of the system was maintained throughout using the USBL positioning system. The vessel maintained a powered drift positioned forward of each target and was allowed to move at a tow speed of approximately 0.5 kts to 1.5 kts (0.25 to 0.75 m/sec).

Representative photographs from each camera station are included in **Appendix 1,** and all collected and analysed seafloor images are included in **Digital Appendix 1**.

2.3.2 Benthic Grab

The primary seabed sampler was a 0.1 m^2 Van Veen grab. A record of the sampler's touch down location and deployment depth were monitored by means of a load cell (within the crane) which recorded tension on the cable and could be zeroed immediately prior to sampling. Samples were subject to quality control on retrieval and were retained in the following circumstances:

- Water above sample was undisturbed;
- Spade closure complete allowing no sediment washout;
- Penetration of the box was sufficient to maintain a seal at the base of the grab but not over penetrated allowing water to remain above the sample when recovered;
- Sampler was retrieved perfectly upright and had not fouled in any way;
- Inspection/access doors had closed properly enclosing the sample;
- No disruption of the sample through striking the side of the vessel;
- Sample were taken inside the acceptable target range; and,
- The sample was acceptable to the principle scientist.

For each sample, the retained sediment was inspected, described, and photographed before a small sub-sampled was removed and placed in a labelled zip-lock bag for sediment grain size analysis. The remaining sample was then processed onboard using an auto-siever over a 500 µm aperture mesh. Key observations from samples were colour, sediment classification, layering, smell (including the presence of H_2S), obvious fauna and evidence of bioturbation. The preservation of materials was undertaken using standard techniques. Faunal samples were fixed in 10% buffered formalin for storage and transportation. All biological samples were double-labelled with internal tags. Coordinates for field sampling operations are presented in **Table 2.4** and grab sample locations are shown in **Figure 2.2g**, and details of sediment samples acquired are outlined in **Appendix 2**.

Table 2.4 - Sample locations and samples collected

Station	Latitude	Longitude	Samples Collected
R13_BHM_001	54.16092636	-130.3390846	PSA, Fauna
R13_BHM_002	54.16157769	-130.3630666	PSA, Fauna
R13_BHM_003	54.16445303	-130.4419421	PSA, Fauna
R13_BHM_005	54.17997235	-130.4478866	PSA, Fauna
R13_BHM_007	54.20414806	-130.3428785	PSA, Fauna
R13_BHM_010	54.21729723	-130.3642355	PSA, Fauna
R13_BHM_011	54.22875974	-130.4020155	PSA, Fauna
R13_BHM_013	54.24059821	-130.4382631	PSA, Fauna
WGS 84			

2.4 SURVEY GEODESY

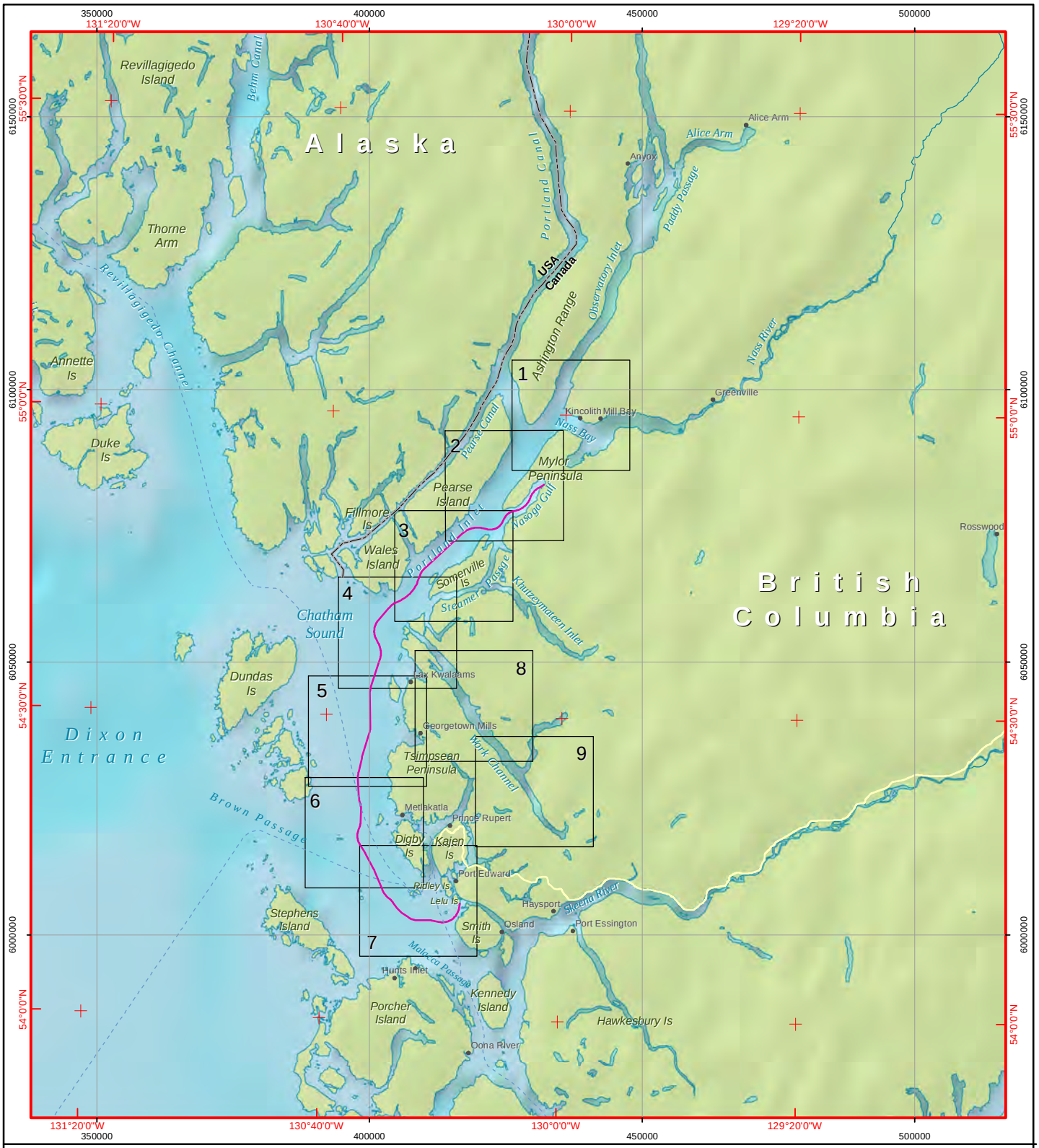
The geodetic parameters used were as follows:

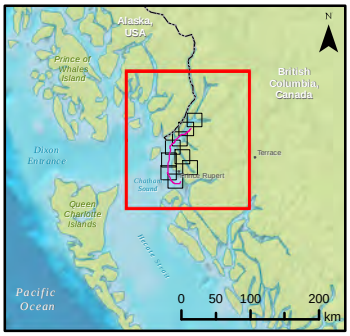
Geodetic Parameters:

Parameter	Value
Geodetic CRS Name	WGS 84
Ellipsoid Name	WGS 84
Semi-Major Axis (a)	6,376,137.0 m
Semi-Major Axis (b)	6,356,752.3142 m
Inverse Flattening (1/f)	298.2572235

Acquisition Parameters:

Parameter	Value
Projection	Transverse Mercator
Zone	9N
Central Meridian	-129.0
Latitude of Origin	0.0
False Easting	500000.0
False Northing	0.0
Scale Factor	0.9996





Location Map

Survey Area

Prince Rupert, BC, Canada

0 5 10 20 30 km

Map Block

Route F03

Nasoga Gulf to Lelu East

Primary Highway

Ferry Route

Alaska/BC Border

WGS 1984 UTM Zone 9N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -129.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

McGregor GeoScience Limited

TransCanada *In business to deliver*

Note:
Map scale 1:1,000,000 when printed on 8.5x11 size paper

N W E S

Figure: 2.1

Date Saved: 11/03/2014 9:16:11 AM
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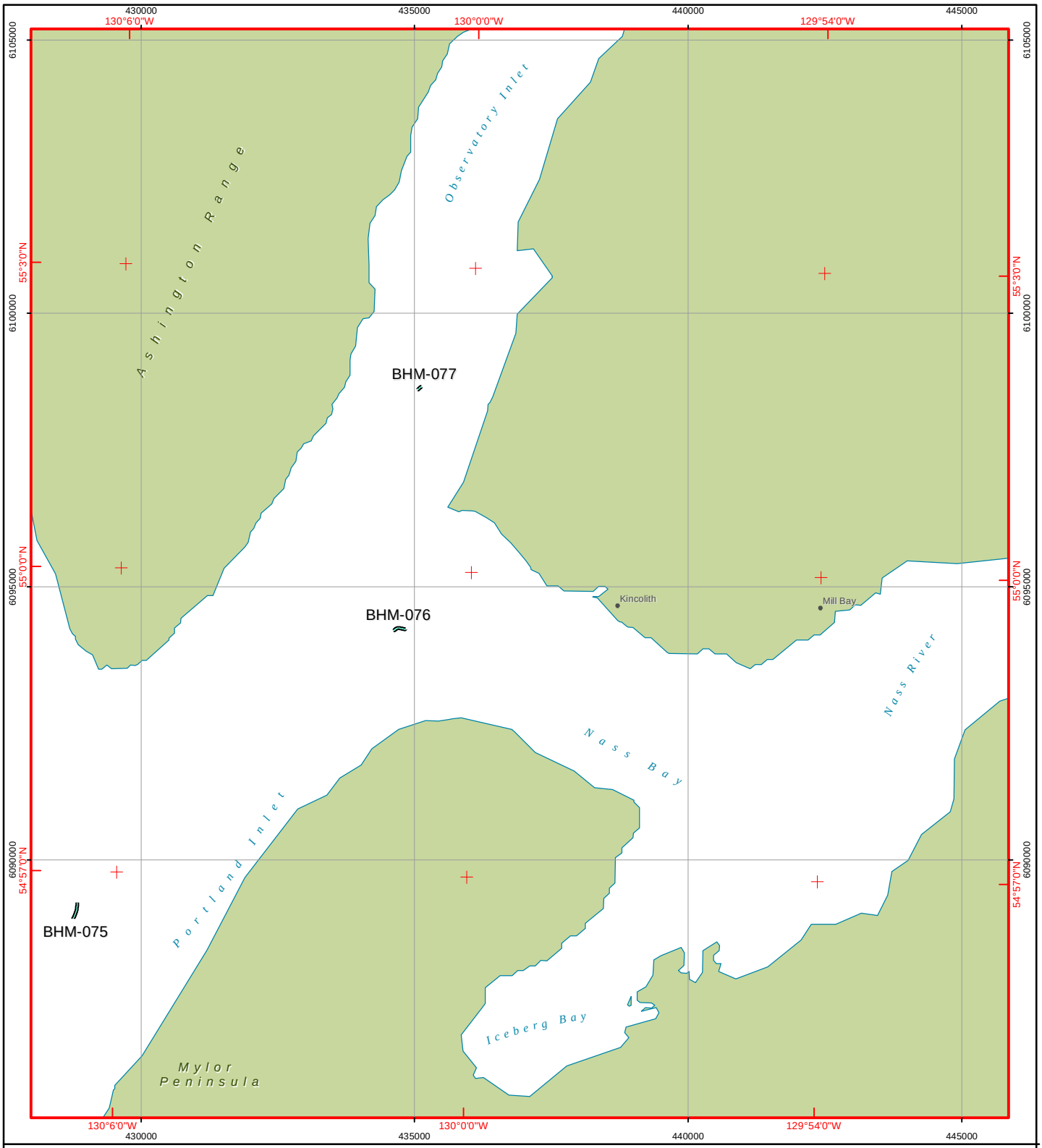

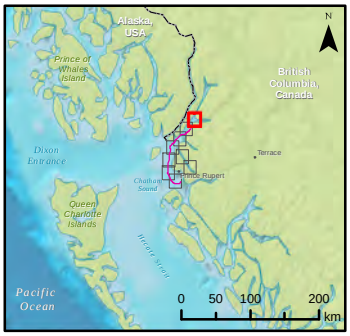

Camera Transect/Grab Locations

Survey Area - Map Block 1

Prince Rupert, BC, Canada

0 1 2 4
km

Route F03

Nasoga Gulf to Lelu East

Samples

Camera Track

Grab Sample (PRPA Area Only)

WGS 1984 UTM Zone 9N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -129.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

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Note:
Map scale 1:100,000 when printed on 8.5x11 size paper

N
W E
S

Figure: 2.2a

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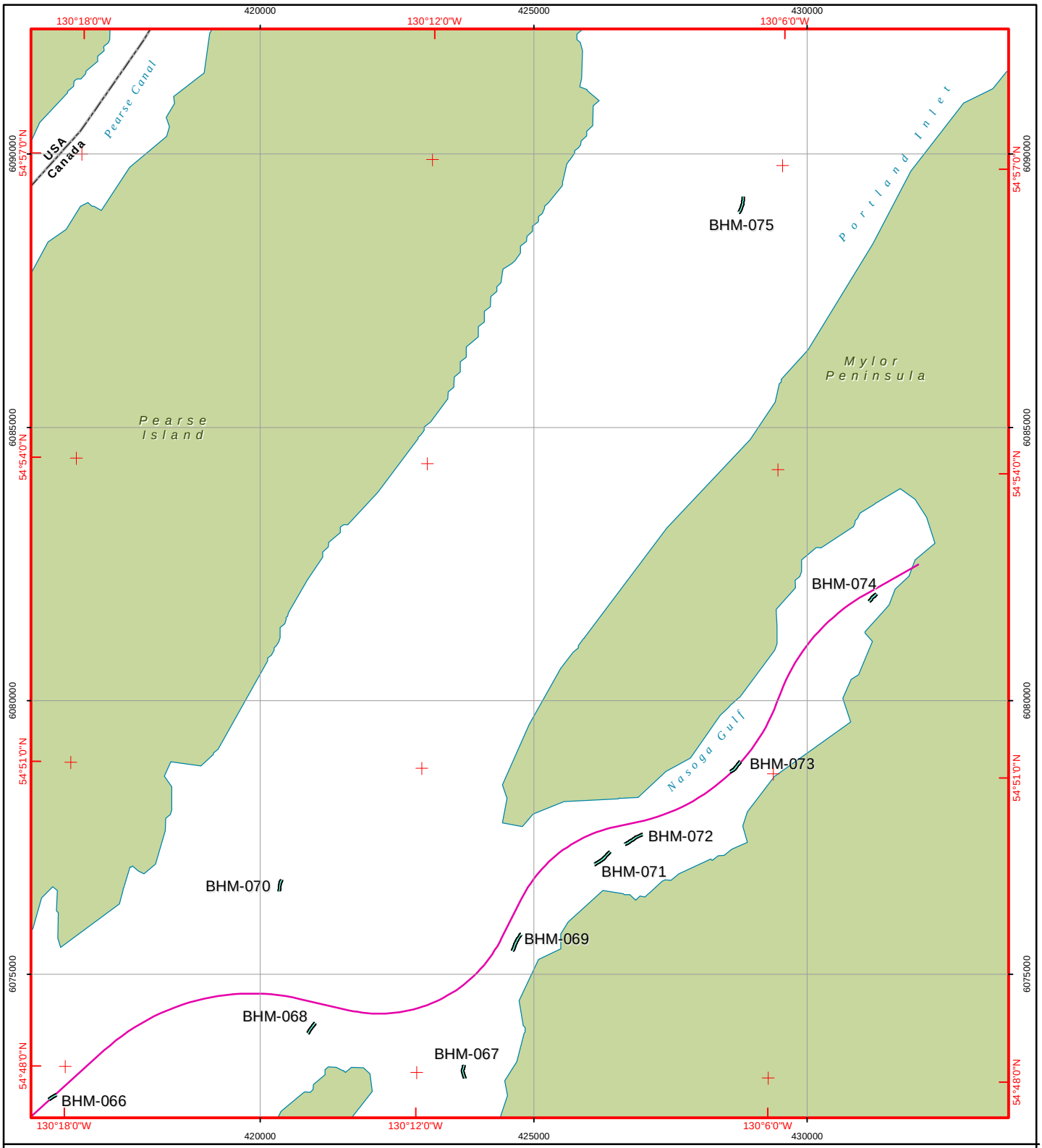
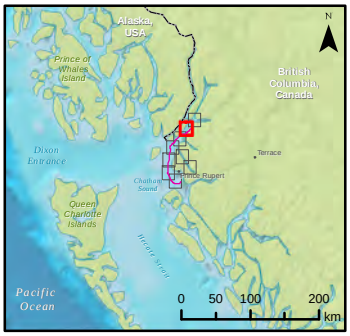




Camera Transect/Grab Locations

Survey Area - Map Block 2

Prince Rupert, BC, Canada

0 1 2 4
km

Route F03

Nasoga Gulf to Lelu East

Samples

Camera Track

Grab Sample (PRPA Area Only)

WGS 1984 UTM Zone 9N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -129.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

McGregor GeoScience Limited

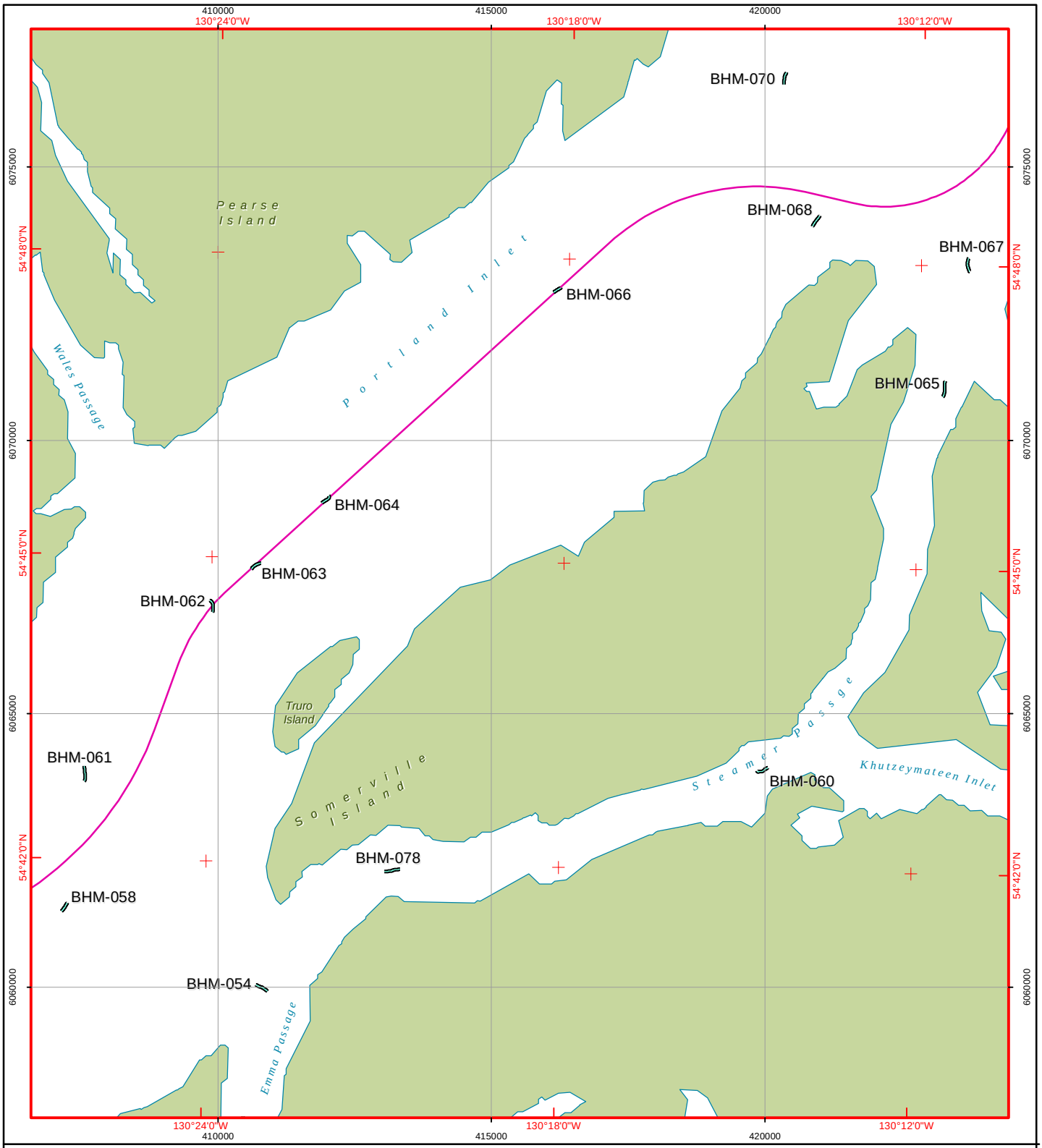
TransCanada
In business to deliver

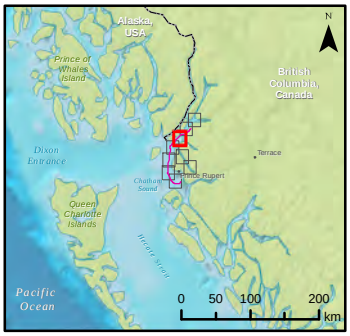
Note:
Map scale 1:100,000 when printed on 8.5x11 size paper

N
W E
S

Figure: 2.2b

Date Saved: 11/03/2014 8:45:43 AM
McGregor Project No.: 1311
Filename: 1311_CamGrab_x9





Camera Transect/Grab Locations

Survey Area - Map Block 3

Prince Rupert, BC, Canada

0 1 2 4
km

Route F03

Nasoga Gulf to Lelu East

Samples

Camera Track

Grab Sample (PRPA Area Only)

WGS 1984 UTM Zone 9N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -129.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

McGregor GeoScience Limited

TransCanada
In business to deliver

Note:
Map scale 1:100,000 when printed on 8.5x11 size paper

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Figure: 2.2c

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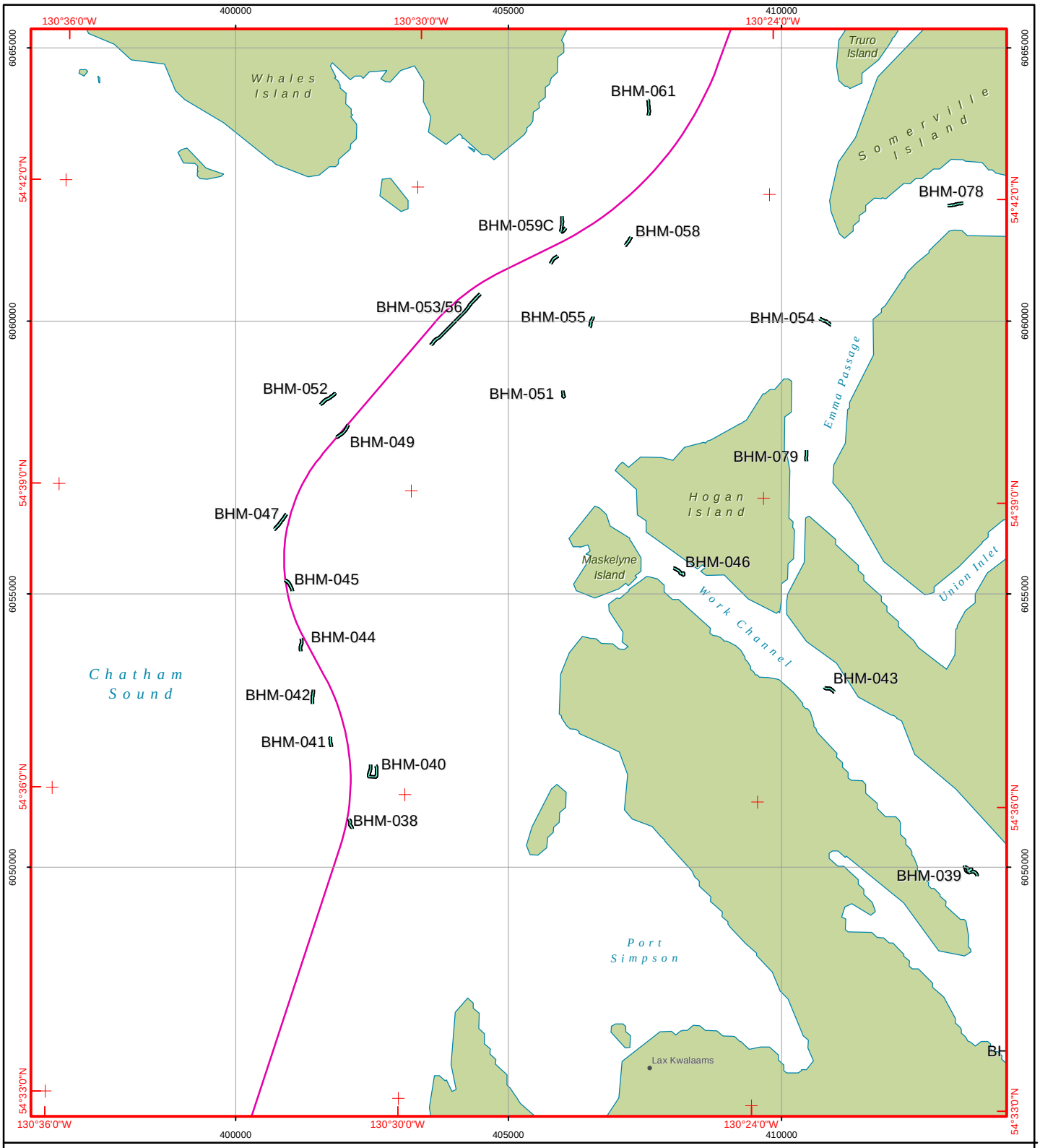

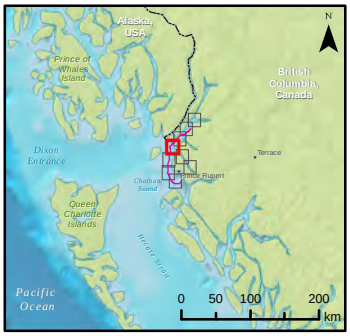

Camera Transect/Grab Locations

Survey Area - Map Block 4

Prince Rupert, BC, Canada

0 1 2 4
km

Route F03

Nasoga Gulf to Lelu East

Samples

Camera Track

Grab Sample (PRPA Area Only)

WGS 1984 UTM Zone 9N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -129.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

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TransCanada in business to deliver

Note:
Map scale 1:100,000 when printed on 8.5x11 size paper

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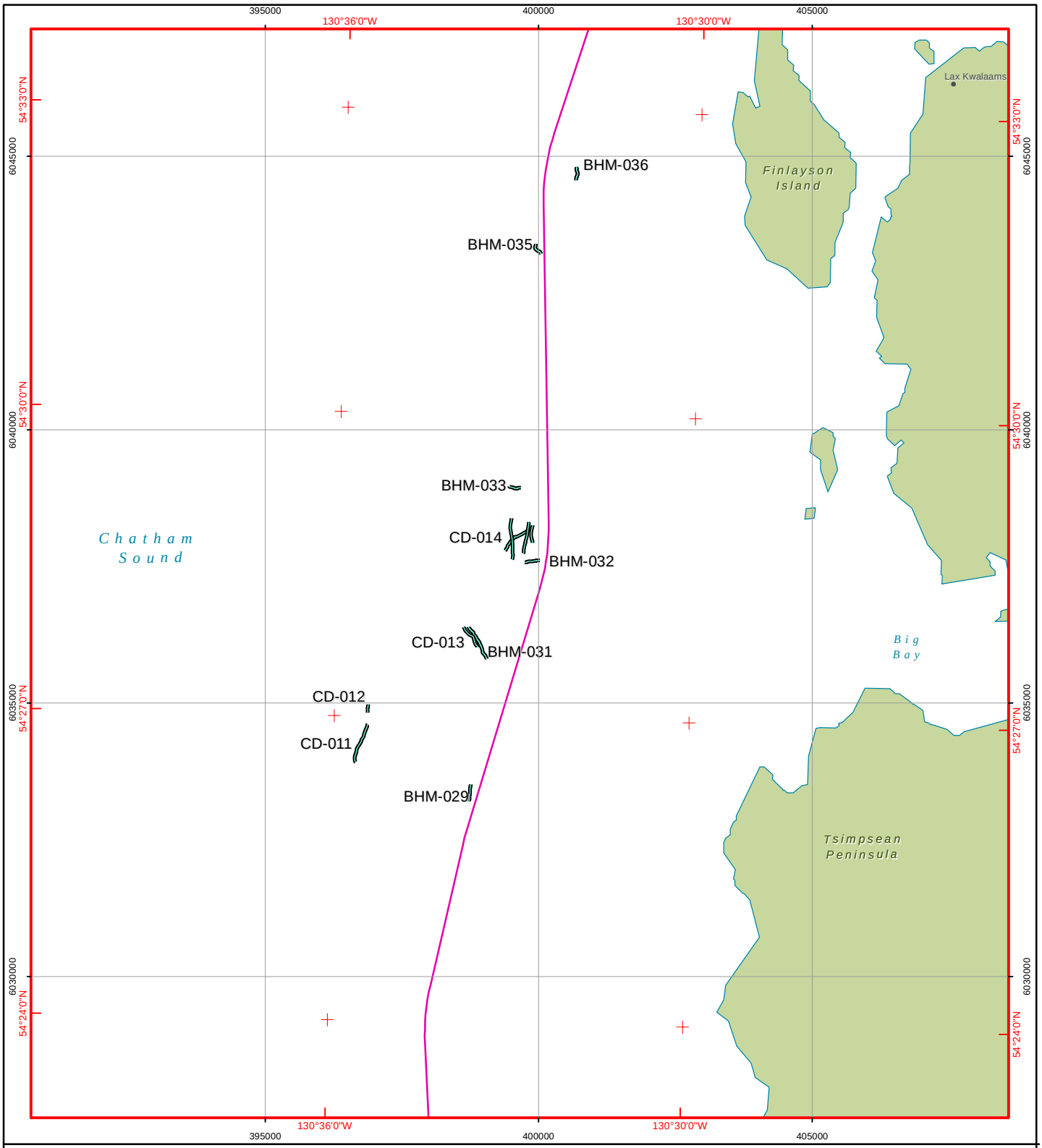
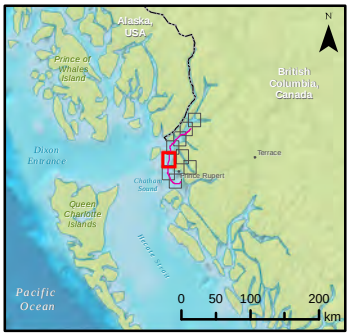
Figure: 2.2d

Date Saved: 11/03/2014 8:45:43 AM
McGregor Project No.: 1311
Filename: 1311_CamGrab_x9





Camera Transect/Grab Locations

Survey Area - Map Block 5

Prince Rupert, BC, Canada

0 1 2 4
km

Route F03

Nasoga Gulf to Lelu East

Samples

Camera Track

Grab Sample (PRPA Area Only)

WGS 1984 UTM Zone 9N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -129.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

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Note:
Map scale 1:100,000 when printed on 8.5x11 size paper

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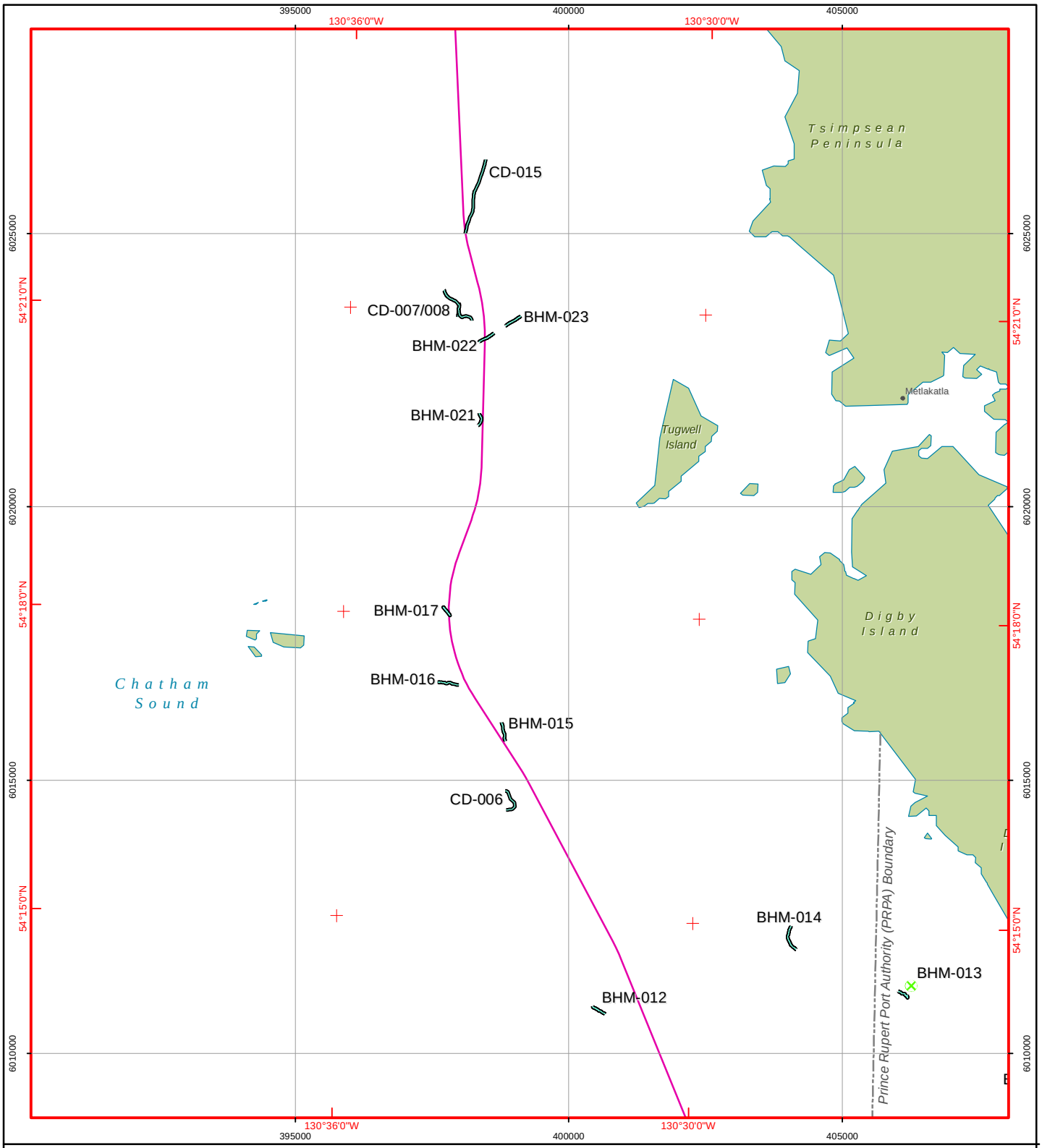
Figure: 2.2e

Date Saved: 11/03/2014 8:45:43 AM
McGregor Project No.: 1311
Filename: 1311_CamGrab_x9



Camera Transect/Grab Locations

Survey Area - Map Block 6

Prince Rupert, BC, Canada

0 1 2 4
km

Route F03

Nasoga Gulf to Lelu East

Samples

Camera Track

Grab Sample (PRPA Area Only)

WGS 1984 UTM Zone 9N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -129.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

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Note:
Map scale 1:100,000 when printed on 8.5x11 size paper

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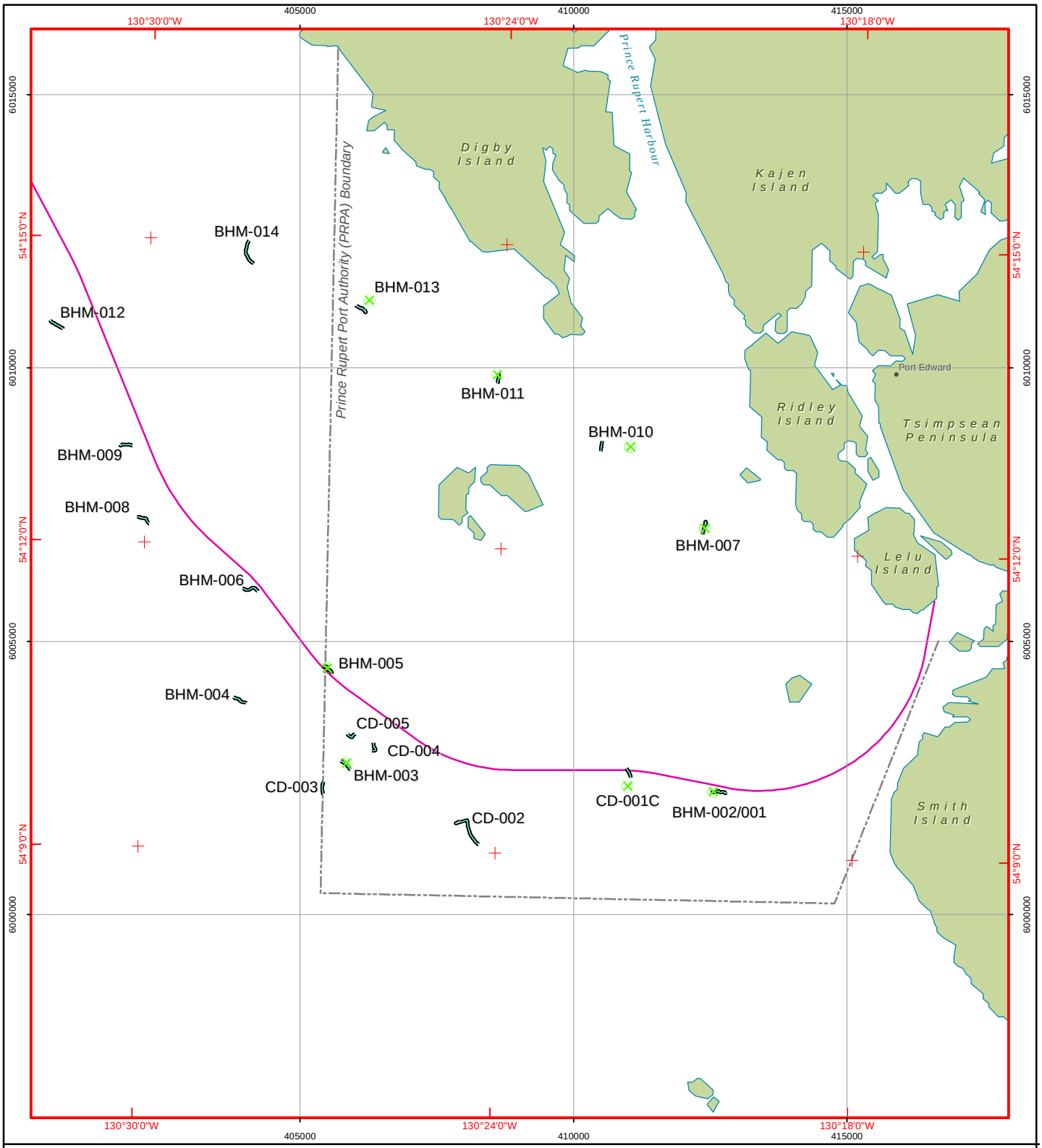
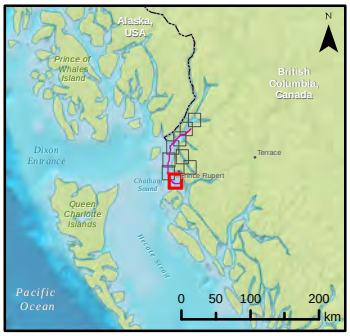
Figure: 2.2f

Date Saved: 11/03/2014 8:45:43 AM
McGregor Project No.: 1311
Filename: 1311_CamGrab_x9





Camera Transect/Grab Locations

Survey Area - Map Block 7

Prince Rupert, BC, Canada

0 1 2 4
km

Route F03

Nasoga Gulf to Lelu East

Samples

Camera Track

Grab Sample (PRPA Area Only)

WGS 1984 UTM Zone 9N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -129.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

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TransCanada
In business to deliver

Note:
Map scale 1:100,000 when printed on 8.5x11 size paper

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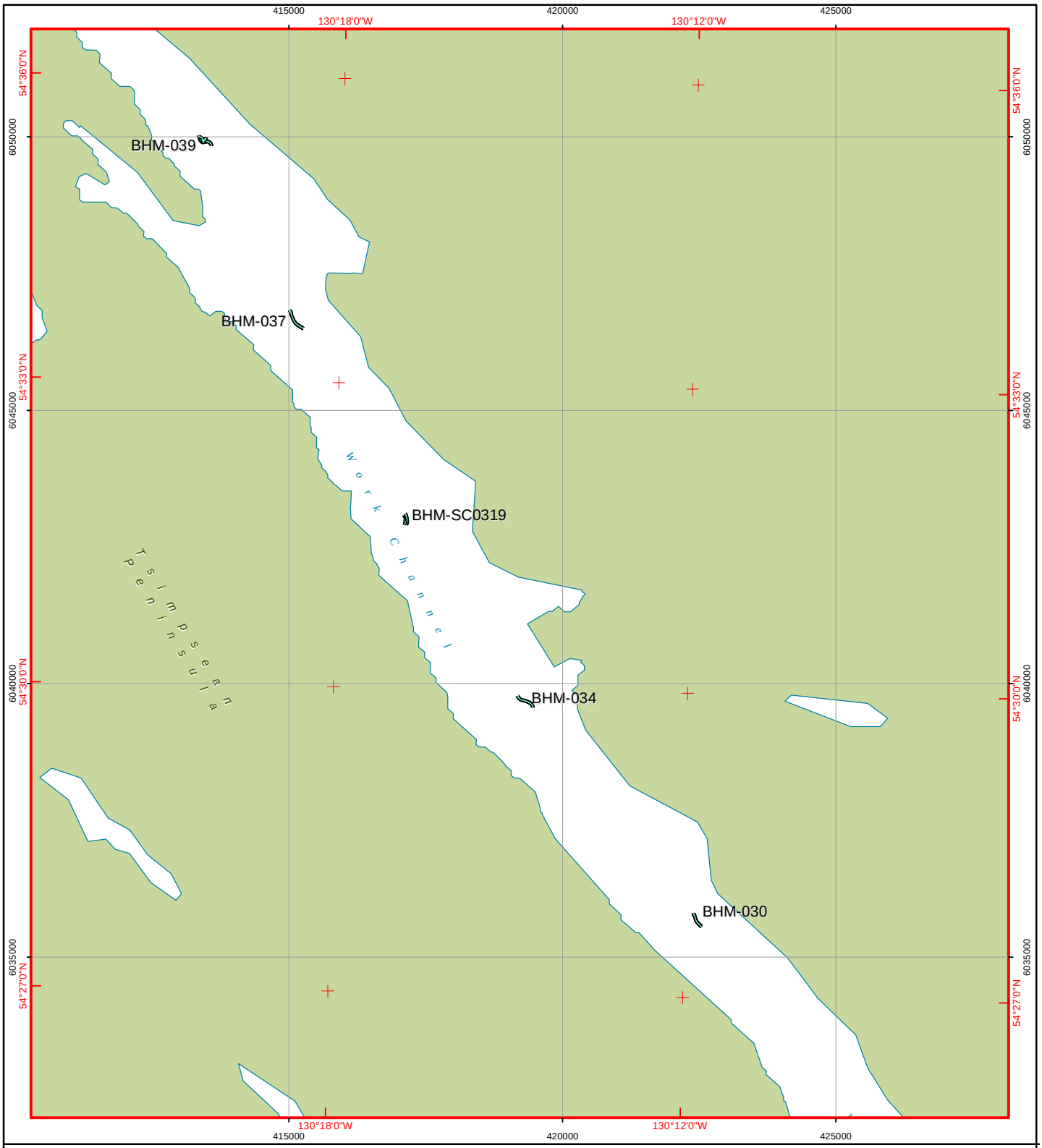
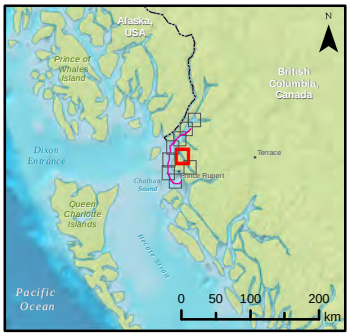
Figure: 2.2g

Date Saved: 11/03/2014 8:45:43 AM
McGregor Project No.: 1311
Filename: 1311_CamGrab_x9





Camera Transect/Grab Locations

Survey Area - Map Block 8

Prince Rupert, BC, Canada

0 1 2 4
km

Route F03

Nasoga Gulf to Lelu East

Samples

Camera Track

Grab Sample (PRPA Area Only)

WGS 1984 UTM Zone 9N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -129.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

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in business to deliver

Note:
Map scale 1:100,000 when printed on 8.5x11 size paper

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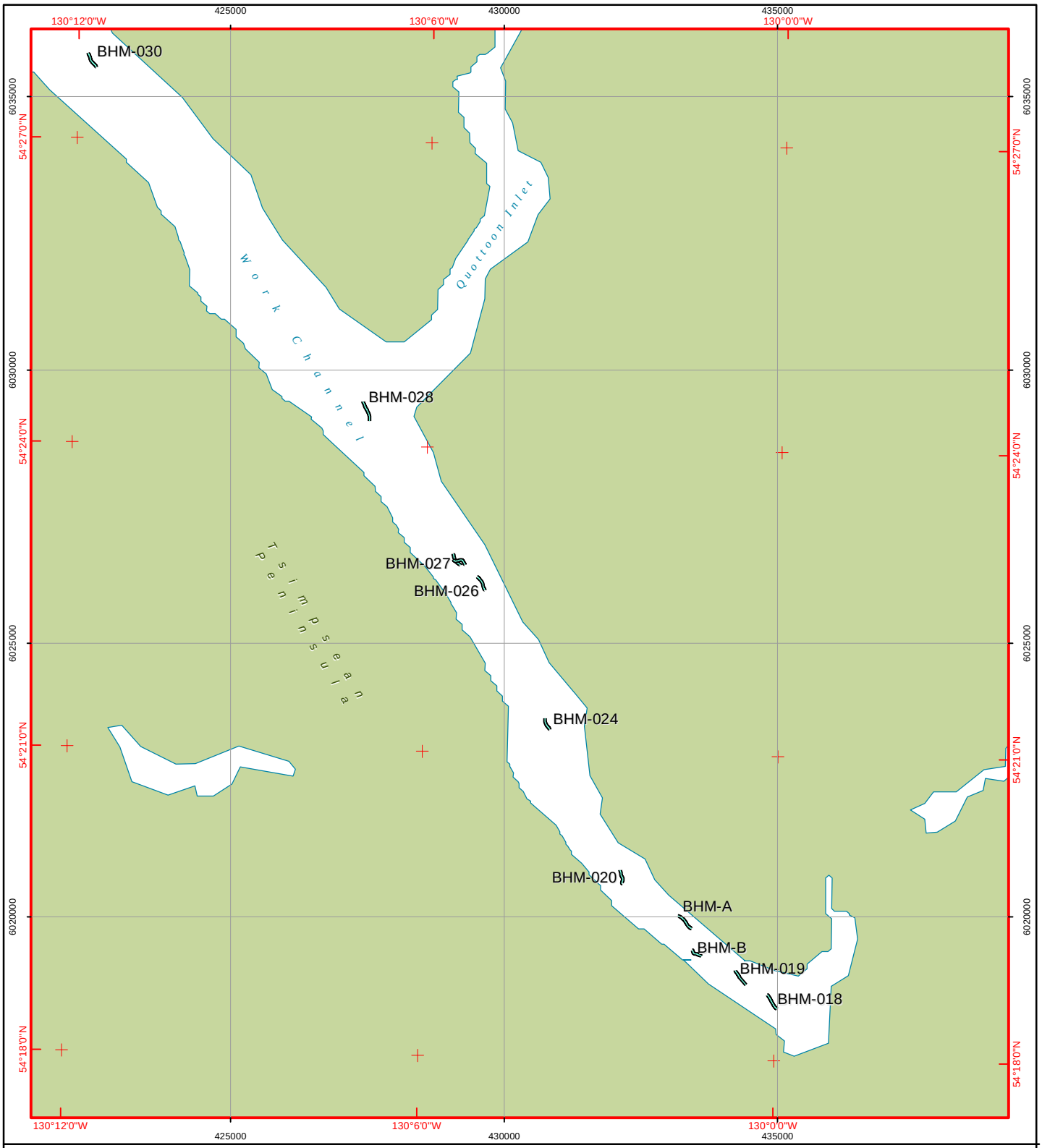
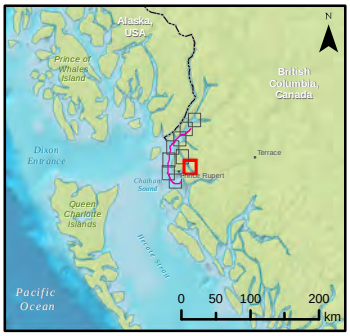
Figure: 2.2h

Date Saved: 11/03/2014 8:45:43 AM
McGregor Project No.: 1311
Filename: 1311_CamGrab_x9





Camera Transect/Grab Locations

Survey Area - Map Block 9

Prince Rupert, BC, Canada

0 1 2 4
km

Route F03

Nasoga Gulf to Lelu East

Samples

Camera Track

Grab Sample (PRPA Area Only)

WGS 1984 UTM Zone 9N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -129.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

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Note:
Map scale 1:100,000 when printed on 8.5x11 size paper

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S

Figure: 2.2i

Date Saved: 11/03/2014 8:45:43 AM
McGregor Project No.: 1311
Filename: 1311_CamGrab_x9

3 DATA/SAMPLE ANALYSIS

3.1 ACOUSTIC INTERPRETATION

Bathymetry and backscatter data are commonly used for habitat characterisation and mapping of benthic systems, and there are many studies reported in the scientific literature which demonstrate the benefits and advantages of using this type of data for benthic habitat mapping applications (Brown and Blondel, 2009; Brown *et al*., 2011 (a); Brown *et al,* 2011 (b) ; McGonigle *et al*, 2011). The acoustic backscatter signal from MBES and SSS is commonly used to segment the seafloor into geological classes (*i.e.* surficial sediment types) and/or benthic habitat classes, and the close association between acoustic backscatter strength and seafloor geological/biological characteristics is now widely accepted (Brown and Collier, 2008; Collier and Brown, 2005; Ferrini and Flood, 2006). Similarly, digital elevation models (DTM) generated from multibeam sonar bathymetry data provides information on seafloor geomorphology, and can also be used to facilitate the spatial segmention of the seafloor into different bottom types (*i.e.* surficial geology biological/habitat classes), and there are now many examples published in the scientific literature which support this approach (Brown *et al*., 2011(a) and 2012; Kostylev *et al.,* 2001; Roberts *et al.*, 2005).

Bathymetric data were exported as xyz ASCII files from CARIS HIPS, and imported into ArcGIS v.10 for further processing and evaluation. The bathymetric data were gridded at 10 m resolution and secondary bathymetric data layers were generated at the same resolution depicting seafloor slope and curvature (*i.e.* roughness) information. Although the bathymetric data were of high enough density to grid at a much finer resolution in some areas of the survey route (*i.e.* 2-5 m), 10 m was chosen as a grid-cell size as it reduced subsequent computation time. A 10 m grid size was also considered to be an appropriate scale at which to capture broad benthic habitat features over the scale of the proposed pipeline route for the purpose of benthic map production based on previous, similar surveys of this type (Brown *et al.*, 2011(a)). The choice of which secondary bathymetric layers to produce (*i.e.* slope and curvature) was based on previous published studies (Iampietro *et al.*, 2008; Monk *et al.*, 2010; Rattray *et al.*, 2009; Wilson *et al.*, 2007), and iterative testing of a large number of different layers in previous studies (Brown *et al.*, 2012).

A MBES backscatter mosaic was generated for the survey route using the *Geocoder* mosaicing tools within the *QPS Fledermaus FMGT* suite of software (see section 2.1 above). Gridded backscatter intensity (dB) were exported as xyz ASCII files from *QPS Fledermaus FMGT* and imported into ArcGIS v.10 for further processing and evaluation. The data were gridded in ArcGIS at the same cell size (10 m) as the bathymetric data. Finally, SSS mosaics (GeoTiff images) were imported into Arc GIS v10.0 for interpretation. A list of all the data layers used for interpretation and subsequent production of benthic habitat maps is provided in **Table 3.1**.

The data sets were segmented using conventional expert interpretation, whereby the data layers were divided into regions of similar texture, backscatter strength and/or geomorphic bottom type "by eye". The survey route was divided into 9 map blocks for presentation purposes in the report (**Figure 2.1**). The acoustic segments (acoustic facies) were delineated by polygons drawn around the boundaries of each acoustic bottom type in Arc GIS (v.10) based on evaluation of all available acoustic data layers. By subsequently overlaying the positions of the classified ground-truthing data sets (video, seafloor photographs and grabs sample positions - see Sections 3.2 - 3.4) the acoustic interpretation could be used for production of the benthic habitat maps (Section 5).

Table 3.1 - Acoustic data layers

Data layer	Resolution (grid size)	Description
MBES Bathymetry	10 m	Processed multibeam bathymetric data, re-gridded to 10 m resolution. Provides information on water depth and seafloor geomorphology.
MBES Backscatter	10 m	Processed and mosaiced MBES backscatter, gridded at 10 m resolution. Provides inferred information on seafloor surficial geology/benthic habitat.
SSS Backscatter	2 m	Processed and mosaiced SSS backscatter, gridded at 2 m resolution. Provides inferred information on seafloor surficial geology/benthic habitat.
Slope	10 m	Secondary-derived bathymetric product. Provides information on seafloor gradient, which can facilitate delineation of seafloor features, and help to define benthic habitat characteristics.
Curvature	10 m	Secondary-derived bathymetric product. Provides information on seafloor morphology (*i.e.* convex/concave/level seafloor), and provides a proxy for seafloor complexity/roughness. This can facilitate delineation of seafloor features, and help to define benthic habitat characteristics.

3.2 SEDIMENT PARTICLE SIZE ANALYSIS (PSA)

After collection, sediment samples were transported to McGregor's facilities for laboratory analysis. The formalin-preserved samples for macrofauna analysis, and sediment grain size subsamples were stored on board the survey vessel, demobilised in Prince Rupert, BC, and subsequently transferred to McGregor's facilities in Bedford, NS.

The various sample components were analysed at the following laboratories:

- Maxxam Analytics: Particle Size Analysis,
- McGregor GeoSciences: Onsite Macro-Invertebrate Analysis.

Physical characteristics of the sediment grab samples were analyzed by Maxxam Analytics, classifying the proportion (%) of sample based on the Wentworth (1922) substrate scale (**Table 3.2**), as well as a detailed Particle Size Analysis (PSA) of the grain size fractions. To determine the proportion of samples that were gravel, sand, silt and clay, the organic and carbonate components were removed by treating the samples with hydrogen peroxide.

Wet sieving (63 μm mesh sieve) was used to separate the gravel and sand fractions by passing the samples through a series of nested sieves to separate the fractions based on particle diameter. A detailed PSA of the fine grain size fraction was conducted using a pipette analysis. Sample aliquots were extracted from the sample by pipette and then dried to constant weight. Stoke's Law was used to determine the diameter of each fraction and quantify it on the Phi Scale. The Phi scale is a logarithmic representation of the Wentworth scale (**Table 3.2**).

Table 3.2 - Phi and sieve apertures with Wentworth classification

Aperture in microns (µm)	Aperture in Phi	Sediment Description	
2000	-1	Granule	Gravel
1410	-0.5	Very Coarse Sand	Sands
1000	0		
710	0.5	Coarse Sand	
500	1		
355	1.5	Medium Sand	
250	2		
177	2.5	Fine Sand	
125	3		
88	3.5	Very Fine Sand	
63	4		
44	4.5	Coarse Silt	Fines (Silts)
31.5	5		
22	5.5	Medium Silt	
15.6	6		
11	6.5	Fine Silt	
7.8	7		
5.5	7.5	Very Fine Silt	
3.9	8		
2	9	Clay	Fines (Clays)
1	10		

3.3 MACRO-INVERTEBRATE ANALYSIS

McGregor has a well defined set of procedures for the collection and analysis of seabed video and stills data. The procedures described in the sections below have been developed to comply with Canadian, OSPAR (Oslo and Paris Convention for the protection of the marine environment in the North-East Atlantic) and National Marine Biological Analytical Quality Control Scheme (NMBAQC) regulations, and have been successfully employed on numerous previous similar surveys.

3.3.1 Underwater Still Imagery

A total of 98 underwater video/photographic transects were surveyed along the proposed pipeline route (**Figure 2.2**). High-resolution still images were collected during each video transect, providing a large number of seafloor images for benthic habitat characterisation and full species identification and enumeration. The still images provided quantitative epifaunal community characterisation to a lower taxonomic level than that provided by the video data alone (see also section 3.3.2).

Classification into benthic habitat classes was undertaken visually for each seafloor photograph where the seafloor was clearly visible. A reference list of photographs was compiled by the senior taxonomist and used to identify species in video and still images (**Appendix 3**). In total, 5,999 georeferenced seafloor photographs from the 98 camera stations were classified into benthic habitat classes based on visible bio-physical characteristics (*i.e.* broad sediment and faunal features). From the total 5,999 images, a subset off 458 high-quality seafloor images representative of the substrate and species were chosen for detailed analysis. A minimum of 5 pictures were retained per station. Visible fauna were identified to the lowest taxonomic level possible and quantified (where possible). Substrate characteristics were described using the Wentworth-Udden classification (**Table 3.2**), and % substrate-type coverage (*i.e.* % bedrock/boulders, cobbles, gravel, sand and mud) was estimated for each image to the nearest 5%. Using the laser-dots from the scaling laser, the total area of the field of view (represented in m^2) was estimated for each image to standardise faunal abundance (per 10 m^2 of seafloor) to allow quantitative analysis of the epifaunal community composition.

All visible fauna were identified to the lowest taxonomic level possible and quantified (where possible) as percent cover or absolute abundance/unit area. Colonial species such as tunicates, bryozoans and hydrozoans, and encrusting sponges were noted as presence/absence within the stills. Miscellaneous features such as burrows, shell fragments etc. were also noted.

3.3.2 Underwater Video

Seafloor video data offer a means of identifying broad habitat characteristics and identification of conspicuous, large epibiota species, but with limited capability for more detailed taxonomic identification of benthic species.

Video data were analyzed to characterise and quantify the habitat characteristics from the survey area. Qualitative/semi-quantitative data were generated to characterise: 1) Substrate; 2) Epifauna (invertebrates and fish). A reference list of photographs was compiled by the senior taxonomist and used to identify species in video and still images (**Appendix 3**).

Substrate:

Initially, footage from each transect was reviewed and sub-divided into 'reaches' based on the distribution of dominant seafloor type (*i.e.* each of the 15 benthic habitat classes defined from the seafloor photographs – see section 3.3.1 above). Each reach was described on the basis of proportional (%) distribution of the substrate type, with each reach consisting of similar substrate composition. Any significant changes in the substrate type along a video transect, or a shift in the proportional representation of that substrate type, was used to delineate one reach from another. Substrate characteristics were described using the Wentworth-Udden classification (**Table 3.2**).

Epifauna:

All epifauna encountered in the video footage were identified to the lowest practical taxonomic level and assessed for relative abundance. The relative abundance was determined from the proportional representation of each taxon for each reach, with a reach comprising a distinctive bottom type, and the proportional representation of each reach within the overall survey corridor. The relative abundance of each taxon was based on the accepted SACFOR scale (S = Super-abundant; A = Abundant; C = Common; F = Frequent; O = Occasional; R = Rare) (developed by Connor *et al*, 2004; adapted from Joint Nature Conservation Committee (JNCC), 2011 (www.jncc.defra.gov.uk)) (**Table 3.3**).

Table 3.3 - Details of the SACFOR

% cover of sample	Growth form		Size of Individuals				Number in trawl
	Crust/meadow	Massive/turf	<1cm	1-3cm	3-15cm	>15cm	
>80%	S	-	S	-	-	-	>100,000
40-70%	A	S	A	S	-	-	10,000-99,000
20-39%	C	A	C	A	S	-	1,000-9,999
10-19%	F	C	F	C	A	S	100-999
5-9%	O	F	O	F	C	A	<9 (7-9)
1-5%	R	O	R	O	F	C	3-6
<1%	-	R	-	R	O	F	2
-	-	-	-	-	R	O	1
-	-	-	-	-	-	R	-
(adapted from www.jncc.defra.gov.uk)							

3.3.3 Grab Sample Analysis

Eight benthic grab samples were collected within Prince Rupert Port Authority (PRPA) area on 17 September 2013 (Figure 2.2). Images of McGregor benthic grabs and sieved samples are available in **Figure 3.1**. A flowchart of the steps involved in the processing of the samples is included in **Appendix 4.**

Sediment samples were washed on a sieve with a mesh size of 500 µm, and all residues were preserved in 6-10% buffered formalin in the field. The sieve was rinsed thoroughly between samples. In the McGregor GeoScience environmental laboratory, samples were washed with freshwater over a 500µm sieve to remove any preservative residue and sorted in accordance with NMBAQC standards. The washing methods are summarized in a flow chart in **Appendix 4**

All macrofaunal animals encountered in the samples were quantified and identified to the lowest practical taxonomic level, typically genus or species, by experienced taxonomic experts within McGregor GeoScience. The senior taxonomist has been involved in previous identification in near-shore and off-shore sites in the North Atlantic and Pacific regions (Baffin Bay, Scotian Shelf, Gulf of St. Lawrence, Bay of Fundy, and BC coast)

A reference collection of all species was also developed in the laboratory and archived for future use. All of the sample residues were retained for re-examination to determine sorting efficiency with an objective of obtaining sorting efficiencies of 90% or greater.

3.3.4 Data Standardisation and Analysis

Because diversity indices are based on counted numbers of individuals and because of the difficulty assocaited with counting individuals within a colony, all species falling into colonial taxa (such as tunicates, bryozoans and hydrozoans, and encrusting sponges) were excluded from the univariate analyses within the dataset. The primary and univariate parameters used in this report are shown in **Table 3.4**.

Table 3.4 - Primary and Univariate parameter calculations

Variable	Parameter	Formula	Description
Species Richness	S	Number of species recorded	Total number of species
Abundance	N	Number of individuals recorded in a sample	Total Individuals per sample
Shannon-Wiener Diversity Index	H'	$H' = -\sum P_i(\log_2 P_i)$ Where P_i is the proportion of each species in the sample.	Diversity: using both richness and evenness, recorded in base 2. (Shannon and Weaver, 1963)
Margalefs Richness Index	D_{Mg}	$D_{Mg} = (S-1) / (\log_2 N)$ Where S = number of species and N = total number of individuals.	Richness derived from number of species and total number of individuals (Margalef, 1963)
Pielou's Evenness Index	J	$J = H' / (\log_2 S)$ Where S = number of species, and H = Shannon-Wiener diversity index	Evenness or distribution between species (Pielou, 1969)
Simpson's Diversity Index	1-D	$D = \sum \{[N_i(N_i-1)] / [N(N-1)]\}$ Where N_i = number of individuals in species **i**, and N = total number of individuals recorded	Diversity, related to dominance of most common species (Simpson, 1949)

Species richness refers to the total number of species in a sample or area. Diversity is the number of different species in a sample or area and is measured by a number of different indices, as shown in **Table 3.4**. Species evenness is a measure of how evenly the individuals are distributed among the different species. A sample where all the species are represented by the same number of individuals has high species evenness. A sample where some species are represented by many individuals, and other species are represented by very few individuals has a low species evenness.

3.4 DATA INTEGRATION AND HABITAT MAP PRODUCTION

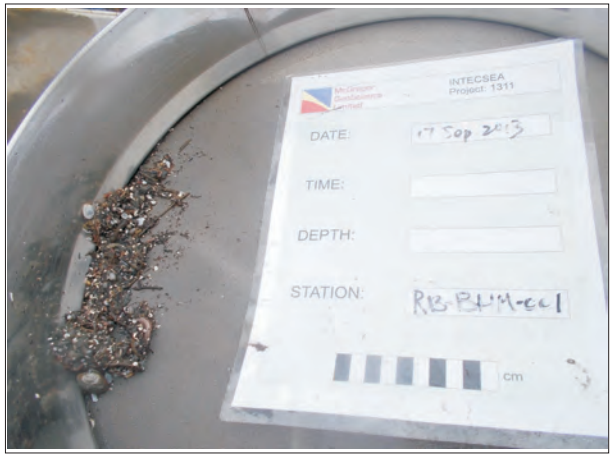
Following analysis of all benthic ground-truthing data (*i.e.* underwater video, seafloor photographs, and benthic grab sample analysis - Section 3.2 - 3.3), the results were used to derive and define seafloor habitat classes from the acoustic interpretation (section 3.1) which represent discrete seafloor types along the length of the proposed route. The habitat classes were defined based on <u>all</u> available information.

Georeferenced sampling locations for camera and grab samples were plotted in Arc GIS (v10).

The correlation between acoustic seafloor types derived from the interpreted sidescan and multibeam data sets (section 3.1 above) and seafloor characteristics determined from the ground-truthing (sections 3.2 and 3.3) were then determined. On this basis, seafloor characteristics (benthic habitat types) measured at the in situ sampling locations were spatially extrapolated on the basis of the acoustic characteristics using widely accepted habitat mapping methodology (Brown *et al.*, 2011). In this way benthic habitat maps were generated for the entire length of the cable corridor (> 20 m water depth). Where necessary (*i.e.* where there was not a 1:1 relationship between the interpreted acoustic classes and the benthic habitat classes derived from the ground-truthing data), benthic habitat classes were combined for map production.

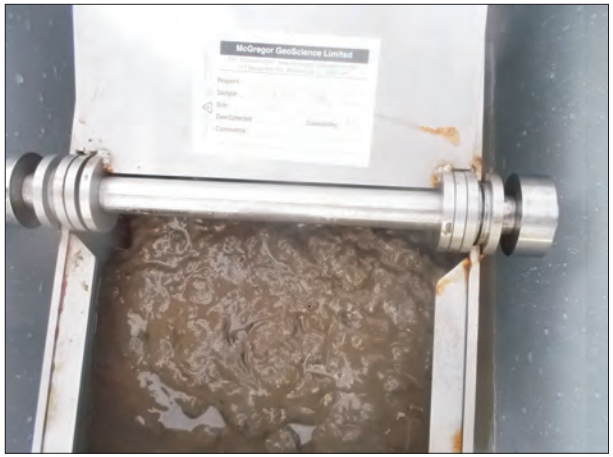
Grab Sample - R13_BHM_001

R13_BHM_001 - DSCN0529
Northing: 6002255
Easting: 412565



R13_BHM_001 - DSCN0533
Northing: 6002255
Easting: 412565

Grab Sample - R13_BHM_002



R13_BHM_002 - DSCN0521
Northing: 6002357.4
Easting: 411000.6

R13_BHM_002 - DSCN0524
Northing: 6002357.4
Easting: 411000.6

Grab Sample - R13_BHM_003

R13_BHM_003 - DSCN0510
Northing: 6002779.5
Easting: 405857.4

R13_BHM_003 - DSCN0515
Northing: 6002779.5
Easting: 405857.4

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Figure 3.1 - Photographs of Sediment Samples and Sieved Macrofauna

Figure 3.1

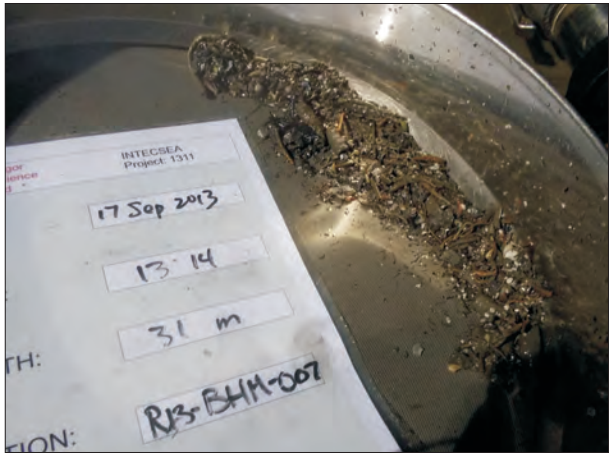
Grab Sample - R13_BHM_005

R13_BHM_005 - DSCN0503
Northing: 6004514
Easting: 405504.7

R13_BHM_005 - DSCN0508
Northing: 6004514
Easting: 405504.7

Grab Sample - R13_BHM_007

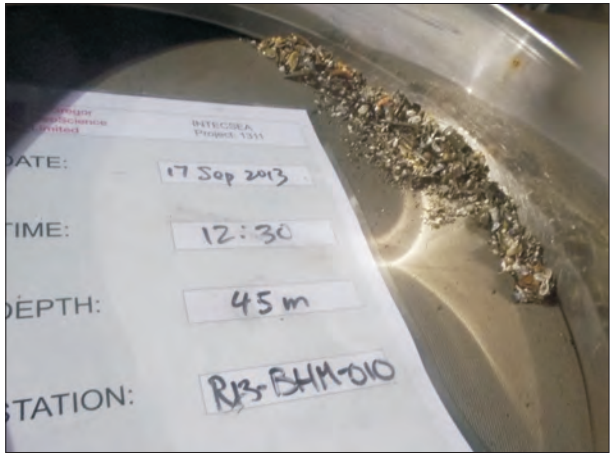
R13_BHM_007 - DSCN0490
Northing: 6007068.3
Easting: 412408.7



R13_BHM_007 - DSCN0496
Northing: 6007068.3
Easting: 412408.7

Grab Sample - R13_BHM_010

R13_BHM_010 - DSCN0484
Northing: 6008557.9
Easting: 411044



R13_BHM_010 - DSCN0488
Northing: 6008557.9
Easting: 411044

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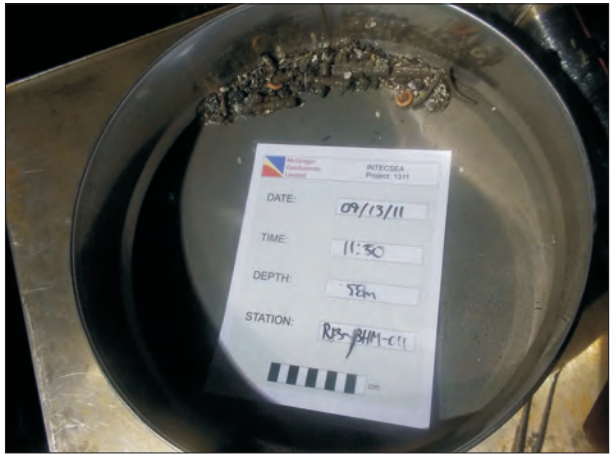
Figure 3.1 - Photographs of Sediment Samples and Sieved Macrofauna

Figure 3.1

Grab Sample - R13_BHM_011

R13_BHM_011 - DSCN0478
Northing: 6009881.4
Easting: 408606



R13_BHM_011 - DSCN0482
Northing: 6009881.4
Easting: 408606

Grab Sample - R13_BHM_013

R13_BHM_013 - DSCN0471
Northing: 6011246
Easting: 406270.1

N/A

R13_BHM_013 - Photo name N/A
Northing: 6011246
Easting: 406270.1

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Figure 3.1 - Photographs of Sediment Samples and Sieved Macrofauna

Figure 3.1

4 DISCUSSION

4.1 ROUTE DEVELOPMENT AND HIGHLY SENSITIVE SEAFLOOR HABITAT FEATURES

A number of potential HSSHF were identified from the processed MBES and SSS data during field operations, which were subsequently ground-truthed using the underwater camera system. All of these features were located in Chatham Sound, and were characterised by distinctive seafloor geomorphology appearing as topographically-complex bathymetry with variable backscatter characteristics. Large concentrations of these features were particularly dense to the east of Melville Island, Dunria Island and Baron Island (**Figure 4.1**). Ground-truthing revealed that these features were sometimes associated with dense sponge aggregations/reefs (e.g. station 1311-CD013, 1311-CD014, 1311-CD014b, 1311-CD007/008) (**Figure 4.2**). It was decided that these features constituted HSSHF, and alternative routing was investigated further east of the features. Three potential north-south corridors were investigated before a suitable route was mapped without dense aggregation of the sponge reef features.

Glass sponge reefs (Porifera, Hexactinellida) are unique to the Pacific coast of Canada, and have been reported throughout the western Canadian continental shelf (Conway *et al.*, 1991, 2001, 2005, 2007; Cook *et al.*, 2008). Sponge reefs have been routinely mapped using MBES and SSS, and reef morphology has been reported to vary from region to region (Conway *et al.*, 2005). Glass sponges will colonise rock substrata, but there are also reefs (bioherms) in which skeletons of successive generations of sponges settle and grow on each other (Chu and Leys, 2010). Typical reefs like this gradually accumulate where the bulk of the reef mounds consist of dead sponges smothered in sediments, with only the most recent generations growing on the surface (Chu and Leys, 2010; Conway *et al.*, 2005). The extent and density of live sponges on the surface of the bioherms can vary, and despite the value of MBES technology for mapping the reefs, it is not always possible to differentiate between live, dead and buried portions of the glass sponge bioherms from the MBES bathymetric and backscatter data (Chu and Leys, 2010).

The features identified in Chatham Sound (**Figure 4.1 and 4.2**), are characteristic of these glass sponge bioherms. The features were extensive on the three exploratory N-S

routes, showing dense aggregations of mounds in water depths ranging from 40-200 m. Areas of low SSS and MBES backscatter returns were associated with the reef features, in agreement with previous studies which have mapped glass sponge habitat (Conway *et al.*, 2005). The reefs also appeared clearly in derived slope and curvature map layers, with reefs displaying high slope and curvature values associated with the complex topography of the reef surface. Based on this information, areas of potential dense sponge reef are delineated in **Figure 4.1**.

Although it is not always possible to differentiate between live, dead and buried portions of the glass sponge bioherms from the MBES bathymetric and backscatter data (Chu and Leys, 2010), live sponges were only recorded on 3 discrete reefs (camera stations BHM-031, CD-007/008, CD-013 and CD-014) within the final proposed route. These three live reefs were located on the edge of the 1km corridor, and not directly in line with the proposed pipeline. All other reefs ground-truthed on the main route revealed low-relief, smothered reef, and at much lower densities than the reefs imaged on the three exploratory N-S routes.

4.2 BENTHIC HABITATS

Visual inspection of the 5,999 seafloor photographs from the 98 camera stations was undertaken to classify the images into broad benthic habitat classes. A total of 15 benthic habitat types were identified from the images based on broad substrate and faunal features visible in the photographs. Each of the 5,999 georeferenced images was classified into one of these 15 classes based on visual similarity. These classes are described below in **Table 4.1**, with examples shown in **Figure 4.3**.

Table 4.1 - Benthic habitat classes derived from seabed photographs

Benthic Habitat Class	# images	Description
Class A1: Bioturbated mud	3,697	Soft sediment with smooth sediment/water interface. Faunal burrows frequent. Burrow morphology/characteristics diverse and variable along the route suggesting possible changes in infaunal composition/characteristics within this bottom type. Infaunal grab samples required to confirm infaunal characteristics.
Class A2: Bioturbated cohesive/consolidated mud	247	Soft sediment. The sediment/ surface, appears consolidated suggesting cohesive sediments. The sediment surface appears to have some structure, and

Benthic Habitat Class	# images	Description
		evidence of bioturbation in the form of faunal burrow.
Class B1: Muddy mixed substrata with faunal turf	632	Mixed, muddy substrata. Faunal turf visible at the sediment surface. Sediment surface appears to have texture, with sediment consolidated by the faunal turf. Could be smothered biogenic reef.
Class B2: Muddy low-relief reef with faunal turf	66	Muddy, low-relief reef with visible faunal turf. Similar to class B1, but with obvious vertical relief. Could be smothered biogenic reef.
Class C: Biogenic sponge reef	196	Dense aggregation of sponges (>20% coverage) over low-relief muddy reef surface. High density and diversity of epifauna.
Class D1: Muddy gravel with epifauna	262	Uniform mixed substrata comprising predominantly gravel with high mud content. Epifauna abundant and clearly visible, including brittle stars.
Class D2: Gravel and cobbles with epifauna	66	Coarse substrata of predominantly gravel and cobble. Substrata appear consolidated forming a hard sediment "pavement". High-energy environment, with no evidence of soft sediment deposition. Sparse epifauna.
Class E1: Muddy sand	120	Muddy sand substrata. No visible evidence of bioturbation by megafauna. Substrata appear coarser than soft mud classes (A1 and A2). Frequent epifauna visible, particularly brittle stars.
Class E2: Gravelly muddy sand	189	Substrata very similar in appearance to Class E1, comprising muddy sand, but with gravel content (<20%). Frequent epifauna visible, particularly brittle stars.
Class E3: Bioturbated muddy sand	147	Muddy sand substrata similar to class E1, but with visible evidence of bioturbation by megafauna. Frequent, visible epifauna on sediment surface, particularly brittle stars.
Class F: Mobile silt with bedforms	64	Sediment consisting of fine grain material (silt). Large bedform features visible. Sediment surface very smooth, with sharp sediment ridges. No visible fauna.
Class G: High-energy, rock with dense, diverse epifauna	61	Rock densely covered in epifauna (*i.e.* anemones, sponges, echinoderms etc.). Steep-sided relief of bedrock and boulders.
Class H1: High-relief rock with cold water corals	9	High-relief rock (bedrock and boulders) with dense aggregation of cold water corals (predominantly Gorgonians), and other epifauna. Presence of dense aggregations of coral suggests high currents.
Class H2: High-relief rock with sparse epifauna	234	Similar to Class H1, consisting of high-relief rock (bedrock and boulders), but cold water corals absent. Rock surface covered in a thin deposit of silt, with

Benthic Habitat Class	# images	Description
		sparse epifauna visible in places.
Class H3: Low-energy, silt-covered boulder/cobble reef with sparse epifauna	9	Boulder/cobble reef covered in a thin layer of silt. Sparse epifauna.

4.3 SEAFLOOR GEOMORPHOLOGY AND SURFICIAL GEOLOGY

Seafloor geomorphology and surficial sediment characteristics varied along the proposed route, and are described below for each of the 9 map blocks (**Figure 2.1**). Due to proprietary rights please contact PRGT for any inquiry regarding the multibeam, backscatter and sidescan backscatter data and imagery used for seafloor geomorphology and surficial geology interpretation.

4.3.1 Interpretation of geophysical/hydrographic data sets

Map Block 1 – Nass Bay, Observatory Inlet, and the head of Portland Inlet (**Figure 5a**):

Map block one encompassed the intersection between Nass Bay, Observatory Inlet (leading to Alice Arm) and Portland Inlet. Water depths ranged from 27 m close to shore in Nass Bay, to 375 m in Portland Inlet. Shallow-water regions in the mouth of Nass Bay and Observatory Inlet were characterised by low backscatter returns, indicating softer seafloor characteristics. MBES backscatter over the majority of the surveyed route in Map Block 1 was higher than the shallow-water regions, and relatively homogenous. A distinctive sediment erosion channel was clearly visible emanating from Nass Bay, extending to a depth of up to 100 m below the surrounding seafloor. The erosion channel decreased in depth as it extended down Portland inlet, terminating in broad sediment bedforms fields approximately 12 km SW of the mouth of Nass Bay. The erosion channel was clearly delineated by high seafloor slope associated with the sides of the channel and the bedform features. Similarly, high curvature values were also associated with the feature reflecting the complex topography relative to the uniform, flat surround seafloor adjacent to the erosion channel. Areas of steep topography were also associated with the channel walls of Portland Inlet on the edge of the survey coverage.

Map Block 2 – Portland Inlet and Nasoga Gulf (**Figure 5b**):

Map block two encompassed the middle section of Portland Inlet, and the proposed route into Nasoga Gulf. Water depths ranged from 32 m in the shallowest parts of Nasoga Gulf, to 495 m in Portland Inlet. Water depths increased from north to south along Portland Inlet, with the erosion channel and sediment bedform features associated with the outflow from the Nass River visible in the northern half of Map Block 2. Water depth in this area increased from around 270 m in the north, to around 400 m at the termination of the bedform features. Backscatter returns were relatively low and uniform over much of the seafloor in Portland Inlet, suggesting soft seafloor characteristics over much of the channel. Variable backscatter returns were associated with the bed-form features in the north. High backscatter returns were associated with the steep-sided topography of the walls of the channel along the periphery of the surveyed route, suggesting hard substrata. These channel wall features were also associated with regions of high seabed slope and curvature, in contrast to the relatively level, smooth seafloor over much of the bottom of Portland Inlet.

Nasoga Gulf opens into Portland inlet through a channel approximately 2 km wide, with steep-sided topography associated with Mylor Peninsula to the north and Somerville Island to the south. Water depths became increasingly shallow extending into Nasoga Gulf, decreasing gradually from approximately 350 m at the mouth of the Gulf, to 32 m at the head of the Gulf. Backscatter gradually decreased with increasing distance into the Gulf.

Map Block 3 – South Portland Inlet and Steamer Passage (**Figure 5c**):

Map block three encompassed the southern section of Portland Inlet, and Steamer Passage. Water depths ranged from 37 m in the shallowest parts of Steamer Passage, to 617 m in Portland Inlet. Water depths increased from north to south towards the entrance to Portland inlet. The steep-sided walls of Portland Inlet were clearly visible from the bathymetric and backscatter data, and from the derived slope and curvature layers where they were imaged by the MBES. Off note were the steep-sided features to the NW of Truro Island showing bathymetric changes of up to 450 m. Steep bathymetric features were also present to the north and south shores of Somerville Island at either

end of Steamer Passage. These regions were also associated with high backscatter, seafloor slope and curvature characteristics. At the northern entrance to Steamer Passage, sediment bedform features and an erosion channel were visible emanating from the Kwinamass Estuary. Water depths in Steamer Passage were relatively shallow, and for much of the Passage were between 50-70 m. The seafloor over the majority of Steamer Passage and Portland Inlet was relatively featureless and flat with low backscatter returns, suggesting soft surficial geology characteristics.

Map Block 4 – Mouth of Work Channel, Approaches to Portland Inlet, North Chatham Sound and Emma Passage (**Figure 5d**):

Map block four encompassed the approaches to Portland Inlet in north Chatham Sound, and included the entrance to the Work Channel and Emma Passage. Water depths ranged from 23 m on the flanks of the entrance to the work passage, to 640 m in approaches to Portland Inlet. Water depths in Emma Passage through to Union Inlet were shallow, ranging from approximately 150 m to 65 m. Seabed morphology was similar to that of Steamer Passage, comprising relatively homogenous, level seafloor with low backscatter returns.

The seafloor morphology at the entrance to the Work Channel was complex. A bathymetric trough was imaged along the outside of the Work channel at a depth of 600 m, approximately 1.5 km outside of the mouth of the passage. The seafloor rose steeply to the narrow entrance of the passage at a depth of approximately 140 m. Steep-sided walls to the passage extended out into Portland Inlet from the Work Channel, and the complex morphology was characterised by high seafloor slope (45° in places) and curvature values in this region. Backscatter returns were high in this region, indicating hard seafloor substrata. The very narrow mouth of the Work Channel between Hogan Island and Maskelyne Island (< 400 m wide) was flanked by steep-sided hard substrata walls extending 3-4 km along the channel, with seafloor bathymetry gradually increasing with distance into the Work Channel. The sides of the channel remain extremely steep along the entire length of the channel, with the MBES derived slope values often $>25^o$. The channel gradually widens and increases in depth with increasing distance from the mouth, and backscatter returns also indicate that the bottom of the channel becomes softer.

Outside of Portland Inlet the survey corridor turns south and passes along an underwater channel between bathymetric features flanking the channel (imaged on the periphery of the MBES coverage in places). Here water depth were at their maximum (640 m) and where the route changes direction the seafloor backscatter was higher, suggesting coarser substrata. As the route moves south the seafloor becomes shallower (170-200 m) and relatively flat/homogenous.

Map Block 5 – Mid Chatham Sound (**Figure 5e**):

Map block five encompassed the survey corridor in mid Chatham Sound. Bathymetry in this region changed from deeper water in the north of the survey block (max 211 m), to shallower depths in the south of the survey block (min 63 m). A distinctive depth change occured directly west of Big Bay, separating the deeper, flat seafloor in the north of the block from the more complex morphology in the shallower water depths in the south. The southern region marked the beginning of bathymetric features associated with glass sponge reefs described under Section 4.1 above. Route development took place to the west of this region to avoid glass sponge reefs (see section 4.1 above). These biogenic reefs encroached onto the periphery of the survey channel in the south section of the survey route in the south of survey block 5, and were characterised by complex seafloor morphology of hummocks, ridges and mounds standing 5 – 30 m proud of the surrounding seafloor. Backscatter returns from these features were slightly lower than the surround seafloor, and the features displayed high slope (up to 30°) and high curvature values. The proposed pipeline route in this region was located on level seafloor, a minimum of 400 m away from the nearest reef feature.

Map Block 6 – South Chatham Sound (**Figure 5f**):

Map block six encompassed the southern region of Chatham sound. Depths in this area ranged from 24 m to 154 m, with a number of reef features visible throughout the survey corridor. All of the reefs in the area displayed very similar geomorphology, and were characterised by slightly higher backscatter returns and high seafloor slope and curvature values. The seafloor was relatively flat and featureless between the reefs, allowing positioning of the proposed pipeline route to avoid the bathymetric features. In the south of the survey block two exploratory corridors were surveyed entering the Prince Rupert Port Authority (PRPA) Area.

Map Block 7 – Prince Rupert Port Authority (PRPA) Area (**Figure 5g**):

Map block seven covered the PRPA area and approaches to Lelu Island. Water depths ranged from 19 – 190 m, with the deepest area surveyed on the SW bounday of the PRPA area. Two distinct banks were imaged on the southern survey leg just outside the PRPA area, in water depths of 50 – 60 m. These banks displayed higher backscatter returns. Smaller reefs were frequent throughout this map block, characterised by high backscatter, slope and curvature values.

Map Block 8 and 9 – Work Channel (**Figure 5h and 5i**):

The Work Channel shown in Map Block 8 and 9 was characterised by a narrow channel (< 2 km wide, and ranging in water depth from 30 to 354 m). The channel depth in the north was approximate 200 m in depth, with a distinctive increase in water depth into a deeper basin extending through the middle section of the Work Channel at around 300 m water depth. The deep basin terminated where the work channel joined Quottoon Inlet, and bathymetry decreased at this point to around 190 m. The channel then gradually decreased in depth to around 60 m at the head of the channel. Backscatter values were lower in the mid section of the channel within the bathymetric basin, indicating softer substrata. In the shallower areas to the north and south of the basin the backscatter values were slightly higher, suggesting coarser substrata. The sides of the channel were extremely steep, indicated by the very high slope and curvature values. Evidence of rock slides were visible at a number of locations along the channel.

4.3.2 Surficial Geology

Surficial sediment characteristics were determined from percentage cover of sediment classes from still images. Data were derived from the detailed analysis of the subset of photographs analysed from each station. Mean percentage cover is presented in **Appendix 5, Table A** (mean percentage cover by station) and **Appendix 5, Table B** (mean percentage cover by benthic habitat class), Detailed grain size analysis by Maxxam Analytics from analysis of sediment grain size subsamples is presented in **Appendix 5, Table C**. Mean percentage sediment composition derived from analysis of the subset of seafloor photographs is also shown in **Figure 5 a-i**. In summary, sediments along the survey route were dominated by soft sediment (silt).

4.4 MACROFAUNAL COMMUNITY CHARACTERISTICS

4.4.1 Overview of epifaunal community characteristics

Within the study area, photographic ground truthing data were obtained and analysed from 79 stations (excluding the HSSHF videos) considered to be of acoustic interest or representative of typical habitats within the survey area. A total of 406 seafloor images were chosen for analysis, and visible fauna were identified to the lowest taxonomic level possible and quantified (where possible). Substrate characteristics (% bedrock/boulders, cobbles, gravel, sand, mud and shells) were also estimated for each image and reach of the video (to the nearest 5%) (see section 4.3 above).

The seafloor video and stills revealed a diverse benthic environment over the area. Species of interest included the glass sponges *Heterochone calyx* and *Aphrocallistes vastus* as well as the soft coral *Primnoa sp*.

Among species with commercial value, crustaceans and fish were found over the entire area. The crustaceans included the snow crab *Chionoecetes bairdi* and the shrimps *Pandalus sp.* which were numerous on the soft bottom, reaching densities up to 28 individuals/m^2. Throughout the survey area, commonly observed were rockfish (*Sebastes spp.*) around hard bottom structures and flatfish (Pleuronectidae) and prickleback fish (Stichaeidae) on soft bottoms. The spotted ratfish (*Hydrolagus colliei*) and the longnose skate (*Raja rhina*) were found at several stations. In addition, large number of the cod *Gadus* sp. was observed at station BHM074.

It should be noted that whilst the video provides better spatial coverage than the digital stills, species identification is much more difficult from the video due to poorer image resolution and image blurring due to the camera movement. The video and stills data therefore provide two different but complementary means with which to characterise the seafloor epifaunal community composition. The data are therefore analysed using various statistical techniques, and the results are used to establish if any faunal differences can be detected between the various acoustic seafloor classes, and to identify characterising fauna from each distinct ground-type. The two data sets are then combined to provide a comprehensive description of the faunal characteristics of each

bottom class (*i.e.* benthic habitat class) and the spatial extent of each class mapped on the basis of the acoustic backscatter segmentation.

4.4.2 Analysis of video data

Video data from the 79 camera stations (excluding HSSHF videos) were analysed using the methodology described in Section 3.3.1. The analysis revealed distinct differences in seafloor characteristics over the survey area, which coincided with differences in the acoustic backscatter interpretation. The results from the video analysis are summarised in **Appendix 6** and all video data are included in **Digital Appendix 1**.

In total, 82 taxa were identified from the 79 video stations. The dominant species recorded from the video include the shrimp *Pandalus* sp., the sea pen *Virgularia* sp., the cod *Gadus* sp., which was mainly found at BHM074, and unidentified sea star species on soft sediments, and the sea urchin *Strongylocentrotus pallidus*, which was mostly recorded at BHM043, the sea anemones *Metridium farcimen* and *Urticina* spp., and the hydrocoral *Stylaster campylecus* on the hard substratum.

4.4.3 Analysis of seafloor photographic data

A total of 406 seafloor photographs were analysed from across the 79 camera stations using the methodology described in Section 3.3.1. Visible fauna were identified and their abundance recorded for each image. Analyses from the images were recorded in a matrix (**Digital Appendix 3**). Abundance values were standardised per unit area of seafloor using the laser dots visible in each image. For each station, 5-8 images were processed and data were pooled for subsequent analysis. Standardised abundances were summed to provide data on species composition and abundance per camera station.

Diversity measures were calculated from the epifaunal data from the still images by camera station and benthic habitat class. A total of 177 taxa were recorded over the 79 camera stations. Calculation of Diversity measures on countable abundance data showed dramatic variation with no clear patterns among the benthic habitat classes, except for BHCG (**Appendix 7**, and **Figure 4.4**). The highest abundance and lowest

diversity recorded at BHM046 (BHC G) was attributed to the high density (2012 / m^2) of the sea anemone *Epizoanthus scotinus*. Other dominant species found in the still images included the brittle stars *Ophiura sarsii* and *O. lutkeni*, the shrimp *Pandalus* sp., the brachiopod *Terebratulina* sp., the polychaete *Serpulidae* spp., and the sea pen *Virgularia* sp. (**Digital Appendix 3**).

ANOSIM was used to test the significance in faunal composition between epifaunal groups, and SIMPER used to determine percentage contributions of each species to similarity. Significant differences, as determined by ANOSIM test, were found between the benthic habitat classes ($p < 0.01$) and among geographical locations ($p < 0.05$), while percentage of dissimilarity, as determined by SIMPER analysis, were moderately high (60 – 100%) between the epifaunal groups. If the BHC A1 stations were excluded, however, differences between faunal groups were not significant. Care should be taken when interpreting these values, as dissimilarity measures are likely artificially high due to the relatively low abundance and diversity of epifauna visible within the images.

Characterising species for each acoustic class were determined where possible from the SIMPER analysis (only possible where more than one station fell within a benthic habitat class). Where this was not possible, characterising species were determined based on species abundance from each station. Characterising species are listed in **Table 4.2.**

Table 4.2 - Characterising epifauna species for each benthic habitat class

Benthic Habitat Class	Characterising Species	Contrib.%	Cum.%
A1	*Pandalus* sp.	68.55	68.55
	Unid. brittle star	5.41	73.96
	Euphausia sp.	5.30	79.26
A2	*Pandalus* sp.	77.35	77.35
	Pandalus platyceros	22.65	100
B1	*Ophiura lutkeni*	20.92	20.92
	Amphiodia periercta	18.08	38.99
	Pandalus sp.	17.48	56.47
B2	*Terebratulina* sp.	57.68	57.68
	Pandalus sp.	11.54	69.22
	Stylaster campylecus	11.54	80.76
C	*Heterochone calyx*	39.39	39.39
	Munida quadrispina	16.16	55.55
	Pandalus sp.	10.10	65.65
D1	*Ophiura sarsii*	46.00	46.00
	Terebratulina sp.	22.50	68.50
	Pandalus sp.	18.48	86.98
D2	*Terebratulina* sp.	53.17	53.17
	Patinopecten caurinus	20.63	73.80
E1	*Ophiura lutkeni*	44.03	44.03
	Pandalus sp.	27.72	71.75
E2	*Pandalus* sp.	46.35	46.35
	Terebratulina sp.	16.79	63.14
	*Ophiura sarsi*i	11.63	74.77
E3	*Ophiura sarsii*	61.78	61.78
	Pandalus sp.	24.23	86.01
	Serpulidae sp.2	13.99	100
F	*Pandalus* sp.	74.42	74.42
	Pandalus platyceros	23.26	97.68
G	*Epizoanthus scotinus*	99.66	99.66
H1	*Primnoa* sp.	N/A	N/A
H2	*Pandalus* sp.	46.82	46.82
	Terebratulina sp.	19.36	66.18
	Stylaster campylecus	9.06	75.23
H3	*Stylaster norvigicus*	27.59	27.59
	Sponge sp.8	13.79	41.38

(from SIMPER analysis where available, or based on abundance where only 1 camera station available)

4.4.4 Macrofauna from Physical Samples

Eight sediment samples for macrofaunal analysis were collected within the PRPA region. The majority of the survey area comprises soft sediment (*i.e.* BHC A1 – Biotubated mud), with only sparse epifauna visible from the seafloor photographs and video (see section 4.4.2 and 4.4.3 above). Collection of additional benthic infaunal samples along the remainder of the survey route outside the PRPA area is planned for early 2014 subject to receiving an OGC sampling permit. These samples are needed to fully characterise the benthic faunal characteristics of the soft sediment habitat classes (particularly BHC A1 which was very widespread over much of the survey corridor). It is anticipated that the infaunal community patterns will help define faunal patterns across the full extent of the survey route. The information presented below provides a preliminary, limited assessment of the 8 samples collected in the PRPA region.

The benthic samples were processed and identified at the McGregor's environmental laboratory using the methodology described in Section 3.3.3. **Table 4.3** shows the grab location, depth, date collected and the associated benthic habitat class. Countable and uncountable taxa, which were identified to the lowest taxonomic level possible, are shown in **Digital Appendix 4**. Uncountable faunal data were not included in statistical analysis.

Table 4.3 - Analyzed grab samples with benthic habitat class (BHC)

Sample Name	Latitude	Longitude	Depth (m)	Date Collected	BHC
BHM001	54.16092636	-130.3390846	27	17-Sep-13	A1
BHM002	54.16157769	-130.3630666	70	17-Sep-13	A1
BHM003	54.16445303	-130.4419421	109	17-Sep-13	A1
BHM005	54.17997235	-130.4478866	89	17-Sep-13	A1
BHM007	54.20414806	-130.3428785	31	17-Sep-13	A1
BHM010	54.21729723	-130.3642355	45	17-Sep-13	B1
BHM011	54.22875974	-130.4020155	58	17-Sep-13	A1
BHM013	54.24059821	-130.4382631	49	17-Sep-13	B1
WGS84					

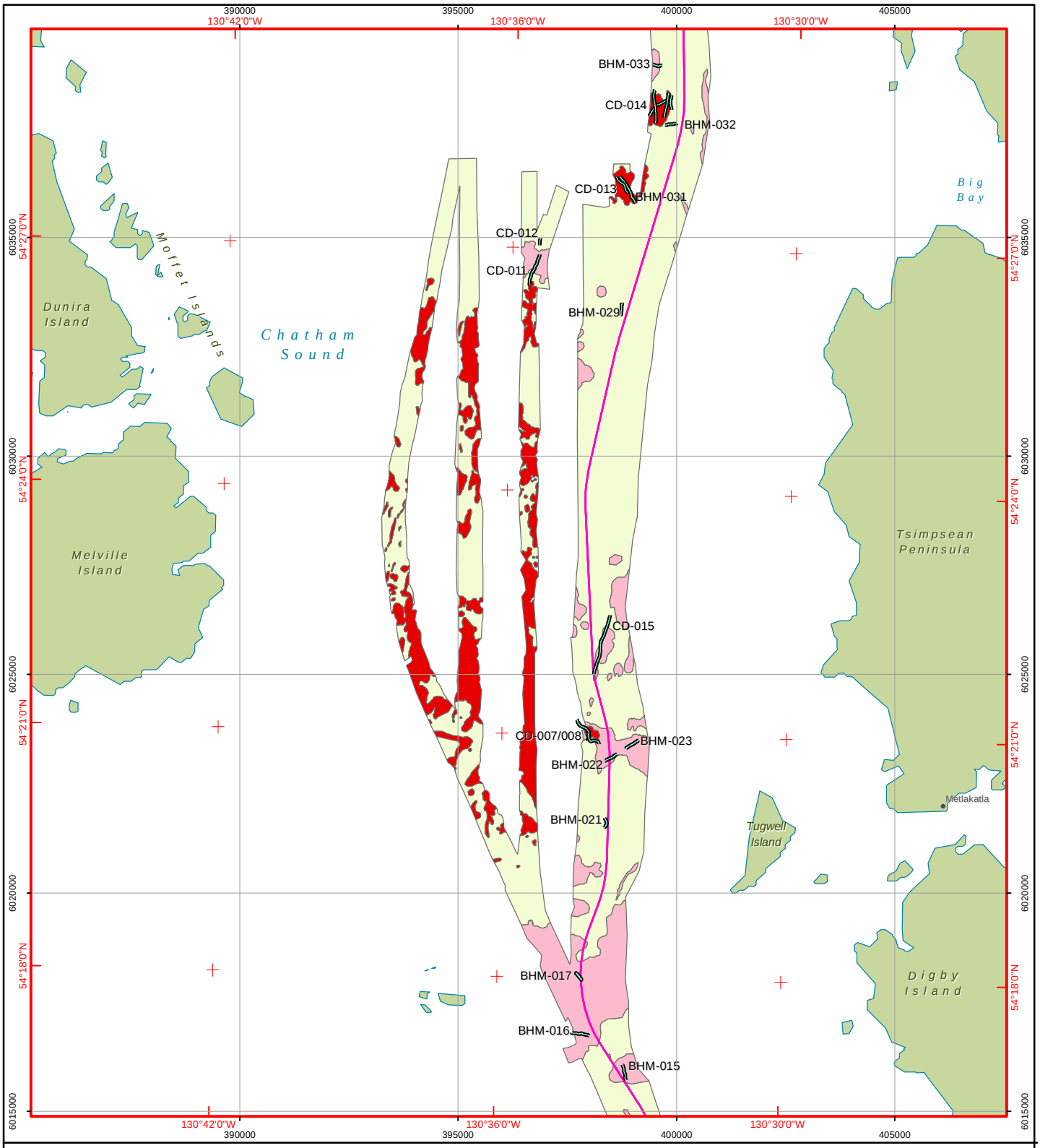
A total of 5344 animals comprised of 170 taxa were recorded from the 8 samples collected from the PRPA area in September 2013. Polychaetes were the most diversified group with 81 species recorded, accounting for 47.6% of the total taxa, while the most abundant group was bivalves (2706 individuals, accounting for 50.6% of the total

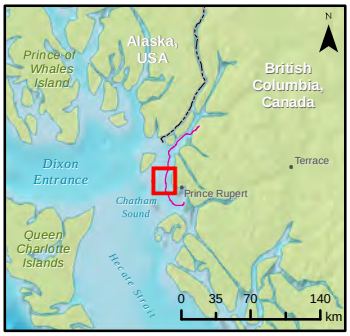
individuals collected). Other diversified groups included bivalves (25 species accounting for 14.7%), amphipods (18 species accounting for 10.6%), and gastropods (16 species accounting for 9.4%). The most abundant species in the PRPA area was the bivalve *Axinopsida serricata*. (**Digital Appendix 4**). Top dominant species included the bivalves *Axinopsida serricata*, *Nutricola ovalis*, *Nuculana hamata*, and *Ennucula tenuis*, and the poloychaetes *Sternaspis scutata*, *Tharyx secundus* and *Galathowenia oculata* (**Table 4.4**).

Table 4.4 - Dominant species and abundance percentages from PRPA

Station	Species	%	Station	Species	%
BHM001	*Nutricola ovalis*	18.17	BHM007	*Nutricola ovalis*	26.05
	Sternaspis scutata	11.91		*Nuculana hamata*	9.10
	Ennucula tenuis	9.85		*Axinopsida serricata*	7.58
	Axinopsida serricata	6.98		*Galathowenia oculata*	7.05
				Sternaspis scutata	7.05
BHM002	*Acila castrensis*	13.46	BHM010	*Axinopsida serricata*	14.36
	Tharyx secundus	10.83		*Nuculana hamata*	14.18
	Sternaspis scutata	10.52		*Galathowenia oculata*	8.33
	Clymenura sp.	9.88		*Nutricola ovalis*	8.33
	Axinopsida serricata	8.83		*Ennucula tenuis*	7.80
BHM003	*Axinopsida serricata*	51.84	BHM011	*Axinopsida serricata*	22.67
	Tharyx secundus	5.88		*Acila castrensis*	27.71
				Ennucula tenuis	7.56
				Nutricola ovalis	6.98
				Tharyx secundus	5.81
BHM005	*Axinopsida serricata*	30.48	BHM013	*Tharyx secundus*	9.63
	Tharyx secundus	12.70		*Ennucula tenuis*	9.63
	Melinna cristata	5.40		*Galathowenia oculata*	9.43
	Levinsenia gracilis	4.76		*Macoma calcarea*	7.38
				Lumbrineris luti	6.97

The highest abundance (1117 animals / 0.1 m^2) was recorded at station BHM007 and the highest species richness (103 species / 0.1 m^2) was found at BHM001, while the lowest values for both parameters were recorded at BHM003 (272 animals / 0.1 m^2 and 48 species / 0.1 m^2, respectively) (**Figure 4.5**). Shannon-Wiener index (base 2) varied between 3.46 at BHM003 and 4.98 at BHM013, and Margelef's richness index ranged from 8.38 at BHM003 to 14.53 at BHM001 (**Figure 4.5**). Both Pielou's and Simpson's indices had highest values at BHM013 (0.82 and 0.95, respectively) and lowest values at BHM013 (0.62 and 0.72, respectively) (**Figure 4.5**).





Benthic Interpretation

Route Development Survey Area

Prince Rupert, BC, Canada

0 1 2 4
km

Route F03
Camera Track

Class A1: Bioturbated mud
Class B1/2: Muddy low-relief reef with faunal turf
Potential Biogenic Sponge Reef

WGS 1984 UTM Zone 9N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -129.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

Figure: 4.1

Date Saved: 11/03/2014 8:43:53 AM
McGregor Project No.: 1311
Filename: 1311_RoutDev_Interp

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TransCanada
In business to deliver

Note:
Map scale 1:125,000 when printed on 8.5x11 size paper

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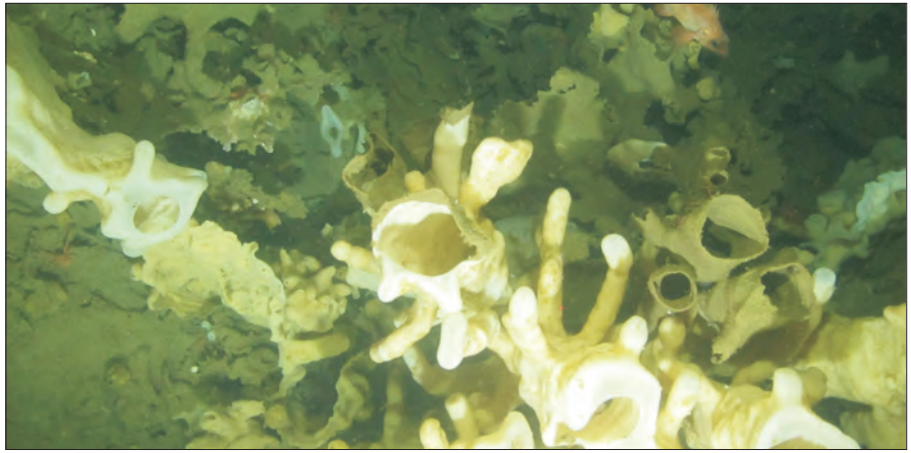

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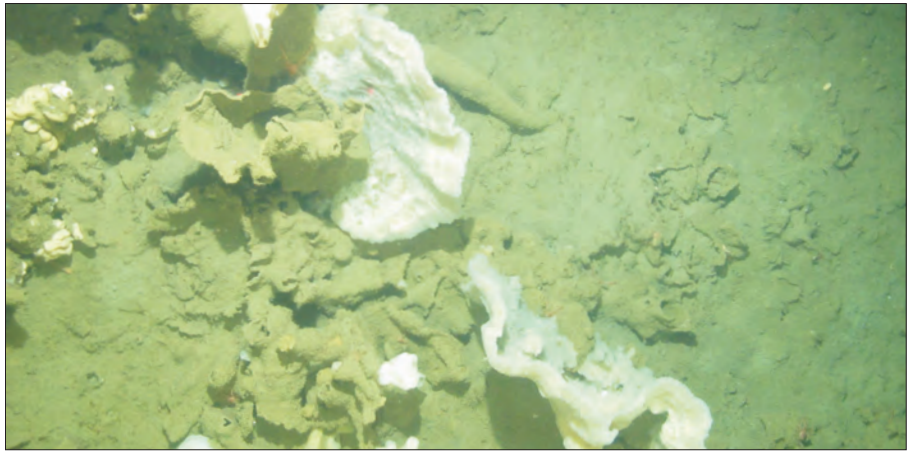
Easting: 398834.95



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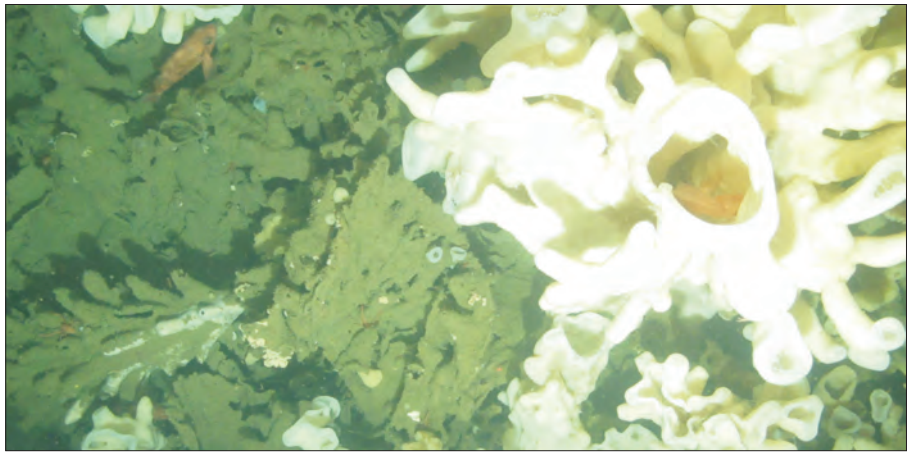

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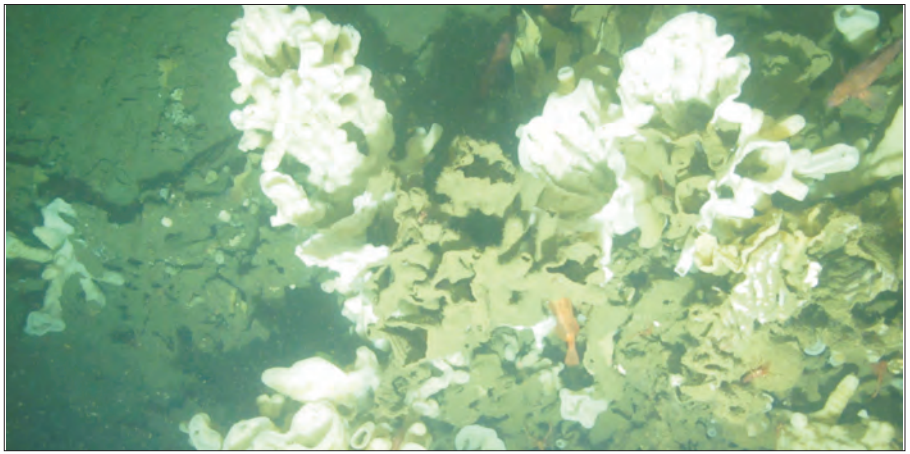

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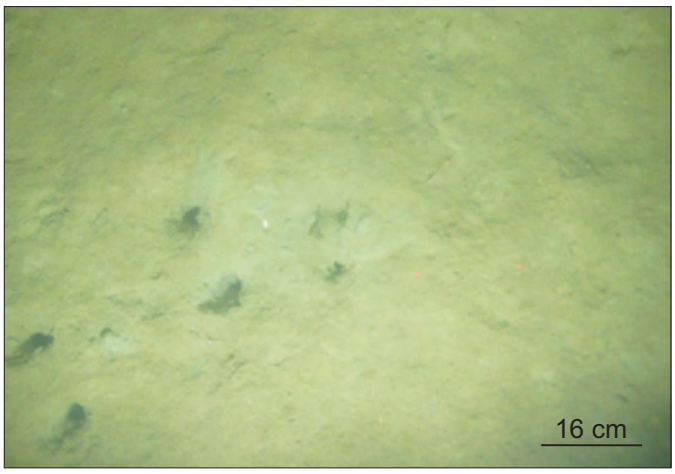
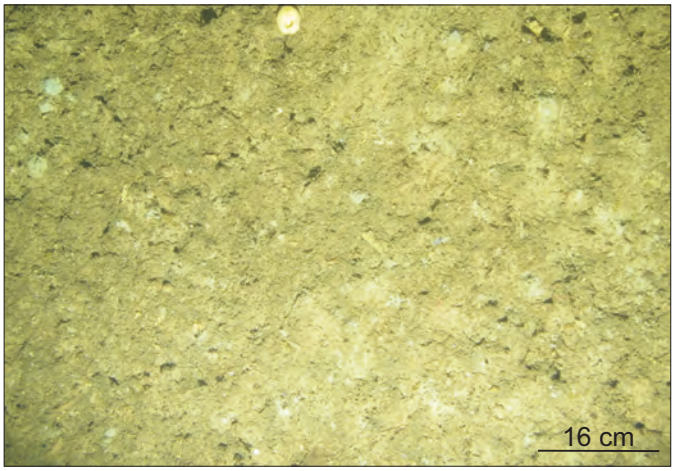
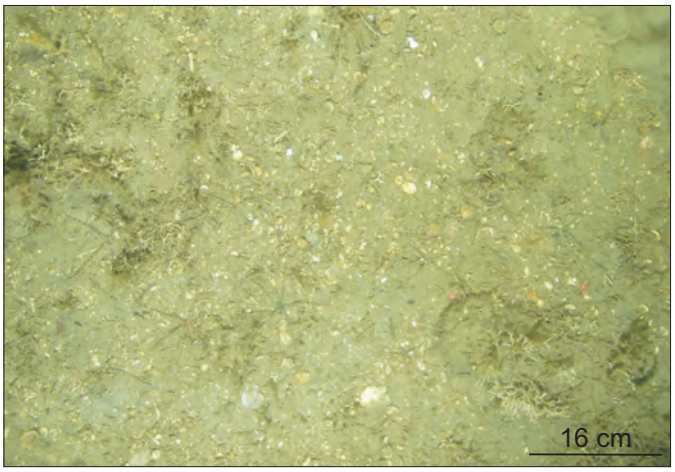
Figure 4.2 - Representative Sponge Reef Photographs



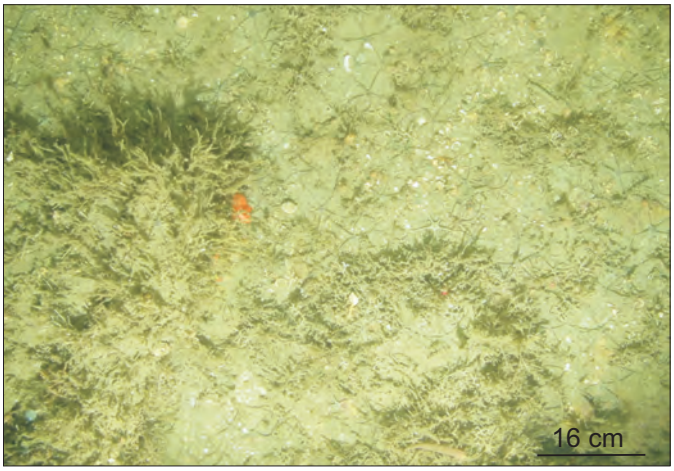
A1. Bioturbated soft mud with burrowing fauna



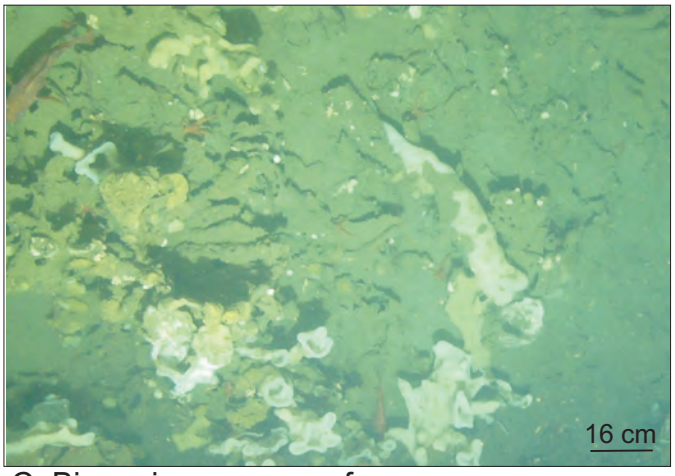
A2. Bioturbated cohesive/consolidated mud



B1. Muddy mixed substrata with faunal turf



B2. Muddy low-relief reef with faunal turf



C. Biogenic sponge reef

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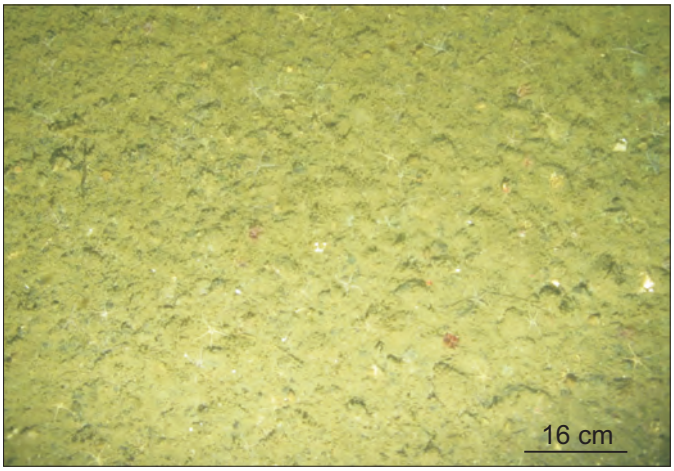
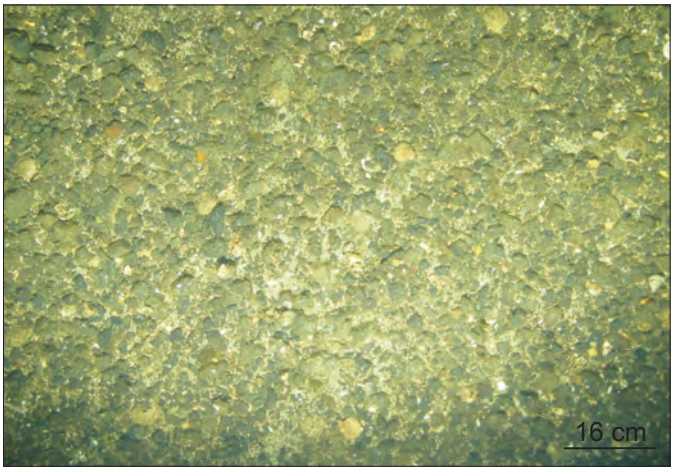
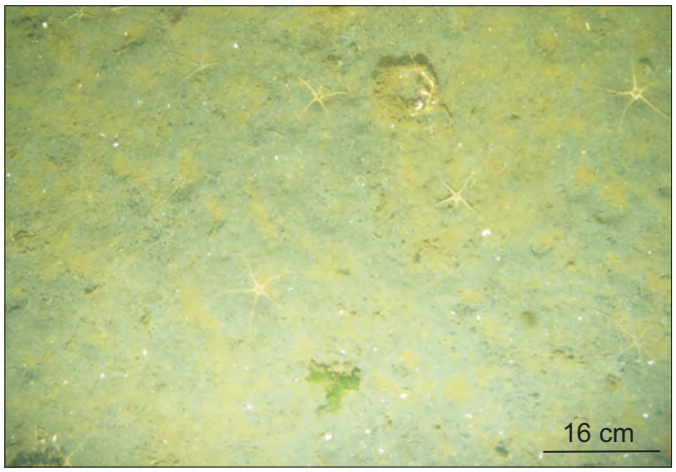
Figure 4.3 Benthic Habitat Classes derived from visual analysis of seafloor photograph



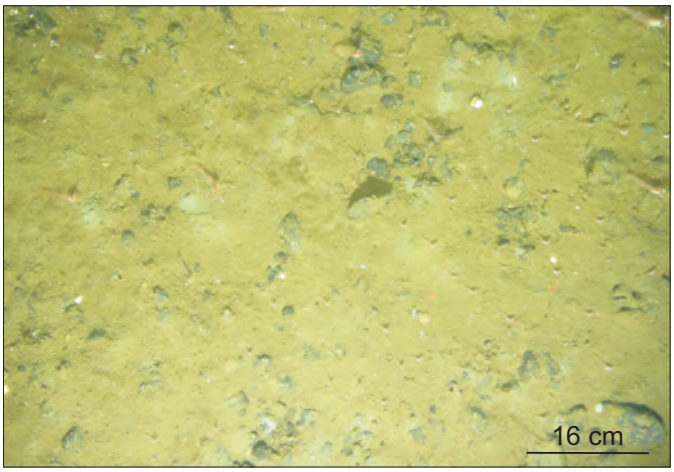
D1. Muddy gravel with epifauna



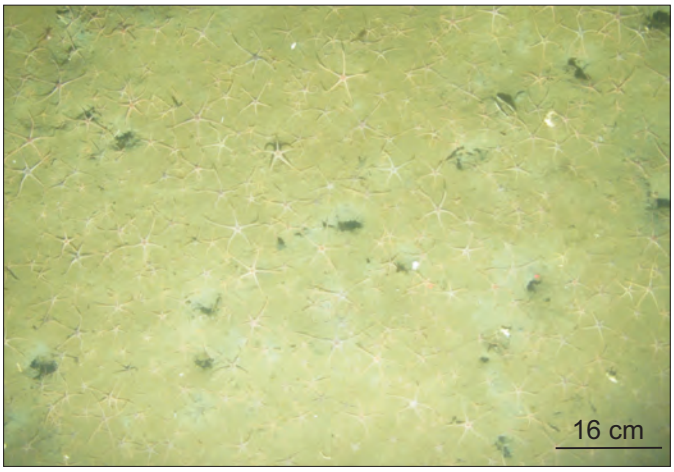
D2. Gravel and cobbles with epifauna



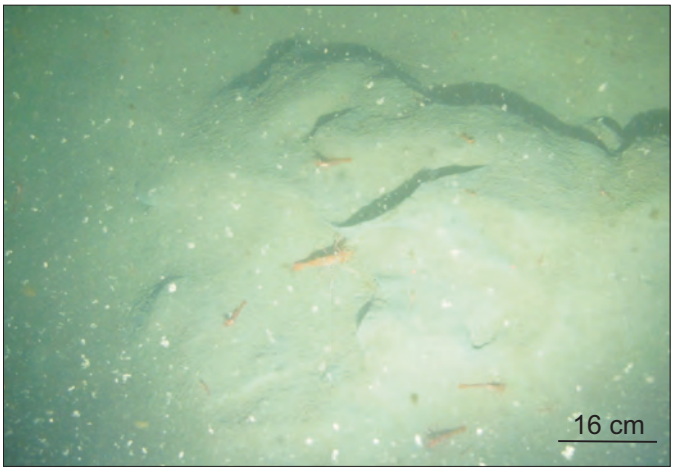
E1. Muddy sand



E2. Gravelly muddy sand



E3. Bioturbated muddy sand



F. Mobile silt with bedforms

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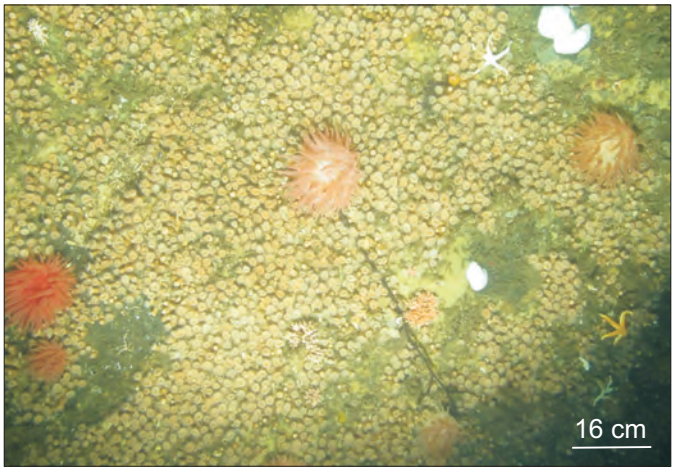
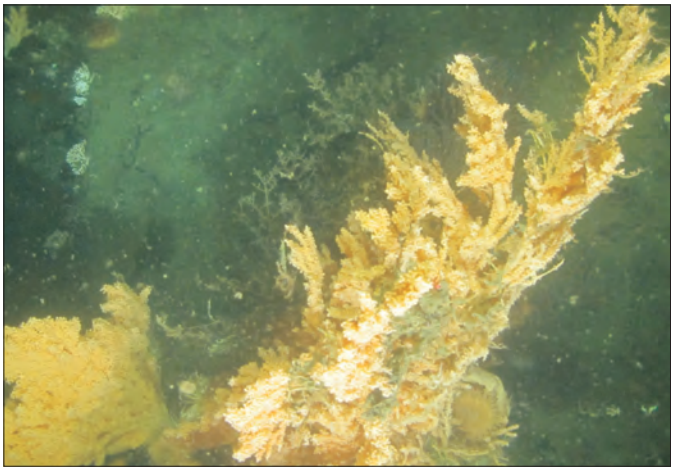
Figure 4.3 Benthic Habitat Classes derived from visual analysis of seafloor photograph

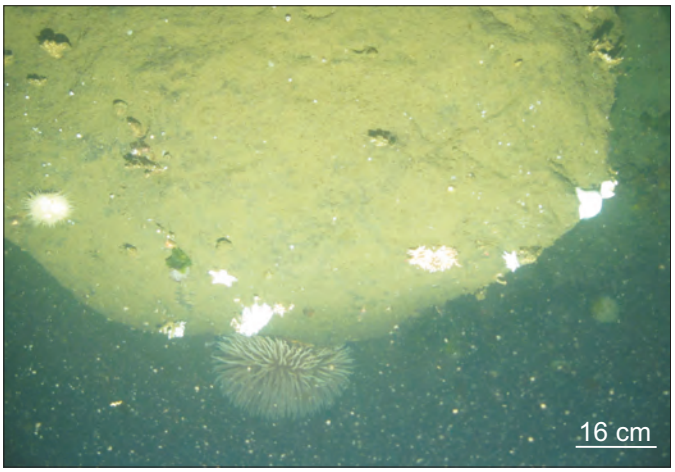


G. High-energy, rock with dense, diverse epifauna



H1. High energy, high-relief rock with cold water corals

H2. Low-energy, high-relief rock with sparse epifauna



H3. Low-energy, silt-covered boulder/cobble reef with sparse epifauna

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Figure 4.3 Benthic Habitat Classes derived from visual analysis of seafloor photograph

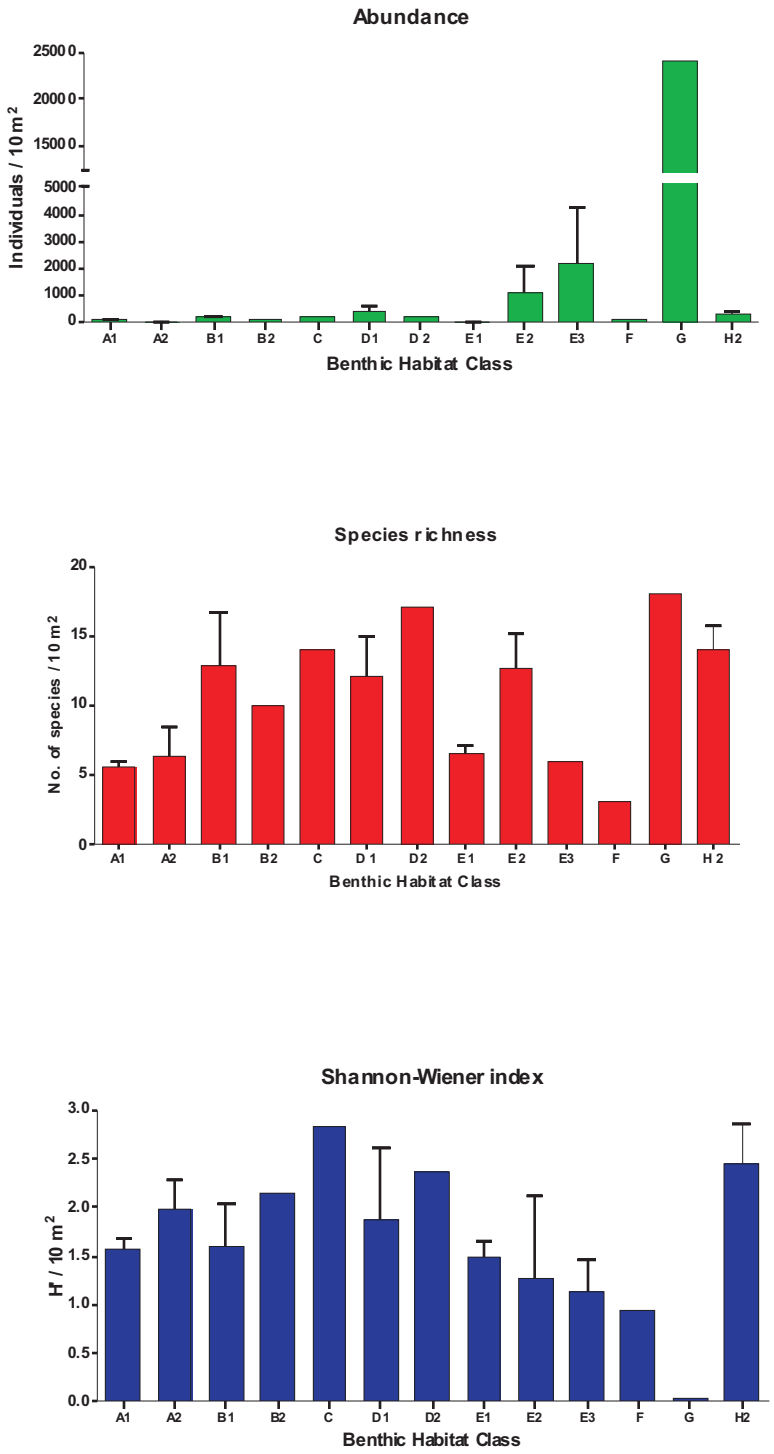

Figure 4.4a Epifaunal diversity indices from seafloor photographic data by benthic habitat class

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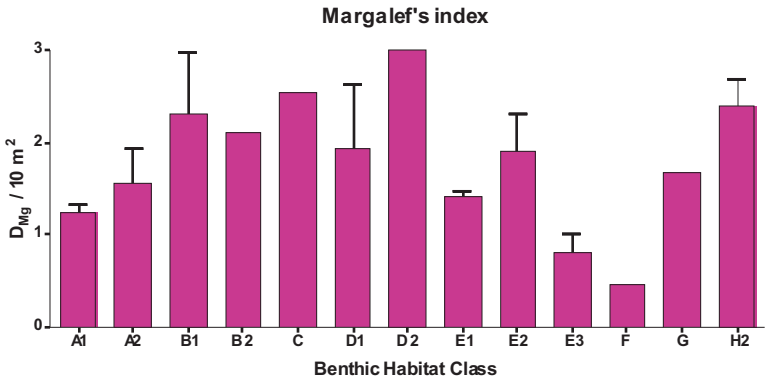

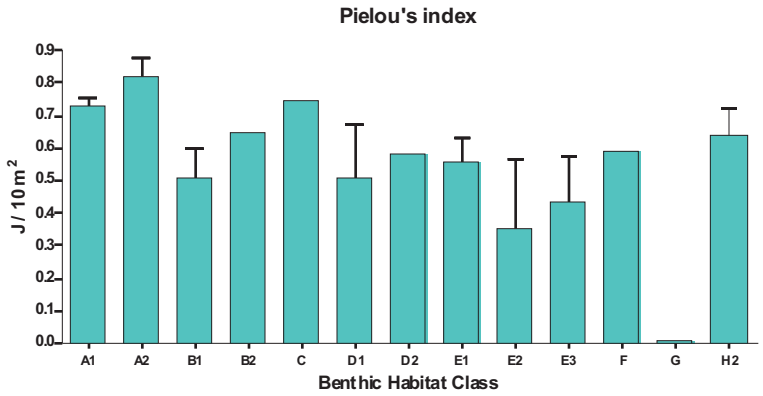

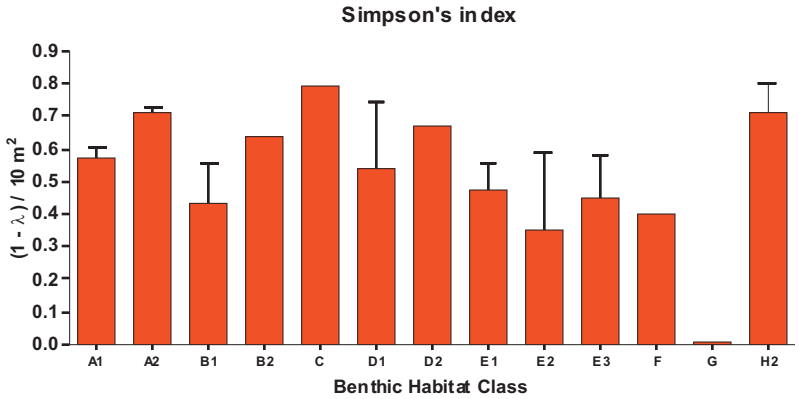

Figure 4.4b Epifaunal diversity indices from seafloor photographic data by benthic habitat class

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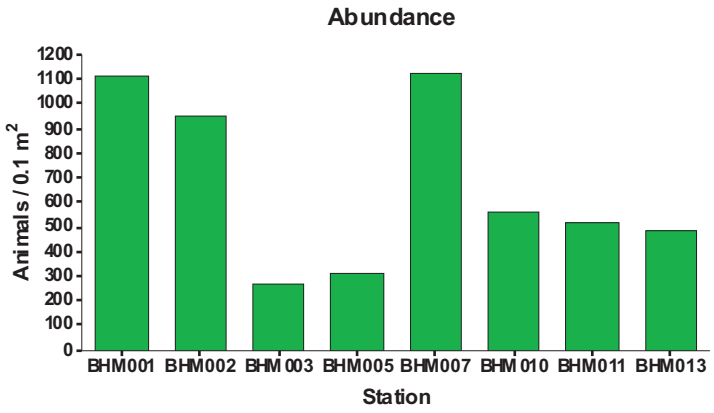
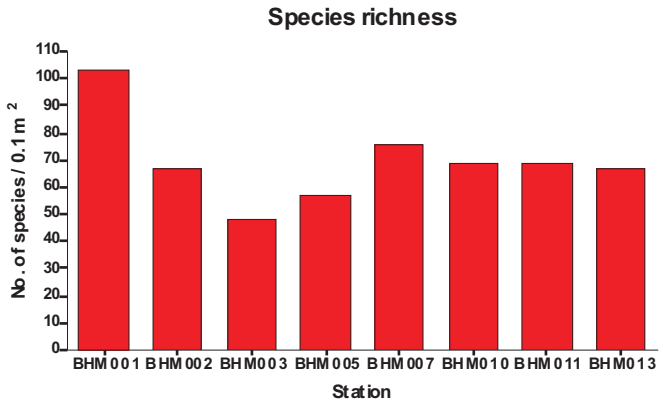




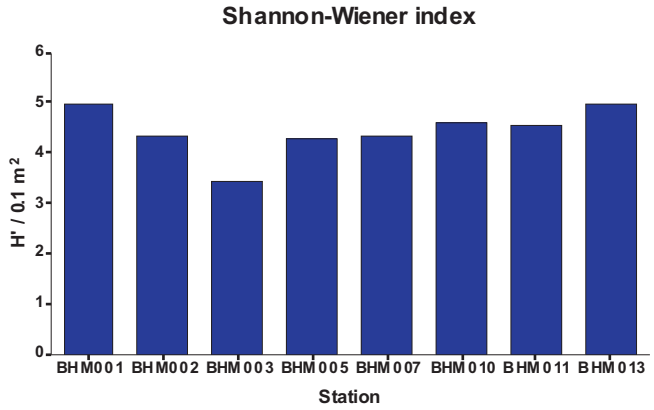
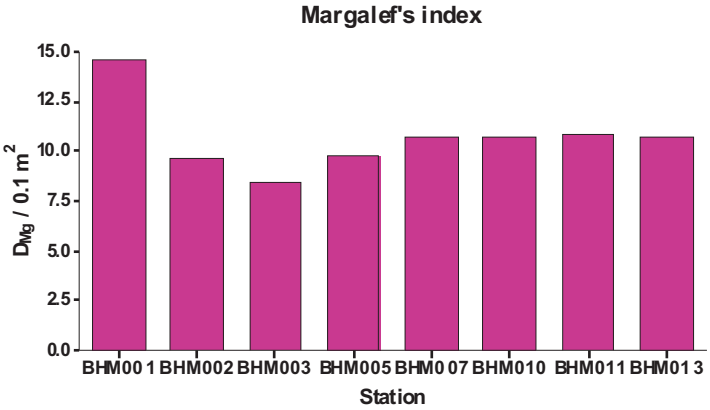
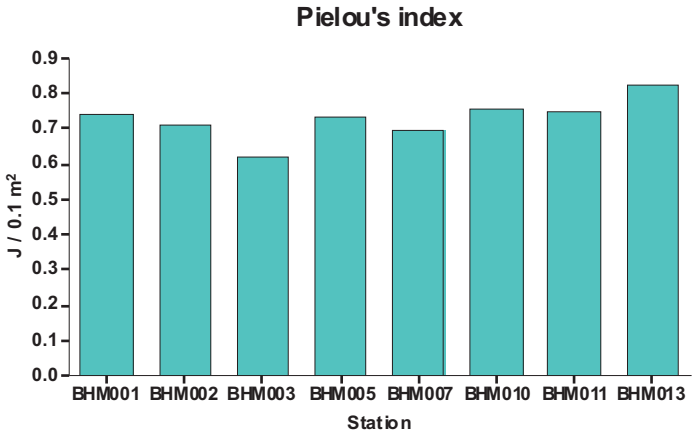


Figure 4.5a Macrofaunal diversity indices from infaunal data by station





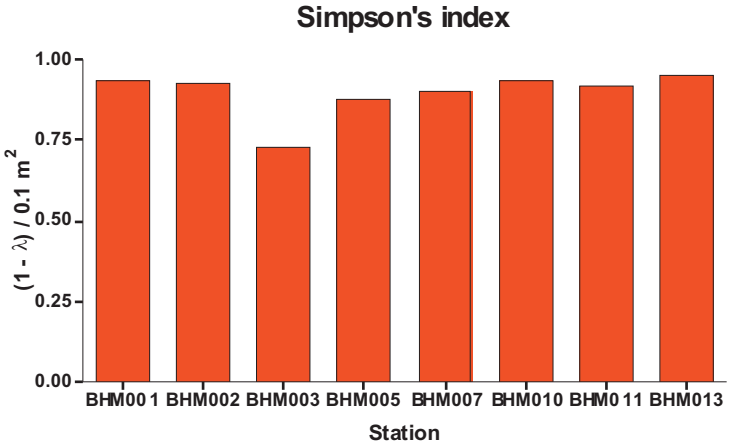


Figure 4.5b Macrofaunal diversity indices from infaunal data by station

5 BENTHIC HABITAT MAPS

Following analysis of all benthic ground-truthing data and interpretation of the MBES and SSS data layers (see Section 4), the results were used to delineate and map discrete benthic habitats encountered along the length of the survey corridor. For the purpose of this study, our working definition of a habitat is *"a spatially defined area where the physical, chemical, and biological environment is distinctly different from the surrounding environment"* (Brown *et al.*, 2011; Kostylev *et al.*, 2001). The derived habitat classes/maps were therefore defined based on **all** available information presented previously.

The majority of the seafloor within the survey area comprised of bioturbated mud (BHC A1), and this benthic habitat was found throughout the survey route (**Figure 5a-i**). This habitat class was extensive over flat regions of the seafloor throughout the survey corridor, and over a variety of water depths. Epifauna species diversity was low based on analysis of the video and stills data (Section 4.4), with characterising species including *Pandalus sp.*, unidentified brittle stars and *Euphausia sp.* (**Appendix 7**). The density of burrows visible from the seafloor photographs and video was high, suggesting that this habitat supports an extensive infaunal community. Grab samples from the PRPA support this hypothesis, with very high species abundance and species numbers recorded from this area (e.g. 1117 animals / 0.1 m^2 recorded at BHM007; 103 species / 0.1 m^2 recorded at BHM001) (see section 4.4.4). Differences in infaunal community structure along the length of the survey corridor are also expected, and further infaunal sampling is needed to determine infaunal community patterns over this BHC.

BHC A2 was similar to BHC A1, but was confined to a deeper water basin in the Work Channel (**Figure 5h and i**). Substrate characteristics for BHC A2 were different to that of BHC A1, appearing more consolidates/cohesive, but still with a high density of burrows visible at the sediment surface. Characterising epifauna was similar to BHC A1, with *Pandalus sp*, and *Pandalus platyceros* contributing the most to similarity within this bottom type (**Appendix 7**). Diversity levels were slightly higher than BHC A1. Further infaunal sampling is needed to determine infaunal community patterns over this BHC.

BHC B1 and B2 were combined for the purpose of benthic habitat map production. These benthic habitat classes were similar in appearance and faunal characteristics. BHC B1 comprised muddy mixed substrata with faunal turf, and BHC B2 comprised muddy mixed substrata with faunal turf but with obvious vertical relief (*i.e.* visible evidence of low-relief reef). Characterising species for these two classes included *Pandalus sp*.(common to both BHC B1 and B2), *Ophiura lutkeni* and *Amphiodia periercta* (BHC B1), and *Terebratulina sp.* and *Stylaster campylecus* (BHC B2) (**Appendix 7**). Overlay of the georeferenced classified photograph positions on the geophysical data layers indicated that both BHC B1 and B2 coincided spatially with the reef features (*i.e.* high slope and curvature) in Chatham Sound (**Figure 5 d, e, f and g**). A single map class (Class B1/2) was therefore defined and delineated combining both BHC B1 and B2.

BHC C comprised the biogenic sponge reef, characterised by the presence of glass sponges (*Heterochone calyx*), and burrowing crustaceans *Munida quadrispina* and *Pandalus sp.* (**Appendix 7**). Diversity levels were high for this BHC (**Figure 4.4**). This BHC was associated with areas of low SSS and MBES backscatter returns and high slope and curvatures values, associated with the complex topography of the reef surface. However, it was not always possible to differentiate between live, dead and buried portions of the glass sponge bioherms from the MBES bathymetric and backscatter data (see section 4.1), and BHC C appeared very similar to BHC1/2 in the acoustic data layers. Live sponges were only recorded on three discrete reefs (camera stations BHM-031, CD-007/008, CD-013 and CD-014) within the final proposed route (**Figure 5e and f**). These three live reefs were located on the edge of the 1km corridor, and not directly in line with the proposed pipeline. Due to difficulty in distinguishing live reef (BHC C) from dead and buried reef (BHC B1/2), only the reefs where ground-truthing recorded live sponges were mapped as BHC C. All other reef features delineated from the MBES and SSS data were classed as BHC B1/2 (**Figure 5 d, e, f and g**).

BHC D was characterised by muddy gravel, with visible epifauna, and was identified and mapped along a section of the Work Channel (**Figure 5d and h**), and in a deep water region in Chatham Sound just outside mouth of Portland Inlet (**Figure 5d**). Seabed morphology was flat, and MBES and SSS backscatter was higher than surround

Bioturbated mud regions. Characterising species included the brittle star *Ophiura sarsii*, the brachiopod *Terebratulina sp.,* and the crustacean *Pandalus sp*.

BHC D2 was confined to the Work Channel, and coincided with the level seafloor between the steep sided wall at the mouth of the channel, and extending into the Channel past Paradise Passage (**Figure 5d**). The BHC was easily delineated on the basis of the seafloor morphology and SSS and MBES backscatter characteristics. Epifaunal diversity was relatively high (**Figure 4.4**), with characterising species including the brachiopod *Terebratulina sp*. and the bivalve *Patinopecten caurinus* (**Appendix 7**).

BHC E1 and E2 were similar in visual characteristics, although could be distinguished from each other on the basis of higher gravel content in BHC E2 (*i.e.* BHC E1 – Muddy sand; BHC E2 – Gravelly muddy sand). The two classes shared characterising species identified from the SIMPER analysis (*Pandalus sp*. and two species of the genus Ophiura – **Appendix 7**). Overlay of the classified georeferenced photographs on the MBES and SSS derived map layers suggested that it was not possible to acoustically distinguish between these two classes, and therefore for the purpose of map production they were combined into a single benthic habitat map class (BHM E1/2). Geographically, stations classified with this BHC were confined to Nasoga Gulf (**Figure 5b**), and two distinct areas of BHC E1/2 were delineated in the channel either side of BHC E3.

BHC E3 was also similar to BHC E1 and E2. Substrate characteristics were similar (muddy sand) but there was evidence of bioturbation with dense burrows visible in the seafloor photographs. Characterising species defined from the SIMPER analysis showed similarity to BHC E1 and E2 (*Ophiura sarsii* and *Pandalus sp*.). This BHC could be delineated based on backscatter traits within Nasoga Gulf, forming a contiguous area between two bounding areas of BHC1/2 (**Figure 5b**).

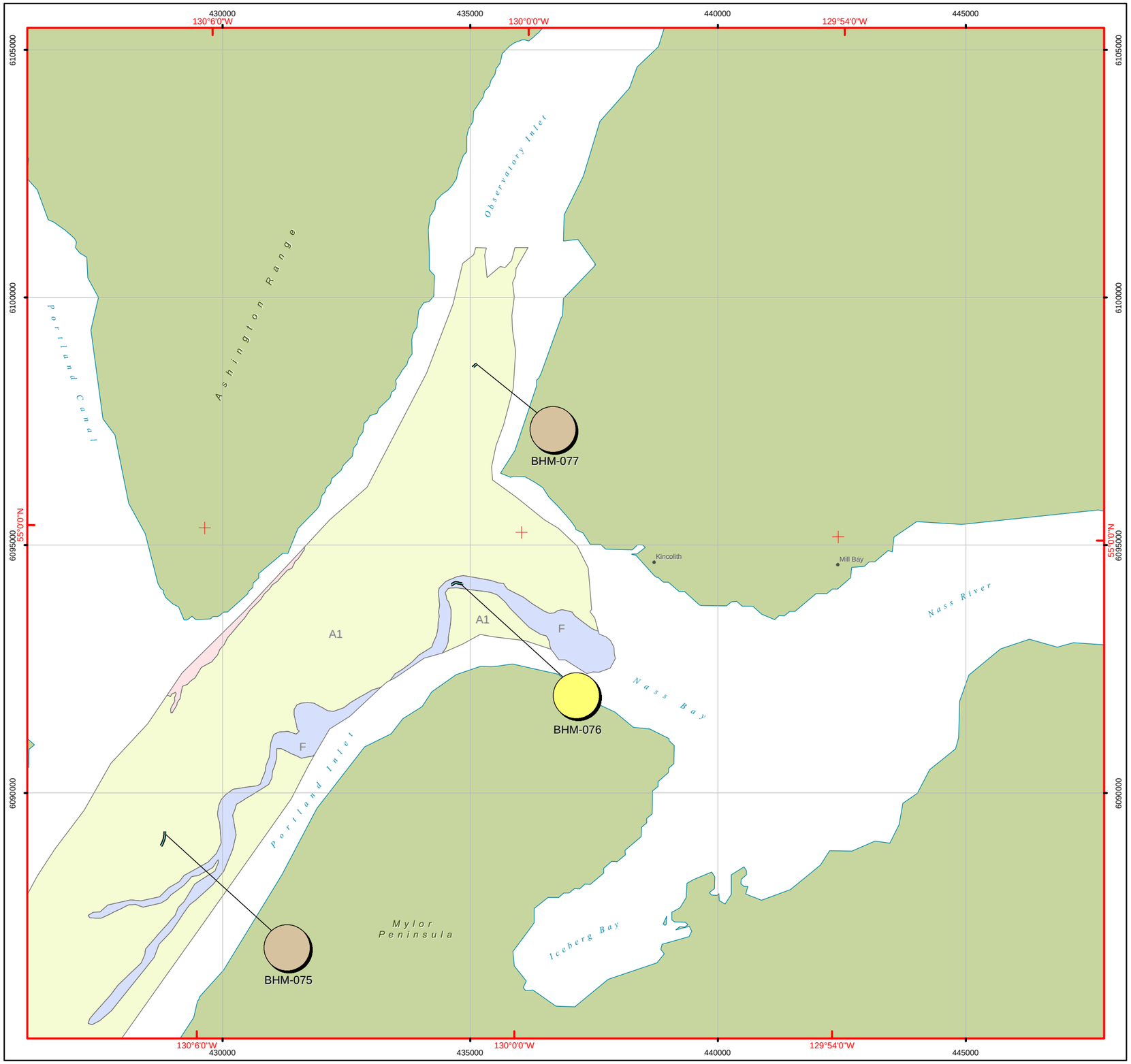
BHC F was a very distinctive class consisting of soft, fine grained sediment with distinctive bedforms. Once station was classified as this benthic class, and was located at the mouth of Nass Bay within a sediment transport channel that could be clearly delineated from the MBES and SSS data (**Figure 5a**). Epifaunal species diversity was low compared to other benthic habitat classes (**Figure 4.4**), and characterising species

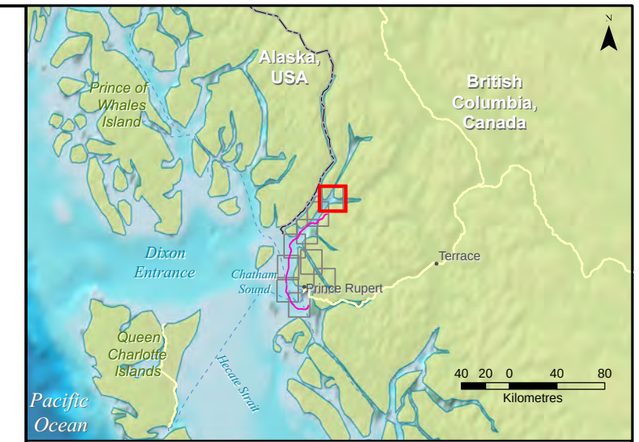
identified from the Simper analysis included *Pandalus sp.* and *Pandalus platyceros* (**Appendix 7**).

BHC G was a unique BHC located in the mouth of the Work Channel (**Figure 5d**). It was characterised by very steep sided hard substrata (bedrock and boulders) which could be delineated from the MBES and SSS data. The rock surfaces were covered in a very dense epifaunal community of anemones, sponges, echinoderms. This BHC displayed the highest species abundance, with extremely high numbers of the sea anemone *Epizoanthus scotinus* (2012 individuals / m^2) attached to the steep walls of the channel (**Appendix 7** and **Figure 4.4**). The morphology of the mouth of the channel, combined with the high density of suspension-feeding epifauna along the channels walls at the mouth of the channel and the coarse gravel substrate at the bottom of the channel (BHC D2), suggest that this area is a high-energy area with strong water currents.

BHC H1 and H2 coincided with the high slope, high curvature, high backscatter regions along the survey route in the approached to Portland Inlet, and in places along the periphery of the surveyed route within Portland Inlet and the Work Channel (**Figure 5 a-d and e-i**). Both benthic habitat classes were very similar, comprising silt-covered bedrock with epifauna. However, BHC H1 differed in the presence of cold water corals (*Primnoa sp.*), which were very dense in places (see section 4.4). The presence of corals appeared patchy, and at no stations were coral present throughout the duration of a transect. BHC H1 was recorded at station BHM052, BHM059C and BHM051, and was interspersed with BHC H2. Where corals were recorded, the features (polygons) delineated from the MBES and SSS data layers were mapped as BHM H1. All other featured displaying these acoustic characteristics were mapped as BHC H2. However, it should be noted that it is highly probably that cold water corals are much more widespread on the high-relief rock walls of the channel throughout the survey area.

BHC H3 was only recorded in 9 seafloor photographs, and did not form a distinctive map class in the final benthic habitat maps.





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Latitude Of Origin: 0.0000
Units: Meter

N W E S

0 2 4 8
Kilometers

Camera Track

Classification

- Class A1: Bioturbated mud
- Class F: Mobile silt with bedforms
- Class H2: Low-energy, high-relief rock with sparse epifauna

Sediment Type

- Sand
- Gravel
- Cobble
- Boulder
- Bedrock
- Silt covered Bedrock
- Silt
- Biogenic Reef

Note:
Map scale 1:82,000 when printed on 11x17 size paper

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Benthic Interpretation

Survey Area - Map Block 1

Prince Rupert
British Columbia, Canada

McGregor GeoScience Limited

McGregor GeoScience Ltd.
Bedford, Nova Scotia, Canada

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Figure: 5a

McGregor Project No.: 1311

Filename: 1311_Interp_x9_11x17_pies_

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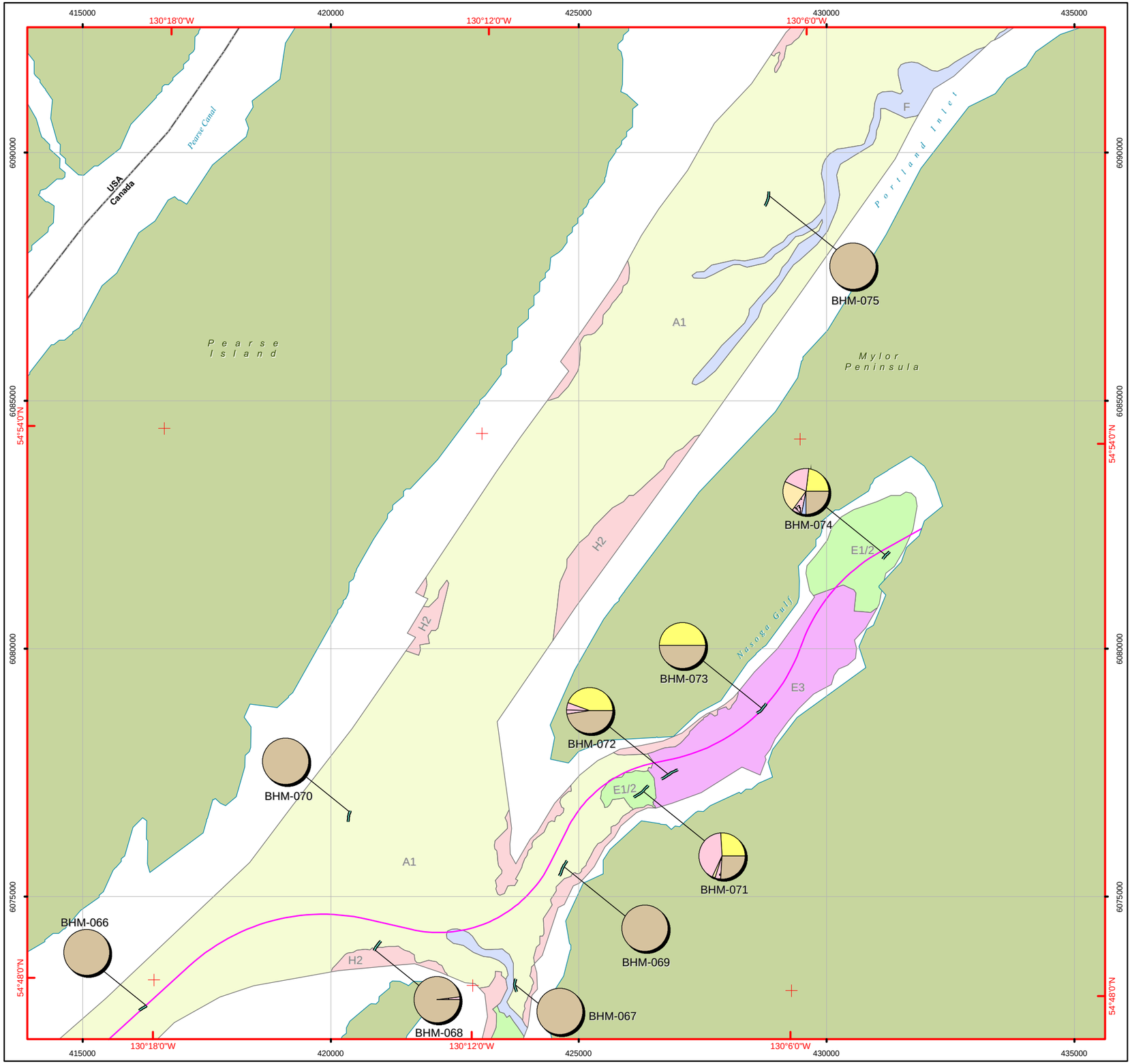

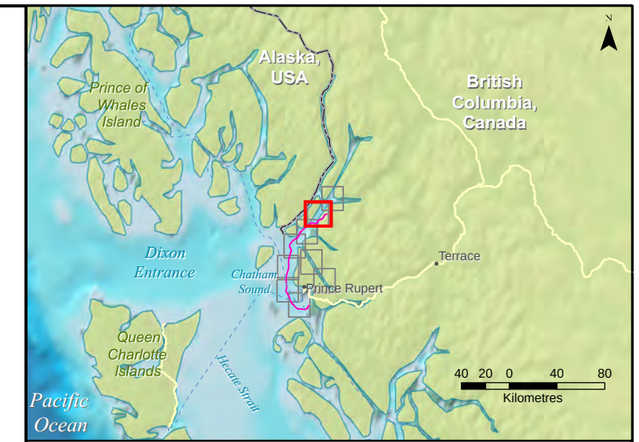

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Units: Meter

N W E S

0 2 4 8
Kilometers

Camera Track

Alaska BC Border

Route F03

Nasoga Gulf to Lelu East

Classification

- Class A1: Bioturbated mud
- Class E1/2: Muddy sand/Gravelly muddy sand
- Class E3: Bioturbated muddy sand
- Class F: Mobile silt with bedforms
- Class H2: Low-energy, high-relief rock with sparse epifauna

Sediment Type

- Sand
- Gravel
- Cobble
- Boulder
- Bedrock
- Silt covered Bedrock
- Silt
- Biogenic Reef

Note:
Map scale 1:82,000 when printed on 11x17 size paper

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Benthic Interpretation

Survey Area - Map Block 2

Prince Rupert
British Columbia, Canada

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Figure: 5b

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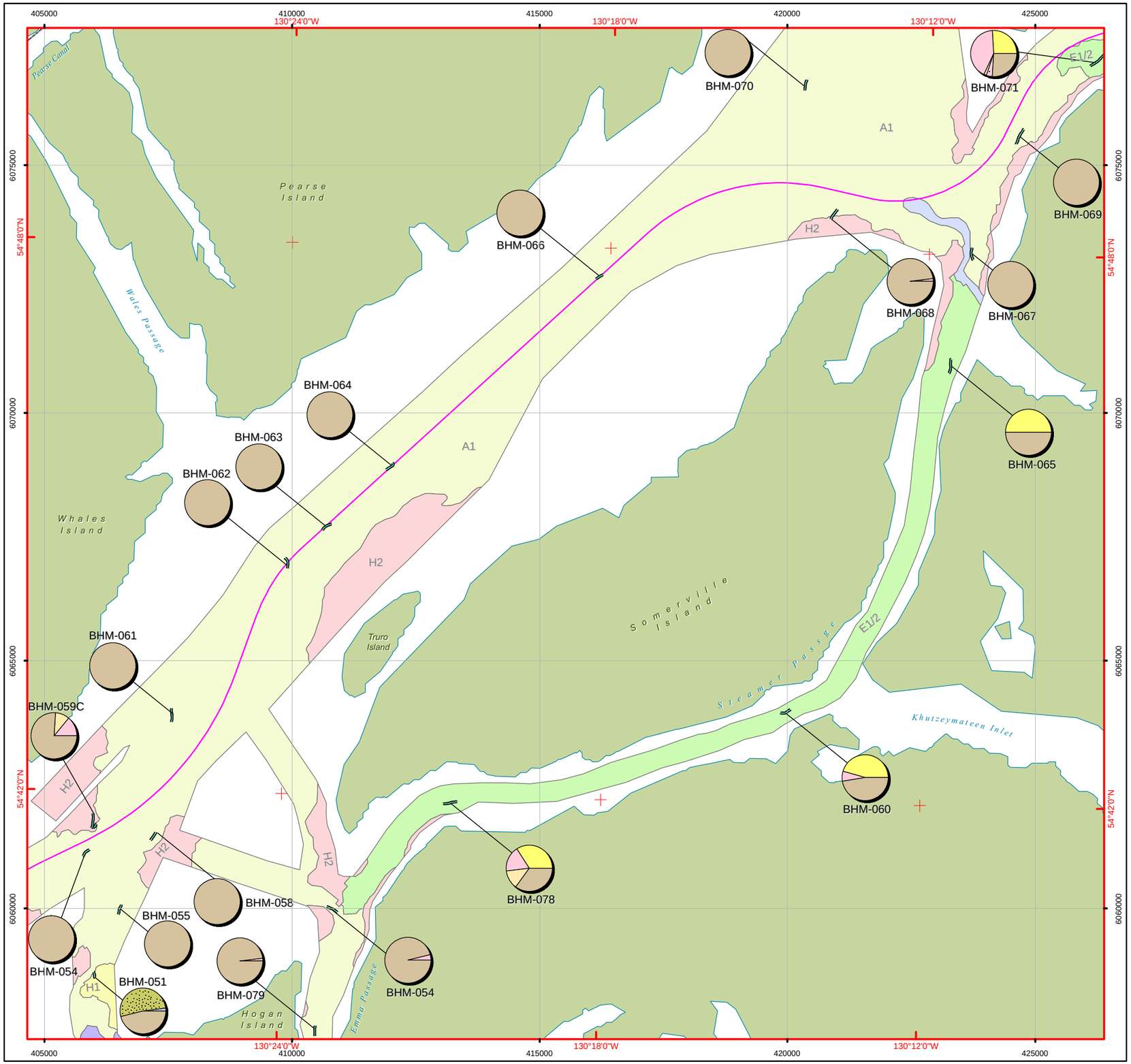

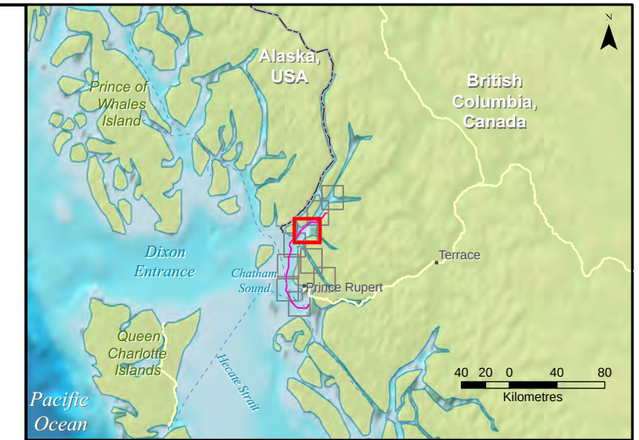

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Latitude Of Origin: 0.0000
Units: Meter

N W E S

0 2 4 8
Kilometers

Camera Track

Alaska BC Border

Route F03

Nasoga Gulf to Lelu East

Classification

- Class A1: Bioturbated mud
- Class E1/2: Muddy sand/Gravelly muddy sand
- Class F: Mobile silt with bedforms
- Class G: High-energy, rock with dense, diverse epifauna
- Class H1: High-energy, high-relief rock with cold water corals
- Class H2: Low-energy, high-relief rock with sparse epifauna

Sediment Type

- Sand
- Gravel
- Cobble
- Boulder
- Bedrock
- Silt covered Bedrock
- Silt
- Biogenic Reef

Note:
Map scale 1:82,000 when printed on 11x17 size paper

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Benthic Interpretation

Survey Area - Map Block 3

Prince Rupert
British Columbia, Canada

McGregor GeoScience Limited

McGregor GeoScience Ltd.
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Filename: 1311_Interp_x9_11x17_pies_

Figure: 5c

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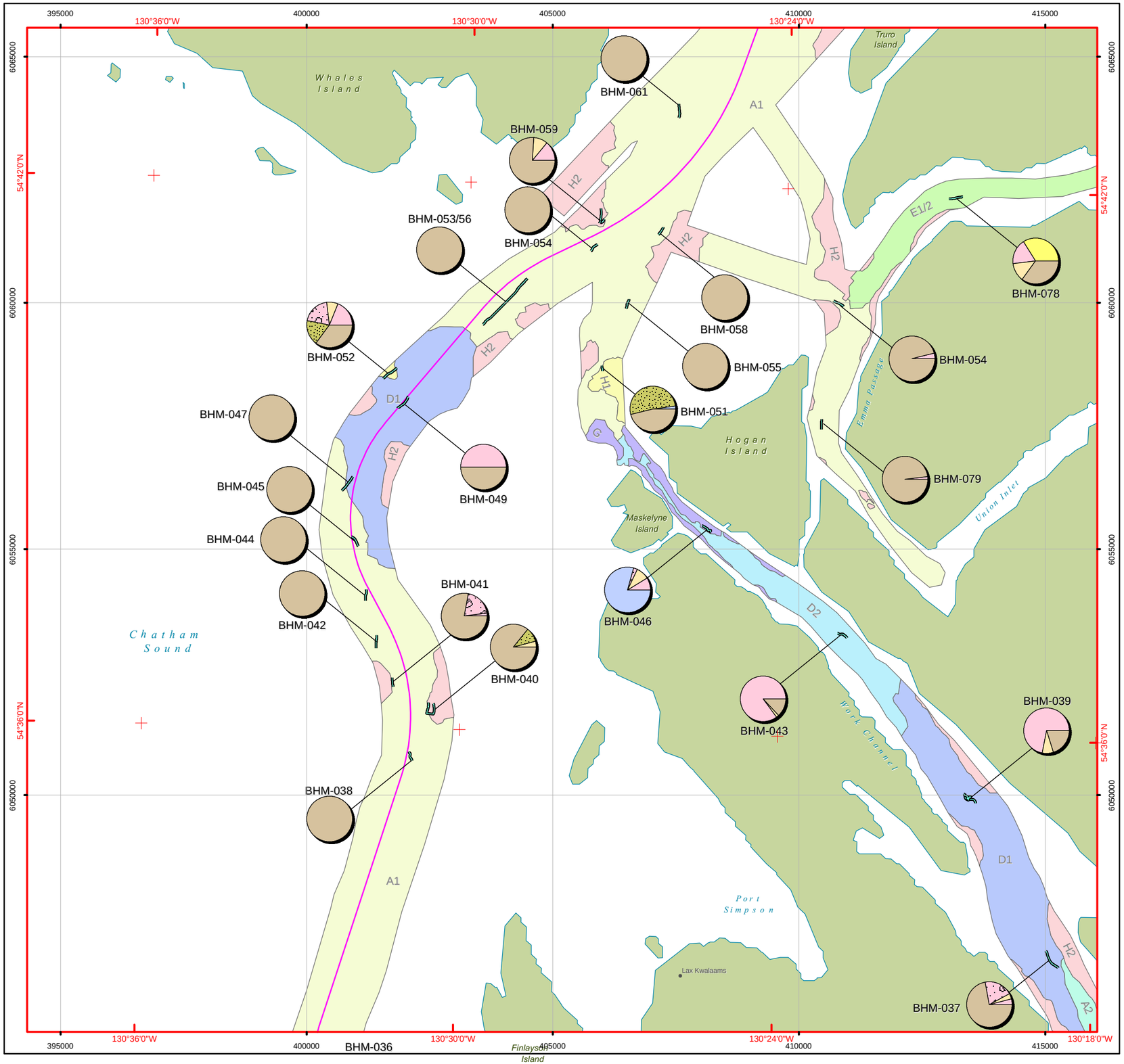

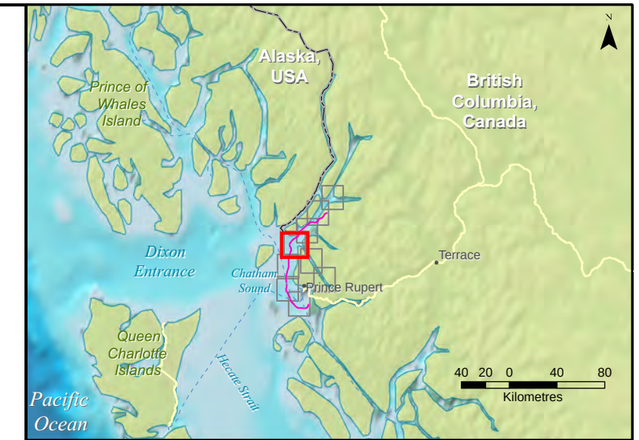

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Units: Meter

0 2 4 8
Kilometers

Camera Track

Route F03

Nasoga Gulf to Lelu East

Classification

- Class A1: Bioturbated mud
- Class A2: Bioturbated cohesive/consolidated mud
- Class D1: Muddy gravel with epifauna
- Class D2: Gravel and cobbles with epifauna
- Class E1/2: Muddy sand/Gravelly muddy sand
- Class G: High-energy, rock with dense, diverse epifauna
- Class H1: High-energy, high-relief rock with cold water corals
- Class H2: Low-energy, high-relief rock with sparse epifauna

Sediment Type

- Sand
- Gravel
- Cobble
- Boulder
- Bedrock
- Silt covered Bedrock
- Silt
- Biogenic Reef

Note:
Map scale 1:82,000 when printed on 11x17 size paper

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Benthic Interpretation

Survey Area - Map Block 4

Prince Rupert
British Columbia, Canada

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Figure: 5d

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Filename: 1311_Interp_x9_11x17_pies_

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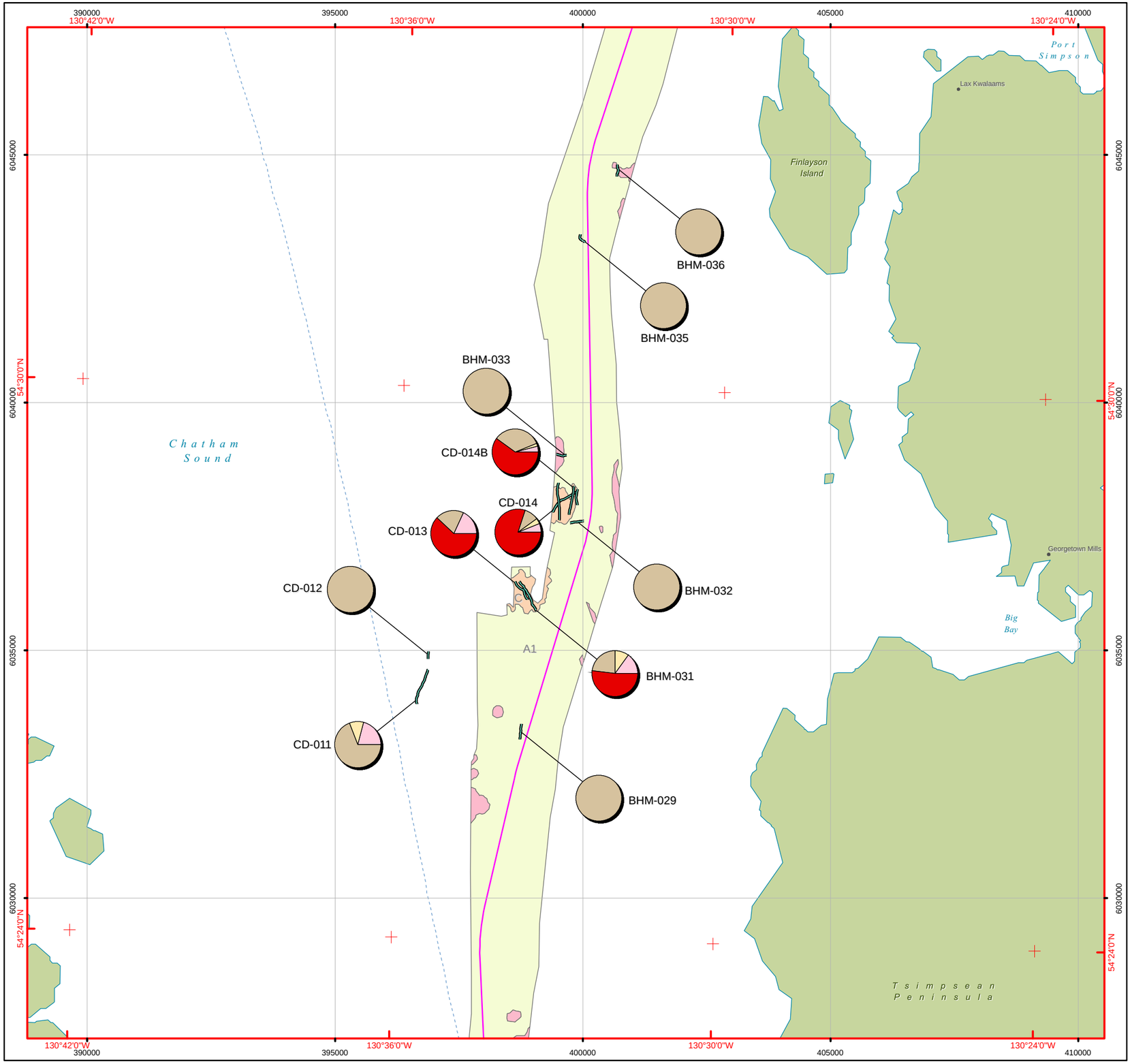

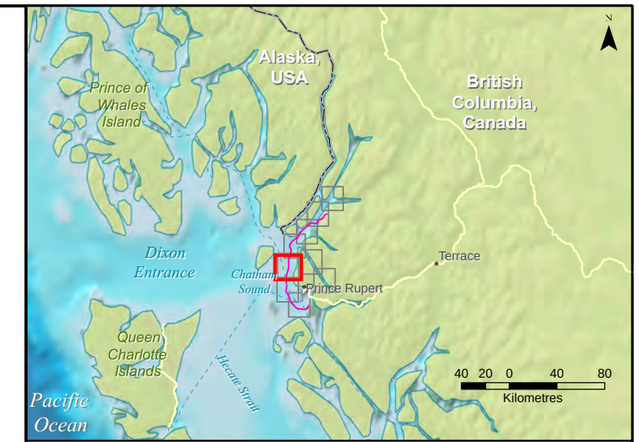

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Units: Meter

N W E S

0 2 4 8
Kilometers

Camera Track

Ferry Route

Route F03

Nasoga Gulf to Lelu East

Classification

- Class A1: Bioturbated mud
- Class B1/2: Muddy low-relief reef with faunal turf
- Class C: Biogenic sponge reef

Sediment Type

- Sand
- Gravel
- Cobble
- Boulder
- Bedrock
- Silt covered Bedrock
- Silt
- Biogenic Reef

Note:
Map scale 1:82,000 when printed on 11x17 size paper

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Benthic Interpretation

Survey Area - Map Block 5

Prince Rupert
British Columbia, Canada

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Figure: 5e

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Filename: 1311_Interp_x9_11x17_pies_

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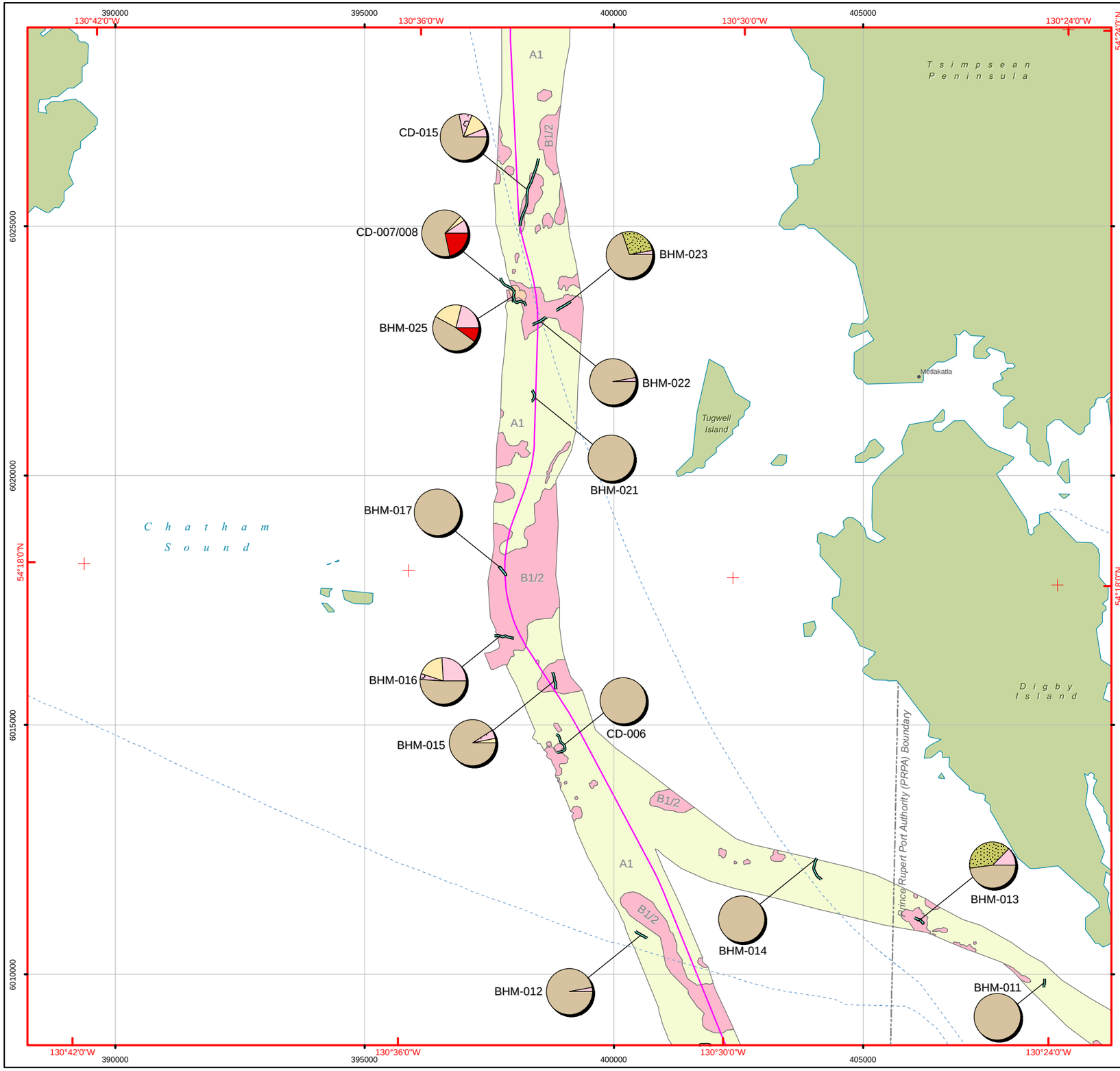

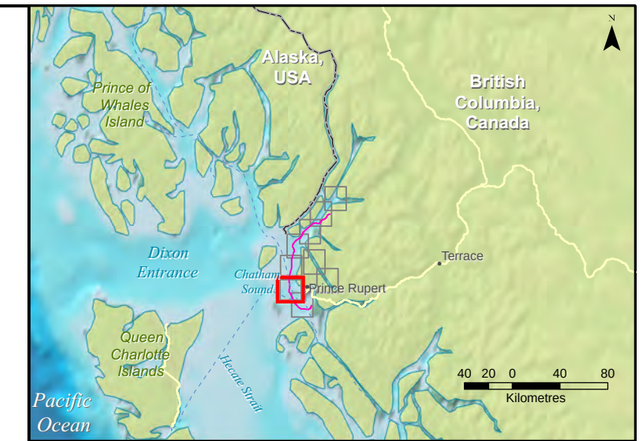

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Units: Meter

N W E S

0 2 4 8
Kilometers

Camera Track
Prince Rupert Port Authority
Ferry Route

Route F03
Nasoga Gulf to Lelu East

Classification
Class A1: Bioturbated mud
Class B1/2: Muddy low-relief reef with faunal turf
Class C: Biogenic sponge reef

Sediment Type
Sand
Gravel
Cobble
Boulder
Bedrock
Silt covered Bedrock
Silt
Biogenic Reef

Note:
Map scale 1:82,000 when printed on 11x17 size paper

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Benthic Interpretation

Survey Area - Map Block 6

Prince Rupert
British Columbia, Canada

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Bedford, Nova Scotia, Canada

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Filename: 1311_Interp_x9_11x17_pies_

Figure: 5f

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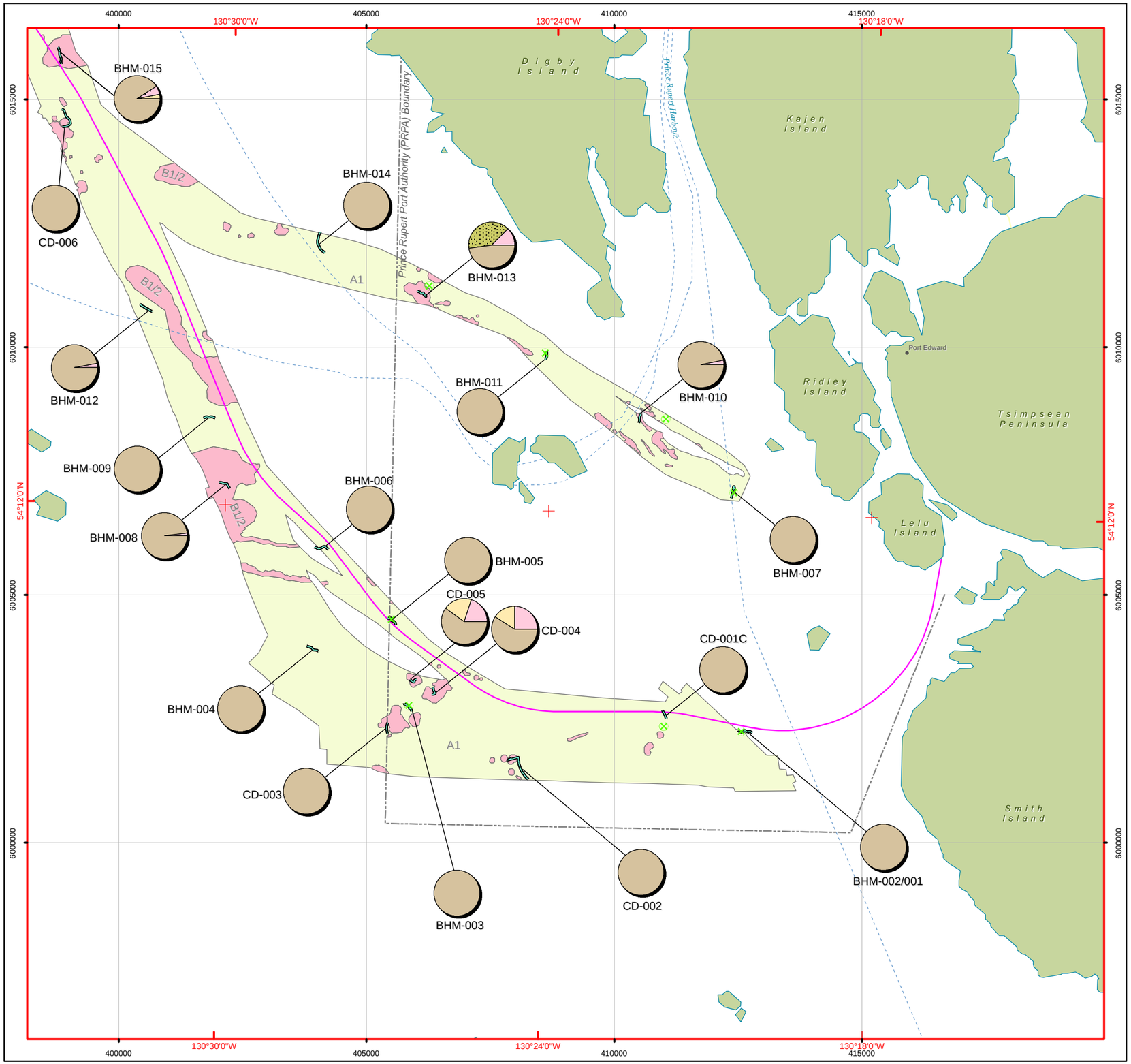

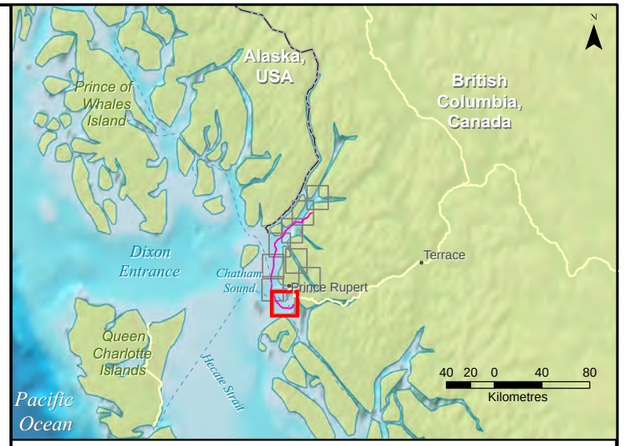

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Units: Meter

N W E S

0 2 4 8
Kilometers

Grab Sample (PRPA Area)
Camera Track
Prince Rupert Port Authority
Primary Highway
Ferry Route

Route F03
Nasoga Gulf to Lelu East

Classification
Class A1: Bioturbated mud
Class B1/2: Muddy low-relief reef with faunal turf

Sediment Type
Sand
Gravel
Cobble
Boulder
Bedrock
Silt covered Bedrock
Silt
Biogenic Reef

Note:
Map scale 1:82,000 when printed on 11x17 size paper

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Benthic Interpretation

Survey Area - Map Block 7

Prince Rupert
British Columbia, Canada

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Figure: 5g

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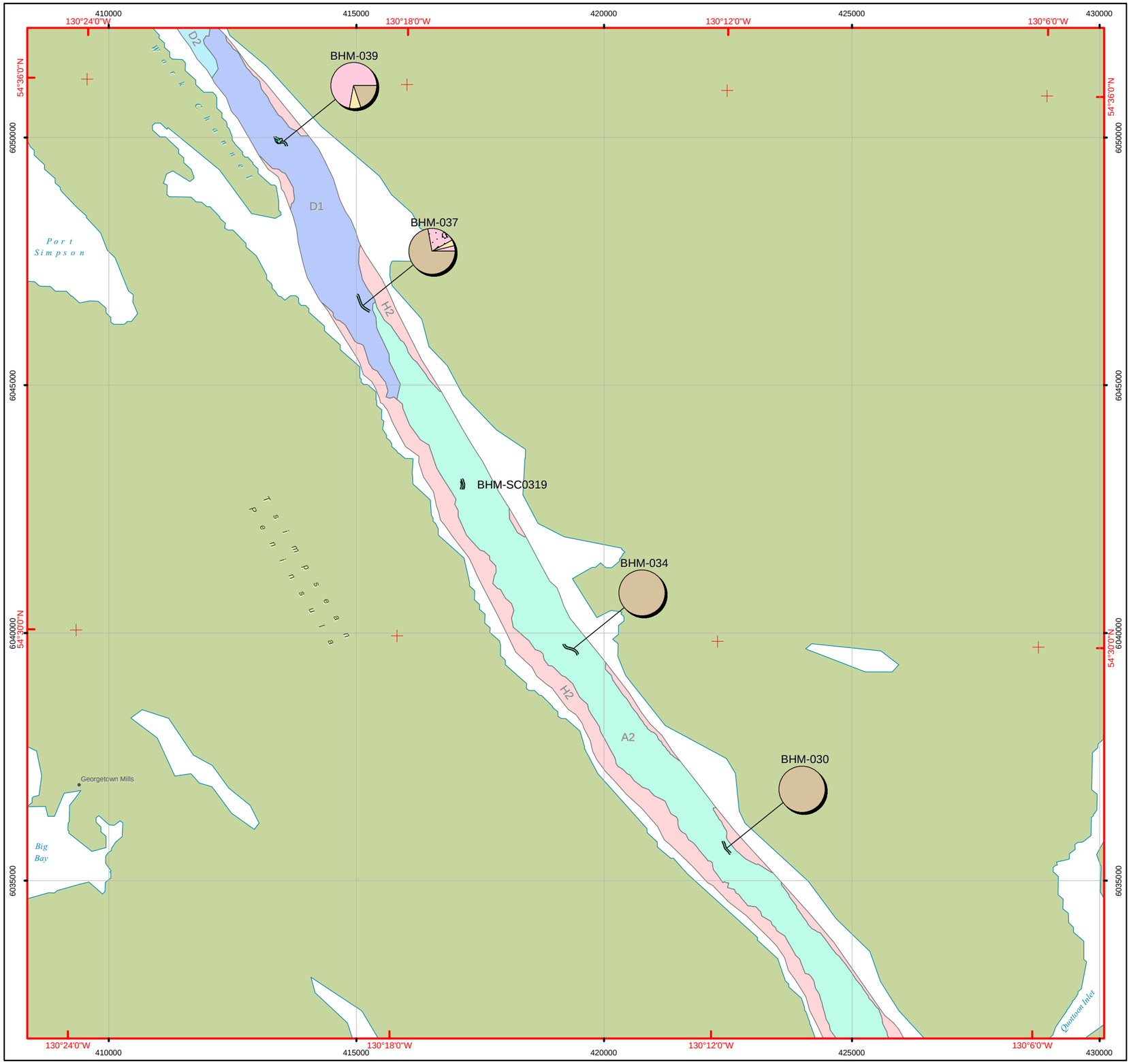

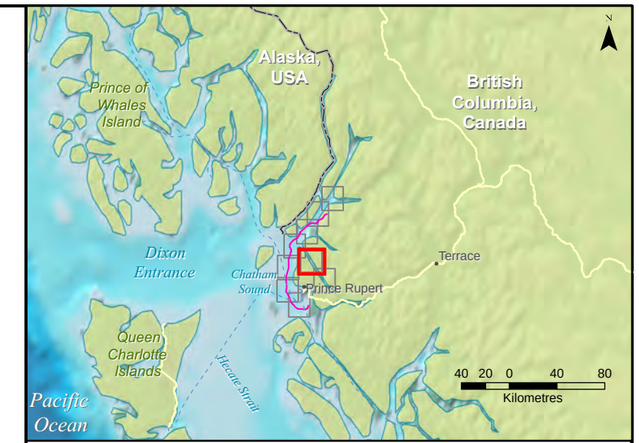

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Units: Meter

N W E S

0 2 4 8
Kilometers

Camera Track

Classification

- Class A2: Bioturbated cohesive/consolidated mud
- Class D1: Muddy gravel with epifauna
- Class D2: Gravel and cobbles with epifauna
- Class H2: Low-energy, high-relief rock with sparse epifauna

Sediment Type

- Sand
- Gravel
- Cobble
- Boulder
- Bedrock
- Silt covered Bedrock
- Silt
- Biogenic Reef

Note:
Map scale 1:82,000 when printed on 11x17 size paper

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Benthic Interpretation

Survey Area - Map Block 8

Prince Rupert
British Columbia, Canada

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Figure: 5h

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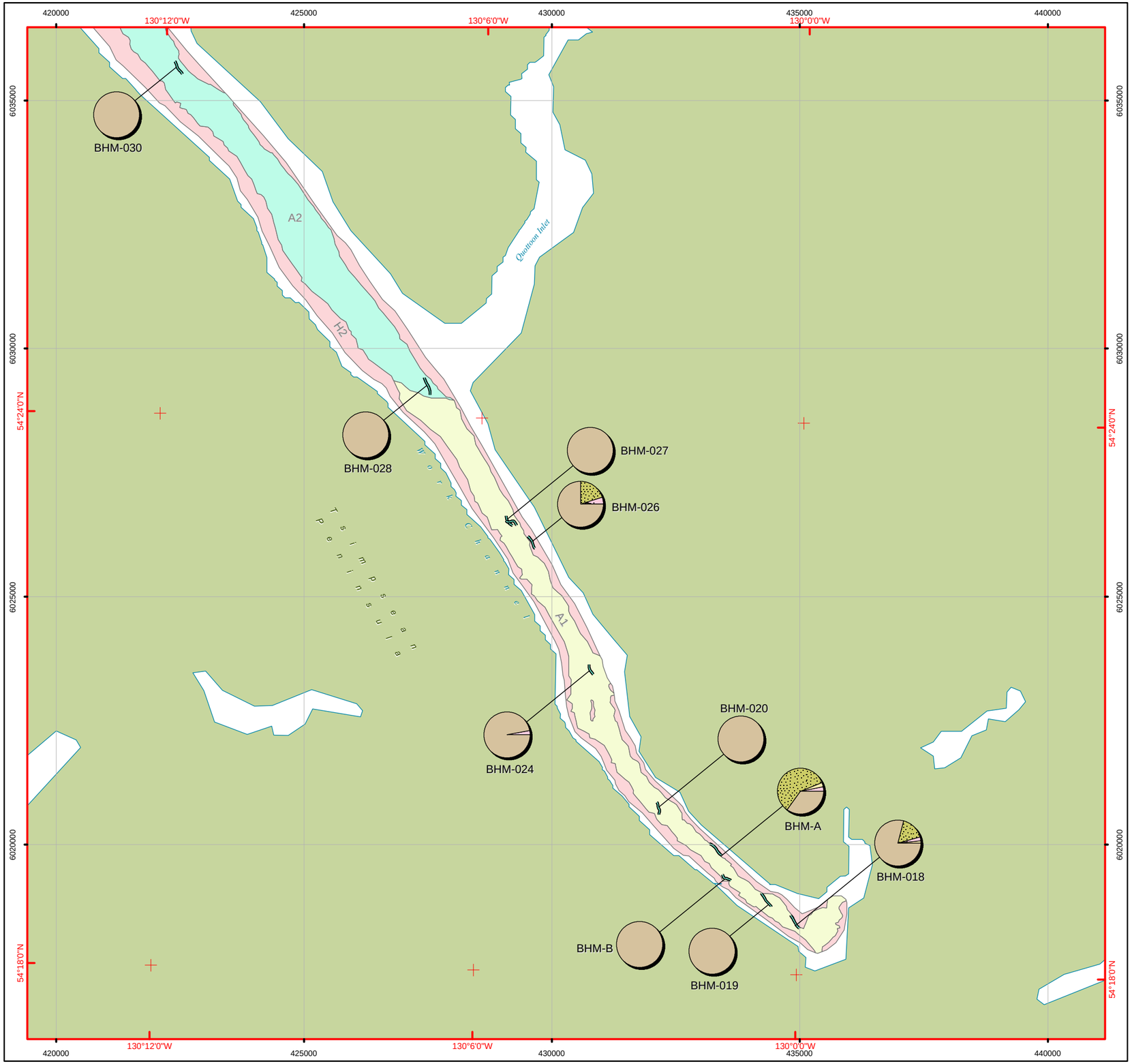

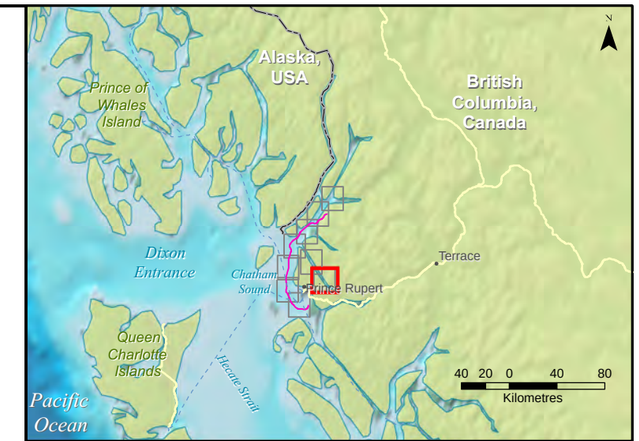

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Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

N W E S

0 2 4 8
Kilometers

Camera Track

Classification

- Class A1: Bioturbated mud
- Class A2: Bioturbated cohesive/consolidated mud
- Class H2: Low-energy, high-relief rock with sparse epifauna

Sediment Type

- Sand
- Gravel
- Cobble
- Boulder
- Bedrock
- Silt covered Bedrock
- Silt
- Biogenic Reef

Note:
Map scale 1:82,000 when printed on 11x17 size paper

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Benthic Interpretation

Survey Area - Map Block 9

Prince Rupert
British Columbia, Canada

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Bedford, Nova Scotia, Canada

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Figure: 5i

McGregor Project No.: 1311

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