Appendix G.21
Brown Passage Subtidal Survey

Brown Passage Subtidal Survey

Pacific NorthWest LNG Limited Partnership

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Abbreviations

ASL	ASL Environmental Sciences Inc.
CRA	Commercial, recreational and aboriginal
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
EA	Environmental Assessment
EC	Environment Canada
EIS	Environmental Impact Statement/Environmental Assessment
GIS	Geographic Information Systems
km	Kilometer
LED	Light Emitting Diode
m	Meter
MOF	Materials Off-Loading Facility
nm	Nautical Mile
PNW LNG	Pacific NorthWest LNG
ROV	Remotely-Operated Vehicle
SARA	Species At Risk Act
Spp	Species

Glossary

Disposal At Sea	Disposal of waste and other matter at sea
Dredging	Underwater excavation activity
Fauna	All animal life at a particular region or time
Flora	All plant life at a particular region or time
Sessile	Immobile animal species
Substrate	The surface or material on or from which an organism lives, grows, or obtains its nourishment

1.0 INTRODUCTION

Pacific NorthWest LNG Limited Partnership (PNW LNG) has proposed to build a liquefied natural gas (LNG) plant on Lelu Island, near Port Edward, British Columbia (BC). The Pacific NorthWest LNG Project (the Project) development will include marine infrastructure and construction activities that have the potential to impact the marine environment, including dredging and subsequent disposal at sea of dredged sediment during construction.

Through the Environmental Impact Statement (EIS) review process, the PNW LNG working group recommended further characterization of species and habitats present at the previously-used Brown Passage disposal site (the disposal site), as many marine species are of commercial, recreational and cultural value to Aboriginal and various other user groups. To supplement existing data, a subtidal survey using a remotely operated vehicle (ROV) was conducted at and near the disposal site in July 2014.

The EIS described potential dredging activities at both the materials off-loading facility (MOF) and LNG carrier berth to enable safe navigation of vessels into these areas. The project plan outlined in the EIS included a total of 7,615,000 m^3 of dredged material requiring disposal: 615,000 m^3 from the MOF and 7,000,000 m^3 from the LNG carrier berth area. Since the implementation and completion of this subtidal survey, the project design has been altered, with dredging at the LNG carrier berth area no longer required for project construction. Dredged material from the MOF, now estimated to be less than 200,000 m^3 in volume, is still proposed for disposal at the Brown Passage disposal site. The site is located approximately 30 km northwest of Lelu Island, extending in a 0.5 nautical mile (nm) radius from the center point of 54°18.50 N, 130°45.50 W (Figure 1). This site has been used seven times for disposal at sea since it was first used in 1982, with the most recent disposal event occurring in 2006/2007.

In Section 13.5 of the EIS and Section 5.0 of the "Follow-Up Report on Sediment and Water Quality Associated with Construction of the Terminal Berth Area" (Stantec 2014a), effects to marine organisms and habitats at and near the previously-used Brown Passage disposal site were predicted to be temporary and localized, based on the information used to characterize habitats and species use of the site, in addition to sediment dispersion modelling results. The majority of mobile and pelagic marine organisms are expected to avoid the affected area during disposal events, while benthic organisms are expected to recolonize deposition areas relatively rapidly, as deposited material is predicted to be similar to substrates of existing habitats. As stated the EIS, the potential residual effects on marine fish and fish habitat are expected to be not significant.

2.0 STUDY AREA

The extent of the survey area was determined based on sediment dispersion modelling conducted by ASL Environmental Sciences Inc. (ASL) in support of the EIS (Stantec 2014a, Appendix C). At the time of study design for this subtidal survey, dredging for the LNG carrier berth area was still a component of the project design. To determine study areas for the subtidal survey, final sediment deposition predicted at the disposal site following disposal of sediments dredged from the MOF, was overlaid with the sediment deposition predicted at the disposal site following disposal of sediments dredged from the LNG carrier berth area to provide an estimate of cumulative sediment deposition (Figure 2). This cumulative deposition area was used to develop the study design boundaries and develop siting criteria for the subtidal transects. The survey area was divided into four study areas, based on the final predicted accumulation of sediment deposition from disposal events (Figure 2).

A limited amount of historical data describes substrate, flora and fauna present at and near the Brown Passage disposal site. An assessment of marine effects for the Fairview Phase II Project indicated that some fisheries overlap occurred with Brown Passage although it indicated that effort/catch was lower for the disposal site when compared to adjacent areas. The Fairview report indicated that several important species were likely present including Dungeness crab, tanner crab, *Pandalus* shrimp and other demersal fish (Stantec 2009). In 2011, Environment Canada (EC) conducted a subtidal survey of two transect lines within the disposal site. The EC survey indicated the area consisted of soft bottom substrates with no rocky outcrops suitable for glass sponges, cold water corals, rockfish or other species of conservation concern. A literature review was conducted to collect any other publicly available information regarding species or habitats present within Brown Passage. These results further indicate the area was composed of predominantly soft sediments with some species use by salmon for migration, the potential for moderate abundance of herring, eulachon, dogfish, various flatfish species and *Pandalus* shrimp. There was low potential for pacific cod, blackcod, rockfish, sand lance, surf smelt, crab species and most bivalves due to insufficient habitat characteristics and the deep depth (Stantec 2014b). The closest observation of habitat-forming reef sponges was 8,971 m northeast the disposal site (PRGT 2014).

3.0 FIELD STUDIES

3.1 METHODS

Four study areas were defined based on the depth of sediment deposition expected from the predicted cumulative deposition (from disposal of both MOF and LNG carrier berth area sediments). Study area 1 (SA-1) was defined as the area predicted to accumulate a total sediment deposition of more than 2 cm. The deposition depth of 2 cm was selected based on the expected presence of spot prawns in the area, and their predicted sensitivity to sediment

depositions greater than 2 cm (Nicholls 2009). This area (SA-1) was bounded by what was termed the 'deposition contour of ecological significance' (Figure 2). Study area 2 (SA-2) encompassed the area predicted to accumulate between 1 and 2 cm of sediment deposition, while study area 3 (SA-3) was predicted to accumulate less than 1 cm of sediment deposition. The area outside the cumulative deposition area was deemed study area 4 (SA-4), and was included in the survey area to provide additional information on habitats and species present in the greater Brown Passage area that were not expected to be affected by operations at the disposal site. The design mitigation to eliminate dredging at the LNG carrier berth area and subsequent disposal of 7,000,000 m^3 of sediment at the disposal site greatly reduced the expected sediment dispersal resulting from disposal operations at the Brown Passage disposal site. When comparing the sediment dispersion modelling results for disposal of just material dredged from the MOF to the cumulative sediment deposition areas used to design this subtidal survey, SA-1 and SA-2 are the only areas surveyed that are expected to accumulate any measurable depth of sediment deposition (Figure 3). This assumption is also conservative, since sediment dispersion of material dredged from the MOF was modelled for a sediment volume of 615,000 m^3; dredging and disposal of sediments from the MOF is now expected to consist of less than 200,000 m^3 of material.

A total of 12 transects were included in the study design, with three subtidal transects included in each study area (Figure 3). Each transect was composed of three segments arranged in a triangle, with the ends of two segments overlapping (Figure 3, inset). The survey depth for all transects was between 150 and 200 m chart datum (CD). A complete list of transect start and end points, as well as transect lengths are provided in Appendix A-1.

The ROV and its handling were customized to obtain the most informative footage possible. Typical flight speed was 0.3 m/s and the ROV was generally less than 0.5 m above the seabed due to poor visibility throughout the area. Each video frame was stamped with a GPS position (latitude/longitude), date and time. Five high intensity and three variable intensity white light-emitting diode (LED) lights were mounted on the ROV frame to provide illumination. Two cameras, a fixed wide angle and one close-up zoom, were used to film the seafloor and organisms encountered. The ROV was fitted with parallel scaling lasers mounted 20 cm apart to allow for accurate size estimation of organisms and objects when reviewing video footage.

Video footage from each transect was reviewed following the completion of surveys and species and habitat types were determined and recorded by trained biologists. Specifically, the substrate type, as well as species of flora and fauna observed, was recorded for all transect video. Transect lines plotted in figures reflect a line of best fit for the GPS tracking data from each transect. Based on video observations, the density of species observed was calculated per 100 m. In cases where individuals could not effectively be counted, percent cover of the species was estimated.

Substrate types were categorized as:

- Soft bottom
- Soft bottom with woody debris
- Soft bottom with shell
- Mixed bottom
- Mixed bottom with woody debris
- Hard bottom
- Hard bottom with woody debris
- Woody debris
- Anthropogenic.

The subtidal survey was carried out by Ocean Dynamics Inc. and Stantec from July 26 to 31, 2014, using a Seaeye Falcon ROV (Photos 1 and 2). All data collected from video footage was mapped using geographic information system (GIS) software.

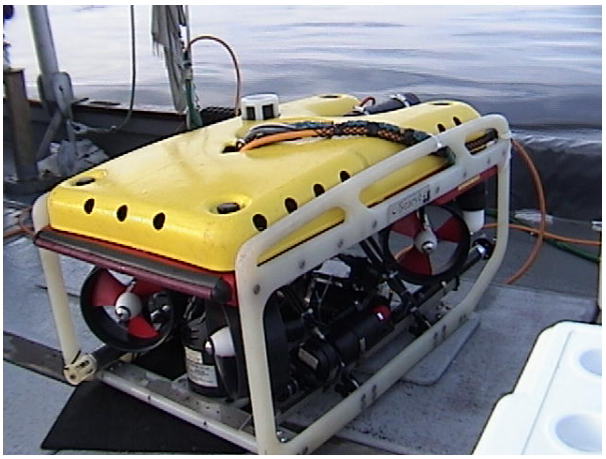

Photo 1 Seaeye Falcon ROV on the Boat

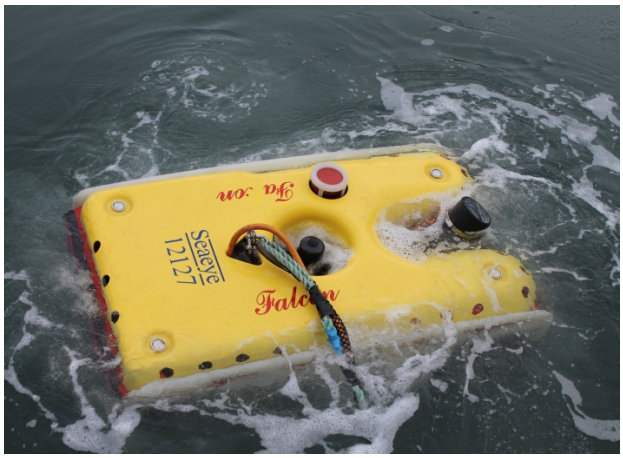

Photo 2 Seaeye Falcon ROV Surfacing

3.2 RESULTS

Substrate type, flora and fauna results are outlined for each of the four study areas. Three transects were flown in each study area: SA-1 includes T01 to T03, SA-2 includes T04 to T06, SA-3 includes T07 to T09 and SA-4 includes T10 to T12. A total of 53.3 km of transect length were surveyed; approximately 11.1 km of transect length covered areas within the disposal site (most of transects T01, T02, and T03), while 42.2 km of transect fell outside of this 1 nm area.

The results are subdivided into sections describing substrate, flora, and fauna. No flora species were observed along any transects within SA-1, SA-2 or SA-3; transects in these areas were at substantial depth with little to no light penetration. Table 3-1 describes all species observed during the subtidal survey that are listed under the Species At Risk Act or with the Committee on Endangered Wildlife in Canada, as well as habitat forming species of cultural and ecological

importance. In addition, a complete list of species observed, with corresponding count and density data, is provided in Appendix B-2. Observations of species at risk, in addition to habitat-forming species of cultural or ecological importance are summarized in Table 3-1.

Table 3-1 Observations of Species at Risk and Habitat-forming Species by Study Area

Study Area	Species At Risk Observed in this Study Area	Habitat-forming Species of Cultural or Ecological Importance[1]
SA-1	None observed	Cloud Sponge (*Aphrocallistes vastus*) Sharp-lipped Boot Sponge (*Rhabdocalyptus dawsoni*)
SA-2	Canary Rockfish (*Sebastes pinniger*)[3] Quillback Rockfish (*Sebastes maliger*)[3] Eulachon (*Thaleichthys pacificus*)[4]	Cloud Sponge (*Aphrocallistes vastus*)
SA-3	Canary Rockfish (*Sebastes pinniger*)[3] Quillback Rockfish (*Sebastes maliger*)[3]	Cloud Sponge (*Aphrocallistes vastus*)
SA-4	Quillback Rockfish (*Sebastes maliger*)[3] Yelloweye Rockfish (*Sebastes ruberrimus*)[2,4]	Cloud Sponge (*Aphrocallistes vastus*) Sharp-lipped Boot Sponge (*Rhabdocalyptus dawsoni*) Sugar Kelp (*Laminaria saccharina*)

Notes:
[1] Species noted here are consistent with those used as indicators in the EIS, and includes habitat-forming species and those of cultural or ecological importance.
[2] "Schedule 1" status assigned under the Species at Risk Act (SARA)
[3] "Threatened" status assigned by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
[4] "Special Concern" status assigned by the COSEWIC

3.2.1 Study Area 1

3.2.1.1 Substrate

Two substrate types were observed in SA-1: soft bottom and soft bottom with shell (Figure 4 and Figure 5). Soft bottom was the most abundant substrate observed along all three transects. Soft bottom with shell was limited to small regions of T03. Very limited amounts of boulder and cobble were present. Depths were relatively deep, ranging from 137 to 288 m.

3.2.1.2 Fauna

3.2.1.2.1 Fish

Fourteen species of fish from six families were observed in SA-1 (Figure 6 and Figure 7). Ratfish (*Hydrolagus colliei*) were the most common fish species observed in the area, with an average density of 4.24 individuals per 100 m. Ratfish were seen along all three transects, usually swimming a few meters above the sea floor.

Halibut (*Hippoglossus stenolepsis*), rock sole (*Lepidopsetta bilineata*), rex sole (*Glyptocephalus zacharius*), Dover sole (*Microstomus pacificus*), and English sole (*Parophyrus vetulus*) were among the species of right-eye flounders (*Pleuronectidae*) observed in SA-1. Rock sole and halibut were the most frequently observed species and were found along all three transects in relatively low densities.

Three species of cod (*Gadidae*) were observed in low numbers along all three transects. Pacific cod (*Gadus macrocephalus*) and Pacific tomcod (*Microgadus proximus*) were observed in two out of the three transects, and walleye pollock (*Microgadus proximus*) was observed in one transect. Other species observed in relatively low abundance included leister sculpin (*Enophrys lucasi*) and longnose skate (*Raja rhina*).

One tiger rockfish (*Sebastes nigrocintus*) and one silvergray rockfish (*Sebastes brevispinis*) were observed in SA-1, swimming over areas of soft substrate.

3.2.1.2.2 Crabs and Shrimp

Pandalus shrimp (*Pandalidae*) were the most common species from the phylum Arthropoda observed in SA-1, with an average density of 3.4 individuals per 100 m. Pacific prawn (*Pandalus platyceros*) was the only prawn species that could be effectively identified. Two brown box crabs (*Lipholithodes formaminatus*), four hermit crabs (*Pagarus* spp) and one unidentified crab were also observed Figure 8 and Figure 9).

3.2.1.2.3 Other Invertebrates

Invertebrate fauna from six phyla were observed along all transects of SA-1(Figure 10 and Figure 11). Of these phyla, Echinodermata was the most diverse, with a total of 22 species of sea star, 3 species of urchin, and 2 species of sea cucumber observed within this area. Brittle stars (*Opiura sarsii*) were the most abundant of the Echinoderms, densely covering the seafloor of transects T01 and T03. Due to their abundance and small size, enumerating individual brittle stars was not feasible and they were classified as 'abundant'. Vermillion stars (*Mediaster aequalis*) and blood stars (*Henricia leviuscula*) were relatively common, with average densities of 1.0 and 1.1 individuals per 100 m along T01 and T03, respectively. All other Echinodermata species observed had average densities of less than1 individual per 100 m.

Several Mollusca, Cnidaria and Tunicata species were found throughout SA-1. Although relatively common in the area, with an average density of 2.0 individuals per 100 m, *Pectinidae* scallops were primarily found in T01 and T03. Other Mollusca observed included nudibranchs (*Nudibranchia*), octopuses (*Octopodidae*), and whelks (*Neptunea* spp). Hydroids (*Sertulariidae*) were common throughout the soft bottom substrate of T01 and T03. Of the Cnidaria species, sea whips (*Hapipteris willemoesi*) were most abundant, with an average density of 2.2 individuals per 100 m relatively evenly distributed among the three transects. Crimson anemones, the most common of the five anemones observed, were noted at densities of 0.9 individuals per 100 m. Hydrocorals, hydroids, and jellies were observed throughout the area in low numbers. Sea vases (*Ciona savignyi*) were relatively common in T01 and T03, with an average density of 3.7 individuals per 100 m across the two transects. Feather-duster *Sebellidae* tubeworms were the

most common of the Annelida species, and were especially frequent in T01, with a density of 10.3 individuals per 100 m compared to an overall average density of 4.3 individuals per 100 m for all transects in SA-1. These tubeworms were most frequently found on soft bottom substrate throughout the entire depth range of the area. By contrast, calcareous *Serpulidae* tubeworms were observed less frequently, on the limited rocky substrates found in SA-1.

Individual developing cloud sponges (*Anthrocallistes vastus*) were observed along all three transects within SA-1. Larger, more defined cloud sponge structures, present as single, non-reefing individuals, were observed at an average density of 12.1 individuals per 100 m, across all depths on primarily soft bottom and soft bottom with shell substrates. Other siliceous sponges (*Hexactinellida*), including sharp-lipped boot sponge (*Rhabdocalyptus dawsoni*), and demosponges, including spiny tennis ball sponge (*Craniella spinosa*), tough yellow branching sponge (*Syringella amphispicula*), rough scallop sponge (*Myxilla increstans*), and encrusting sponges were also observed in low abundance (Figure 12 and Figure 13).

3.2.2 Study Area 2

3.2.2.1 Substrate

Transects T04, T05, and T06 of SA-2 were comprised almost entirely of soft bottom substrate, with exception of a few areas of hard bottom substrate in T04 (Figure 4 and Figure 5). Anthropogenic cables were observed at the east side of T06. Depths ranged from 96 to 202 m.

3.2.2.2 Fauna

3.2.2.2.1 Fish

Study area 2 was the most diverse area for fish assessed during the subtidal survey, comprising 21 species from 10 families (Figure 6 and Figure 7). Ratfish were the most abundant fish species observed in SA-2, with an average density of 3.9 individuals per 100 m. Halibut was more abundant in SA-2 than the other study areas, but still had a relatively low density of less than1 individual per 100 m. Other right-eyed flatfish, including rock sole, English sole, and slender sole were also observed in low densities.

The only observation of eulachon (*Thaleichthys pacificus*) throughout the subtidal survey was in T06 of SA-2. On one occasion, a school of approximately 20 eulachon was observed, with two additional observations of individual eulachon along T06. Other bottom-dwelling fish were observed in low densities (less than 1 individual per 100 m) including skates (*Rajidae*), eelpouts (*Zoarcidae*), pricklebacks (*Stichaeidae*), spinyhead sculpin (*Dsycottus setiger*), at least three species of cod (*Gadidae*), and juvenile snailfish (*Scorpaeniform*). Five species of rockfish were observed in SA-2 in areas of hard substrate and rocky outcrops, including quillback rockfish (*Sebastes maliger*), canary rockfish (*Sebastes pinniger*), copper rockfish (*Sebastes caurinus*), and greenstriped rockfish (*Sebastes elongastus*).

3.2.2.2.2 Crabs and Shrimp

Pandalus shrimp were the dominant Arthropoda species in the SA-2, with an average density of 11.1 individuals per 100 m. *Pandalus* shrimp were found along all three transects on soft bottom substrates over the entire depth range of the area. The Pacific prawn was the only species that could be effectively identified. Crab species observed included hermit crabs and two unidentified crabs (Figure 8 and Figure 9).

3.2.2.2.3 Other Invertebrates

Six phyla of invertebrates (other than crab and shrimp) were observed in SA-2 (Figure 10 and Figure 11). Those from the family Echinodermata were most diverse, with 19 sea star species, 1 urchin species, 1 sea cucumber species, and feather stars observed. Brittle stars were abundant on the seafloor along T04, but were not present in the other transects. Giant California sea cucumbers (*Parastichopus californicus*) were relatively abundant in T04, with 5.3 individuals per 100 m, but were not observed along the other transects. Vermillion stars were relatively common, with an average of one individual per 100 m. All other species were seen at frequencies of less than1 individual per 100 m. Annelida worms, calcareous *Serpulidae* and feather duster *Sabellidae* tubeworms were also observed in small numbers.

In total, 12 species from Cnidaria, Mollusca, and Tunicata were observed throughout the area. Of the Cnidarians, sea whips were the most abundant, with an average density of 18.0 individuals per 100 m, the highest abundance observed in any of the subtidal survey areas. Sea whips were observed on soft substrate throughout the entire depth range. Pink gorgonians (*Calcigorgia sciculifera*) were observed on the mixed and hard bottom substrate of T04 at 6.1 percent cover per 100 m, but were not seen anywhere else in the area. Giant plumose anemones (*Metridium farcimen*) were relatively common in T04 as well, with a density of 4.5 individuals per 100 m. Crimson anemones (*Cribrinopsis fernaldi*), cross jellyfish (*Earleria cellularia*), moon jellyfish (*Aurelia labiata*), hydroids and orange sea pens (*Ptilosarcus gurneyi*) were observed in low numbers throughout SA-2. Of the Mollusca species, *Pectinidae* scallops were observed most frequently, primarily in T04, at a density of 3.7 scallops per 100 m. Octopuses, (including giant Pacific octopus, *Enteroctopus dofleini*), stubby squid (*Rossia pacifica*), and nudibranchs were also observed. Sea vases were observed in T04 only, with 4.2 individuals per 100 m, and were the only Tunicata species present.

The highest abundance of cloud sponge observed within the subtidal survey area was in T04 of SA-2, with a density of 25.0 percent cover per 100 m. Both developing cloud sponge aggregations and developed individuals were seen. Within SA-2, all sponge species observations (aside from cloud sponges) were restricted to T04. These included siliceous sharp-lipped boot sponge, and several species of demosponge including tough yellow branching sponge, and encrusting sponge. In areas of hard bottom substrate (boulder and cobble), encrusting sponge was observed in densities of 2.3 percent cover per 100 m (Figure 8 and Figure 9).

3.2.3 Study Area 3

3.2.3.1 Substrate

Transects T07, T-08 and T09 of SA-3 were comprised primarily of soft bottom substrate with small areas of hard bottom, mixed bottom and soft bottom with shell substrates (Figure 4 and Figure 5). Depths ranged from 89 to 225 m. An unknown anthropogenic object was observed in T09.

3.2.3.2 Fauna

3.2.3.2.1 Fish

In SA-3, 18 fish species from 9 families were observed, with pricklebacks being the most abundant (Figure 6 and Figure 7). Although pricklebacks were seen in both T07 and T08, their abundance was much higher in T07, with an average density of 15.6 individuals per 100 m throughout the 89 to 128 m depth range. Some individuals could be effectively identified as snake pricklebacks, but not all pricklebacks could be identified down to a species level.

Yellowtail rockfish (*Sebastes flavidus*) were observed in relatively high numbers, with a density of 2.6 individuals per 100 m along T07. Yellowtail rockfish were generally observed in schools, with some single individuals swimming nearby. Two schools were observed in T07, with estimated sizes of 17 and 50 individuals. Most yellowtail rockfish were observed along T07, either on areas of hard or mixed bottom substrate or in areas of rocky outcrop. At least five other species of rockfish were observed in the area, including canary rockfish, greenstriped rockfish, quillback rockfish, and silvergrey rockfish, which were observed in low numbers along T07 and T08. No rockfish were observed in T09, an area primarily composed of soft bottom substrate.

Right-eye flounders were represented by at least four species observed across all three transects in relatively low numbers, with halibut and rock sole being the most common. Ratfish, skates, eelpouts (*Zoarcidae*), sculpins (*Cottidae*), lingcod (*Ophiodon elongastus*), along with at least three species of cod were observed in low numbers throughout the area.

3.2.3.2.2 Crabs and Shrimp

Four species of the family Arthropoda were observed in SA-3; more than at any other area of the subtidal survey area (Figure 8 and Figure 9). *Pandalus* shrimp were the most abundant organism in SA-3, with an average density of 59.7 individuals per 100 m; the highest density of any organism observed in any of the subtidal survey areas. *Pandalas* shrimp were observed in all three transects, but most frequently in T07, with a density of 123.2 individuals per 100 m. *Pandalas* shrimp were mostly commonly observed on soft bottom substrate and throughout the entire depth range of the area. Tanner crabs (*Chionoecetes bairdi*) squat lobsters (*Munida quadrispina*), and hermit crabs were observed in low numbers

3.2.3.2.3 Other Invertebrates

Several other species of invertebrates were observed throughout the SA-3 (Figure 10 and Figure 11). Phylum Echinodermata was most diverse, with ten species of sea star, one species of sea cucumber, three species of urchin, feather stars and hydroids observed. All Echinodermata

species were found in densities of less than1 individual per 100 m. Mollusca were observed in low numbers, and included nudibranchs, octopuses and scallops. A single sea vase and low numbers of *Serpulidae* tubeworms were also observed.

Both the number of species and density of sponges observed were lower in SA-3 than any other study area (Figure 12 and Figure 13). Cloud sponges were observed in T07 and T08 only, with an average density of 2.5 percent cover per 100 m between the two transects. Encrusting sponge was the only other sponge species observed, present on areas of cobble substrate.

3.2.4 Study Area 4

3.2.4.1 Substrate

The most variability in substrate types was observed in SA-4 than in any of the other surveyed areas (Figure 4 and Figure 5). Transects (T10, T11, and T12) were located on the outermost edges of the survey area with the greatest distance between individual transects. Transect T10 was primarily composed of soft bottom and soft bottom with shell substrate. In contrast, T11 was composed of mixed bottom and soft bottom substrate, while T12 was primarily soft bottom. Depth was also variable between the three transects, ranging from 18 to 172 m. Transect T11 was the shallowest transect of the survey, with depths ranging from 18 to 38 m, allowing the growth of the only flora species observed throughout the subtidal survey. An unidentified anthropogenic item was also detected in T11.

3.2.4.2 Flora

As the majority of the subtidal survey depths were generally below 100 m, floral growth was limited to the shallow depths surveyed along T11 between the depths of 18 and 38 m.

Red algae was the most dominant algal group observed. Crustose corraline algae was the most abundant species, covering up to 80 percent of the rocky substrate in T11. These species encrusted the gravel, cobble and boulder that comprised the mixed bottom substrate of T11. Brown algae, including *Laminaria* species and unidentified kelp species, were common along the transect, growing on both mixed and soft bottom substrate. Bladed red algae (*Rhodophyta*) were also commonly observed along T11, growing on similar substrates but in lower abundance than brown algae.

3.2.4.3 Fauna

3.2.4.3.1 Fish

Seventeen species from nine fish families were observed in SA-4 (Figure 6 and Figure 7). As in the other study areas, ratfish was the most abundant fish species observed; however, the average density of 7.1 individuals per 100 m observed in SA-4 was higher than in any of the three other study areas. Ratfish were rarely seen in T11, which was shallower than the other transect sites. Skates, eelpouts, right-eye flounders (including halibut and rock sole), kelp greenling (*Hexagrammos decagrammus*), cod, pricklebacks and sculpins were observed throughout the area in low numbers.

Four species of rockfish, including quillback rockfish, tiger rockfish, yelloweye rockfish and yellowtail rockfish were observed, primarily throughout the rockier areas of T10 and T11.

3.2.4.3.2 Crabs and Shrimp

Few species of crab and shrimp were observed in the SA-4 (Figure 8 and Figure 9). *Pandalus* shrimp were observed in the soft bottom areas of T12, at depths between 152 and 169 m, with a density of 16.8 individuals per 100 m. Hermit crabs and a single red rock crab (*Cancer productus*) were also observed, in addition to two unidentified crabs.

3.2.4.3.3 Other Invertebrates

Of the remaining six phyla of invertebrates observed, scallops were the most abundant in the area (Figures 7-1 and 7-2). However, the highest numbers were observed throughout the soft bottom with shell and soft bottom substrates of transect T10. At a density of 57.8 individuals per 100 m, scallop densities were higher at T10 than in any other transect surveyed. Other Mollusca species observed included octopuses, nudibranch and whelk.

Much like the other three study areas, the phylum Echinodermata was the most diverse of the invertebrate phyla, with 20 sea star species, 1 sea cucumber species, 4 urchin species and feather stars observed in SA-4. Of the sea stars, vermillion stars were relatively common, with an average density of 3.1 individuals per 100 m. Rainbow stars (*Orthasterias koehleri*) were observed throughout the area, with an average density of 1.4 individuals per 100 m. Giant California sea cucumbers were also common in T10 and T11, with densities of 3.1 and 8.3 individuals per 100 m, respectively. No sea cucumbers were observed in T12. Sea vases were the only tunicates observed, with a density of 8.6 individuals per 100 m in T10, and lower densities along the other transects within SA-4. Five species of the phylum Cnidaria were observed in the area; giant plumose anemones were the most common, with an average density of 1.2 individuals per 100 m. Hydroids were common at T11 while other anemones and jellies were observed in low numbers. A small number of *Serpulidae* tubeworms were the only annelid worms observed in the area.

Cloud sponges were observed in SA-4, primarily in T10, which had a density of 9.0 percent cover per 100 m (Figures 8-1 and 8-2). Sharp lipped boot sponge, tough yellow branching sponge and vase sponge (*Polymastia pachymastia*) were other sponge species observed in low numbers. Encrusting sponge was observed on areas of mixed bottom.

3.3 DISCUSSION

Results from this subtidal survey are generally consistent with predictions made in the EIS regarding species and habitats likely to be present at and near the disposal site, based on the data obtained from the Fairview Phase II Project and the previous EC subtidal survey. The Brown Passage disposal site, encompassed by SA-1, consisted primarily of soft bottom substrate at depths ranging from 137 to 228 m.

The disposal site area, as well as all other surveyed areas, supported cloud sponges, which are known to be vulnerable to disturbances, including sedimentation (Conway et al. 2001; Jamieson and Chew 2002). Cloud sponges in these areas were in the developing and developed stages of growth and were sometimes found in aggregations; however, none were in habitat-forming reef formations.

Several species of rockfish, listed as either "Special Concern" or "Threatened" by SARA were observed in SA-2 and SA-3 (no listed rockfish were observed in SA-1). However, rockfish are highly mobile organisms and are likely to avoid the area during the disposal event and return once the disturbance is completed. The same is predicted for eulachon observed in the survey area. Other species of value to commercial, recreational and Aboriginal fisheries observed in SA-1 included *Pandalus* shrimp, scallops and halibut. No Dungeness crab were observed in any surveyed transects. Most species observed at and near the disposal site were mobile species, able to move away from the site during disposal events and likely avoid effects from sediment deposition.

4.0 CLOSURE

This supplemental data report has been prepared for PNW LNG to describe baseline conditions of marine resources within the project area, specifically at and near the previously-used disposal site in Brown Passage. Subtidal surveys, conducted in July 2014, provided further information regarding species use and substrate types present at and near this disposal site.

5.0 REFERENCES

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Nicholls, P., Norkko, A., Ellis, J., Hewitt, J., and D. Bull. 2009. Short Term Behavioral Responses of Selected Benthic Invertebrates Inhabiting Muddy Habitats to Burial by Terrestrial Clay. Prepared by NIWA for Auckland Regional Council. Auckland Regional Council Technical Report 2009/116.

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Stantec Consulting Ltd. [Stantec]. 2014a. Follow-Up Report on Sediment and Water Quality Associated with Construction of the Terminal Berth Area, Section 13 - Marine Resources. Prepared for Pacific NorthWest LNG Limited Partnership. Prepared by Stantec Consulting Ltd. June 23, 2014.

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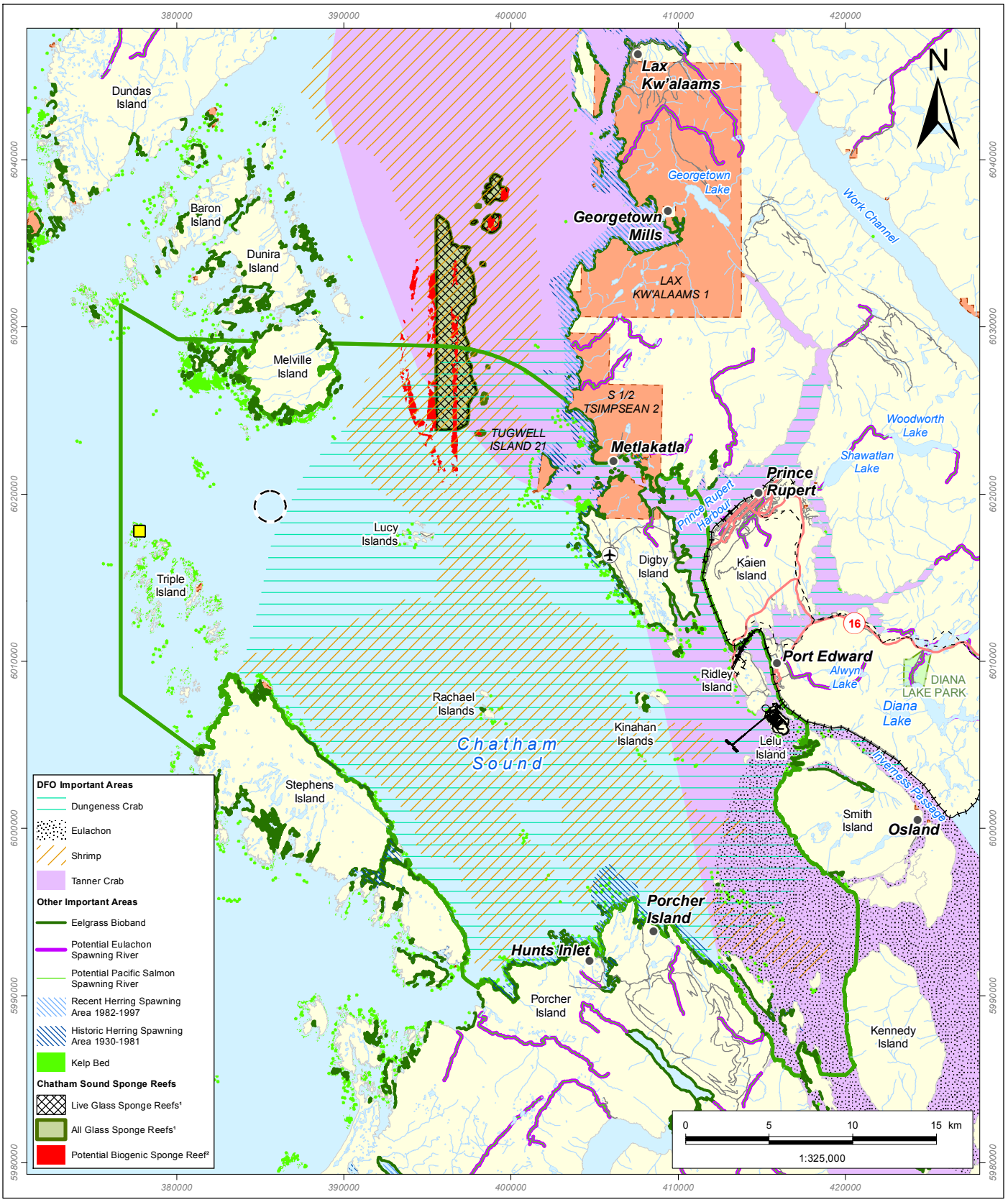
6.0 FIGURES



Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Marine Terminal Design Mitigation
Railway
Secondary Road
Watercourse
Brown Passage Disposal Site
Indian Reserve
Local and Regional Assessment Area
Protected Area
Waterbody

Notes:
1. Approximate extent of glass sponge reefs within Chatham Sound as determined by geophysical survey and subsequent ROV inspection completed for the proposed Westcoast Connector Gas Transmission Project (Archipelago Marine Research Ltd. 2014)
2. Potential biogenic sponge reef, delineated during benthic habitat mapping completed for the proposed Prince Rupert Gas Transmission Project (PRGT) by McGregor GeoScience Limited on behalf of Stantec (PRGT 2014).

Pacific NorthWest LNG

PNW LNG Project Areas and Brown Passage Disposal Site Location

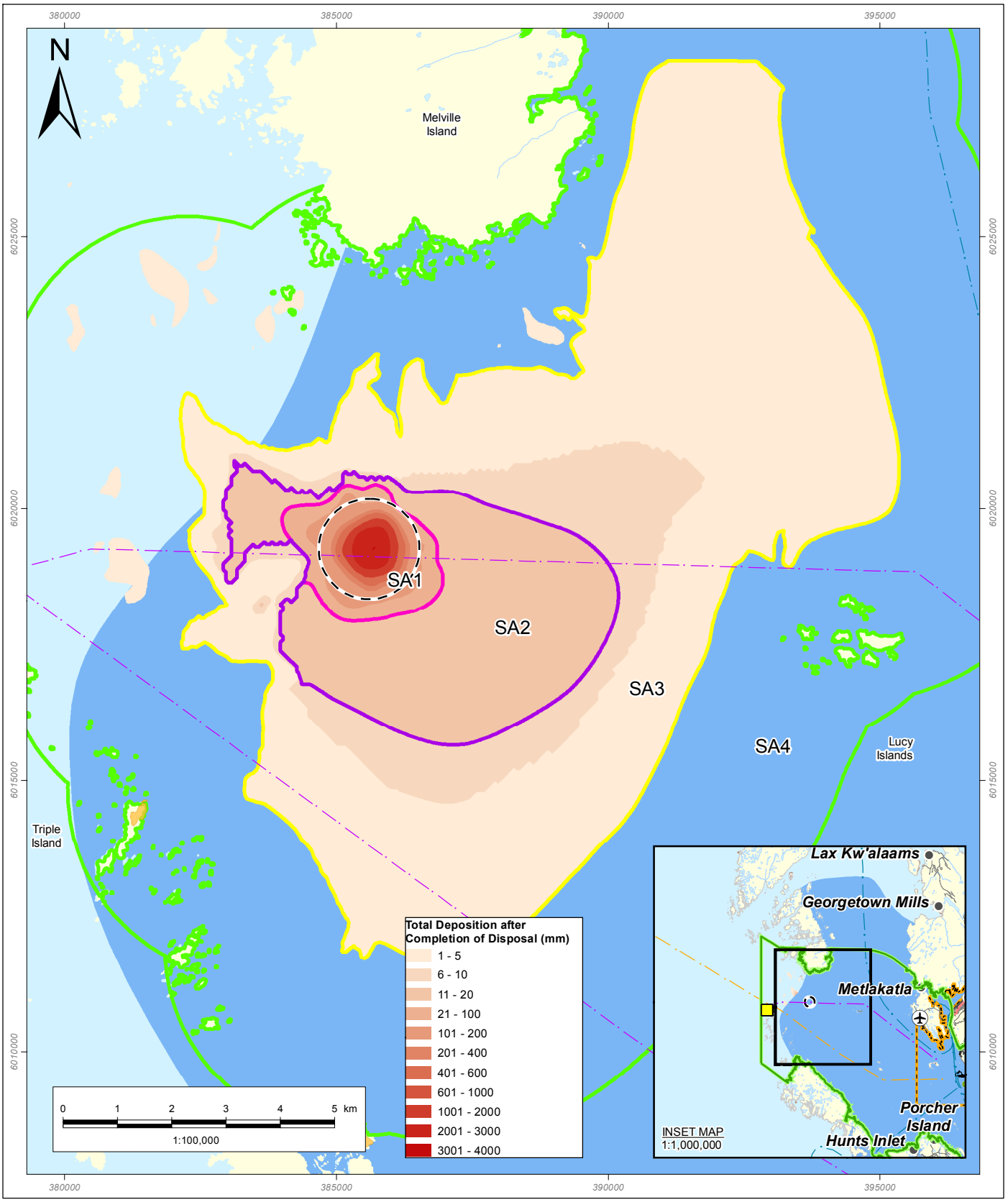
Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information. Refer to Appendix 9 of the EIS/Application Appendix M for full citations. Archipelago Marine Research Ltd. 2014. Westcoast Connector Gas Transmission Project: Marine Environmental Technical Data Report (Appendix 2-F). April 2014. Prince Rupert Gas Transmission Project. 2014. Application for an Environmental Assessment Certificate, Appendix L: Marine Resources (prepared for TransCanada). May 2014. Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 23-OCT-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-830	DATUM: NAD 83
DRAWN BY: M. BATE	CHECKED BY: M. BREWIS

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: 1



Brown Passage Disposal Site
Potential Shipping Route
Ferry Route
River or Stream
Indian Reserve
Water Body
Skeena Estuary

Study Area Boundary
SA-1
SA-2
SA-3
SA-4

*Bottom sediment accumulation for the MOF was modelled as 615,000m³

Pacific NorthWest LNG

Predicted Cumulative Sediment Deposition Used to Select the Study Areas for the Brown Passage Subtidal Survey

Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. Skeena Estuary data provided by ESSA Technologies Ltd (2013).

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 23-OCT-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-723	DATUM: NAD 83
DRAWN BY: M. BATE	CHECKED BY: L. DU GAS

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **2**

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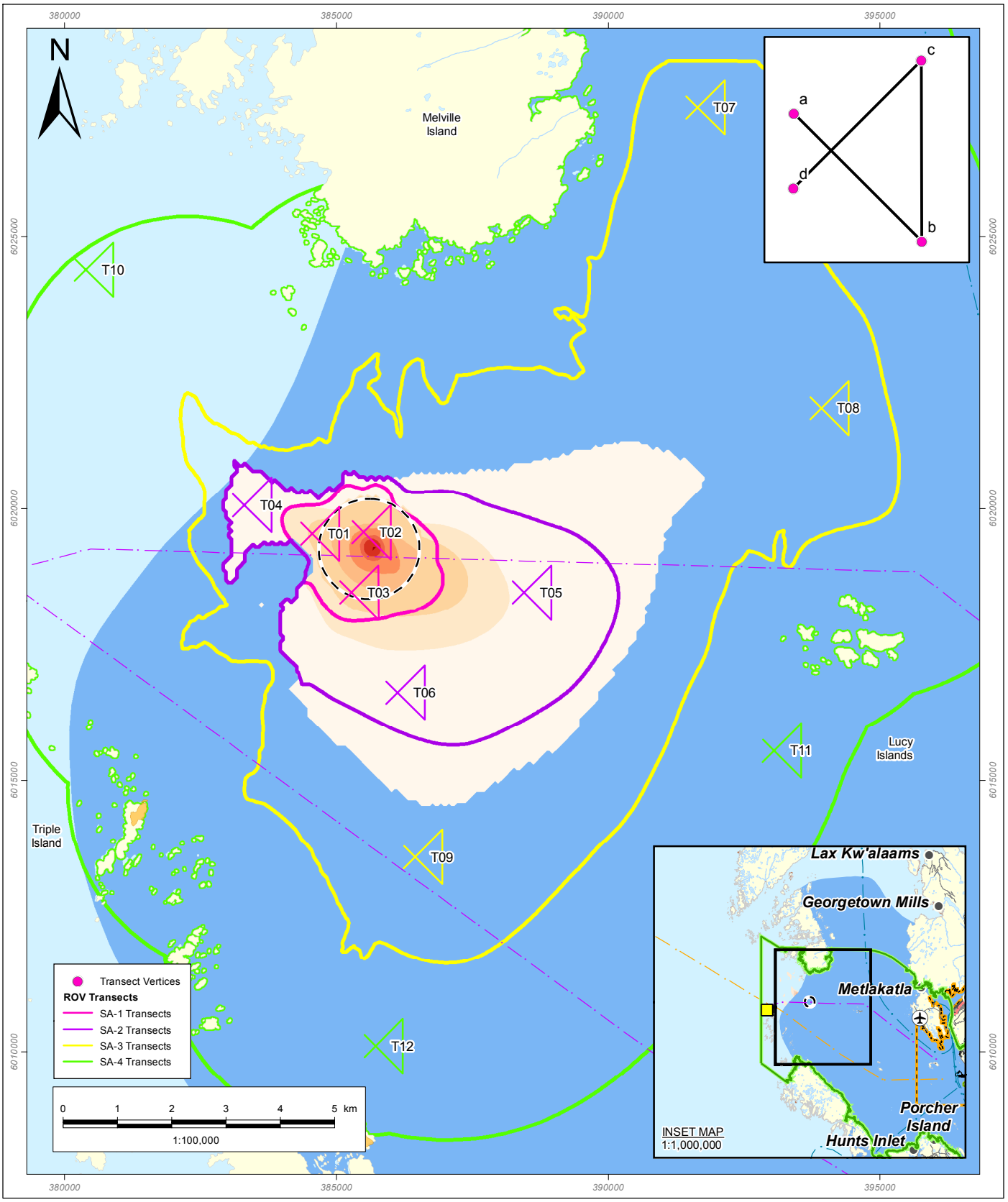

Brown Passage Disposal Site
Potential Shipping Route
Ferry Route
River or Stream
Indian Reserve
Water Body
Skeena Estuary

Total Deposition after Completion of Disposal (mm)

1
5
10
50
100
500
1,000
2,000

*Bottom sediment accumulation for the MOF was modelled as 615,000m³

Study Area Boundary

SA-1
SA-2
SA-3
SA-4

Pacific NorthWest LNG

Study Areas and Transect Locations for the Brown Passage Subtidal Survey, Overlaid with Predicted MOF Sediment Deposition

Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. Skeena Estuary data provided by ESSA Technologies Ltd (2013).

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 23-OCT-14
FIGURE ID: 123110537-723
DRAWN BY: M. BATE

PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: L. DU GAS

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **3**

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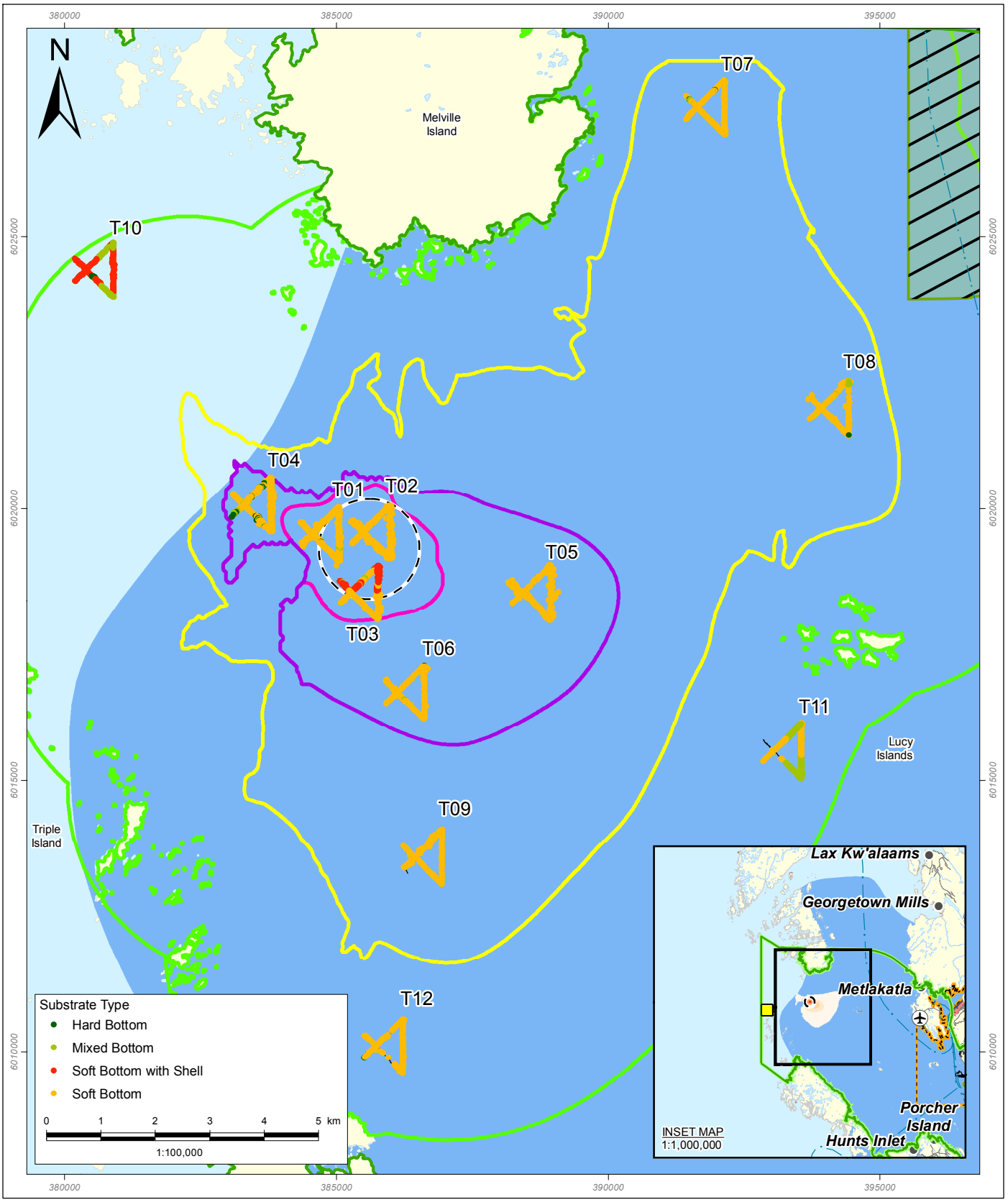

Airport
City or Town
Pilotage Station
Ferry Route
ROV Transect Locations
All Glass Sponge Reefs
Brown Passage Disposal Site
Live Glass Sponge Reefs
Local and Regional Assessment Area
Prince Rupert Port Authority Boundary
Water Body
Skeena Estuary

Study Area Boundary
SA-1
SA-2
SA-3
SA-4

Note: Bottom sediment accumulation for the MOF was modelled as 615,000m3.

Pacific NorthWest LNG

Substrate
Brown Passage

Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. Skeena Estuary data provided by ESSA Technologies Ltd (2013).

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 23-OCT-14
FIGURE ID: 123110537-822
DRAWN BY: M. BATE
PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: L. DU GAS

PREPARED BY: Stantec
PREPARED FOR: Pacific NorthWest LNG
FIGURE NO: 4

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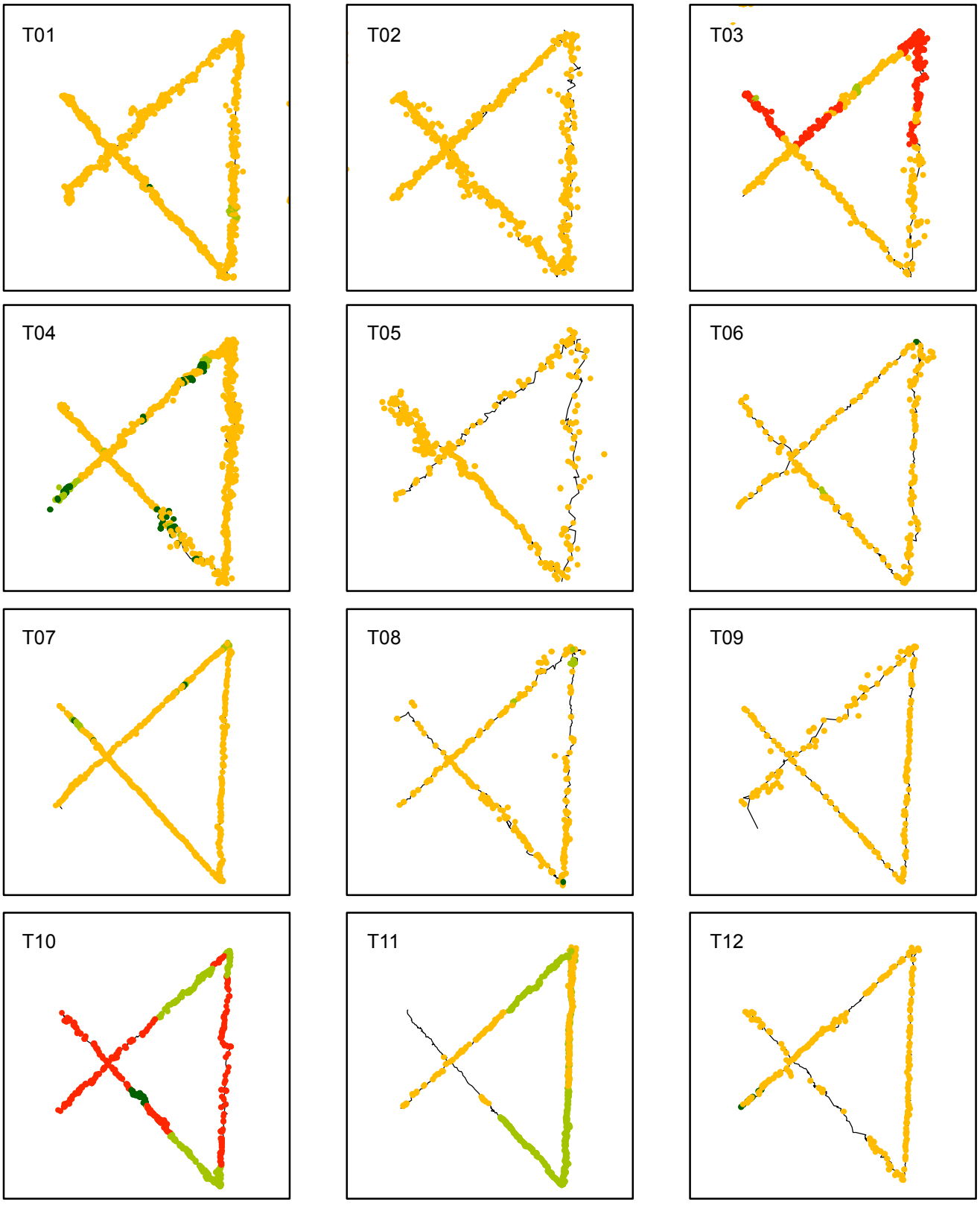

ROV Transect Locations

Substrate Type

- Hard Bottom
- Mixed Bottom
- Soft Bottom with Shell
- Soft Bottom

Note:
Bottom sediment accumulation for the MOF was modelled as 615,000m3.

N

0 250 500 m

1:23,000

Pacific NorthWest LNG

Substrate
Brown Passage

Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. Skeena Estuary data provided by ESSA Technologies Ltd (2013).

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 23-OCT-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-822	DATUM: NAD 83
DRAWN BY: K. JAMES	CHECKED BY: L. DU GAS

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **5**

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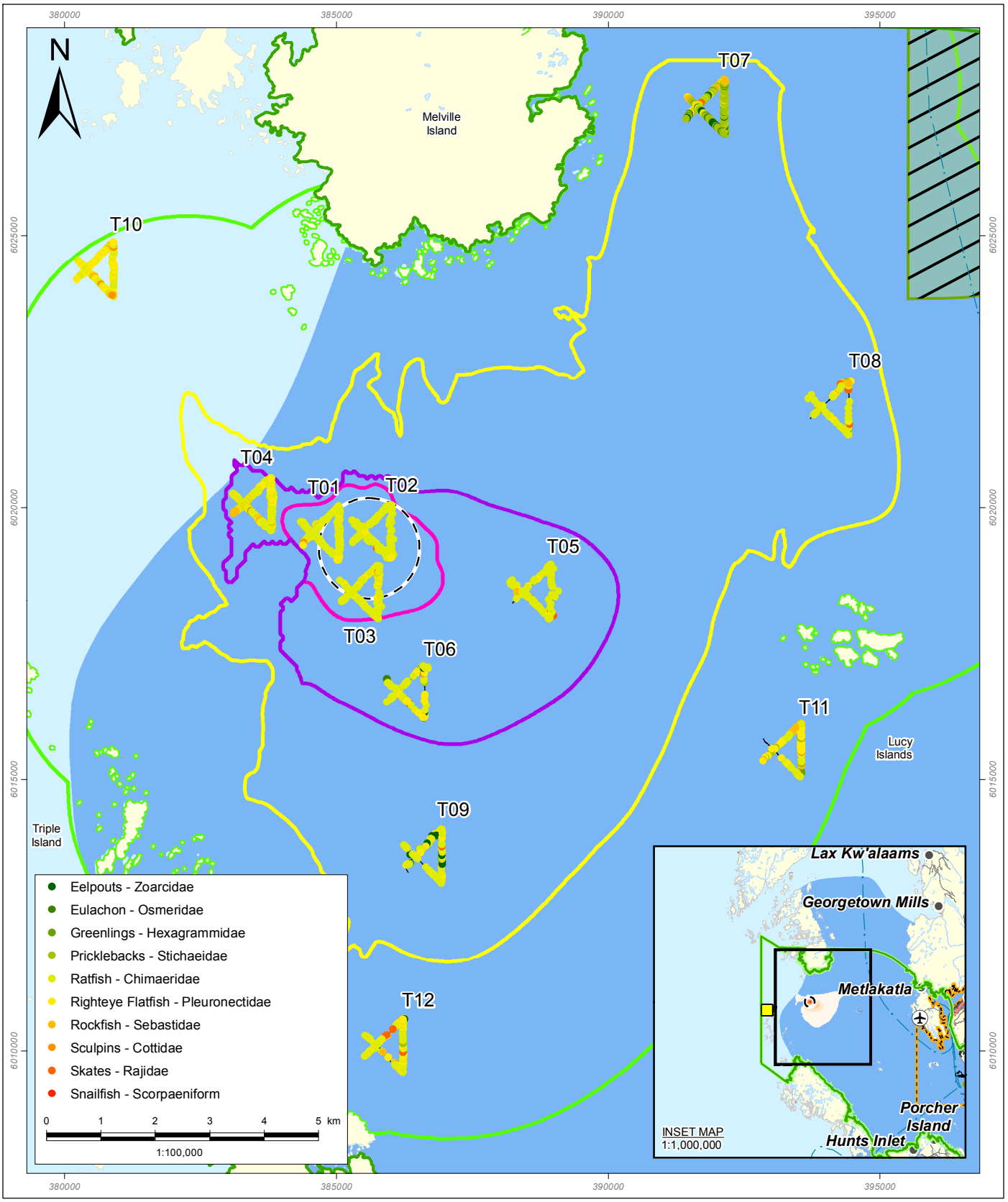

Airport
City or Town
Pilotage Station
Ferry Route
ROV Transect Locations
All Glass Sponge Reefs
Brown Passage Disposal Site
Live Glass Sponge Reefs
Local and Regional Assessment Area
Prince Rupert Port Authority Boundary
Skeena Estuary
Water Body

Study Area Boundary
SA-1
SA-2
SA-3
SA-4

Note: Bottom sediment accumulation for the MOF was modelled as 615,000m3.

Pacific NorthWest LNG

Fish Family Distribution
Brown Passage

Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. Skeena Estuary data provided by ESSA Technologies Ltd (2013).

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 23-OCT-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-822	DATUM: NAD 83
DRAWN BY: M. BATE	CHECKED BY: L. DU GAS

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: 6

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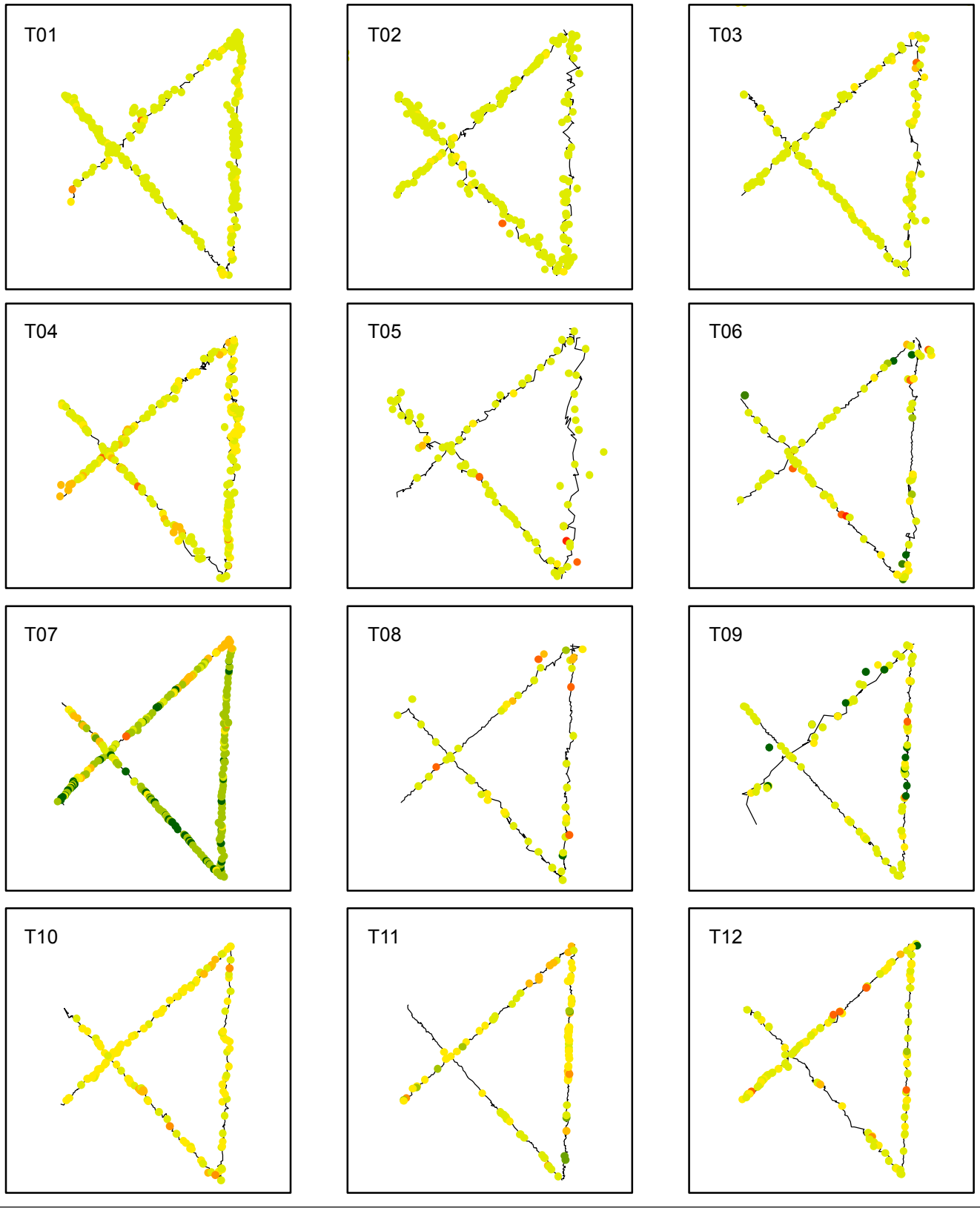


ROV Transect Locations
- Eelpouts - Zoarcidae
- Eulachon - Osmeridae
- Greenlings - Hexagrammidae
- Pricklebacks - Stichaeidae
- Ratfish - Chimaeridae
- Righteye Flatfish - Pleuronectidae
- Rockfish - Sebastidae
- Sculpins - Cottidae
- Skates - Rajidae
- Snailfish - Scorpaeniform

Note:
Bottom sediment accumulation for the MOF was modelled as 615,000m3.

N

0 250 500 m

1:23,000

Pacific NorthWest LNG

Fish Family Distribution
Brown Passage

Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. Skeena Estuary data provided by ESSA Technologies Ltd (2013).

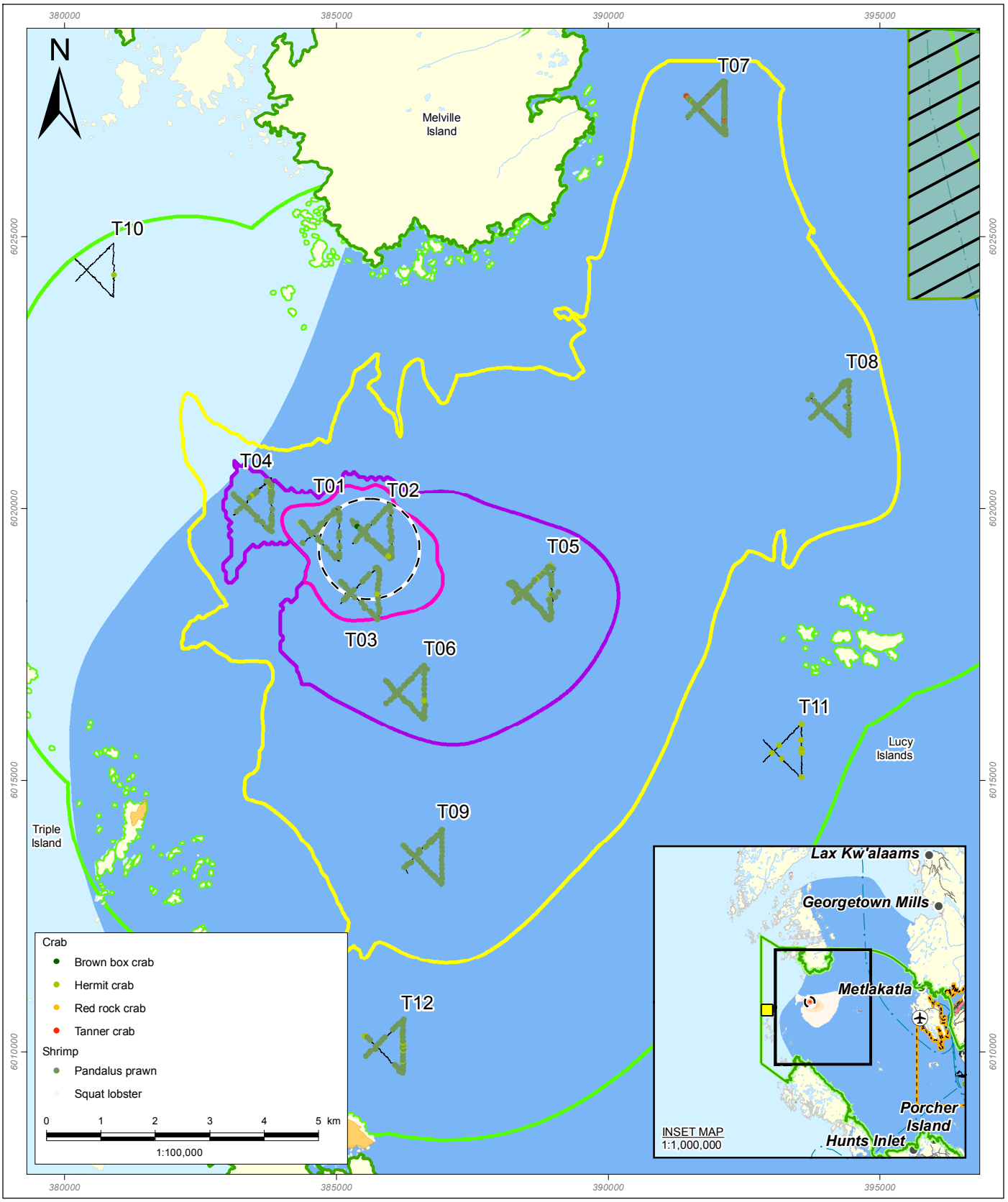
Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 23-OCT-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-822	DATUM: NAD 83
DRAWN BY: K. JAMES	CHECKED BY: L. DU GAS

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7**



Airport
City or Town
Pilotage Station
Ferry Route
ROV Transect Locations
All Glass Sponge Reefs
Brown Passage Disposal Site
Live Glass Sponge Reefs
Local and Regional Assessment Area
Prince Rupert Port Authority Boundary
Water Body
Skeena Estuary

Study Area Boundary
SA-1
SA-2
SA-3
SA-4

Note: Bottom sediment accumulation for the MOF was modelled as 615,000m3.

Pacific NorthWest LNG

Crab and Shrimp Distribution
Brown Passage

Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. Skeena Estuary data provided by ESSA Technologies Ltd (2013).

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 23-OCT-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-821	DATUM: NAD 83
DRAWN BY: M. BATE	CHECKED BY: L. DU GAS

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **8**

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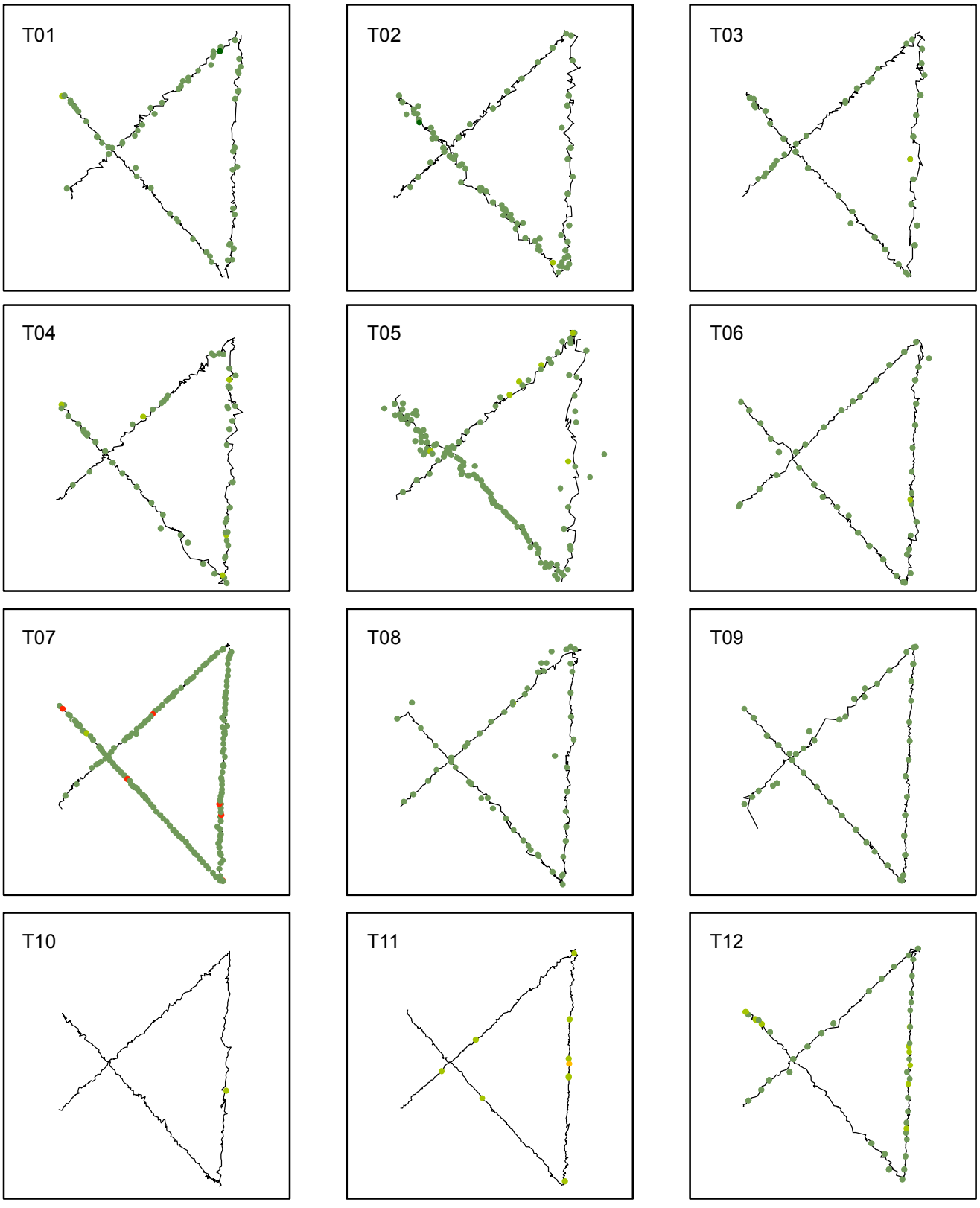

——— ROV Transect Locations

Crab
- Brown box crab
- Hermit crab
- Red rock crab
- Tanner crab

Shrimp
- Pandalus prawn
- Squat lobster

Note:
Bottom sediment accumulation for the MOF was modelled as 615,000m3.

N

0 250 500 m

1:23,000

Pacific NorthWest LNG

Crab and Shrimp Distribution
Brown Passage

Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. Skeena Estuary data provided by ESSA Technologies Ltd (2013).

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 23-OCT-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-822	DATUM: NAD 83
DRAWN BY: K. JAMES	CHECKED BY: L. DU GAS

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **9**

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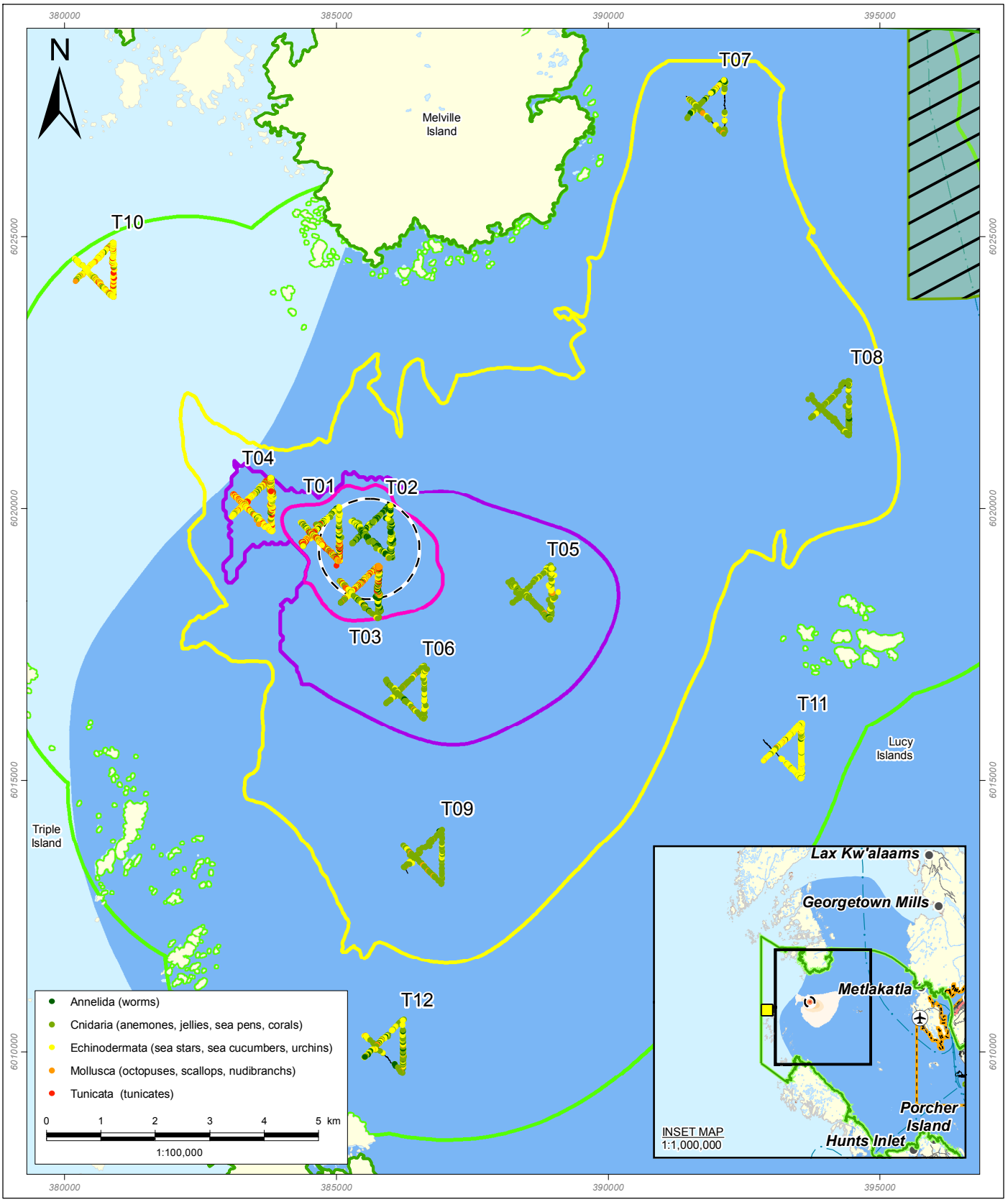

Airport
Pilotage Station
Ferry Route
ROV Transect Locations
All Glass Sponge Reefs
Brown Passage Disposal Site
Live Glass Sponge Reefs
Local and Regional Assessment Area
Prince Rupert Port Authority Boundary
Water Body
Skeena Estuary

Study Area Boundary
SA-1
SA-2
SA-3
SA-4

Note: Bottom sediment accumulation for the MOF was modelled as 615,000m3.

Pacific NorthWest LNG

Invertebrate Distribution
Brown Passage

Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. Skeena Estuary data provided by ESSA Technologies Ltd (2013).

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 23-OCT-14
FIGURE ID: 123110537-822
DRAWN BY: M. BATE
PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: L. DU GAS

PREPARED BY: Stantec
PREPARED FOR: Pacific NorthWest LNG
FIGURE NO: **10**

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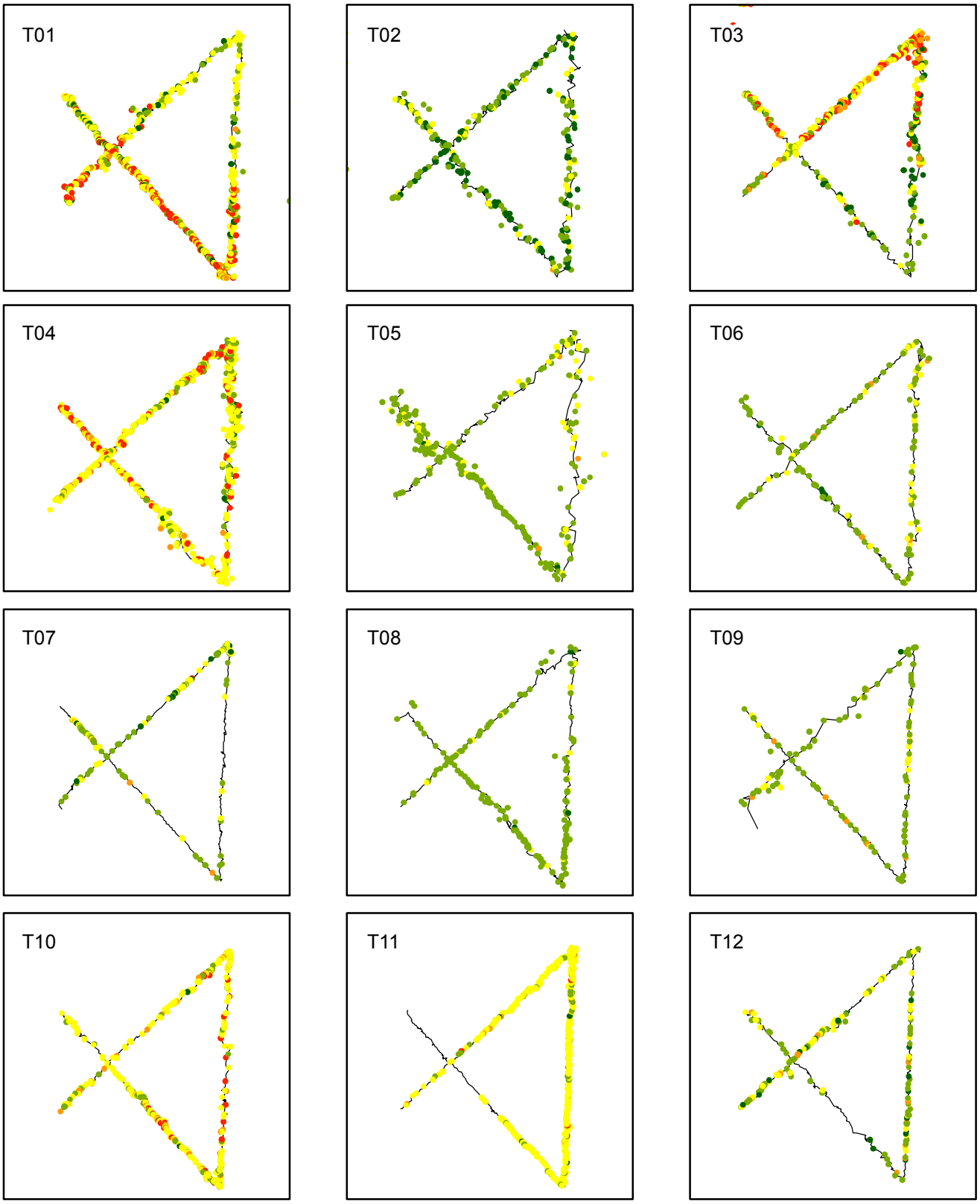

ROV Transect Locations
- Annelida (worms)
- Cnidaria (anemones, jellies, sea pens, corals)
- Echinodermata (sea stars, sea cucumbers, urchins)
- Mollusca (octopuses, scallops, nudibranchs)
- Tunicata (tunicates)

Note:
Bottom sediment accumulation for the MOF was modelled as 615,000m3.

N

0 250 500 m

1:23,000

Pacific NorthWest LNG

Invertebrate Distribution
Brown Passage

Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. Skeena Estuary data provided by ESSA Technologies Ltd (2013).

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 23-OCT-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-822	DATUM: NAD 83
DRAWN BY: K. JAMES	CHECKED BY: L. DU GAS

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11**

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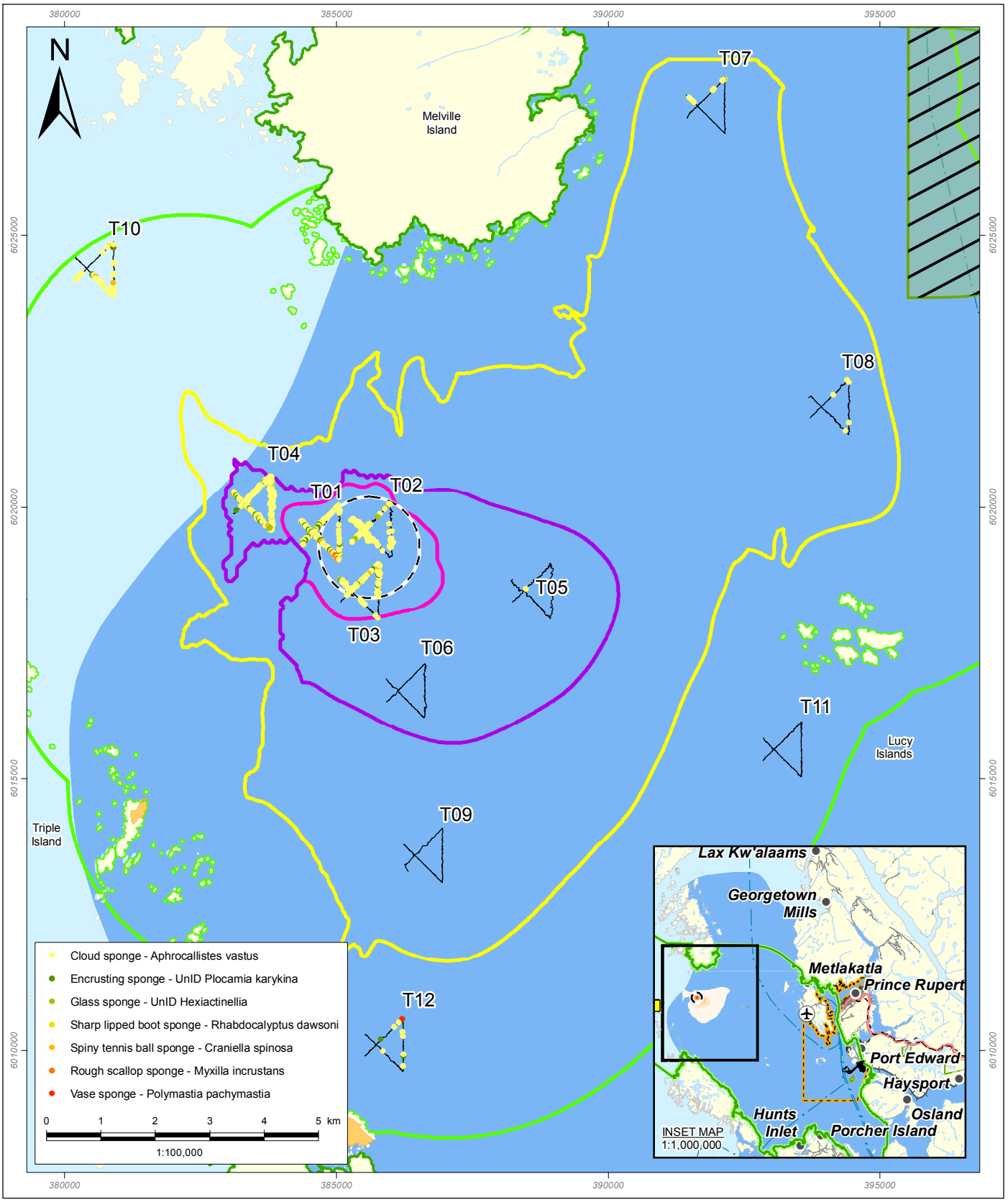

Airport
City or Town
Pilotage Station
Ferry Route
ROV Transect Locations
All Glass Sponge Reefs
Brown Passage Disposal Site

Live Glass Sponge Reefs
Local and Regional Assessment Area
Prince Rupert Port Authority Boundary
Water Body
Skeena Estuary

Study Area Boundary
SA-1
SA-2
SA-3
SA-4

Note: Bottom sediment accumulation for the MOF was modelled as 615,000m3.

Pacific NorthWest LNG

Sponge Distribution
Brown Passage

Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. Skeena Estuary data provided by ESSA Technologies Ltd (2013).

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 23-OCT-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-819	DATUM: NAD 83
DRAWN BY: M. BATE	CHECKED BY: L. DU GAS

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **12**

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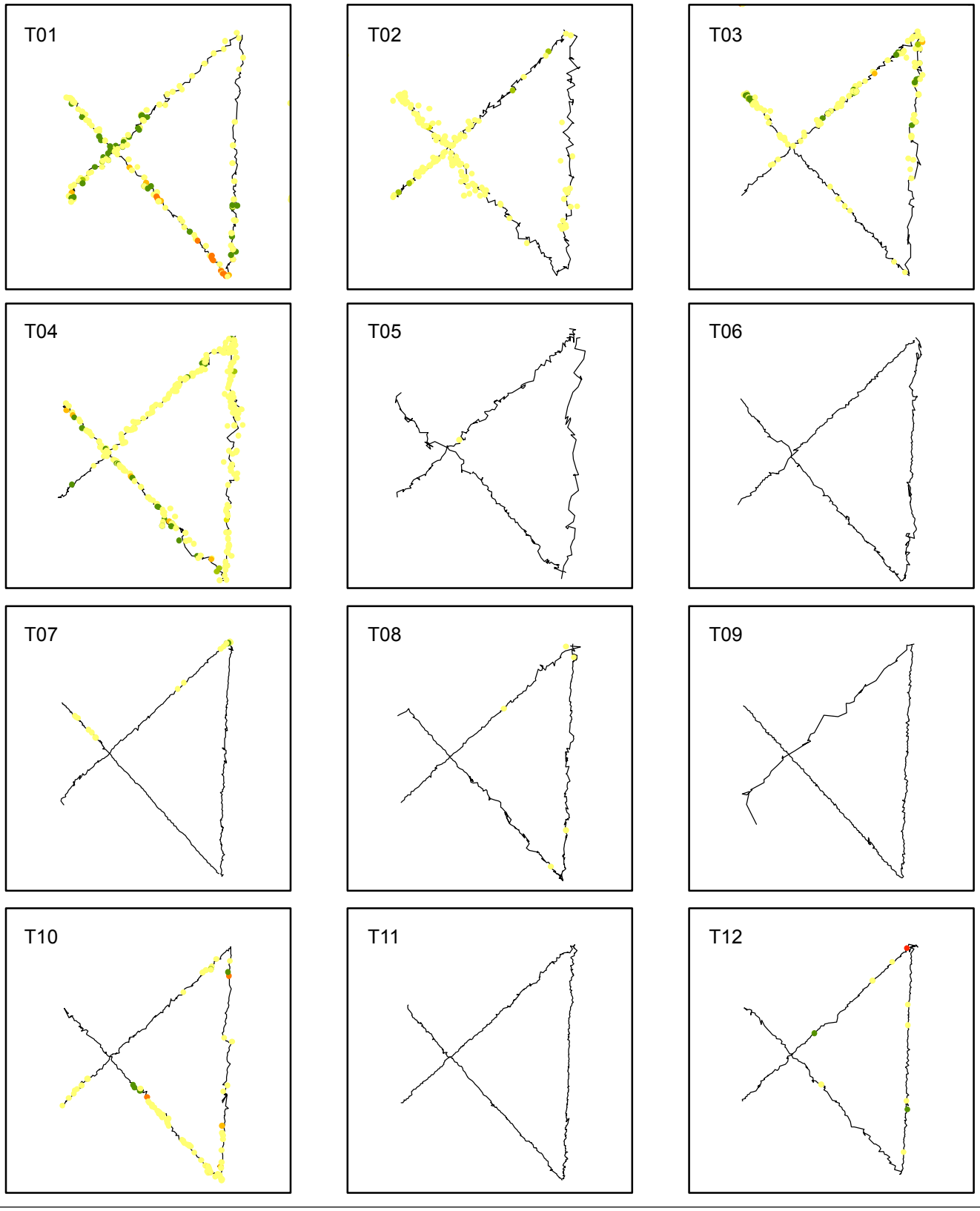

- ROV Transect Locations
- Cloud sponge - Aphrocallistes vastus
- Encrusting sponge - UnID Plocamia karykina
- Glass sponge - UnID Hexiactinellia
- Sharp lipped boot sponge - Rhabdocalyptus dawsoni
- Spiny tennis ball sponge - Craniella spinosa
- Rough scallop sponge - Myxilla incrustans
- Vase sponge - Polymastia pachymastia

Note:
Bottom sediment accumulation for the MOF was modelled as 615,000m3.

N

0 250 500 m

1:24,000

Pacific NorthWest LNG

Sponge Distribution
Brown Passage

Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. Skeena Estuary data provided by ESSA Technologies Ltd (2013).

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 23-OCT-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-822	DATUM: NAD 83
DRAWN BY: K. JAMES	CHECKED BY: L. DU GAS

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **13**

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Appendix A

TABLE A-1: LOCATION AND LENGTH OF SUBTIDAL ROV TRANSECTS

Transect	Date (mm-dd-yyyy)	Start Point		End Point		Transect Depth (m)		Transect Length (m)
		Latitude	Longitude	Latitude	Longitude	Max	Min	
T01						222	137	4390
T01AB	07-26-2014	N5418.7445	W13046.6664	N5418.3727	W13045.9989			
T01BC	07-26-2014	N5418.3727	W13045.9989	N5418.9129	W13046.0243			
T01CD	07-26-2014	N5418.9129	W13046.0243	N5418.5181	W13046.6543			
T02						228	188	5872
T02AB	07-25-2014	N5418.7704	W13045.7941	N5418.4050	W13045.1211			
T02BC	07-25-2014	N5418.4050	W13045.1211	N5418.9426	W13045.1551			
T02CD	07-25-2014	N5418.9426	W13045.1551	N5418.7540	W13045.4700			
T03						194	154	4773
T03AB	07-26-2014	N5418.1731	W13045.9764	N5417.7978	W13045.3107			
T03BC	07-26-2014	N5417.7978	W13045.3107	N5418.3407	W13045.3323			
T03CD	07-27-2014	N5418.3368	W13045.3365	N5417.9478	W13045.9661			
T04						199	96	4812
T04AB	07-27-2014	N5419.0133	W13047.8304	N5418.6442	W13047.1581			
T04BC	07-27-2014	N5418.6442	W13047.1634	N5419.1828	W13047.1891			
T04CD	07-27-2014	N5419.1828	W13047.1891	N5418.7865	W13047.8241			
T05						202	178	4992
T05AB	07-24-2014	N5418.2190	W13043.0539	N5417.8423	W13042.3815			
T05BC	07-24-2014	N5417.8423	W13042.3815	N5418.3817	W13042.3975			
T05CD	07-25-2014	N5418.3858	W13042.4089	N5417.9904	W13043.0443			
T06						180	157	4267
T06AB	07-27-2014	N5417.1947	W13045.1484	N5416.9887	W13044.7879			
T06BC	07-28-2014	N5416.8218	W13044.4838	N5417.3618	W13044.5092			
T06CD	07-28-2014	N5417.3618	W13044.5092	N5416.9658	W13045.1399			
T07						128	89	3708
T07AB	07-30-2014	N5423.0651	W13040.3021	N5422.6949	W13039.6350			
T07BC	07-30-2014	N5422.6949	W13039.6350	N5423.2335	W13039.6590			
T07CD	07-30-2014	N5423.2335	W13039.6590	N5422.8429	W13040.2914			

Transect	Date (mm-dd-yyyy)	Start Point		End Point		Transect Depth (m)		Transect Length (m)
		Latitude	Longitude	Latitude	Longitude	Max	Min	
T08						225	171	4485
T08AB	07-30-2014	N5420.1115	W13038.0816	N5419.7419	W13037.4080			
T08BC	07-30-2014	N5419.7419	W13037.4080	N5420.2806	W13037.4322			
T08CD	07-30-2014	N5420.2806	W13037.4322	N5419.8903	W13038.0719			
T09						162	151	3967
T09AB	07-31-2014	N5415.5674	W13044.7854	N5415.1946	W13044.1203			
T09BC	07-31-2014	N5415.1946	W13044.1203	N5415.7336	W13044.1370			
T09CD	07-31-2014	N5415.7336	W13044.1370	N5415.3405	W13044.7784			
T10						79	59	4255
T10AB	07-28-2014	N5421.2984	W13050.5984	N5420.9319	W13049.9418			
T10BC	07-28-2014	N5420.9313	W13049.9404	N5421.4702	W13049.9687			
T10CD	07-28-2014	N5421.4702	W13049.9687	N5421.0794	W13050.5989			
T11						38	18	3907
T11AB	07-30-2014	N5416.7040	W13038.7390	N5416.3282	W13038.0824			
T11BC	07-31-2014	N5416.3295	W13038.0814	N5416.8703	W13038.0990			
T11CD	07-31-2014	N5416.8703	W13038.0990	N5416.4782	W13038.7393			
T12						172	150	3888
T12AB	07-29-2014	N5413.6798	W13045.3672	N5413.3107	W13044.7021			
T12BC	07-31-2014	N5413.3113	W13044.7049	N5413.8397	W13044.7287			
T12CD	07-31-2014	N5413.8397	W13044.7287	N5413.4513	W13045.3611			

Appendix B

TABLE B-1: NUMBER OF INDIVIDUALS OBSERVED PER 100 M DURING THE SUBTIDAL SURVEY AT AND NEAR THE BROWN PASSAGE DISPOSAL SITE

Taxon	Common name	Scientific Name	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	Cumulative Total
Crabs and Shrimp															
Cancridae	Red Rock Crab	*Cancer productus*											0.03		0.03
Galatheidae	Squat Lobster	*Munida quadrispina*							0.03						0.03
Lithodidae	Brown Box Crab	*Lopholithodes foraminatus*	0.02	0.02											0.04
Oregoniidae	Tanner Crab	*Chionoecetes bairdi*							0.16						0.16
Paguroidea	Hermit Crab	*Pagurus spp*	0.02	0.02	0.40	0.12	0.10	0.02	0.03	0.56		0.02	0.23	0.62	2.14
Pandalidae	Pacific Prawn	*Pandalus platyceros*			0.04			0.02	1.02	0.18	0.03			0.10	1.40
Pandalidae	UnID Pandalus Prawn	*Pandalus spp*	1.66	4.07	4.44	3.70	16.57	13.12	123.16	35.25	20.64			16.82	239.43
UnID Crab	UnID Crab	*UnID Crab*		0.02			0.02					0.02	0.03		0.09
Fish															
Chimaeridae	Ratfish	*Hydrolagus colliei*	6.10	4.12	2.49	4.63	5.77	1.27	0.94	1.76	1.56	10.86	0.95	9.59	50.05
Cottidae	Leister Sculpin	*Enophrys lucasi*	0.02												0.02
Cottidae	Sculpin	*UnID Cottidae*							0.03			0.09	0.05	0.03	0.20
Cottidae	Spinyhead Sculpin	*Dasycottus setiger*				0.02								0.03	0.05

Taxon	Common name	Scientific Name	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	Cumulative Total
Gadidae	Pacific Cod	*Gadus macrocephalus*		0.05	0.06	0.04		0.05	0.05			0.05			0.30
Gadidae	Pacific Tomcod	*Microgadus proximus*	0.02		0.06				0.03	0.02				0.03	0.16
Gadidae	UnID Cod	*UnID Gadidae*	0.02	0.05	0.10	0.06	0.16	0.05	0.11	0.09	0.13	0.68			1.45
Gadidae	Walleye Pollock	*Theragra chalcogramma*			0.04		0.04	0.02			0.03	0.02			0.15
Hexagrammidae	Kelp Greenling	*Hexagrammos decagrammus*											0.13		0.13
Hexagrammidae	Lingcod	*Ophiodon elongatus*							0.03						0.03
Osmeridae	Eulachon	*Thaleichthys pacificus*						0.61							0.61
Pleuronectidae	Dover Sole	*Microstomus pacificus*		0.02											0.02
Pleuronectidae	English Sole	*Parophrys vetulus*	0.02			0.02			0.03			0.24		0.03	0.33
Pleuronectidae	Halibut	*Hippoglossus stenolepis*	0.14	0.05	0.04	0.71	0.04	0.14	0.11	0.11	0.23	0.12		0.31	1.99
Pleuronectidae	Rex Sole	*Glyptocephalus zacharius*			0.08									0.08	0.16
Pleuronectidae	Rock Sole	*Lepidopsetta bilineata*	0.20	0.09	0.17	0.37	0.08	0.02	0.03	0.02	0.03	0.78	0.56	0.31	2.66
Pleuronectidae	Slender Sole	*Lyopsetta exilis*	0.11	0.02		0.10		0.12	0.16		0.08	0.05	0.03	0.18	0.84
Pleuronectidae	UnID Right Eye Flounders	*UnID Pleuronectidae*	0.07	0.02	0.06	0.25		0.05	0.13	0.02	0.05	0.87	0.49	0.31	2.32
Rajidae	Big Skate	*Raja binoculata*				0.08		0.02	0.03	0.02				0.05	0.21
Rajidae	Longnose Skate	*Raja rhina*	0.02	0.02	0.02	0.06	0.08	0.07		0.07	0.05			0.13	0.52
Scorpaeniform	Snailfish	*Liparidae spp*					0.04	0.05							0.09

Taxon	Common name	Scientific Name	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	Cumulative Total
Sebastidae	Canary Rockfish	*Sebastes pinniger*				0.02		0.05	0.22						0.28
Sebastidae	Copper Rockfish	*Sebastes caurinus*				0.02									0.02
Sebastidae	Greenstripe Rockfish	*Sebastes elongatus*				0.08			0.11	0.02					0.21
Sebastidae	Quillback Rockfish	*Sebastes maliger*				0.08			0.22			0.09	0.38		0.78
Sebastidae	Rockfish	*Sebastes spp*				0.25			0.32	0.09		0.16		0.03	0.85
Sebastidae	Unidentified Rockfish	*Sebastes rosaceus*				0.02									0.02
Sebastidae	Silvergray Rockfish	*Sebastes brevispinis*	0.02						0.03						0.05
Sebastidae	Tiger Rockfish	*Sebastes nigrocinctus*			0.02	0.04		0.02				0.02		0.03	0.14
Sebastidae	Yelloweye Rockfish	*Sebastes ruberrimus*				0.02						0.02			0.04
Sebastidae	Yellowtail Rockfish	*Sebastes flavidus*							2.62			0.31			2.92
Stichaeidae	Prickleback	*Xiphister spp*						0.07	15.61	0.02				0.03	15.73
Stichaeidae	Snake Prickleback	*Lumpenus sagitta*							0.03				0.13		0.15
UnID Fish	UnID Fish	*UnID Fish*	0.02		0.02		0.12	0.02		0.07		0.16			0.42
Zoarcidae	Black Belly Eelpout	*Lycodes pacificus*						0.05	0.11						0.15
Zoarcidae	Black Eelpout	*Lycodes diapterus*						0.02							0.02
Zoarcidae	Eelpout	*Lycodes spp*							1.29	0.02	0.38			0.03	1.72
Other Invertebrates															
Annelida	Orange Feather Duster Tubeworm	*Chone aurantiaca*	0.27												0.27

Taxon	Common name	Scientific Name	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	Cumulative Total
Annelida	UnID Calcareous Tubeworms	*UnID Serpulidae*	0.14	0.09	0.04			1.01	1.46		0.03		0.15	0.26	3.16
Annelida	UnID Feather Duster worm	*UnID Sabellidae*	10.25	1.69	1.09										13.02
Annelida	UnID Tubeworm	*UnID Serpulidae*	0.75		5.61	0.60	0.02		0.30	0.47		0.42	0.03	1.11	9.31
Cnidaria	Crimson Anemone	*Cribrinopsis fernaldi*	1.05	0.85	0.75	0.44	0.58	1.41	0.62	3.19	1.76	0.12		1.18	11.95
Cnidaria	Cross Jelly	*Earleria cellularia*				0.02									0.02
Cnidaria	Giant Plumose Anemone	*Metridium farcimen*	0.05		0.04	4.49	0.04		2.24			2.07	1.48	0.15	10.56
Cnidaria	Lion's Mane	*Cyanea capillata*		0.02							0.03				0.04
Cnidaria	Moon Jellyfish	*Aurelia labiata*	0.02				0.02			0.02		0.02		0.05	0.14
Cnidaria	Orange Sea Pen	*Ptilosarcus gurneyi*	0.02			0.06						1.60	0.59		2.27
Cnidaria	Pom Pom Anemone	*Liponema spp*	0.05												0.05
Cnidaria	Sea Whip	*Halipteris willemoesi*	1.43	1.12	1.07	3.43	14.99	35.50	0.78	17.99	25.31	0.02	0.03	2.83	104.50
Cnidaria	Swimming Anemone	*Stomphia didemon*			0.02										0.02
Cnidaria	Tube-Dwelling Anemone	*Cerianthus spp*			0.04						0.05				0.09
Cnidaria	UnID Anemone	*UnID Anthozoa*	0.25	0.05	0.06	0.15		0.02	0.13	0.16	0.05		0.08		0.95
Cnidaria	UnID Jelly	*UnID Cnidaria*					0.02								0.02
Echinodermata	Basket Star	*Gorgonocephalus eucnemis*			0.02	0.02	0.02	0.02				0.07		0.03	0.18
Echinodermata	Bat Star	*Asterina miniata*	0.05			0.08						0.02			0.15

Taxon	Common name	Scientific Name	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	Cumulative Total
Echinodermata	Blood Star	*Henricia leviuscula*	2.19	0.09	0.94	2.74	0.02		0.19	0.02		1.46	0.36		8.00
Echinodermata	Cookie Star	*Ceramaster patagonicus*	0.05		0.02										0.07
Echinodermata	Creeping Pedal Sea Cucumber	*Psolus chitinoides*							0.05	0.02					0.08
Echinodermata	Cushion Star	*Pteraster tesselatus*										0.05			0.05
Echinodermata	Fat Blood Star	*Henricia sanguinolenta*			0.04	0.04							0.03		0.11
Echinodermata	Feather Stars	*Florometra serratissima*	0.25	0.02	0.27	0.56			0.11	0.02		0.21		0.10	1.55
Echinodermata	Giant California Sea Cucumber	*Parastichopus californicus*	0.25			5.34			0.11			3.13	8.32		17.14
Echinodermata	Green Urchin	*Strongylocentrotus droebachiensis*	0.30		0.04								2.82		3.15
Echinodermata	Gunpowder Sea star	*Gephyreaster swifti*	0.07	0.02		0.17	0.02								0.27
Echinodermata	Leather Star	*Dermasterias imbricata*	0.09									0.24	0.18		0.51
Echinodermata	Morning Sunstar	*Solaster dawsoni*	0.11	0.03	0.02	0.12	0.02					0.71	0.03	0.08	1.12
Echinodermata	Orange Sunstar	*Solaster paxillatus*	0.18	0.03	0.04	0.06							0.05		0.37
Echinodermata	Purple Urchin	*Strongylocentrotus purpuratus*			0.02							0.03		0.05	
Echinodermata	Rainbow Star	*Orthasterias koehleri*	.077	0.03	0.69	0.48		0.02				1.57	2.48	0.10	6.16
Echinodermata	Red Urchin	*Strongylocentrotus franciscanus*	0.27						0.05				1.41		1.74

Taxon	Common name	Scientific Name	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	Cumulative Total
Echinodermata	Rose Star	*Crossaster papposus*	0.20		0.13	0.17						0.28	0.23	0.03	1.03
Echinodermata	Sandstar	*Luidia foliolata*	0.18	0.10	0.17	0.42	0.04	0.05	0.32	0.02	0.05	0.21	0.79	0.26	2.61
Echinodermata	Slime Star	*Pteraster tesselatus*	0.02		0.06	0.21			0.03			0.02			0.34
Echinodermata	Spiny Pink Star	*Pisaster brevispinus*	0.02					0.02			0.03	0.02	0.90	0.08	1.07
Echinodermata	Spiny red Star	*Hippasteria spinosa*	0.16	0.03	0.17	0.15	0.04	0.42	0.03		0.03	0.21	0.03	0.10	1.36
Echinodermata	Striped Sunstar	*Solaster stimpsoni*	0.02		0.02	0.02						0.38	0.38		0.82
Echinodermata	Sunflower Star	*Pycnopodia helianthoides*	0.07		0.15	0.04			0.22	0.02	0.03	0.38		0.10	1.00
Echinodermata	UnID Sea star	*UnID Asteroidea*	0.82		0.21	0.46			0.03	0.02		0.12			1.65
Echinodermata	Urchin	*Strongylocentrotus spp*	0.11	0.02		0.81			0.03	0.04		0.05		0.13	1.19
Echinodermata	Velcro Star	*Stylasterias forreri*	0.02			0.10			0.11			0.21	0.54		0.98
Echinodermata	Vermillion Star	*Mediaster aequalis*	2.46	0.29	0.42	2.78	0.06	0.07	0.73	0.04		2.12	6.60	0.72	16.29
Echinodermata	White Urchin	*Strongylocentrotus pallidus*	0.48	0.00			0.02						0.05	0.03	0.58
Echinodermata	Wrinkled Star	*Pteraster militaris*			0.02	0.15			0.05			0.21		0.03	0.46
Mollusca	Diamondback Nudibranch	*Tritonia festiva*											0.10		0.10
Mollusca	Giant Pacific Octopus	*Enteroctopus dofleini*	0.02				0.02					0.02			0.07
Mollusca	Gumboot Chiton	*Cryptochiton stelleri*											0.03		0.03
Mollusca	Sea Lemon Nudibranch	*Ansidoris noibilis*										0.02			0.02

Taxon	Common name	Scientific Name	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	Cumulative Total
Mollusca	Siphon Holes	*UnID Siphon holes*				0.00									0.00
Mollusca	Striped Nudibranch	*Armina californica*					0.02	0.05			0.15				0.22
Mollusca	Stubby Squid	*Rossia pacifica*					0.02								0.02
Mollusca	UnID Moon Snail	*Euspira spp*										0.02			0.02
Mollusca	UnID Nudibranch	*UnID Nudibranchia*	0.09			0.08			0.08			0.05	0.03		0.33
Mollusca	UnID Octopus	*UnID Octopus*			0.04	0.02		0.12	0.05		0.05				0.28
Mollusca	UnID Scallop	*UnID Pectinidae*	3.83	0.02	2.20	3.70			0.03			57.76		0.62	68.15
Mollusca	UnID Whelk	*Neptunea spp*	0.20					0.02				0.07	0.15	0.26	0.71
Tunicata															
Tunicata	Pacific Sea Peach	*Halocynthia aurantium*										0.02	0.03		0.05
Tunicata	Sea Vase	*Ciona savignyi*	5.22		2.14	4.22			0.03			8.62	0.18		20.40

TABLE B-2: SUMMARY OF SPECIES RECORDED AS PERCENT COVER, OBSERVED DURING THE SUBTIDAL SURVEY AT AND NEAR THE BROWN PASSAGE DISPOSAL SITE

Taxon	Common name	Scientific Name	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12
Other Invertebrates														
Cnidaria	Encrusting Hydrocorals	*Stylantheca sp*	P											
Cnidaria	Hydroid	*Abietinaria spp*	P		P	P			P			P	P	
Cnidaria	Orange Cup Coral	*Balanophyllia elegans*											P	P
Cnidaria	Pink Gorgonian	*Calcigorgia sciculifera*				P						P		
Echinodermata	Brittle Star	*Ophiura sarsii*	A		P	A								
Porifera	Cloud Sponge	*Aphrocallistes vastus*	P	P	P	C	P		P	P		P		P
Porifera	Rough Scallop Sponge	*Myxilla incrustans*				P								
Porifera	Sharp Lipped Boot Sponge	*Rhabdocalyptus dawsoni*	P									P		
Porifera	Spiny Tennis Ball Sponge	*Craniella spinosa*		P	P	P								
Porifera	Tough Yellow Branching Sponge	*Syringella amphispicula*	P		P	P						P		
Porifera	UnID Encrusting Sponge	*UnID encrusting sponge*	P		P	P			P			P		P
Porifera	UnID Glass Sponge	*UnID Hexactinellida*	P	P	P	P								
Porifera	UnID Sponge	*UnID Sponge*	P	P	P	P			P	P		P		P

Taxon	Common name	Scientific Name	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12
Porifera	Vase Sponge	*Polymastia pachymastia*												P
Flora														
Heterokontophyta	Sugar Kelp	*Laminaria saccharina*											A	
Heterokontophyta	UnID Brown Algae	*UnID Heterokontophyta*											C	
Rhodophyta	UnID Crustose Corraline Algae	*UnID Corallinales*											A	
Rhodophyta	UnID Red Algae	*UnID Rhodophyta*											P	

Legend: P = Present <25%, C = Common 25-75%, A = Abundant >76%