APPENDIX D
TENERA REPORT

Ocean Bottom Seismometer Cable Landing Habitat Characterization Study

Diablo Canyon Power Plant

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Introduction

A data cable for the proposed Diablo Canyon Power Plant (DCPP) Ocean Bottom Seismometer (OBS) project linking offshore sensors will be routed to an onshore location in the DCPP intake cove. The intake cove is an artificially constructed embayment with two breakwaters to protect the power plant cooling water intake structure. The intake cove will allow the cable to transition from sea onto land in a wave-protected environment.

The shoreline perimeter of the ~6.1 ha (15 ac) intake cove consists of a combination of granite boulder rip-rap, concrete tribars that form the breakwaters, natural bedrock, and the concrete sea wall of the intake structure itself. The seabed of the intake cove consists of sand and soft sediments, boulder fields, low rock ridges, and emergent rocks during low tides.

A biological habitat assessment was completed on May 17–20, 2011 by Tenera Environmental, Inc. to characterize the marine habitat and substrates along a projected cable pathway in the intake cove and to identify the location of any bottom features in the cove that should be avoided in the cable-laying process. The proposed nearshore cable route includes sand and fine sediments but will also necessarily traverse some rocky habitat.

Methods

The basic approach for surveying the shallow seafloor along the route was to have diver-biologists swim along the corridor while recording observations and taking photographs. A deployed meter tape was used to mark the cable route underwater. The nearshore portion of the route started at the designated landing point, extended through the DCPP intake cove, and emerged into the open ocean between the east and west breakwaters (**Figure 1**). The path was chosen to provide a direct route for installing the cable from the cove entrance to the landing point adjacent to the service building, while at the same time avoiding known areas of emergent

rocky outcroppings. The latitude/longitude of reference points along this route were marked with a GPS and used in the field to position drop buoys, which were used as targets to align the survey transect meter tapes along the proposed cable route.

A pair of 100 m (328 ft) reeled measuring tapes was deployed sequentially from the boat along the projected cable route starting from the embankment onshore and out through the intake cove to a location approximately 100 m (328 ft) beyond the end of the west breakwater (**Figure 1**). Weighted buoy lines marked the start and end of each transect segment.

The area surveyed was a 6 m (19.7 ft) wide corridor centered on the deployed meter tapes. The transect was divided into survey sections of 50 m (164 ft). In each section the presence/absence of giant kelp, other algal types, conspicuous macro-invertebrates, and substrates were recorded onto waterproof data sheets. Fish species were not recorded because they would be unaffected by any cable placement. Photographs were also taken to document the substrate types and biota.

A short intertidal segment of the route was delineated at low tide by deploying a meter tape from the top of the embankment to the water line . Particular attention was given to searching for black abalone (*Haliotis cracherodii*), a mid-intertidal species recently listed as federally endangered. In addition to conducting observations along exposed rock surfaces, flashlights were used to search for black abalone habitat between boulders and in crevices. Other nearby areas with potential black abalone habitat along the embankment, but outside of the designated survey corridor, were also searched.

Results: Habitat Characterization

The subtidal portion of the habitat characterization was completed on May 17–18, 2011 by two Tenera Environmental senior biologists (Mr. Jay Carroll and Mr. Scott Kimura) using SCUBA equipment from a 24’ support boat operated by a topside tender. Diving conditions were adequate for completion of the work with underwater visibility ranging between approximately 3.0–4.6 m (10–15 ft) and only low to moderate underwater surge conditions. The intertidal portion of the survey was completed at low tide on May 20, 2011 when the tide level was -0.4 m (-1.3 ft) MLLW.

A list of common species that were observed is presented in **Table 1**. Because the objective of the survey was to provide a general characterization of habitats along the proposed cable route, detailed species lists were not developed. Many more species of algae and invertebrates, particularly smaller and less conspicuous species, are known to occur along outer coast habitats and within the intake cove. However, **Table 1** includes most of the major habitat-forming algal species and macro-invertebrates occurring along the surveyed corridor.

Descriptions of the habitat types, depth ranges, and predominant species by transect are summarized in **Table 2**. Differences in depth, wave exposure, and substrate type affected the composition of species occurring along the transect. In order to describe these dissimilarities, the

area traversed by the proposed nearshore cable route was classified into six habitat zones (**Figure 2**). A depth profile of the transect and these delineated habitat zones is shown in **Figure 3**.

Zone 1: This short, steep segment (Transect 0-A) crossed the rock rip-rap embankment from the upper intertidal zone down to the lower intertidal zone. Most of the rocks were barren with little or no algae, but some had aggregations of several species of limpets and scattered barnacles (**Figure 4**). Green sea lettuce (*Ulva* spp.) was common. No black abalone or red abalone (*H. rufescens*) were found.

Zone 2: This zone was largely an expansive submerged boulder field with some rock outcrops and isolated pockets of fine sand and mud, and included some rocks forming the base of the rip-rap embankment. The average depth was approximately -5 m (-16 ft) MLLW. Nearly all of the submerged rocks throughout this zone were colonized by a mixture of algal understory types, but green sea lettuce was particularly common. Giant kelp was also common with a dense algal understory of perennial foliose and branched species (**Figure 5**). Detritus and fine sediments occurred as a layer covering some of the rocks, and drift (detached and disintegrating) algal blades were present. The cover of fine sediments resulted from quiescent conditions in the interior section of the intake cove; there are no currents and very little wave motion that would otherwise prevent these layers from accumulating. Sea cucumbers (*Parastichopus parvimensis*) and bat stars (*Patiria miniata*) were common macro-invertebrates.

Zone 3: Zone 3 extended along the north (inside) margin of the east breakwater, and the bottom was largely composed of loosely compacted fine sediments. The average depth was approximately -11 m (-36 ft) MLLW. Some low-lying boulders and rocky outcrops supported scattered plants of giant kelp, and common macro-invertebrates included moon snails (*Euspira lewisii*) and tube anemones (*Pachycerianthus fimbriatus*).

Zone 4: The area between the entrance to the intake cove and the DCPP intake structure is largely a compacted sand bottom (**Figure 6**) influenced by onshore currents generated by operation of the DCPP cooling water intake. The bottom was at an average depth of approximately -10 m (-33 ft) and was populated with ornate tube worms (*Diopatra ornata*), benthic filamentous diatoms, and the annual brown alga *Desmarestia* spp..

Zone 5: The seabed at the entrance to the intake cove is a slope comprised of rocky outcrops and large boulders emerging from the surrounding sand base (**Figure 7**). This zone also includes some concrete tribar fragments and granitic rocks forming portions of both breakwater bases. The average depth was approximately -17 m (-56 ft) MLLW during the survey. The rocks were colonized with subsurface kelps (*Pterygophora californica* and *Laminaria setchellii*), and common macroinvertebrates included bat stars, anemones (*Corynactis californica*, *Urticina* spp.), and several species of encrusting colonial invertebrates (**Figure 8**).

Zone 6: The area at the terminus of the survey transect outside the intake cove is a flat bottom of sand, gravel, and shell debris. The average depth was -22 m (72 ft) MLLW during the survey. Several *P. californica* plants were emergent through the sand base (stipes half-buried), indicating that the sand level in this area can vary, depending on bedload transport due to the action of waves and currents.

Some of the more conspicuous macro-invertebrate species observed along the transect were photographed during the survey (**Figure 9)**. They include both motile and sessile species, and all can be considered common in their preferred habitats.

Discussion

A general habitat characterization survey of the nearshore and DCPP intake cove for the proposed OBS cable route demonstrated that the areas likely to be crossed included a mixture of soft bottom and rock habitat. Much of the cable along this route will pass over sand and soft sediment areas, particularly in front of the intake structure and along the inshore edge of the east breakwater. Much of the giant kelp and seasonal bull kelp (*Nereocystis luetkeana*) growing in these areas is attached to rocks and tri-bars forming the breakwaters and does not occur in the center of the cove. Cable that is deployed over segments of sand and soft sediment can be expected to become periodically buried and possibly re-exposed over time from natural sediment movement. The cable deployed over rocky areas will likely become colonized over time by surrounding species.

One objective of the survey was to determine if black abalone, a federally endangered species, was present in or near an intertidal segment of the rip-rap embankment where the cable could come ashore. No black abalone were found. While the boulders of the embankment represent suitable habitat where abalone could occur, their preferred habitat is along the wave-swept outer coast and not in protected embayments such as the intake cove[1]. Consequently, it is highly improbable that black abalone would be in or near the immediate project area when the cable is deployed.

In conclusion, none of the species that could be potentially affected by the placement or long-term presence of the cable is considered unique or rare for the area. In addition, many of the conspicuous species that were observed were present in high numbers. All of the species observed are adapted to periodic disturbances and would be considered to have high levels of recovery potential. Consequently, any impacts, should they occur, would be small relative to the numbers of unaffected individuals in the population in the project area.

[1] Carlton, J. T. 2007. The Light and Smith Manual: Intertidal invertebrates from central California and Oregon. 4th edition. University of California Press. Berkeley, California.

Table 1. Common algal and macro-invertebrate species observed in the intake cove habitat characterization survey (May 17–20, 2011).

Algae		Invertebrates	
Scientific Name	**Common Name or Description**	**Scientific Name**	**Common Name or Description**
Chrysophyta		**Porifera**	
Chrysophyta unid.	unid. benthic diatoms	Porifera unid.	unid. encrusting sponges
Chlorophyta		*Tethya aurantia*	orange puffball sponge
Acrosiphonia spp.	filamentous green algae	**Cnidaria**	
Ulva spp.	green sea lettuce	*Balanophyllia elegans*	orange cup coral
Phaeophyta		*Corynactis californica*	strawberry anemone
Egregia menziesii	feather boa kelp	*Epiactis prolifica*	proliferating anemone
Desmarestia spp.	foliose brown algae	*Pachycerianthus fimbriatus*	tube anemone
Laminaria setchellii	oar kelp	**Polychaeta**	
Macrocystis pyrifera	giant kelp	Cirratulidae/Terebellidae	polychaete worms
Nereocystis luetkeana	bull kelp	*Diopatra ornata*	ornate tube worm
Pterygophora californica	tree kelp	*Phragmatopoma californica*	sand tube worm
Sargassum muticum	bladder chain kelp	*Phyllochaetopterus prolifica*	parchment tube worm
Rhodophyta		*Serpula vermicularis*	calcareous tube worm
Ahnfeltiopsis leptophylla	branched red alga	*Spirobranchus spinosus*	calcareous tube worm
Calliarthron / Bossiella spp.	articulated coralline algae	*Spirorbis* spp.	calcareous tube worms
Chondracanthus corymbiferus	foliose red alga	**Arthropoda**	
Cryptopleura ruprechtiana	foliose red alga	*Pachygrapsus crassipes*	lined shore crab
Constantinea simplex	foliose red alga	*Tetraclita rubescens*	barnacle
Corallina chilensis	articulated coralline alga	**Mollusca**	
Corallina vancouveriensis	articulated coralline alga	*Cryptochiton stelleri*	gumboot chiton
Corallinaceae	crustose coralline algae	*Euspira lewisii*	moon snail
Gastroclonium coulteri	branched red alga	*Hermissenda crassicornis*	nudibranch
Gelidium coulteri	branched red alga	*Littorina* spp.	snail
Gracilariopsis andersonii	branched red alga	*Lottia pelta*	limpet
Mastocarpus papillatus	foliose red alga	*Lottia scabra*	limpet
Mazzaella splendens	foliose red alga	*Lottia scutum*	limpet
Plocamium cartilagineum	branched red alga	*Panopea abrupta*	geoduck clam
Polysiphonia spp.	filamentous red algae	*Pomaulax gibberosa*	top snail
Prionitis spp.	branched red algae	**Echinodermata**	
Rhodoptilum plumosum	branched red alga	*Parastichopus parvimensis*	sea cucumber
Rhodymenia spp.	foliose red algae	*Patiria miniata*	bat star
Sarcodiotheca gaudichaudii	branched red alga	*Pisaster brevispinus*	short-spined sea star
		Pycnopodia helianthoides	sunflower star
		Ascideacea	
		Ascideacea unid.	sea squirts

Table 2. Habitat characteristics by transect segments.

Transect Segment	Depth Range (ft / m MLLW)[1]	Physical Characteristics	Common Biota
0-A	+6' to -1' (+1.8 m to -0.3 m)	Intertidal zone. Substrate of emplaced boulders (concrete, granite, and native rock).	Green sea lettuce, foliose, and branched algae covering all rocks in the low intertidal. Mid- and upper-intertidal rocks largely barren, but populated with limpets and barnacles. No black abalone.
0-B	-1' to -5' (-0.3 m to -1.5 m)	Shallow subtidal zone. Substrate of emplaced boulders (concrete, granite, and native rock).	Low-intertidal algal species as above. Several bladder chain kelp and giant kelp plants present. Fine detritus silt covering rocks and algae. Bat stars common.
1	-3' to -11' (-0.9 m to -3.4 m)	Boulder field (approx. 90%) but with some rock ridges and pockets of sediment. Sheltered from most wave motion.	Giant kelp plants common with dense algal understory. Bat stars and sea cucumbers common. Fine detritus silt covering rocks and algae.
2	-11' to -21' (-3.4 m to -6.4 m)	Same as Segment 1.	Same as Segment 1.
3	-18' to -33' (-5.5 m to -10.1 m)	Transition from boulder field to fine soft sediment flat near east breakwater. Sheltered.	Same as Segment 1 but with less biota near the east breakwater due to fewer rock surfaces and greater percentage of fine soft sediments. Gumboot chitons present.
4	-33' to -38' (-10.1 m to -11.6 m)	Fine sediment flat with scattered emergent rocks. Sheltered.	Giant kelp plants common, but algal understory less abundant, due to less rock. Tube anemones and moon snails present.
5	-25' to -37' (-7.6 m to -11.3 m)	Eastern portion of fine soft sediment with scattered emergent rocks. Western portion an extensive compacted sand flat and no emergent rocks. Onshore current flows due to DCPP intake pumps.	Eastern portion similar to above in biota. In contrast, western portion an extensive sand flat colonized by ornate tube worms and foliose brown algae loosely attached to the sand flat. No giant kelp.
6	-30' to -33' (-9.1 m to (-10.1 m)	Extension of the sand substrates in Segment 5 with >95% sand and some scattered emergent rocks. Strong intake currents.	Scattered rocks populated with tree kelp and few giant kelp plants. Benthic diatom mats. Ornate tube worms and geoduck clams on/in sand flat.
7	-35' to -46' (-10.7 m to -14.0 m)	30%-90% sand flat. Scattered low relief rocks, tribars, and boulders. Less intake current flow but more swell influence.	Rocks populated mainly with tree kelp. Bat stars common throughout. Ornate tube worms on/in portions of sand flat.
8	-40' to -64' -12.2 m to -19.5 m)	15%-50% sand flat with low relief rocks. Influenced by prevailing swells.	Rocks populated with tree kelp and oar kelp. Bat stars common. Scattered solitary anemones and some encrusting colonial invertebrates.
9	-64' to -72' (-19.5 m to -22.0 m)	Northern section with high-relief rock outcroppings and vertical rock walls up to 5 m (16.4 ft) tall. Transect terminus at southern end mainly sand, pebble, and shell debris. Can be influenced by larger prevailing swells.	Northern section with dense kelp, abundant encrusting invertebrates on rocks, and some ornate tube worms in sand pockets between rocks. Occasional tree kelp plants emerging from sand near the transect terminus (south end). Bat stars common throughout.

[1] Tide-corrected to MLLW from depths recorded during subtidal survey.

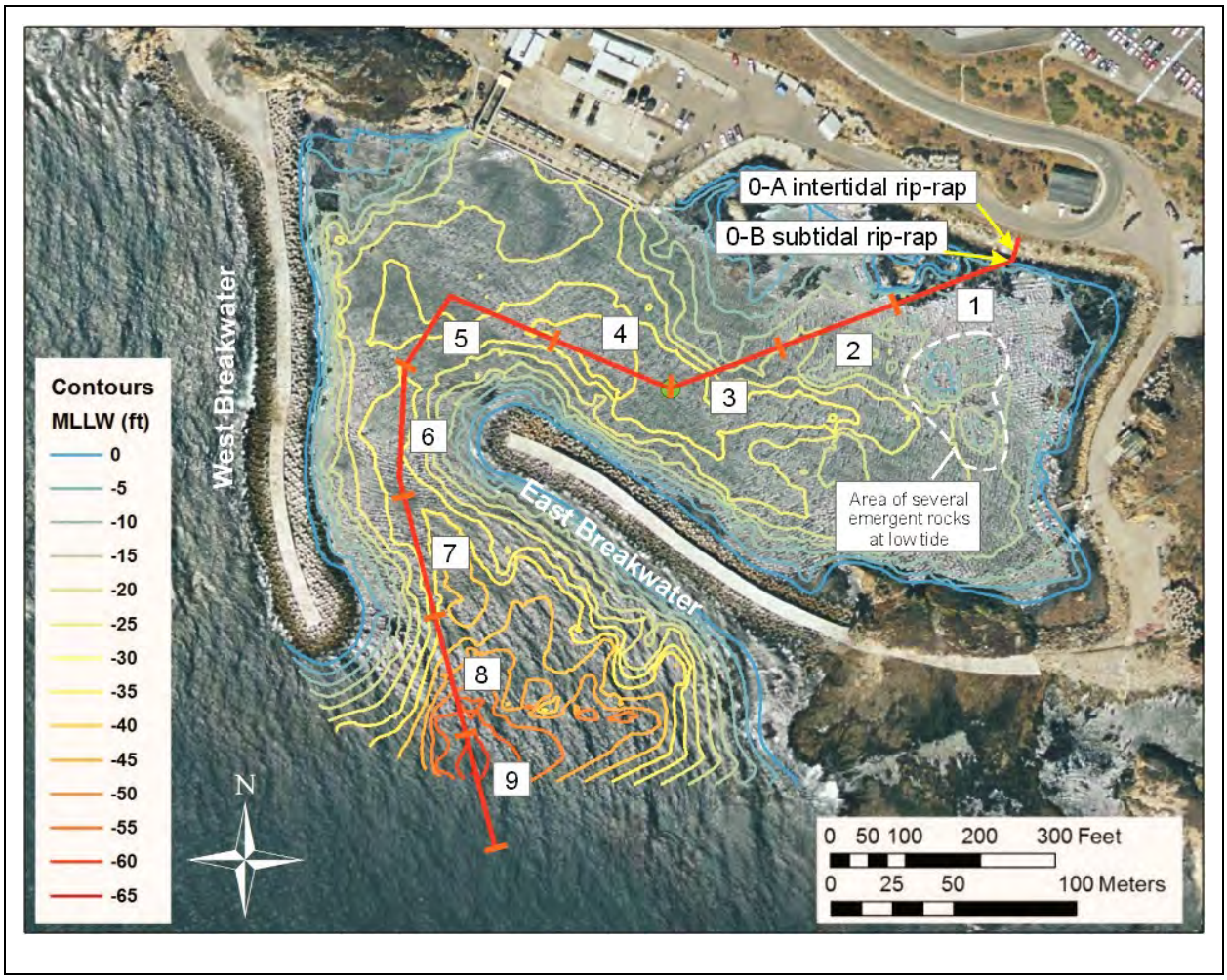

Figure 1. Proposed OBS cable corridor route (red line) and transect segments surveyed through the DCPP intake cove on May 17–20, 2011. Depth contours are from multi-beam hydroacoustic surveys conducted in 2005.

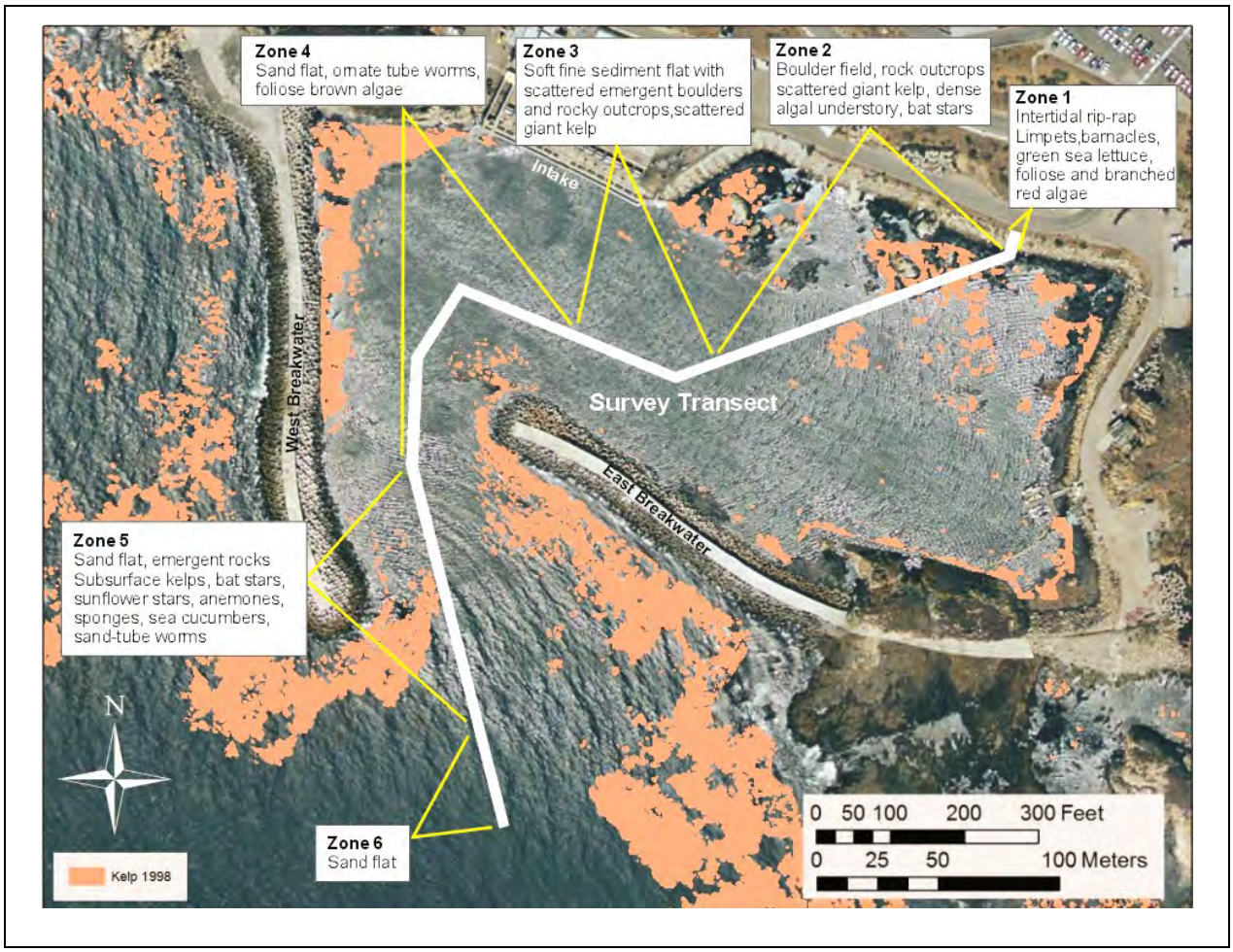

Figure 2. Survey transect and general habitat zones along nearshore segment of proposed OBS cable route. Depiction of kelp surface canopy is from an aerial kelp mapping survey done in fall 1998.

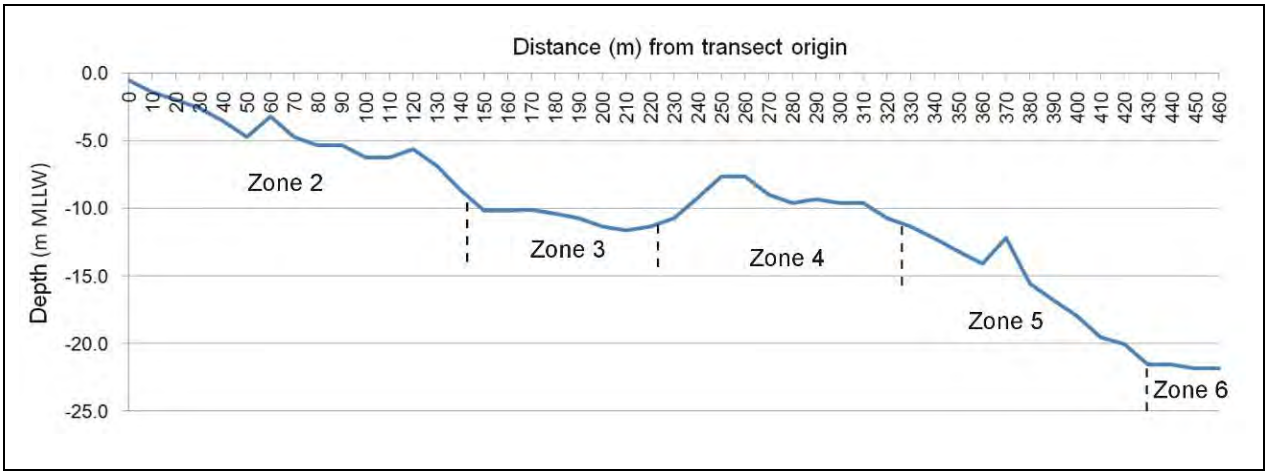

Figure 3. Depth profile of the subtidal survey transect showing locations of general habitat zones described in Figure 2. Vertical exaggeration of the depth scale is approximately 6:1.

Figure 4. Proposed landing area for the OBS cable. A) Terminus of existing conduits at top of rip-rap embankment; B) Proposed conduit extension route up the rip-rap embankment; C) Intertidal zone; and D) Common intertidal biota.

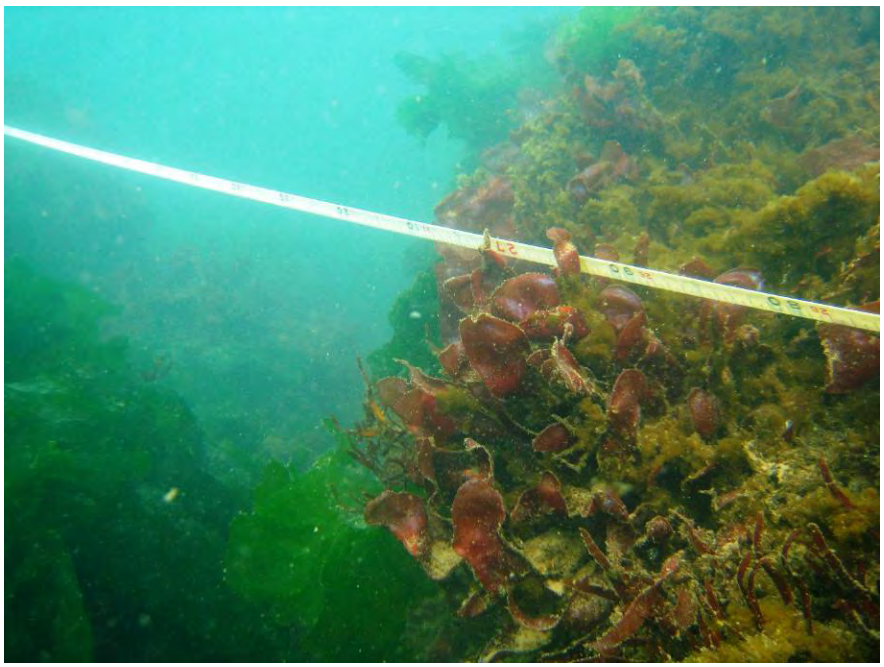

Figure 5. Rocky habitat at a depth of -3 m (-10 ft) MLLW in Zone 2 with a dense understory of red algae and green sea lettuce (*Ulva* spp.).

Figure 6. Low-relief sand area at a depth of -10 m (-33) ft MLLW in Zone 4 between the east and west breakwaters. The dark patches are clusters of low-growing foliose brown algae and benthic filamentous diatoms.

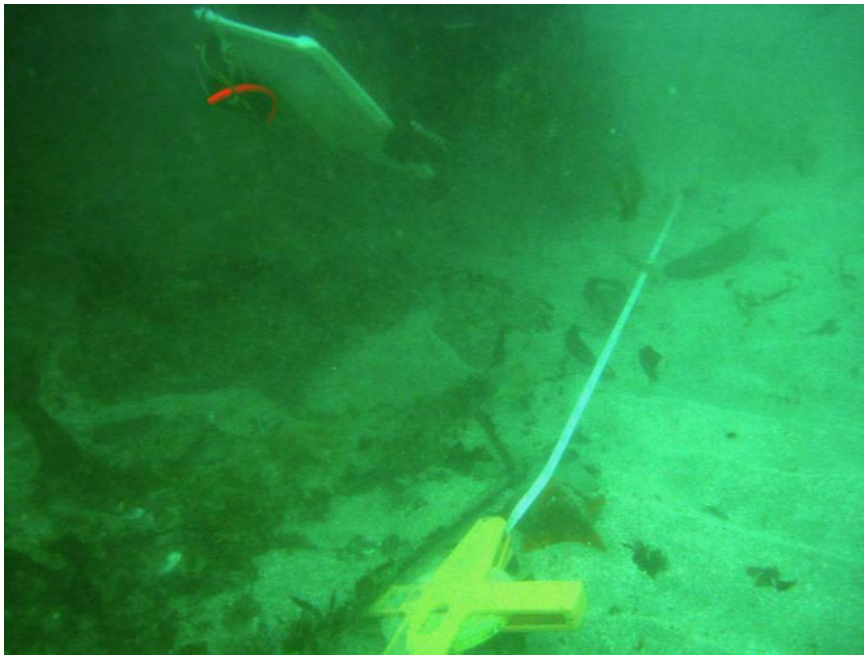

Figure 7. Diver-biologist surveys transect segment at -13 m (-43 ft) MLLW depth in Zone 5. Drift algae at the sand-rock interface includes detached fronds of tree kelp *Pterygophora californica*.

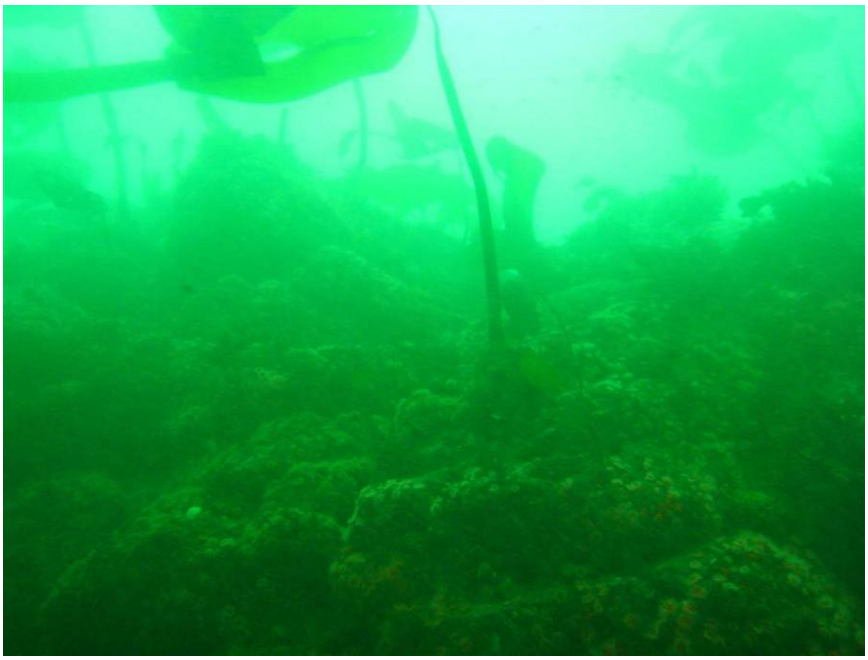

Figure 8. Rock outcrop at depth of -17 m (-56 ft) MLLW in Zone 5 at intake cove entrance. The sessile biota includes colonies of strawberry anemone, encrusting bryozoans and sponges along with scattered oar kelp plants *Laminaria setchellii*.

Figure 9. Examples of macro-invertebrate fauna observed along the survey corridor: A) bat star (*Patiria miniata*), B) strawberry anemone (*Corynactis californica*), C) anemone (*Urticina* sp.), D) tube anemone (*Pachycerianthus fimbriatus*), E) moon snail (*Euspira lewisii*), and F) sea cucumber (*Parastichopus parvimensis*).