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Adding Texture and Relief to Seattle's New Seawall, an Application of Ecological Engineering

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Habitat Enhancements in Seattle's Seawall– Ecological Engineering and Adaptive Management

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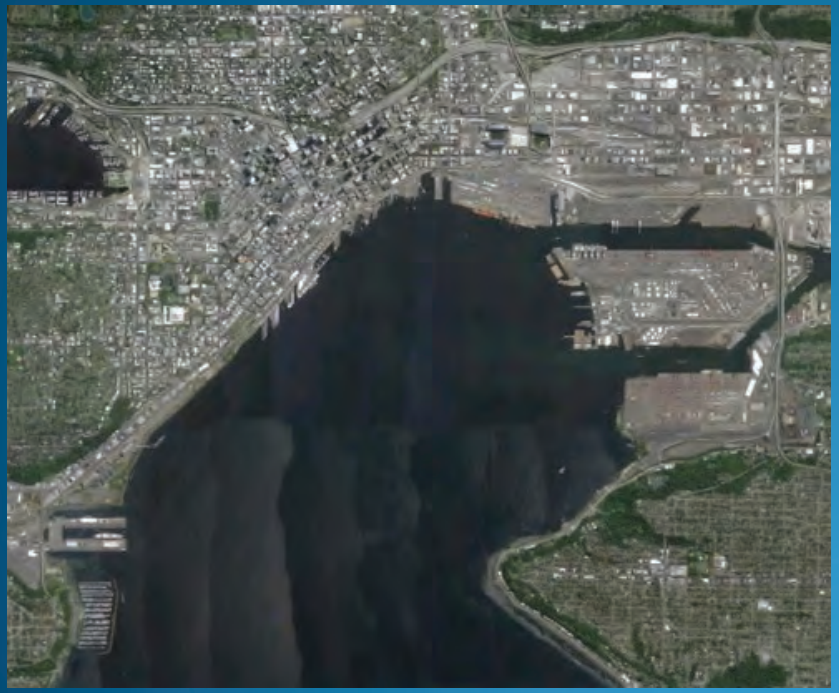


Elliott Bay Seawall Project

Sea Grant Washington

ESTUARY & SALMON RESTORATION PROGRAM

King Conservation District

Seattle Art Museum

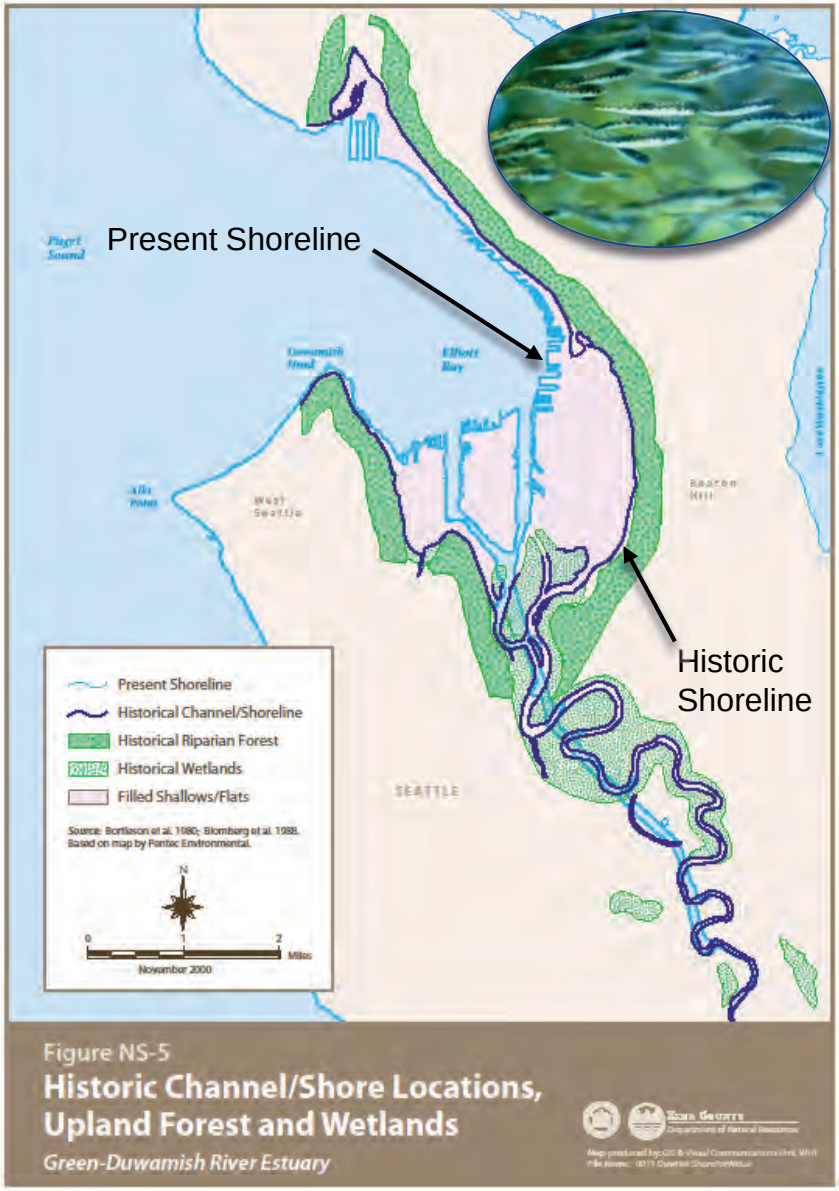
SDOT Seattle Department of Transportation

Seattle Seawall

- Seawall was built in 1930's to create a deep-water port.
- This transformed a sloping beach to a vertical wall
- Few shallow areas remain within the Seattle waterfront area
- 2001 Nisqually earthquake caused a 100-foot section of the seawall to settle, and inspections showed that it was in disrepair and needed to be rebuilt

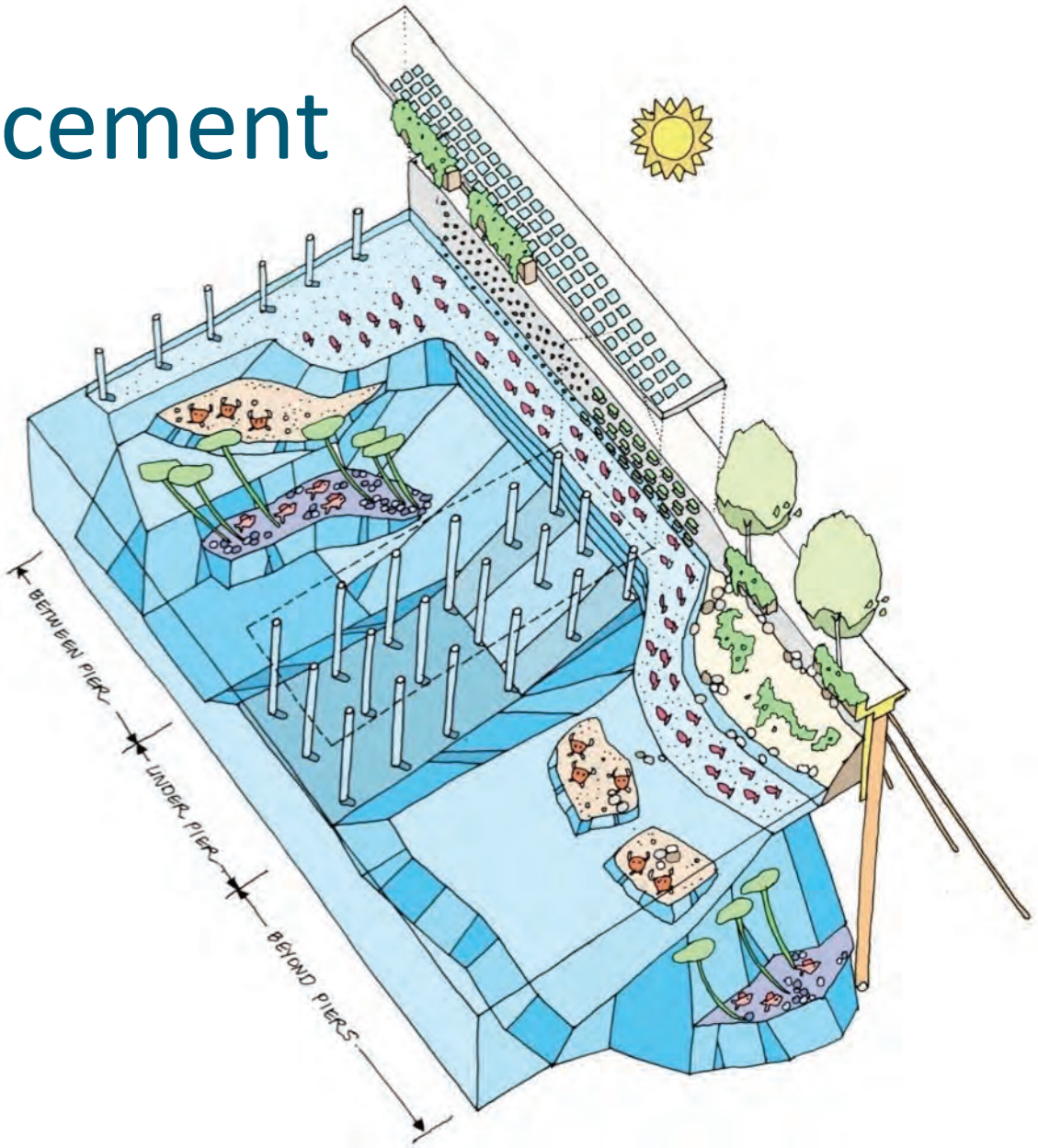
Shoreline Salmon

- Migratory corridor & rearing habitat for juvenile salmon
- Green River and Duwamish populations
  - Pink, Chum, and ESA listed Chinook salmon outmigrate along Seattle's waterfront
  - City of Seattle sponsored UW research found:
    - Juvenile salmon were abundant very close to the seawall
    - Their diets were linked to intertidal



Habitat Enhancement

- New seawall
- Intertidal corridor
- Lighting
- Riparian vegetation
- Textured wall
- Substrate enhancement
- Cobble reefs



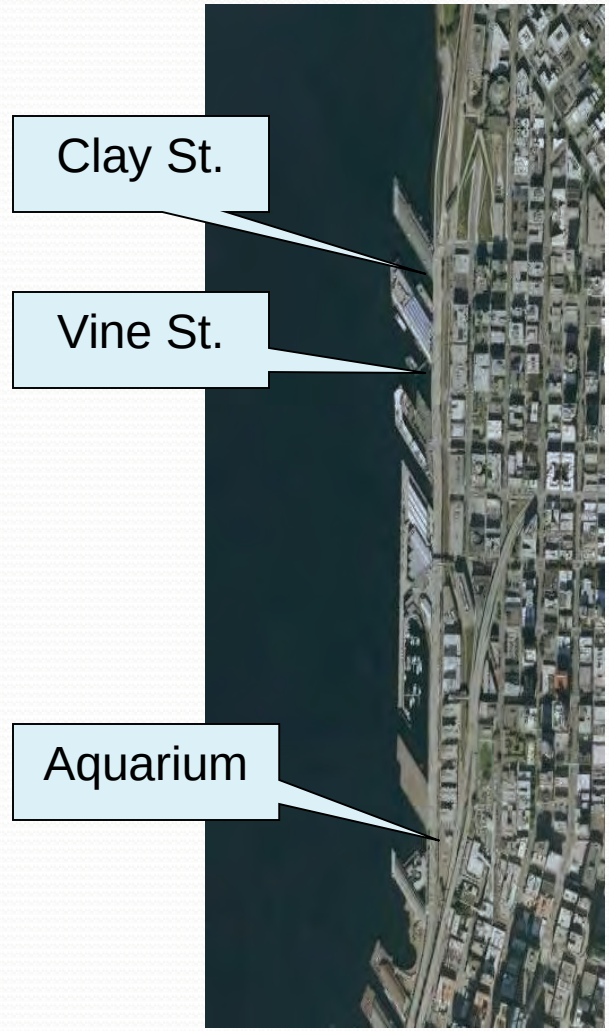
Olympic Sculpture Park habitat enhancement: replaced shoreline armoring with a beach and a habitat bench

- Habitat bench resulted in enhanced juvenile salmon densities, increased chum salmon feeding rates, increased invertebrates
- Pocket Beach resulted in increased larval fish, Chinook feeding rates, some invertebrate taxa

Toft, J.T., Ogston, A.S., , Heerhartz, S.M., Cordell, J.R., Flemer, E.E. 2013. Ecological response and physical stability of habitat enhancements along an urban armored shoreline. *Ecological Engineering*, 57: 97-108.

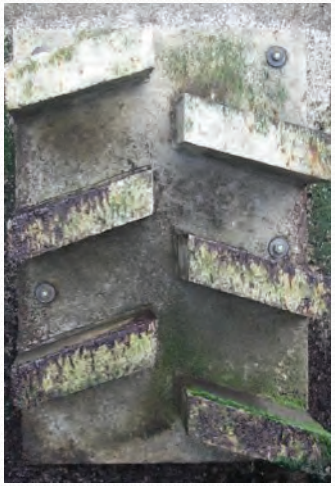
Textured Seawalls

3 Sites



3 panel designs, each with 2 surface treatments;
plus Reference and Control






Mussels

- Early high recruitment of mussels on cobble surfaces
- After four years, mussel populations had increased greatly on most of the panel types as compared to the pre-existing seawall surface.

Rockweed

- Rockweed favored the higher relief of the finned and stepped panels, regardless of whether or not they had the cobble texture.

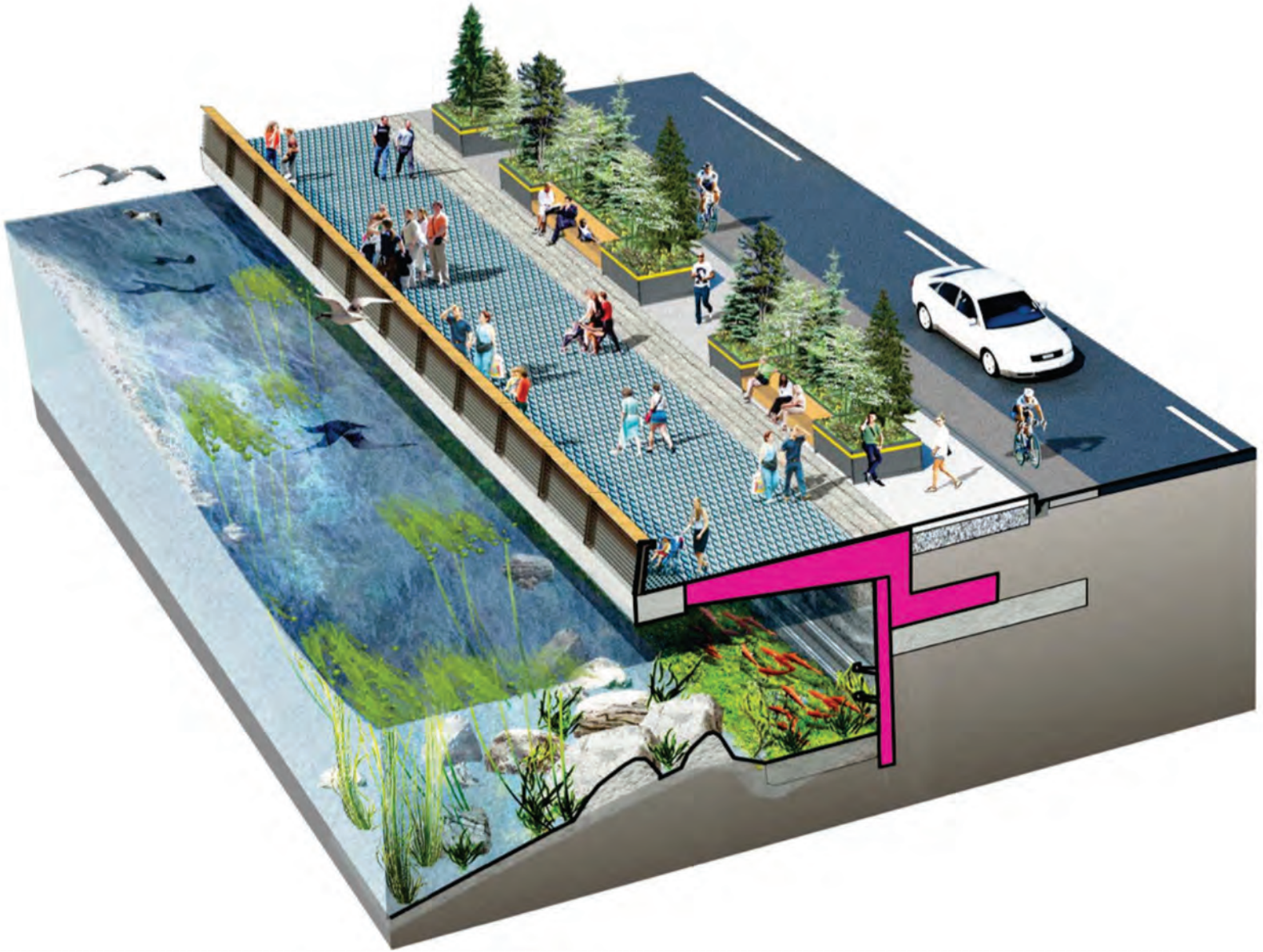
Epibenthic Invertebrates

- Small invertebrates favored by juvenile salmon had higher species diversity on the stepped and finned panels.

Outcome

Engineered habitat enhancements—addition of habitat benches, beaches and textured walls—are being added to Seattle's seawall to improve ecology of the intertidal zone.

- **Desired Results:**
- Increased diversity and abundances
  - Epibenthic organisms (harpacticoid copepods)
  - Sessile Organisms
- Benefits for juvenile salmon
  - Outmigration corridor
  - Feeding opportunities



Adaptation of Habitat Plan—Addition of Light

- The seawall rebuild will pull the seawall back 10-15 feet, but the sidewalk will stay where it is, shading the habitat.
- Juvenile salmon do not like to cross shadow lines, and are uncommon in shaded habitat under piers.*
- Salmon do not feed under piers, and little is known about how much light they require to feed.*
- Shaded habitats do not produce algae and invertebrates that comprise the food web.

*Munsch, S.H., Cordell, J.R., Toft, J.T. In press. Effects of seawalls and piers on fish assemblages and juvenile salmon feeding behavior. *North American Journal of Fisheries Management*.

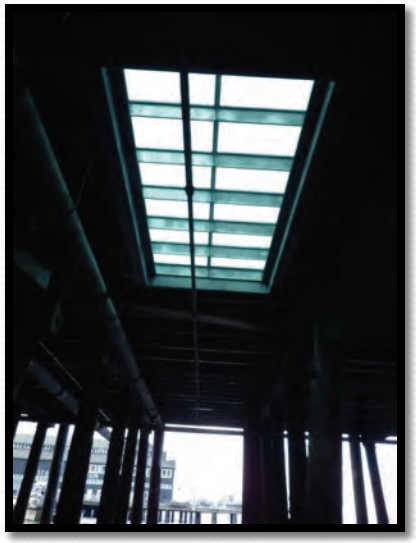
Juvenile Chinook salmon feeding

Light Penetrating Surfaces

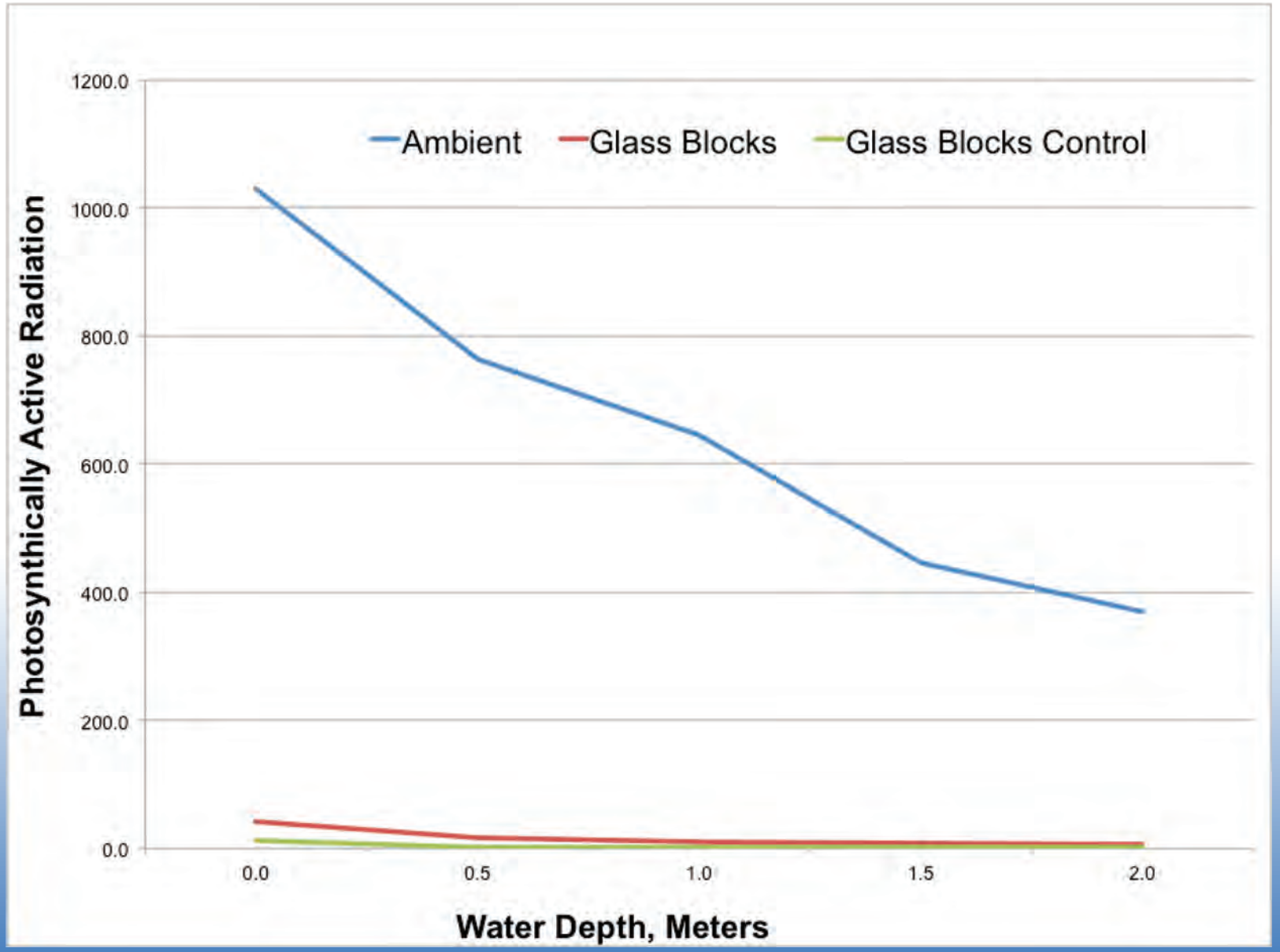
Metal Grating

Glass Panels

Solar Tube



Light Penetration Under Glass Panels



Recommendations

- Post construction monitoring, as per the 10-year monitoring and adaptive management plan
- Prolonged salmon observations under piers using cameras
- Quantifying light levels under & adjacent to piers under a variety of weather conditions and throughout salmon presence window
- Effects of LPS on invertebrate communities