

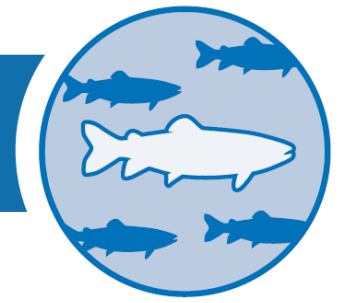
Beach Nourishment in the Salish Sea & Birch Bay – the region’s largest beach nourishment/restoration project

Jim Johannessen, MS, LEG

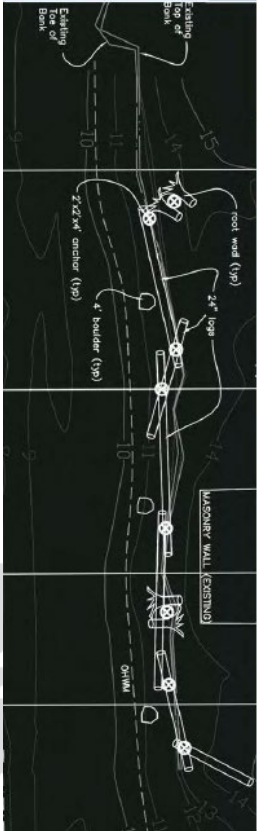
Natural Systems Design + Coastal Geologic Services



Marine Shoreline Design Guidelines



Washington State Aquatic Habitat Guidelines Program



Marine Shoreline Design Guidelines

MSD G

Coastal Geologic Services, with a chapter by Qwg Geology, 2014
Prepared for WDFW and:



The Aquatic Habitat Guidelines Program

The Marine Shoreline Design Guidelines is one of a series of guidance documents being developed by the Aquatic Habitat Guidelines (AHG) Program. AHG is a joint effort among state resource management agencies in Washington, including the Washington Departments of Fish and Wildlife, Ecology, Transportation, and Natural Resources; the Recreation and Conservation Office, and the Puget Sound Partnership.



Beach Nourishment in the Salish Sea, April 17, 2024

Shoreline Stabilization Continuum

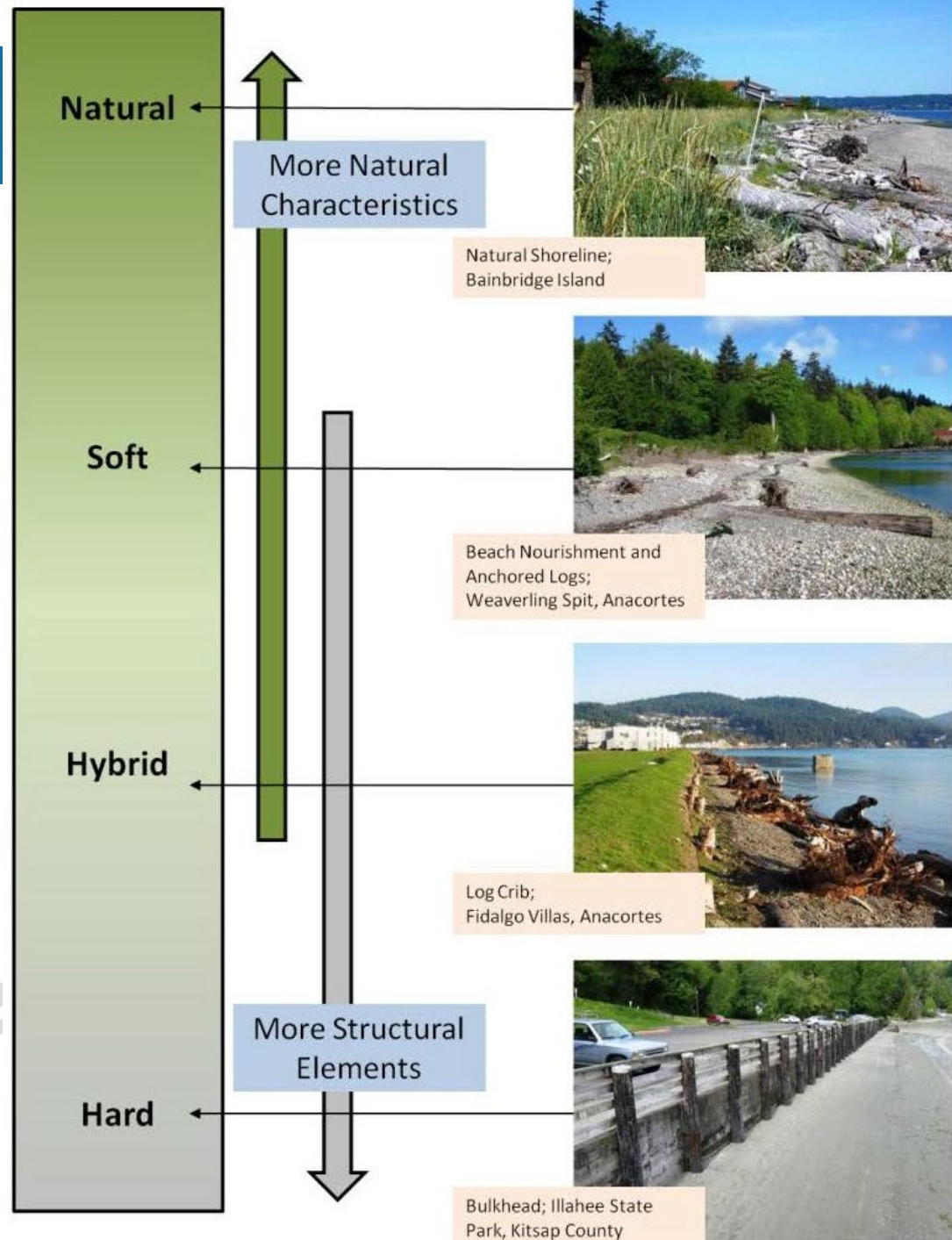
Natural Shoreline

Soft Shoreline Protection (Nature-based design)

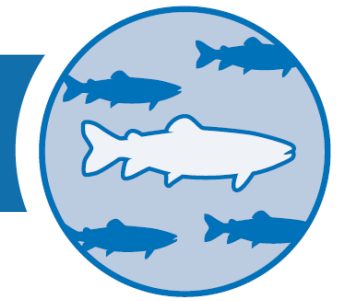
Hybrid Stabilization

Hard Shoreline Stabilization

From: Soft Shoreline Stabilization - Shoreline Master Program Planning and Implementation Guidance
K Gianou, Ecology Pub.14-06-009



Range of Design Techniques

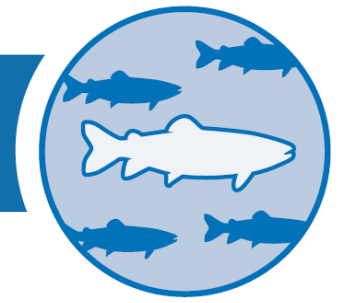


In Marine Shoreline Design Guidelines

Type of Approach	Design Technique	Key Elements	Impacts to Processes
Restoration	Bulkhead removal	Removal of structures to restore the natural beach profile	Improvement
Passive Techniques	Best management practices Vegetation management Relocation	Nonengineered management practices such as planting native vegetation and managing surface and groundwater Preservation/enhancement of natural processes Infrastructure unaffected, relocated, or removed	None
Soft Shore Protection	Beach nourishment Large wood Reslope/revegetation	Preservation of natural processes and coastal dynamics Use of natural materials Slowing rather than eliminating erosion	Low
Hard Armor	Revetments Vertical bulkhead (“seawall”)	Halting natural processes, creating a static shoreline Lost beach area and substrate Attempts to eliminate erosion	Moderate-to-high

- Design techniques can be used alone or in combination
- The spatial extent can vary from portion of a parcel to multiple parcels
- Designs should address the project needs/objectives

Marine Shoreline Design Guidelines

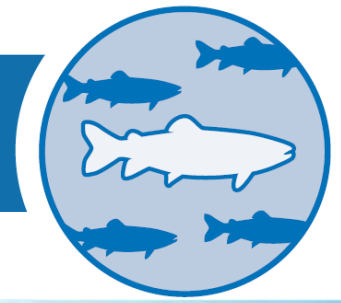


Chapter 7: Beach nourishment - Description

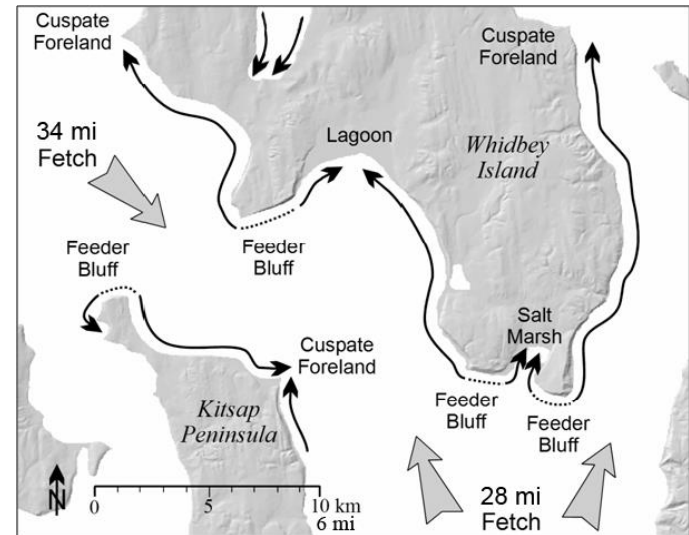
- Artificial placement of sand and gravel to increase the volume of beach sediment
- Often used to replace degraded sediment supply
- Sediment size similar to or slightly larger than native; gravel beach nourishment is common in the region
- Offsets millennia of beach sediment mining
- Nourishment is very common worldwide



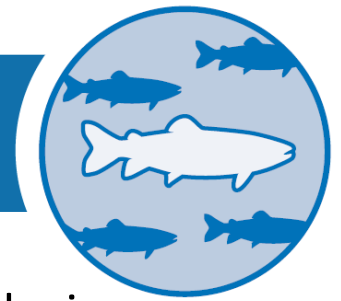
Application



- Erosion control through creating a broad and higher beach profile (augment sediment volume on site)
- Mitigate for beach and backshore erosion/damage
- Mitigate for loss of fine or mixed grain sediment for habitat restoration/enhancement
- Augment littoral sediment supply for down-drift beaches and habitats



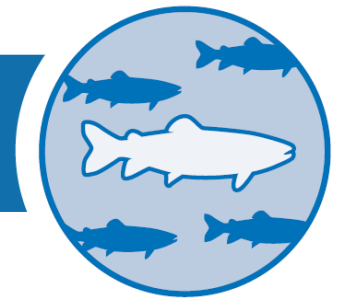
Effects



- Replenished beach profile absorbs incoming wave energy, reducing wave runup
- Coarser sediment leads to steeper beachface and higher berms to absorb wave energy and partially reflect waves
- A higher storm berm reduces overtopping & backshore erosion/damage
- Can provide sediment to down-drift beaches
- Coarser sediment can impact habitats such as forage fish spawning and benthic invertebrate assemblages



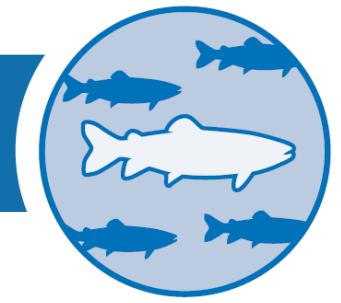
Design Elements



- Project length and placement approach
- Wave energy and volume density
- Site geometry →
- Sediment size selection
- Beach habitat consideration
- Site grading



Beach Habitat Considerations



- Sediment much coarser or finer than native impacts native habitats
- Forage fish spawning (1-7 mm grain sizes) near and below MHHW
- Avoid/minimize impacts to eelgrass
- Consider littoral transport of native and placed sediment

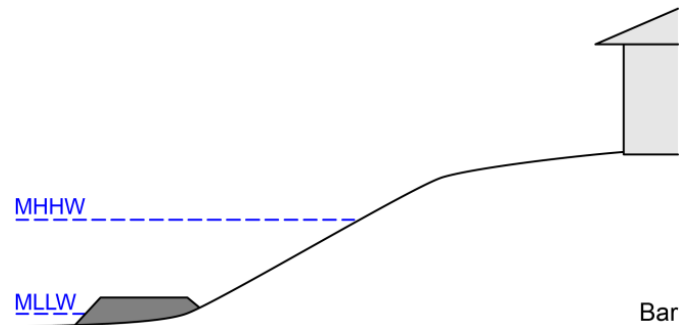
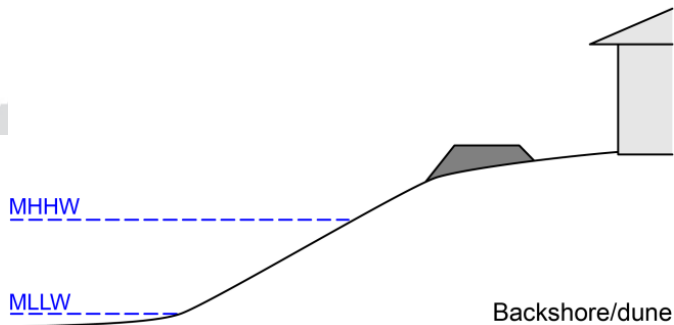
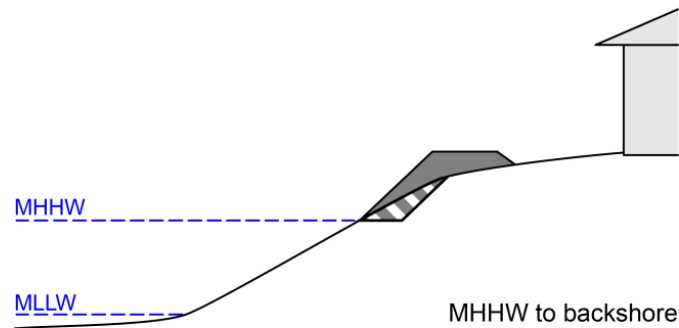
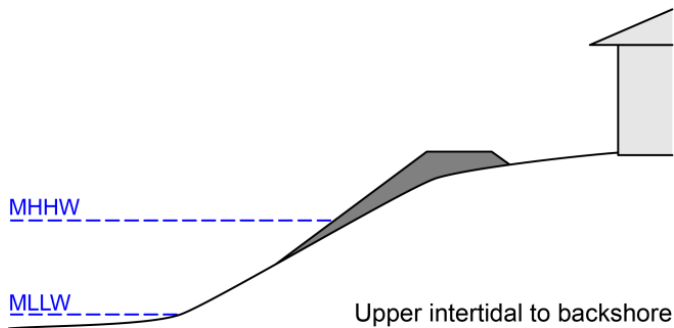
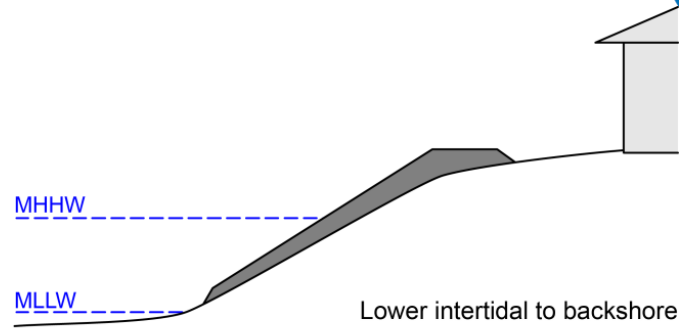
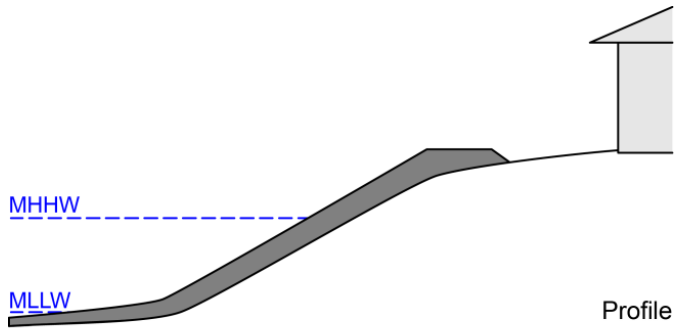
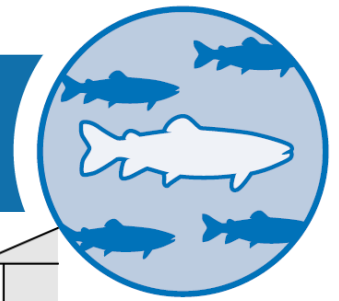


Lummi Shore Road Before/
After revetment *and* nourishment

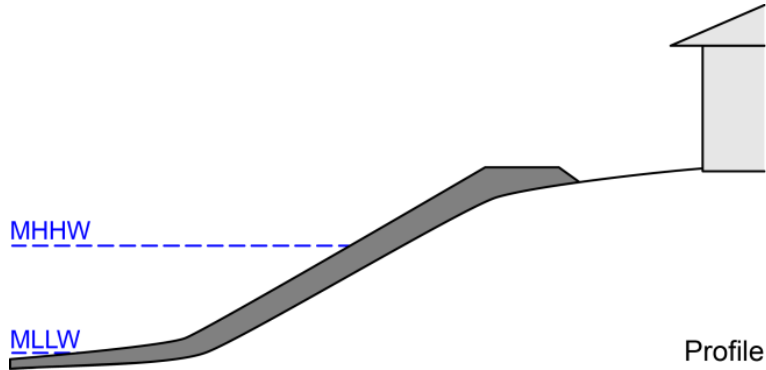


Beach Nourishment in the Salish Sea, April 17, 2024

Project Length and Placement Approach



Profile Placement



Profile

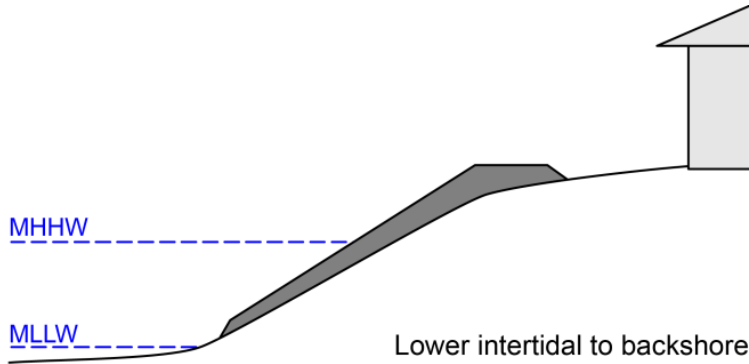
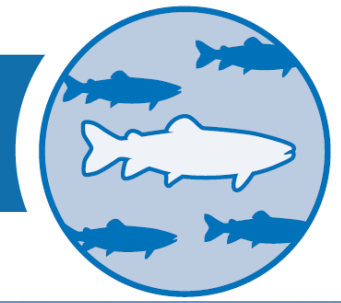
Seahurst Park, Burien
2004, 2010



North Beach, Samish Is, Skagit Co.
1998



Lower Intertidal to Backshore Placement



Driftwood Beach, Blakely Is., San Juan Co.

1998

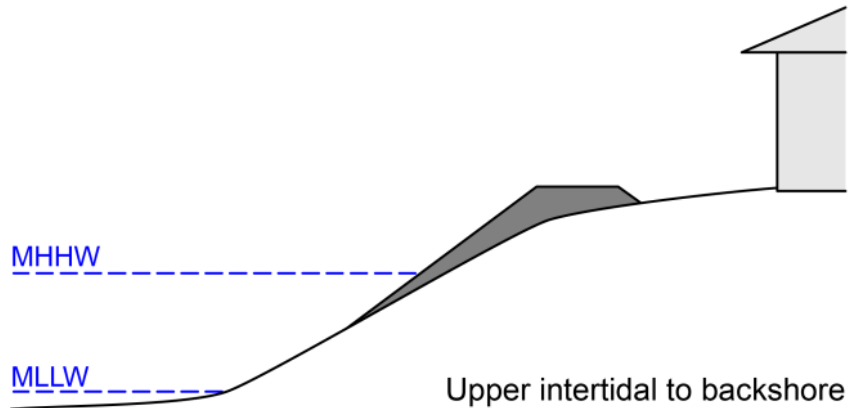
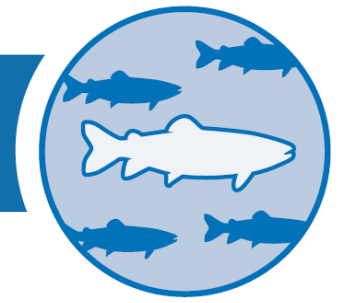


Tolmie State Park, Nisqually

1978



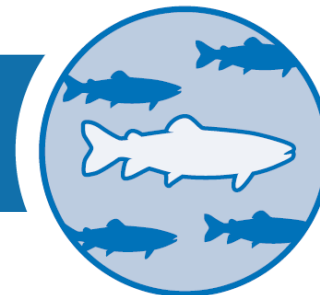
Upper Intertidal to Backshore Placement



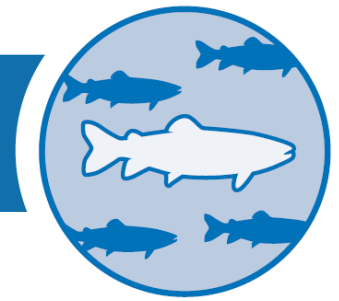
Oak Bay, Jefferson Co.
1999



Cost



Project Name	Project Length (ft)	Year Installed	Density (CY/ft)	Cost 2012 Dollars	Cost Per ft-2012 Dollars	Cost Per CY-2012 Dollars
East Dungeness	1,500	2006	1.2	267,632	178	154
Snakelum Point	50	2002	0.8	8,551	171	225
Marine Park Bellingham	300	2004	10	243,085	810	88
North Beach Orcas Is.	510	1992	4.9	75,277	148	30
East Lummi Island	181	2004	2.4	9,116	50	21
Seacrest Park	1200	1988	-	873,350	1,092	-
Seahurst Park-South	1,050	2005	7.5	1,293,156	1,232	165
Mount Baker Terminal	1,100	2005	12.7	1,998,514	1,817	143
Blakely Is.-Driftwood Bch	650	1999	2.5	110,249	170	68



Birch Bay – The story of the region’s largest beach nourishment/restoration project

Jim Johannessen, LEG
NSD + CGS



Roland Middleton, LEG
Whatcom Co. Public Works

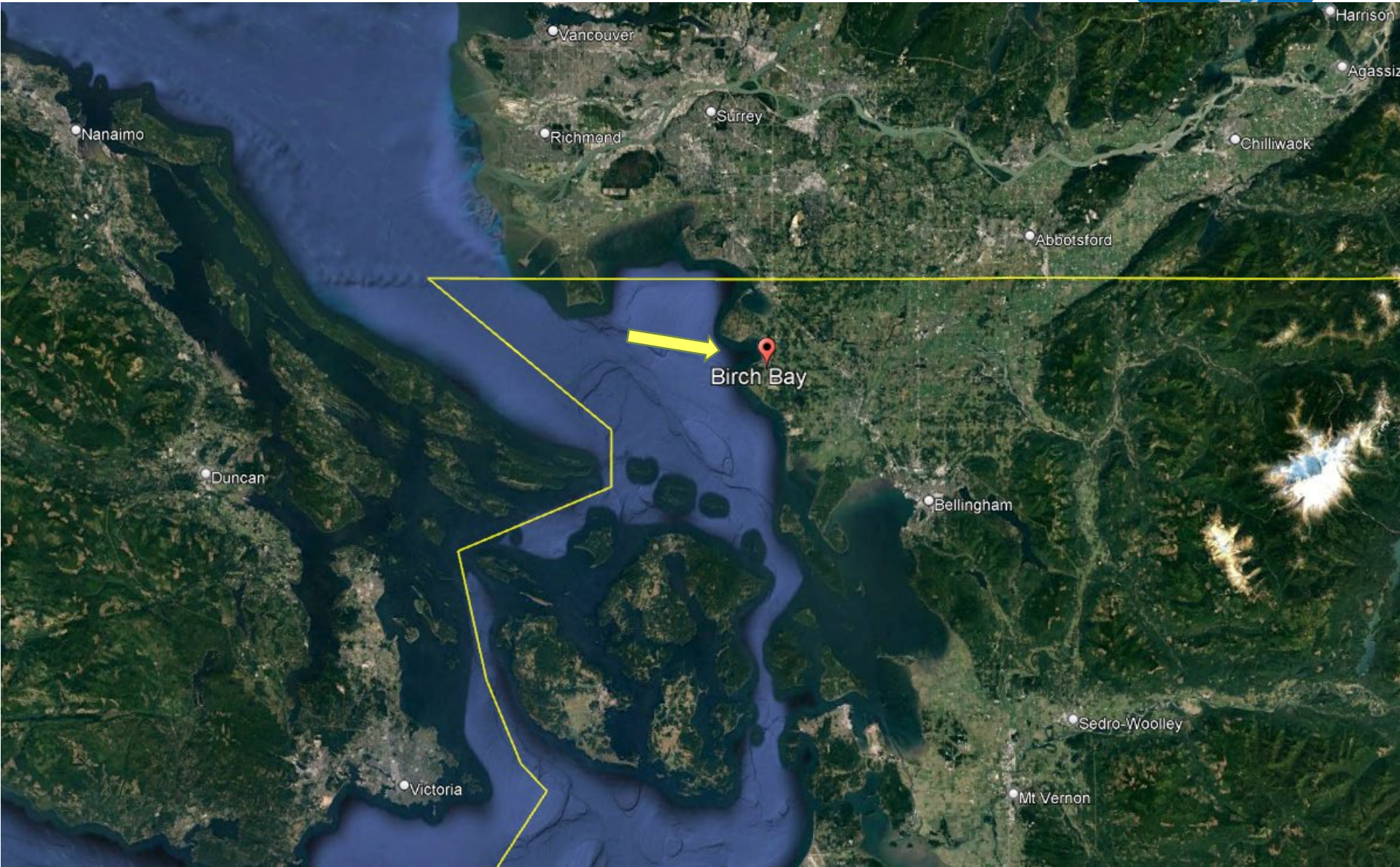
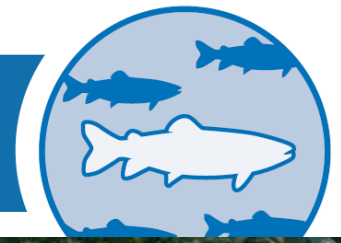


Wolf Bauer, PE

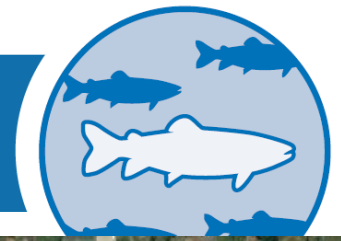
Bob Battalio, PE
ESA



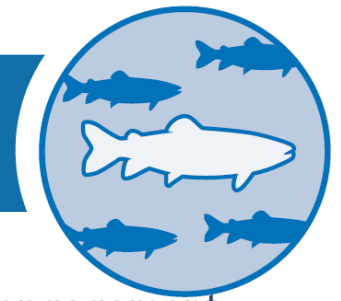
Location



Location



Project Team



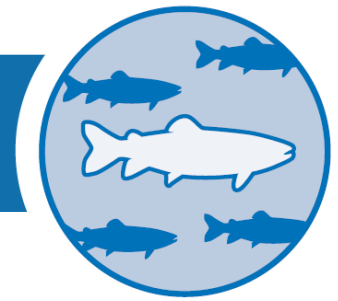
Whatcom Co. Public Works: Owner/Project management, funding, community engagement, bidding, implementation

ESA (Environment Science Associates): Prime consultant, management, wave modeling, civil engineering, drainage/outfall design, biological reporting, landscape architecture, cultural resources, permitting

Coastal Geologic Services (now NSD + CGS): Shore change, reference beach study, Rogers Slough study, sediment source study, past nourishment history and monitoring, co-lead beach nourishment design, post-project monitoring



Project Timeline, Metrics



1975 - Wolf Bauer beach concept

1986 - pilot beach nourishment project built

...outreach & project development, pilot project monitoring

2014-2020 - design, right of way acquisition, permitting

2020-2021 – construction:

1.6-mile-long beach nourishment project

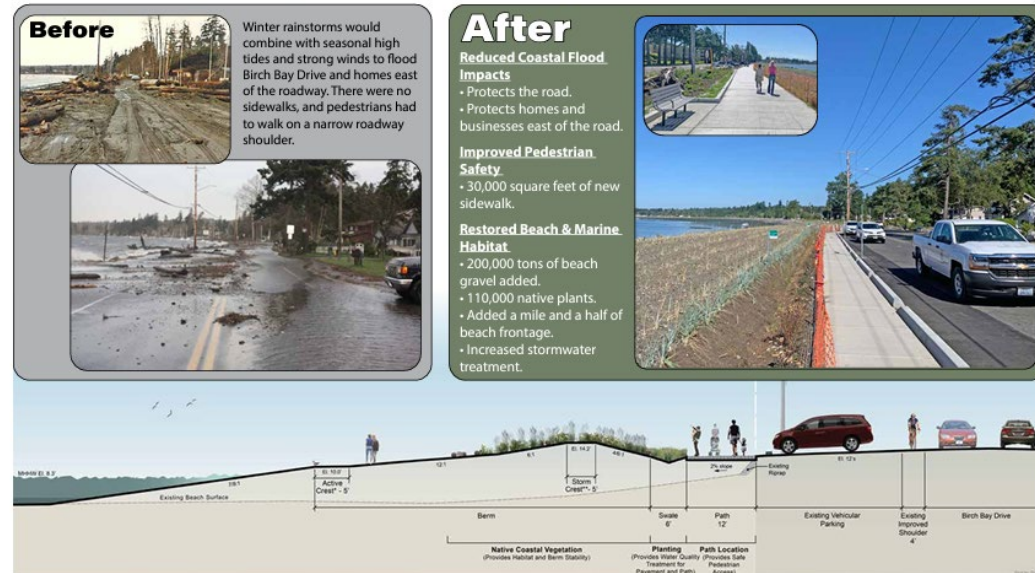
105,000 cubic yards of gravel and sand graded

\$15.3 million project



Birch Bay Drive & Pedestrian Facility AKA 'The Berm'

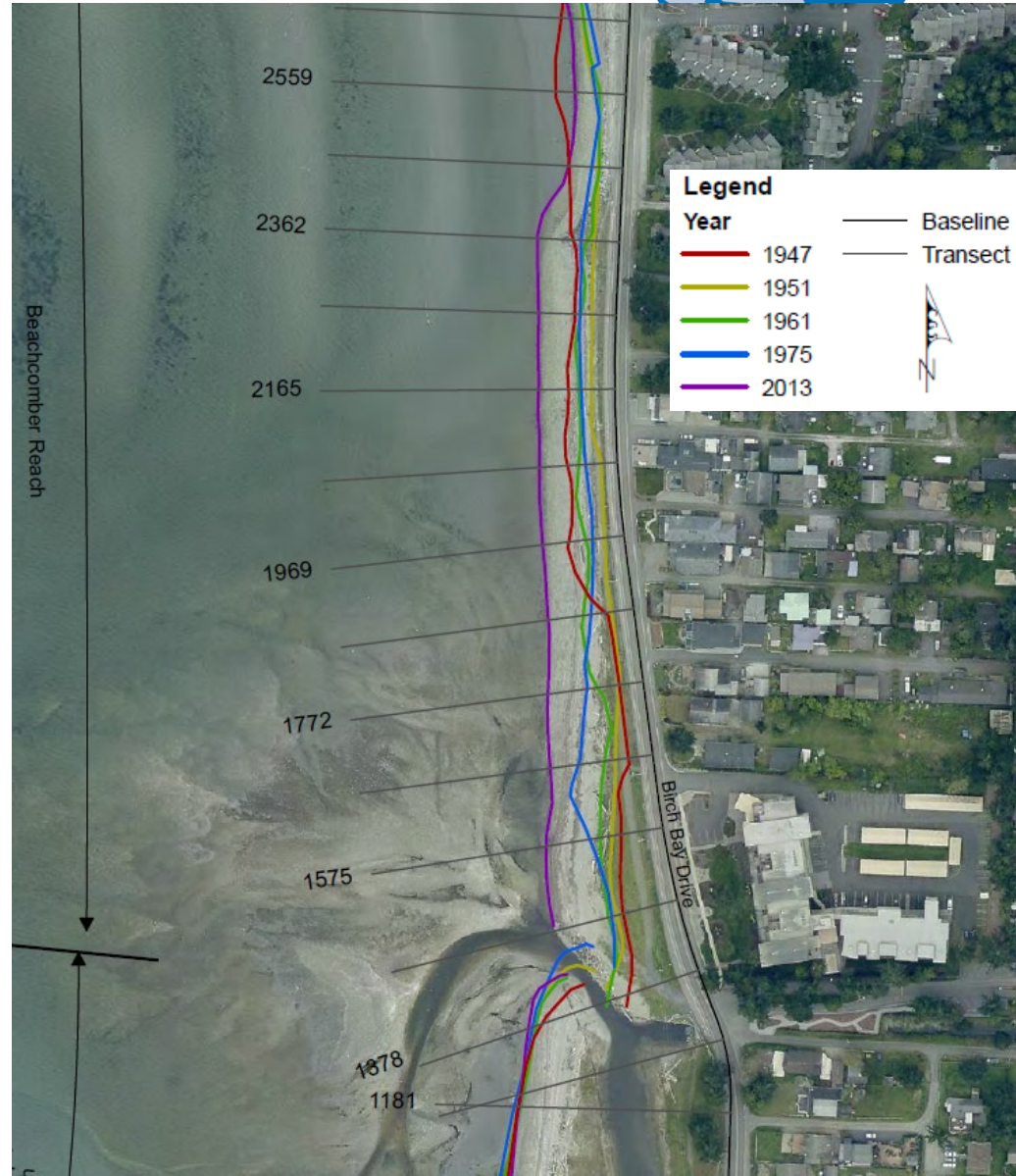
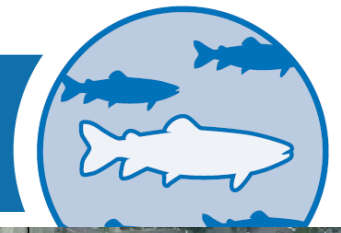
The largest project Whatcom County Public Works has ever done!



Past Storms



Shore Change Mapping



Shore Change Mapping



Legend

Year

- 1947
- 1951
- 1961
- 1975
- 2013

— Baseline

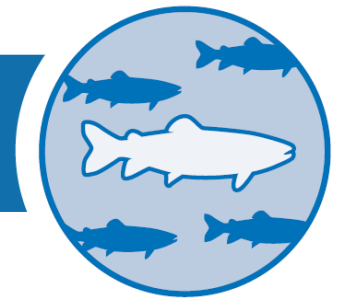
— Transect



Shore Change M



Project Goals



Public Involvement

Minimize Disruptions & Disturbances

Shoreline Restoration

- Improved habitat
- Improved recreational access
- Improved flood protection
- Improved road preservation

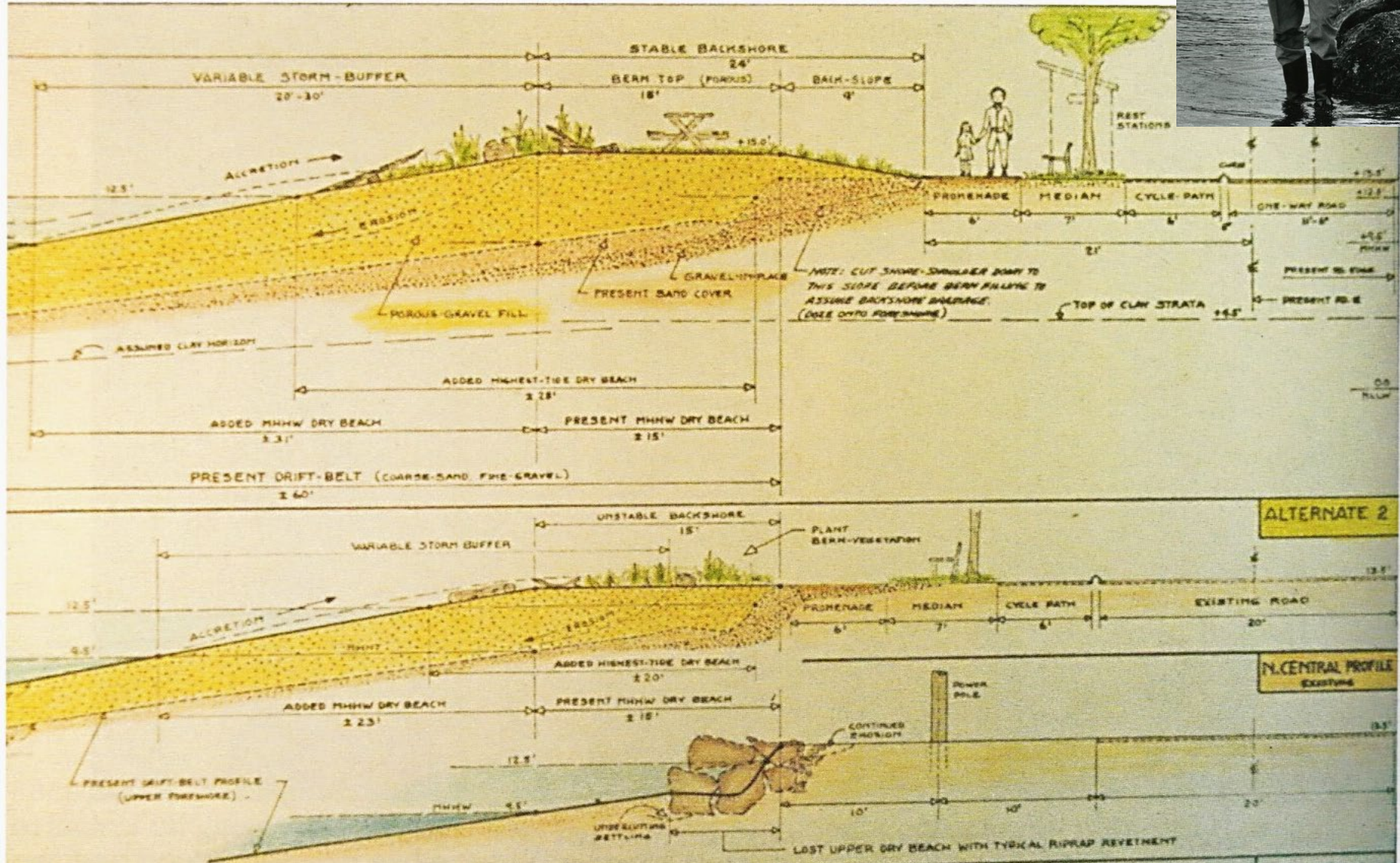
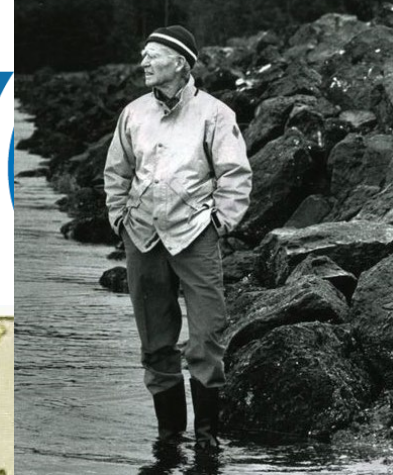
Infrastructure Rehabilitation

- Protect Birch Bay Drive with soft shore protection
- Seawall replacement
- Improved pedestrian facilities
- Coast Millennium Trail connection
- Improved storm drainage systems

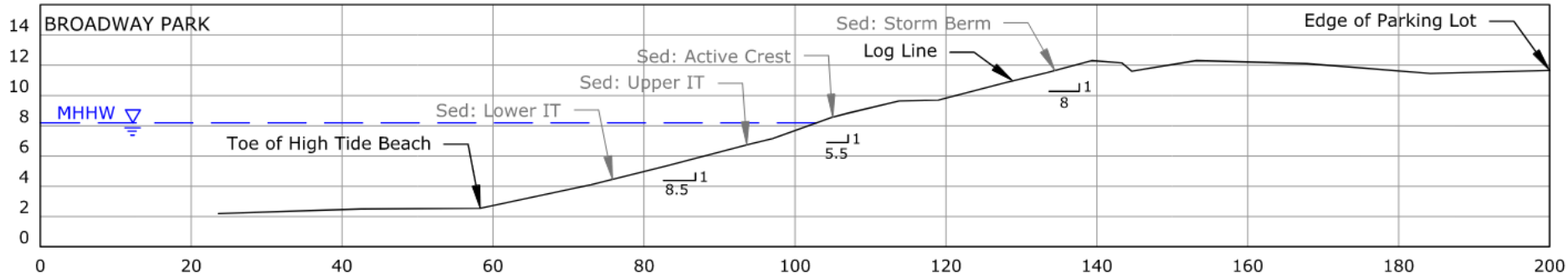
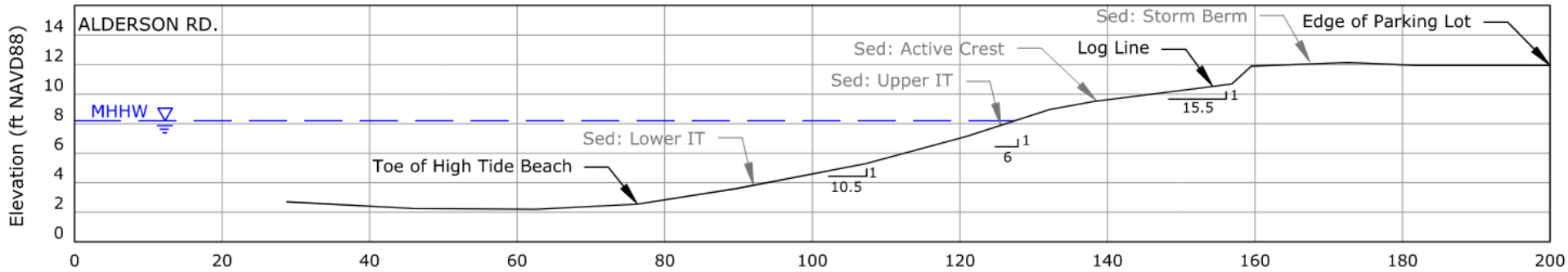
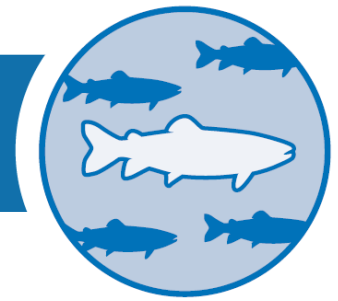
Other

- Aesthetics
- Preserve trees wherever possible
- Minimize cultural resource disturbance
- Provide amenities, signage, and landscaping

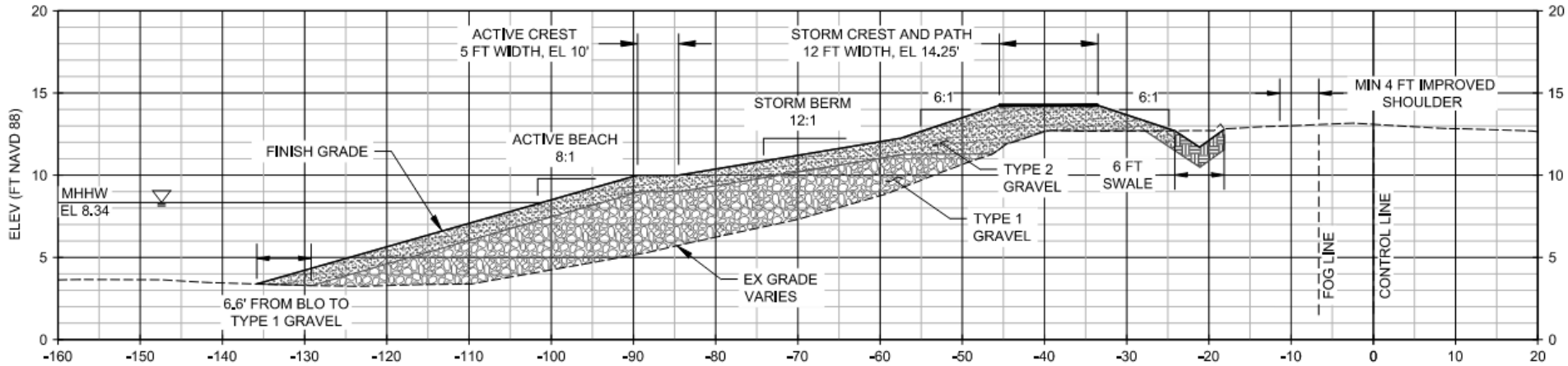
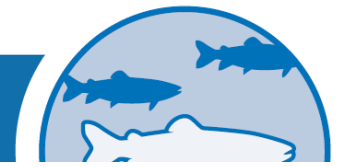
Wolf Bauer's 1975 Cross Sections



Reference Beach Cross Sections

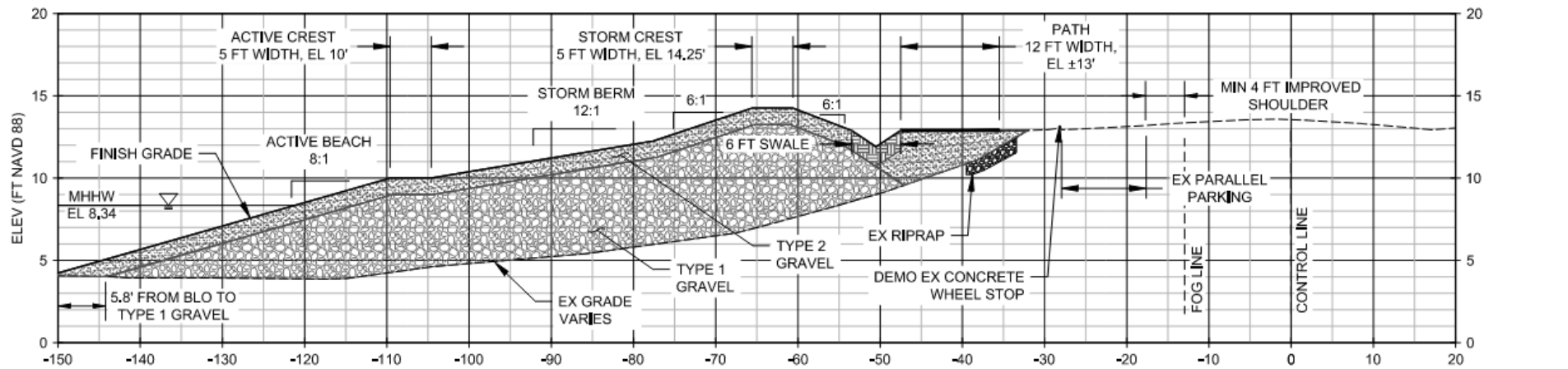


Cross Section – Design Sheets (typical)



G
-
TYPICAL BERM GRADING - STA 32+00 TO 34+00

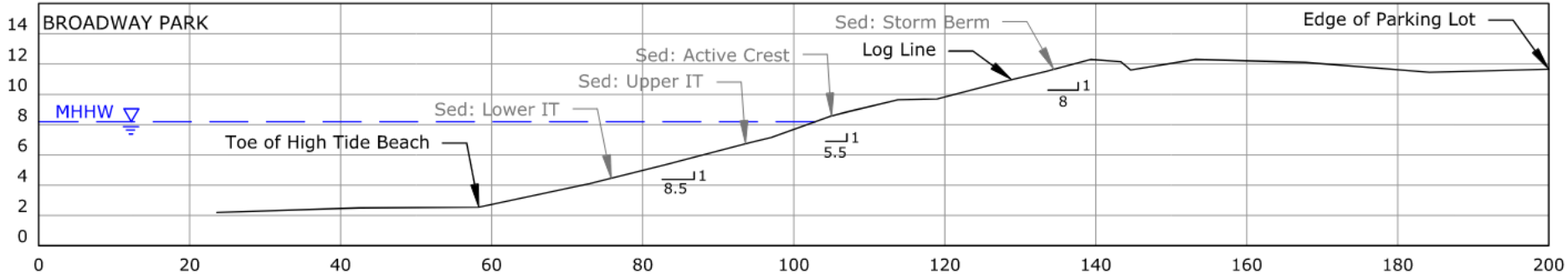
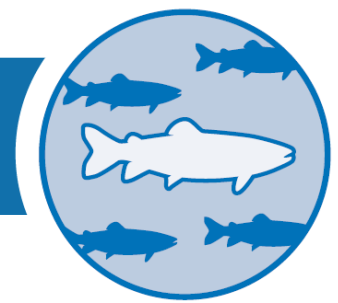
SCALE (WHEN PRINTED 22"X34"):
HORIZONTAL: 1" = 10'
VERTICAL: 1" = 5'



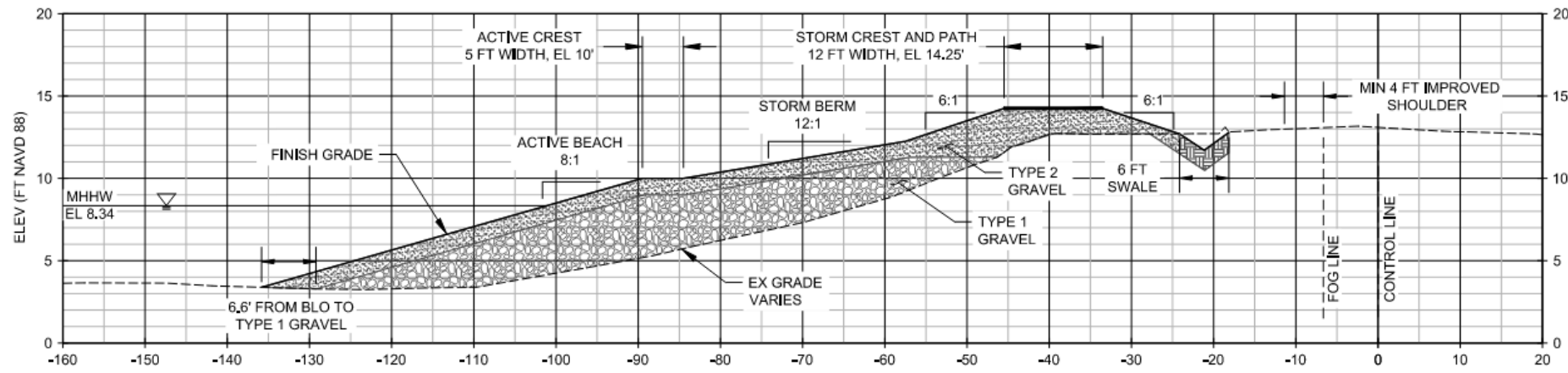
H
-
TYPICAL BERM GRADING - STA 34+00 TO 41+00

SCALE (WHEN PRINTED 22"X34"):
HORIZONTAL: 1" = 10'
VERTICAL: 1" = 5'

Cross Section Comparison



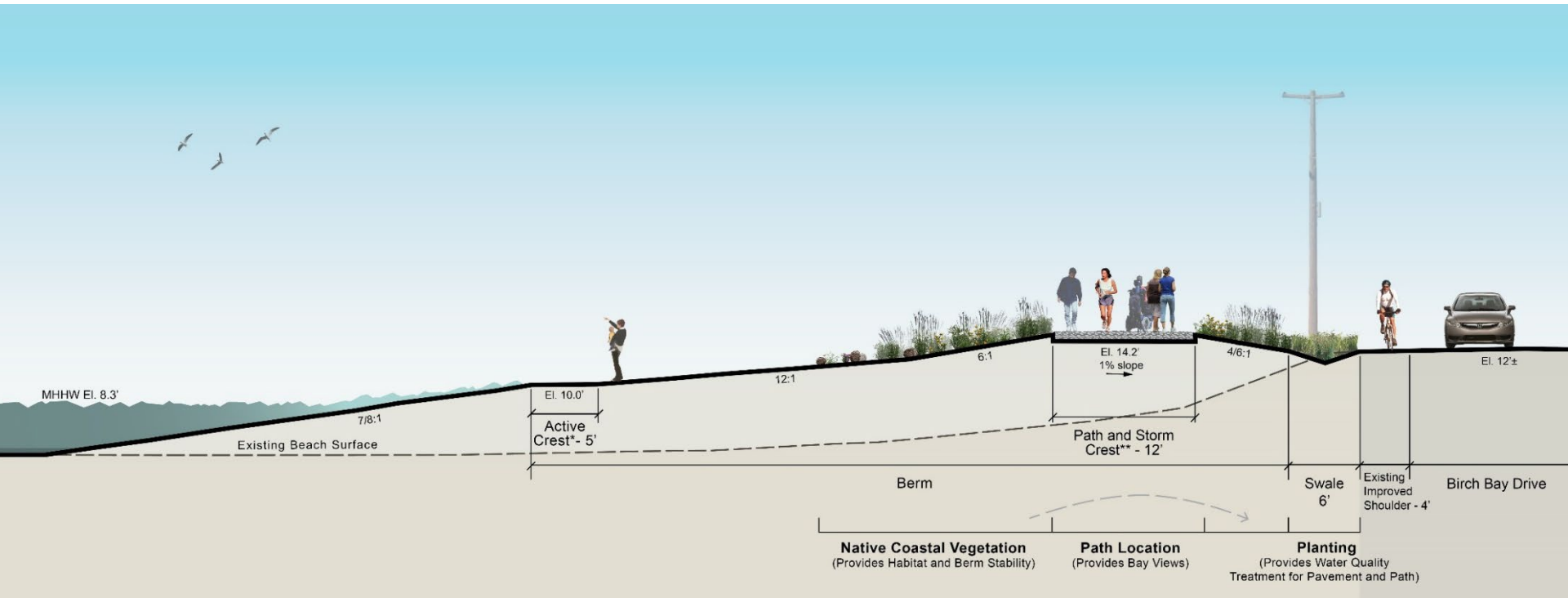
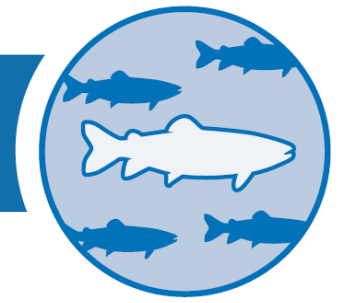
Toe high-tide beach |



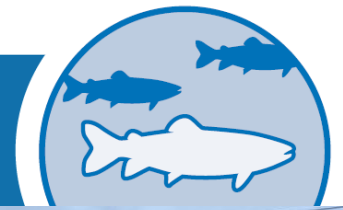
G TYPICAL BERM GRADING - STA 32+00 TO 34+00

SCALE (WHEN PRINTED 22"X34"):
 HORIZONTAL: 1" = 10'
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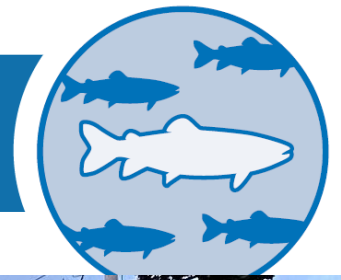
Cross Section - Landscape



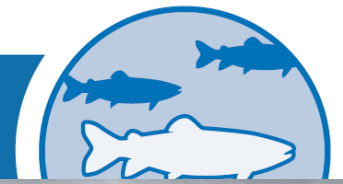
Implementation 2019-2020



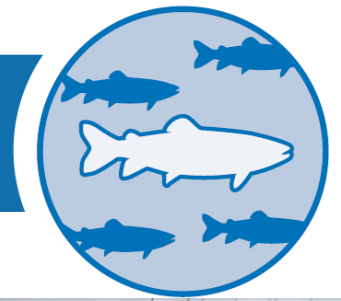
Grading



Winter beach, Backshore planting



Water quality swales, planting



Dec 20, 2018, as construction started

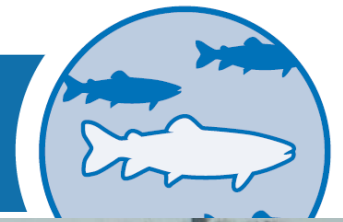
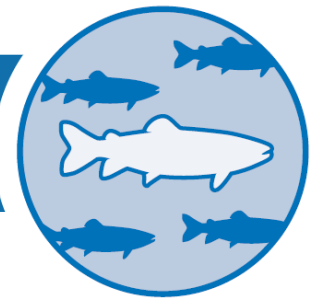


PHOTO BY OLIVER LAZENBY,
NORTHERN LIGHT

County Graphic



BERM AND RESTORED NATURAL SHORELINE BEFORE JAN. 13, 2021 STORM SHOWING SLOPING BEACH.



BERM AND RESTORED NATURAL SHORELINE AFTER JAN. 13, 2021 STORM SHOWING LOGS PUSHED UP BEACH, BUT NOT ON THE ROADWAY.



Jan. 7, 2022 Storm – South of project

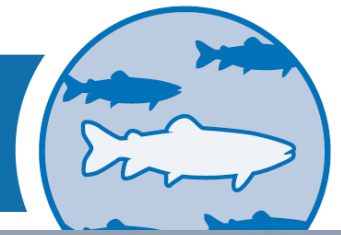
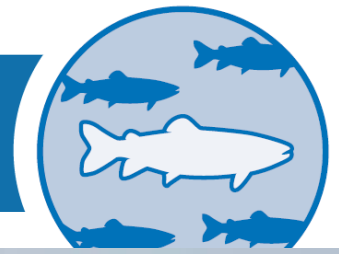
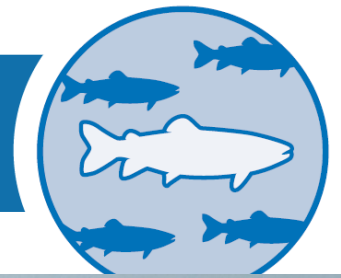


photo by WARREN STERLING

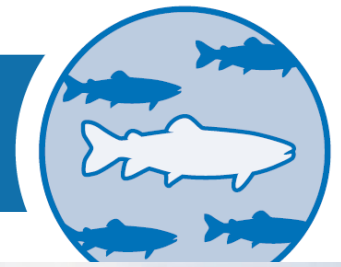
Jan. 7, 2022 Storm at high water



South of Project area – Post storm



Greatest Overwash Area

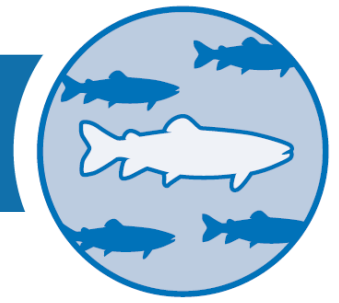


High water debris line near 31+00, Jan 2021.

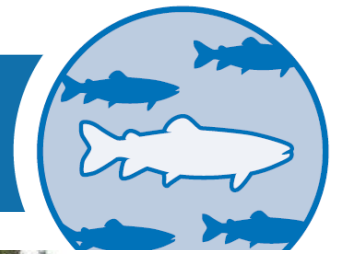


High water debris line near 31+00, Jan 2022.

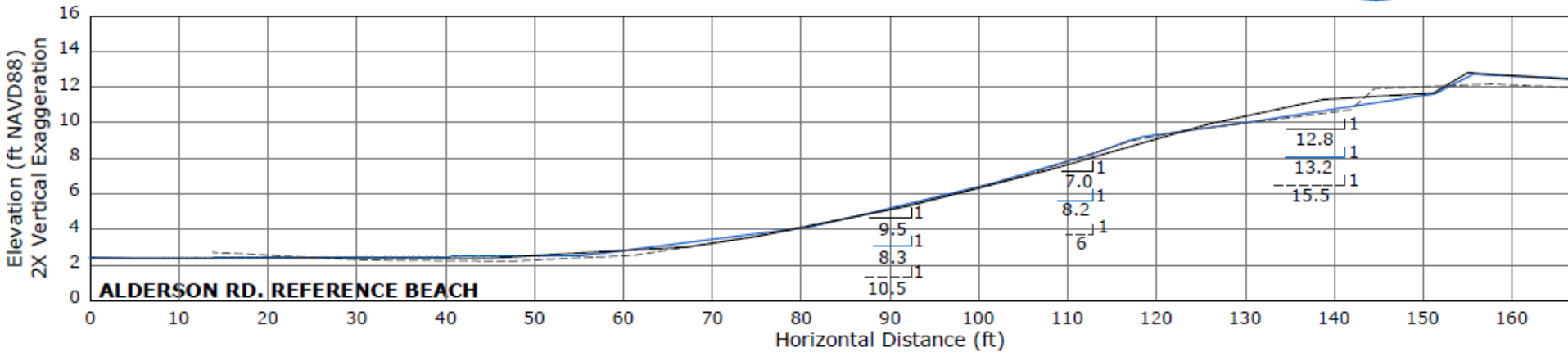
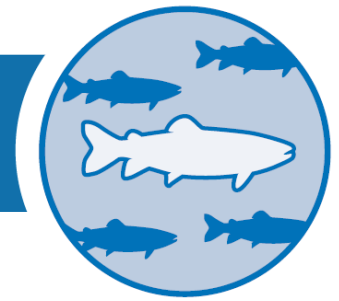
Jan. 8, 2022, Post storm



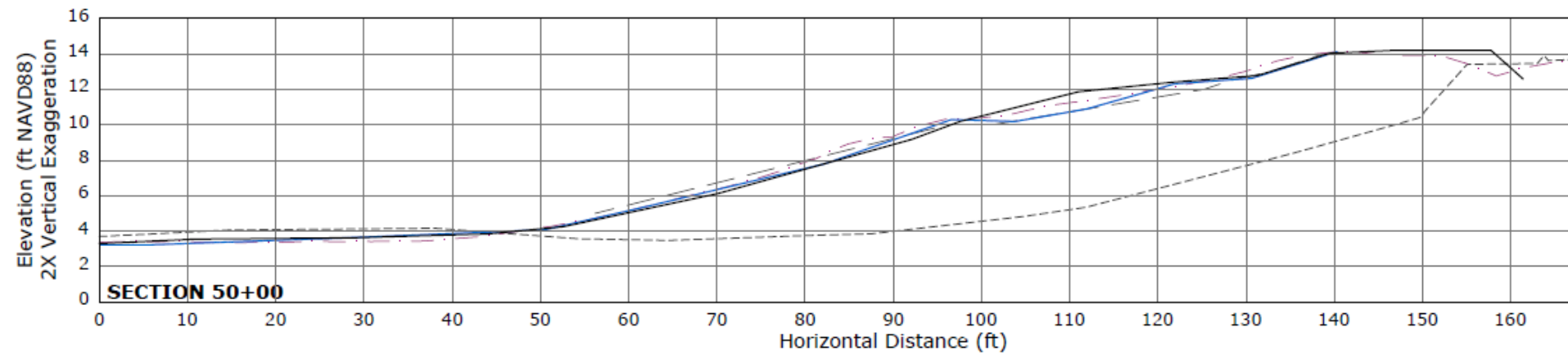
Summer 2023



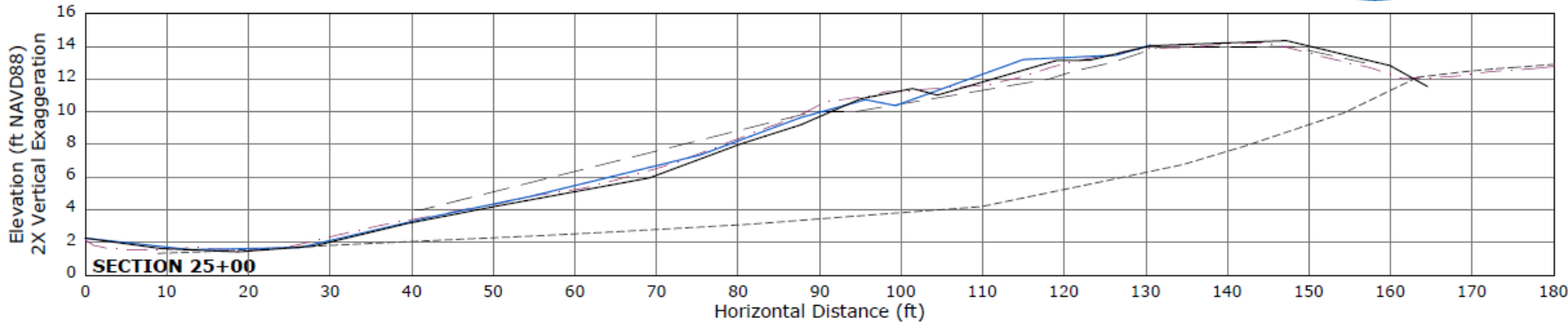
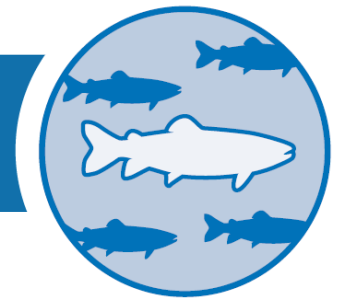
Typical Profile - Summer 2023



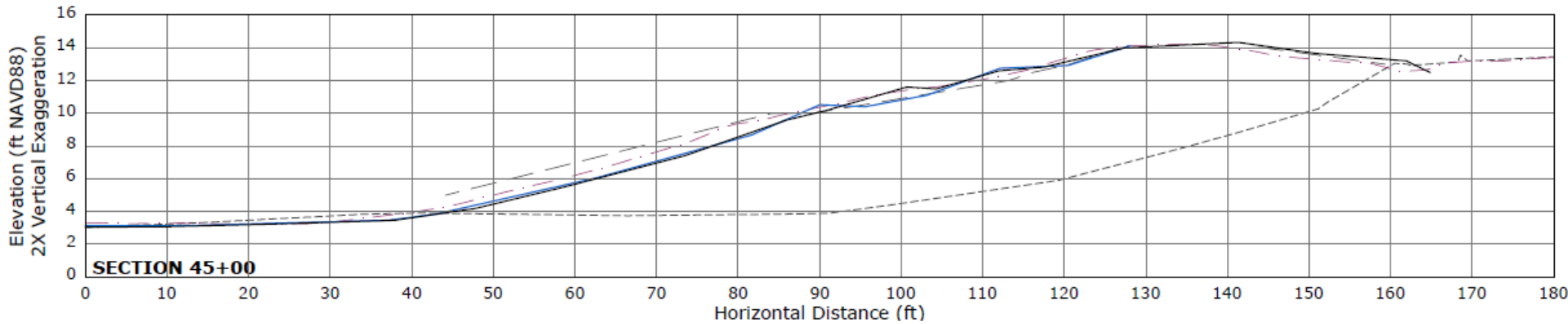
- LEGEND:**
- 2014 PRE PROJECT
 - PROPOSED DESIGN
 - SEP. 2021 TOPOGRAPHY
 - JAN. 2022 POST STORM MONITORING
 - SEP. 2022 TOPOGRAPHY
 - OCT. 2023 TOPOGRAPHY



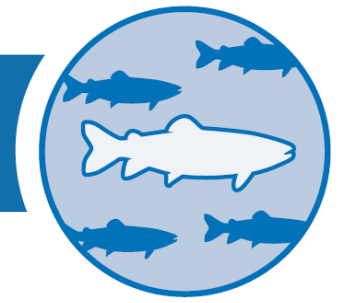
Profiles - Summer 2023



- LEGEND:**
- 2014 PRE PROJECT (dashed line)
 - PROPOSED DESIGN (long-dashed line)
 - SEP. 2021 TOPOGRAPHY (dash-dot line)
 - JAN. 2022 POST STORM MONITORING (dotted line)
 - SEP. 2022 TOPOGRAPHY (solid blue line)
 - OCT. 2023 TOPOGRAPHY (solid black line)



Conclusions



It took 45 years to build Wolf Bauer's beach design!

The combination of geomorphic and modeling approaches was critical in design stage

Floods and damage averted in several major storms after project

Wave action regraded within 1-2 months of placement within greater intertidal

- Could have gotten by with simpler cross section grading

Project very successful to date; minor onshore gravel transport surveyed

Right of way acquisition took several years

Coordination with WSDOT, Tribes, & agencies were significant efforts

1.6-mile-long project with 105,000 cubic yards of gravel/sand largest in Puget Sound region

\$15.3 M project had many components (and would cost more now)

