**Carkeek Pedestrian Bridge – ADA Study**

**08/01/2023**

The following study provides a summary of challenges, constraints, and considerations for providing accessible access from the parking lot to the beach side of the Carkeek Pedestrian Bridge Replacement project. The study considered both a ramp + stair approach (Scheme 1) and an elevator with a smaller ramp + stair (Scheme 2). Both schemes would generate a larger impact beyond the baseline scenario (viewing platform and stair) on this sensitive and challenging shoreline site.

**Site footprint** - Ramp at a minimum will require 530ft +of ramp (1:12) slope, generating a significantly large site footprint an structural foundations on the sensitive beach environment. A larger footprint should be considered to accommodate more generous access for such an extensive ramp. Elevator foundations will require a larger site footprint along with some ramp required to keep elevator landing at a reasonable height above the water level.

**Soil Conditions** - Challenge of installing and maintaining more extensive structural systems and sensitive elevator equipment within liquefiable soil conditions. Elevator will require extensive foundations.

**Topography** – Beach is +10ft elevation and subject to regular tidal and periodic flood events (proximate to FEMA 100-year flood plain).

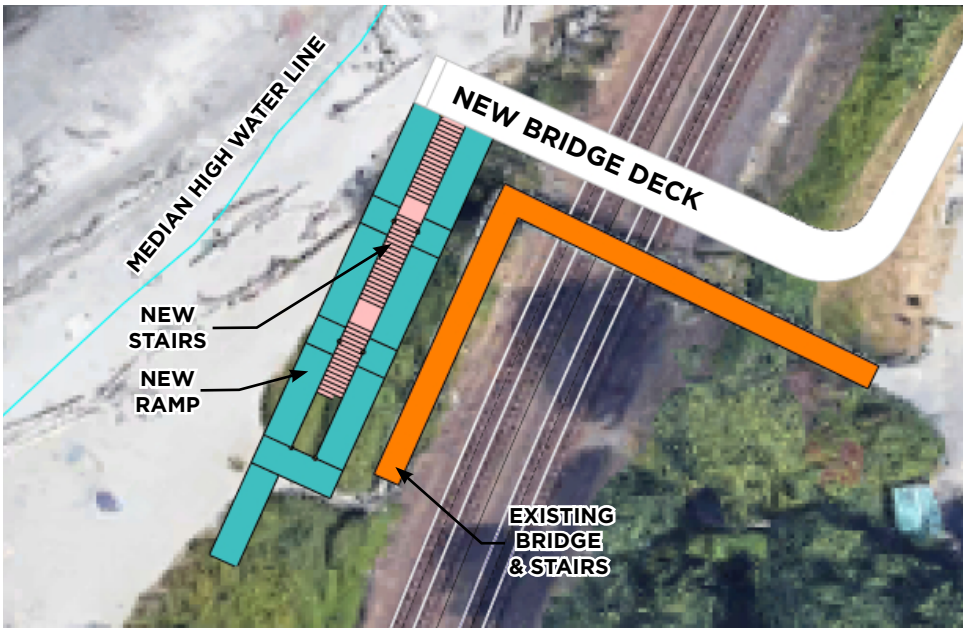
**Marine environment** – Effects of salt, sand, and ongoing dewatering requirements for elevator may lead to regular maintence closures. Additional site walls and vestibule/ enclosure would be recommended to help protect the elevator and equipment, leading to a more extensive site footprint.

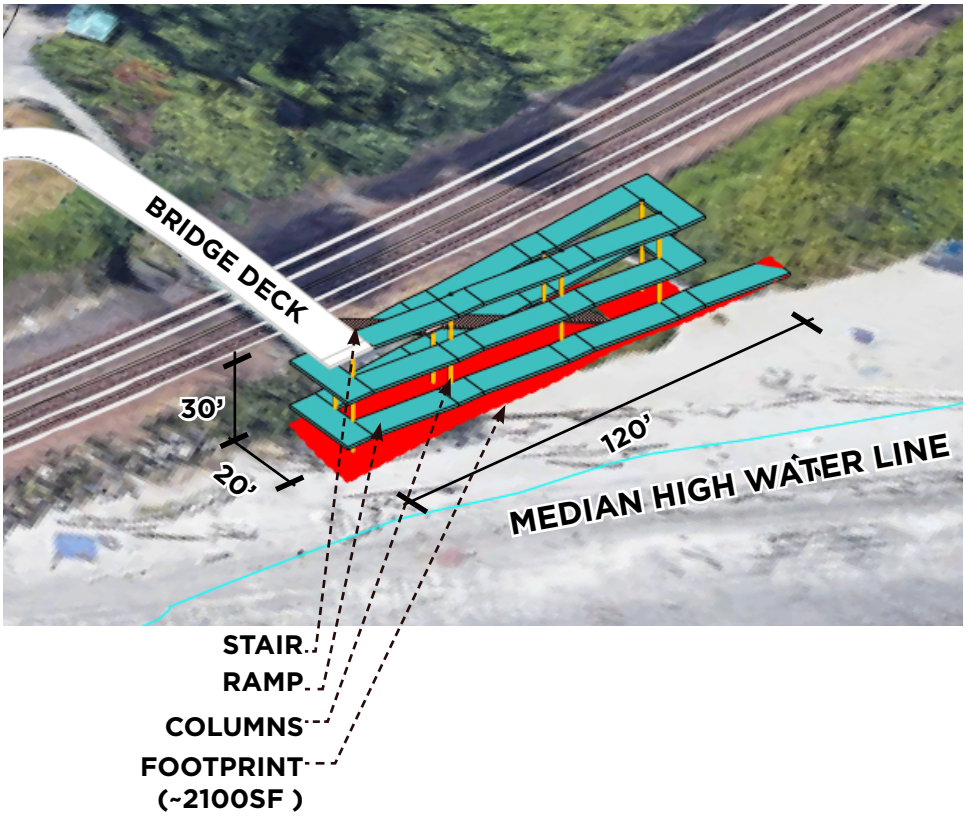
**Constructability and site access** - Further challenges for limited site access would be for a more extensive structural system and elevator equipment construction and maintenance within the shoreline, steep slope, and BNSF right of way. Considerations should be made for the challenges and impacts of delivering and operating heavy construction equipment on a beach environment.

**Environmental site permitting** – Army Corps of Engineers regulates construction in tidal waters. More extensive construction and a larger affected site area may have limitations on permitting.

**Utilities** – Power and potentially water (for maintenance) will need to be supplied to the beach side.

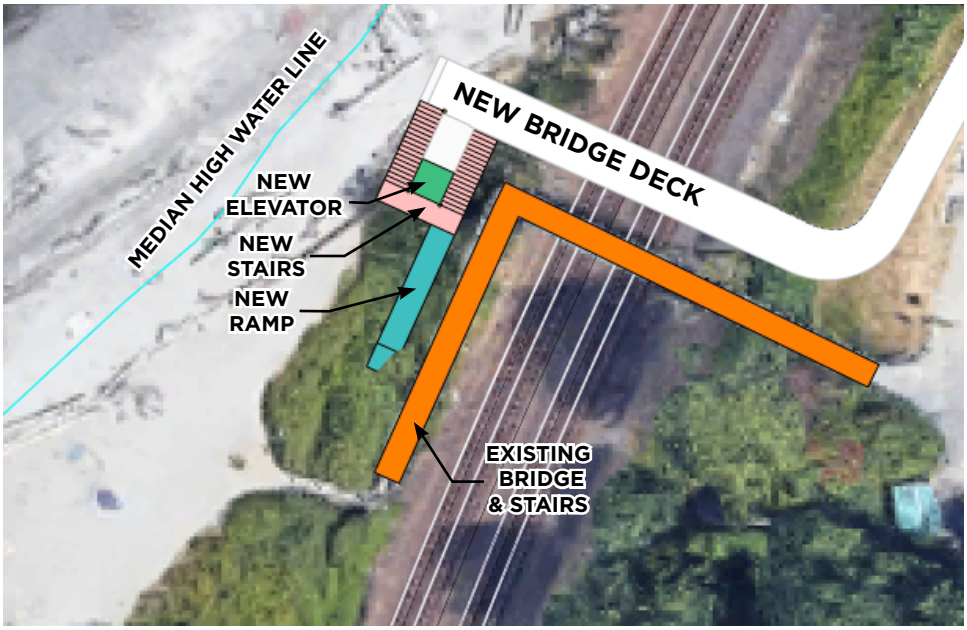
## SCHEME 1 - STAIR & RAMP

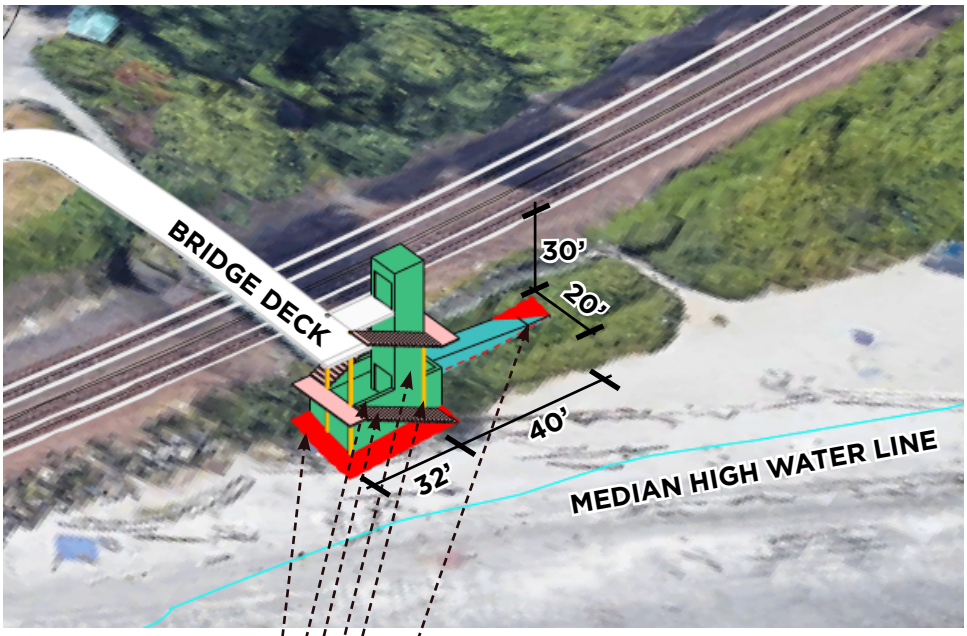



- LARGE IMPACT FOOTPRINT ON NATURAL BEACH ENVIRONMENT
- EXTENSIVE COLUMNS AND FOOTINGS REQUIRED
- ~530' OF RAMPING REQUIRED @ 1/12 SLOPE

## SCHEME 2 - STAIR, RAMP, & ELEVATOR




FOOTPRINT (~640SF )
PLATFORM / WALL
STAIR
ELEVATOR
COLUMNS
RAMP

- POWER MUST BE SUPPLIED TO BEACH
- POTENTIAL DIFFICULTY OF MAINTAINING ELEVATOR SYSTEMS IN MARINE ENVIRONMENT
- PROXIMITY TO WATER LINE LIKELY REQUIRES EXTENSIVE PUMPING
- NEEDS PLATFORM AND WALL @ GRADE TO PROTECT ELEVATOR FROM WATER
- DIFFICULTY OF OPERATING HEAVY CONSTRUCTION EQUIPMENT ON BEACH
- DIFFICULTY OF DELIVERING ELEVATOR MACHINERY ETC. TO BEACH
- ELEVATOR REQUIRES EXTENSIVE FOUNDATIONS ON BEACH ENVIRONMENT
- ~30' OF RAMPING REQUIRED @ 1/12 SLOPE
- SMALLER IMPACT FOOTPRINT
- LESS COLUMNS

Carkeek Park Pedestrian Bridge Replacement Study

**Summary for the Feasibility of a Tunnel Option**

This summary of the feasibility evaluation addresses Seattle Parks and Recreations' (SPR) question about the possibility of a tunnel option in lieu of replacing the bridge, as shown in Figure 1. The RHC team revisited the site condition and reviewed the reference project, Meadowdale Beach and Estuary Restoration Project. It was found that a tunnel option is infeasible or very challenging for the Carkeek site. This is based on the following considerations:

1. Existing setting
2. Topography and flood mitigation
3. Soil condition
4. User experience, crime prevention and safety
5. Utilities and maintenance including lighting and dewatering etc.
6. Cost and constructability
7. BNSF Coordination
8. Environmental compliance and permitting
9. Comparison with the reference project

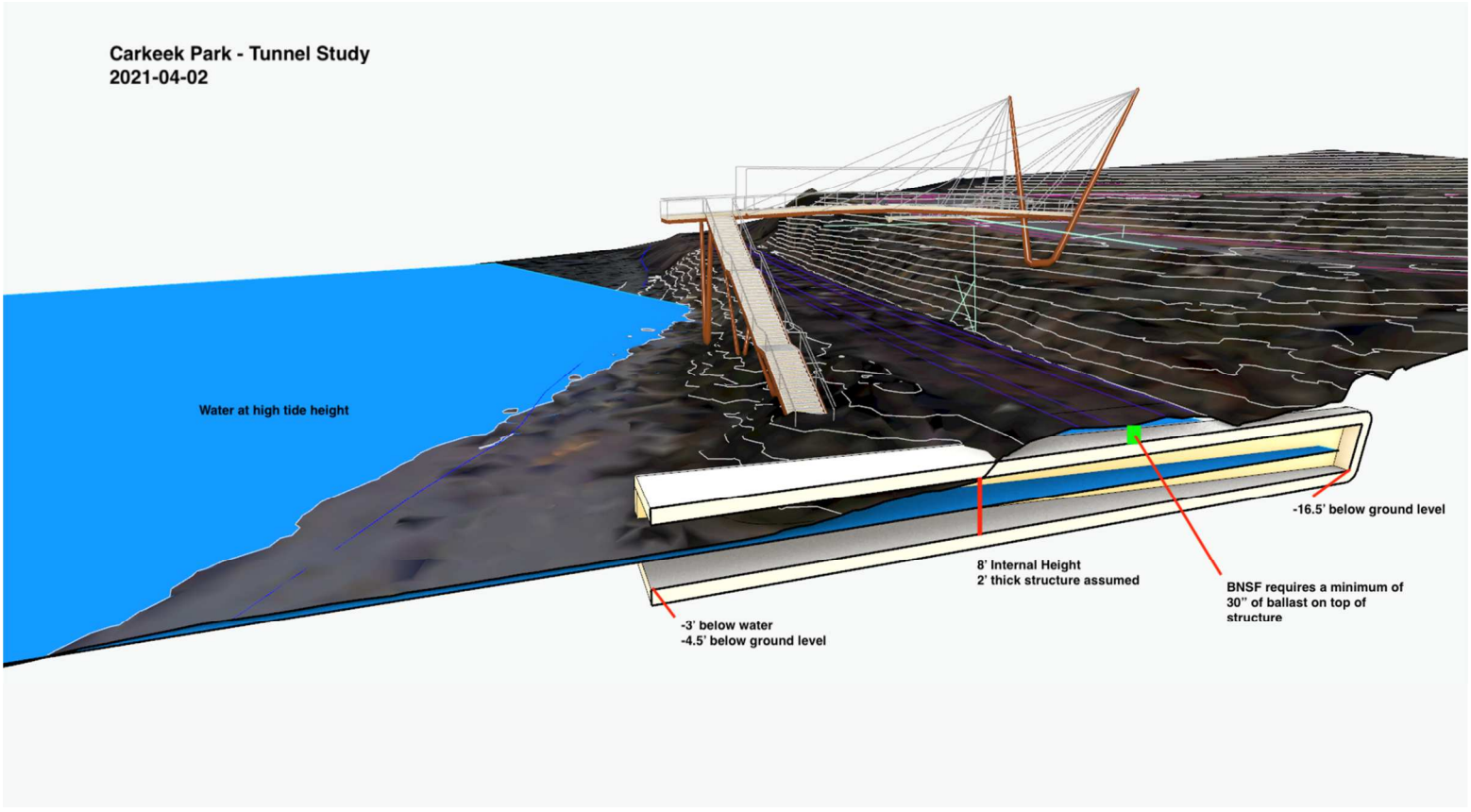



Figure 1 Rendering of a Tunnel Scenario versus a Bridge

**1. Existing Setting**

The existing setting for Carkeek Park is a pedestrian bridge over BNSF tracks. This reflects the site condition that the beach side is much lower than the upper park side. To change the pass to an underground tunnel, the existing bridge site would not be an idea location. A possibility would be through Piper Creek at the south side of the bridge. However, Piper Creek is a designated wetland area. Constructing a tunnel may require additional environmental assessments.

**2. Topography and Flood Mitigation**

The beach area's ground elevation is around 10 feet, the BNSF track top's elevation is between 15 to 20 feet, the upper ground elevation is around 35 feet, and Piper Creek's elevation is between 10 to 15 feet adjacent to the BNSF track. For a pedestrian tunnel, a 10-foot vertical clearance is required, and a total depth of at least 15 feet from the BNSF track top is needed, considering the top and bottom slab thickness. With these elevations, the tunnel will be the lowest point in the vicinity. Figure 2 shows the FEMA 100-year flood plain. With a tunnel option, the underpass will be subject to flooding and drainage issues. Figure 3 shows the existing culvert at Piper Creek.

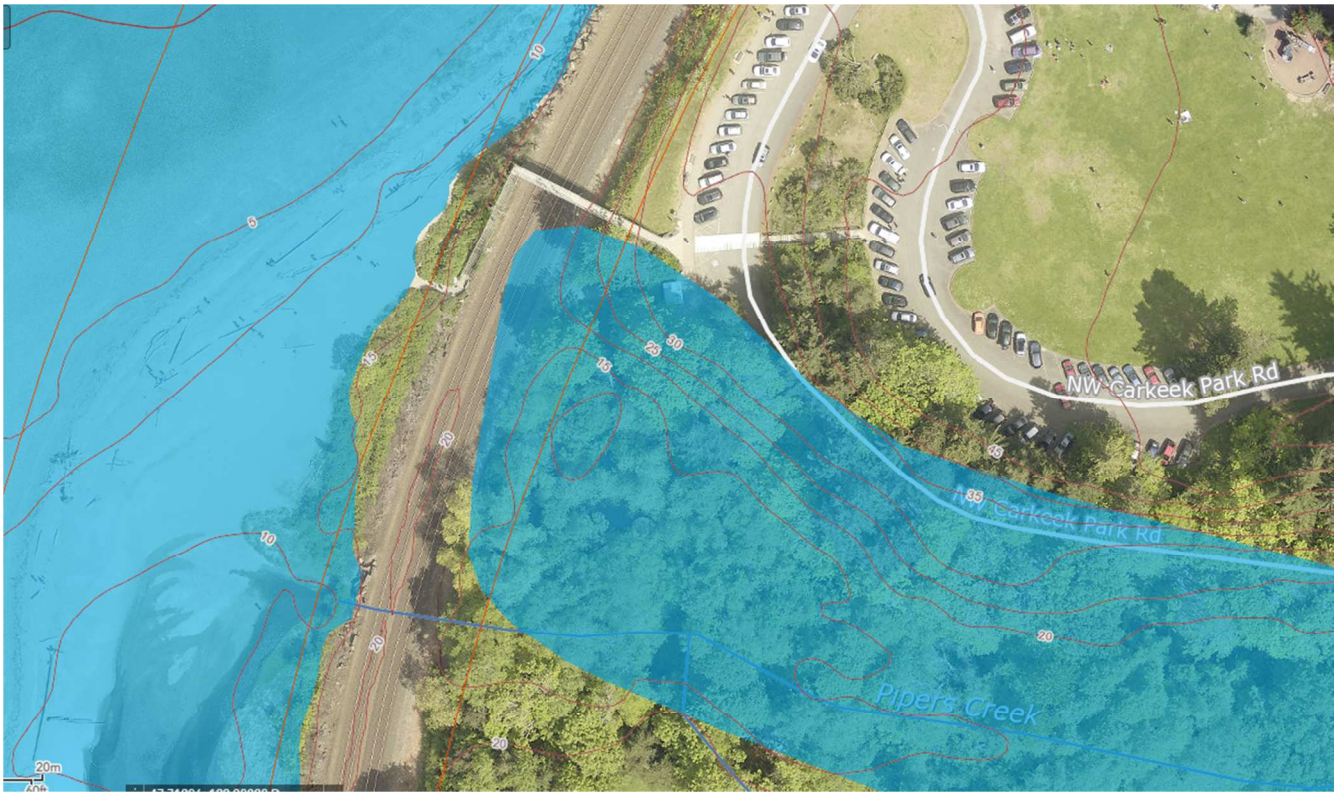



Figure 2 FEMA 100-Year Flood Plain Shown in Blue

Figure 3 Existing Piper Creek Culvert at Carkeek Park

**3. Soil Condition**

Puget Sound is well known for its seismic activity with liquefiable soil. The Carkeek site includes deep layers of liquefiable soil. If soil liquefies during an earthquake, the tunnel will be compromised unless soil improvement or deep foundation is used. Soil improvement or a deep foundation for a tunnel would cost significantly more than a conventional tunnel.

**4. User Experience, Crime Prevention and Safety**

Although both options are structurally safe for pedestrian usage, a tunnel and a bridge would provide different user experiences. A tunnel would attract to be a sheltered place for crime activities and would impact public safety.

**5. Utilities and ,Maintenance**

Lighting and dewatering sump pumps may be needed. These utilities may require periodic maintenance.

**6. Cost and Constructability**

The cost of a bridge is currently estimated at $10,000 per linear foot and the cost of a tunnel is currently estimated at least $20,000 per linear foot. The length of a bridge or a tunnel would be comparable with the same ADA slope constraints.

Constructing a bridge will include foundations that require some soil exaction work and most superstructures could be built through prefabricated components. In contrast, constructing a tunnel will involve significant ground disturbance and tunneling through with a boring machine could cost more than open cut construction.

**7. BNSF Coordination**

Constructing a tunnel may significantly impact BNSF operation, especially with the open cut construction. The existing tracks would have to be removed and then restored. Different from replacing the existing bridge, the tunnel option may be subject to new BNSF easement and project review.

**8. Environmental Compliance and Permitting**

Corps of Engineers has specific regulatory jurisdiction for construction in tidal waters. Section 404 and Section 10 regulates construction in wetlands, structures and work within low marshes, which would occur with the tunnel construction.

**9. Comparison with a Reference Project**

The comparison between Carkeek Park and Meadowdale Beach Park is presented here, with information available for the Meadowdale Estuary and Restoration project. Both projects have goals of connecting the park area with the beach side through BNSF tracks. The existing setting for Carkeek Park is a pedestrian bridge over BNSF tracks, while the existing setting for Meadowdale Beach Park is a culvert under the BNSF tracks, as shown in Figure 4. The difference in existing settings reflects the different site conditions and constraints when the original passes were built. For the Carkeek Park Bridge site, the beach side is lower than the park side, while for the Meadowdale Beach Park site, the beach side almost at the same elevation with the park side.

The Meadowdale Beach County Park Feasibility Study report concluded that a bigger opening under the track is needed to address the flood rise issue. For Carkeek Park, a similar situation exists, therefore a 10-foot tunnel will most likely not be wide enough to reduce the flood rise.

Existing Carkeek Park Bridge with BNSF tracks under the bridge

Existing Meadowdale Beach Park Culvert with BNSF tracks on top (source: www.snohomishcountywa.gov)

Figure 4 Existing Setting Comparison for Carkeek Bridge and Reference Project

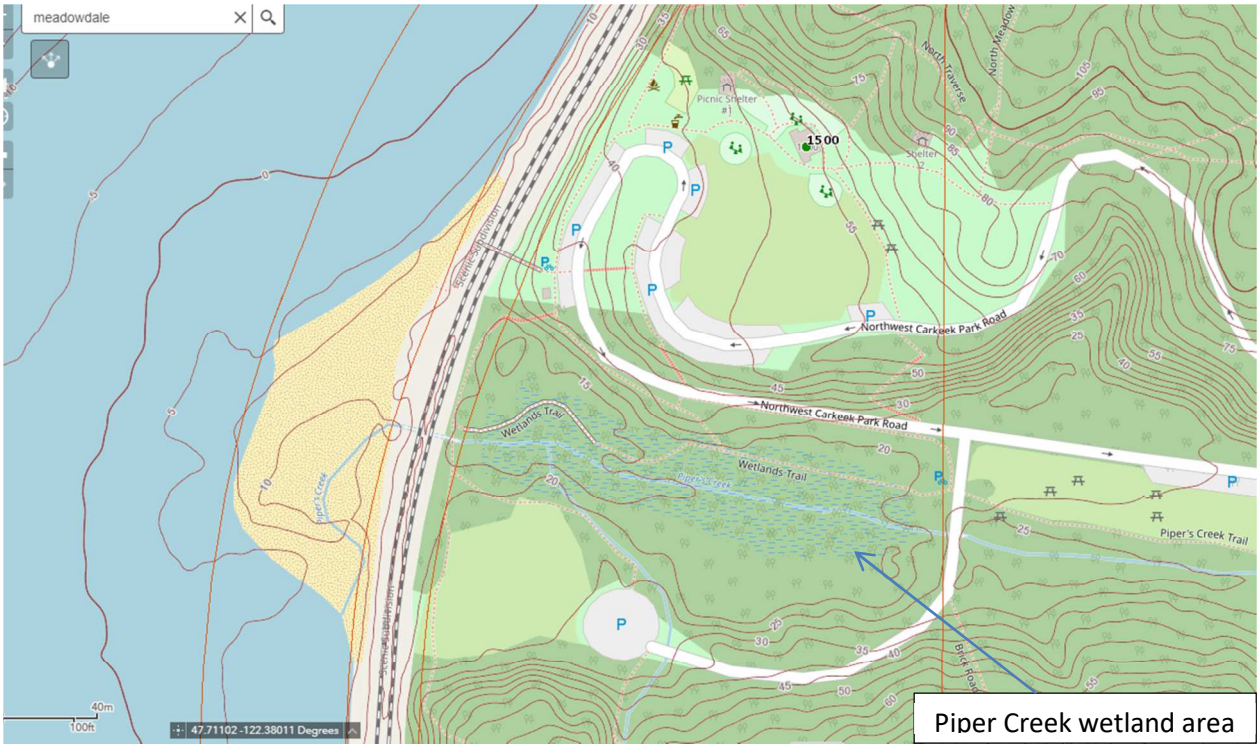



Figure 5 GIS Map of Carkeek Park

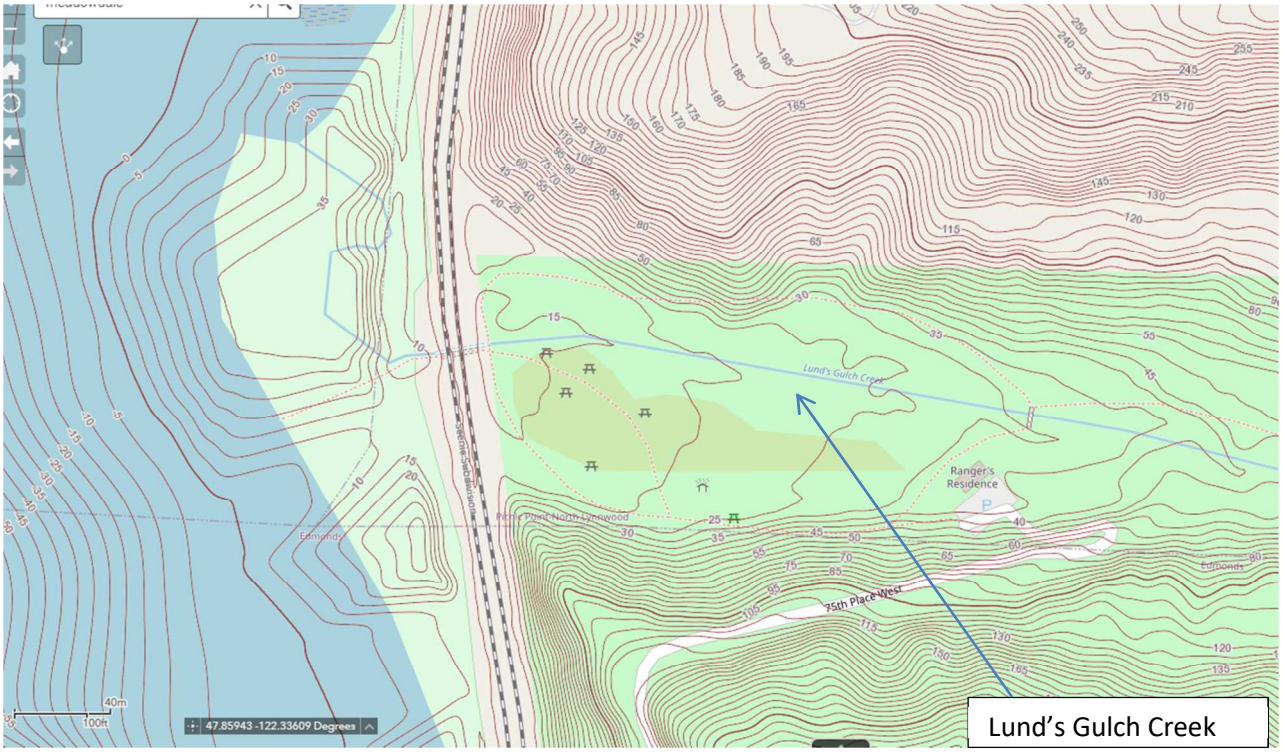



Figure 6 GIS Map of Meadowdale Beach Park