Avon River Aboiteau And Causeway Upgrading Design

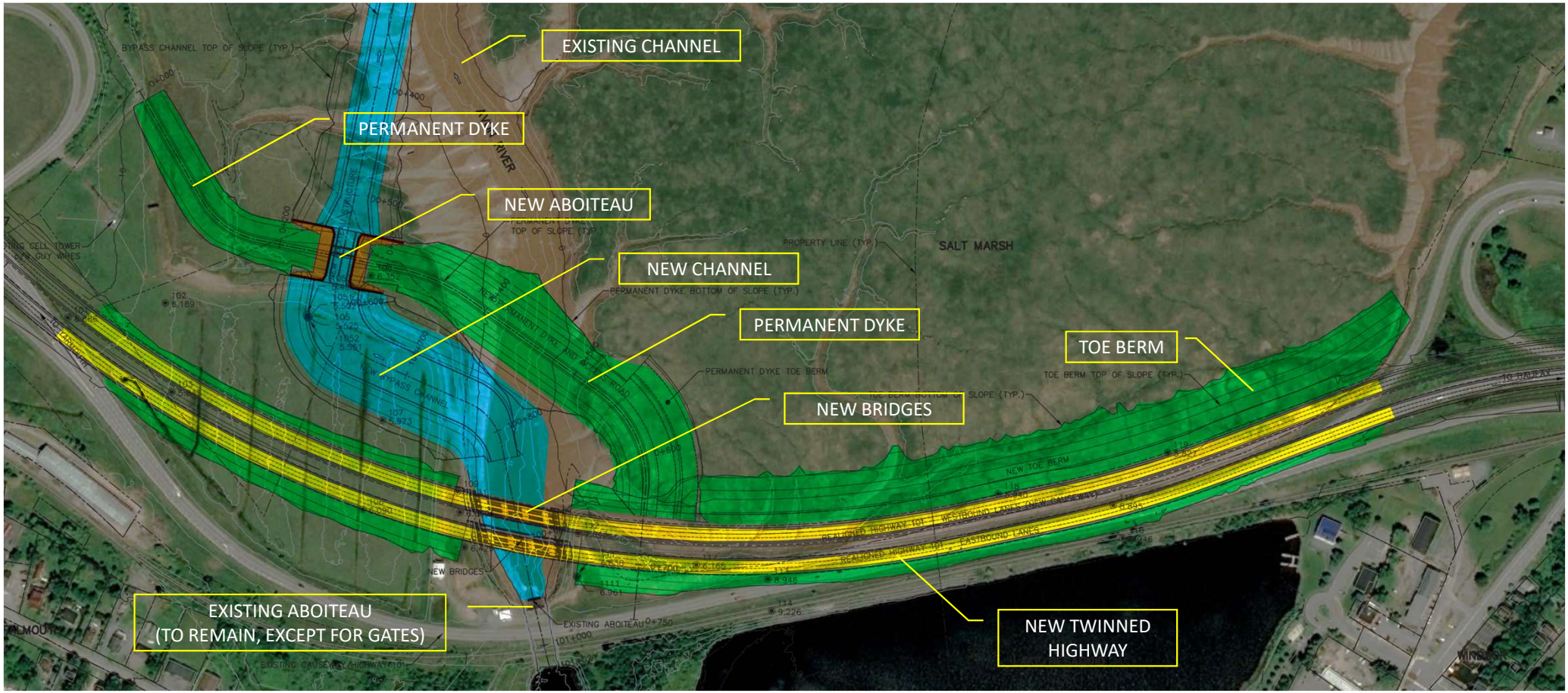
Design Update – October 2020

Agenda:

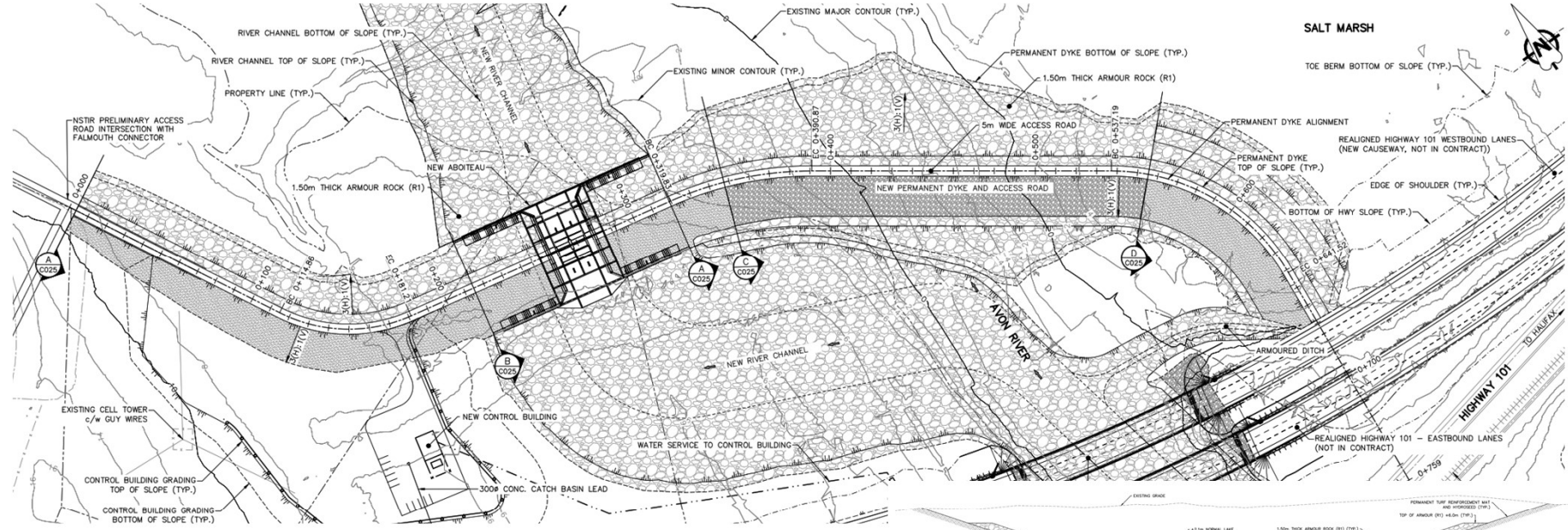
- Site Overview/Layout
- Aboiteau Design Overview
- Fish Passage Design
- DFO Submission
- Additional Environmental Surveys/Monitoring
- Other Permitting

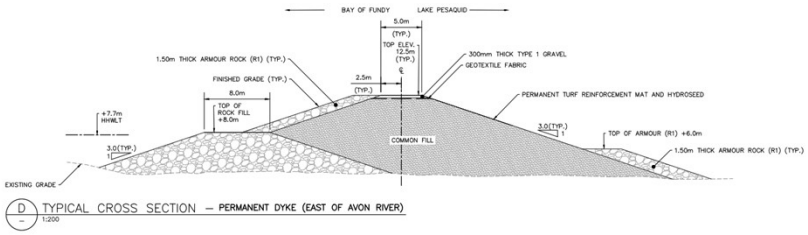
Presented by:
CBCL

Site Overview

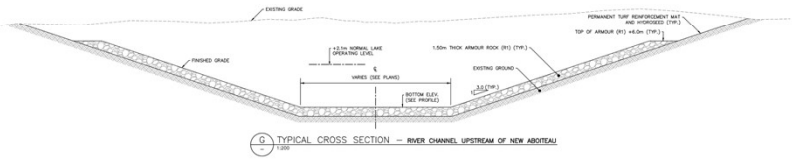


Site Plan – Dyke/Channel

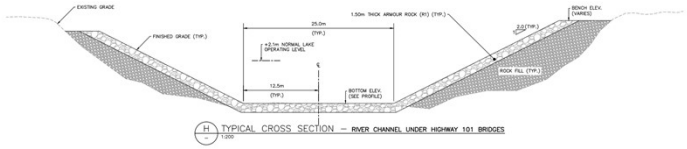




D TYPICAL CROSS SECTION – PERMANENT DYKE (EAST OF AVON RIVER)
1:200

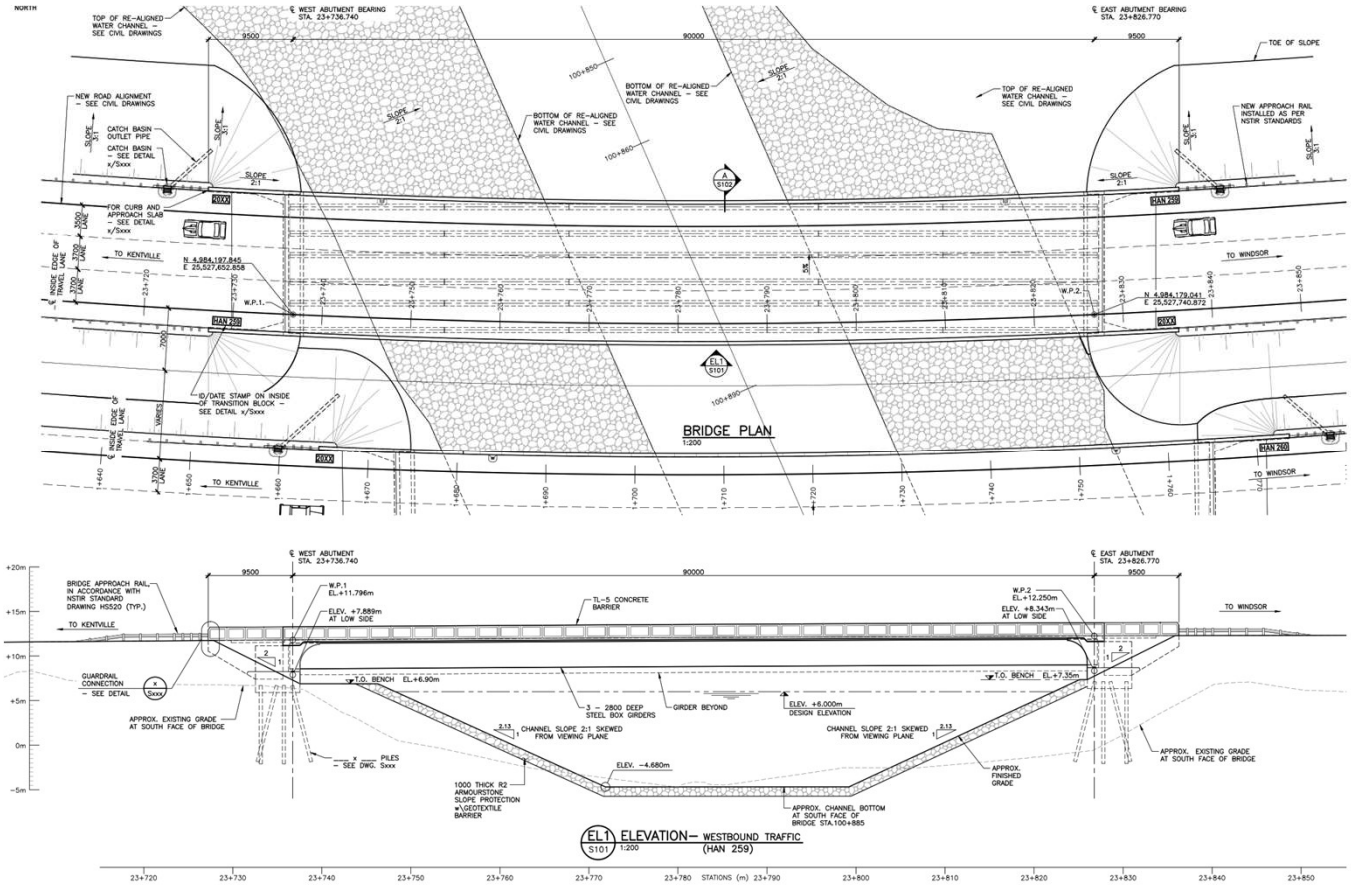


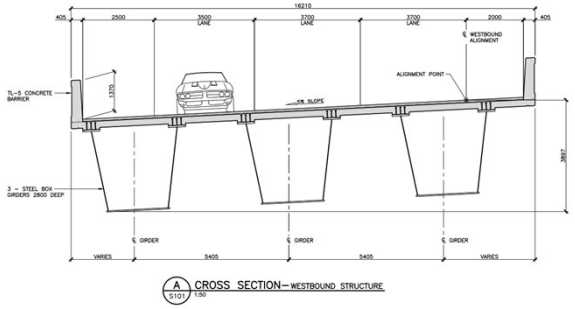
G TYPICAL CROSS SECTION – RIVER CHANNEL UPSTREAM OF NEW ABOITEAU
1:200



H TYPICAL CROSS SECTION – RIVER CHANNEL UNDER HIGHWAY 101 BRIDGES
1:200

Bridges – General Arrangement (WB)



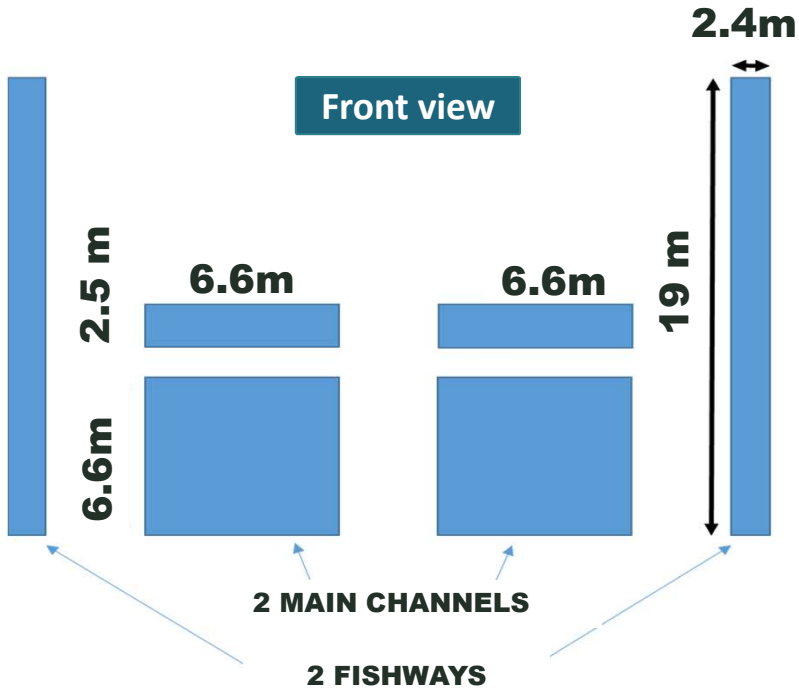


Rendering

Aboiteau General Arrangement

Configuration and Features:

- Flood protection through main gates, overflow to protect against malfunctions (equipment, sediment)
- Short, open structure – better for fish
- Fishways designed to allow 2-way passage through the full tidal range
- Gates on all openings can be operated based on water management scenario to maximize fish passage and manage water levels, salinity and sedimentation



CLICK FOR 3D MODEL

Design Considerations

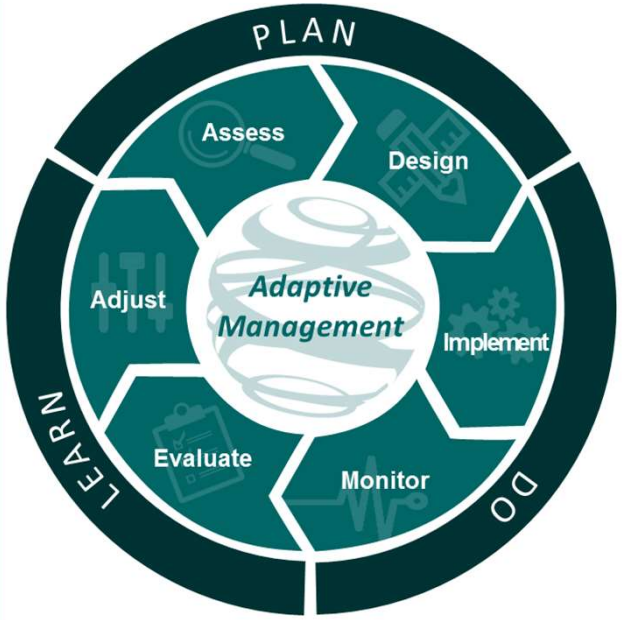
- Flood Protection
- Fish Passage
- Aboriginal and Treaty Rights
- Societal impacts
- Climate Change
- 100 yr service life
- Hydrology and Hydraulics
  - Tidal versus Lake
  - Sediment and salinity
  - Velocities
- Geotechnical
- Structural
- Construction

Water Management Scenarios – Why?

- Orig. design requirement – maintain lake
- Challenges:
  - Design requirement – improve fish passage
  - Flow from the lake required
  - Seasonal dry periods would drain lake unless fish passage was blocked until lake levels permit outflow
- Therefore, other methods of operation were explored in an effort to understand if balance could be improved

Water Management Scenarios

- **NSTIR and NSDA have advanced a hybrid approach which can facilitate a range of water management scenarios to allow for adaptive management of the system**
- Flexible gate management system
- Management of structure will be driven by flood protection and DFO fish passage requirements
- Ecosystem will not tolerate rapidly or constantly changing conditions
- Freshwater lake could be transitioned gradually to slightly brackish if fish passage not adequate
- Monitoring of fish passage to be continued during operation



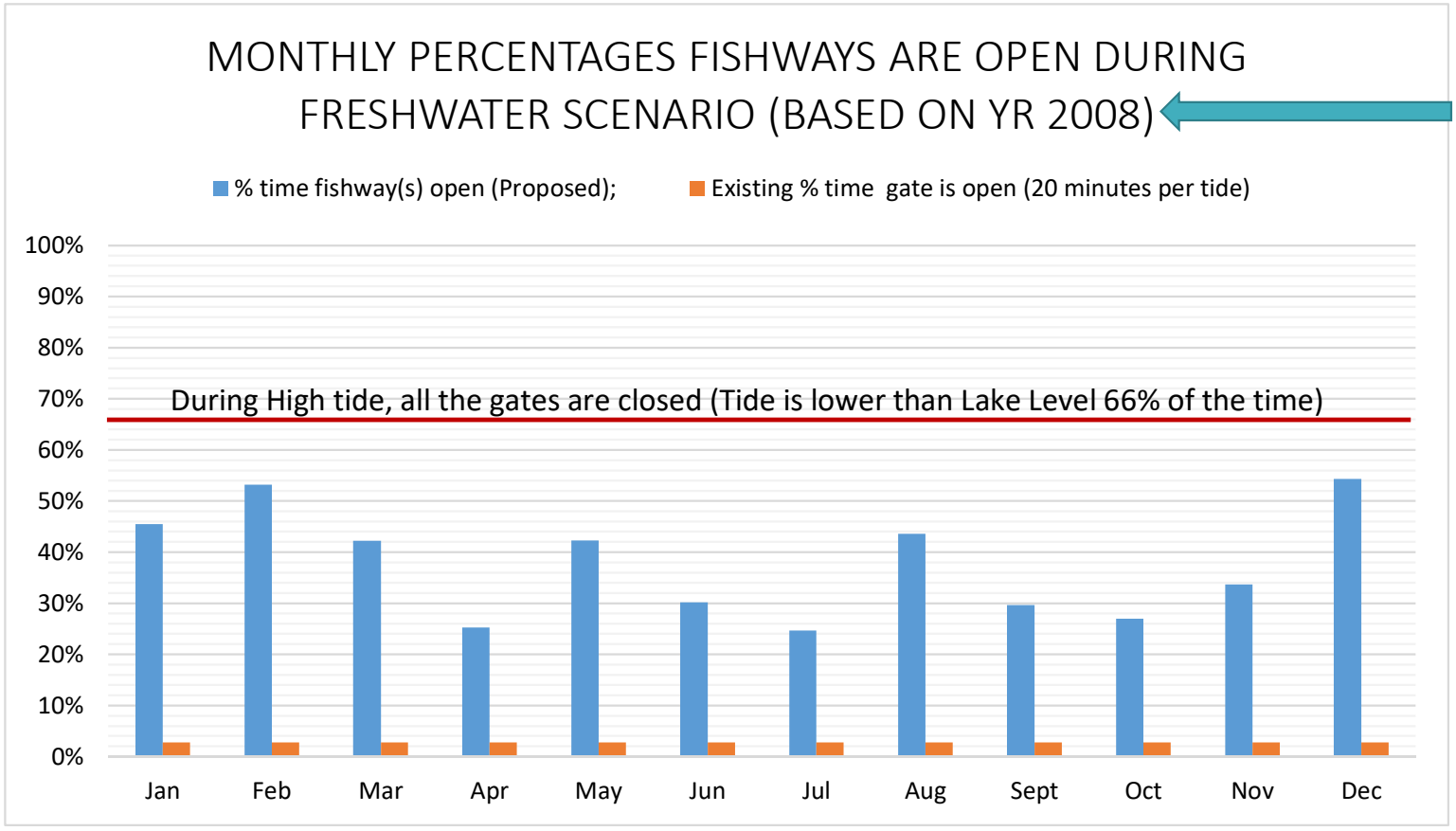
Water Management Scenarios

Freshwater Lake

- **Maintain lake level and no tidal influx while maximizing fish passage**

- 2-way fish passage, closed during high tides
- Open fishway gates when enough water available in lake – limits fish passage during dry periods
- Tidal influx eliminated, except for leakage
- More freshwater habitat, stable ecology
- Water quality degradation in warmer months
- Lowest risk initial approach

Water Management Scenarios



2008 = avg. year in terms of total rainfall over ~30 years of data

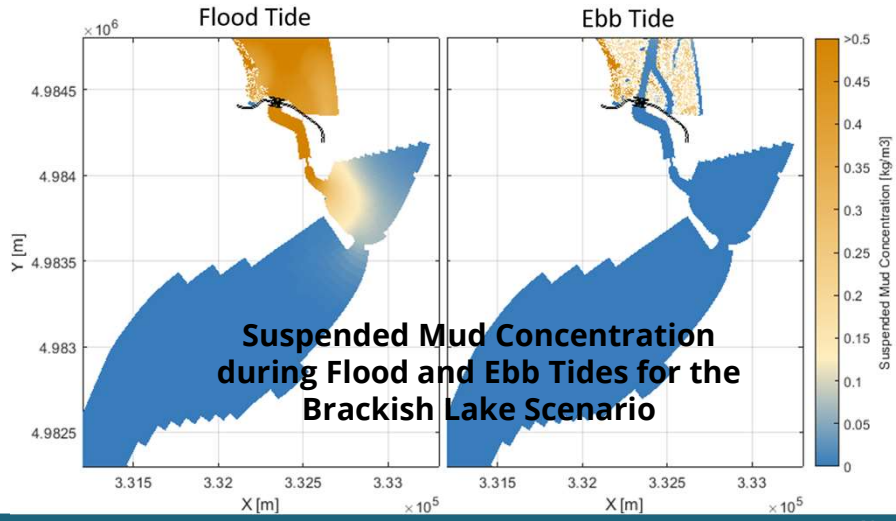
Variable annually

Water Management Scenarios

Brackish Lake

- **Maintain lake level while maximizing fish passage**

- 2-way fish passage, fishways (almost) always open
- Some tide water will enter the lake, creating a small tide of approx. 1-2ft
- Some ingress of sediment and salinity
  - Variable based on (1) distance upstream from aboiteau, (2) amount of stormwater runoff and (3) tides
  - Gates can be controlled to adjust tidal ingress and associated salinity/sediment
- More natural (dynamic) ecosystem, ~25% less freshwater habitat



Suspended Mud Concentration during Flood and Ebb Tides for the Brackish Lake Scenario

Water Management Scenarios

Dampened Tidal Estuary

- **Maximize fish passage and passive operation**

- 2-way fishways (almost) always open
- Passive flap gates on main channel (no roller gates)
- Reduced tide range in the lake (1.5m), creating brackish environment including mudflats and salt marsh.
- Some ingress of sediment and salinity
- Gates can be controlled to protect against flooding, adjust tide range and sediment/salinity

Fishway Design Considerations

Fishway types reviewed:

- Pool and weir fishway
- Vertical slot fishway

  Note: Both types above are one-way flow, ie. only use water from the lake and would close during high tide and are prone to sedimentation leading to maintenance and performance issues
- Denil
  - Alaskan Steeppass

Fishway Design Considerations

Fishway types reviewed (cont'd):

- Denil or Alaska Steeppass fishways have the ability to function in two directions, use the tidal water to pass fish, and, therefore, can stay open for the entire tidal cycle

- Alaska Steeppass fishway regulates water velocities such that:
  - lowest velocities are at the surface (ideal for fish passage), and
  - highest velocities near the bottom (ideal to prevent sedimentation)
    - ➢ This type of fishway was therefore selected

- Main gates will allow a window of time open for all species to pass as velocities permit (gates could be operated similarly to current, if desired, to supplement fishways)

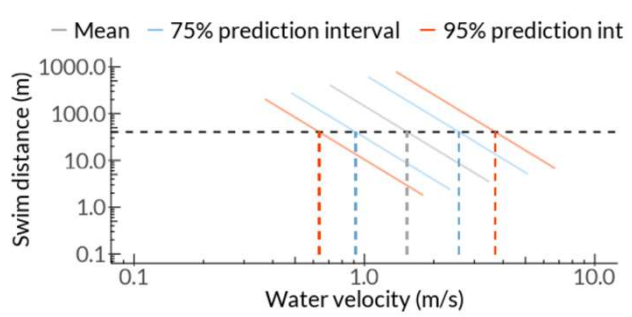
Design Considerations - Fish Passage

The swimming behavior and requirements of fish affected by:

- Species
- age class
- body shape and size
- group behavior
- level of fatigue

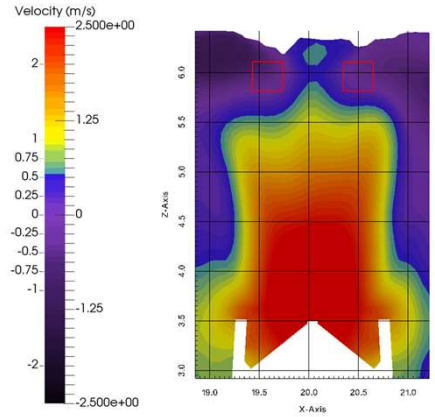
Flow characteristics typically required by fish include, but are not limited to, the below criteria:

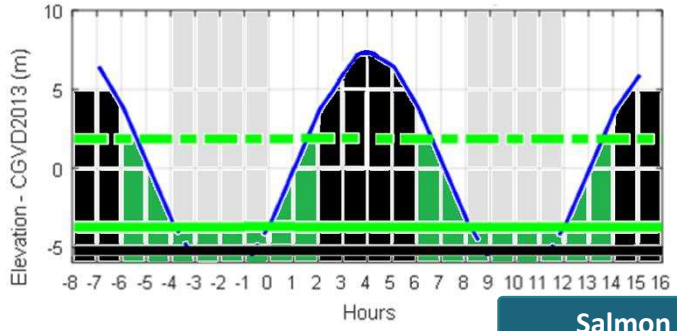
- Velocity
- Flow Patterns, Attraction
- Passage width
- Passage height
- Depth/cover & timing



Percent fish able to swim in velocities:
2.5% in 3.7 m/s; 12.5% in 2.6 m/s; 50% in 1.5 m/s; 87.5% in 0.91 m/s; 97.5% in 0.64 m/s

Fig. 7. Water velocity (V) for 40.5 m swim distance: Atlantic salmon of L_e = 500 mm; Salmon & Walleye Group

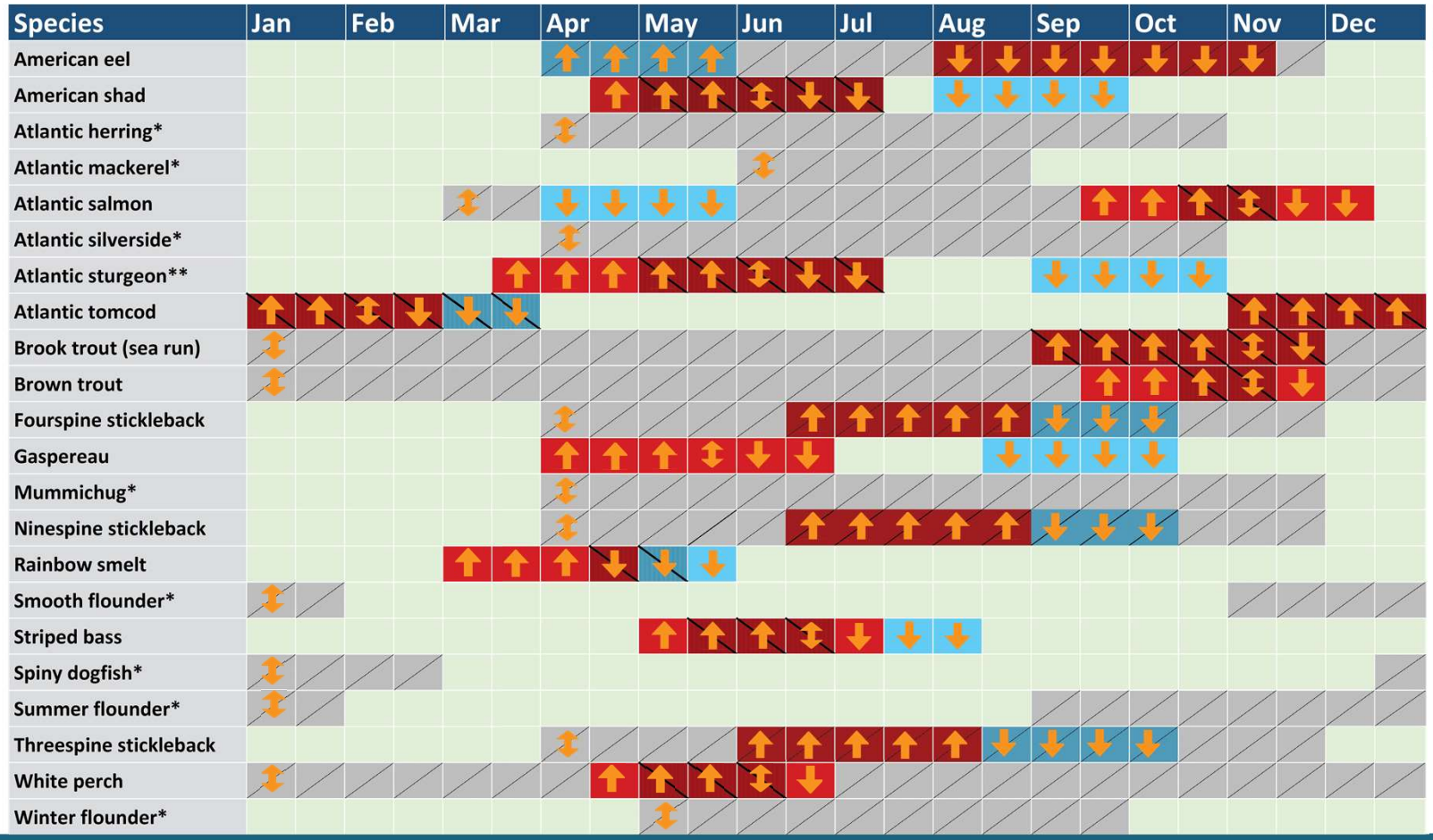


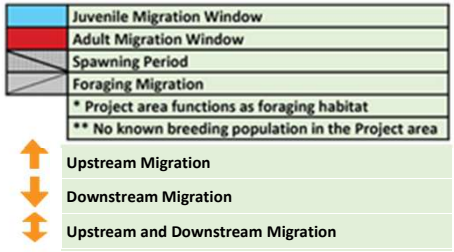


Salmon Passage (Preliminary)

Freshwater Scenario

Design Considerations - Fish Behaviour





Proposed 10% Sloped Fishway with/without Extended Wall

Environmental Permitting Requirements

Regulatory Authorities Key Issues

NSE
- Alteration to a Wetland of Special Significance (i.e., salt marsh)

DFO
- Effects to fish and fish habitat
- Fish passage

NS Department of Lands and Forestry (NSLF)
- Works on submerged crown lands (salt water)

Transport Canada (TC)
- Interference with navigation

Environmental Permitting Requirements

Supplemental Environmental Surveys

- Fish Habitat Assessment - Completed for Phase 1 permit applications
- Vegetation Assessment - June-July, 2019
- Water Quality Monitoring - May, August, October & December, 2019
- Groundwater Monitoring – Started early 2020
- Wetland Monitoring – Pre/Post Construction (by others)
- Fish Presence Monitoring (Pre-const) - May 2017 – ongoing (by others)
- Fish Passage Monitoring (Post-const) – planning now

Past and Ongoing Monitoring Requirements

Post-Construction Fish Passage Monitoring

- Under development
- Data Collection
  - Before/after comparison
  - Sampling timing, locations, methods
- Effectiveness:
  - Confirm that fish species requiring passage of the Avon River aboiteau can pass
- Efficiency:
  - Confirm that an adequate number of fish can pass to fully utilize the available habitat upstream
  - Confirm entrance conditions and cues are suitable for fish that want to pass

Past and Ongoing Monitoring Requirements

Off-setting Projects

- CBWES has developed Offsetting Projects for the compensation for loss of wetland and fish habitat
  - Truro – Onslow Salt Marsh Restoration and Dyke Realignment
  - St. Croix River - High Salt Marsh & Tidal Wetland Restoration
  - Mavillette Tidal Wetland Restoration
- Habitat developed includes tidal wetland & river floodplain habitat (salt marsh, brackish & tidal fresh water wetland); and tidal and freshwater river habitat

Questions/Discussion


Thank you