



Avon River Aboiteau and Causeway Upgrading Design CLC Meeting 19th Sept 2018

Note added on Sept 24: some annotations were made on the last slide based on comments heard during and after the CLC meeting.

Project Key Objectives:

PUBLIC SAFETY

- Maintain corridor over Avon River for Highway 101 Twinning and continuity of rail, trail and utility services
- Continued protection of communities and agricultural land from the effects of flooding and future effects from sea level rise and climate change

REGULATORY REQUIREMENTS

- Improve Fish Passage (Fisheries Act-Sect.20 and EA Condition)
- Minimize Environmental Impacts (i.e. Impact to Salt Marsh)

MINIMIZE SOCIO-ECONOMIC IMPACTS

- On business groups, farming, ski, canoeing as well as recreational communities





Options Considered

- **Maintaining “Status Quo”, or the “do nothing” approach**
- **Scenario “A”: Maintain freshwater reservoir, with the upstream water level target being a priority over fish passage**
- **Scenario “B”: Maintain freshwater reservoir, with the fish passage being a priority over maintaining the water level**
- **Scenario “C”: Fish Passage is the design priority, provided with controlled tidal exchange**

“Do Nothing” Approach

Do Nothing
Approach

Is it an option to maintain the Status Quo ?

Factors to Consider:

- The current structure is at the end of its life: the bearings, seals and rollers cannot be accessed safely to be replaced, i.e. the gate could get stuck at any moment.
- The costs involved mean that federal funding is required. The current opportunity for funding may not present itself again for many years.
- Consequences of the gate being stuck in place would be disastrous and lead to first an emptying of the reservoir, and then flooding of Windsor and Falmouth.

If the gate fails in the open position – low tide view

Do Nothing
Approach



If the gate fails in the open / closed position – high tide view

Do Nothing
Approach



Design

- Before looking at water management scenarios, a location has to be identified for design, that allows the safe construction of the structure with minimized impacts on the surrounding area.

Location Options

Scenarios A, B
and C



Scenarios A, B
and C

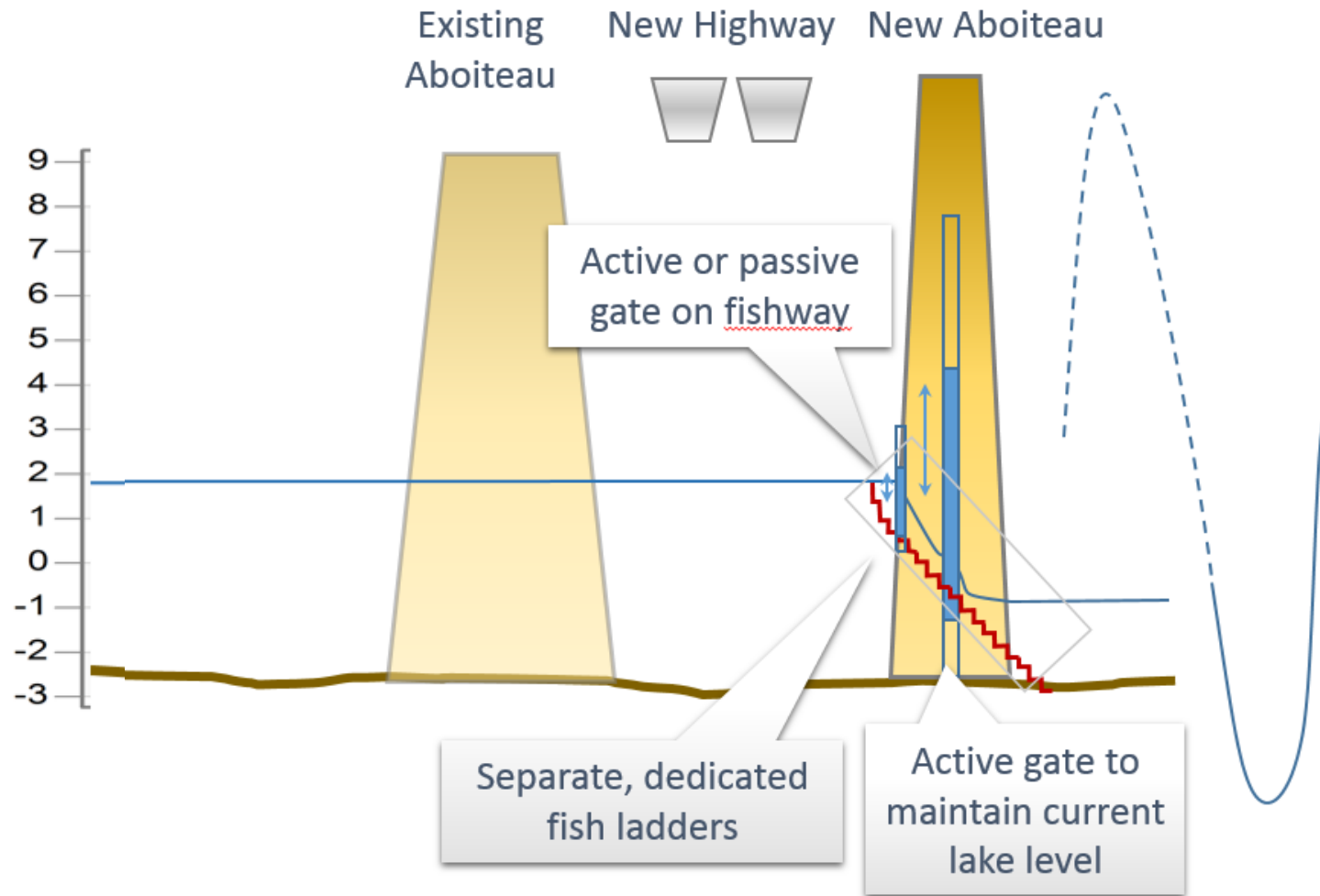
Location Option 1



Initial Design Goals

- Prevent flooding risks upstream of the causeway (not increasing water levels beyond their current peaks);
- Improve fish passage (it is currently estimated to be of very low quality and limited duration), accommodate the 25 species identified;
- Protect the downstream salt marsh of international significance (protected under Ramsar Convention);
- Prevent saltwater intrusion upstream of the causeway;
- Prevent silt from moving upstream of the causeway, as well as blocking the tide gates and fishways, and
- Allow water levels to remain at current target in the summer (roughly +2.4m CGVD28 when flow management allows it).

Freshwater Fishway Design (fish ladder)



Scenario “A”: Freshwater Reservoir (Water level is priority over fishway)

The fishway would have very little improvement over the current situation:

- Fishways would need to be closed during the summer months to avoid lowering the upstream water levels
- Fishways would only flow when excess water is available in the lake. This is likely to be seldom, since dry weather flows either evaporate or infiltrate in the ground and through the causeway
- Highly prone to plugging with sediment

➡ Therefore, the fishway will not be very effective

Scenario “A”: Freshwater Reservoir (Water level is priority over fishway)

Other Considerations:

- The fishway low effectiveness not likely to meet the Fisheries Act, Section 20
- Concerns from First Nations, CRA fisheries groups, other advocacy groups
- More complex gate needed, with flood warning and forecasting systems
- Continued upstream sedimentation, water quality degradation

Scenario “B”: Freshwater Reservoir (Fishway is priority over water level)

Goal 1 – Prevent blockage with sediment (needs high velocities)

Goal 2 – Fish passage for as many local species as possible (needs low velocities, sufficient water depth and width), and be adaptive in response to sea level rise

➡ Difficult to meet contradictory goals

We identified a design to balance both goals, but it does not meet either goal very well, and results in a fairly small fishway (400 mm width x 300 mm height)

Scenario “B”: Freshwater Reservoir

Impacts on upstream water levels

- Since we know that the gate can remain closed for several months in the summertime, this demonstrates that the summer river flows evaporate or infiltrate (into the ground or through the causeway) and cannot contribute to fishway flows
- The only source of water for the fishway is the lake, which will be drawn down by the fishway
- Modelling has shown that to maintain the flushing velocities in the fishway, water levels would be lower than the current target 330 days per year and the level would be completely drawn down (no water left) 36 days per year on average.
- Climate change is expected to further decrease water available

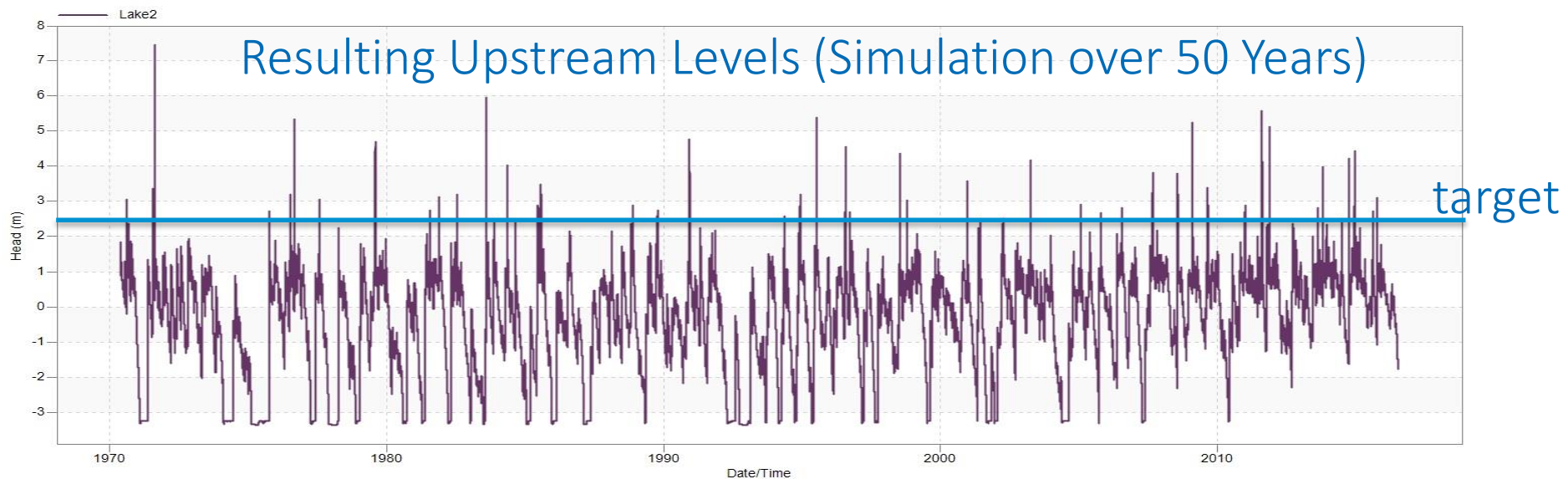
Scenario “B”: Freshwater Reservoir

Impacts on quality of fish passage

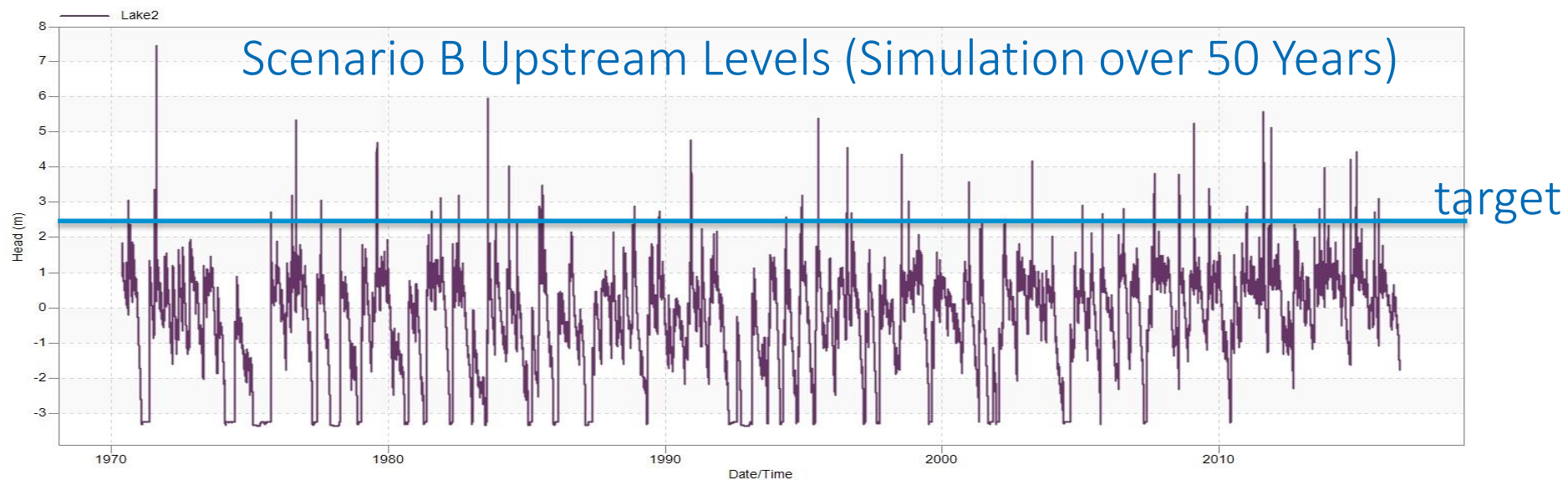
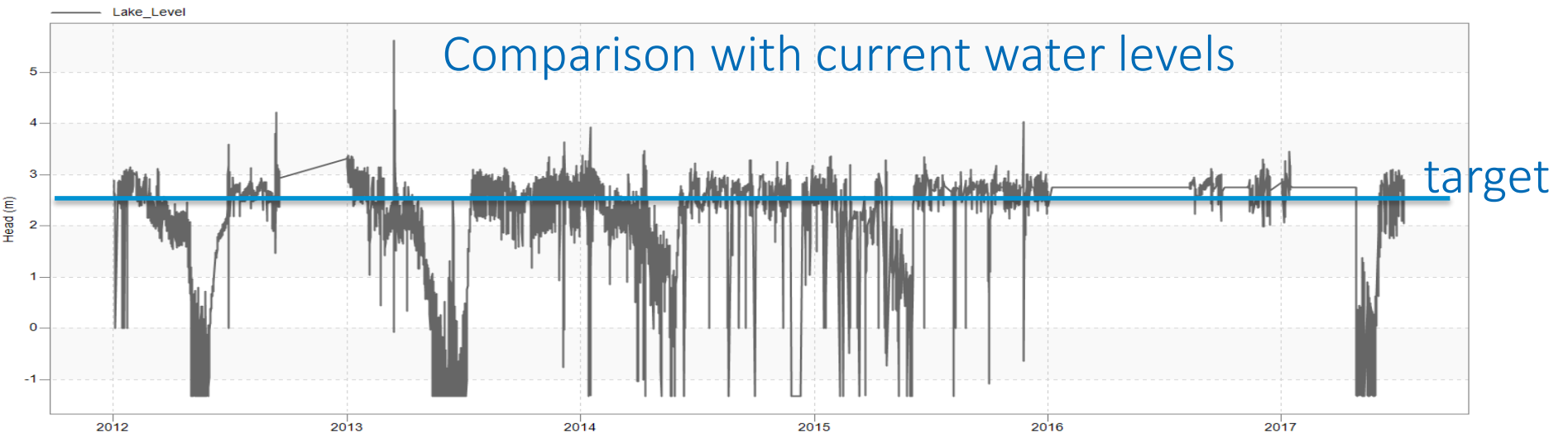
- A small fast-flowing fishway would prevent juveniles, small fish, as well as large fish from swimming up the fishway
- The fishway has to be closed half the time to prevent tides from flowing upstream.
- 36 days with no flow per year (during the late summer fish migration) would negatively impact the goal of providing significantly improved fish passage
- 36 days with no flow would lead to complete blockage of the fishway with sediment (very challenging to maintain for access and safety reasons)

Scenario “B”: Freshwater Reservoir

For a fishway width of 400mm		Probability that the given water level is NOT AVAILABLE during that month											
Water Depth	Flow	January	February	March	April	May	June	July	August	September	October	November	December
0.3	0.308	#N/A	#N/A	#N/A	#N/A	#N/A	15.2%	18.7%	43.9%	42.6%	28.4%	3.9%	#N/A
0.4	0.44	#N/A	#N/A	#N/A	#N/A	5.5%	29.4%	37.4%	47.1%	48.4%	43.5%	5.2%	0.6%
0.5	0.578	3.5%	#N/A	#N/A	1.0%	15.5%	30.0%	43.9%	59.7%	60.6%	56.1%	7.7%	1.0%
0.6	0.716	8.4%	#N/A	#N/A	2.6%	22.9%	34.2%	51.3%	68.4%	64.8%	61.0%	15.8%	3.5%
0.7	0.856	11.0%	7.0%	#N/A	4.8%	28.1%	46.5%	61.3%	76.5%	74.2%	63.5%	24.2%	7.7%
0.8	0.998	12.6%	7.0%	#N/A	6.1%	29.4%	51.0%	68.4%	79.4%	77.1%	66.5%	31.0%	10.6%
0.9	1.1398	15.2%	7.7%	1.7%	7.4%	32.3%	55.8%	80.0%	82.6%	81.0%	71.6%	34.2%	13.5%
1	1.282	16.5%	9.3%	5.0%	8.1%	35.2%	61.3%	84.8%	84.8%	83.5%	78.7%	38.4%	17.4%
1.1	1.424	19.4%	14.7%	8.7%	8.1%	36.8%	64.8%	88.4%	85.8%	87.7%	80.0%	39.0%	19.4%



Scenario "B": Freshwater Reservoir



Scenario “B”: Freshwater Reservoir

- Significant impacts on water levels
- Not expected to meet the Section 20 of the Fisheries Act.

Even if construction proceeds, post-construction monitoring is typically required to demonstrate that adequate fish passage has been achieved. If this can not be demonstrated, the structure may need to be modified until sufficient fish passage is achieved (e.g., LaPlanche River Aboiteau – removal of a gate, which allows saltwater inflow upstream of the aboiteau, or partial tidal exchange).

Other considerations:

Water Quality - Would continue to deteriorate, with more chances of weeds/algae, odours, public safety concerns/ contact restrictions, and poor fish habitat / mortality.

Continued sedimentation of the lake.

Current accommodations for fish passage in April have led to public concerns over dust clouds



Growth in Lake Pesaquid (2015, Google Earth)

Other considerations:

Operation & Maintenance

- Higher potential for flood risk (more complex gate)
- Regular maintenance required to clean sediment blockages
- Continuous modifications may be needed to meet fish passage requirements
- Impossible to fully prevent seepage through causeway (saltwater seepage will limit freshwater biota and fish habitat to current level)

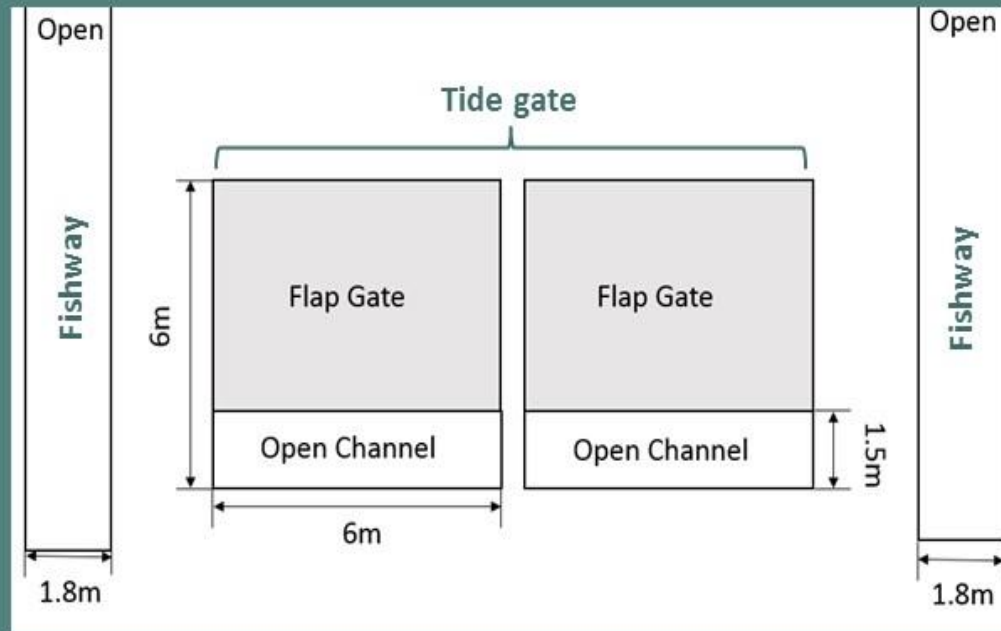
Revised Design:

Partial Tidal Exchange: Scenario “C”

- Provides controlled partial exchange of tidal water
- Year-round fish passage for all species
- Adaptive design for anticipated climate change and sea-level rise

Modelled aboiteau and fishway design. Partial Tidal Passage

Elevation

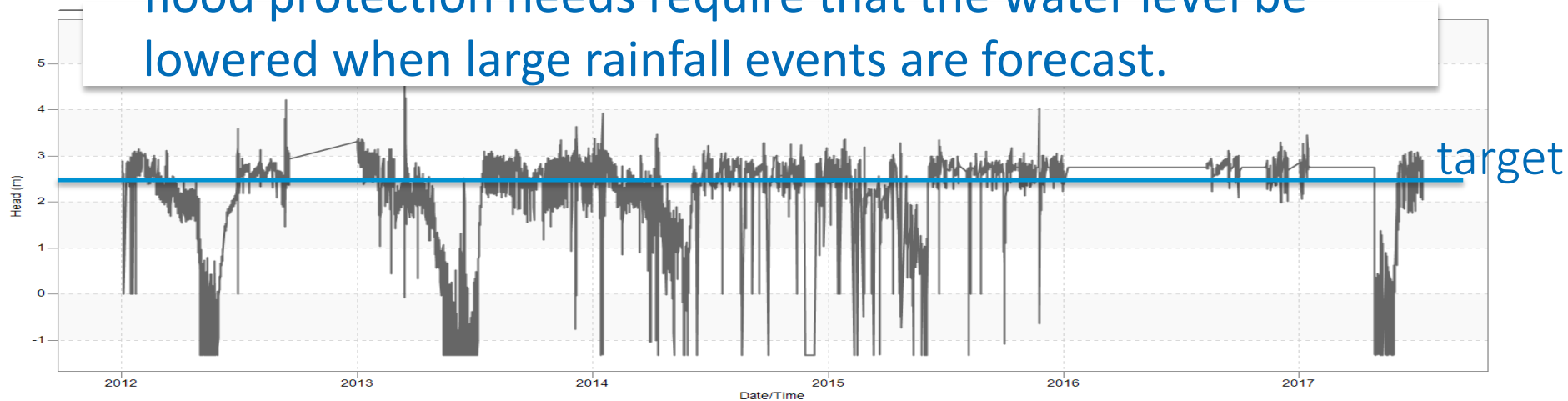


Profile



Flexible Design:

- The intention is that such a configuration can be adjusted as needed. It is able to function safely and effectively with minimal operation, but can be adjusted to meet various needs, such as allowing water levels to rise in the lake for specific events.
- Currently, the water level in the reservoir is only at the target elevation (2.7m/ 9ft) for a few weeks in the year, given that flood protection needs require that the water level be lowered when large rainfall events are forecast.



Changes Anticipated with Partial Tidal Exchange:

Fish Passage – Significantly greater fish passage and habitat potential

Water level - The water level would be approx. 0.6m to 2.1m (2-7 ft.) below the existing target water level. This is intentional, to protect the farming ditches from saltwater intrusion.

Currents - Currents would change but still remain safe for canoeing / boating.

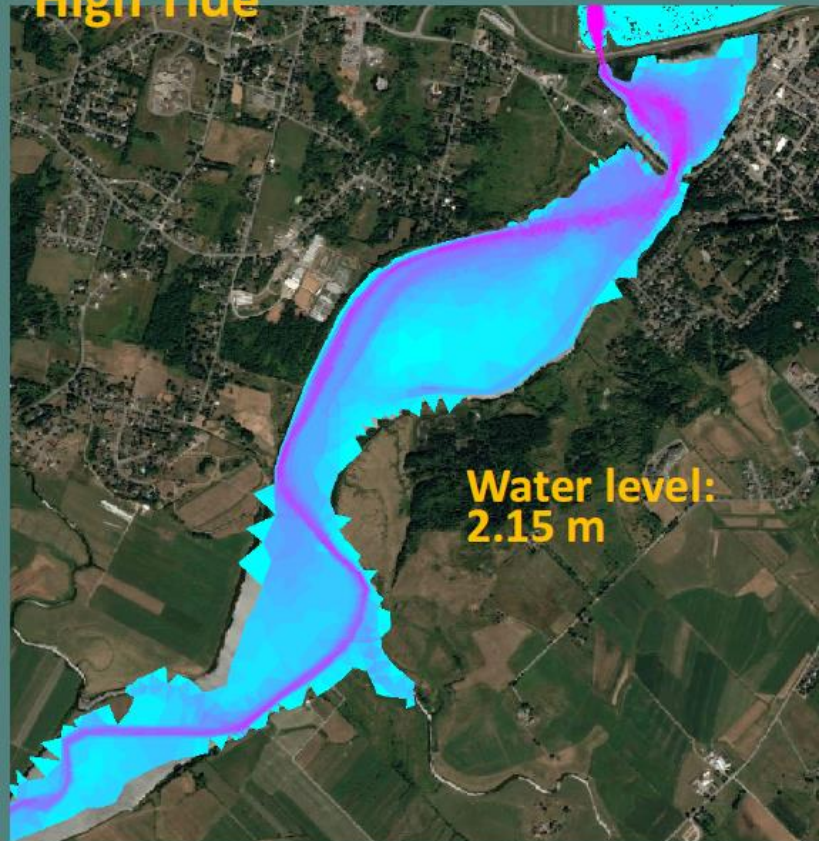
Salinity (salt) - Would not impact current farming operations. Salt would not reach Martock water intake except during a combination of extreme low runoff and high tides in late summer.

Temperature - Tidal exchange would cool water, restore natural flushing and improve water quality (important for algae control and fish habitat/health).

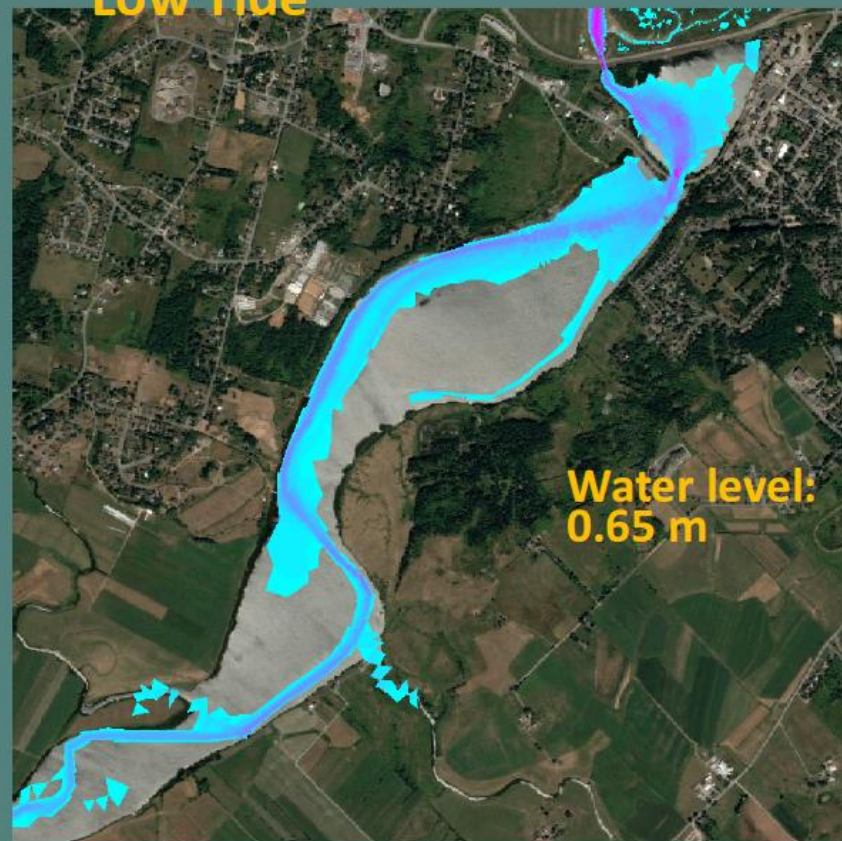
Sediments - Minor sediment deposition would occur in shallow areas; no sedimentation is expected in the main channels.

Expected Water Depths

High Tide



Low Tide



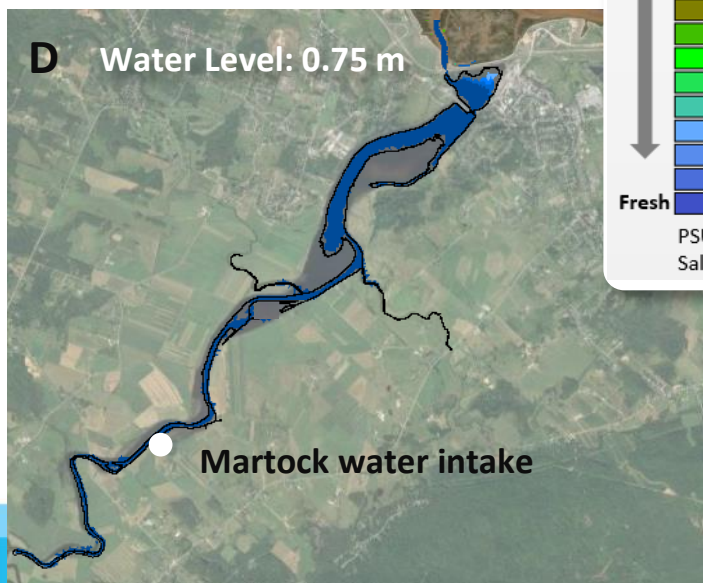
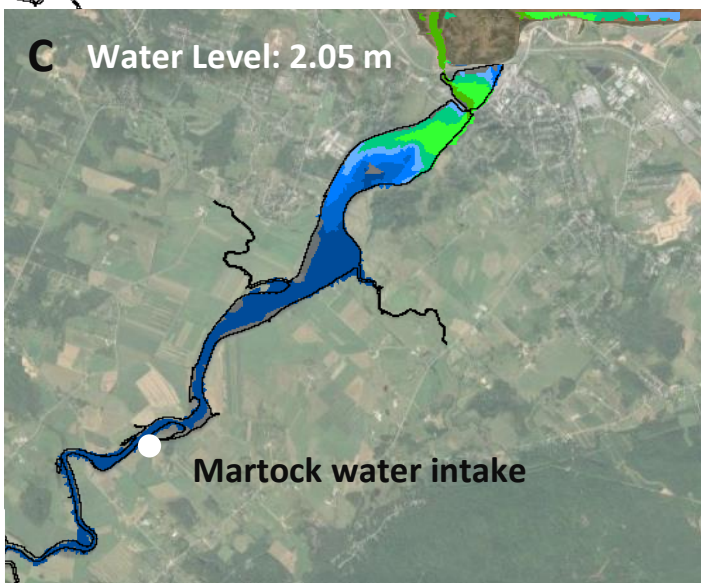
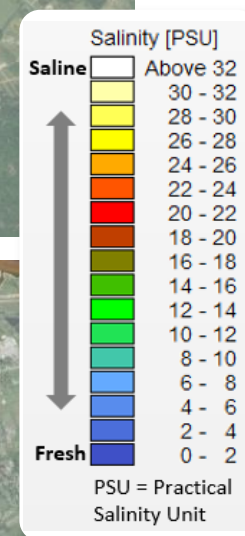
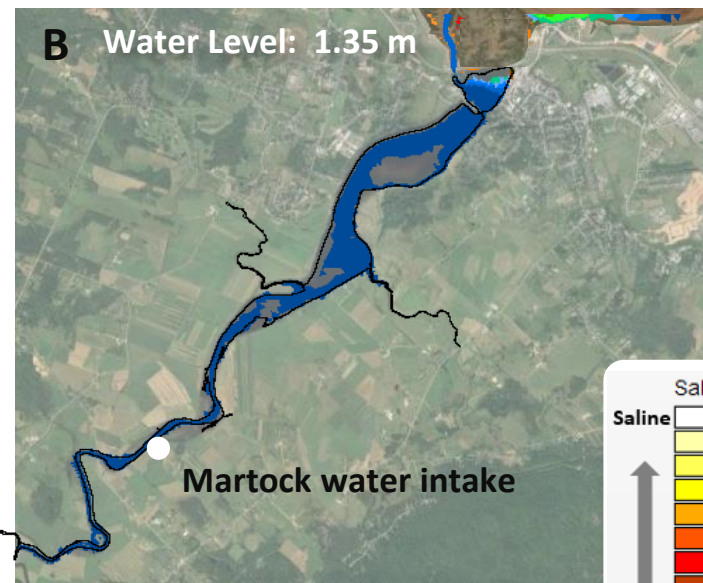
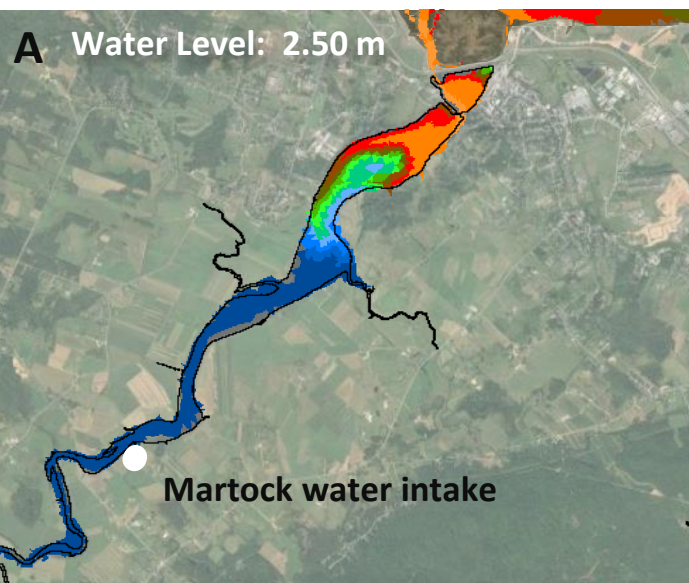
- Local activities (pumpkin regatta, boating, etc.) can be accommodated by adjusting timing with the tide.

*These depths take into account sedimentation (see last slide).

Expected Salinity Patterns

High Tide

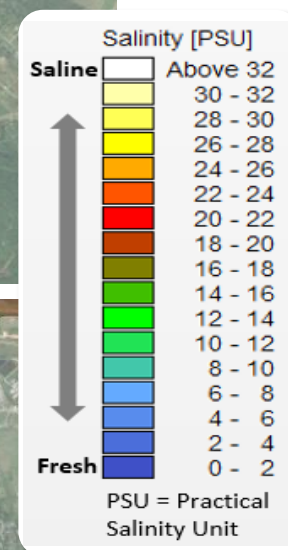
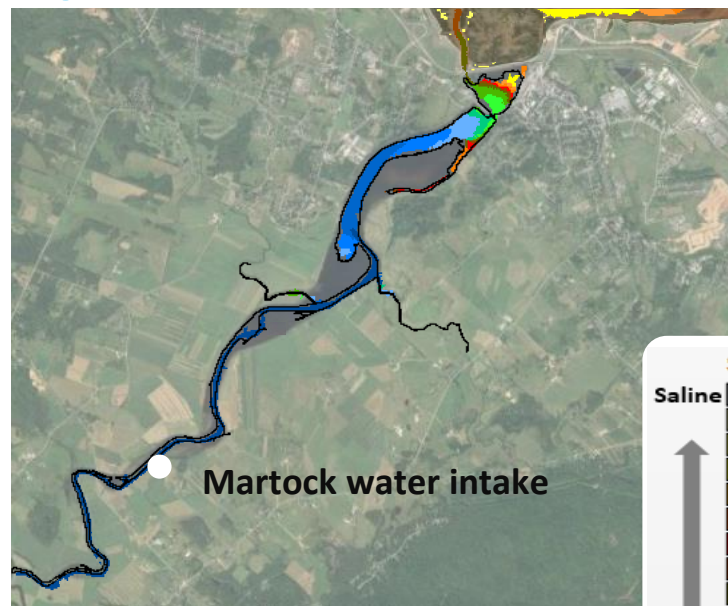
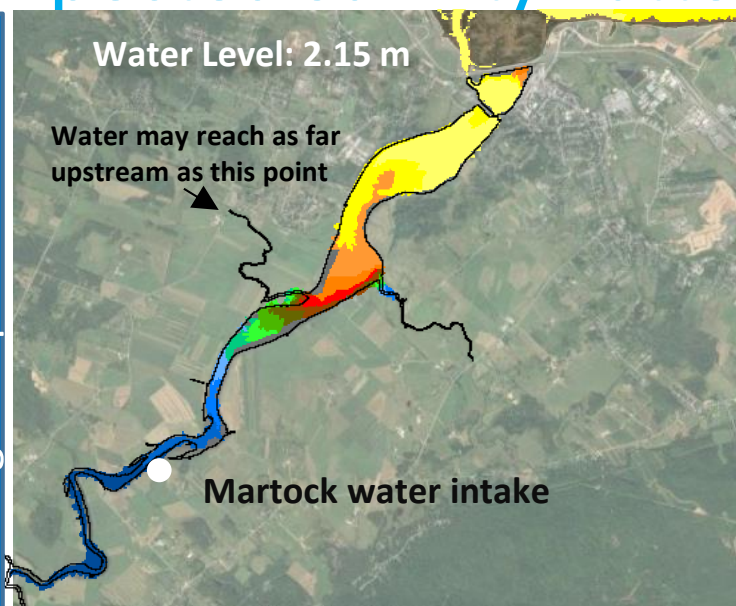
Low Tide



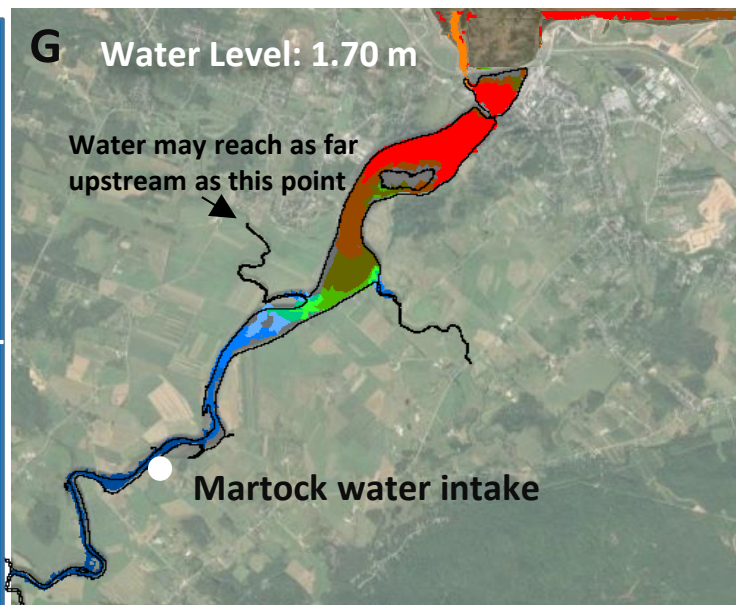
Expected Salinity Patterns

Low Runoff

Large Amplitude Tide



Small Amplitude Tide



Avon River - High Tide (2.1m / 7 ft)

Scenario C



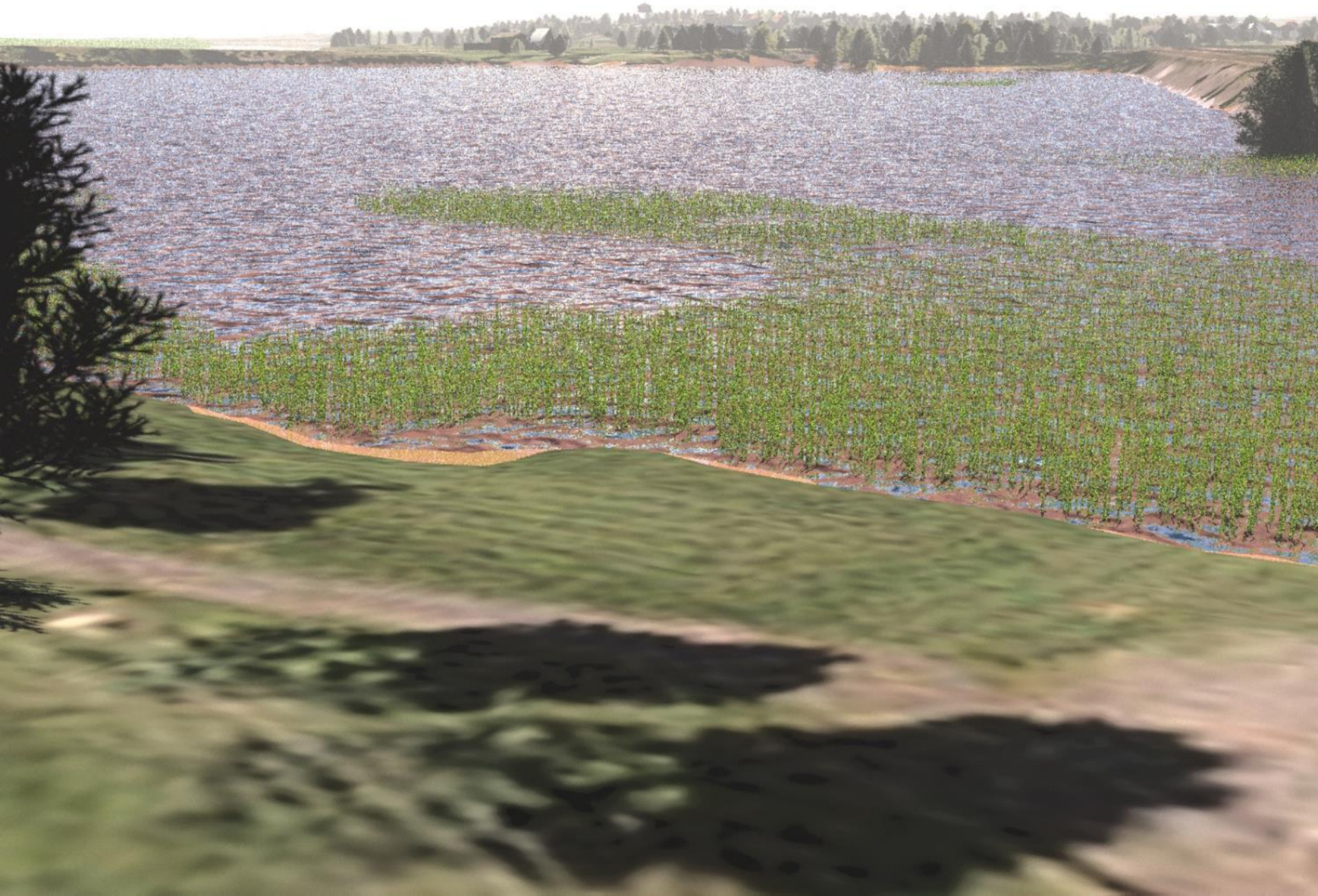
Avon River - Low Tide (0.6m / 2 ft)

Scenario C



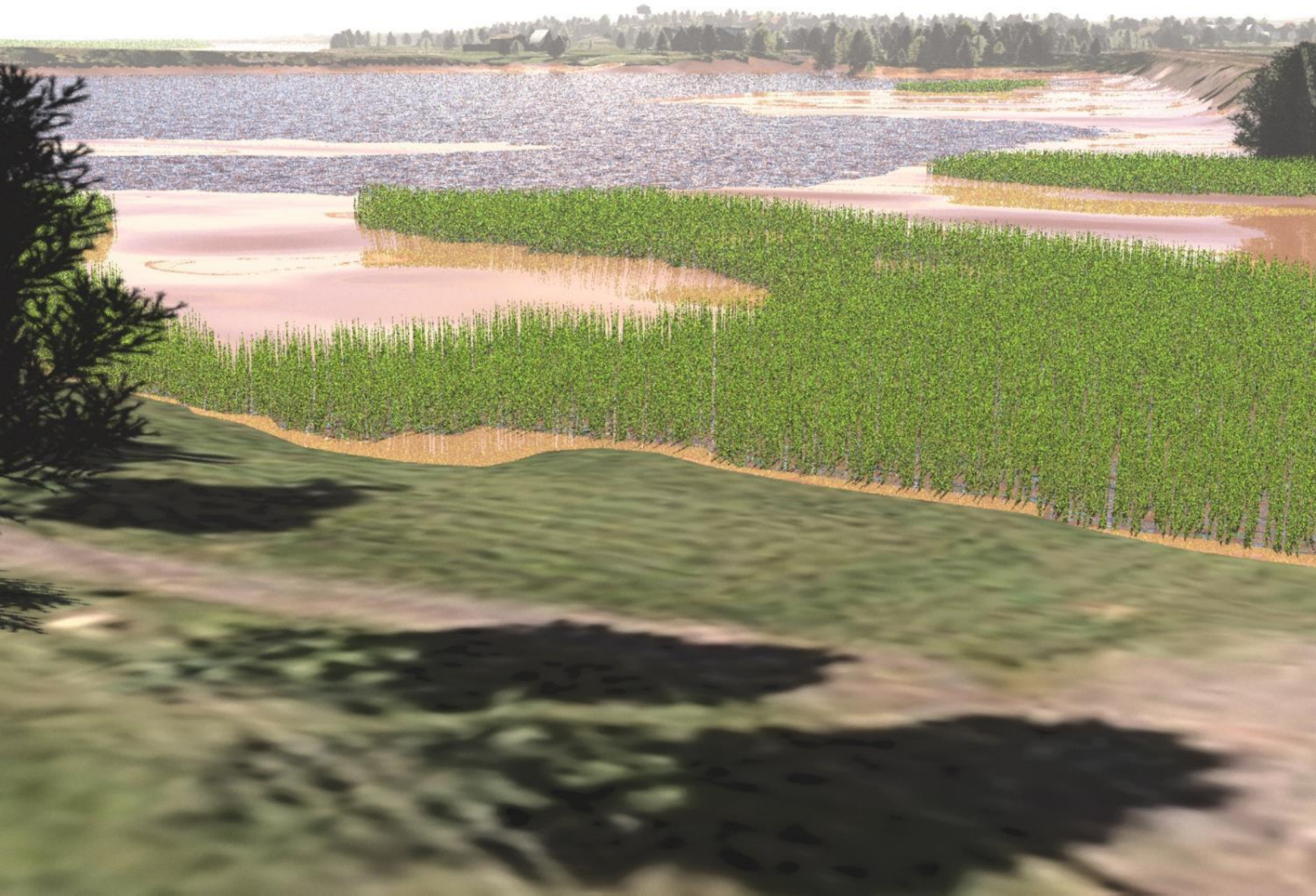
Pisiquid Canoe Club - High Tide (2.1m / 7 ft)

Scenario C



Pisiquid Canoe Club - Low Tide (0.6m / 2 ft)

Scenario C





August 2012



April 2016



1963



Avon River Causeway Shortly
Before October 1970 Opening



Results: Partial Tidal Exchange

- Improved flood protection (simpler, passive, standard system).
- System would be reverted back to a more natural functioning river and healthier habitat.
- Fish passage would be of very high quality for all fish species 24 hours a day, 365 days a year. Little chance of sedimentation of the fishway.
- Restored passage would generate significant recreational fishing opportunities (e.g., striped bass, shad)
- Water quality would be improved (reduced algae blooms, if any).
- Competitive Canoeing would be impacted.
- Salt marsh establishment upstream of the causeway would bring significant ecosystem benefits (including invaluable bird habitat), as well as recreational / tourism opportunities such as walking, birding, fishing, kayaking, etc.

Summary

Freshwater Scenarios “A” and “B”

- In both cases, fishways have very limited effectiveness, prone to sedimentation - not meeting requirements of Fisheries Act
- In Scenario “B”, upstream water levels would vary significantly, emptying every year (in late summer instead of currently in April), to supply fishway with water
- Lake Pesaquid currently is poor habitat for fish, has potential for long-term water quality issues, and would continue to gradually infill from upstream sediment.

Partial Tidal Exchange Scenario “C”

- Would allow for restoration to a more natural and healthier river system with significantly improved fish passage (meets Fisheries Act)
- Can be operated to provide target water levels for events
- Improved water quality, salt marsh with ecosystem benefits

Thank you

Note:

We heard the strong community interest in keeping the lake high in the summer, and we are now in the process of exploring a new option “D” to maintain the lake as well as fish passage.

Photo from van Proosdij (2018)