CH2MHILL

englishman river
WATER SERVICE

ERWS: Intake, Supply Mains, and Water Treatment Plant Project

Preliminary design:

Board Meeting

5 June 2014

Outline

- Background and Objectives
- Future water demands
- Project components
  - River Hydrology and intake
  - Water treatment plant and features
  - Transmission Mains
- Preliminary costs & funding
- Next steps

Why do we need Water Treatment?

<u>Condition 6.</u>

<u>To be constructed by December 31, 2016</u>

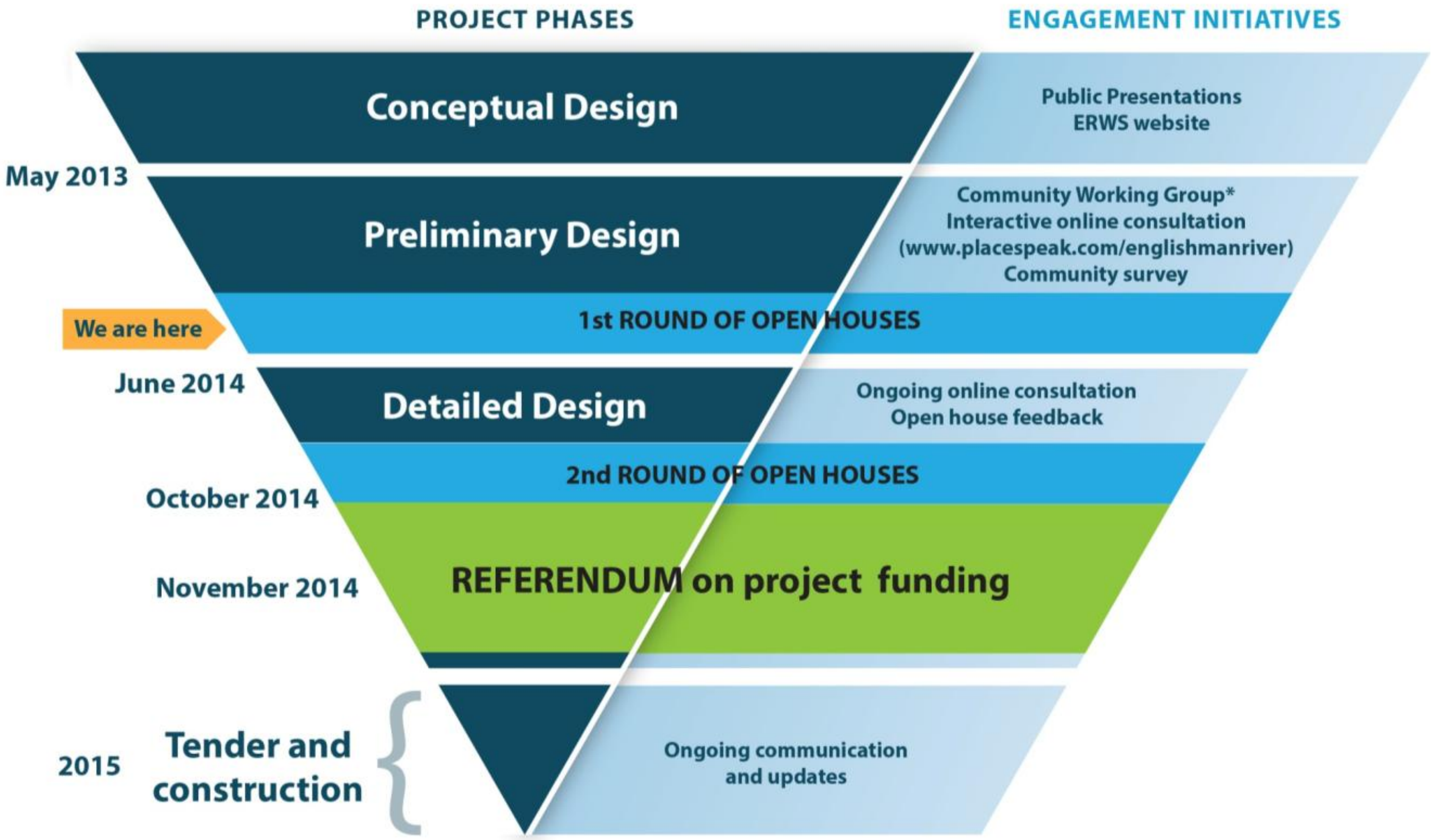
In accordance with VIHA 4321 treatment policy for the Englishman River water source, provide finished water quality using technology that will achieve the following performance standard; a 4-log removal/inactivation of viruses, a 3-log removal/inactivation of Giardia cysts and Cryptospordium oocysts, provide two treatment processes and produce finished water with less that 1 NTU turbidity.

In consultation with, and in reference to the City of Parksville letter dated February 4, 2009 (Your file 5600-10-AWS), the City of Parksville is required to meet the following implementation plan:

<u>May, 2009</u>: Obtain the services of a professional engineering firm to develop a conceptual plan and preliminary design for a water intake and treatment facility.
<u>November, 2010</u>: Conceptual plan and preliminary design is completed.
<u>December, 2013</u>: Detailed design of the new intake and treatment facility is completed.
<u>January, 2015</u>: Construction for the water intake and treatment facility commences with completion scheduled for December 31, 2016.

Date: April 24, 2009

Project phases



Design objectives

- Affordable to ensure public acceptance
- Sustainable: maintain a healthy river system; reduce energy and chemical; generate less waste
- Easy to operate and maintain
- Public education

What work has been completed to date

- **How much water do we need?**
  - Revised water demands for Parksville and Nanoose

- **How much water do we have and where is the best place to get the water from?**
  - River hydrology
  - Intake location

What work has been completed to date

- **What is the best way to treat the water economically?**
  - Water quality testing to reduce risk (costs)
  - Selected treatment process
  - RFP for membrane equipment

- **How do we optimize capital expenditures?**
  - Location of the Water Treatment Plant
  - Routing of transmission mains

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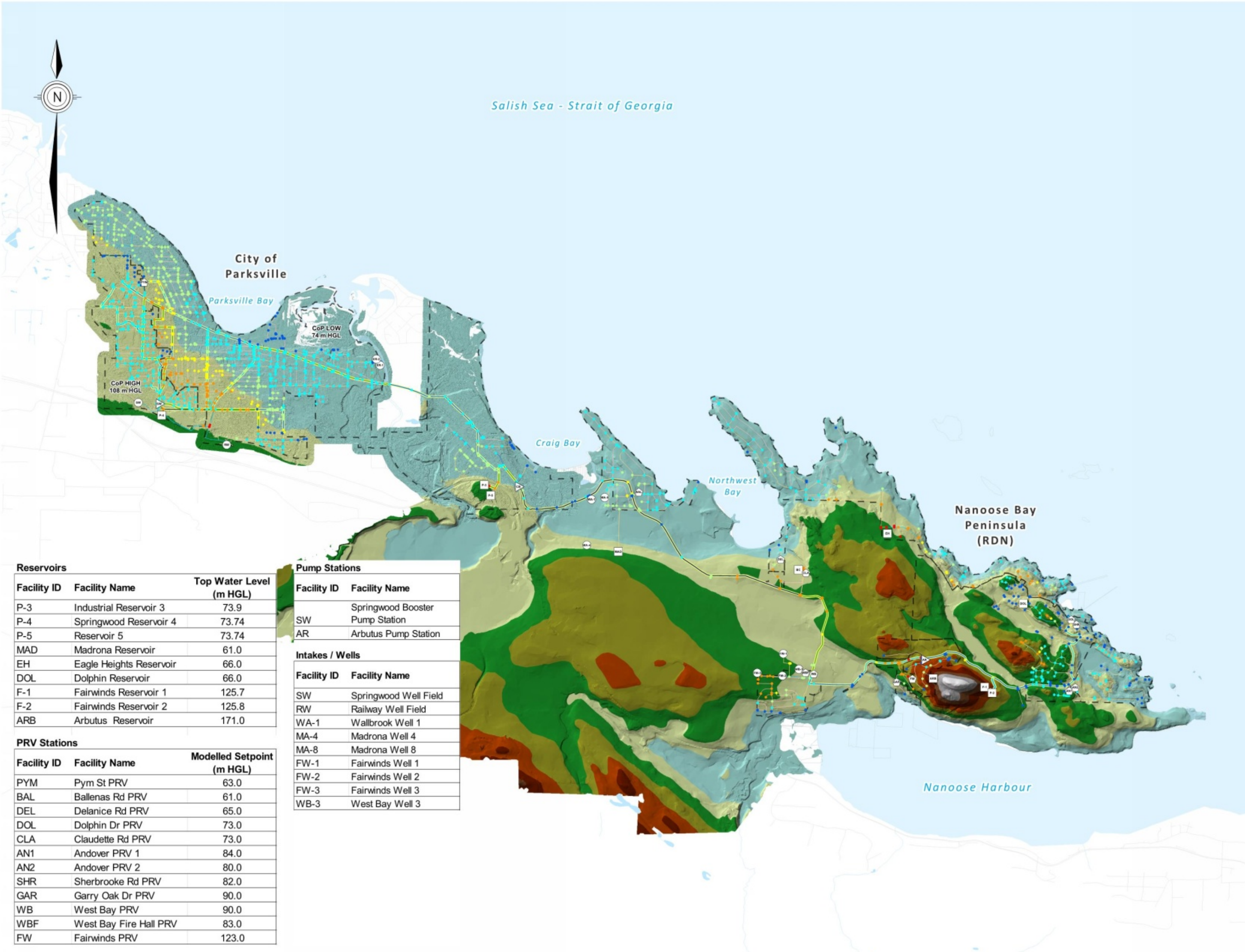
Service Areas



Reservoirs

Facility ID	Facility Name	Top Water Level (m HGL)
P-3	Industrial Reservoir 3	73.9
P-4	Springwood Reservoir 4	73.74
P-5	Reservoir 5	73.74
MAD	Madrona Reservoir	61.0
EH	Eagle Heights Reservoir	66.0
DOL	Dolphin Reservoir	66.0
F-1	Fairwinds Reservoir 1	125.7
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ARB	Arbutus Reservoir	171.0

PRV Stations

Facility ID	Facility Name	Modelled Setpoint (m HGL)
PYM	Pym St PRV	63.0
BAL	Ballenas Rd PRV	61.0
DEL	Delanice Rd PRV	65.0
DOL	Dolphin Dr PRV	73.0
CLA	Claudette Rd PRV	73.0
AN1	Andover PRV 1	84.0
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Pump Stations

Facility ID	Facility Name
SW	Springwood Booster Pump Station
AR	Arbutus Pump Station

Intakes / Wells

Facility ID	Facility Name
SW	Springwood Well Field
RW	Railway Well Field
WA-1	Wallbrook Well 1
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MA-8	Madrona Well 8
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FW-3	Fairwinds Well 3
WB-3	West Bay Well 3

Base Demands

- Base Demand (BD) = Primarily Indoor Water Use

Service Area	Residential Base Demand
City of Parksville	**156 L/ca/day**
Nanoose Bay Peninsula	**163 L/ca/day**
District of Saanich	203 L/ca/day
City of Richmond	208 L/ca/day
Benchmark Single Family Home with Low Flow Appliances	155 – 162 L/ca/day

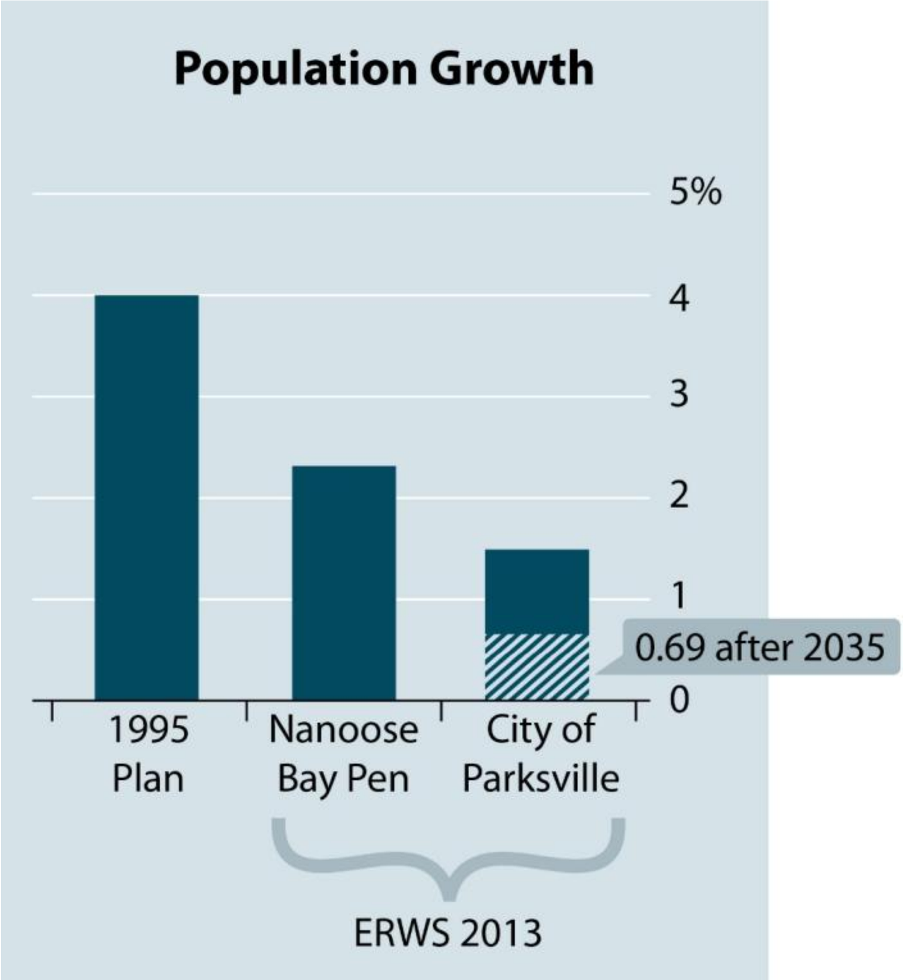
Seasonal Demands

- Seasonal Demand (SD) = Primarily Irrigation
- Calculated from Maximum Day Demand Data

Parameter	Value
Irrigation Rate (2009)	34,300 L/ha/day
Irrigation Rate (2013)	23,800 L/ha/day
District of Saanich (2009)	31,100 – 41,500 L/ha/day
Residential Lot Coverage	65% - Parksville 45% - Nanoose

Future Demands

- 2050, 2035, 2018
- Official Community Plans (OCP)
- Population Growth Projections



Future Demands

Year	Population	City of Parksville		Nanoose Bay Peninsula		Total	
		BD (MLD)	MDD (MLD)	BD (MLD)	MDD (MLD)	BD (MLD)	MDD (MLD)
2013	17,550	3.4	16.3	1.1	6.6	4.5	22.9
2018	19,033	3.6	17.1	1.3	7.0	4.9	24.1
2035	24,290	4.2	19.2	1.9	8.6	6.1	27.8
2050	29,349	4.7	20.8	2.6	10.5	7.3	31.3
2050 (High Growth)	35,818	6.4	25.7	2.6	10.5	9.0	36.2

Maximum Day Demand (MDD) = Base Demand (BD) + Seasonal Demand (SD)

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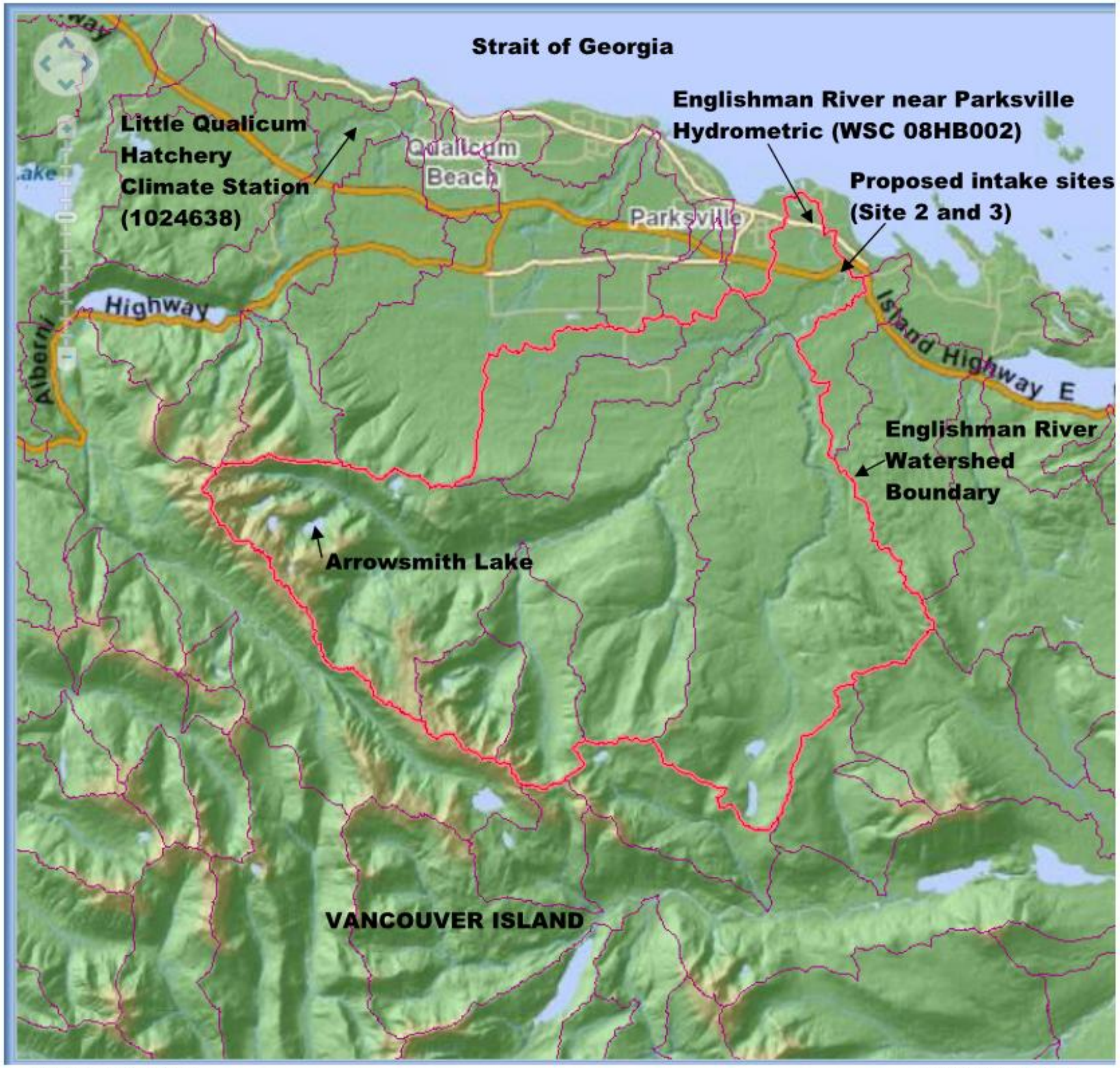
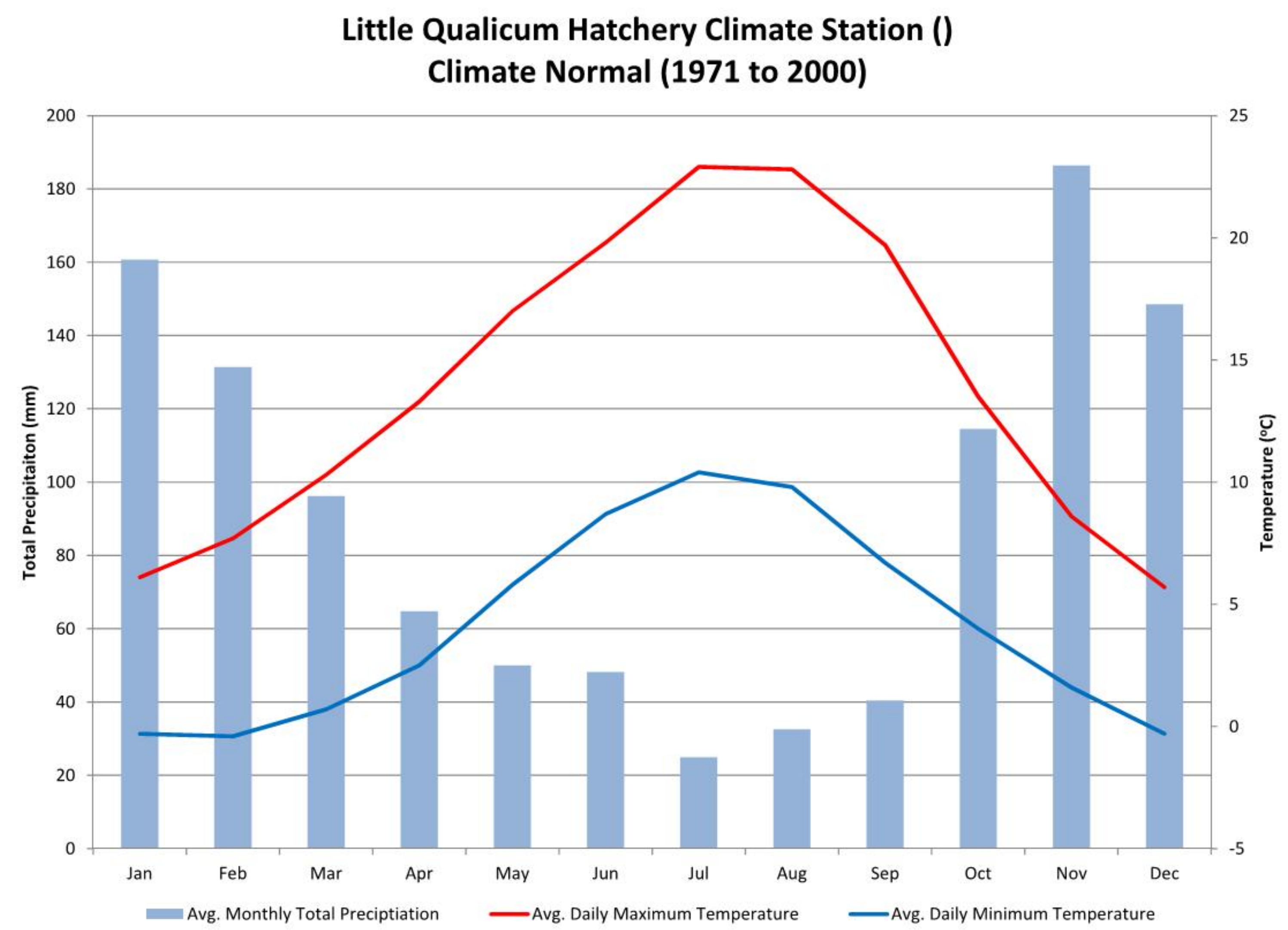
Englishman River Watershed



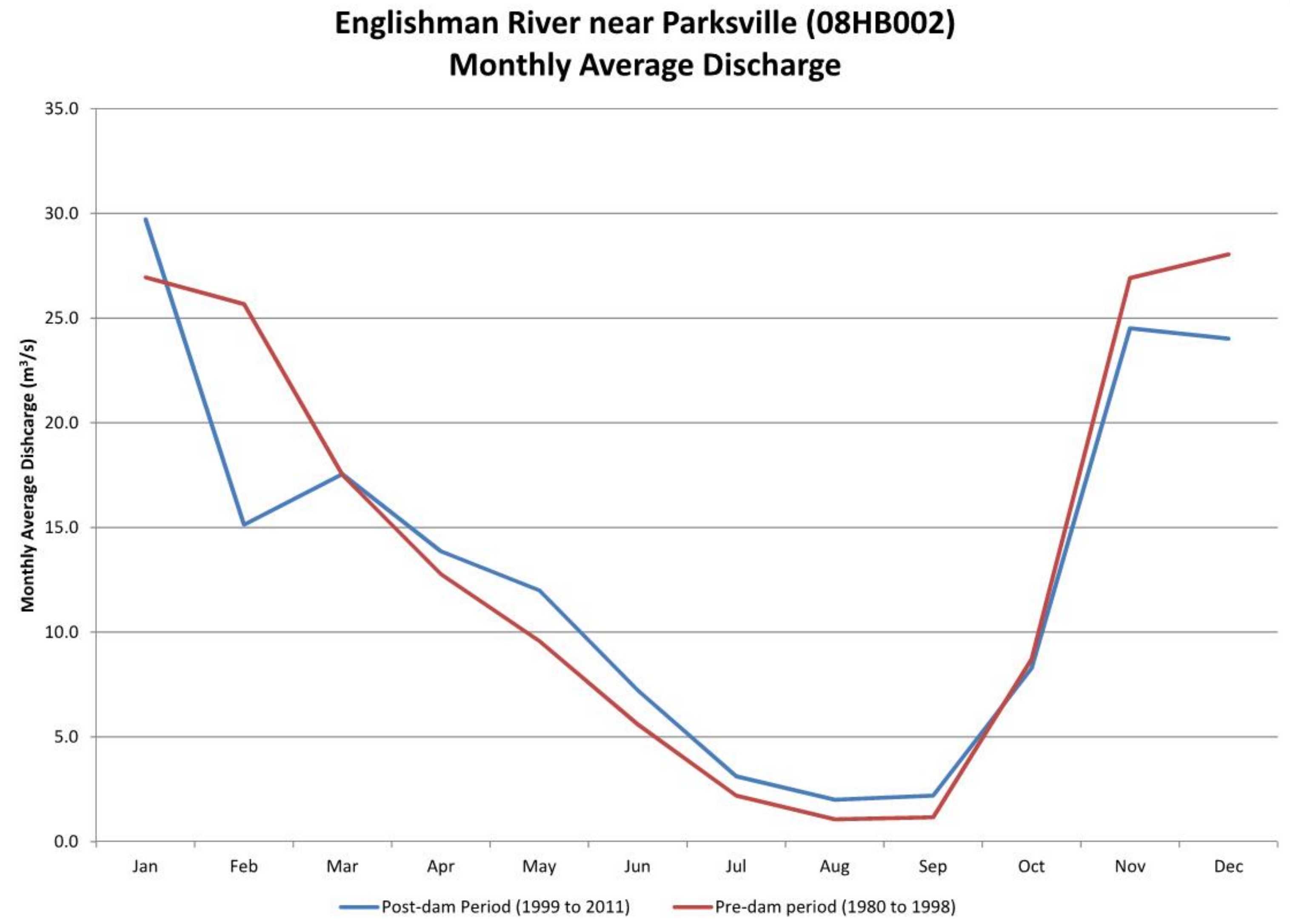
Scale: 1:150,000

Source: iMapBC

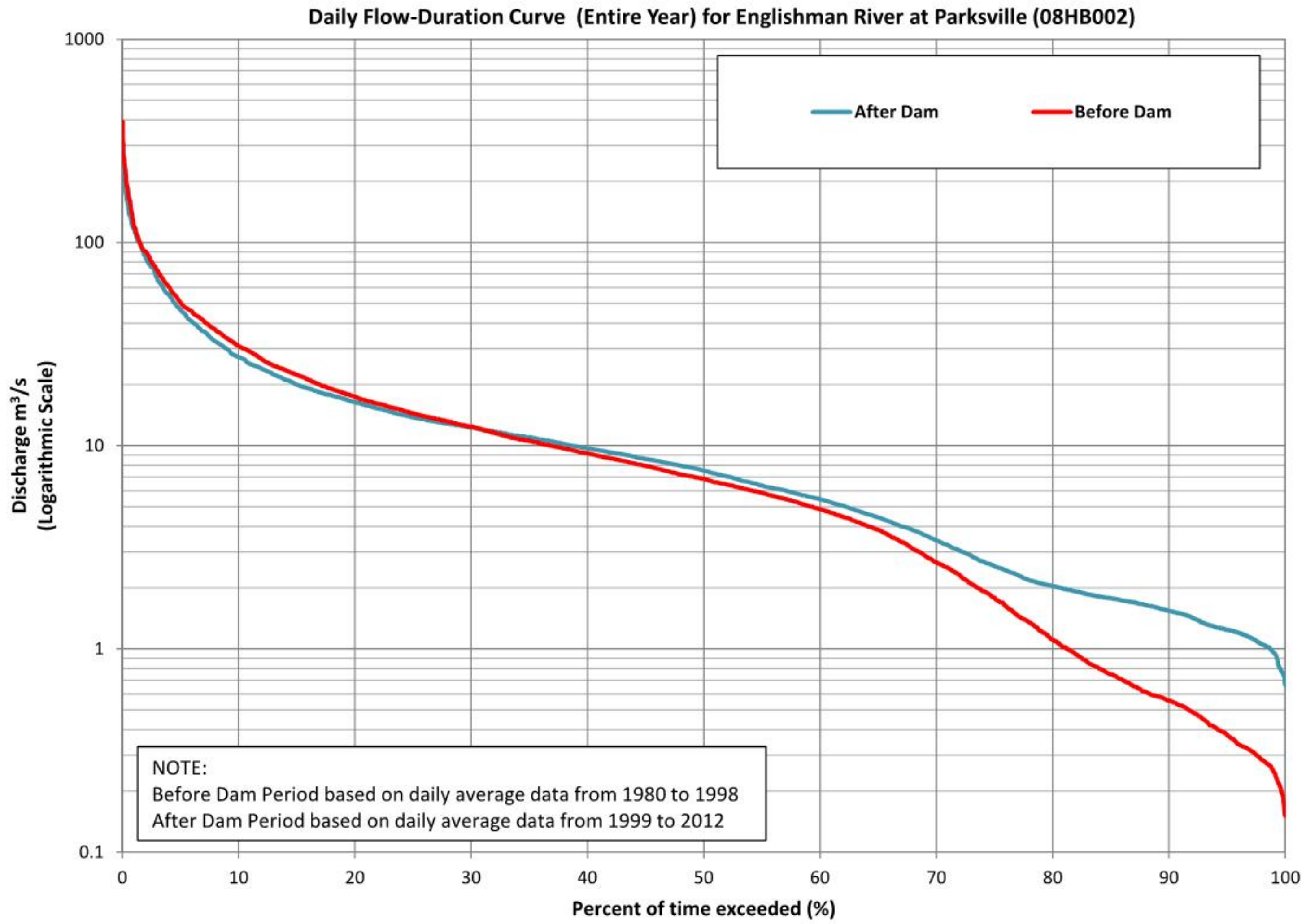
Watershed Climate



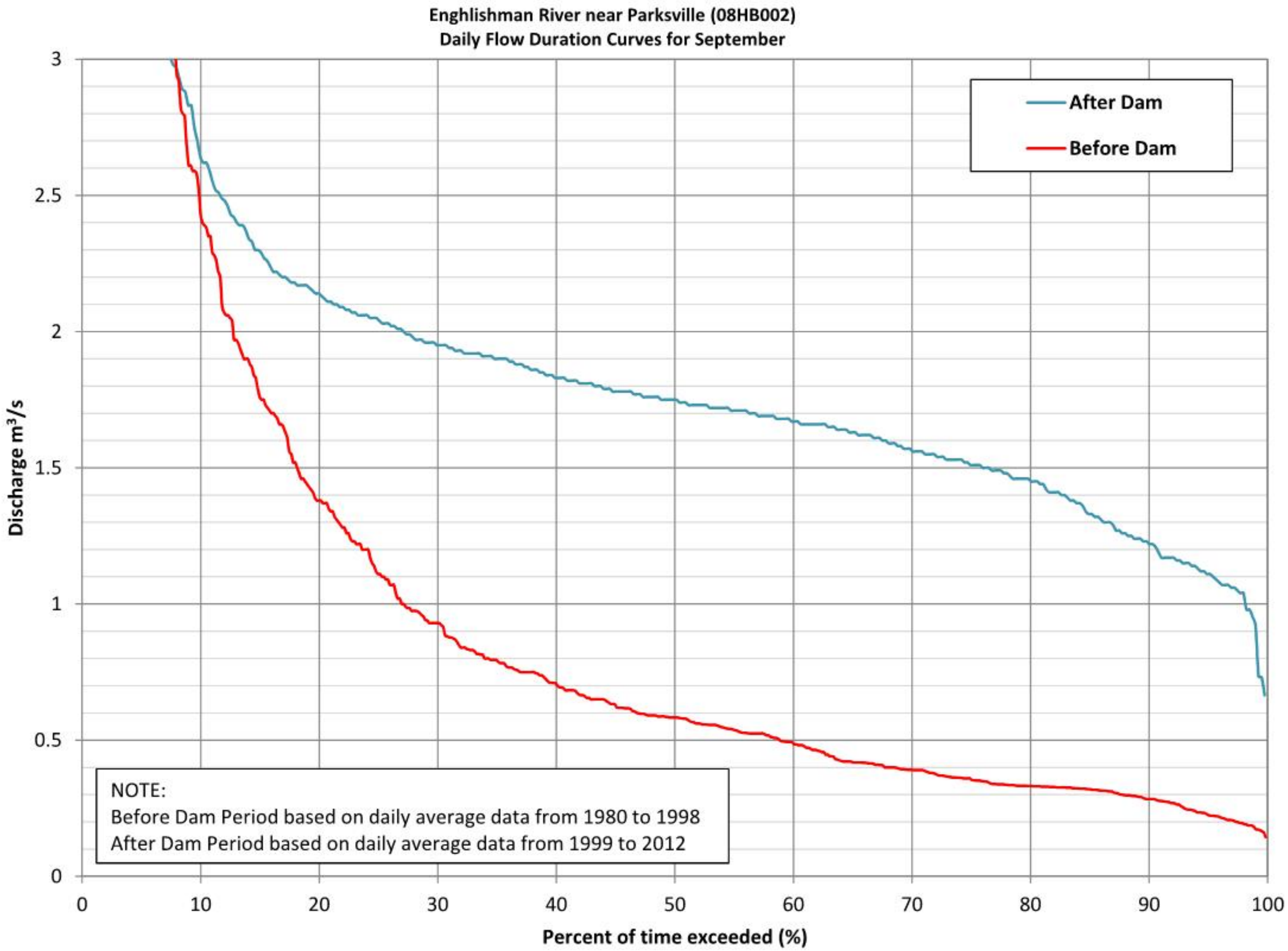
Average River Flows (WSC Gauge)



Flow Duration Curve (Entire Year)



Flow Duration Curve (September)



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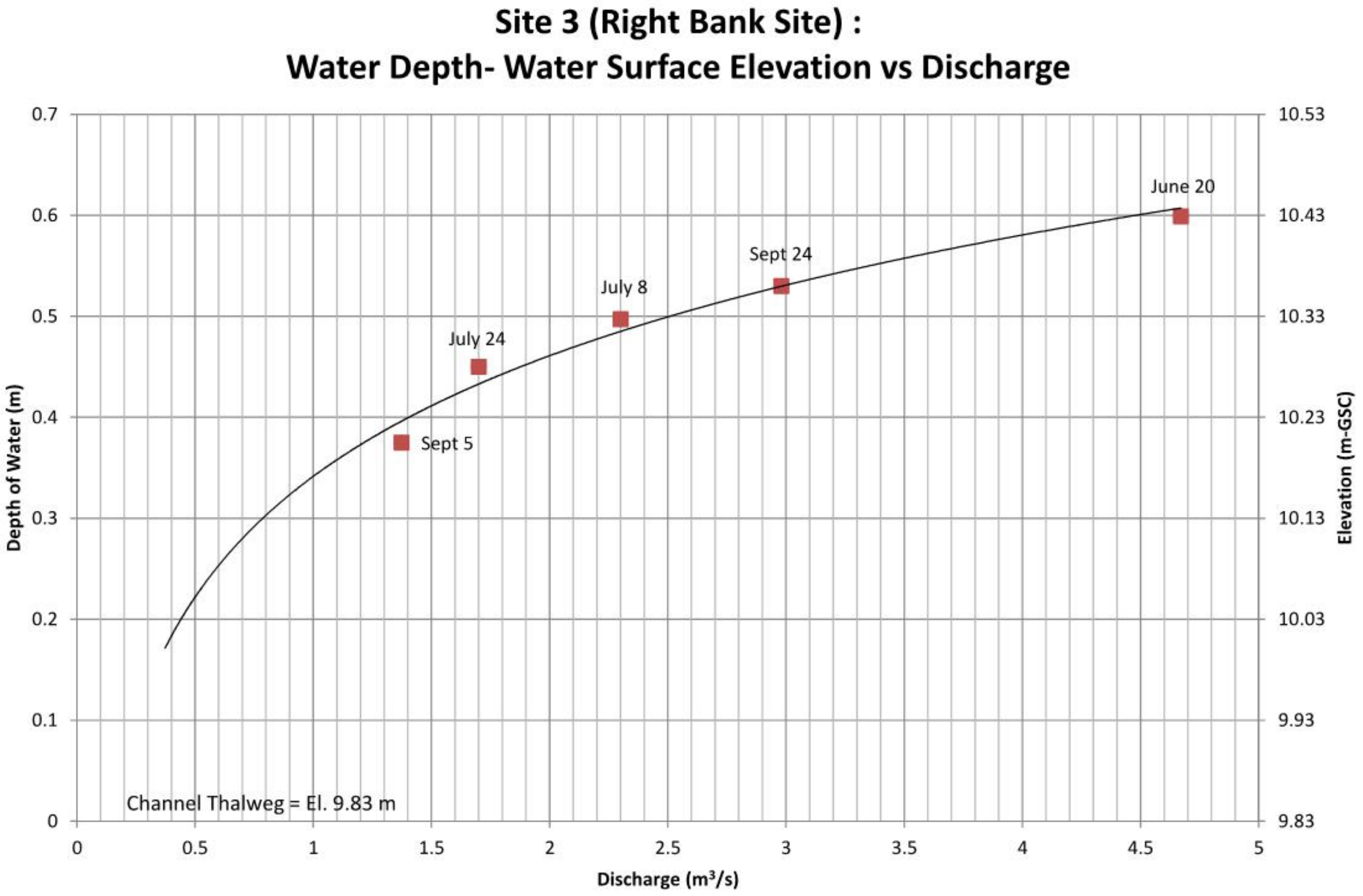
Low Flow Rating Curve at Intake (Site 3)



Design Water Levels at Intake Site

- HEC-RAS Computer Model

- Low-Flow Water Level (1.2 cms) = **10.2 m GSC**
- 200-year Return Period Water Level = **16.4 m GSC**
- Flood Construction Level = **17.4 m GSC**
- Freeboard Allowance = **1.0 m**

Arrowsmith Lake (Storage Reservoir)

- On east side of Mount Arrowsmith
- Surface Area = 0.3 km^2
- Watershed Area = 5 km^2 (1.5% of total)
- Annual Runoff = 8,200,000 m^3 to 24,900,000 m^3

- Designed to deliver minimum 0.9 cms flow during 15-year drought conditions

Water License (2013)

- Water License = *9,000,000 m^3* of storage to support municipal water demands and conservation flows
- June 1 to October 31 => 1.6 cms minimum flow at WSC gauge or 1.13 cms downstream of the existing intake

Rule Curve

- Need to optimize use of existing storage to achieve conservation flows
- Also need to update dam operation based on recent flow data (more data, changing climate)
- Need to consider the flow into the reservoir, the required conservation flows and municipal water requirements

Proposed Conservation Flows

- Low Flow Habitat Assessment (LGL)

Scenario	Downstream Conservation Flow*
Above Average Year	1.6 cms
Below Average Year (2-year to 5-year Drought)	1.4 cms
Dry Year (5-year to 20-year Drought)	1.2 cms
Very Dry Year (> 20-year Drought)	0.9 cms

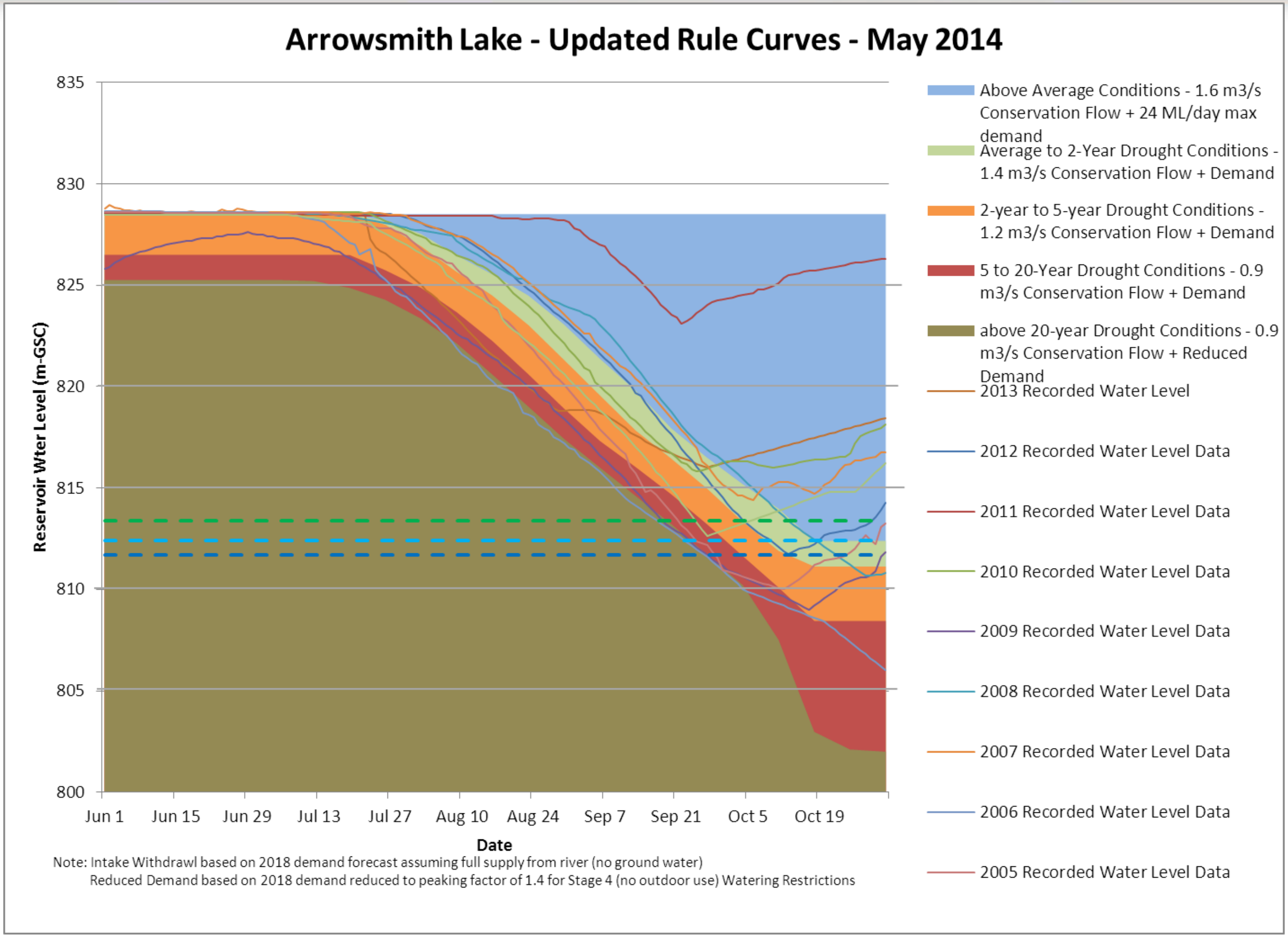
* Below Intake

Proposed Municipal Water Withdrawls

Scenario	Water Withdrawl	Comment
Average Year	24 MLD (0.28 cms)	Phase 1 Intake Capacity
Dry Year (5-year Drought)	18.9 MLD (0.22 cms)	2018 Forecast Demand*
Very Dry Year (> 20-year Drought)	13.7 MLD (0.16 cms)	2018 Demands- Stage 4 Water Restrictions

* Average Monthly

Proposed Dam Operation Rule Curve



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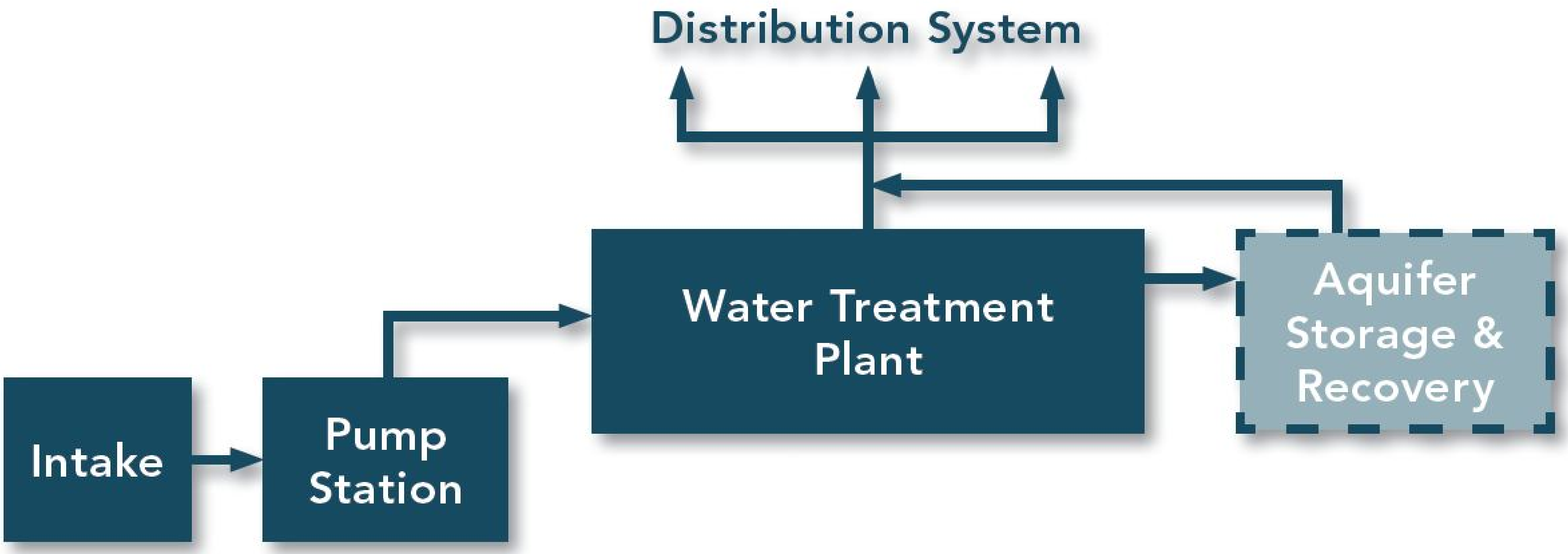
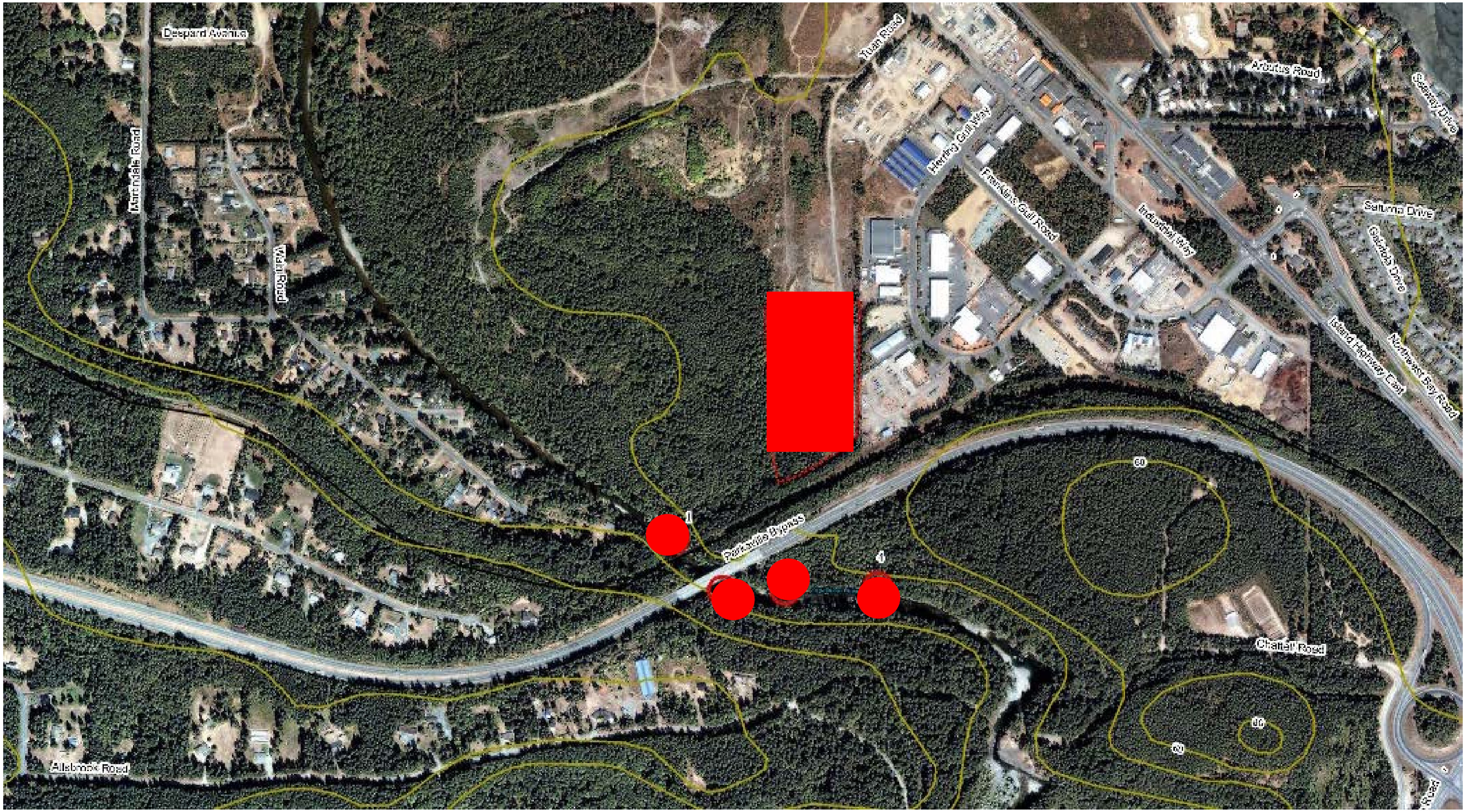
Project components

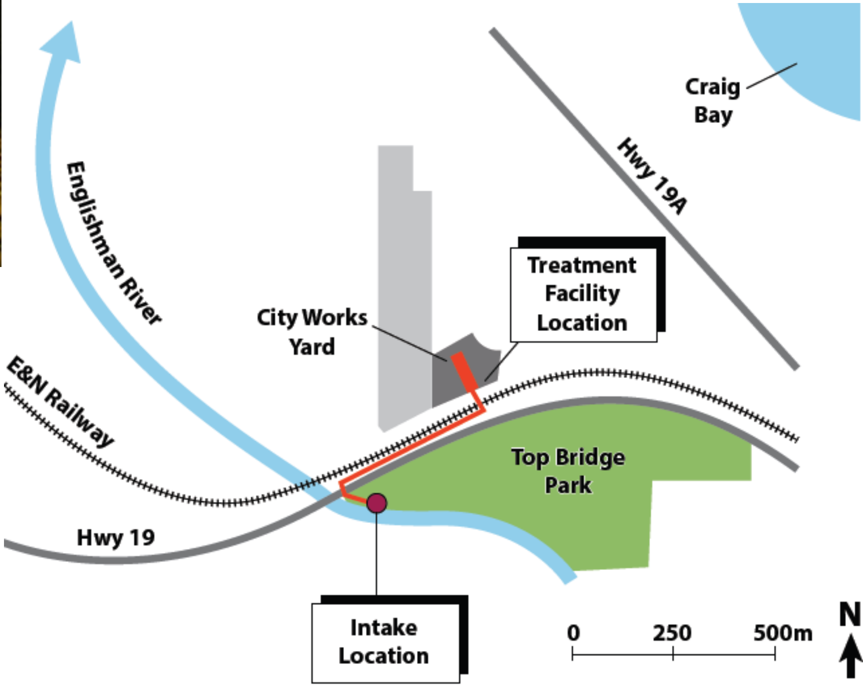


- Capacity
  - Pump and process for 24 ML/d (2035)
  - Facilities and pipes for 48 ML/d

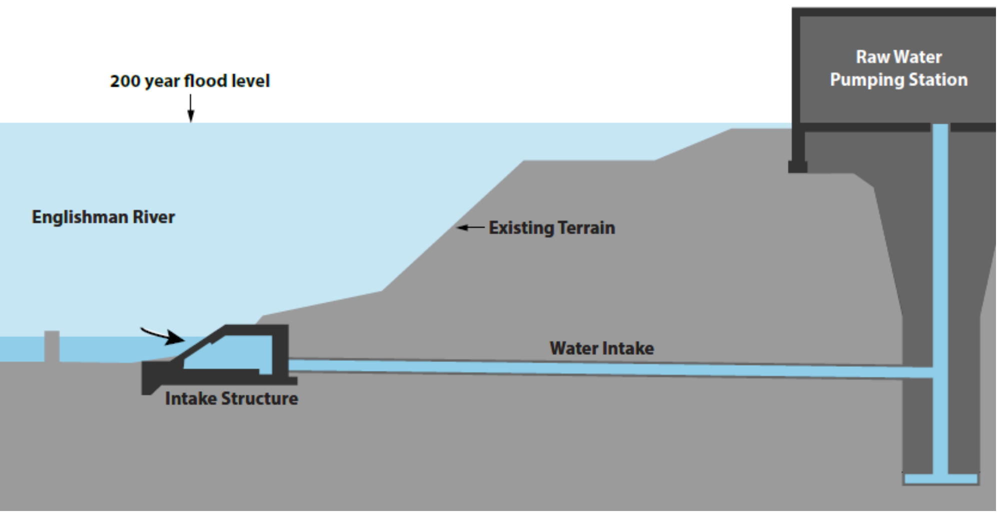
Potential intake locations

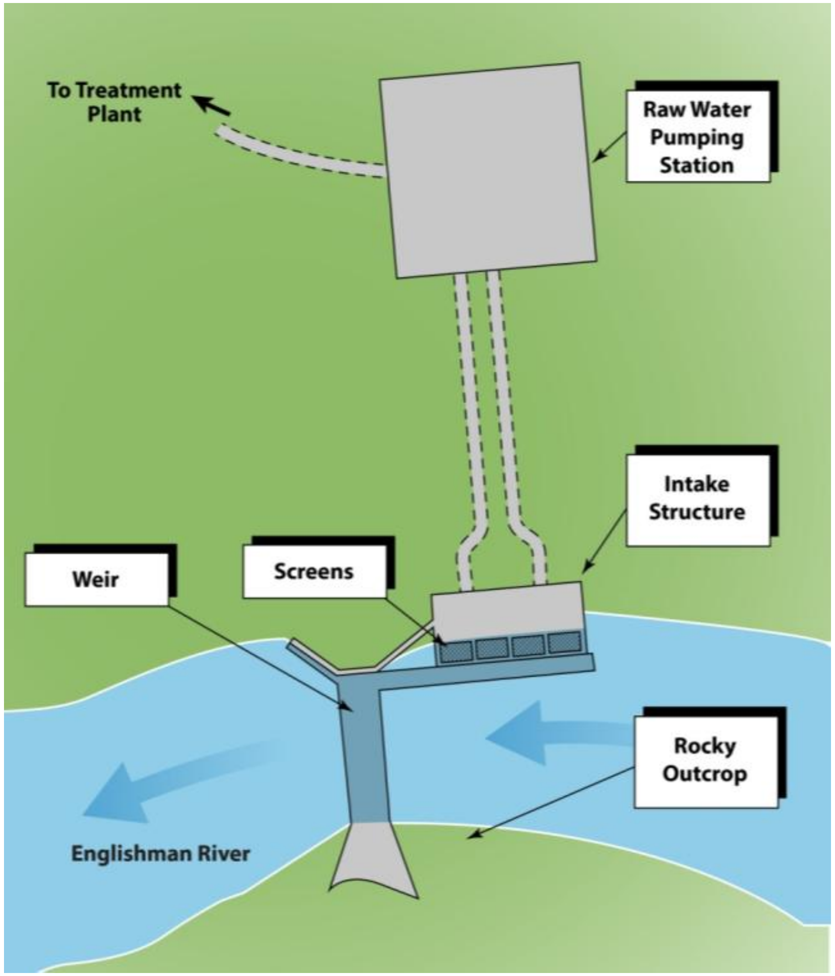


Supply intake location

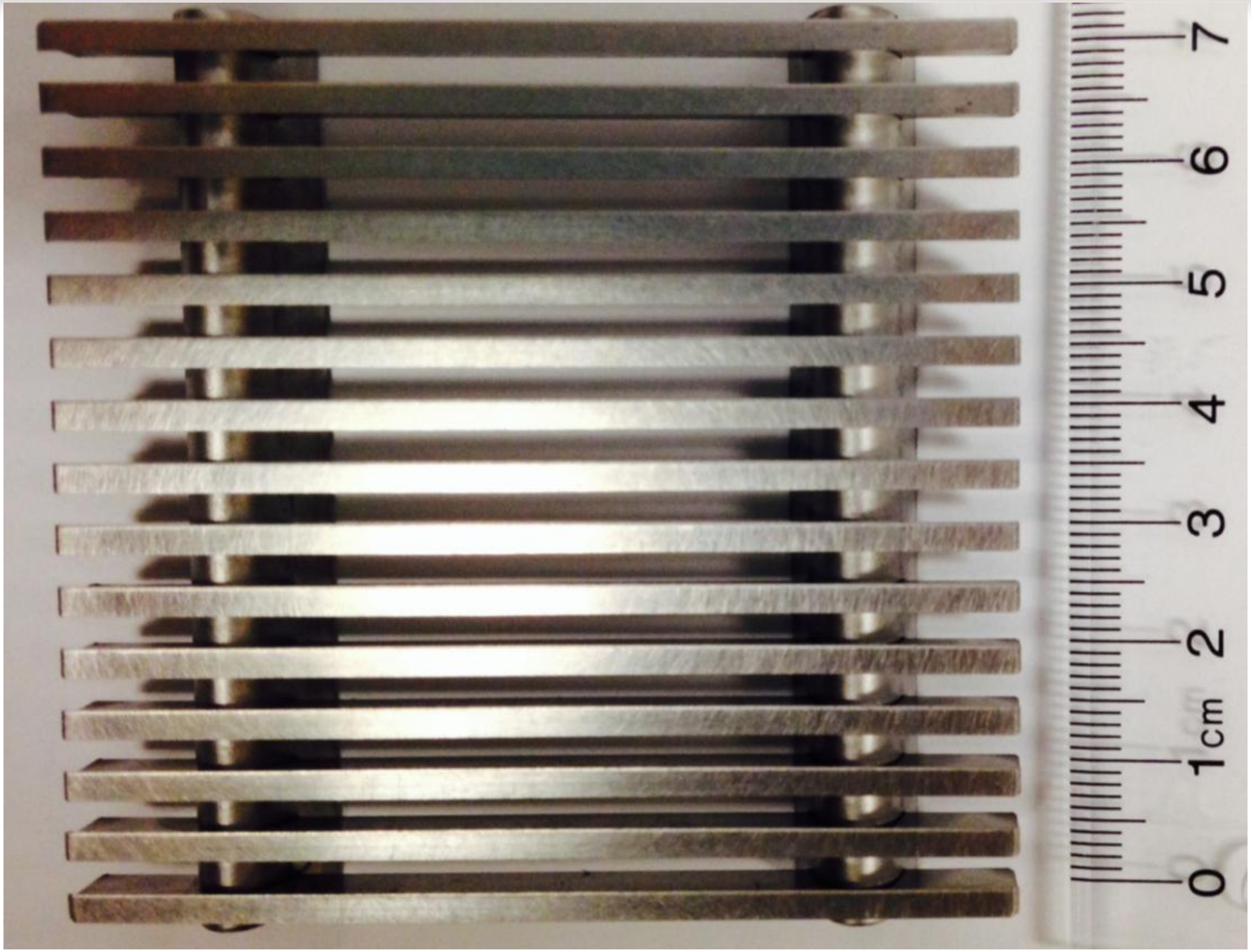


Supply intake

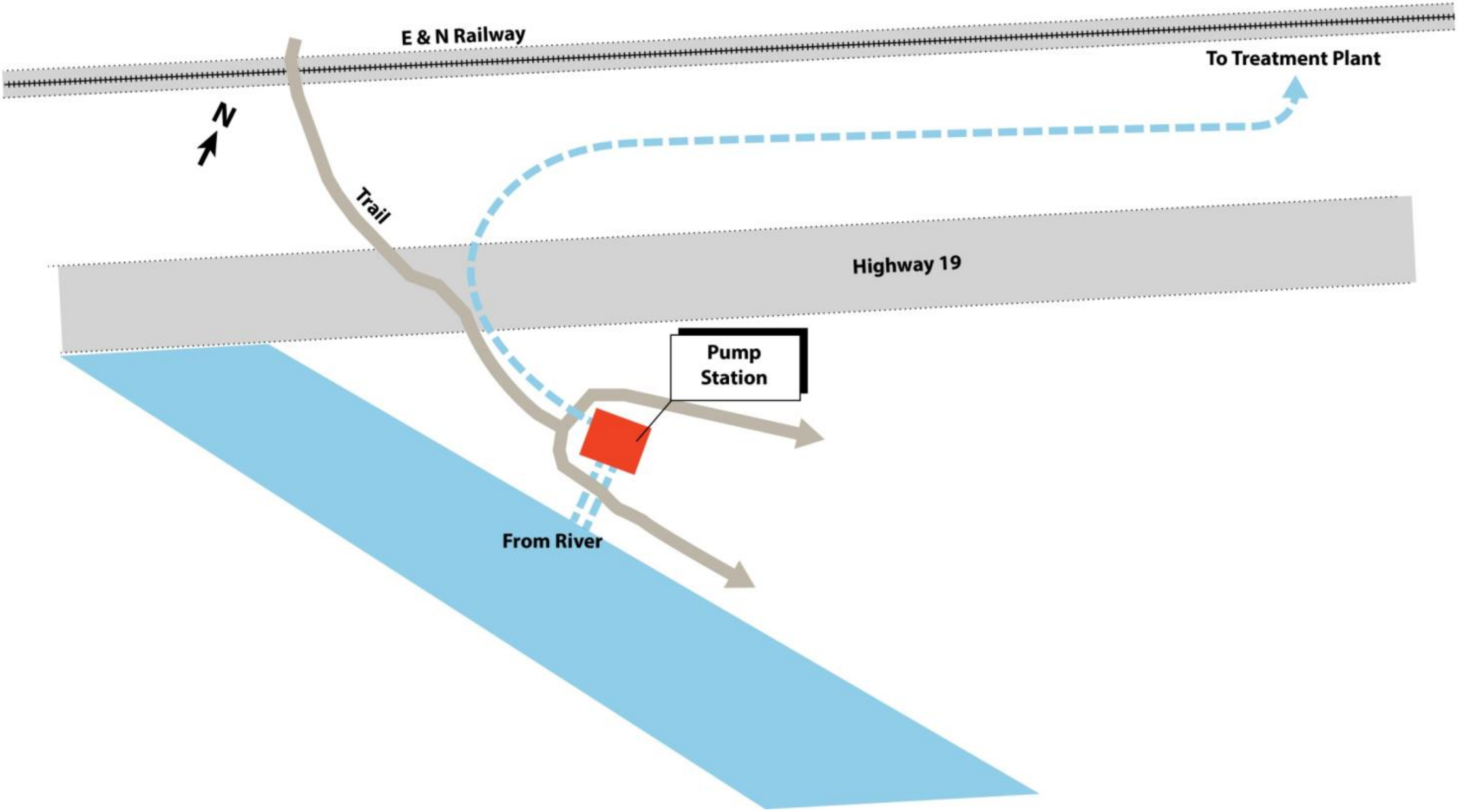




Supply intake



Pump station



Pump station

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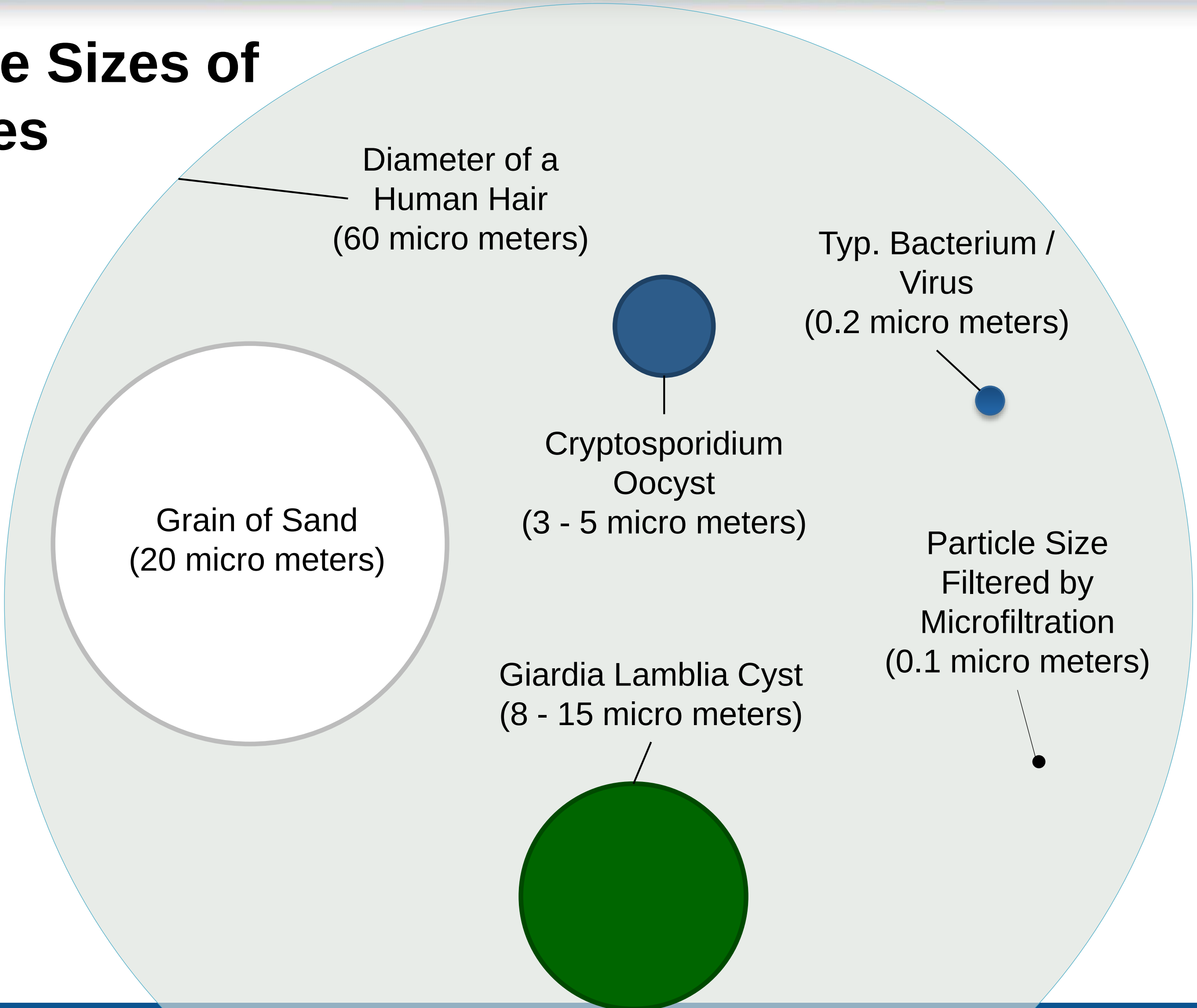
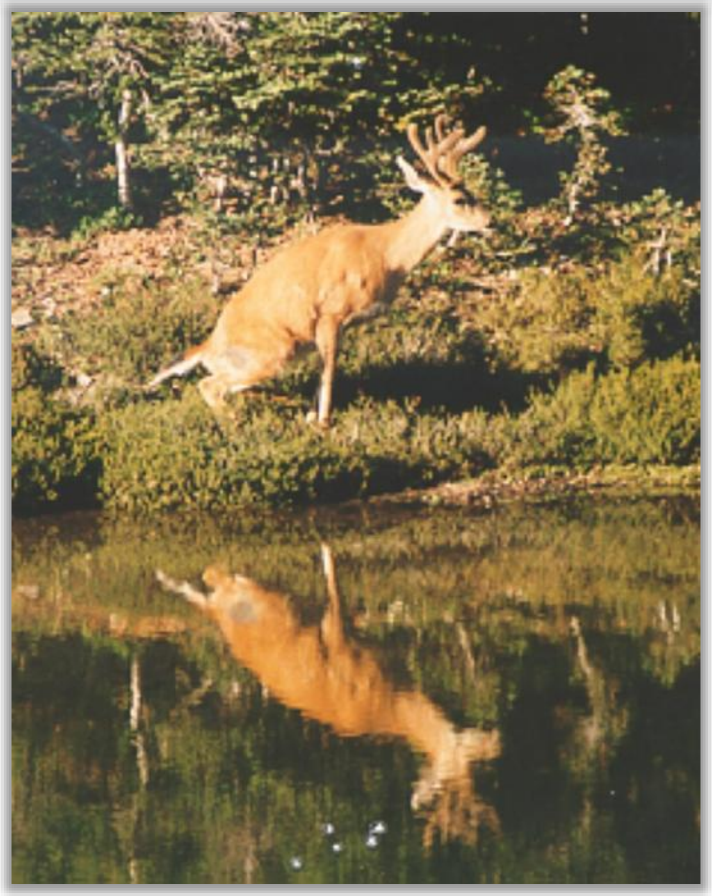
Why do we need Water Treatment?

Relative Sizes of Particles



Why treat?

- To protect public health
- To improve aesthetics
- Island Health requires it



Even the most pristine sources can be contaminated.

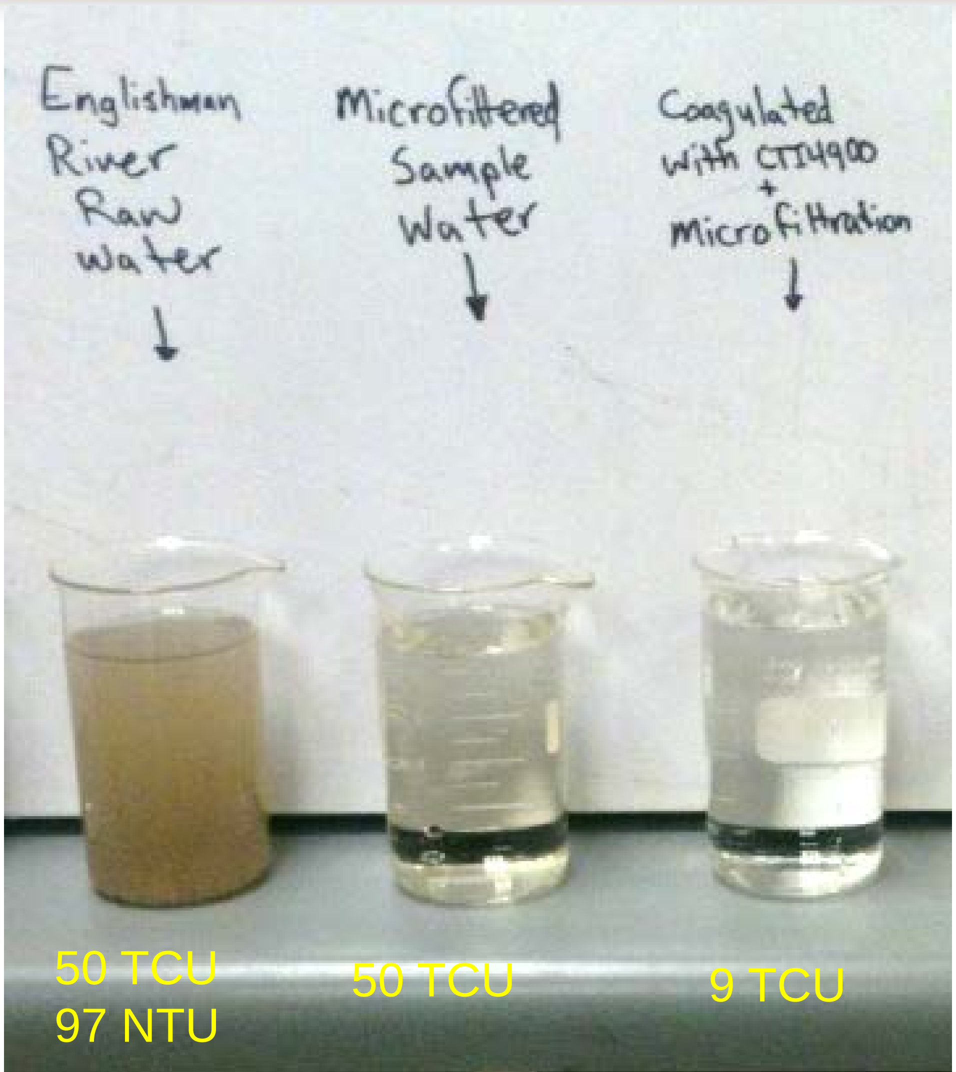
Treatment requirements and options

What must we treat?	What are the treatment options?
• **Microbes** (viruses, bacteria, *Cryptosporidium*, *Giardia*) • **Turbidity**	**Filter** and **disinfec**t water with UV light, and add a small amount of chlorine
• **Colour** • **Disinfection by-products**	1. Add a **chemical coagulant** (aluminum based); or 2. Provide **nanofiltration;** or 3. Provide ion exchange (like home water softener).

What is the best way to treat the water economically?

- Water quality sampling
  - The vendors need to know what they are treating and when the worst water quality occurs?
  - Data from previous phase + new data
- Multiple processes can treat ERWS's water.
  - Which one makes the most sense:
    - Coagulant + membranes
    - Membranes+ nanofiltration
    - Membranes + Ion exchange… etc.

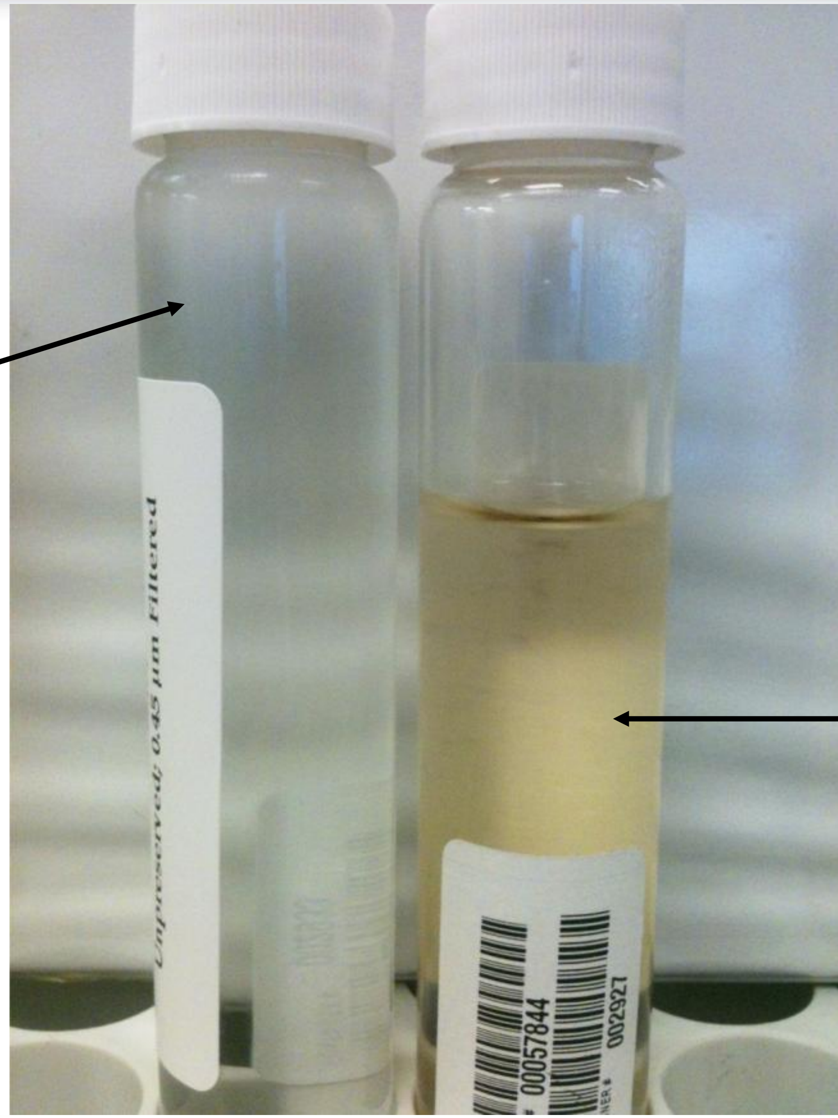
We tested effectiveness of treatment options



Ion exchange does not meet colour requirements

We tested effectiveness - nanofiltrattion

Nanofiltration, clear filtered water



Colour and organics removed by nanofiltration

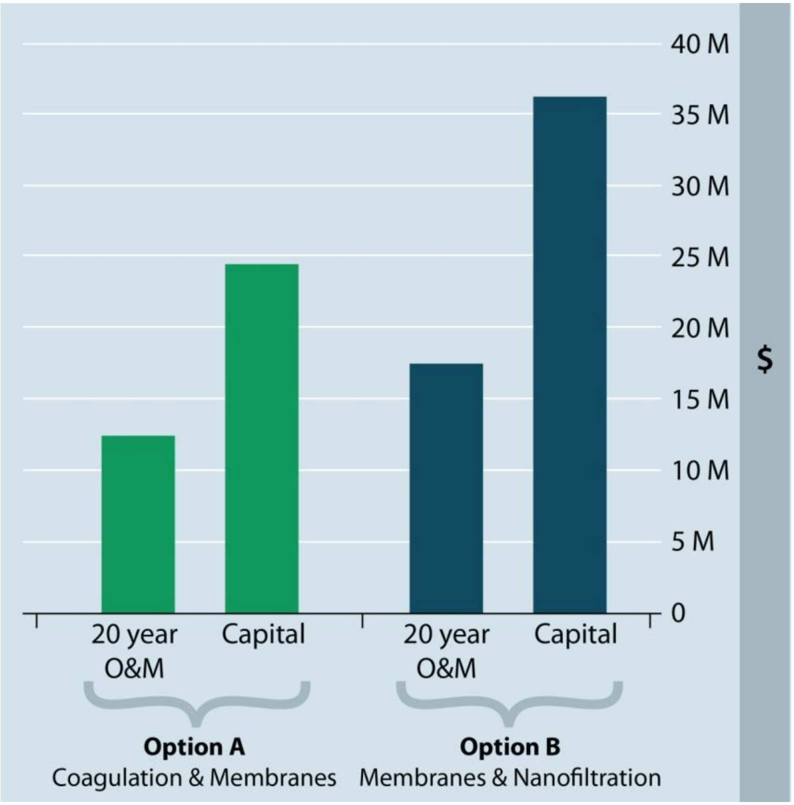
Comparison of treatment options

Criteria	Option A Coagulant + Membranes	Option B Membranes + Nanofiltration
Better, safer water	Fully meets water quality standards	Exceeds water quality standards
Fewer chemicals added to water	Alum added to water, but later removed	No chemicals added to water
Waste water treatment needs	Waste water requires treatment at a sewage plant	Waste water may be treatable in a wetland system
Energy use	Less energy used	Adds $210k per year in energy costs (est 2.5M kWh)
Lifecycle costs	$ 37.5M	$54.2M

Option A: Coagulant + Membranes is preferred option

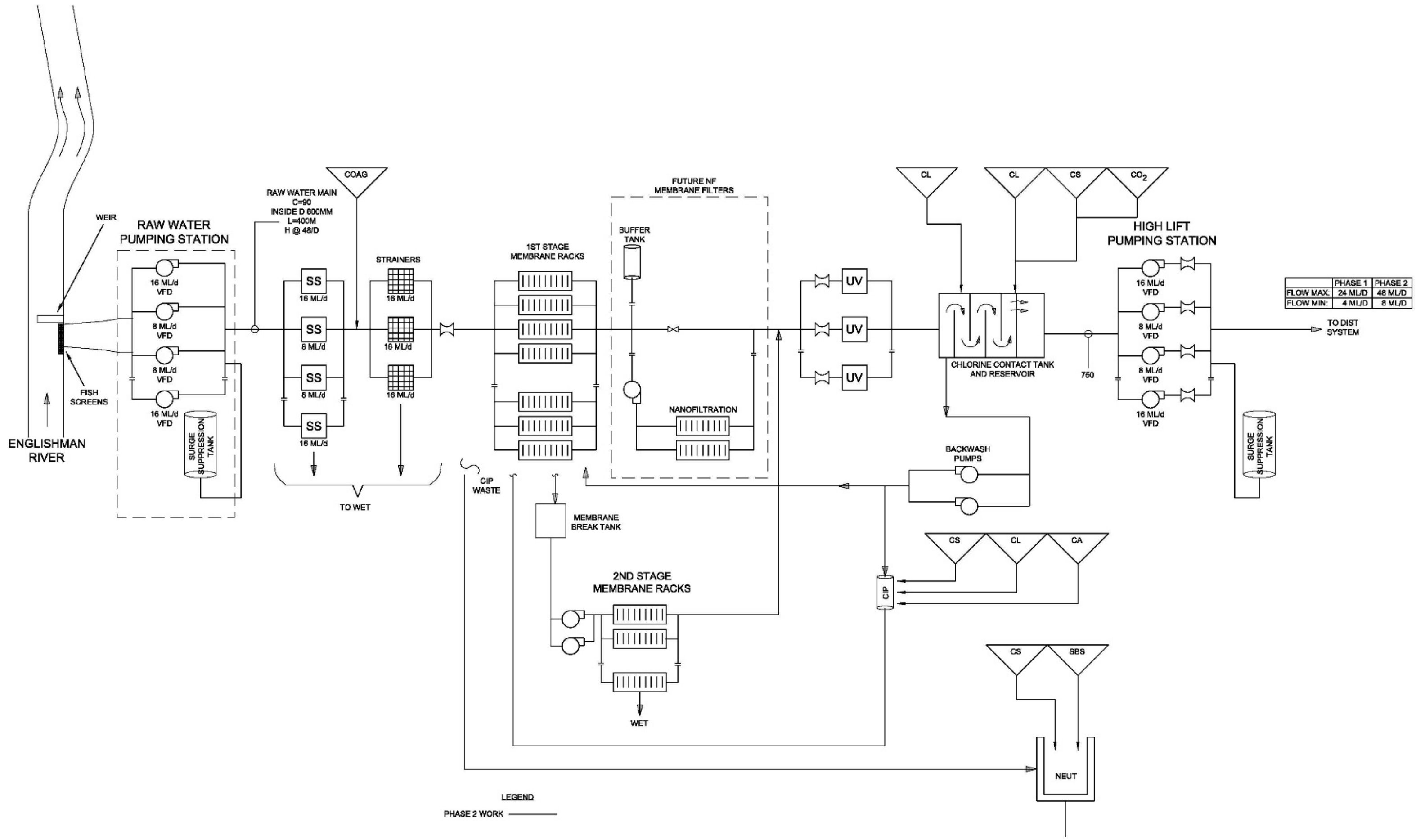
Option A is more affordable

- Options and costs were presented to Community Working Group
- Recommendation to proceed with Option A
- Future provisions for NF



Proposed Treatment Process

- Coagulation + membranes + UV + chlorine + pH/alkalinity adjustment



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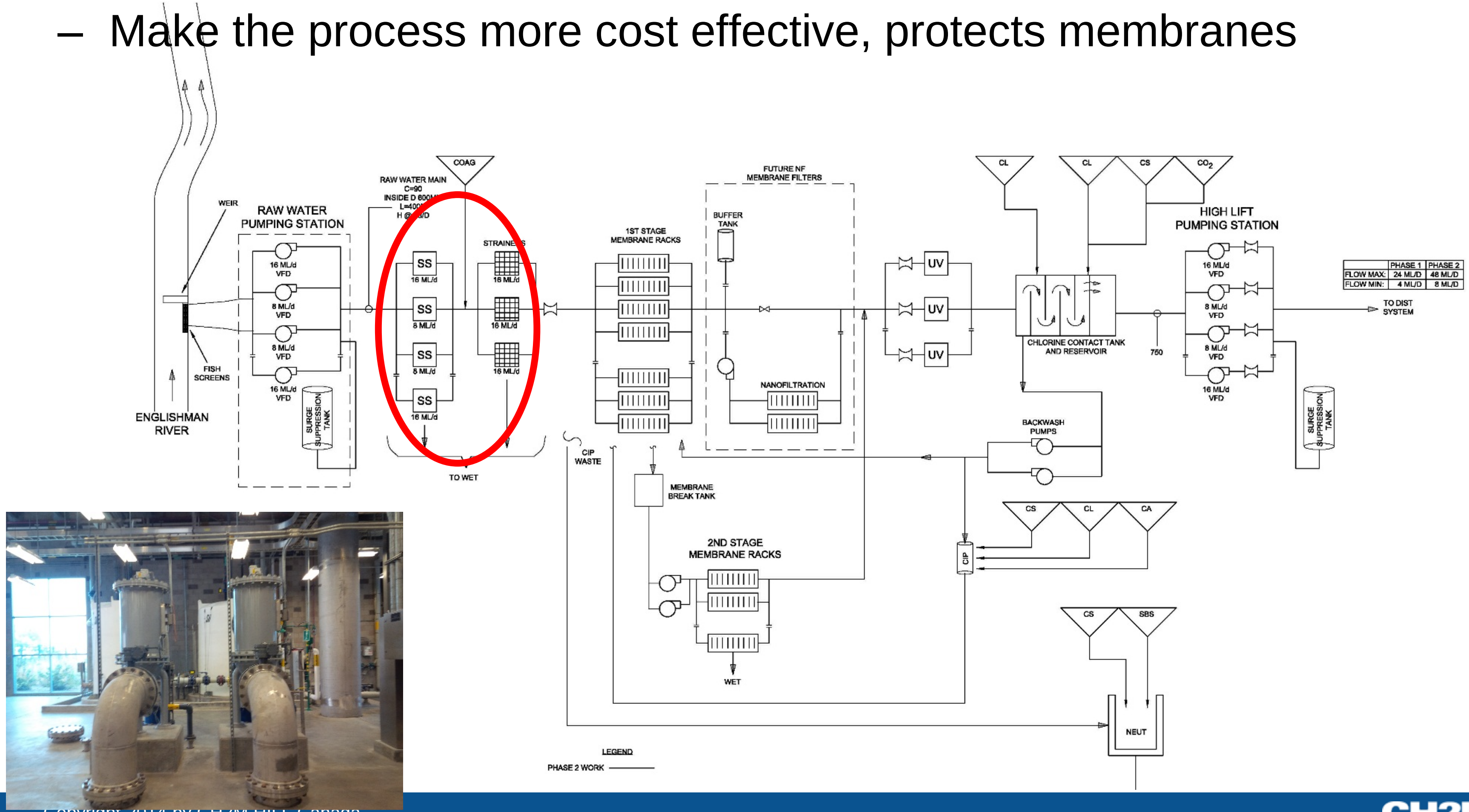
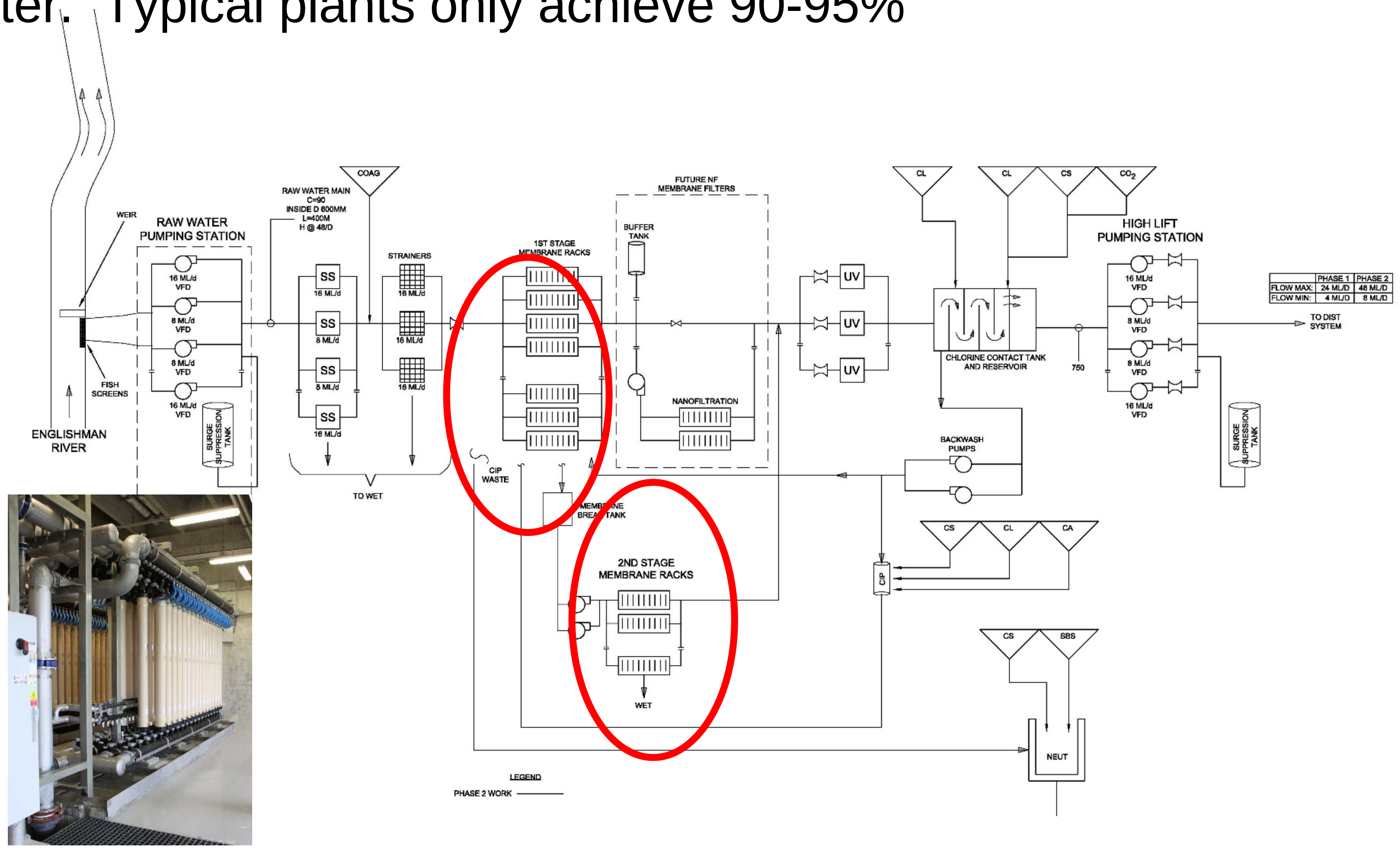
Proposed Treatment Process – economics

- Sand separators and strainers – handle elevated turbidity during storms
  - Make the process more cost effective, protects membranes



Proposed Treatment Process – double barrier

- Two membrane stages covert 99% of raw water into drinking water. Typical plants only achieve 90-95%



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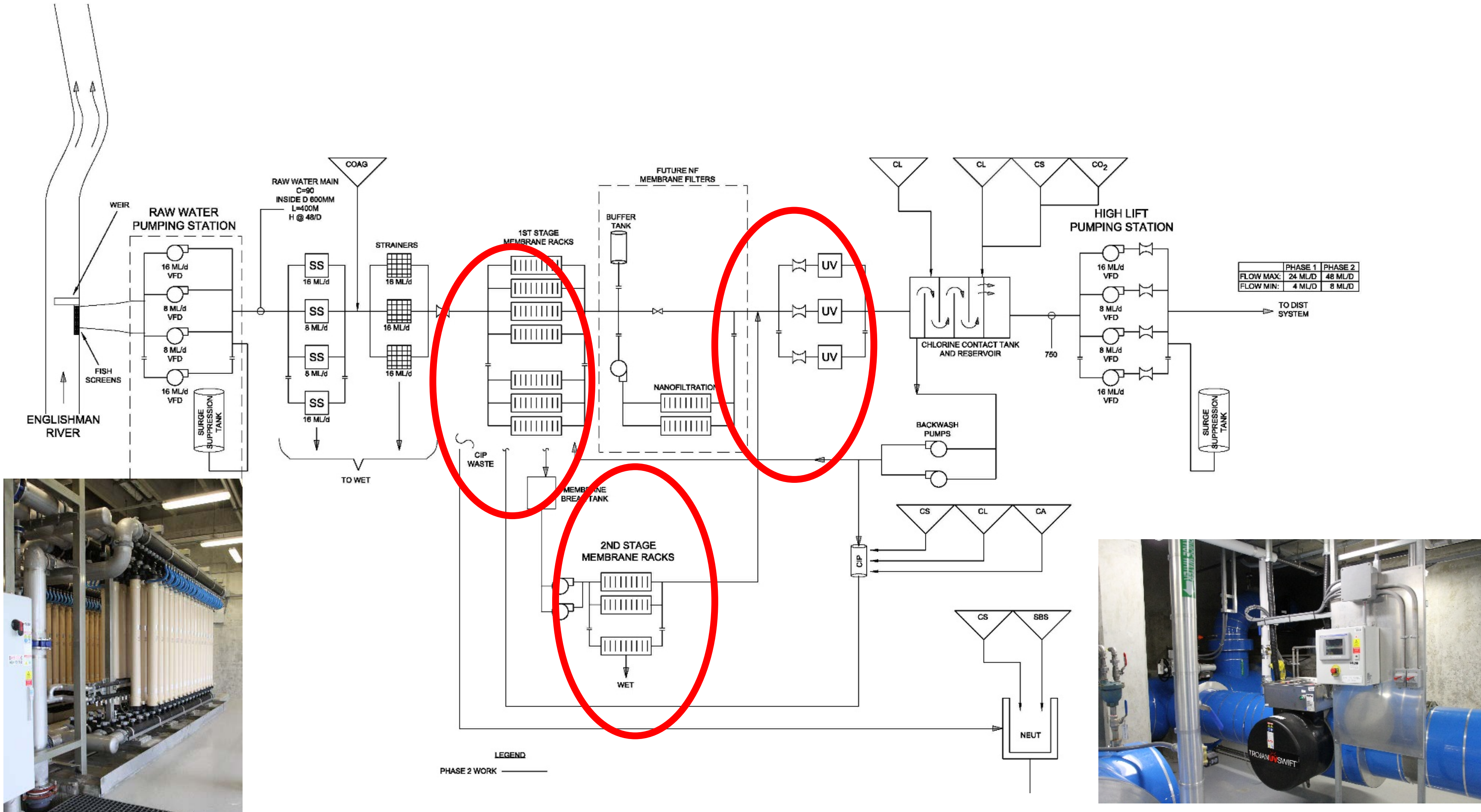
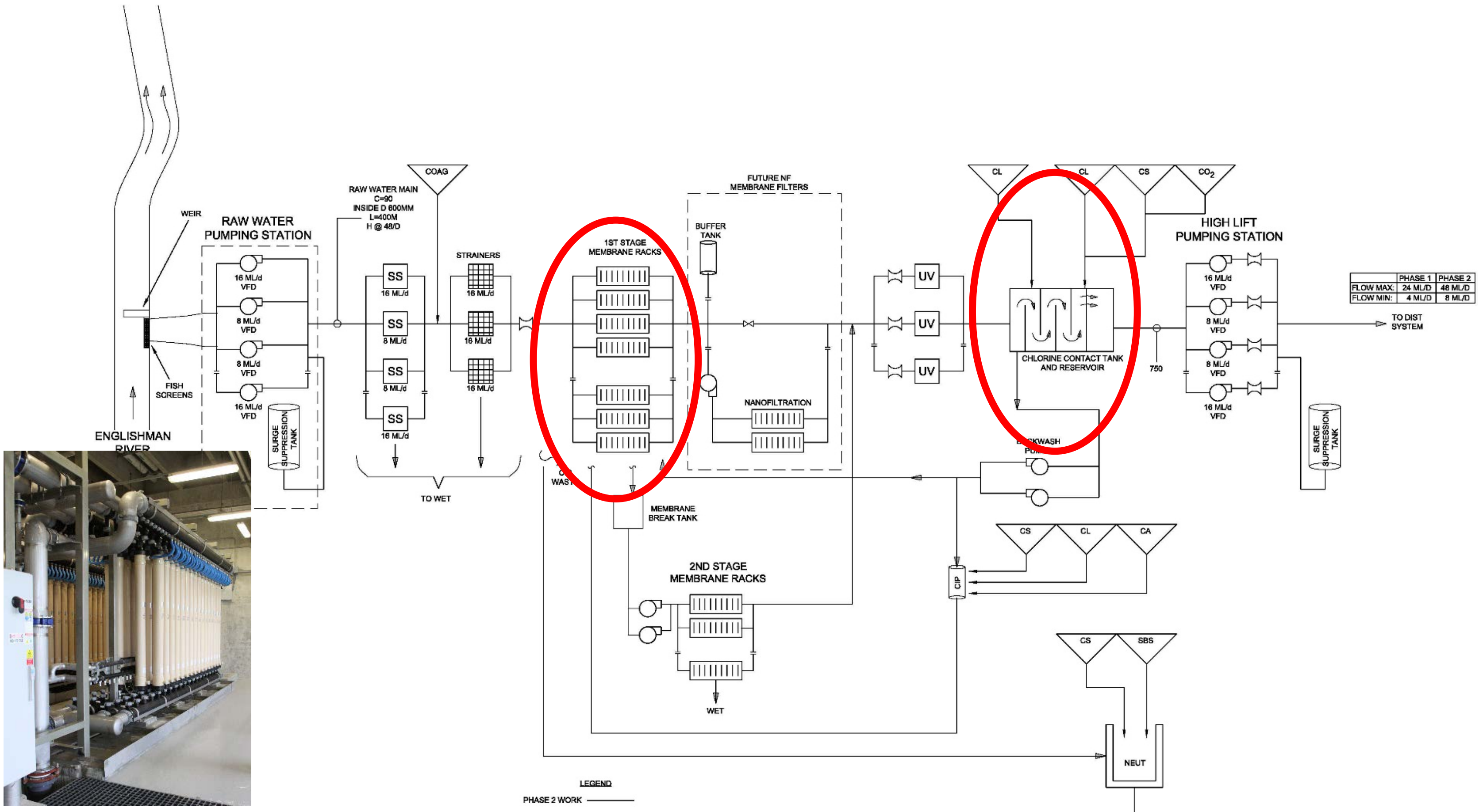
Proposed Treatment Process – double barrier

- membranes + UV protect against Crypto and Giardia



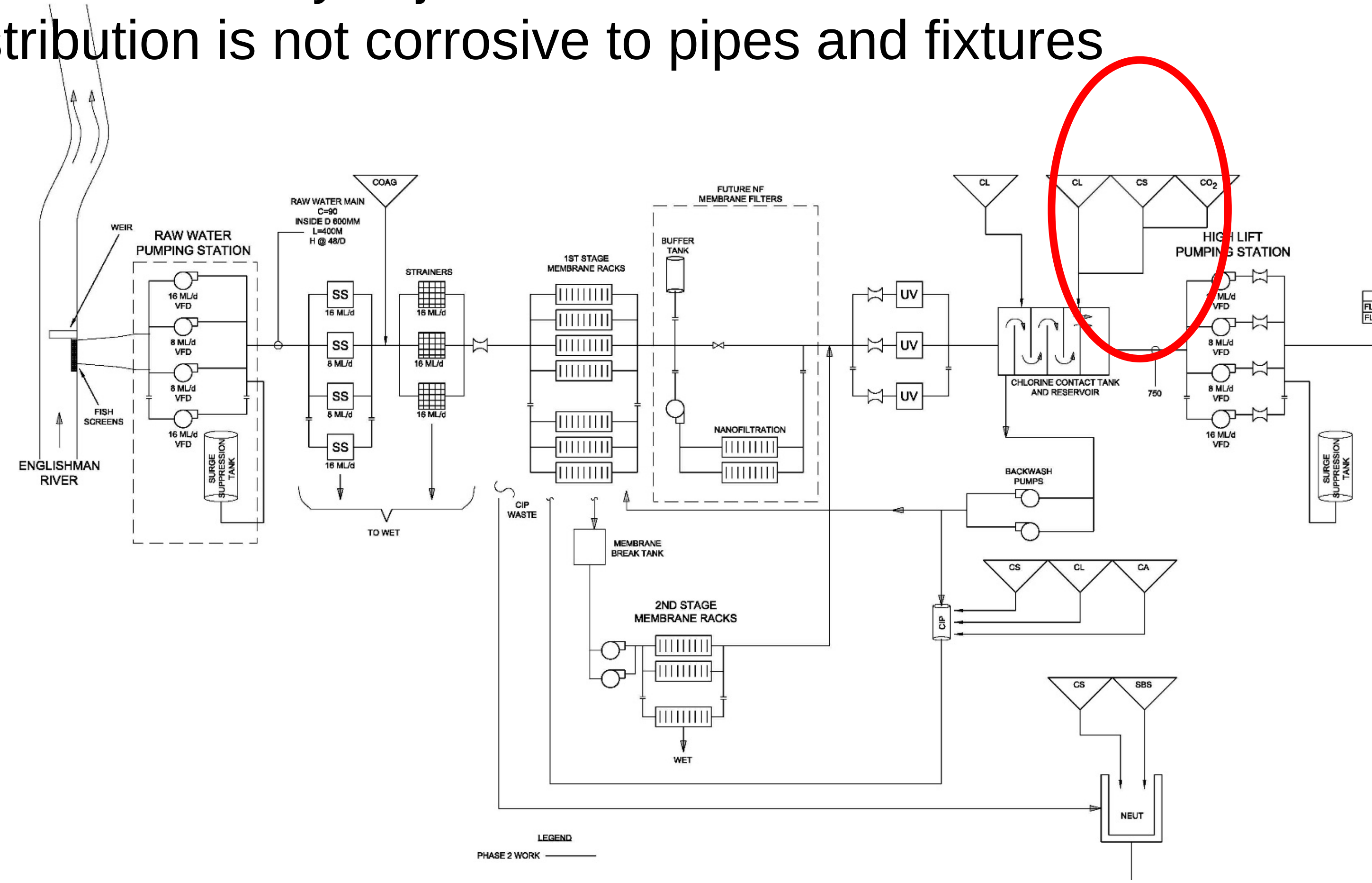
Proposed Treatment Process – double barrier

- membranes + chlorine protect against viruses



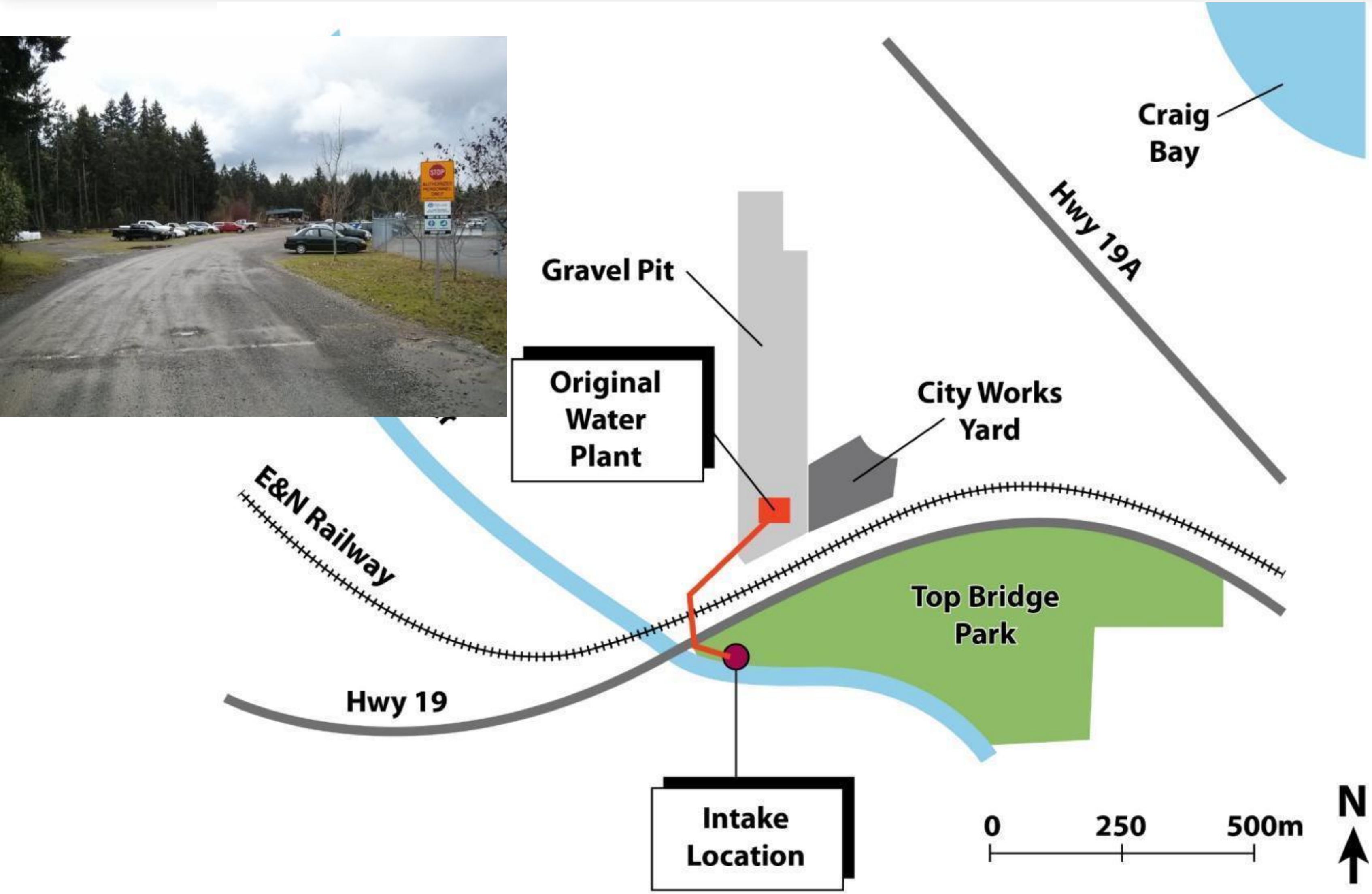
Proposed Treatment Process – economics

- River water is soft
- pH and alkalinity adjustment to make sure that water in distribution is not corrosive to pipes and fixtures

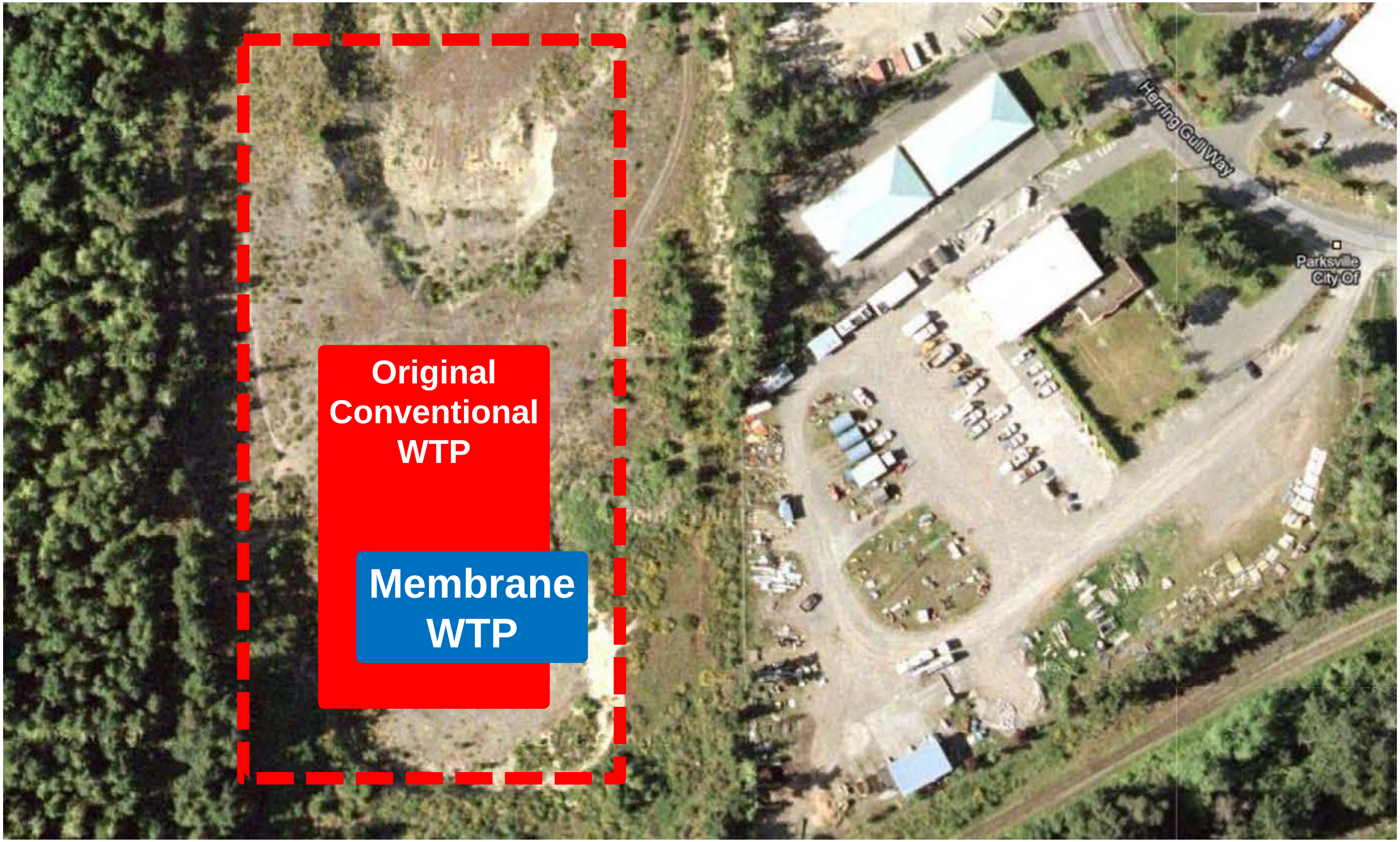


	PHASE 1	PHASE 2
FLOW MAX:	24 ML/D	48 ML/D
FLOW MIN:	4 ML/D	8 ML/D

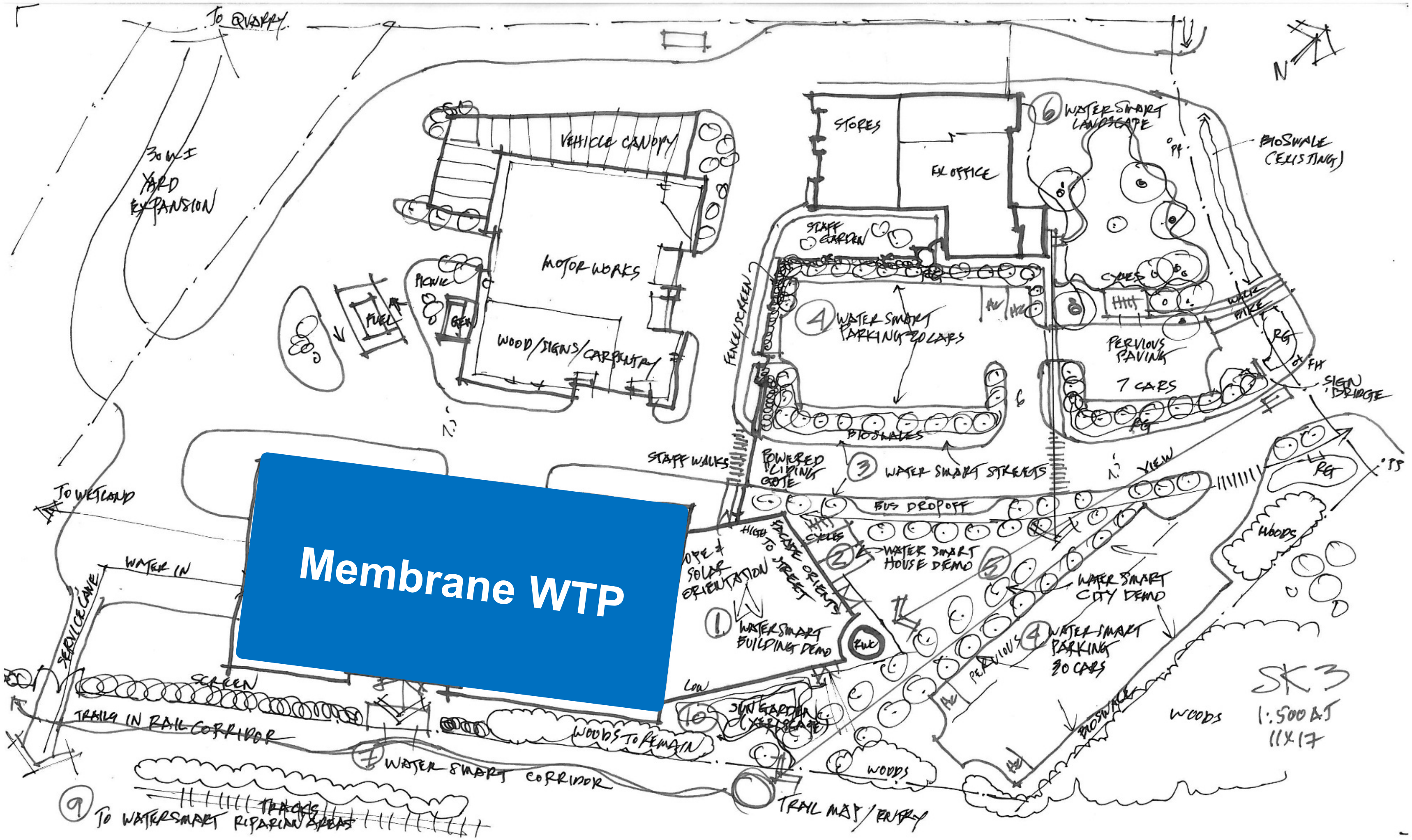
Original water treatment plant location



Existing Site



Initial concept to integrate WTP with site



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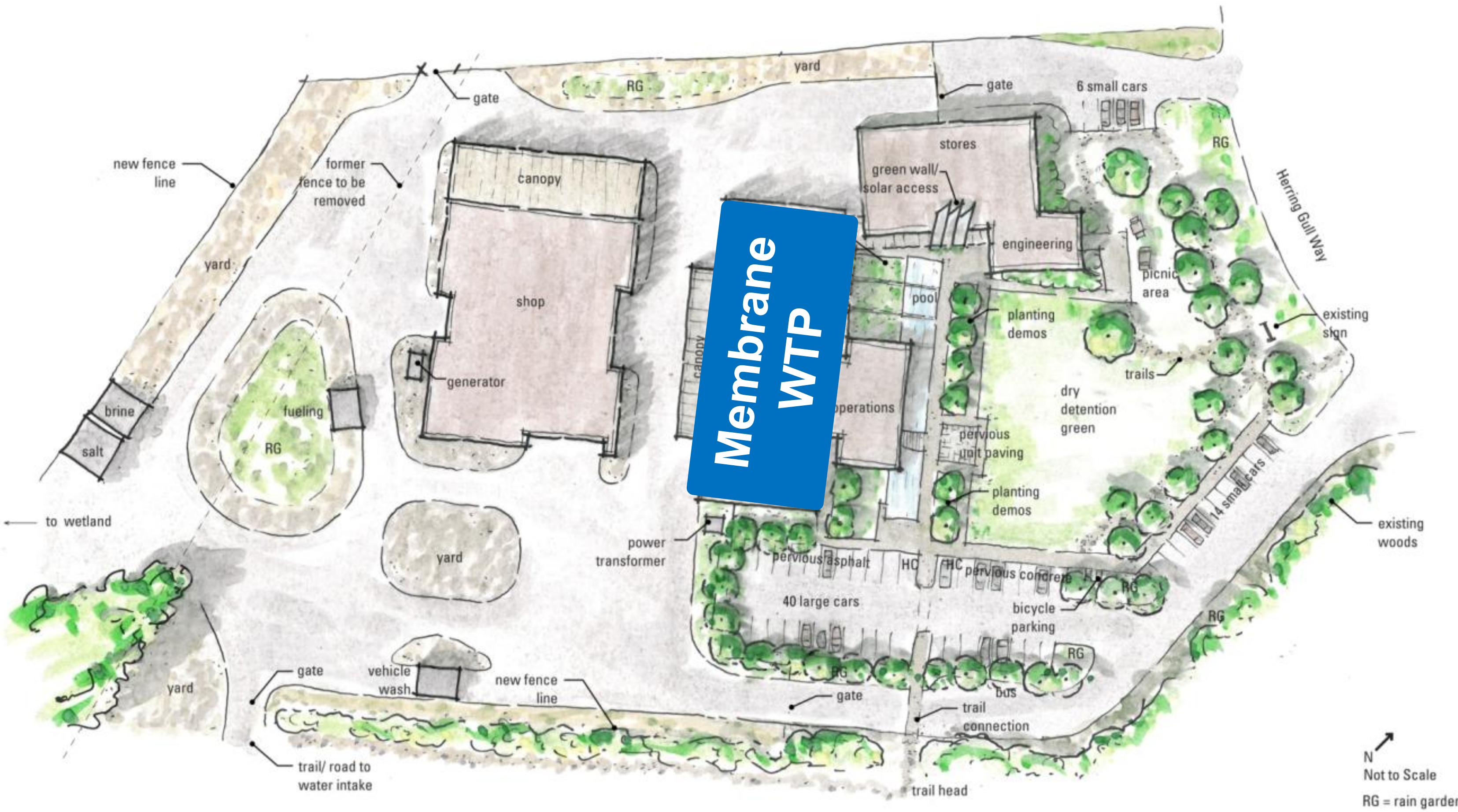
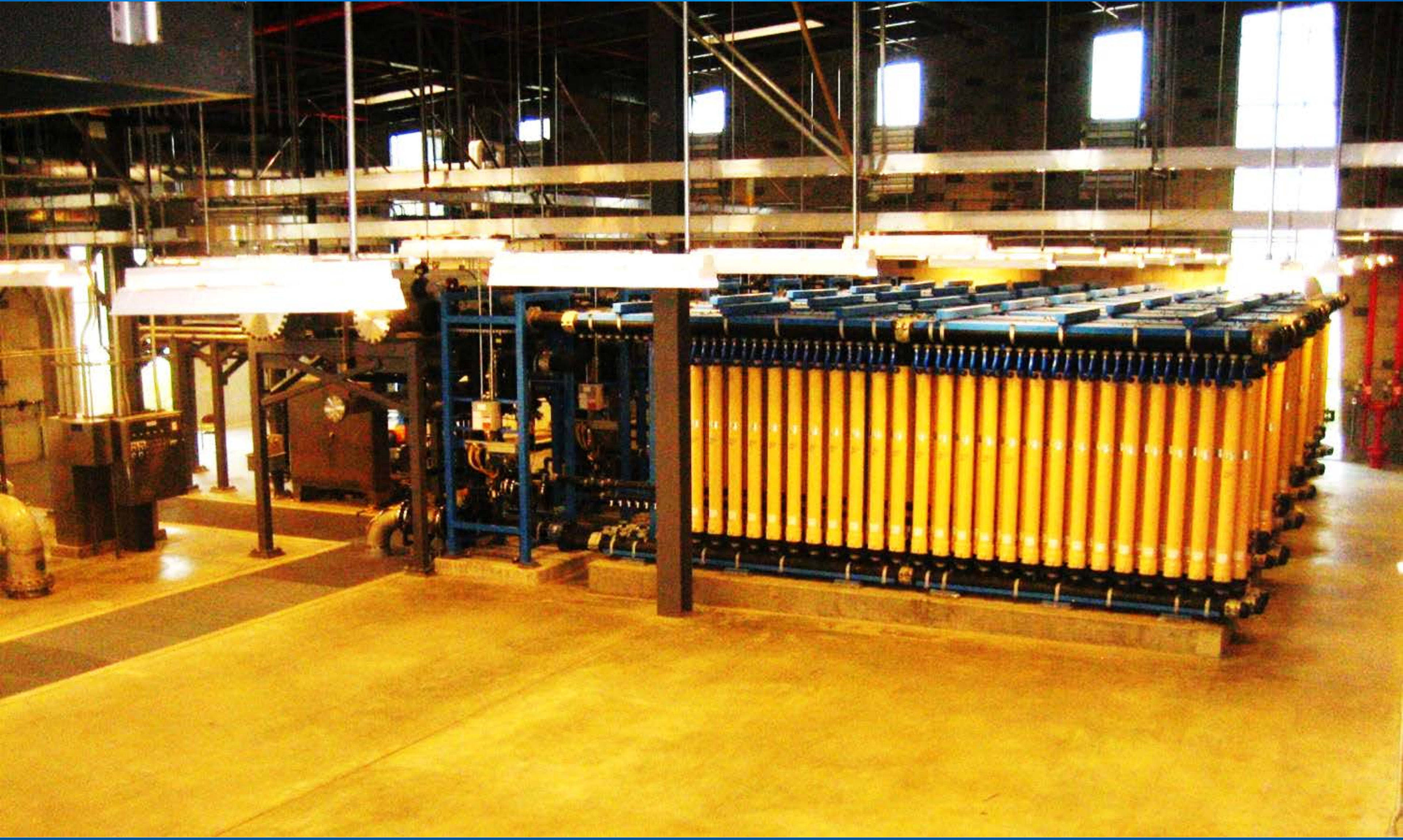
Proposed site layout



Proposed site layout

Inside a process building



Inside a process building

Building design and finish

Public Acceptance and Sustainability Features

- Intake and Pump Station
  - Fish friendly design
  - Potential for fish pool
  - Pump station integrated into trail system
- WTP Site
  - Public access to site and connecting trail system
  - Interpretative displays
  - Operations building with public meeting room and facilities
  - WTP designed for tours

Public Acceptance and Sustainability Features

- High recovery membranes
  - Typically, 5-10% of raw water is wasted.
  - >99% of raw water converted to treated water
- Rain water is collected and stored for irrigation and on-site ponds
- Potential to use solar panels for process heat needs
- Extensive use of natural lighting (skylights, windows, glazing)
- Heat from pump stations re-used for building heating
- ASR storage to help to conserve and provide water during peak demands

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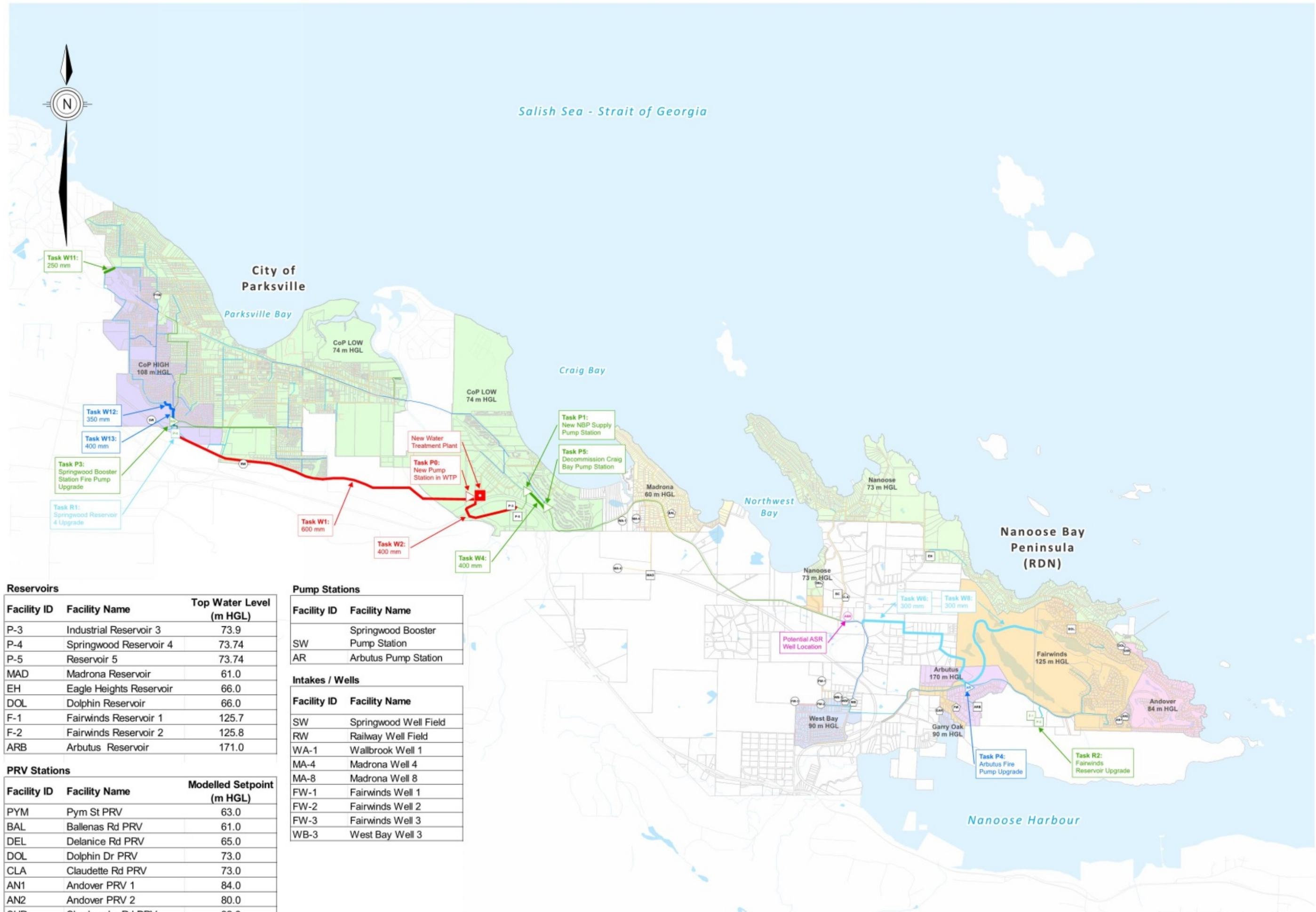
Transmission System Design

- WaterCAD Water Model
- Safety Factor on Demand

Jurisdiction	Safety Factor
City of Parksville	1.25
Nanoose Bay Peninsula	1.15

Transmission System Upgrades



ERWS
Water Intake, Treatment Plant and Supply Mains

Legend

- New Water Treatment Plant
- 2018 Reservoir Upgrade
- 2035 Reservoir Upgrade
- 2016 Pump Station Upgrade
- 2018 Pump Station Upgrade
- 2035 Pump Station Upgrade
- 2050 Pump Station Upgrade
- Potential ASR Well Location

Water Main Diameter (mm)

- < 150
- 200
- 250
- 300
- 350, 400
- > 400
- 2016 Upgrades For WTP
- 2018 Water Main Upgrade
- 2035 Water Main Upgrade
- 2050 Water Main Upgrade
- Existing Well
- Existing Pump Station
- Existing PRV Station
- Existing Reservoir
- Pressure Zone Boundary

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WB-3	West Bay Well 3

Reference: GIS background data from the City of Parksville and the Regional District of Nanaimo.

KERR WOOD LEIDAL
consulting engineers

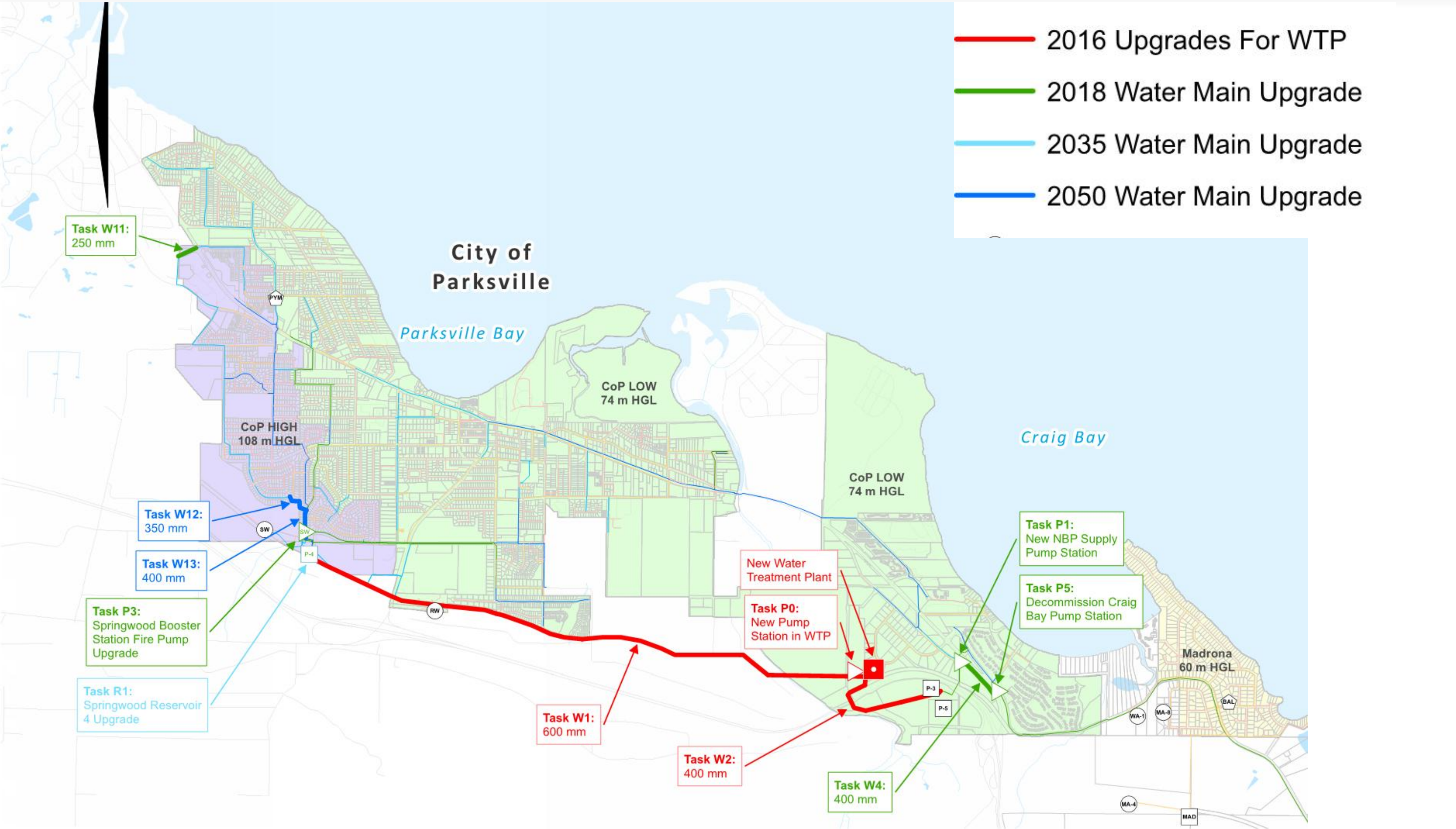
1,000 0 1,000 (m)
1:30,000

Project No.	Date	Drawn By
468-010	June 2014	RS

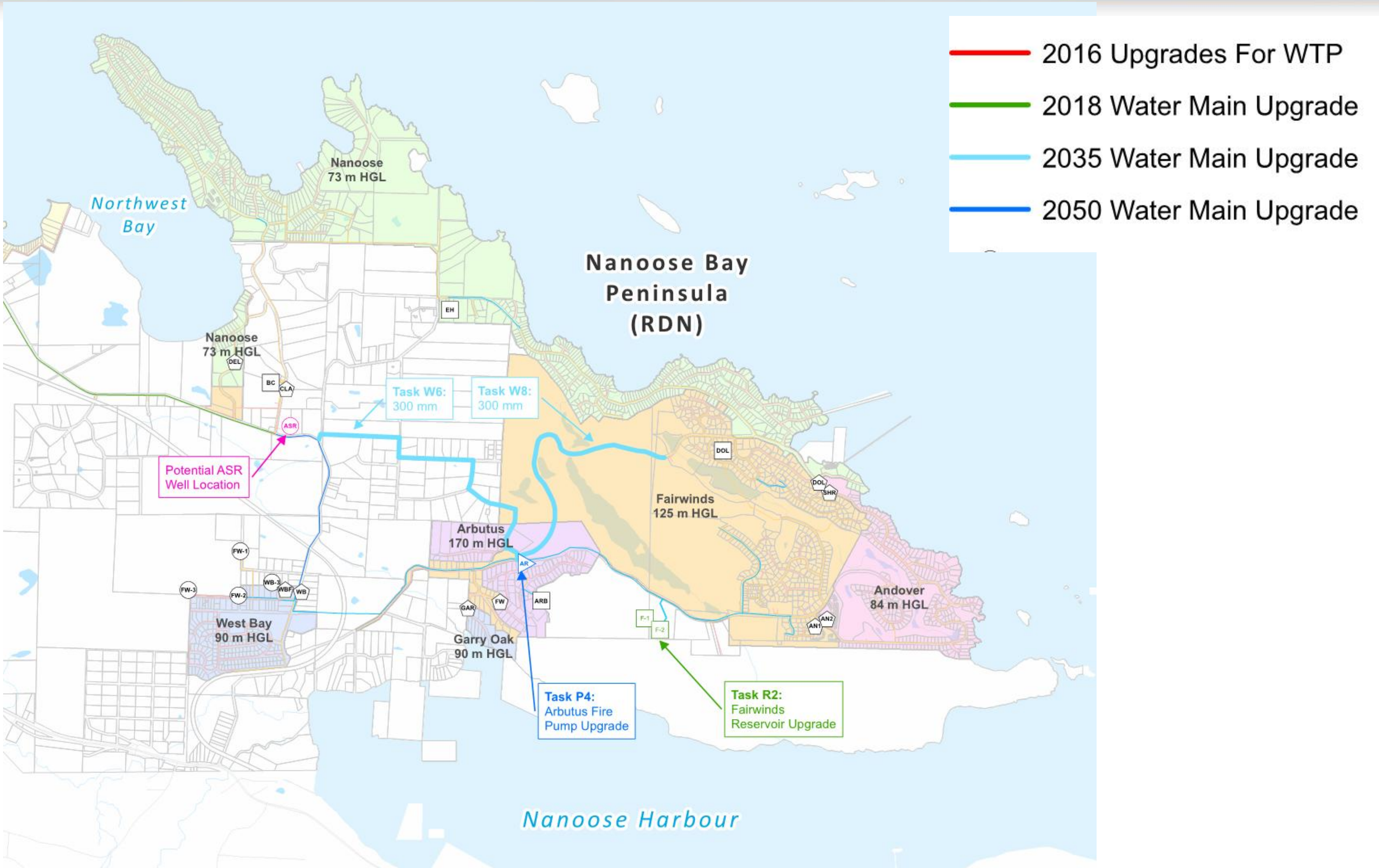
Future Growth Scenarios Recommended Upgrades and Phasing

Figure 5

Transmission System Upgrades



Transmission System Upgrades



Outline

- Background and Objectives
- Future water demands
- Project components
  - River Hydrology and intake
  - Water treatment plant and features
  - Transmission Mains
- Preliminary costs & funding
- Next steps

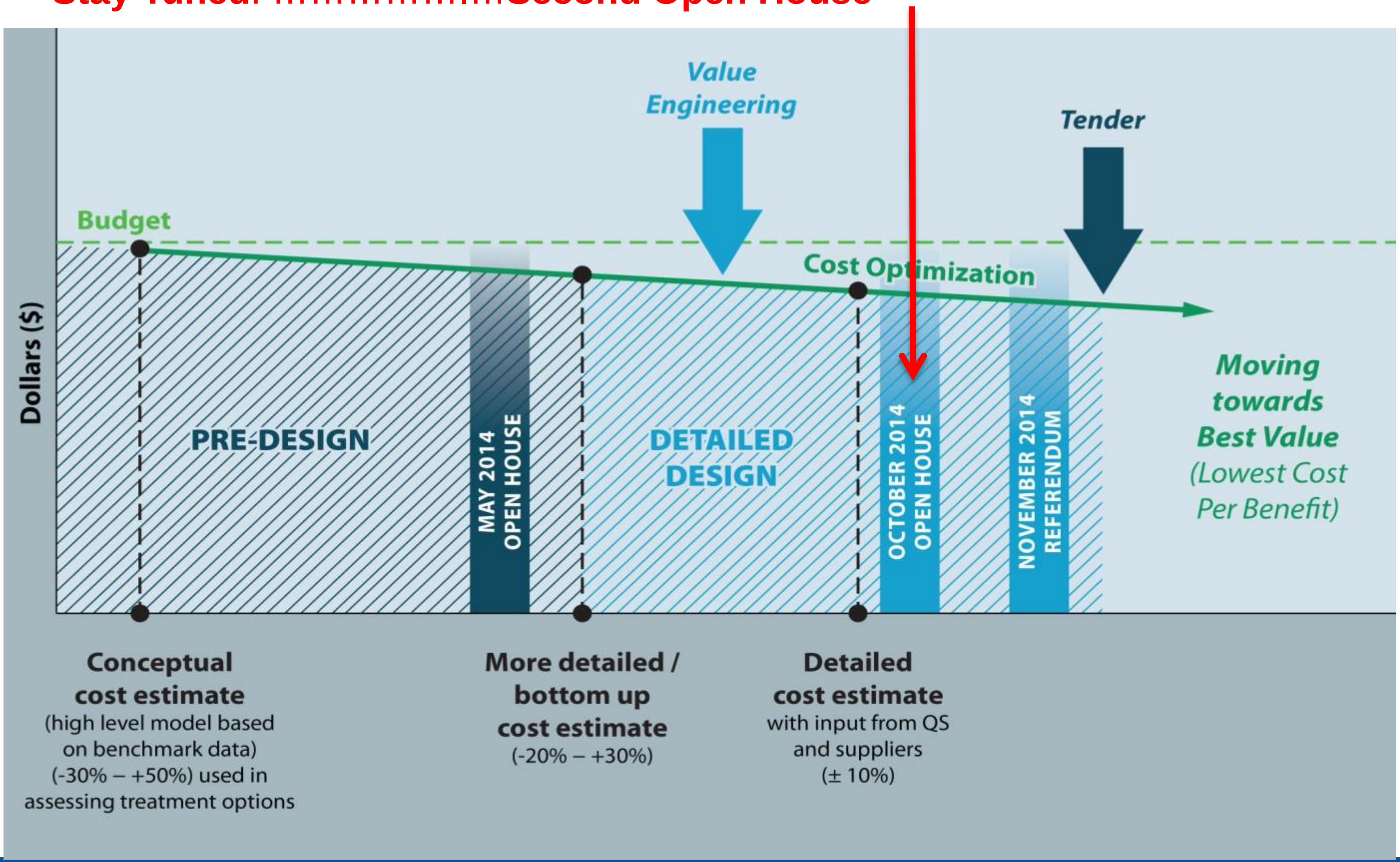
Preliminary Cost Estimate

	Estimated Costs ($)
Intake and Raw Water Pump Station	$3,419,561
Raw Water Main	$1,374,431
Water Treatment Plant	$16,836,483
Siteworks	$4,000,057
Operations Building	$1,559,699
Transmission Mains	$6,989,046
SUB-TOTAL (2016)	$34,179,278
Distribution System Improvements	$4,904,756
SUB-TOTAL (2018)	$4,904,756
TOTAL Estimated Costs	$39,084,034

Note: Class 3 Cost Estimate (-30%, +50%) including Engineering and taxes

FINANCIAL – Summary

Stay Tuned: ………………..**Second Open House**



CH2MHILL.

Outline

- Background and Objectives
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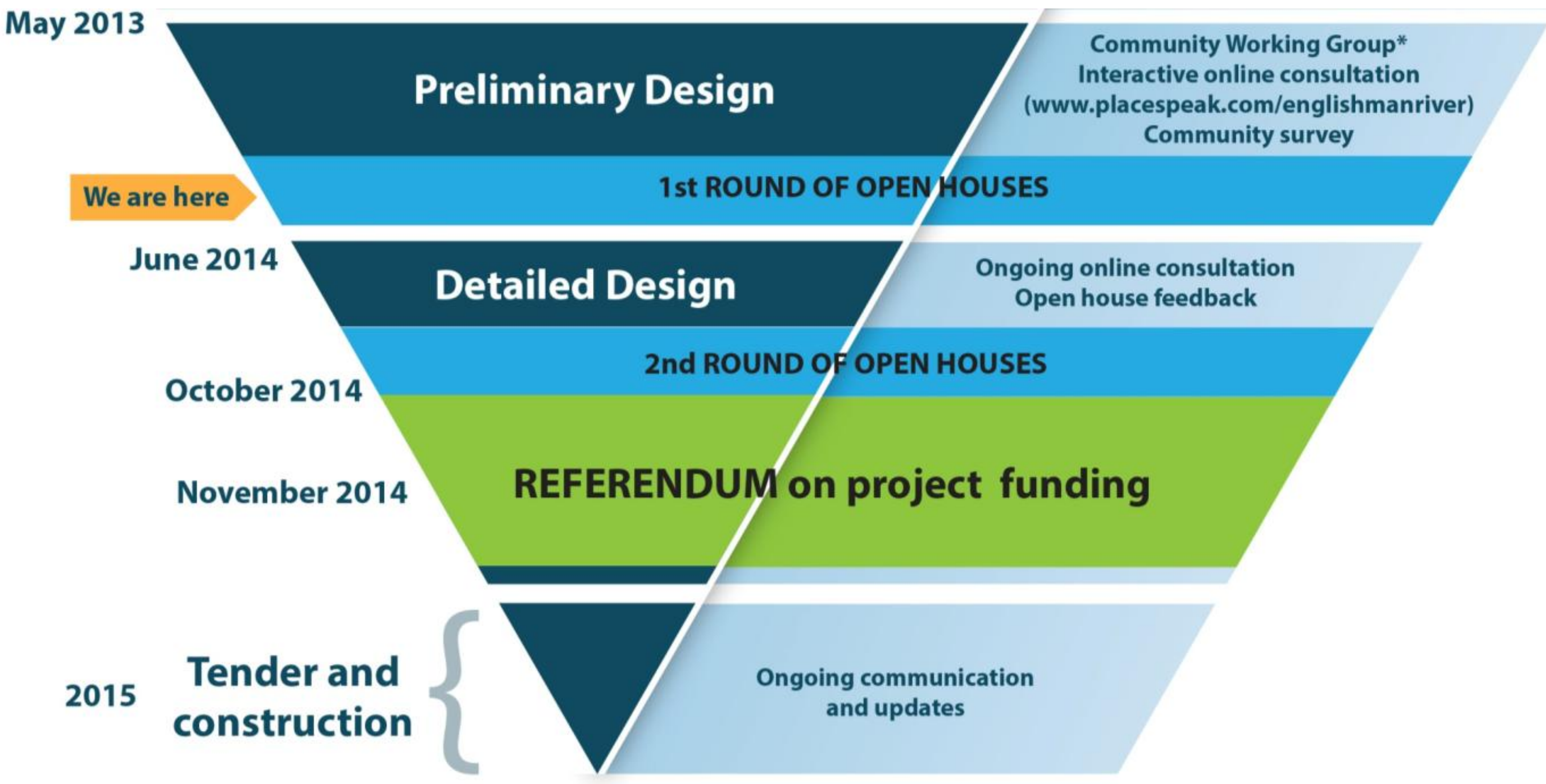
Membrane Equipment Pre-purchased

- Proposals received from 3 qualified vendors
  - GE Water and Process Technologies
  - H2O Innovation
  - PALL Corporation
- Evaluation
  - Technical factors
  - 20 year lifecycle costs (CAPEX/OMEX)

Next Steps



May 2013
Preliminary Design
Community Working Group*
Interactive online consultation
(www.placespeak.com/englishmanriver)
Community survey
We are here
1st ROUND OF OPEN HOUSES
June 2014
Detailed Design
Ongoing online consultation
Open house feedback
2nd ROUND OF OPEN HOUSES
October 2014
November 2014
REFERENDUM on project funding
2015
Tender and construction
Ongoing communication
and updates

An environmentally sensitive use of water to improve fish habitat and domestic water supply.

THANK YOU…….

www.englishmanriverwaterservice.ca