Petro-Canada Re-Uses Treated Edmonton Waste Water

Coking.com Safety Seminar

Calgary

September 2008

Membrane-Treated Waste Water Project

- Petro-Canada has completed modifications at its Edmonton refinery located in the County of Strathcona, to meet new fuels legislation, modifications to process alternate crude oil feed stocks are still under construction, scheduled for completion in 2008.
- Additional quantities of water are required for the production of hydrogen and steam at the Edmonton Refinery
- Direct withdrawal from the river and waste water recycle were evaluated for the increased water requirements
- Rather than directly withdrawing additional water from the North Saskatchewan River, Petro-Canada worked together with City of Edmonton and Strathcona County to meet its water requirements by recycling waste water for re-use
- There was a win-win opportunity to use membrane-treated water from the City of Edmonton's Gold Bar Waste Water Treatment Plant
- All Costs associated with the engineering, procurement and construction of the membrane facilities and the pipeline was borne by Petro-Canada

Membrane-Treated Waste Water Project

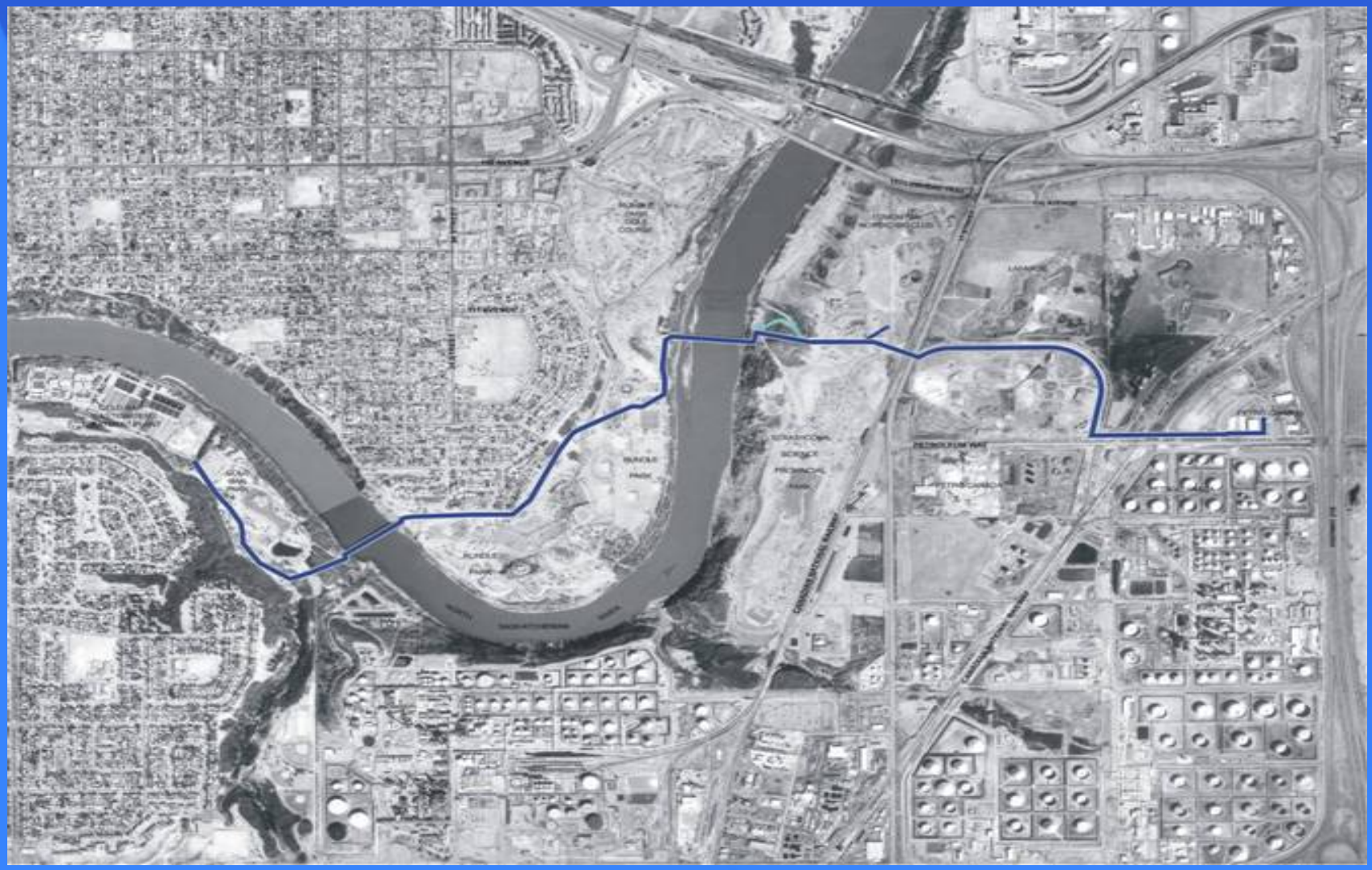
Engineering of the Facility---the easy step

- **In order to produce the right quality of water from the Gold Bar Waste Water Plant effluent, a membrane ultra-filtration treatment facility was constructed at Gold Bar**
- **To get the water to Petro-Canada's refinery from Gold Bar, a new buried recycle water pipeline was built between the facilities routing through two of the City's river parks, Gold Bar and Rundle Park and then through the Province's Strathcona Science Park**
- **Construction at Gold Bar WWTP and the recycle water line were completed and placed into service by year end 2005**
- **Sizing of water line includes capacity for future Petro-Canada needs and also includes consideration for other users**
- **The system has since been expanded from 5ML/d to 15 ML/d**

GOLD BAR TREATMENT PLANT

GOLD BAR TREATMENT PLANT MEMBRANE BUILDING

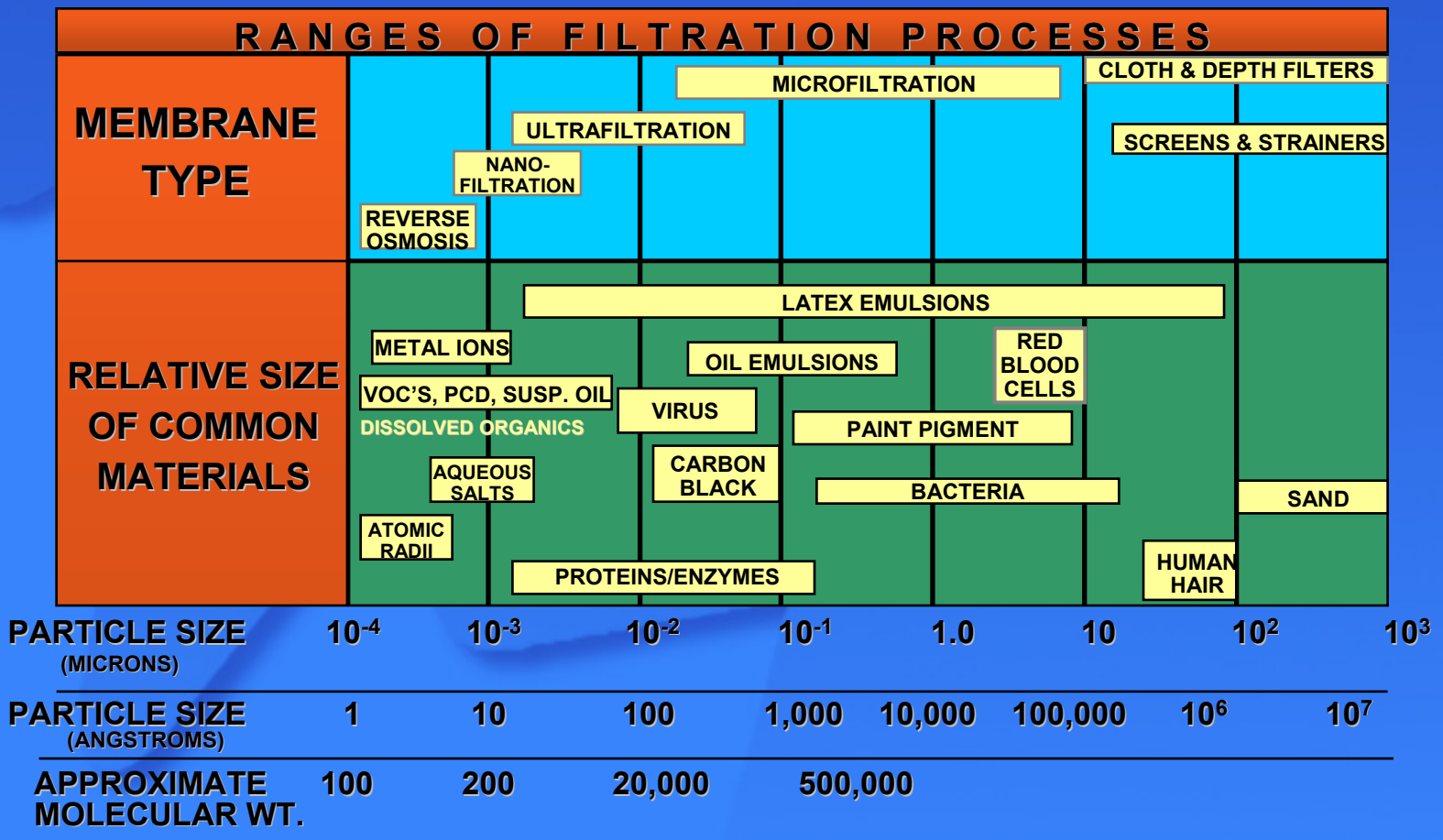
Membrane-Treated Waste Water Project



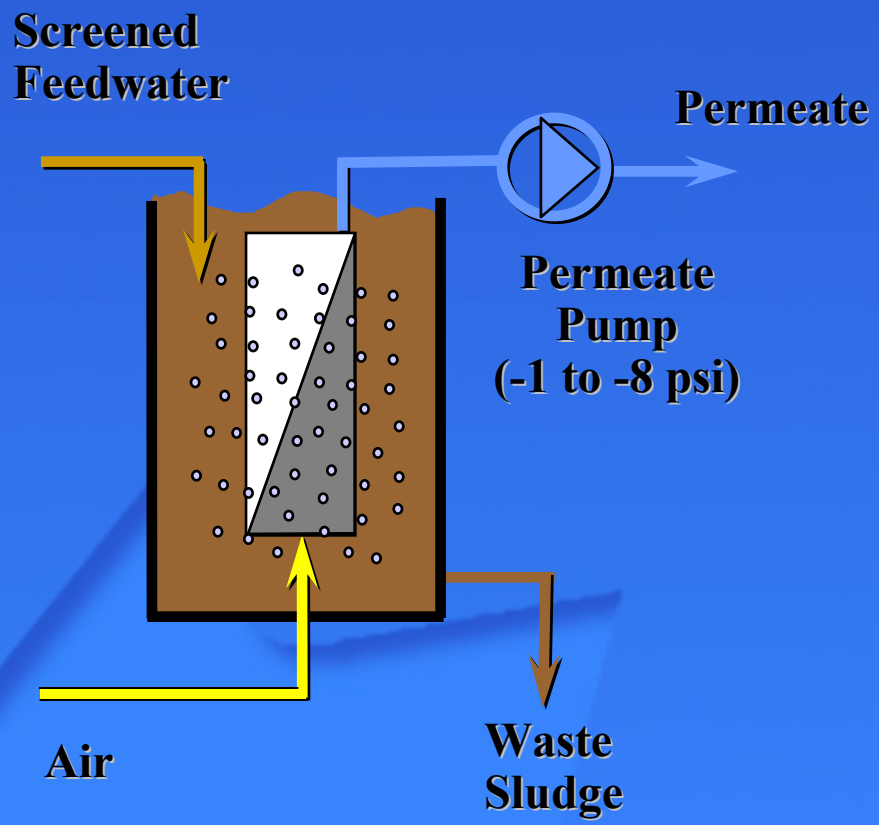
Technical Aspects of the membrane Facility:
Various Water Quality Available

Source	River Water	Potable Water	Gold Bar Recycle Water	Reverse Osmosis water
Turbidity Max Min	 5000 2	 1 0	 1 0	 ND
Chlorides Conductivity	3.5 350	230 350	280 1000	<1 35
Hardness SDI SiO_2	200 NA 8	170 5.4 3	500 3 8	0.5 0 0.25

Filtration Spectrum



Submerged Membranes



Experimental Equipment

ZeeWeed 500D (including 24 elements).

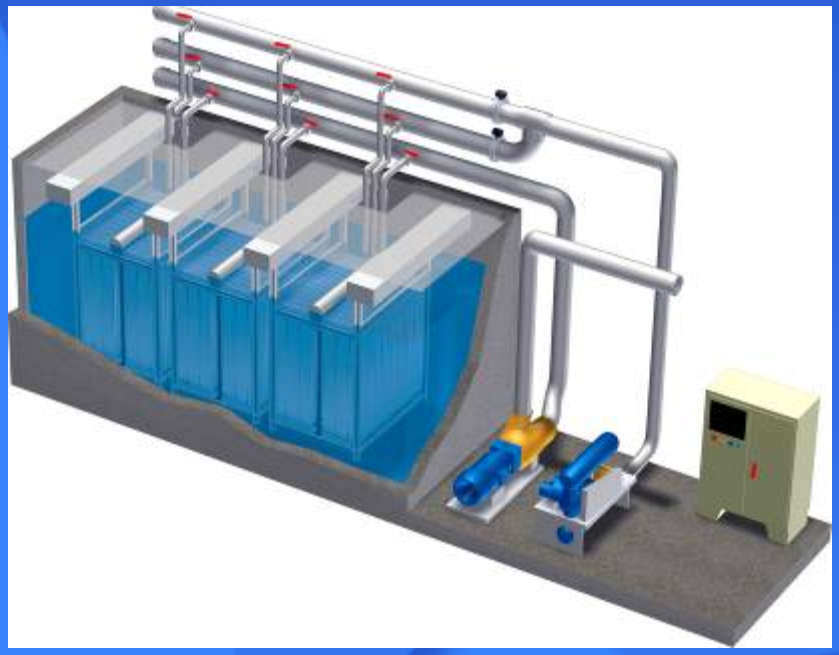
Membrane and Reverse Osmosis pilot plant located in Gold Bar WWTP

Zenon – Ultra Filtration

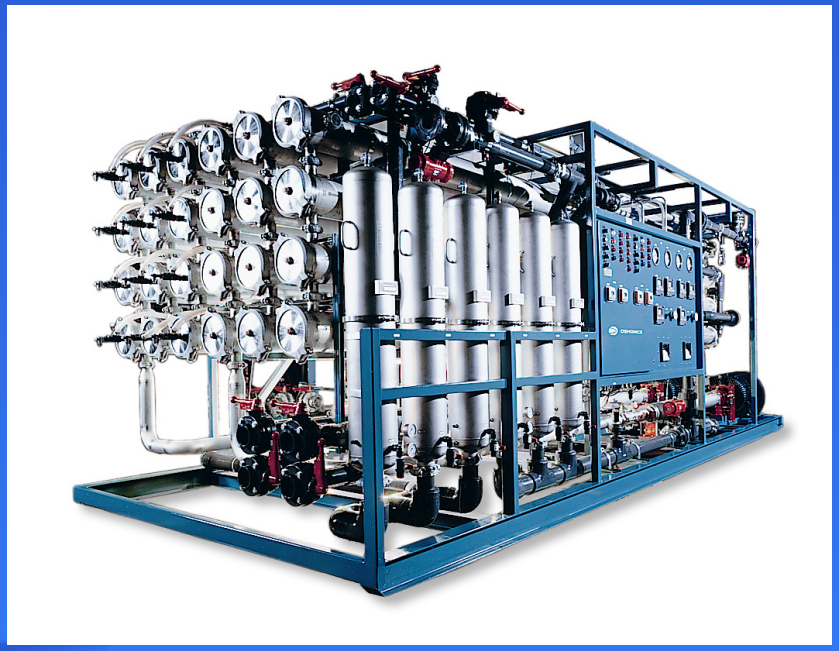
Zenon – Ultra Filtration

Zenon – Ultra Filtration

Membrane-Treated Waste Water Project



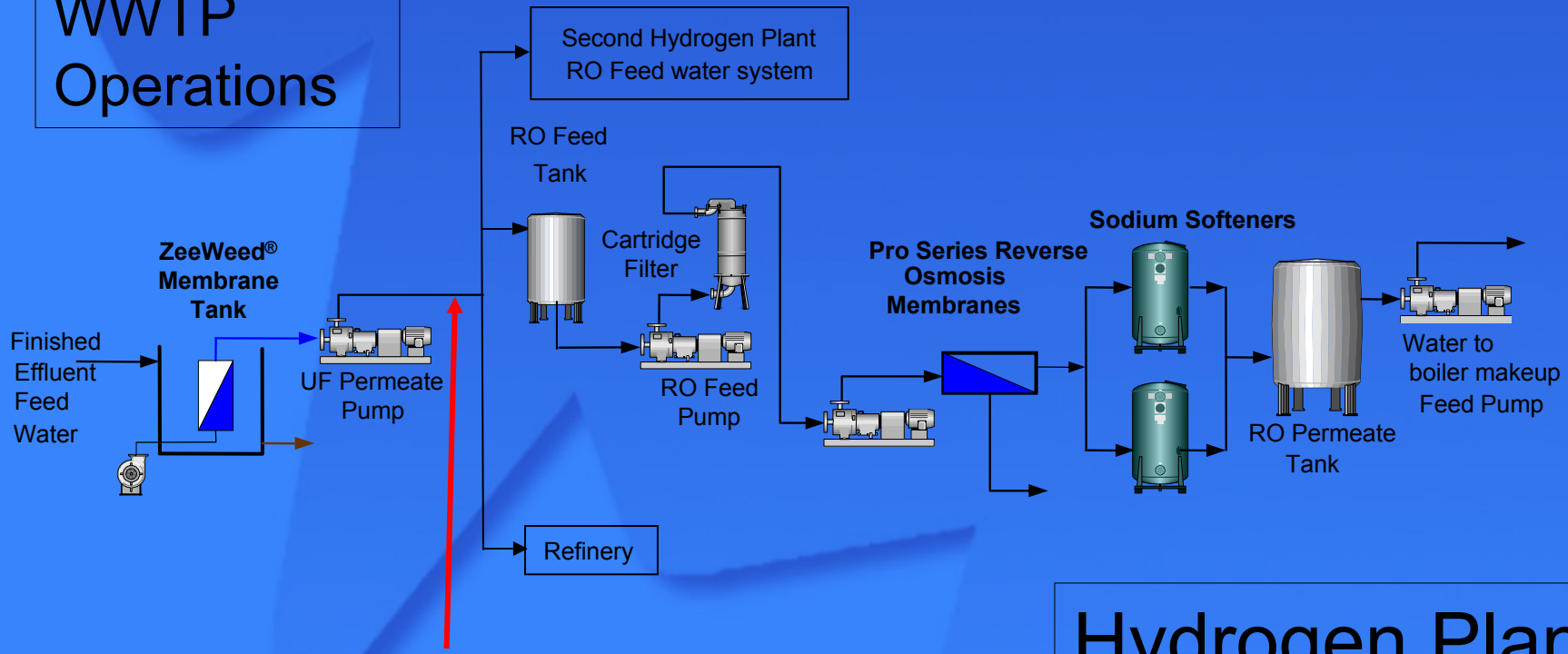
Zee Weed Filtration at Gold Bar



Reverse Osmosis at the Refinery and Hydrogen plants

Hydrogen Plant Configuration

WWTP Operations

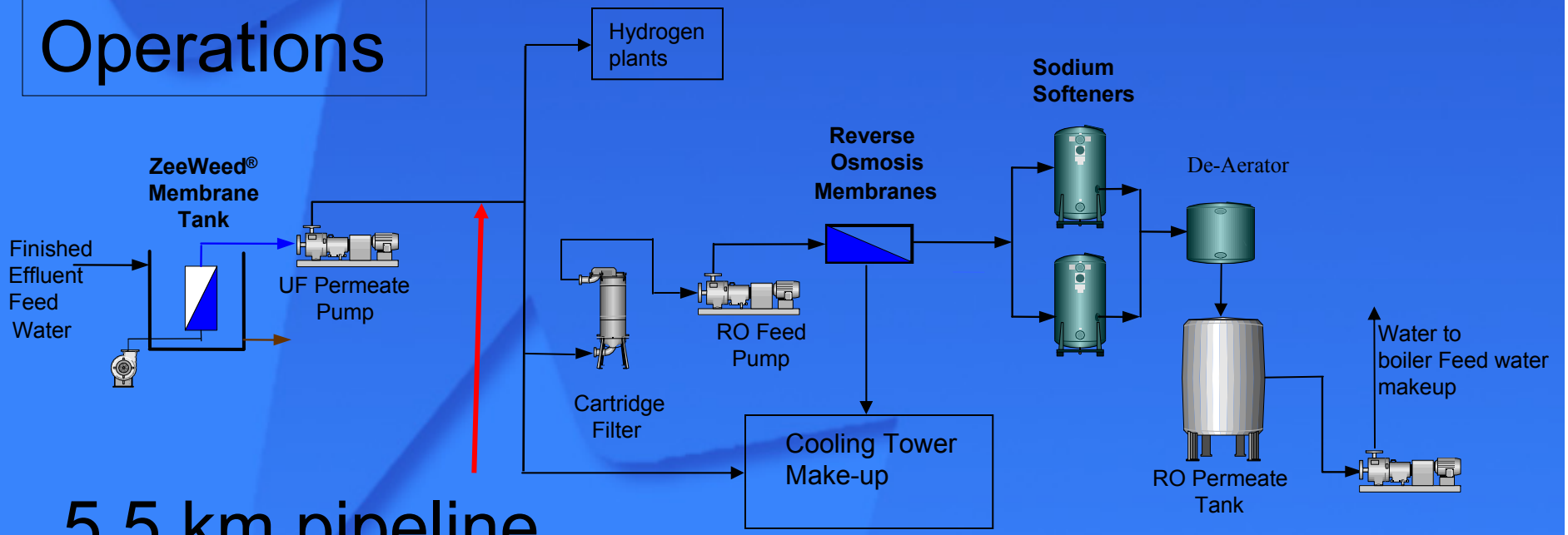


5.5 km pipeline

Hydrogen Plant Operations

Refinery Process Configuration

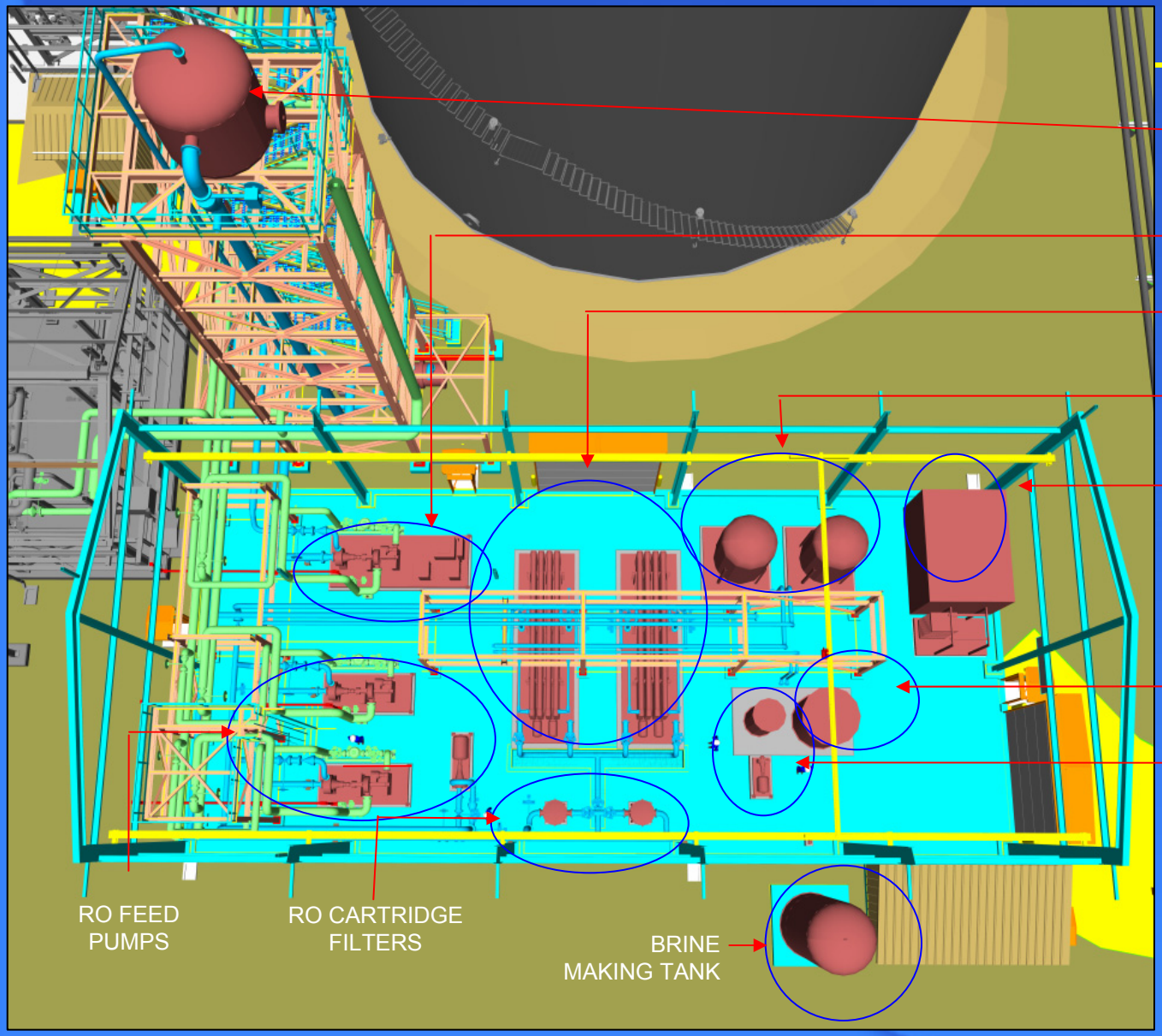
WWTP Operations



5.5 km pipeline

Refinery Operations

MODEL – OF REFINERY PROCESS



New RO system construction

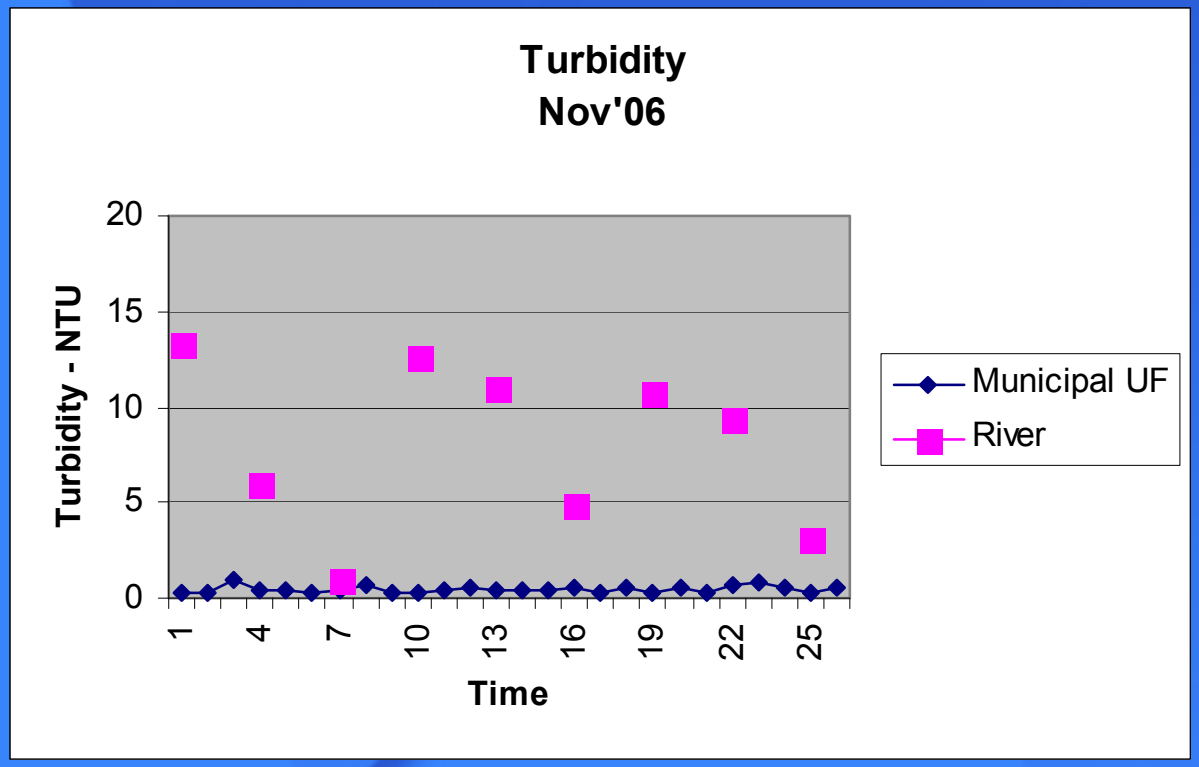
Deaerator platform

Boiler feed water storage tank

Significant Milestones

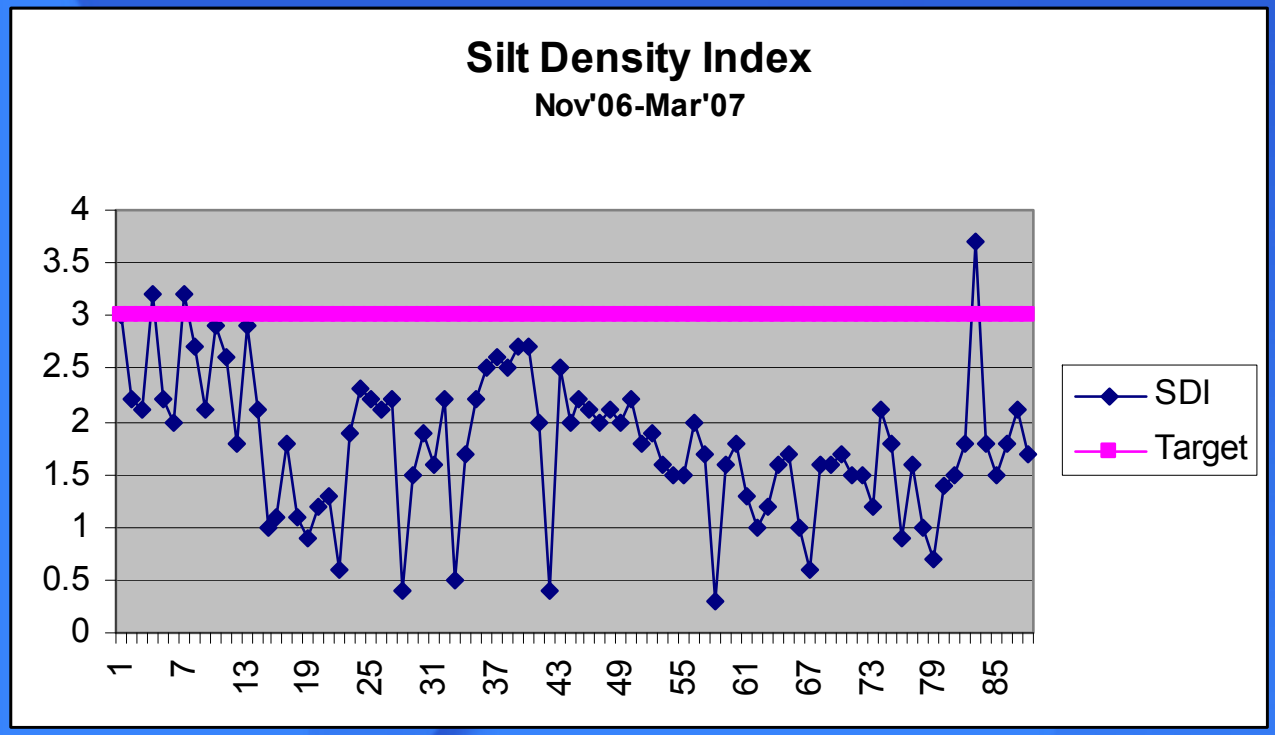
- Pipeline completed December 2005
- Zee weed Membranes on line December 2005 producing 5 ML/d
- First hydrogen plant on line April 2006
- Zee weed membranes expanded to 15 ML/d October 2007
- Second Hydrogen plant operational April 2008
- New refinery Boiler feed water system with Reverse Osmosis on line October 1, 2008

Performance



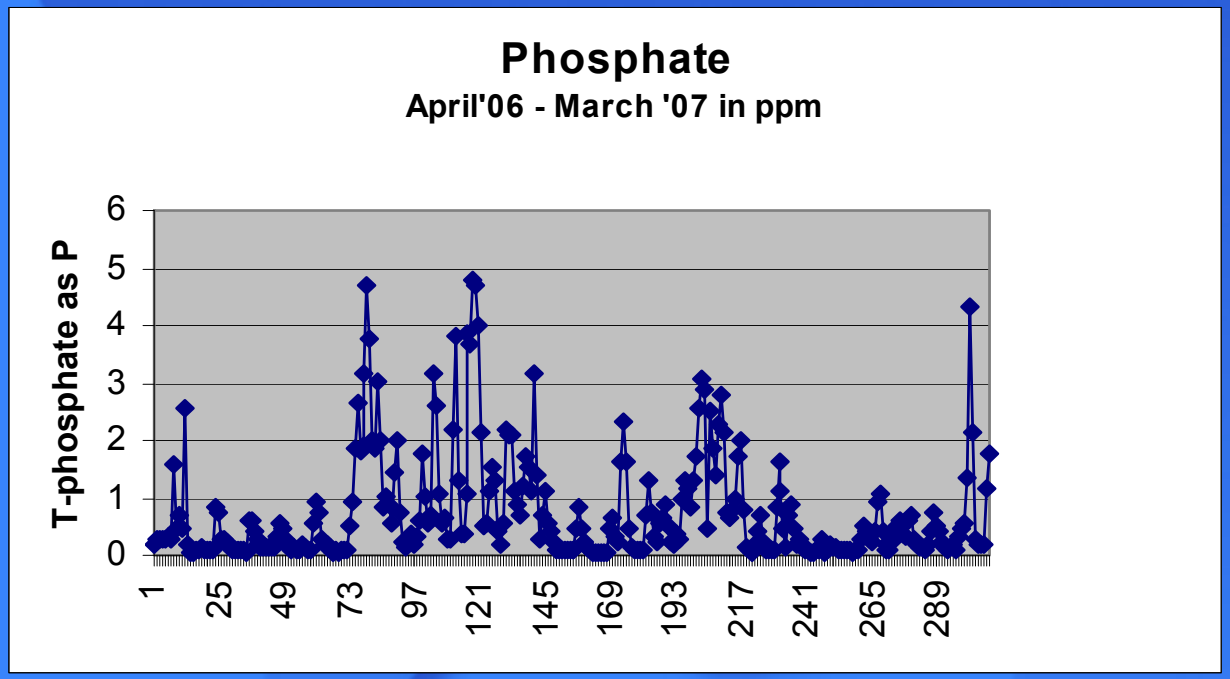
Steady quality and quantity vs. River - Seasonal to 5,000 NTU

Performance



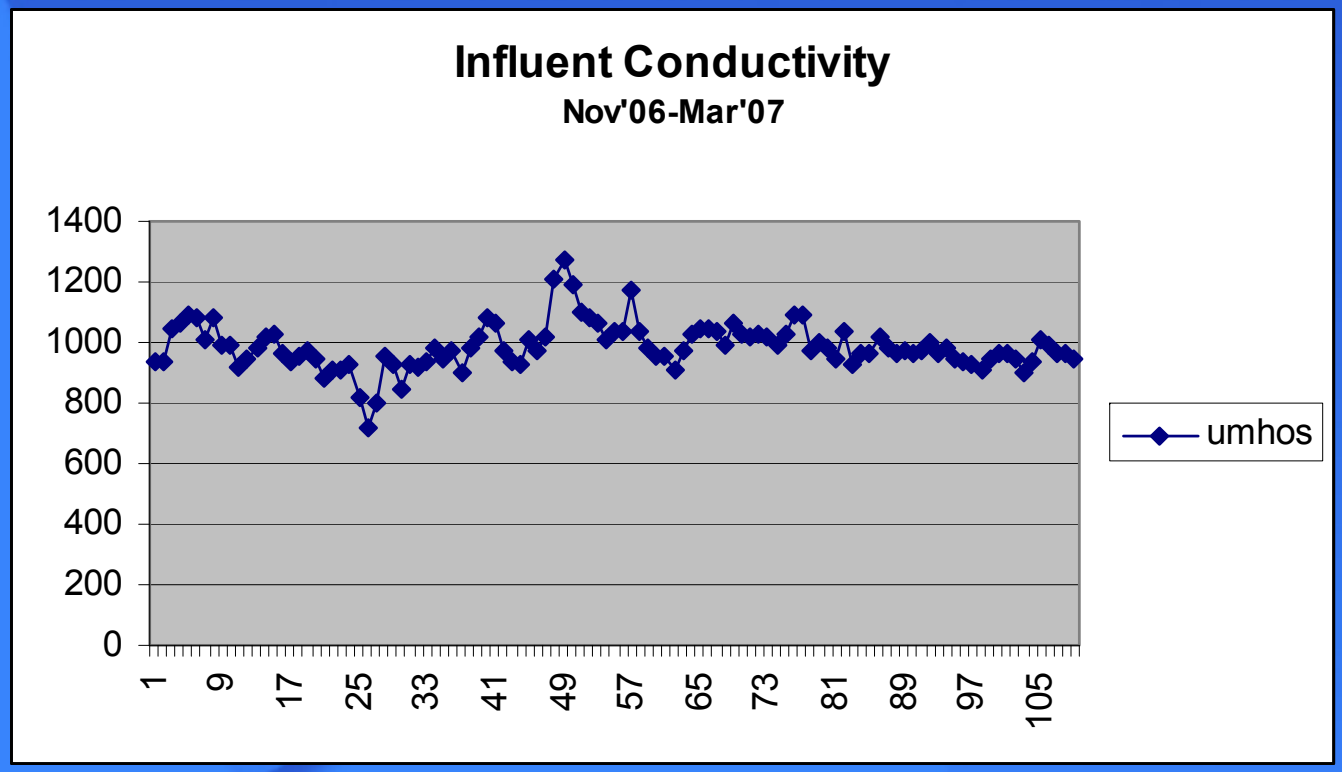
SDI below target 99% of time

Performance



Phosphate higher than expected. High potential for deposition in cooling and scaling of RO membrane

Performance



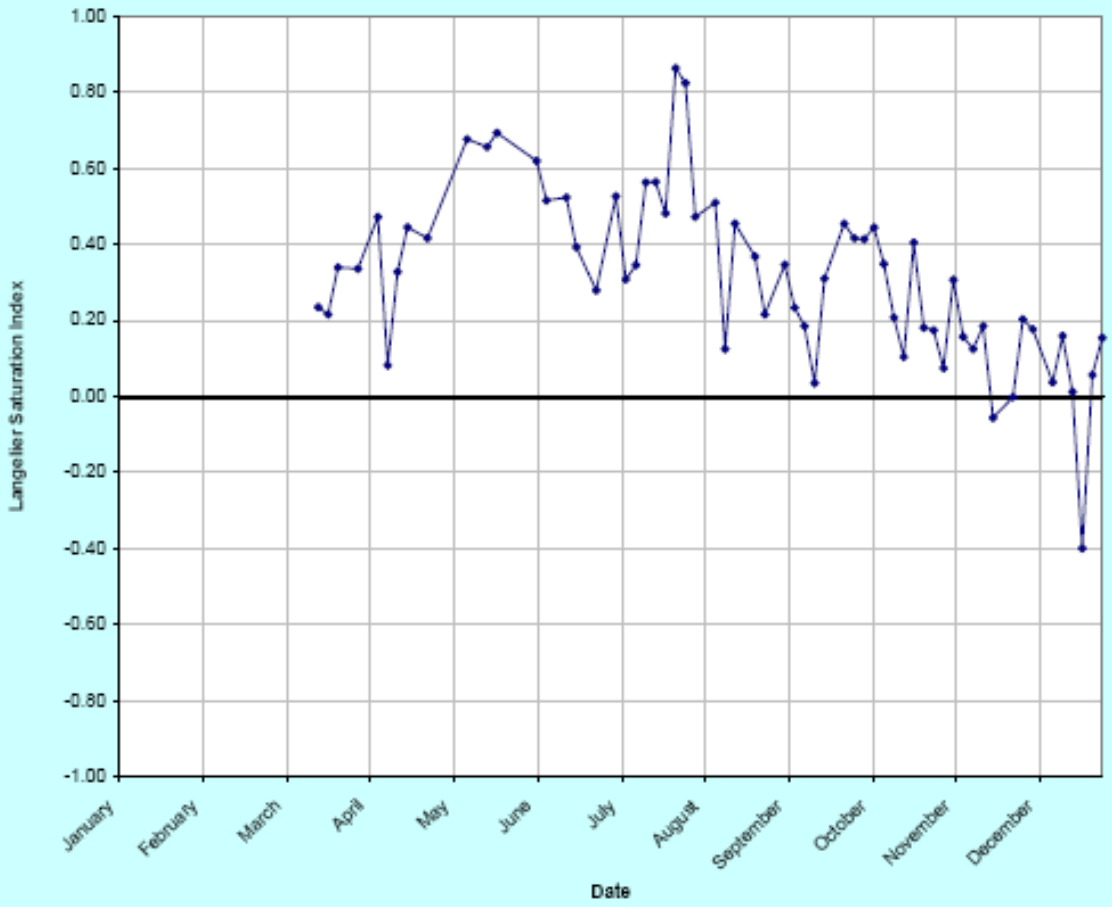
Dissolved solids species steady but 3X river water

Low SDI yields higher benefit than higher TDS

Langelier Saturation Index (LSI)

- Equilibrium model representation
- $LSI = pH - pH_s$
- $pH_s = (9.3 + A + B) - (C + D)$
- Where
  - $A = (\log_{10}[TDS] - 1) / 10$
  - $B = -13.12 \times \log_{10}(\text{temp } ^oK) + 34.55$
  - $C = \text{Log}_{10}[Ca^{2+} \text{ as } CaCO_3] - 0.4$
  - $D = \text{Log}_{10}[\text{Alkalinity as } CaCO_3]$

Performance



LSI is positive: Scale can form and $CaCO_3$ precipitation may occur

LSI is close to zero: Borderline scale potential. Water quality or changes in temperature, or evaporation could change the index.

LSI is negative: No potential to scale, the water will dissolve $CaCO_3$

Areas for improvement

- Chlorination Control – long transmission line, Surge Variability, biological re-growth in storage, fouled RO – correct level and Chlorination control
- Phosphorus – currently above specification, higher scale potential on RO and cooling water - P specific dispersants, BioP and contingency precipitation, Phosphate control at BNR
- TDS – 3X normal, -size correctly and operate with higher scaling index programme
- Langelier Saturation Index (LSI) slightly positive some $CaCO_3$ scaling potential - pH adjustment at membranes

Membrane-Treated Waste Water Project

- This is the first major industrial application of membrane treatment technology using Municipal waste water in Canada
- The technology exists which will allow industry to make more effective environmental decisions
- The use of membrane technology is a cost effective means of meeting increased water demands and reducing the stress on the river ecosystem
- Working together with municipal governments can achieve the desired goals of all
- Petro-Canada along with their partners in the Fort Hills project have announced a similar initiative with the Alberta Capital Region Waste Water Commission to supply water for the Fort Hills Sturgeon Upgrader

Project Recognition

- 2007 GE eco-imagination award
- 2007 Alberta Emerald Foundation – Emerald Award for Large Business
- 2007 Canadian Council Ministers of the Environment Award Winner – Innovation Category
- 2007 Canadian Association of Municipal Administrators – Environmental Award
- 2006 Association of Consulting Engineering of Canada – Schreyer Award
- 2006 Consulting Engineers of Alberta – Award of Excellence, Natural Resources, Mining Industrial – Award of Merit, Environmental
- 2006 Federation of Canadian Municipalities – CH2M Hill Sustainability Award
- 2006 Alberta Municipal Affairs – Minister's Award for Municipal Excellence
- 2006 Association of Professional Engineers, Geologists and Geophysicists of Alberta – Project Achievement Award
- 2006 Canadian Association of Petroleum Producers – Steward of Excellence President's Award
- 2005 Partners for the Saskatchewan River Basin – Fred Heal Award

QUESTIONS

Thank you.