HDR Engineering
Treatment Technology Review and Cost Assessment

Presented to Ecology Director Bellon and
Commerce Director Bonlender

December 3, 2013

Presentation

- Key Outcomes
- Study Sponsorship and Purpose
- Study Design
- Technology Evaluation and Cost
- Study Implications

Key Outcomes

- Oregon's human health-based water quality criteria are very stringent. Certain pollutants are ubiquitous and seem to pose exceptional regulatory challenges (PCBs, mercury, arsenic and benzo(a)pyrene).

- There are no "proven" advanced treatment technology options with demonstrated capability of achieving water quality criteria for PCBs and arsenic, and perhaps not for mercury.

- Advanced treatment technologies are very, very expensive to construct and operate. There would be formidable site-specific challenges in retrofitting existing secondary treatment systems.

- There are significant adverse collateral environmental impacts associated with these technologies.

Study Sponsors and Purpose

Sponsorship

- Association of Washington Business
- Association of Washington Cities
- Washington State Association of Counties

Purpose

- Washington water quality standards revision process seems to favor Oregon-like Human Health Water Quality Criteria
- Is there treatment technology that can achieve these toxic pollutant numeric criteria?
- At what cost? Associated adverse collateral impacts?

Study Design

- Starting point: characterize wastewater quality from a secondary treatment system (municipal/county POTW and industry). AKART is considered well-operated secondary treatment.

- Limit the analysis to four troublesome pollutants: PCBs, mercury, arsenic, and a polyaromatic hydrocarbon (benzo(a)pyrene).

- Use WDOE and permittee wastewater data to define the range of pollutant concentrations.

- Assume Oregon-like ambient water quality criteria need to be achieved at point of discharge; i.e., water quality-based effluent limit.

- Conduct literature review of candidate advanced treatment technologies targeting the four pollutants. Select the two or three most promising technologies. Assess capability to treat. Identify the practical design and operational constraints.

Study Design

- For the candidate technologies, estimate removal efficiencies for the four pollutants.

- For the candidate technologies, estimate capital and O&M cost for a 5 million gallon per day system.

- Scalability: examine costs for a 0.5 MGD and then a 25 MGD treatment system.

- Sensitivity analysis: assume water quality criteria and/or effluent limits are 10x less stringent. Could they be met with advanced treatment technologies?

- Qualitatively identify any adverse collateral environmental impacts. Incremental electrical energy use, GHG emissions, residual management and disposal, air emissions.

Treatment Technology Review and Assessment

- AWB Competitive Consultant Selection

HDR Profile

- 8,473 Employees
  - 197 Locations Worldwide
  - 166 Domestic Offices
- Leading Wastewater Treatment Planning and Design Firm

HDR in Washington

- 419 Employees
- Wastewater Clients
  - Seattle Public Utilities
  - King County
  - LOTT Clean Water Alliance
  - Spokane County
  - City of Hoquiam
  - City of Everett
  - City of Wenatchee
  - Kitsap County
  - City of Mount Vernon
  - City of Bremerton

Evaluation of Toxics Treatment Effectiveness and Costs

Treatment Processes

- Desktop Analysis
  - HDR Experience
  - Technical Literature Review
- Treatment Process Effectiveness for Toxics Removal
  - Existing Secondary Treatment
  - Additional Removals in Advanced Treatment
    - Limited Information Available on Full Scale Performance for Toxics
- Two Advanced Treatment Process Trains Selected
  1. Micro Filtration Membrane followed by Reverse Osmosis (MF/RO)
  2. Micro Filtration Membrane followed by Granular Activated Carbon Adsorption (MF/GAC)

Cost Analysis

- Preliminary Cost Opinions
  - Association for the Advancement of Cost Engineering (AACE International)
    - Recommended Practice No. 17R-97 Cost Estimate Classification System
      - Class 4 Estimate
        - » 5% to 10% Project Definition
        - » Expected Accuracy: -30% to +50%

Microfiltration Membranes

Spokane County Regional Water Reclamation Facility MBR

LOTT Martin Way Reclamation Plant MBR

Microfiltration Followed by Either….

Reverse Osmosis (RO)

Scottsdale, AZ Water Campus

Granular Activated Carbon (GAC)

Potable Water Treatment

Key Findings on Technologies

- Technology/Performance capability
  - PCBs – no demonstration of ability to achieve 0.0000064 ug/l
  - Arsenic – no demonstration of ability to achieve 0.018 ug/l
  - Mercury – possibly able to achieve 0.005 ug/l
  - B(a)P – Insufficient information to make judgment

- Expect many site-specific challenges with retrofit of advanced treatment technology onto existing facilities
  - Disposal of Reverse Osmosis brine (1-10% of influent flow)
  - Land requirements for advanced treatment technologies

Treatment Technology Costs

- 5 Million Gallon per Day (mgd) Facility

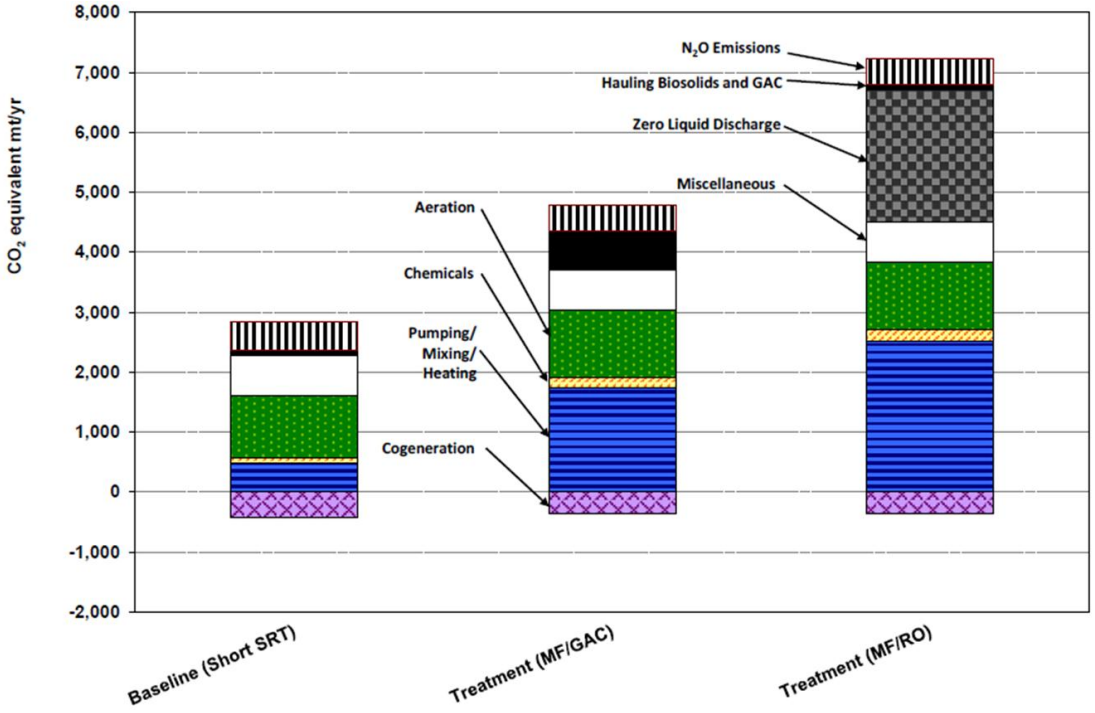
Alternative	Total Construction Cost, 2013 dollars ($ Million)	O&M Net Present Value, 2013 dollars ($ Million) ***	Total Net Present Value, 2013 dollars ($ Million)	NPV Unit Cost, 2013 dollars ($/gpd)
Baseline (Conventional Secondary Treatment) *	59 - 127	5 - 11	65 - 138	13 - 28
Incremental Increase to Advanced Treatment - MF/RO	48 - 104	26 - 56	75 - 160	15 - 32
Advanced Treatment - MF/RO **	108 - 231	31 - 67	139 - 298	28 - 60
Incremental Increase to Advanced Treatment - MF/GAC	71 - 153	45 - 97	117 - 250	23 - 50
Advanced Treatment - MF/GAC	131 - 280	50 - 108	181 - 388	36 - 78

- Basis: Net Present Value, 25 year project life. “Baseline” costs do not include probable needed secondary treatment system upgrades for existing facilities.

Collateral Impacts of Advanced Treatment

- Larger Plant Site Physical Space Requirements for Additional Unit Processes
- High Energy Consumption
  - Additional Pumping, Mixing, etc
- Increased Chemical Use
- Increased Residual Solids Production
- Increased Truck Hauling
- RO Brine Disposal
- Carbon Regeneration

Increased Greenhouse Gas Emissions



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Study Implications

- The absence of proven treatment technology to achieve a water quality criterion for even one pollutant drives extraordinary cost and opens the door on a variety of difficult CWA regulatory issues.

- The technology + operating cost estimates can be scaled to all POTWs and industrial NPDES dischargers to compute a state-wide economic impact.

- These study results need to be considered by Ecology in the Significant Legislative Rule analysis for any regulation proposal (RCW 34.05.328)

- The study examined four prominent pollutants. Recognize that as analytical methodologies improve there may/will be other pollutants which drive unique treatment needs in future.