Preliminary Design of the DC Water Enhanced Clarification Facility

New England Water Environment Association
2015 CSO/Wet Weather Issues Specialty Conference
October 26, 2015

Gregory Heath, AECOM
John Carr, DC Water
Walter Bailey, DC Water
Salil Kharkar, DC Water
Kenneth Watson, AECOM
Presentation Outline

- Background
- Project objectives
- Description of ECF treatment process
- Findings and lessons learned
- Conclusions

Start of Blue Plains Tunnel
Background
DC Water Service Area

- Water and wastewater services
  - 500,000 customers in D.C.
- Wastewater conveyance and treatment services
  - 1.6 million customers in four surrounding counties
Blue Plains AWTP

• Largest advanced wastewater treatment plant in the world
  – 370 mgd ADF design capacity
  – 150 acre site
Integrated CSO LTCP and Nutrient Removal Planning

• DC Water LTCP completed in 2002
  – Enhanced nutrient removal requirements not in place at that time

• Planning for holistic wet weather treatment and nutrient removal begun in 2004

• LTCP Supplement No. 1 completed in 2007
LTCP Supplement No. 1
Recommended Plan

- 157 MG tunnel system
- Complete treatment up to 555/511 mgd
- Excess plant flow diverted to tunnel
- 225 mgd TDPS/ECF
- Reduces peak flow from 740 to 555 mgd
  – (P.F. from 2.0 to 1.5)
Flow Management With ECF On-Line

Sewer System 1076 mgd → Bolling Diversion Str. 521 mgd → Blue Plains Tunnel 157 mgd

Tunnel Dewatering Pumping Station 225 mgd → Enhanced Clarification Facility

Complete Treatment
- New TN facilities
- Centrate Treatment

555 mgd for 4 hrs
511 mgd thereafter

Discharge to Complete Treatment to maintain 002 at 555/511 mgd

Outfall 002

Discharge to 001 when Flow @ 002 ≥ 555/511 mgd, per NPDES permit

Outfall 001
Reduction in TN to Potomac, PF = 2.0
Reduction in TN to Potomac, PF = 1.5
Project Objectives
Project Objectives

• Meet effluent quality established in 2007 LTCP Supplement
  – Drove selection of ballasted flocculation process
• Provide preliminary treatment consistent with:
  – Ballasted flocculation
  – Return flow to main plant
• Rugged, reliable equipment
  – Intermittent duty
• Fit confined site
Description of ECF Treatment Processes
Process Flow Diagram

Flow Diagram:

1. **Primary Influent Channel**
   - From TDPS
   - Screensings
   - Dewatering

2. **Fine Screens**
   - Air
   - Caustic
   - Ferric
   - Grit
   - Dewatering

3. **Grit Removal**
   - Air
   - Grit
   - Dewatering

4. **HRC**
   - Flushing
   - Ballast Recycle
   - Dewatering
   - Waste

5. **Flow Diversion**
   - Polymer

6. **CCT**
   - Sodium Hypochlorite
   - Sodium Bisulfite

Outfall

Secondary Flushing Water Pumps

To West Secondary
Fine Screening

- ¼” perforated plate, 125 mgd unit capacity
- Dedicated washer compactors
- Odor control
- Two duty screens
  - n + 2 redundancy
  - “hot” stand-by
  - Hot water spray system
- Start/stop with lead TDP
Grit Removal

• Vortex technology, 83.3 mgd unit capacity
  – 90 to 95% removal 212 micron or larger particles at peak flow
  – Maintains characteristics of micro-sand
  – Removes grit in flow returned to main plant

• Classifiers and washers
• Odor control
• n + 0 redundancy
• Start/stop with lead TDP
High-Rate Clarification

• Ballasted flocculation (sand or recycled sludge)
  – 62.5 mgd unit capacity

• Performance based on influent TSS ranges
  – Set coagulant and polymer limits, and TSS effluent / percent removal requirements

• Co-settle sludge in primaries

• n + 0 redundancy

• Start on rising influent channel level & stop with lead TDP
Flow Diversion to West Secondary

- Able to divert up to 100 mgd HRC effluent to west secondary
  - ECF start-up
  - To maintain 555/511 mgd to main plant
- Parallel flow control valves
Disinfection

- Sodium hypochlorite disinfection
  - 20 mg/L at peak flow
  - 5 mg/L at minimum flow
  - 15 minute contact time
  - 4 basins, 3 passes, n + 0 redundancy

- Sodium bisulfite de-chlorination
  - 5.5 mg/L at peak flow
  - 1 mg/L at minimum flow
  - 30 second contact time
Disinfection (cont.)

- Induction mixers for hypochlorite and bisulfite
- Chlorine residual analyzers
- Recycle CCT contents for flushing/clean-up
- Tipping buckets for CCT clean-up
- Start-stop on flow into CCT
Ancillary Processes

- Channel aeration
- Odor control
- Post-storm dewatering / clean-up
- Flow diversion for dry weather testing
- HRC chemical storage and feed systems
Findings and Lessons Learned
Design Unit Processes to be Robust

• Uncertainties surrounding “first flush” and “last flush” loadings

• Examples of robust design
  – Over-sized screenings washer/compactors
  – 100% redundancy in suction piping, valves, and pumps on grit system
  – Over-sized grit washer-classifier system
Balance Redundancy with Intermittent Nature of ECF Operation

• Redundant ancillary equipment instead of redundant process trains
  – Grit suction piping, pumps, and valves
  – HRC sludge recirculation pumps
  – Induction mixers (shelf spares)
Account for Wide Variation in Flows

- 10:1 turn-down on HRC
- As much as 0 to 225 mgd to CCT
- Drives number and turn-down capability, especially for chemical metering pumps
Conclusions
Key to Integrated TN / Wet Weather Plan is Reduced Peak Flow to Blue Plains AWTP

• Increases efficiency of primary and BNR
• ECF produces high quality wet weather effluent
Supports Future Application of Integrated TN/Wet Weather Approach

- Establishes precedent for off-loading main plant to achieve reduced effluent loading
- Increases depth / breadth of knowledge for design of wet weather treatment at downstream end of tunnel systems
- Provides design experience / lessons learned for one of the largest ballasted flocculation wet weather treatment systems in North America
Questions