City of O'Fallon

First of it's Kind Treated Effluent Discharge Saves Millions

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Presentation Overview

- Overview of City of O'Fallon, MO
- Overview of O'Fallon Water Resource Recovery Facility (WRRF)
- Project Need & Drivers
- Antidegradation Evaluation for New Discharge
- Notable Successes
- Lessons Learned

City of O'Fallon - Overview

- Mid-West City – Just West of St. Louis
- Population ~ 88,000 - 7th largest City In Missouri
- O'Fallon Wastewater System
  - City Own's & Operates O'Fallon WRRF
  - 18 Collection System Lift Stations
  - 200 Miles of Sewer & 6,000 Manholes
  - 16,000 User Connections
- Accepts Flow From
  - Neighboring City of Lake St. Louis
  - Public Water Supply District #2

City of O'Fallon - Location

Missouri

City of O'Fallon - Aerial

O'Fallon WRRF - Overview

- O'Fallon WRRF
  - 11.25 MGD Permitted Average Day Flow
  - 7.5 MGD Current Average Day Flow
  - 16.5 MGD Current Max Day Flow
- Permitted Discharge to Mississippi River
  - 6 Mile Force Main
  - Large Effluent Pump Station-(4)-150hp Pumps
- Typical Secondary Treatment Permit Limits
  - CBOD/TSS: 25/30 mg/L
  - Ammonia: 23.8 mg/L
  - E Coli: 126/100 mL

O'Fallon WRRF Overview

- Influent Offline Equalization
  - 7.8 MG of Storage
- Preliminary Treatment
  - Screening & Grit Removal
- Primary Clarification
- Biological Treatment
  - Biofilter/Activated Sludge Treatment Process
- Final Clarification
- UV Disinfection
- Effluent Lift Station – To Mississippi River
- Biosolids
  - Thickening, Dewatering & Class-A Processing
  - Biosolids Disposal – Land Application

O'Fallon WRRF Aerial

O'Fallon WRRF Outfall

Project Need & Driver #1

- #1- New & Future Permit Limits:
  - Missouri Department of Natural Resources (MDNR)
  - More stringent Ammonia limits
    - Discharge Permit Renewal in 2016
  - Current Limits: 23.8 mg/L (Monthly Average)
  - Proposed Limits:

    17.8 mg/L (summer monthly average) | 17.0 mg/L (winter monthly average)
  - Required to meet new limits by September 2022
- Existing WRRF Cannot Meet New Limits

Project Need & Driver #2

- #2 – Effluent Pump Station Capacity Limitations
  - Flooding & Backups Into UV Disinfection System
  - Compromise Safety & Permit Compliance
- Cause = Mississippi River Flooding
  - Significant Increase in Static Head
  - Limited Effluent Lift Station Capacity to ~12 MGD
  - Peak Plant Flows Up to 16.5 MGD
- Excess Effluent Flow of 4.5 MGD
- No Where to Go But Backup!

UV Disinfection Flooding

Project Need & Driver #3

- #3 - Additional Capital Improvements
  - Major Electrical Upgrades-80% WRRF
    - Remove Grounded B-Phase System
  - Major Control System Upgrades
  - Primary & Secondary Clarifier Flow Split Upgrades

Overall Need & Driver Summary

- Two Parallel Path Project Needs
  - #1-New Ammonia Limits – April 2021
  - #2-Mitigate Effluent Lift Station Capacity Limitations
- Ammonia Limits Summary – Mississippi River
  - Current Monthly Average = 23.8 mg/L
  - Next Permit Cycle = 17 mg/L
  - Future EPA Limits = 7.2/18.5 mg/L
    - Gil Breathing Snails & Freshwater Mussels
  - Future Total Phosphorous Limits?
  - Future Total Nitrogen Limits?

O'Fallon WRRF Past Outfalls

- 1970's to Early 1990's
  - Treated Effluent Discharge to Peruque Creek
- Early 1990's to Present
  - Treated Effluent Discharge to Mississippi River
- Peruque Creek
  - 7Q10 & Mixing Flow = 0.1 & 0.025 CFS
- Mississippi River – 20,347 CFS @ 7Q10 – Main Channel
  - Mixing Flow In Permit = 508 CFS
- Discharge to Slough of Mississippi River
  - Not Main Channel

Innovative Idea & Challenge!

- Second Treated Effluent Discharge to Peruque Creek
  - Peruque Creek – Adjacent to WRRF Site
  - Favorable Location for Excess Treated Effluent
- Fully Treated & Disinfected Effluent
  - No Bypasses of Secondary Treatment (Blending)
- Significant Challenge
  - No Permitted Discharges Like This in Missouri
  - No Specific Missouri Permit Procedures
  - New Discharge Would Require Antidegradation Evaluation

High Flow to Peruque Creek?

Antidegradation

- Missouri's Antidegradation Implementation Procedure (AIP)
- Similar to Other States – Goals To…
  - Justify the New Discharge
  - Ensure Compliance with State Water Quality Standards (WQS)
  - Justify Economic Benefit of Discharge
  - Conduct a Pollutant by Pollutant Review
- End Product & Delivery
  - Antidegradation Evaluation Report to MDNR

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Missouri Antidegradation Rule and Implementation Procedure

Step #1 – Review Levels

- Tier I – Waterbodies on States 303D List as Impaired
- Tier II – Waterbodies With Water Quality Above State WQS
- Peruque Creek
  - On 303D List – Impaired for Dissolved Oxygen
- Tier I & II Review Combined
  - DO – Tier I Review – 303D Listing
  - Other Pollutants – Tier II Review

Step #2 – Receiving Water Flow

- Goal – Correlate Limits At High Flow Creek Conditions
- Challenges
  - What Are Peruque Creek Flows During High Flow Conditions?
    – No Discharge @ Low Flow
- City Operating Data Evaluation
- When Did Capacity Limitations Occur?
  - Typically UV Surcharges – 2-inches of Rain in a Day
  - Typically UV Surcharges – 3-inches of Rain over 3-days

Step #2 – Evaluation of Pollutants

- USGS & NOAA Data (Flow & Rainfall)
  - Peruque Creek Flow At Corresponding Rainfalls
  - Establish Baseline High Flow Conditions
- Peruque Creek High Flow = 704 CFS (455 MGD)
  - Mixing Zone of 176 CFS (113 MGD)
    - Much More Favorable Than 0.025 CFS Low Flow Mixing Zone
  - 176 CFS Used for Pollutant by Pollutant Evaluation
  - Treated Effluent Discharge of 4.5 MGD
- Max Day & Max Week Limits Calculation Basis
- Anticipated Discharge Frequency
  - 0 to 5 Times Per Year

Step #2 – Evaluation of Dissolved Oxygen

- Peruque Creek Impaired for DO
- DO Modeling of Discharge to Peruque Creek
  - Streeter-Phelps Evaluation
  - Stream Background DO & BOD
- Evaluation Determined
  - To Meet Minimum Day DO Limit of 5 mg/L
    - Reaeration Would Be Needed At WRRF
  - Maximum Day BOD_5 Limit of 45 mg/L
- Ensured Protection of WQS

Summary of Permit Limits

Parameter	Units	Final Effluent Limits			Monitoring Requirements	
		Daily Maximum	Weekly Average	Monthly Average	Measurement Frequency	Sample Type
Flow[1]	MGD	(Note #1)	-----	-----	once/day	(Note #1)
BOD_5[2]	mg/L	-----	45	-----	twice/week	24 hr Comp.
TSS[2]	mg/L	-----	45	-----	twice/week	24 hr Comp.
pH Units[3]	SU	6.5-9.0	-----	-----	once/day	Grab
E. Coli[4]	#/100mL	-----	630	-----	twice/week	Grab
Ammonia-N (4/1 to 9/30)	mg/L	23.8	-----	-----	once/month	Grab
Ammonia-N (10/1 to 3/31)	mg/L	23.8	-----	-----	once/month	Grab
Oil & Grease	mg/L	15	-----	10	once/month	Grab
Total Phosphorous[5]	mg/L	Monitor	-----	0.5 to 1	once/quarter	Unknown
Total Nitrogen[5]	mg/L	Monitor	-----	8 to 10	once/quarter	Unknown
Copper[1] (Total Recoverable)	µg/L	Monitor	-----	Monitor	once/quarter	Grab
Zinc[1] (Total Recoverable)	µg/L	Monitor	-----	Monitor	once/quarter	Grab
Dissolved Oxygen[6]	mg/L	5.0 mg/L[6]	------	-----	once/day	Grab

Step #3 – Less Degrading Alternatives Evaluation

- Requirement of the Missouri AIP
- Base Project & Three Less Degrading Alternatives
  - Base Project – Activated Sludge With BNR & Selectors (BNR AS)
  - Less Degrading #1 – BNR AS & Tertiary Filtration
  - Less Degrading #2 – BNR AS & Filtration + Chemical Addition
  - Less Degrading #3 – Membrane Bioreactor (MBR)
- Missouri AIP – Total LCC at or Below 120% of the Base Project = Economically Viable
- Cost Effective to Further Minimize Degradation?

Less Degrading Alternatives Evaluation Summary

Parameter	BNR Activated Sludge	BNR Activated Sludge with Tertiary Filtration	BNR Activated Sludge with Tertiary Filtration & Chemical Addition	Membrane Bioreactor
Practicability	Yes	Yes	Yes	Yes
Total Initial Capital Cost (I)	$ 29,720,000	$ 43,579,000	$ 46,684,000	$ 48,872,000
Present Value of O&M Costs (O&M)	$ 7,270,000	$ 7,358,000	$ 15,141,000	$ 14,133,000
Present Value Salvage Value (S)	$ (2,101,000)	$ (2,252,000)	$ (2,888,000)	$ (1,493,000)
Total Present Worth (LCC)	$ 34,889,000	$ 48,685,000	$ 58,937,000	$ 61,512,000
Base-to-Alternative Cost Ratio	1.00	1.40	1.69	1.76
Total Annual Costs	$ 411,000	$416,000	$ 856,000	$ 799,000
Economic Efficiency	Economically Efficient	Not Economically Efficient	Not Economically Efficient	Not Economically Efficient

Step #3 - Non-Degrading Alternatives Evaluation

- Requirement of Missouri AIP
- No Increase Flow or Pollutant Loading to Receiving Water Body
- “No Discharge” Alternatives
  - Land Application & Seasonal Storage
  - Subsurface Disposal
  - Alternative Discharge Locations
  - Regionalization
  - Improved O&M
- All Not Feasible

Step #3 – Viable Non-Degrading Alternatives

- Non-Degrading Alternative #1 – Additional Effluent Pumping Capacity – High Flows
  - New High Flow Pump Station & Large Pumps (~1,000 hp each)
  - Major Electrical Improvements
- Non-Degrading Alternative #2 – Parallel Effluent Force Main – Reduce Head Loss
  - Second 30-inch Force Main to Mississippi River
  - 6-Miles Long
  - Reduces Dynamic Head But Not Static Head (Mississippi Flooding)

Step #3 – Non-Degrading Alternatives Summary

Parameter	Peruque Creek High Flow Discharge	Additional Effluent Pump Station Capacity	Parallel Effluent Pump Station Force Main
Practicability	Yes	Yes	Yes
Degrading/Non-Degrading	Degrading	Non-Degrading	Non-Degrading
Total Initial Capital Cost (I)	$ 3,400,000	$ 8,000,000	$ 12,873,000
Present Value of O&M Costs (O&M)	$ 18,000	$ 213,000	$ 36,000
Present Value Salvage Value (S)	$ (75,000)	$ (137,000)	$ (1,791,000)
Total Present Worth (LCC)	$ 3,343,000	$ 8,076,000	$ 11,118,000
Base-to-Alternative Cost Ratio	1.00	2.42	3.33
Total Annual Costs	$ 1,000	$ 12,000	$ 2,000
Economic Efficiency	Economically Efficient	Not Economically Efficient	Not Economically Efficient

Proposed Solution

- High Flow Discharge Lift Station to Peruque Creek
- New Cascade Reaeration System
- New Outfall Pipe to Peruque Creek

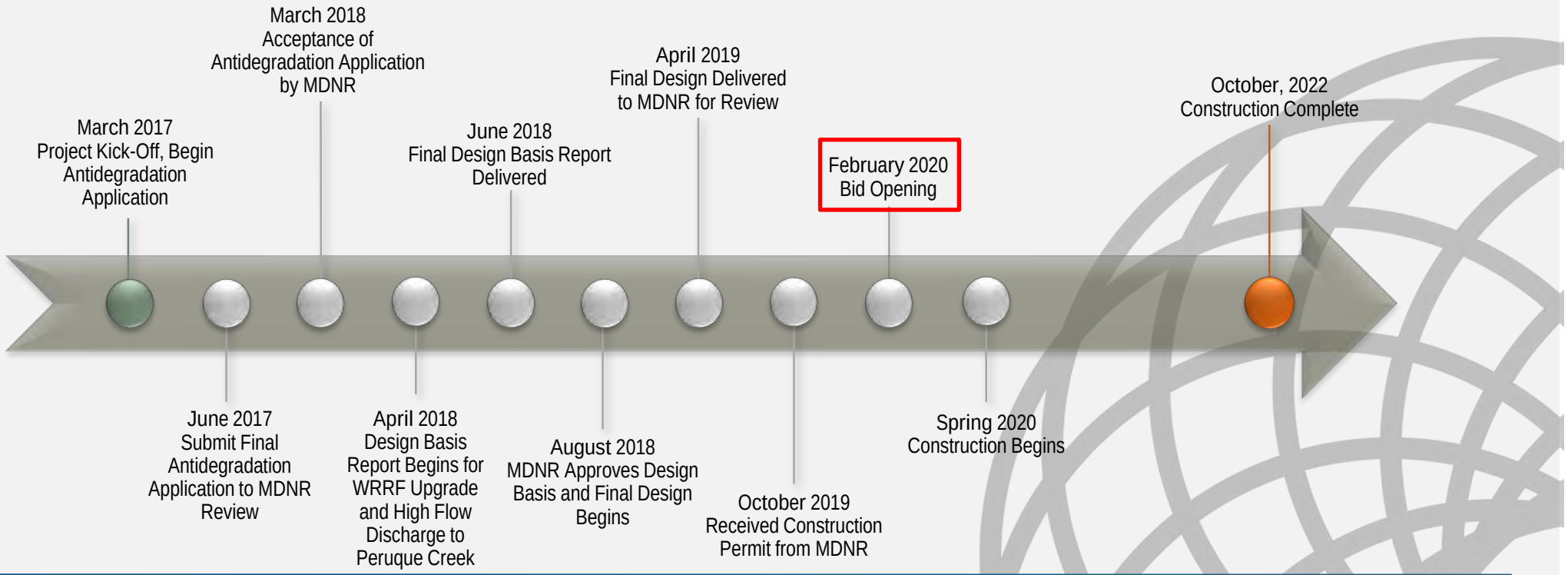
How & When to Discharge?

- How & When Will Discharge Be Allowed?
- Mississippi River Level At or Above Flood Stage
  - Measurement: (USGS Station-Grafton, IL)
- Period Which Caused Backups at WRRF
- Correlated This Level to Peruque Creek Flows
  - At High Flow Discharge Periods

Overview – Proposed Solution

Where We Are & Where We Are Going

- Currently In Bid Phase of $30M Upgrade to WRRF
  - High Flow Discharge to Peruque Creek One Part of Project



Notable Successes

- Getting This Discharge Permitted
  - First of it's Kind in History of State of Missouri
- Significant Cost Savings for City
  - ~$7M Less Than Other Alternatives Evaluated
  - High Flow Lift Station, Cascade Aerator & Outfall
    - Opinion of Probable Cost = $2M
    - Even Better Savings Than Anticipated Initially
- Reasonable Effluent Limits
  - Both for Current & Future Permit Requirements

Lessons to Share

- Communicate Early & Often With Agencies
  - Even Before Starting Work or Application
  - Very Successful & Integral Part of this Process
- See What Information is Available Already About Receiving Water
  - Site Specific Water Quality & Flow Data
  - Previous Watershed Studies
  - Previous Agency Studies
- Research Other Discharges of Similar Nature
- Don't Believe the Naysayers!

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THANK YOU!!

QUESTIONS?