



Water Conservation Projects in Mankato

April 20, 2016

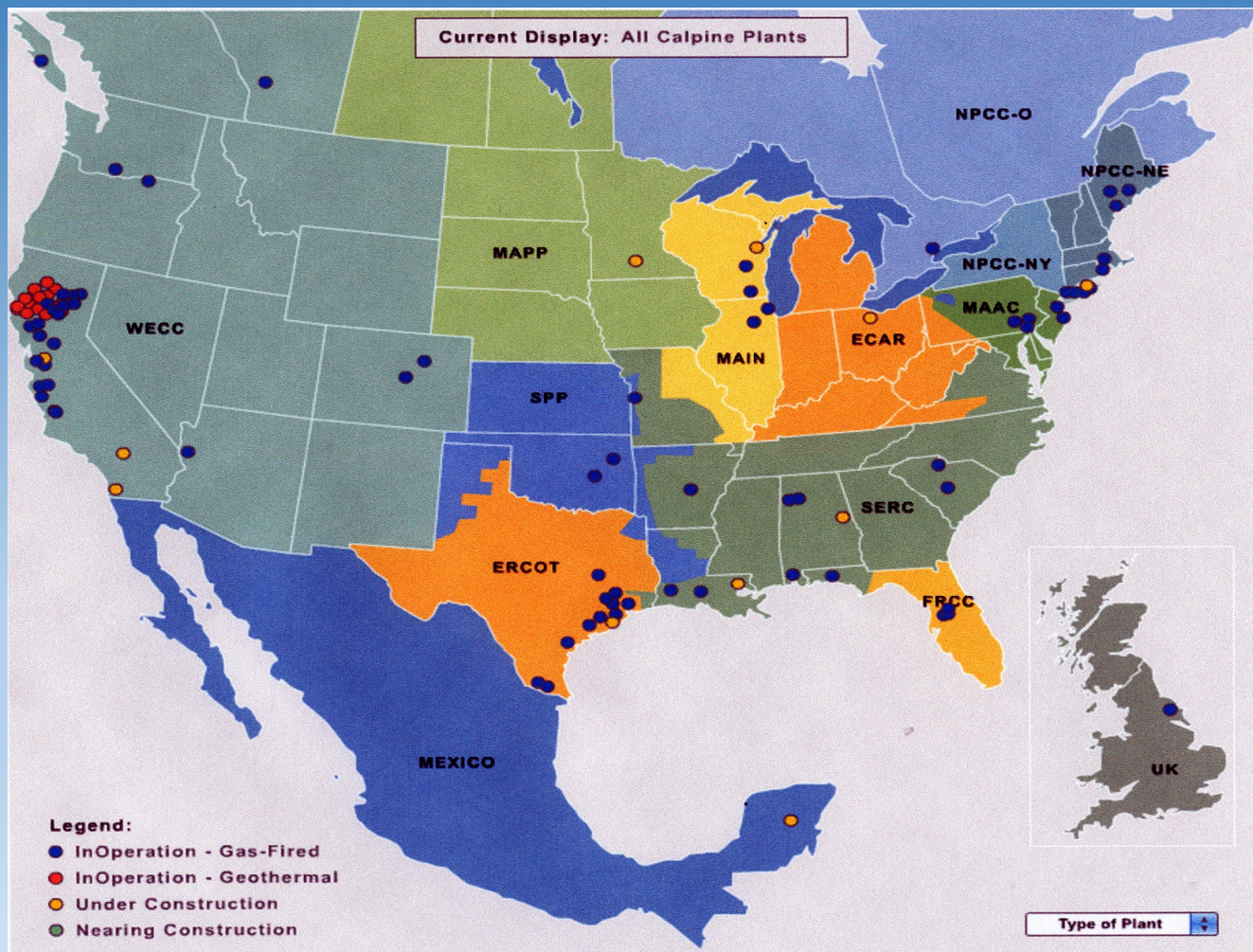
Mary Fralish
Public Utilities Director
City of Mankato



CALPINE

- Independent power producer
- Exclusive focus on clean natural gas and geothermal electricity generation
- Owns/operates 85 generating facilities in 23 states
- Owns and operates more than 30,000 megawatts of installed electric generating capacity

Calpine US Plant locations



Calpine's Mankato Energy Center

- Designed to ultimately produce 630 megawatts of electricity, phase 1 = 365
- 2 natural-gas fired combustion turbines
- 2 heat recovery steam generators
- 1 steam turbine generator
- Operate approximately 60% of the year
- Mainly in the summer and winter

Water needs

- Non-contact cooling water for cooling tower
- Options = MN River, ground water or WWTP effluent
- Peak requirement 6.2 MGD
- Return 1.55 MGD due to evaporative losses of ~75%
- Water will be recycled up to 4 times through the cooling tower before discharge

Water Reclamation Facility

- Phosphorus removal, 12 MGD
- Filtration, 7 MGD
- Chlorination, 7 MGD
- Solids thickening

Facilities

- Chlorine contact basin
- Effluent pumping station
- Stand-by power generator
- MEC Return Monitoring building
- Site work and yard piping

California Title 22 Standards

- Minnesota had no regulations on water reuse at the time
- Use CA standard as model
- Protective of public health in uses to include edible crops, parks, playgrounds, school yards, residential landscaping, and unrestricted golf courses.

California Title 22 Water Reuse

- Turbidity
 - Daily avg. of 6 samples = 2 NTU
 - 95% of samples below 5 NTU
 - Max. single sample = 10 NTU
- Total coliform
 - 7-day median <2.2 MPN/100 ml
 - Max. in 30 days = 23
 - Max. single sample = 240

Mankato Discharge Permit

- Expired, requested renewal
- Phosphorus
 - Internal compliance point of 0.9 mg/l
 - Final effluent 42.6 kg/day ($11.25 \text{ MGD} \times 8.34 \times 1 \text{ ppm} / 2.2$)
 - Ratio of Final effluent/ Internal compliance = or < 1.0

Industrial Discharge Permit

- Considered an SIU
- Sampling facility, at WWTP on return water
- To measure flow, pH, temperature required by Mankato WWTP NPDES Permit, continuous
- MN River temperature increase expected to be <0.66 degrees summer, <.17 degrees winter
- Total phosphorus required by Mankato WWTP, 3 per week
- TSS 30 mg/l, 1 per month
- BOD 22 mg/l, 1 per month

Industrial Discharge Permit, cont.

- Analyses by WWTP lab, periodic split samples
- Cost of sampling included in Service Agreement
- Benefit of having sampling station at WWTP was immediate results for process control
- Low phosphorus chemicals added to boiler water and returned to WWTP with cooling water

Total Phosphorus

- “The net addition of Total Phosphorus at the MEC is limited such that the net addition, by itself, does not cause the City of Mankato to be in violation of its NPDES Permit”

Service Agreement

- 20 year contract
- 4 ten year renewal options

MEC agreed to:

- Capital costs for WRF up to 6.2 MGD
- Upfront capital costs to expand to 12.0 MGD
- Pipelines
- Engineering costs for layout to 20.0 MGD
- Repayment of O & M costs

City agreed to:

- Provide quality water to MEC
- Upfront the O & M costs (reimbursed)
- Capital costs of expansion of WRF from 6.2 MGD to 12 MGD
 - Repayment is in the form of the water provided and O&M
 - Repayment is completed after 20 years

Timeline

- Groundbreaking at MEC 11/19/04
- Groundbreaking at WRF 4/1/05
- WRF startup 5/15/05
- WRF completion 6/1/06
- MEC Providing electricity to the grid June 2006

ECONOMIC BENEFITS

- 1 million man-hours worked
- 300 people working at peak construction
- 20-25 permanent jobs
- Increased bond rating for city
- \$20+ million gift to city
- City/county tax base

ENVIRONMENTAL BENEFITS

- Beneficial reuse of treated effluent water
- MN River water quality improvement
 - Decrease in BOD
 - Decrease in TSS
 - Decrease in TP
- Groundwater preservation
- No new collection or discharge points to the Minnesota River

Benefits to the WWTP

- Increased plant capacity
- Delay of next construction phase
- Cost sharing

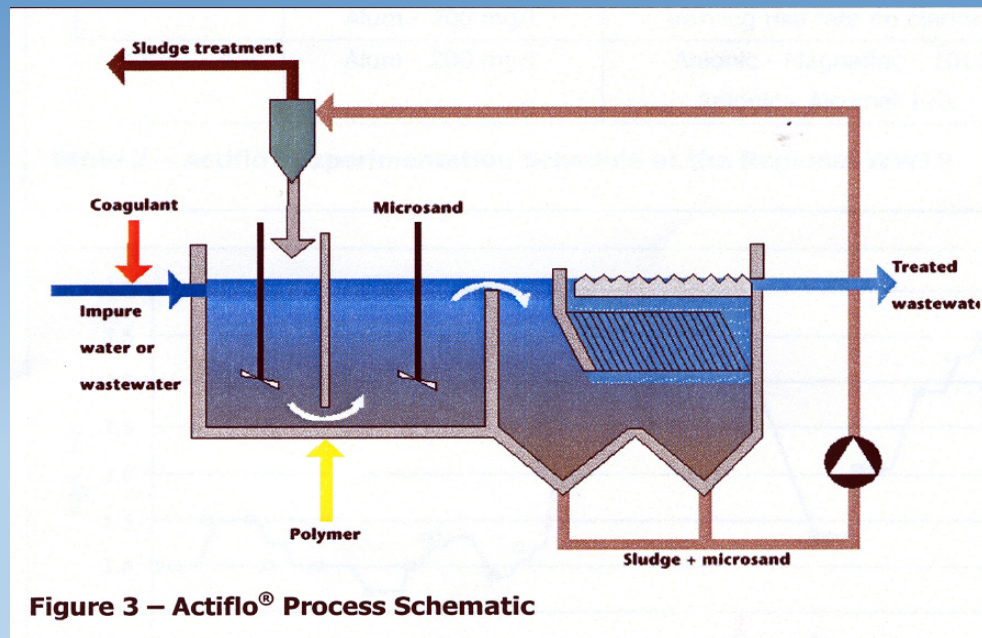
Benefits to Calpine

- Water use
- WRF operated and maintained by Certified staff at the WWTP
- Cost sharing





Actiflo



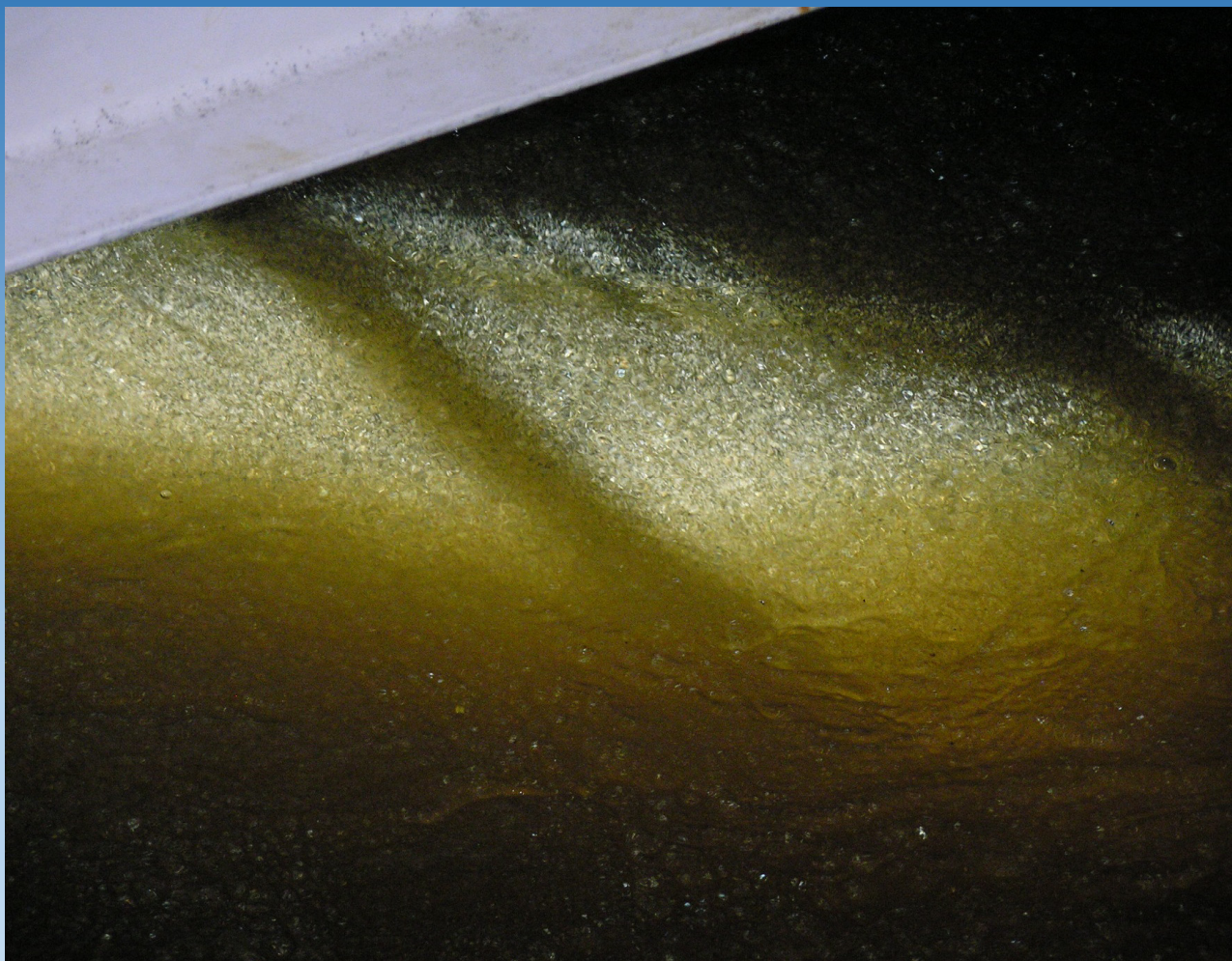






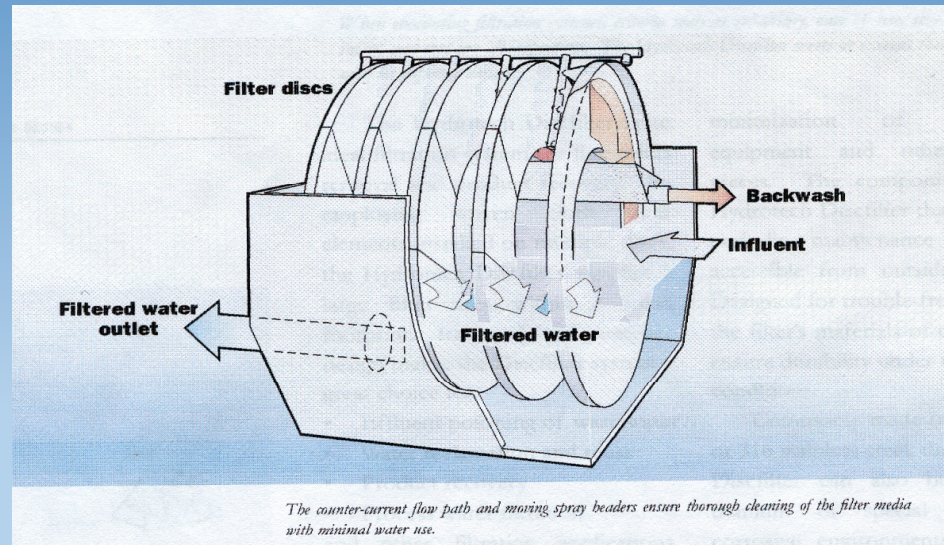








Krüger Disk

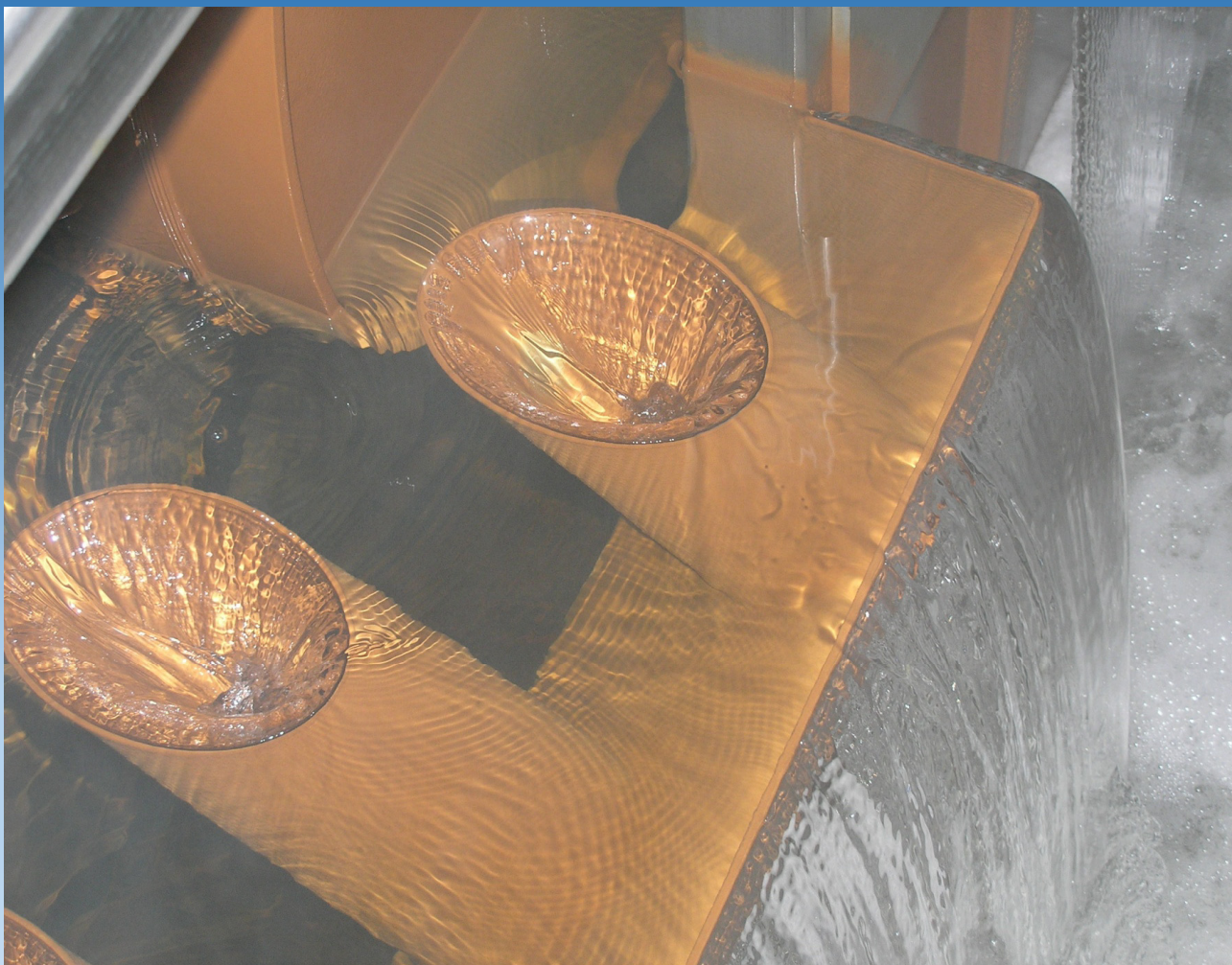






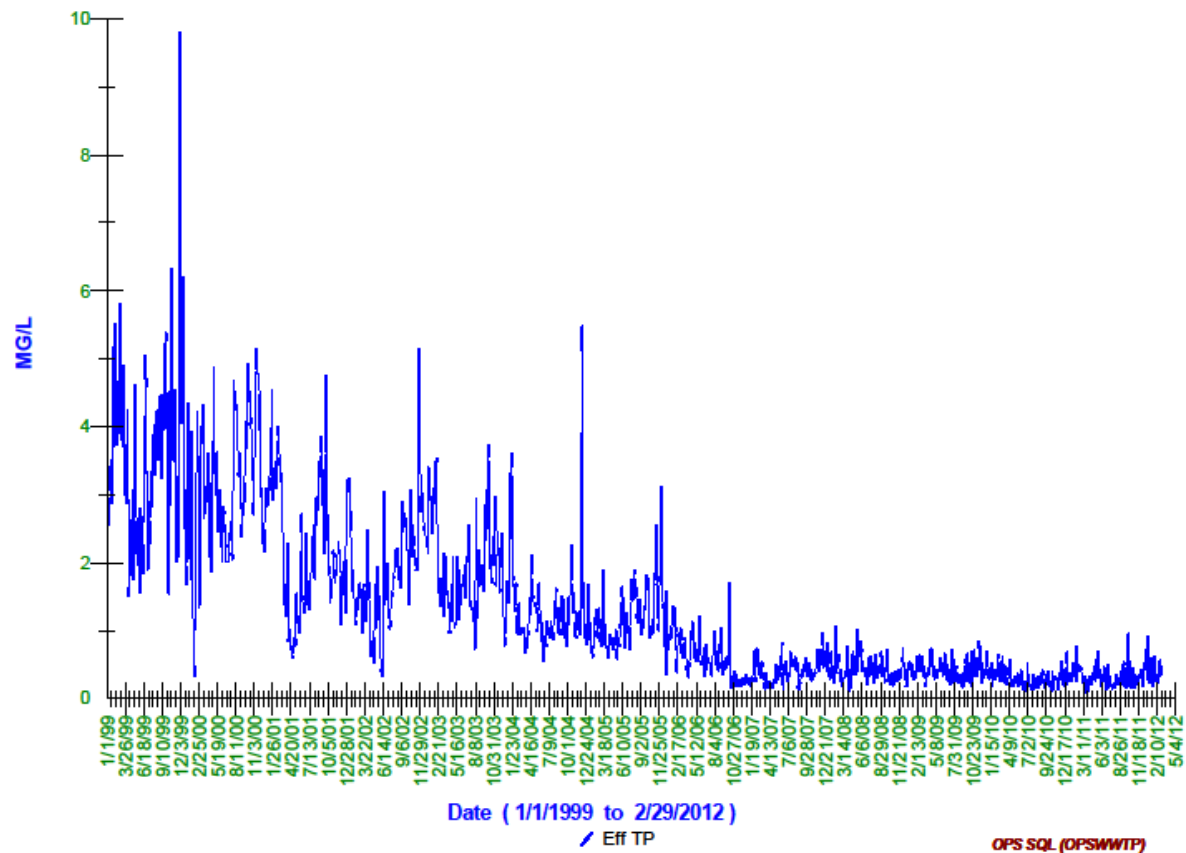








Effluent Total Phosphorus



Phosphorus credit trading

<u>City/Industry</u>		<u>Purchased</u>		<u>Charge, 2010 @\$14.55/kg</u>
ADM Marshall				
ADM Marshall		1610		\$23,425.50
Arlington	52		\$756.60	
GFE		20 May – Sept	\$291.00	
		170 Oct – April	\$2,479.32	
City of Granite Falls		35		\$509.25
New Richland		28		\$407.40
Sacred Heart		8		\$116.40
Starbuck	40		\$582.00	
St. James	74		\$1,076.70	
Walnut Grove		16		\$232.80
Welcome	7		\$101.85	
Willmar		1689		\$24,574.95
Mankato industry surcharges				
CHS		10,892		\$158,478.60
ADM		464		\$6,751.20
			TOTAL	\$219,783.57

Phosphorus costs

PHOSPHORUS REMOVAL COSTS, \$/kg

Chemicals

Ferric Chloride

Sand

WRF Polymer

BFP Polymer

Biosolids

BFP Operation

Disposal

Maintenance

Operational labor costs

Utilities

Electric

Gas Total

Analyses

Admin

TOTAL

Removal

Total kg removed: Influent - Effluent

Cost /kg removed 2010 = \$14.55

PROBLEMS???



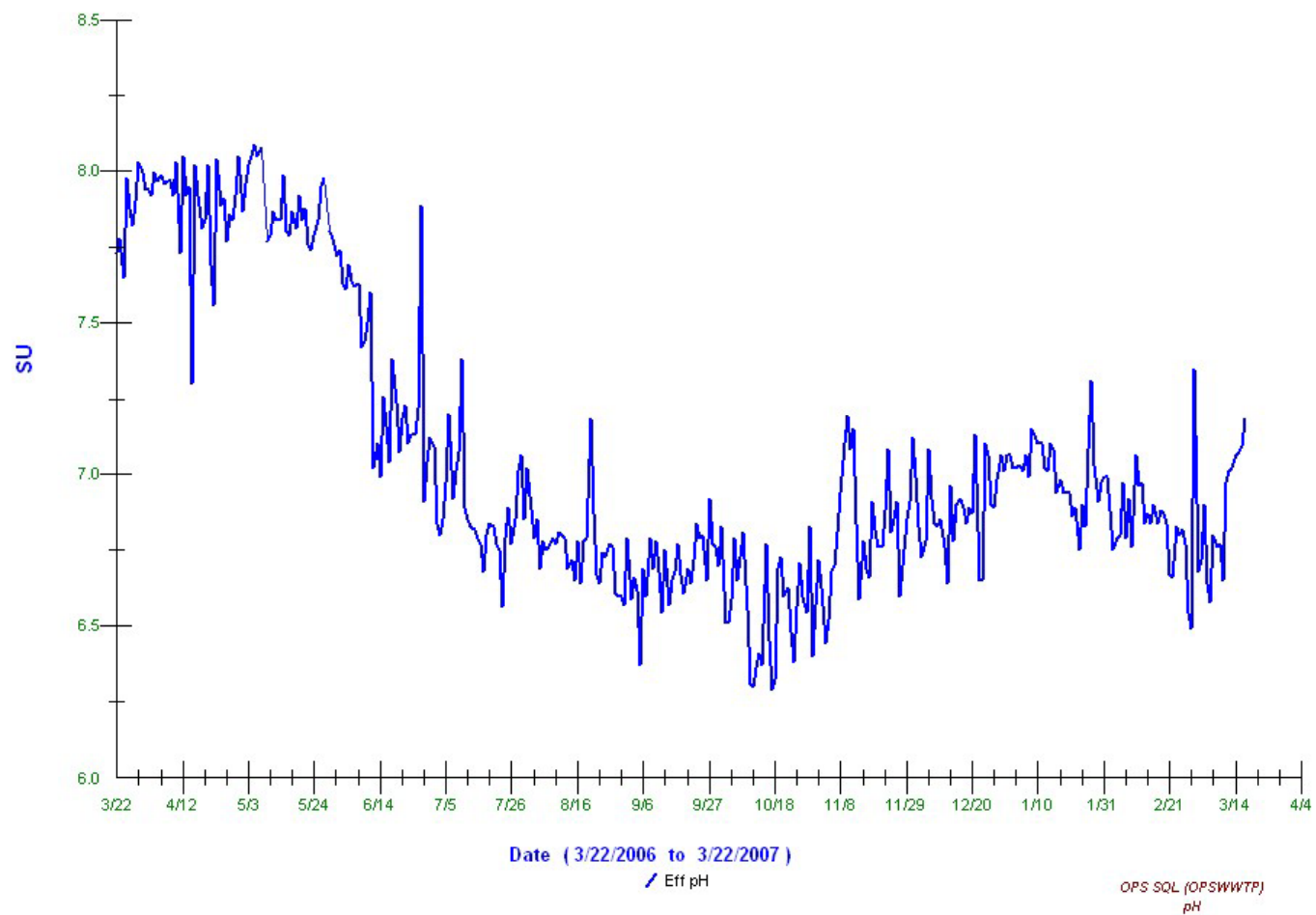




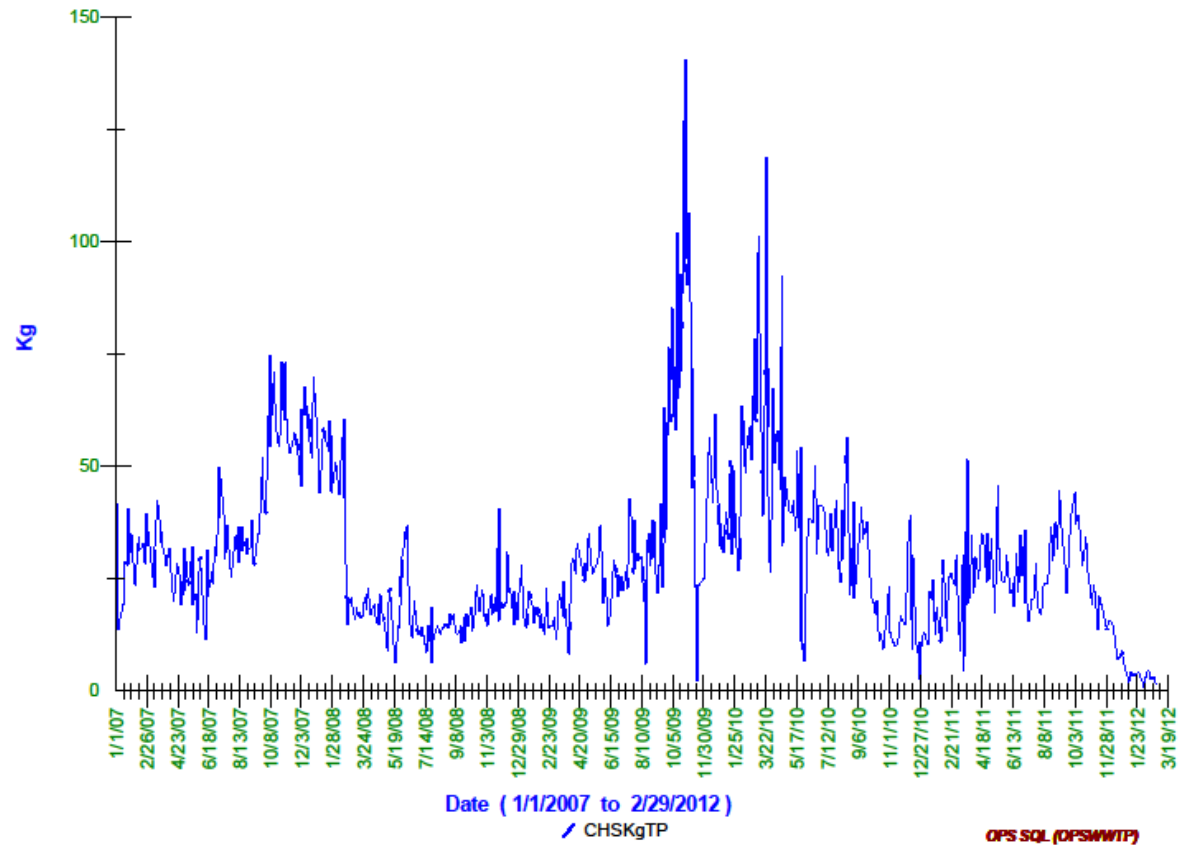




Data Over Time



CHS Total Phosphorus



Requested uses for inclusion in our NPDES permit

- Irrigation
- Vehicle and equipment washing
- Internal equipment cooling
- Cooling towers
- Industrial uses including human contact
- Pipeline testing
- Air conditioning
- Recreational impoundments
- Groundwater recharge
- Flushing toilets and urinals
- Priming drain traps
- Structural fire fighting
- Decorative fountains
- Commercial laundries
- Consolidation of backfill around potable water pipelines
- Artificial snow making
- Commercial car washes including unheated hand washes
- Industrial boiler feed
- Soil compaction
- Mixing concrete
- Dust control on roads and streets
- Cleaning roads, sidewalks and outdoor work areas
- Flushing sanitary sewers
- Other

2015 Reuse Water

- 214,785,000 Internal WWTP uses
- 426,900 Riverfront Park irrigation
- 1,496,000 Recycle Water Station
 - Vehicle cleaning
 - Street sweeping
 - Sod establishment
 - Bare root tree irrigation
- 140,655,000 MEC Power Plant



Riverfront Park #3





We're doing our part to conserve...
we
irrigate
with
reclaimed water



Not for drinking

Award Winning Water Reclamation Facility





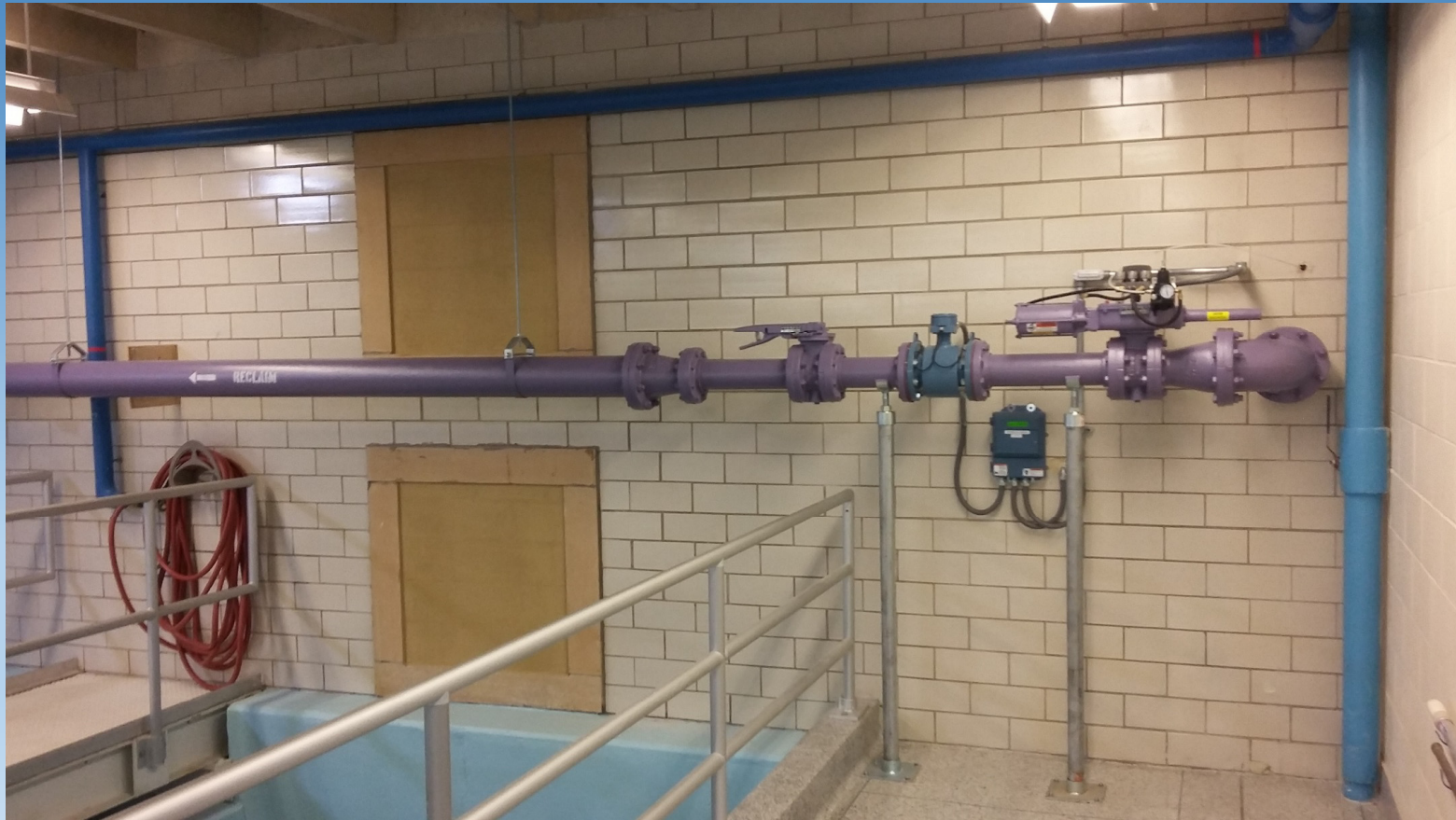








Water Treatment Plant Reuse





- Project cost = \$1.458 million
- MDH allows 10% reuse return rate based on demand
- Currently at 350,000 GPD
- 2016 will total about 184,000,000 gallons water reused
 - Equal to a population of 5,000
- Decreases flow to WWTP which increases available capacity

Bare Root Tree Irrigation











September 3, 2015 at 10:25:51 AM

- The gravel bed trees are purchased in the spring and planted into the gravel. They develop a strong fibrous root system which increases survivability and reduces transplant shock.
- Provides cost effective access to tree stock during the summer and early fall.
- Cost: Bare root trees are not available during the summer and early fall months. Bare root trees are significantly cheaper than containerized or balled and burlapped trees. If a planting is to occur during those months containerized or balled and burlapped trees would need to be purchased.







THANK YOU

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