

# Phosphorus Management Strategies

- Quick facts
- Phosphorus drivers
- Current conditions
- Possible compliance strategies
- Adaptive management-  
opportunities & challenges
- Adaptive management  
pilot/demonstration
- Areas of agreement
- Next steps





# MMSD Quick Facts

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- **Service area:** 180 mi<sup>2</sup>
- **Population:** 340,000
- **Design cap:** 50 MGD
- **Current flow:** ~45 MGD  
(2006-2010)







## Effluent TP Concentrations (mg/l)

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<u>Year</u>	<u>Annual Ave</u>	<u>Monthly Range</u>
2006	0.42	0.29 - 0.61
2007	0.39	0.24 - 0.55
2008	0.30	0.20 - 0.41
2009	0.29	0.20 - 0.47
2010	0.28	0.17 - 0.41
2011 (year to date)	0.29	0.18 - 0.55



# Phosphorus Loads

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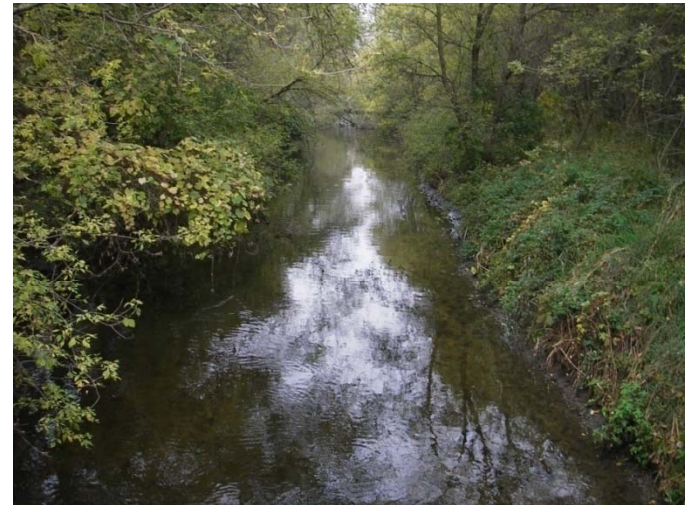
	<u>Badfish Creek</u>	<u>Badger Mill Creek</u>
<b>Basin</b>	<b>Rock</b>	<b>Sugar</b>
<b>Flow</b>	<b>41.4 mgd<sup>(1)</sup></b>	<b>3.6 mgd<sup>(2)</sup></b>
<b>P Load</b>	<b>116 lbs/day<sup>(1)</sup> (42,300 lbs/yr)</b>	<b>9 lbs/day<sup>(2)</sup> (3,300 lbs/yr)</b>

**(1) 2006-2010 average**

**(2) 2011**

# Where do we need to be? (Potential Limits-Badfish Creek)

- Rock River TMDL as driver
- TP limit at current flow
  - 0.15 mg/l
  - 18,000 to 24,000 lb/yr TP reduction
- TP limit at design flow
  - 0.13 mg/l
  - 23,000 to 30,000 lbs/yr TP reduction



# Phosphorus Compliance Strategies

- Advanced treatment (filtration)
- Adaptive management
- Water quality trading
- Combination



# Compliance by Plant Upgrade (CH2MHill Study)

- 9 different nutrient scenarios
- TP only
  - 3 target TP limits
  - 0.075, 0.13, and 0.225 mg/l
- TP and TN
  - Same range of target TP limits
  - 3 and 10 mg/l TN limits
- Substantial completion-late 2011
- All phosphorus targets will require filtration



# Compliance by Trading (Ag BMPs)

- 20 Year PW preliminary cost estimates
- Input from Dane County and UW-Madison experts
  - PI modeling
  - Practices, unit costs, etc.
- Draft statewide trading framework
- Conservative assumptions-costs likely biased high





# Preliminary Cost Estimate (Agricultural BMPs)

<b>Practice</b>	<b>Total Cost<sup>(1)</sup> (million \$)</b>	<b>Unit Cost (\$ per lb of TP)</b>
Crop rotation	\$34	\$59
No-till	\$25	\$43
Perennial Grass	\$48	\$80
<b>Blended</b>	<b>\$35</b>	<b>\$61</b>

(1) 20 Year PW cost at design flow

# What about urban BMPs?

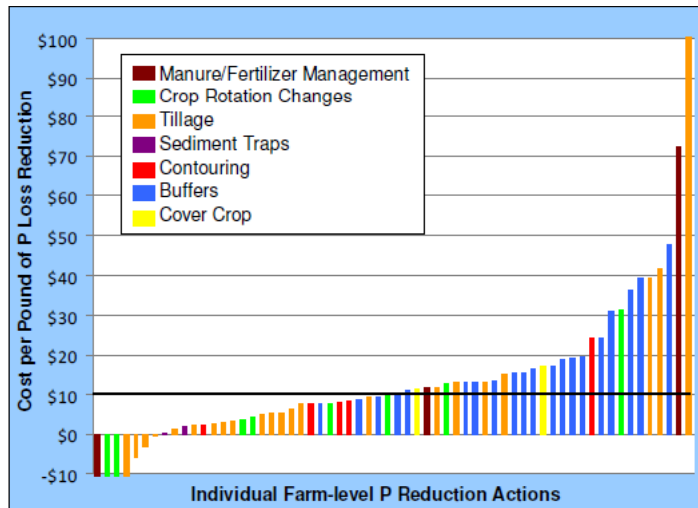
## Urban Water Quality Grant Summary (2005-2009)

Practice	\$/lb TP	Ib/yr TP
Nesbitt Road Sediment Basin	\$34	46.0
Farwell Street Sediment Basin	\$94	50.6
Lake Edge Sediment Basin	\$96	36.5
Commerce Park 1 Sediment Basin	\$105	36.8
Sauk Point Estates Basin	\$188	27.3
Cherrywood Acres Basin	\$203	46.7
Lake Mendota Drive Raingarden	\$269	2.2
Eton Ridge Raingarden	\$270	9.1
Schlapbach Creek Regional Basin	\$369	53.2
Inlet Filter Installation	\$373	1.1
Westwynde Outlot 1 Basin Retrofit	\$476	10.8
Dunn's Marsh Sediment Basin	\$707	14.1

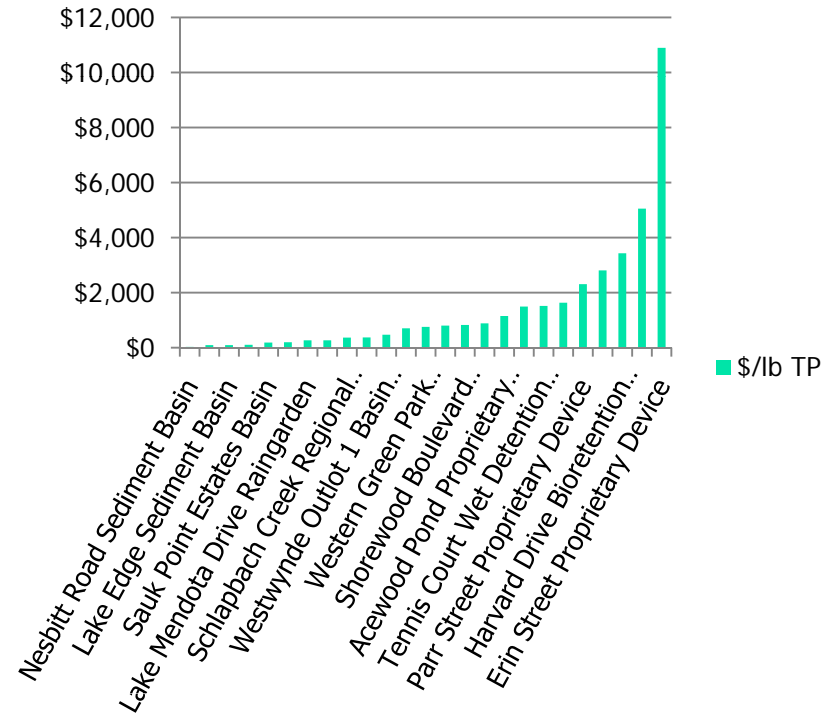
Practice	\$/lb TP	Ib/yr TP
Western Green Park Bioretention Basins	\$759	9.7
Commerce Park 2 Sediment Basin	\$807	6.4
Shorewood Boulevard Bioretention Basin	\$830	1.1
Marsh/Siggelkow Sediment Basin	\$886	6.2
Acewood Pond Proprietary Device	\$1,153	1.7
Circle Close Bioretention Basin	\$1,494	0.4
Tennis Court Wet Detention Basin	\$1,517	11.3
Pheasant Branch Sediment Basin	\$1,639	0.6
Parr Street Proprietary Device	\$2,308	1.3
Topping Road Bioretention Basin	\$2,811	0.3
Harvard Drive Bioretention Basin	\$3,434	0.3
Bioretention Basin - Kipp Corp.	\$5,055	0.3
Erin Street Proprietary Device	\$10,897	0.3

# Wide Range of Unit Costs for both Ag and Urban Management Practices

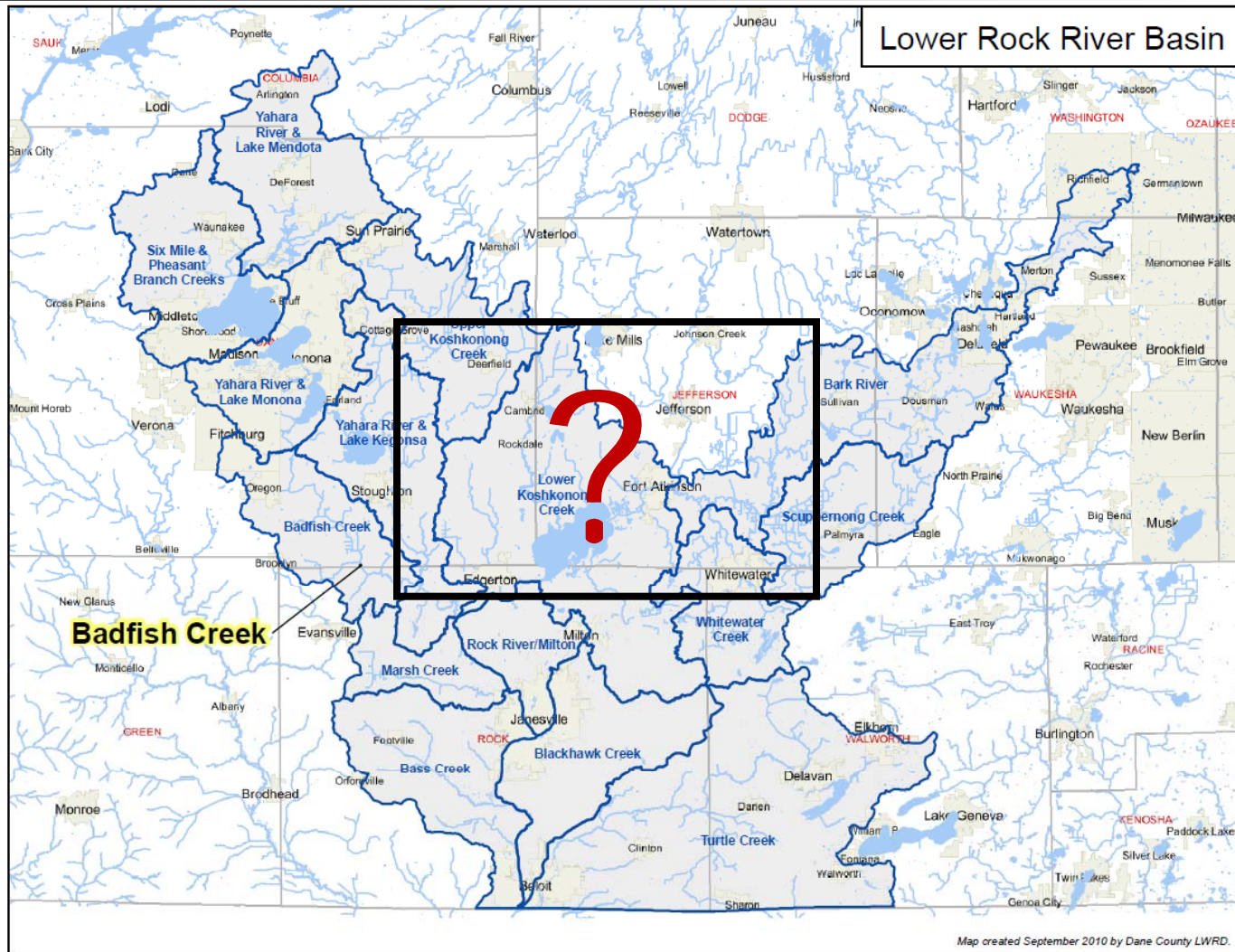
Iowa ag BMP Pilot Project



Urban Water Quality Grant Practices



# Compliance by Adaptive Management





# Adaptive Management-Opportunities

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- Potentially lower cost
- Watershed based approach
- \$\$ to target nonpoint solutions
- WQ improvement in Yahara lakes and upper part of watershed-i.e. MMSD service area
- Improved recreational benefits in Yahara lakes

- Control of other pollutants that are attached to soil or associated with runoff
- Lower carbon footprint-energy and chemicals
- Implementation flexibility
- May pave the way for acceptance of future innovative WQ initiatives



# Adaptive Management-Challenges

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- **New regulatory concept**
- **Building the framework “on the fly”**
- **Many regulatory, administrative and technical issues that need to be resolved**
- **Watershed approach-coordination with multiple partners**
- **Risk and risk management-innovation requires a willingness to take risks**



# Adaptive Management Pilot/Demonstration Project

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## Why here (Yahara Watershed) and why now?

- EPA, DNR and others are interested in gaining experience
- Experience gained can be used to “fine tune” future efforts
- Limited number of point sources in Yahara watershed
- A history of collaboration
- Data rich environment (Rock River TMDL, Yahara Clean)
- District is nimble, proactive, and viewed as a leader



# Adaptive Management Plan (Outline)

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- NR 217 conditions
- Formation of advisory group
- Evaluation of significant TP sources
- Identification of partners
- Load reductions & management practices
- Monitoring
- Goals & milestones
- Communication
- Financial capacity
- Reporting



# Baseline TP Loads-Rock River TMDL

**Table 1: Mean and Median Baseline TP Loads (lbs/year) for Reaches in the Yahara Watershed With Point Sources at Design Flow and an Effluent TP Concentration of 1.0 mg/l**

Source	Mean Load <sup>(1)</sup>	% of Total	Median Load <sup>(1)</sup>	% of Total
NPS	189,100	45.9	131,600	37.5
Background	9,000	2.2	7,500	2.1
MS4	49,600	12.0	47,400	13.5
PS	164,300	39.9	164,300	46.8
<b>Total</b>	<b>412,000</b>	<b>100.0</b>	<b>350,800</b>	<b>100.0</b>

<sup>(1)</sup>NPS load includes nonpoint urban load

Lbs are rounded



# Point Sources-Adjusted Baseline

**Table 5: Point Sources and Corresponding Baseline TP Loads in the Yahara Watershed**

Facility	Reach	TP Load Estimated (lbs/yr) <sup>a</sup>	% of Total Load	TP Load Adjusted <sup>(b)</sup> (lbs/yr)	% of Total Load <sup>(b)</sup>
Madison MSD	69	151,800	92.4	36,600	83.2
Oregon WWTP	69	5,500	3.3	3,100	6.9
Stoughton WWTP	68	5,000	3.1	2,300	5.3
Middleton-Tiedeman Pond	64	1,200	0.7	1,200	2.6
Arlington WWTP	64	360	0.2	360	0.8
Madison Gas and Electric	64	200	0.1	200	0.5
DNR-Nevin Fish Hatchery	65	320	0.2	320	0.7

<sup>(a)</sup> TP loads in Table 1, Figures 1-2, and Table 5 may not match due to rounding

<sup>(b)</sup> Adjustments based on available data on actual flows and effluent TP concentrations  
Lbs are rounded



# TMDL Reductions-All Sources

**Table 8: Minimum TP Load Reduction Needed To Comply With the Rock River TMDL**

Source	Annual TP Load <sup>(1)</sup>	Annual TP Allocation	Annual TP Reduction
<b>NPS</b>	131,600	26,000	105,600
<b>Background</b>	9,000	2,600	6,400
<b>MS4</b>	49,600	27,000	22,600
<b>PS<sup>(2)</sup></b>	43,900	25,300	18,600
<b>Total</b>	234,100	80,900	153,200

<sup>(1)</sup>Annual TP loads based on mean values for all sources except NPS, which is based on median value

<sup>(2)</sup>PS loads for Madison, Oregon and Stoughton adjusted based on actual flow and TP conc.  
All other point sources set at baseline loads  
Lbs are rounded

**Note: NPS baseline and totals will require adjustment based on more recent modeling conducted as part of the Yahara Clean Project and other factors**



# TMDL Reductions-Point Sources

**Table 9: Minimum Phosphorus Reduction Requirements for Point Sources with Discharges in the Yahara Watershed Needed to Comply With the Draft Rock River TMDL**

Facility	Baseline TP Load Adjusted <sup>(1)</sup> (lbs/yr)	TMDL Allocation	TP Reduction (lbs/yr)
Madison MSD	36,600	21,400	15,200
Oregon WWTP	3,000	800	2,200
Stoughton WWTP	2,300	1,700	600
Middleton-Tiedeman Pond	1,200	700	500
Arlington WWTP	400	300	100
Madison Gas and Electric	200	200	-----
DNR-Nevin Fish Hatchery	300	200	100
<b>Total</b>	<b>44,000</b>	<b>25,300</b>	<b>18,700</b>

<sup>(1)</sup>PS loads for Madison, Oregon and Stoughton adjusted based on actual flow and TP conc.  
 All other point sources set at baseline loads  
 Lbs are rounded

**Table 10: Minimum Phosphorus Reduction Requirements for MS4s with Discharges in the Yahara Watershed Needed to Comply With the Draft Rock River TMDL**

MS4	Baseline TP Load (lbs/yr)	TMDL Allocation	TP Reduction (lbs/yr)
Blooming Grove, Town	739	279	460
Bristol, Town	581	168	412
Burke, Town	1,612	474	1,139
Cottage Grove, Town	1,063	427	635
Cottage Grove, Village	401	161	240
DeForest, Village	1,178	341	837
Dunkirk, Town	938	1,496	(558)
Dunn, Town	1,140	506	633
Fitchburg, City	2,979	838	2,141
<b>Madison, City</b>	<b>22,969</b>	<b>6,702</b>	<b>16,267</b>
Madison, Town	812	231	580
Maple Bluff, Village	255	74	181
McFarland, Village	1,231	495	736
Middleton, City	2,846	477	2,370
Middleton, Town	546	68	475
Monona, City	1,283	421	862
Pleasant Springs, Town	1,286	3,861	(2,575)
Shorewood Hills, Village	311	90	221
Stoughton, City	1,569	7,981	(6,412)
Sun Prairie, City	893	259	634
Waunakee, Village	1,583	493	1,091
Westport, Town	1,486	546	939
Windsor, Town	1,902	551	1,351
Totals	49,599	26,940	22,660



# A Jumpstart on NPS Control Practices

Ostara-\$7.5 million dollar struvite harvesting project

## Yahara Watershed TP Loads from Metrogro Program

Year	Acres	Actual TP (lbs)	TP (lbs) Adjusted with Ostara*	TP (lbs) Reduced
2008	2,304	410,000	246,000	164,000
2009	2,322	335,000	201,000	134,000
2010	2,388	343,000	206,000	137,000
<b>Average</b>	2,338	363,000	218,000	145,000

\*Based on a 40% reduction

# Key Regulatory Considerations

- TMDL based limit in WPDES permit
- Badfish Creek
- 20 year timeframe
  - Legacy phosphorus
  - Rate stabilization
  - Standard for facilities planning
- Metrics for success-how compliance is determined



# Annual Transfers Included in Service Charge Rates and Annual Requirements of Debt Service Fund

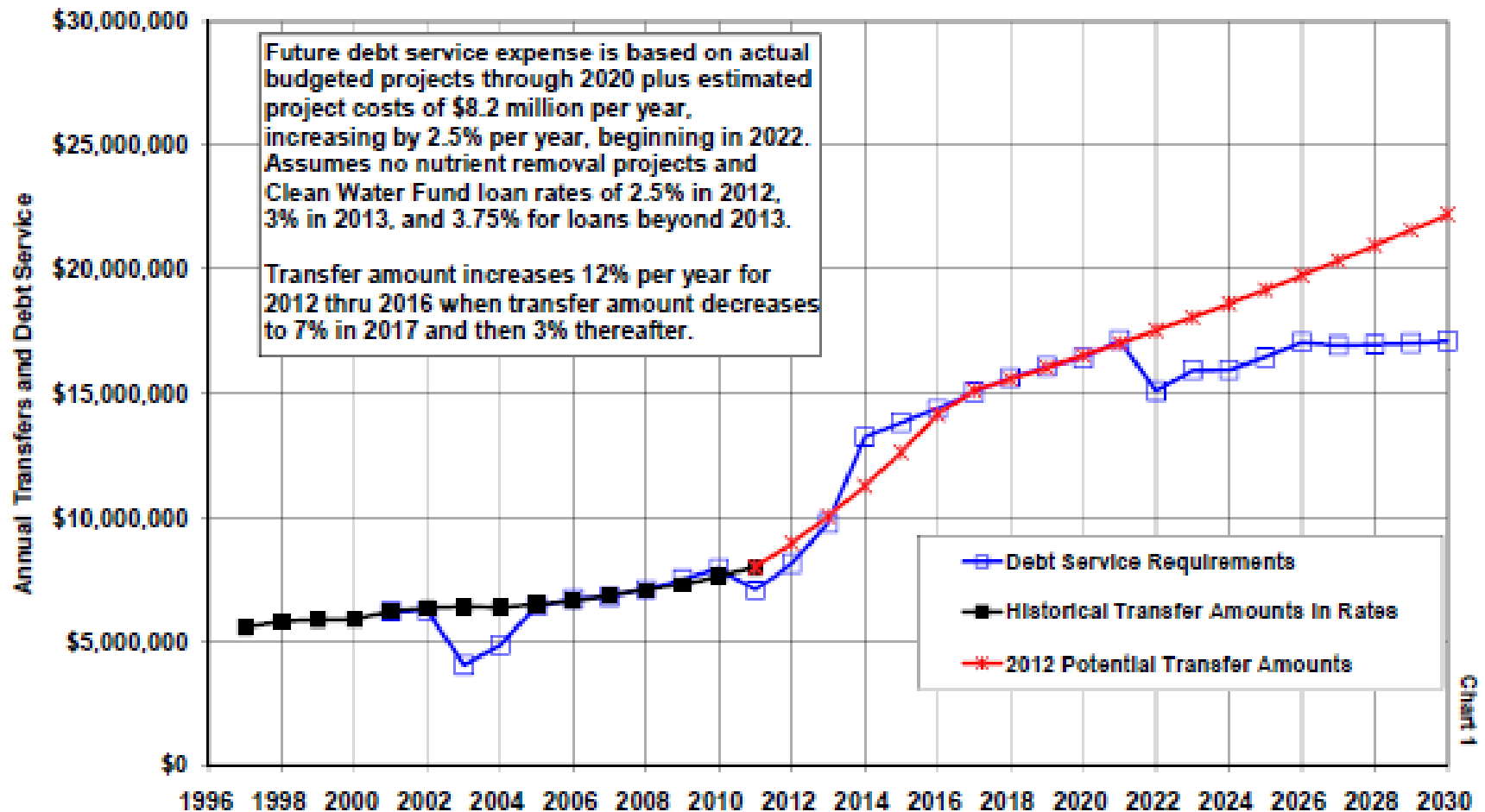


Chart 1

# Debt Service Requirements plus Trading

Scenario includes phosphorous trading and nitrogen removal facilities

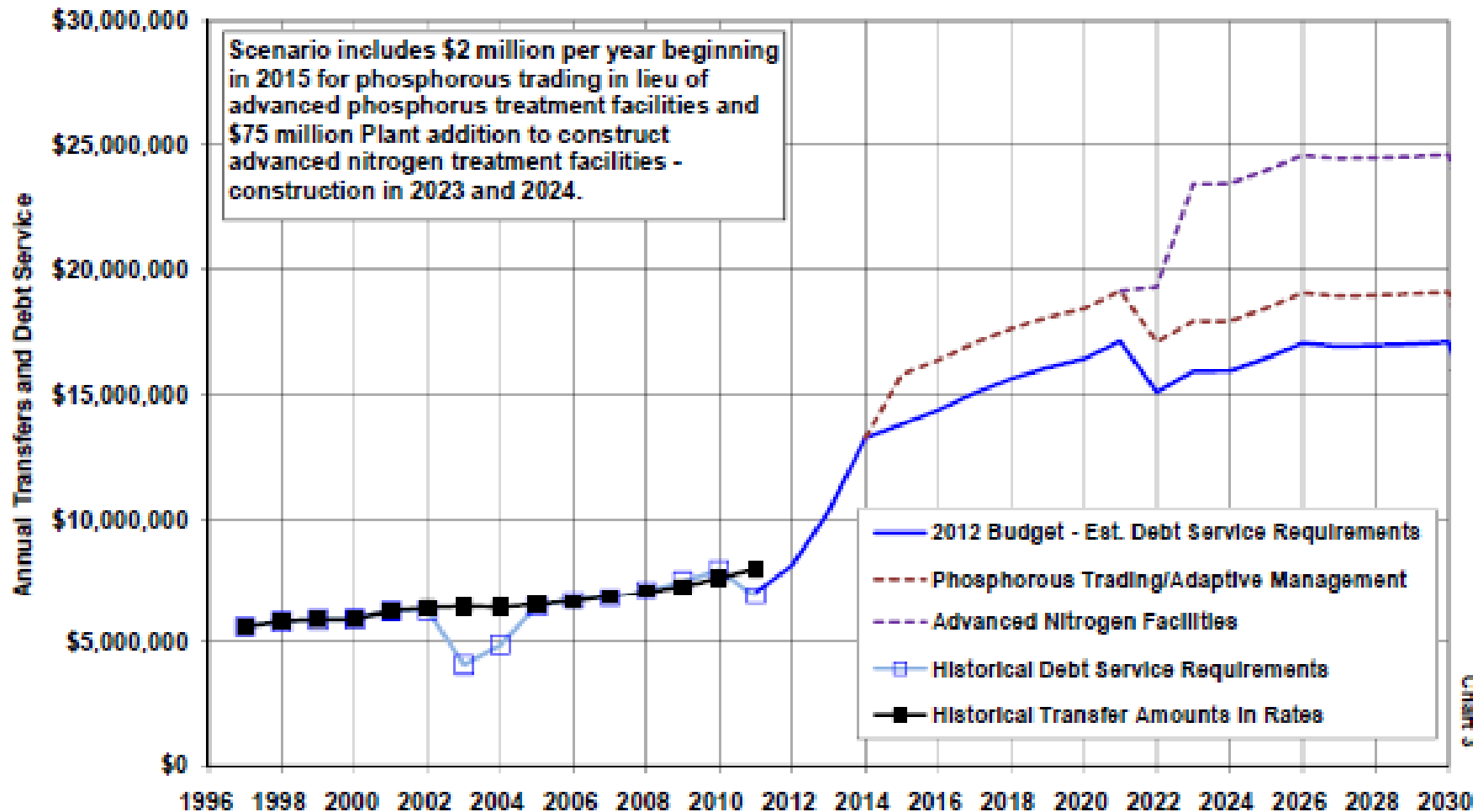


Chart 3

# Debt Service Requirements

Scenario includes nutrient removal facilities for phosphorus and nitrogen

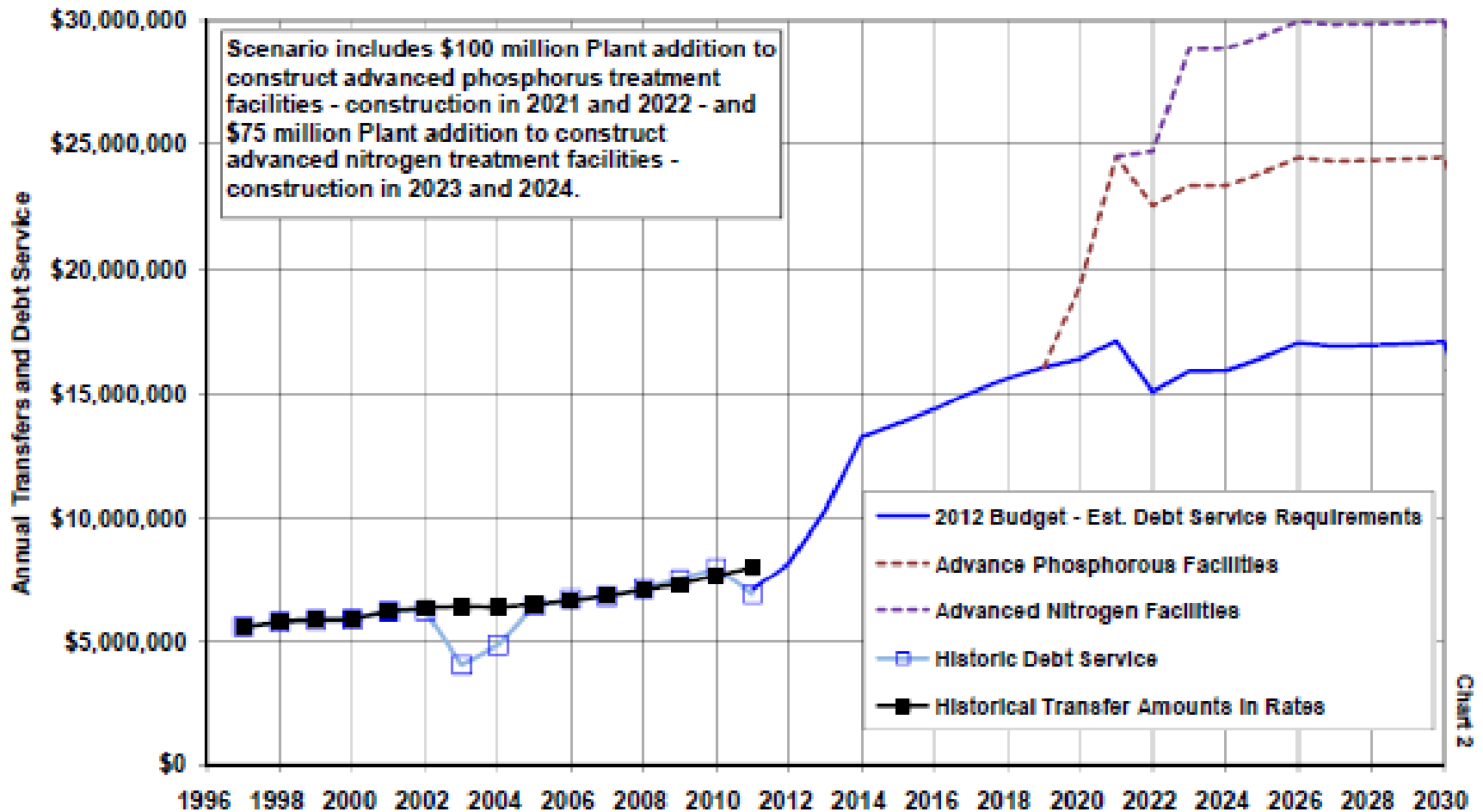


Chart 2

# Option evaluation-where are we now?

- Conducting parallel cost estimates
- Reviewing data
- Building partnerships
- Achieving alignment on approach and metrics
- Reaching agreement on how to address key regulatory issues





# How and When Do We Decide?

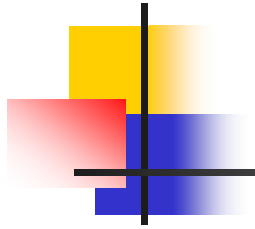
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## How

- Cost
- Achievability
- Risk mitigation/minimization
- Sustainability considerations
- Net environmental benefit

## When

Goal **→** Preliminary recommendation to commission by  
early to mid 2012



# Areas of agreement

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