Adaptive Management Planning for the City of Lodi

IOWA WATER CONFERENCE
MARCH 2016
Overview

- Background: City of Lodi and WWTF
- Phosphorus Compliance Options
- Preparation of Adaptive Management Plan
  - Identifying partners
  - Set load reduction goals
  - Conducting a watershed inventory
  - Determining Critical Source Areas for targeting phosphorus reductions
  - Estimating load reductions based on permit terms
  - Monitoring strategy
  - Financial strategy
  - Implementation schedule
- Q&A/Discussion

Proposed Completion April 2016

All data presented today is subject to change.
Background: City of Lodi and WWTF
Background

» City of Lodi
  • Population 3,050

» Located in a glaciated valley
» Predominately agricultural region
» Ice Age National Scenic Trail nearby
» Lodi Marsh upstream of the City
» Spring Creek flows north, passing through the City
Background

» Lodi’s WWTF
  • Treats 310,000 gal/day
  • Design Flow of 546,000 gal/day
  • Currently meeting 1 mg/L phosphorus limit

» Lodi’s WPDES Permit
  • Reissued 01/01/2012
  • Identifies 2020 phosphorus limit as:
    ▪ 0.075 mg/L – annual average
    ▪ 0.22 mg/L – monthly average
Background

LODI’S WPDES PERMIT PHOSPHORUS LIMITS

Current: 1 mg/L P
Future: 0.075 mg/L P

Compliance Options

• Upgrades at the wastewater treatment facility
• Adaptive Management
• Water Quality Trading
Phosphorus Compliance Options
Phosphorus Compliance Options

» WWTF treatment upgrades
  • “Point Source Reduction”
  • Microsand-ballasted clarification
  • Capital cost for upgrade: $3.54 million
  • Compliance by 2020

» Watershed improvements
  • “Non-Point Source Reduction”
  • Adaptive Management or
  • Water Quality Trading
Phosphorus Compliance Options

» Adaptive Management (AM)
  • Compliance by 2037
  • Focus on *stream* compliance
  • Eligibility requirements must be met

» Water Quality Trading (WQT)
  • Compliance by 2020
  • Focus is on offsetting WWTF’s mass of TP
  • “Credits” and “Trade Ratios”
  • No eligibility restrictions
Phosphorus Compliance Options

Adaptive Management (AM) selected

| Projected Preliminary Costs for WWTF Upgrades and Adaptive Management |
|----------------------------------------------------------|--------------------|
|                                                          | WWTF Upgrade      | Adaptive Management |
| Capital Cost                                            | $3.54 M           | $2.0 M              |
| Annual O&M                                              | $72,600           | $41,200             |
| 20-year Present Value                                   | $4.37 M           | $2.53 M             |

*Adaptive Management has a series of ‘rules and regulations’ that need to be followed. They are nuanced, and will not be discussed at length in this presentation.*
Phosphorus Compliance Options

Adaptive Management (AM) selected

- WWTF is currently 10-15% of annual phosphorus load
- WWTF discharge limit: 0.5 mg/L
- Focus is on stream compliance by 2037 (20 years)
  - Spring Creek very close to limit (2011, 2012, 2015 data)
    - Currently 0.078 mg/L
    - Target of 0.075 mg/L
- P reductions needed
  - ~715 lbs/year @ projected effluent flow in 2035 and final AM term limit
  - ~920 lbs/year @ design flow and final AM term limit
Preparation of Adaptive Management Plan
Preparation of Adaptive Management Plan

Nine Key Element Plan

- Identifying partners
- Set load reduction goals
- Conducting a watershed inventory
- Determining Critical Source Areas for targeting phosphorus reductions
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Preparation of Adaptive Management Plan

Identifying Partners

• Columbia County
• University of Wisconsin - Stevens Point
• Friends of the Scenic Lodi Valley

› Already active in the watershed!
› 2011-2012 Collaborative Sampling Effort
› Phosphorus concentrations pivotal to Adaptive Management

› Coordinate with Columbia County to engage with land owners and prioritize projects
Preparation of Adaptive Management Plan

Boxplot of TP (May 1st - October 31st)
Preparation of Adaptive Management Plan

Boxplot of TP (May 1st - October 31st)
Preparation of Adaptive Management Plan

Nine Key Element Plan

- Identifying partners
- **Set load reduction goals**
- Conducting a watershed inventory
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- **Monitoring strategy**
- Financial strategy
- Implementation schedule
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Set load reduction goals

\[ P \text{ Load Reduction Goal} = P \text{ Load in Stream} + \text{WWTF P Load} - \text{Allowable P Load} \]

- Bi-weekly grab sampling upstream and downstream of the WWTF
- Determine stream flow
- AM rules dictate that P load is based on grab samples, usually baseflow conditions
- However, storm events can be a significant portion of total P Load

- Set permit reduction goal using baseflow grab samples
  - *Conservatively* set ‘internal’ target higher, using baseflow and storm event samples
Preparation of Adaptive Management Plan

Set load reduction goals & monitoring strategy

» Grab Samples taken bi-weekly, Friday 8am

» Two ISCO automated samplers installed May 2015
  • Downstream of WWTF outfall
  • Outlet of Lodi Marsh
    › Fate & transport through the marsh unknown
Preparation of Adaptive Management Plan

Set load reduction goals & monitoring strategy

» Bi-weekly grab samples continue indefinitely
» Automated samplers captured:
  » 11 storms at WWTF
  » 5 storms at the Marsh
  » Interesting diurnal water depth
Preparation of Adaptive Management Plan

Set load reduction goals & monitoring strategy

Phosphorus load reduction goal: ~715 lbs/year at projected 2035 effluent flow of 0.38 MGD and final AM term effluent limit of 0.5 mg/L
Preparation of Adaptive Management Plan

Nine Key Element Plan

- Identifying partners
- Set load reduction goals
- **Conducting a watershed inventory**
- Determining Critical Source Areas for targeting phosphorus reductions
- Estimating load reductions based on permit terms
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Preparation of Adaptive Management Plan

Conducting a watershed inventory

» Gathering all available information about the watershed
  • Historical sampling data
  • Soils
  • Land Use
  • Crop rotations
  • Future urban growth areas
  • Lots of maps!
Preparation of Adaptive Management Plan

Nine Key Element Plan

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Critical Source Areas

» Urban
  • WinSLAMM modeling
  • Improving efficiency of existing ponds
  • Identifying new potential ponds

» Agricultural, Hard Practices
  • Barnyard Analysis
  • Columbia County assessed all of the barnyards in the watershed
  • Economic assessment for best projects

» Agricultural, Soft Practices
  • Identify fields where erosion is most likely to occur using EVAAL
  • Prioritize based on relatively index
Urban Critical Source Areas

- Reviewed 4 existing stormwater BMPs
  - One retrofit option identified (EX3)

- Reviewed urban lands for possible new BMPs
  - Within 300 ft of existing storm sewers (30”+ diameter)
  - City-owned lands or those with lower assessed value
  - Five locations identified for new ponds (PR1-PR5)
Urban Practices

- Average urban structural practices cost approx. $400/lb/yr
- Several proposed BMPs are in park lands, and likely not acceptable to the public
- Therefore, urban CSAs likely not to be implemented as part of the project

<table>
<thead>
<tr>
<th>BMP</th>
<th>Drainage Area (ac)</th>
<th>TP Load (lbs/yr)</th>
<th>BMP Efficiency (%)</th>
<th>TP Trapped (lbs/yr)</th>
<th>Total Construction Cost ($/lb/yr)</th>
<th>TP Capture Present Worth²</th>
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</thead>
<tbody>
<tr>
<td>EX3</td>
<td>47.3</td>
<td>4.9¹</td>
<td>4.9¹</td>
<td>20,000</td>
<td>$311</td>
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<tr>
<td>PR1</td>
<td>17.5</td>
<td>14.4</td>
<td>54.6</td>
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<td>PR2</td>
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<td>45.5</td>
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<td>PR3</td>
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<td>10.5</td>
<td>34.6</td>
<td>3.6</td>
<td>$92,725</td>
<td>$754</td>
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<td>PR4</td>
<td>24.1</td>
<td>22.2</td>
<td>50.3</td>
<td>11.2</td>
<td>$132,200</td>
<td>$358</td>
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<tr>
<td>PR5</td>
<td>78.9</td>
<td>48.6</td>
<td>24.7</td>
<td>12.0</td>
<td>$102,600</td>
<td>$258</td>
</tr>
</tbody>
</table>

1. Net additional TP trapped following modifications to the existing pond outlet structure.
2. Assumes that annual maintenance represents 2% of initial construction cost (maintenance costs for pond EX3 assumed to be equal to the average of all other proposed ponds); that the maintenance life span is 20 years, and that the applied inflation rate is 4.625%.
Preparation of Adaptive Management Plan

Critical Source Areas

» **Urban**
  - WinSLAMM modeling
  - Improving efficiency of existing ponds
  - Identifying new potential ponds

» **Agricultural, Hard Practices**
  - Barnyard Analysis
  - Columbia County assessed all of the barnyards in the watershed
  - Economic assessment for best projects

» **Agricultural, Soft Practices**
  - Identify fields where erosion is most likely to occur using EVAAL
  - Prioritize based on relatively index
Agricultural Hard Practice Priority Areas

Building Upon Columbia County Land & Water Conservation District’s 2014 Livestock Inventories

Columbia County’s Inventory – Original 31 Sites
Agricultural Hard Practice Priority Areas

Building Upon Columbia County Land & Water Conservation District’s 2014 Livestock Inventories

Establishment of Top 20 Priority Sites

Load Reduction = 1170 lb/yr
Agricultural Hard Practice Priority Areas

Building Upon Columbia County Land & Water Conservation District’s 2014 Livestock Inventories

Refinement – Top 7 Priority Sites

- Load Reduction = 860 lb/yr
- Construction Cost = $435,000 - $545,000
- Construction Cost/lb* = $25 - $32

*construction costs by CCLWCD; 20-yr life
Preparation of Adaptive Management Plan

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Agricultural Soft Practice
Priority Areas

Wisconsin DNR EVAAL:
Erosion Vulnerability Assessment for Agricultural Lands

- Based on Universal Soil Loss Equation and Stream Power index
- Removes internally drained areas
- Uses publically available data
- Creates an index specific for the watershed

http://dnr.wi.gov/topic/nonpoint/evaal.html
Agricultural Soft Practice
Priority Areas

Wisconsin DNR EVAAL:
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http://dnr.wi.gov/topic/nonpoint/evaal.html
Agricultural Soft Practice Priority Areas

Windshield Survey

- General idea of existing management practices
- Identify possible BMPs for each field
Combined Hard & Soft Practice Priority Areas

- Landowners where both hard and soft practices may be feasible
- Reduce number of landowner agreements
- Reach P-reduction goals more efficiently
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Estimating Load Reductions

» SnapPlus (Soil Nutrient Application Planner) modeling on two farms
  • Determine site specific P-load reductions at these locations
  • Apply estimated reductions across all CSAs

» STEPL (Spreadsheet Tool for Estimating Pollutant Loads)
  • Estimates P load-reduction potential for soft practices (lbs/acre)
  • Model a set of BMPs individually and in series
  • Average ALL possible BMPs, to estimate a more realistic prediction for P-load reductions
Preparation of Adaptive Management Plan

Using SnapPlus & STEPL

» Estimate P-load reduction from each CSA
» Apply cost estimates for each practice (both hard and soft practices)

» Coordinating CSA implementation with Columbia County
## Preparation of Adaptive Management Plan

<table>
<thead>
<tr>
<th>Critical Source Area</th>
<th>Selection Criteria</th>
<th>Applicable BMPs for Crop Fields</th>
<th>Applicable BMPs for Barnyard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EVAAL</td>
<td>Nutrient Management (if needed), Contour Farming, Contour Buffer Strips, Filter Strips, Continued Use of Cover Crops</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>EVAAL</td>
<td>Nutrient Management (if needed), Grassed Waterways, Contour Farming, Contour Buffer Strips, Filter Strips, Cover Crops</td>
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<tr>
<td>3</td>
<td>EVAAL</td>
<td>Nutrient Management (if needed), Grassed Waterways, Contour Farming, Contour Buffer Strips, Filter Strips, Cover Crops, Grade Stabilization Structure</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Barnyard Analysis</td>
<td></td>
<td>Heavy Use Area Protection, Buffer, Natural Buffer</td>
</tr>
<tr>
<td>5</td>
<td>EVAAL and Barnyard Analysis</td>
<td>Nutrient Management Planning (if needed), Reduced Tillage/Reduced Fall Tillage, Contour Farming, Contour Strips, Contour Buffer Strips, Filter Strips, Cover Crops</td>
<td>Diversions, Roof Gutters</td>
</tr>
<tr>
<td>6</td>
<td>EVAAL</td>
<td>Nutrient Management (if needed), Reduced Tillage/Reduced Fall Tillage, Contour Farming, Contour Strips, Contour Buffer Strips, Filter Strips, Cover Crops</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Barnyard Analysis</td>
<td></td>
<td>Roof Gutters, Livestock Exclusion, Heavy Use Area Protection, Sediment Basin, Buffers</td>
</tr>
</tbody>
</table>
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Ongoing as of February 2015
A/M Plan Recommendations

> Focus on three (3) barnyard CSAs - ~670 lbs/year reduction (~ $50/lb)
> Focus on five (5) soft practice CSAs - ~ 340 lbs/year reduction at 50% participation (~ $60/lb)
> Urban practices – New Urban Practices are most costly (~ $400/lb)
> Total reduction goal of ~ 1,010 lb/yr by the end of the first 5-yr permit term
> This load reduction exceeds the official AM reduction goal of 715 lbs/yr

Expenditures Total Annual Expenditure of ~ $155,000 / year for the first 5-year permit term
Adaptive Management Planning for the City of Lodi

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