

Wastewater Plan as Developed at Technical Workshop No. 5

January 31, 2006

Willmar, Minnesota



Purpose

- **Provide Information Necessary for City to Start “Decision Making Process”**
 - Proceed with Original Concept as Developed Today
 - Revise Original Concept as Developed Today
 - > Minor Revisions
 - > Major Revisions
 - Revisit Concept Development

The Program - “Wastewater Treatment Plant Relocation Master Plan”

- **The Original Concept for This Project**

- Construct WWTF at Biosolids Storage Site
 - > Wastewater Treatment Facilities Plan, November 2000

“...Program Management to oversee the relocation plan for the City of Willmar’s Wastewater Treatment Plant. The Facility Plan recently adopted by the Willmar City Council recommends a new treatment facility and related interceptor sewers be in operation on or before 2010.”

- November 3, 2004 Request for SOQ

The Reasons

- **Odor**
- **Capacity / Growth**
- **Regulations**
- **Performance**
- **Age**

The Components

- **Conveyance**

- Pumping
- Piping

- **Treatment**

- Interim Period (2005 - 2010)
- Future Period (2010 – 2030)

The Expectation

- **Construction Cost = \$33.4M (\$Nov-00)**
 - WWTF = \$28.2M
 - Pump Station and Associated Pipeline = \$1.7M
 - Gravity Pipeline = \$3.5M
- **Construction Cost Index (CCI)**
 - Nov-00 = 6266 and Dec-05 = 7647
 - Inflation Multiplier = $7647/6266 = 1.22$
- **Construction Cost = \$40.7M (\$Dec-05)**
- **Project Cost = \$47M± (\$Dec-05)**

**No Nitrification –
No Ammonia Limit**

The Process

- **Data Gathering and Analysis**
- **Service Area**
- **Flows and Loadings**
- **Regulatory Landscape**

- **Alternatives Evaluation**

- Conveyance
- Treatment



A Plan for Consideration



WE ARE HERE

The Plan Today

The Components

- **Conveyance**

- Pumping
- Piping

- **Treatment**

- Interim Period (2005 - 2010)
- Future Period (2010 – 2030)

Service Area Delineation

- See Handout

Conveyance Alternatives

- See Handout

Conveyance Plan – Southern Interceptor (Cont'd)

- Accommodates in-line storage of peak flows.
- Route through undeveloped land, reducing surface restoration and traffic issues.
- No air relief vents, a source of odor.

Conveyance Plan – Southern Interceptor

- Provides for future potential to serve up to 1,600 acres of new development
- Elimination of Ortenblad lift station.
- Arby's lift station directly connected to interceptor.
- Arby's and Abbot lift station will not require future upgrades.

Conveyance Plan – Southern Interceptor (Cont'd)

- **36% of future wastewater flows directly to the new WWTF.**
- **Eliminates the need to upgrade sewers that are currently at or over capacity.**

Conveyance Plan

- See Handout

Treatment – Future Period

- Increase Treatment Capacity

Average Flow and Loadings	Current	Future
Flow	5.0	5.25
TBOD5	11,302	14,700
TSS	7,235	9600
TKN	-	2550
TP	-	570

Flow in *million gallons per day (mgd)*

TBOD5, TSS, TKN, and TP in *pounds per day (ppd)*

Treatment – Future Period

- New Plant Permit Limits More Stringent

Parameter	Current	New Plant
CBOD5	20	15
TSS	30	30
NH3-N	-	5 ← Cost Driver
TP	-	1 ← Cost Driver

Values in *milligrams per liter (mg/L)*

Treatment – Future Period

- Increase Treatment Capacity

“Robust” Design to Treat Above-Average Loadings

Maximum Month Flow and Loadings	Current	Future
Flow	5.0	7.5
TBOD5	11,302	21,400
TSS	7,235	15,900
TKN	-	4100
TP	-	650

Flow in *million gallons per day (mgd)*

TBOD5, TSS, TKN, and TP in *pounds per day (ppd)*

Treatment – Future Period

- **Increase Hydraulic Capacity**

- **Current**

- Peak Treatment = 8.6 mgd
- Peak Storage = 5.8 mgd
- Total Peak = $8.6 + 5.8 = 14.4$ mgd

- **Future**

- Peak Treatment = 27.4 mgd

Treatment – Future Period

- **Industrial Component**
- **High-Strength Wastewater**
 - Typical Municipal TBOD₅ = 190± mg/L
 - Willmar TBOD₅ = 310 mg/L

Treatment – Future Period

- **Can Calculate Typical Municipal Flows Required to Produce Willmar Loadings**
- **“Equivalent” Municipal Flows**
 - Average = $5.2 \text{ mgd} * (310 \text{ mg/L} / 190 \text{ mg/L}) = 8.5 \text{ mgd}$
 - Max Month = $7.5 \text{ mgd} * (310 \text{ mg/L} / 190 \text{ mg/L}) = 12.2 \text{ mgd}$
- **“Equivalent” Municipal Loading**
 - Max Month BOD = $21,426 \text{ pounds} / 0.23 \text{ pounds/person} = 93,156$
Population Equivalents

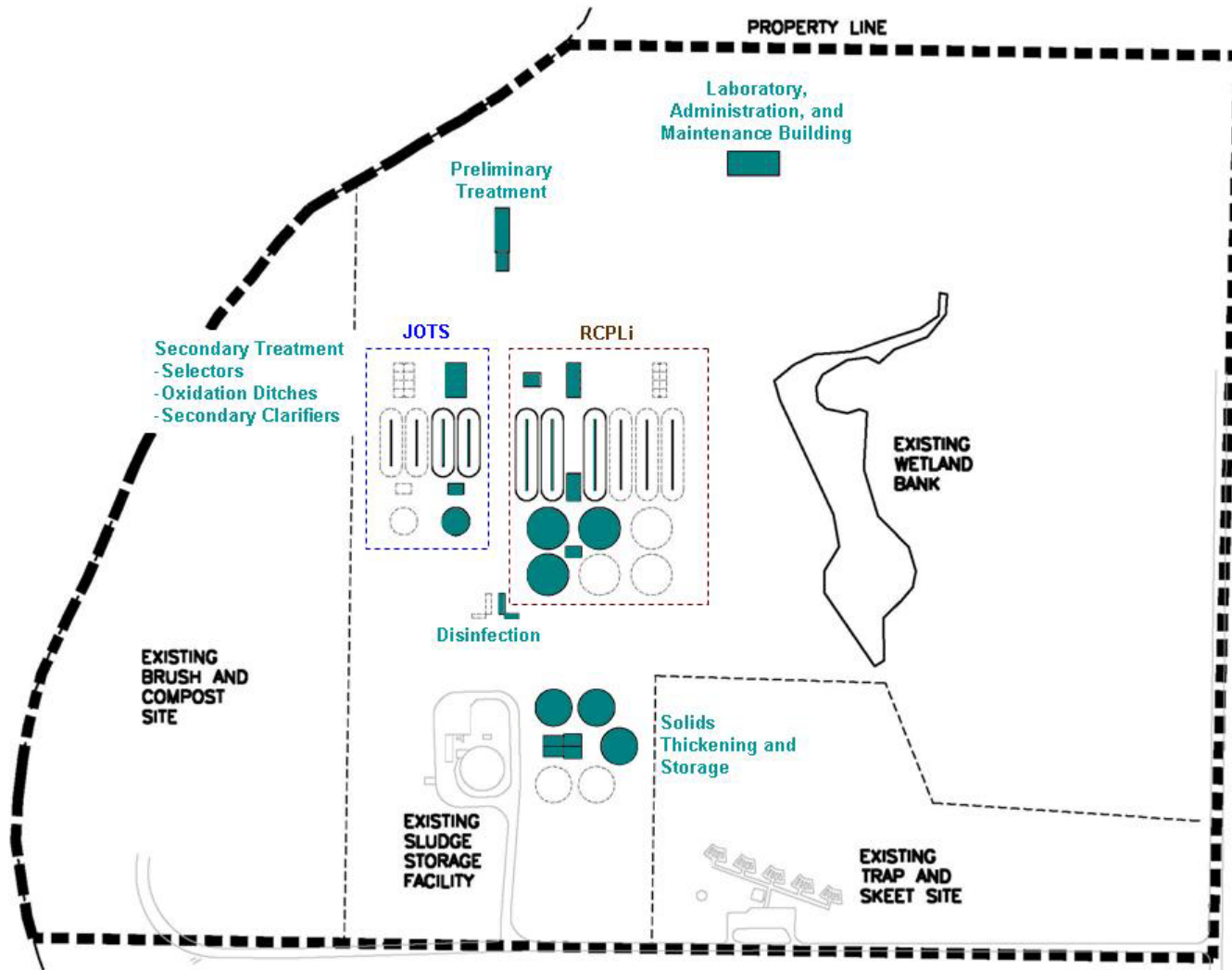
Treatment – Proposed WWTF

- **Separate Treatment “Trains”**
 - City
 - Food Processor
- **Simple**

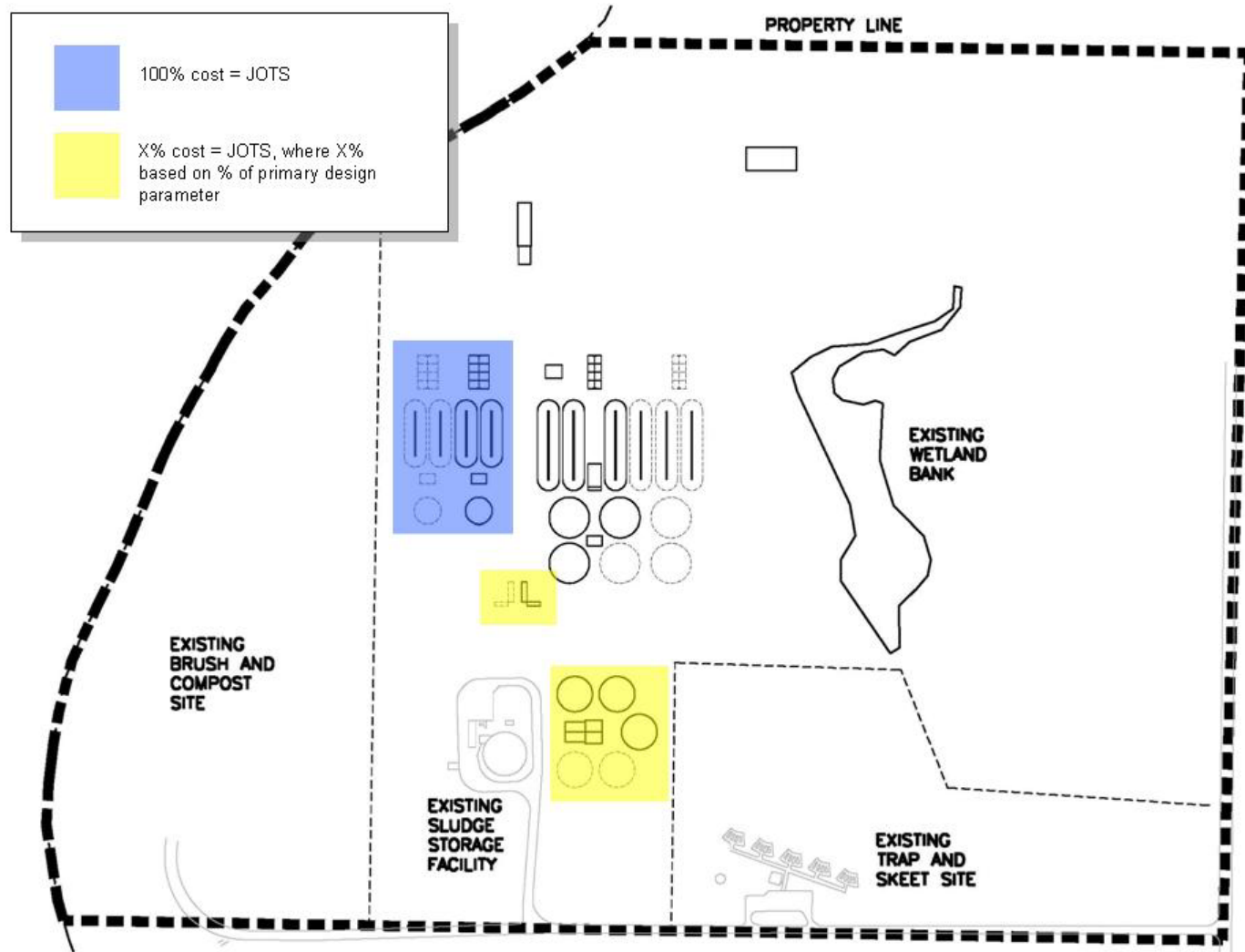
Treatment – Proposed WWTF

- **Simple**
- **Water**
 - Pump
 - Screen
 - React
 - Clarify
 - Disinfect + Aerate
- **Solids**
 - Thicken
 - Store

Treatment – Proposed WWTF



Treatment – Proposed WWTF



Treatment – Proposed WWTF

- Similar Operating Facility



Treatment – Proposed WWTF

- **“Heavy” Construction**

- **Concrete**

- 25,000+ cubic yards
- 3100 Concrete Trucks
- Concrete Truck Every 19 Minutes for 6 Months (8 hr/d, 5 d/wk)

- **Steel**

- 2600+ tons of steel
- Equivalent Weight of Approximately 1200 Ford F150 4x4s
- Four miles of Bumper-to-Bumper Ford F150s

Treatment – Proposed WWTF

- **“Big” Construction and Equipment**
- **Tank Volume**
 - 23 million gallons
 - 70 Acres 1-ft Deep
 - 140 Swimming Pools (25 yd)
 - 400 Basements
- **Horsepower**
 - 3000+ HP

Treatment – Proposed WWTF

- Construction = \$48.4M (\$Dec-05)
- Construction and Demolition = \$49.1 M (\$Dec-05)

Treatment – Proposed WWTF

- **Master Plan for Metropolitan North Georgia Water Planning District, 2003**
 - 4 Million People Year 2000, Project 8 Million People Year 2030
 - Cost Equations for “Greenfield” Wastewater Treatment Facilities Required to Nitrify and Remove Phosphorus
 - Estimates and Bids from Actual Projects
 - Construction = $\$0.80 * (7.7 + 9.6 * Q^{0.71})$ where $Q = \text{Max Mo}$
 - Construction = \$52M (12.2 mgd, \$2003)
 - Construction = \$59M (12.2 mgd, \$Dec-05)

Treatment – Proposed WWTF

- **Estimation of Costs of Phosphorus Removal In Wastewater Treatment Facilities: Construction *De Novo* (i.e., “Greenfield”), June 2004**
 - Developed Cost Curves for Multiple Types of New Treatment Facilities that Remove Phosphorus (No Nitrification Requirement)
 - Construction Costs Using EPA Cost Formulas
 - Construction = $\$8.91 * Q^{0.75}$ where $Q = \text{Ave ('05)}$
 - Construction = \$44M (8.5 mgd, \$Jun-04)
 - Construction = \$48M (8.5 mgd, \$Dec-05)

Treatment – Proposed WWTF

- **Greenfield Site that Nitrifies, Removes Phosphorus, and Uses Long-SRT Process for Sludge Compliance**

- Construction = \$17M (\$1997,8)

- > Average Day Flow = 4.6 mgd

- > No Disinfection

- > No Outfall Pipe

- Construction = \$44M (\$Dec-05)

- > Average Day Flow = 8.5 mgd

- > With Disinfection

- > With Outfall

- **Marshfield, WI**



Treatment – Proposed WWTF

- **Recent Similar Donohue “Greenfield” Project**
 - Evansville, IN
 - 10 mgd Ave / 30 mgd Peak
 - Liquid Treatment Only
 - Construction = \$40M (\$Dec-05)
 - Estimated Cost of Solids Processes = \$8M
 - Construction = \$40M + \$8M = \$48M (\$Dec-05)

Total Program Costs

Existing WWTF	3.1M
– Interim	
– Future Pump Station	
Collection System	18.2M
– City	
– JOTS	
New WWTF (Demo Existing)	49.1M
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Total Construction	70.4M
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Total Program Cost	80.5M*

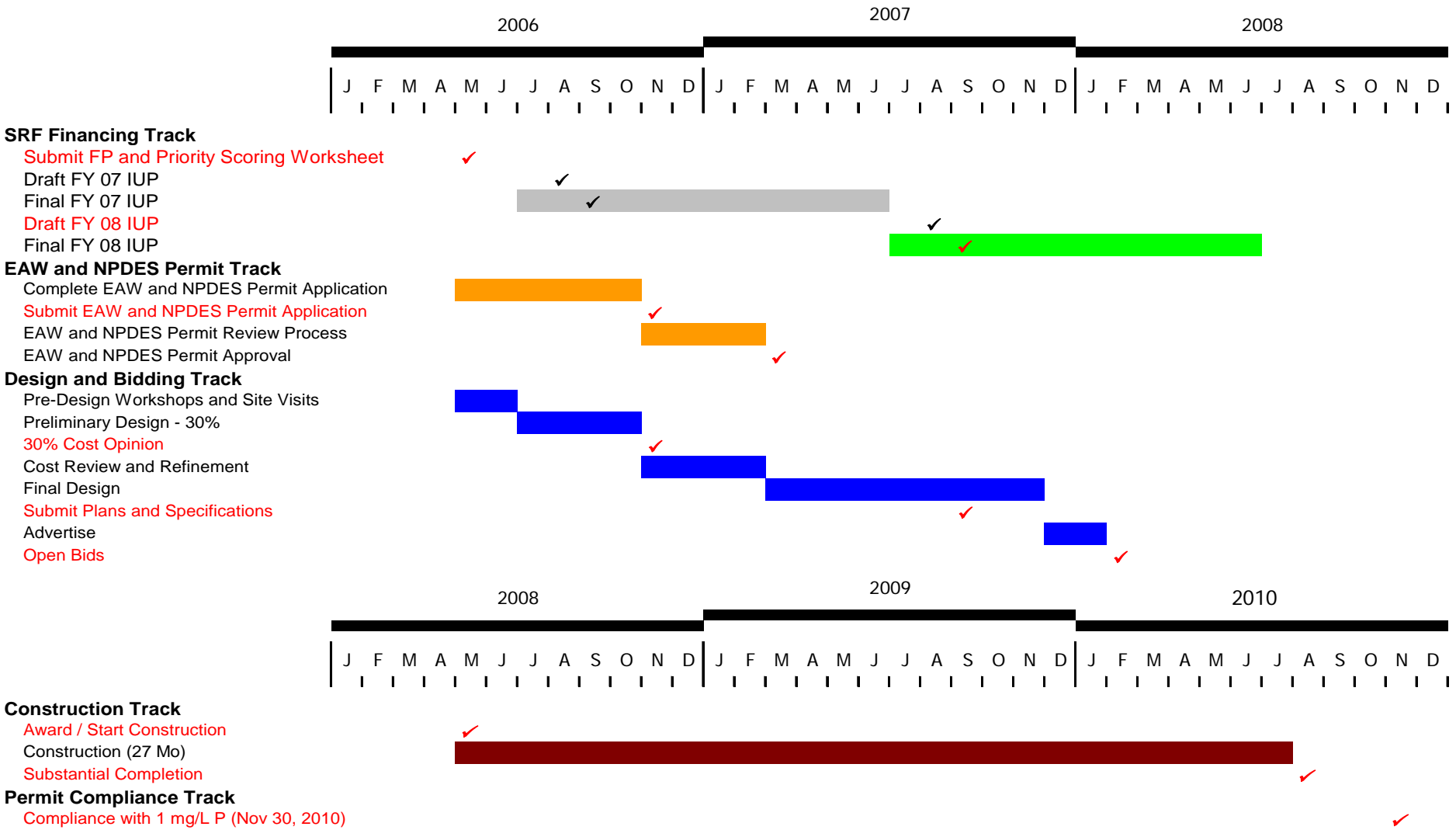
** Only includes collection system costs **DIRECTLY** related to the Program*

Schedule

- **Step 1 – Planning**
- **Step 2 – Design and Bidding**
- **Step 3 – Construction**

Proposed Critical Path Program Schedule

Wastewater Program Willmar, Minnesota



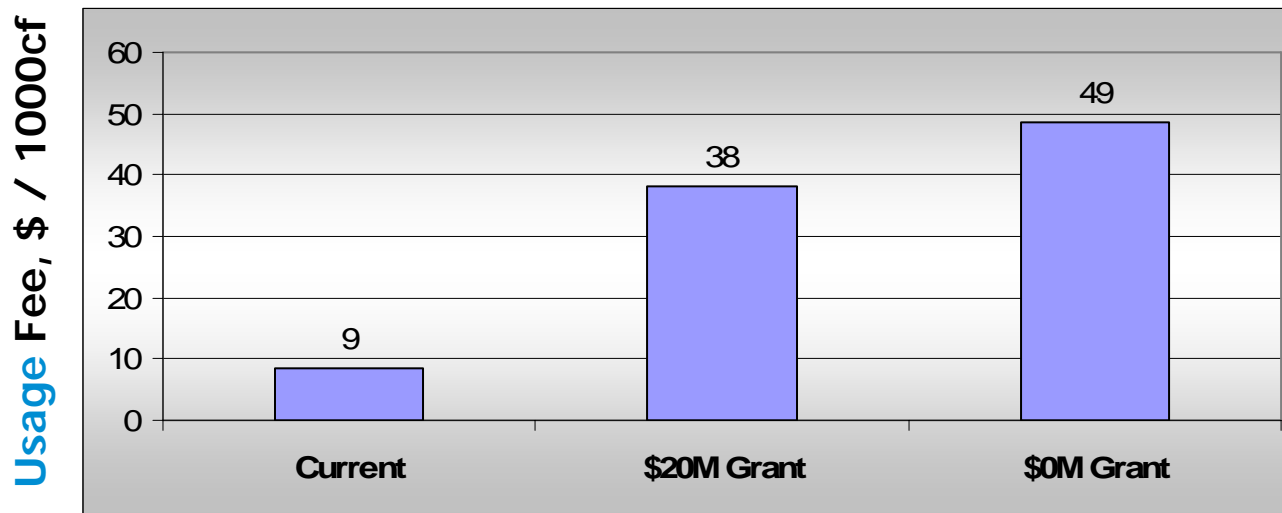
User Charge

Current User Charge

- **Simplified Monthly Residential**
 - Fixed Fee = \$8.18 / mo
 - Usage = \$8.50 / 1000 cubic feet (1000cf)

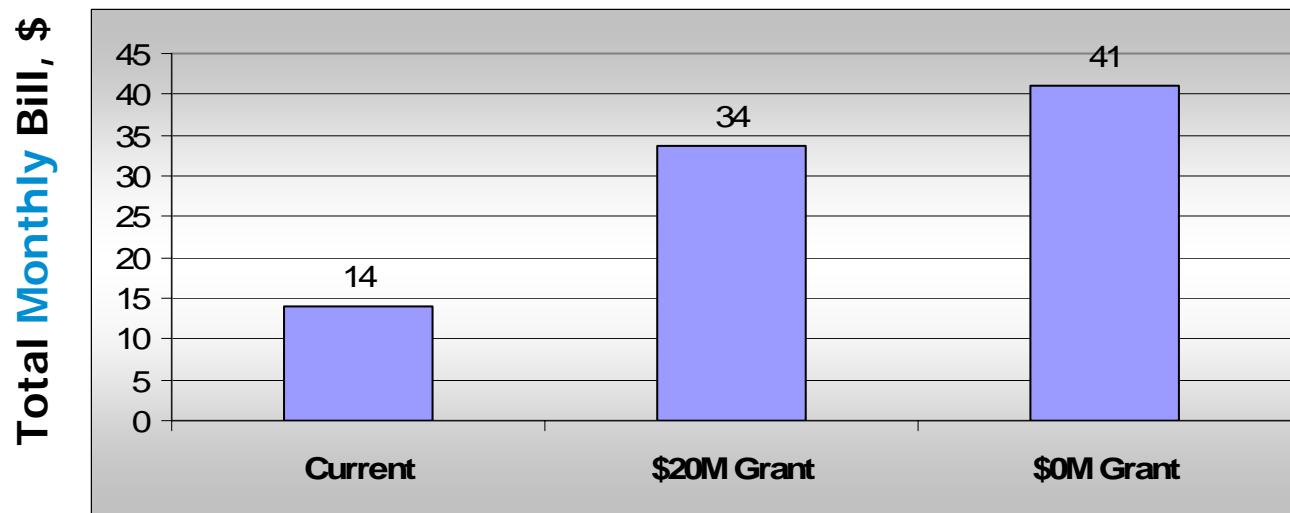
Potential User Charge Required to Finance Current Plan

- Fixed Fee = \$8.18 / mo
- Usage Fee Defined by Grant Amount



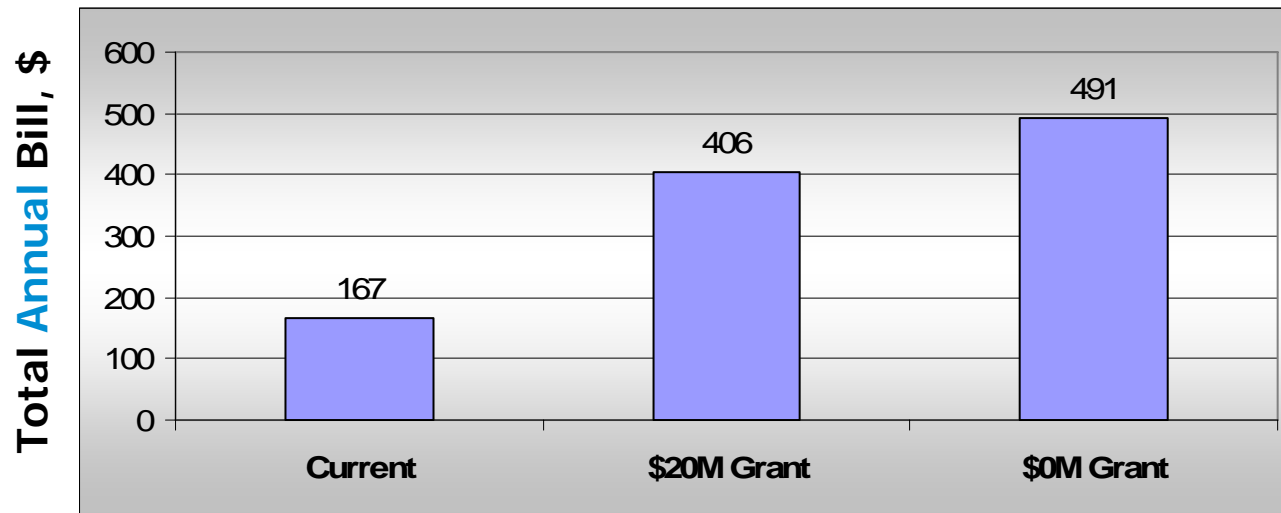
Preliminary Typical Residential Fee

- Fixed Fee = \$8.18 / month
- Usage Fee Defined by Grant Amount and Usage
 - For Willmar “Typical” Usage = 8100 1000cf/y = 675 1000cf/mo



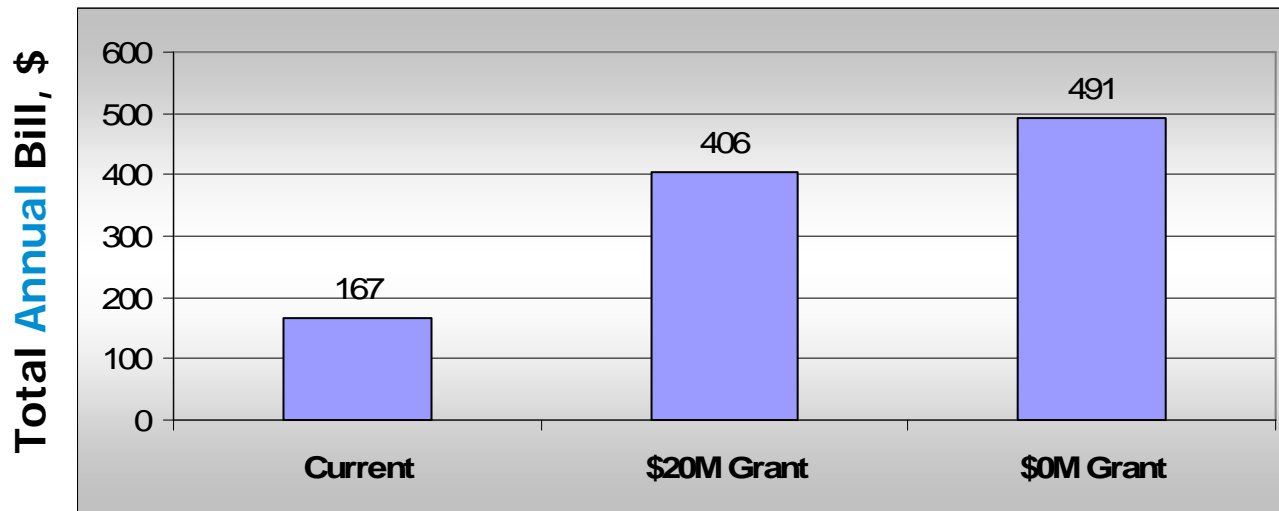
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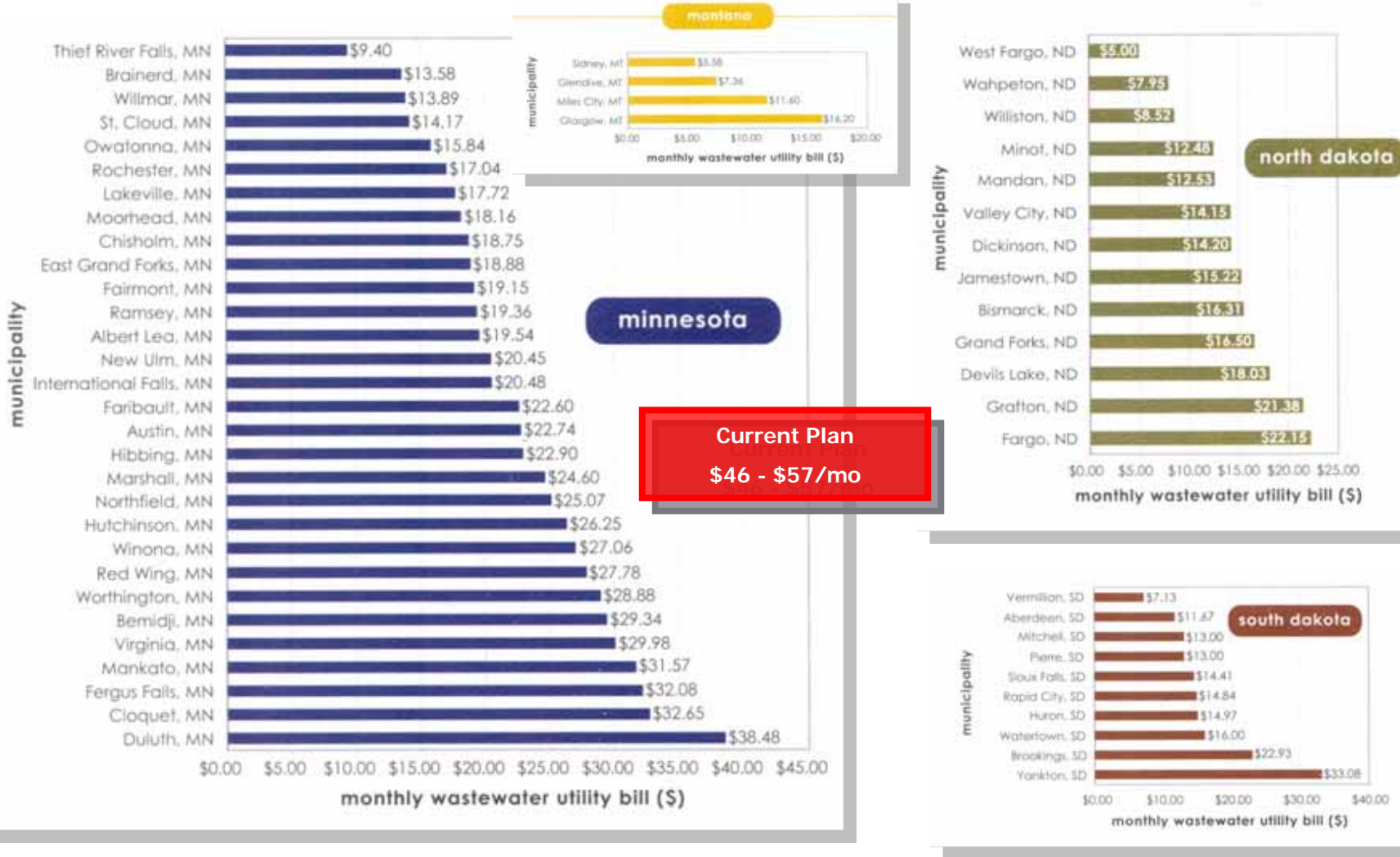


Regional User Charge Perspective

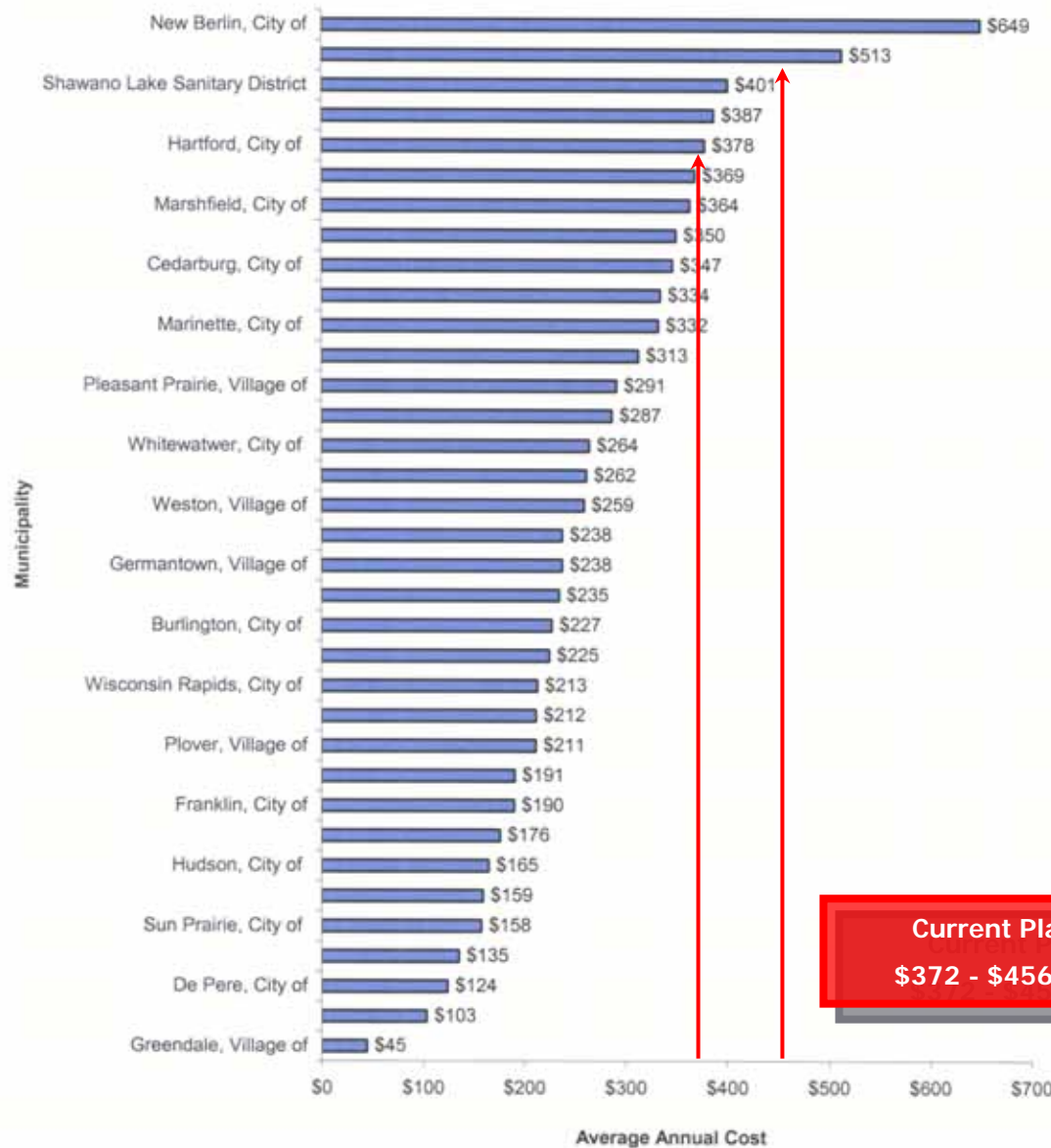
- Average MN-ND-SD-MT = \$194
- Average Wisconsin = \$380
- Minnesota Regulations Changing



User Charge Perspective – MN-ND-SD-MT



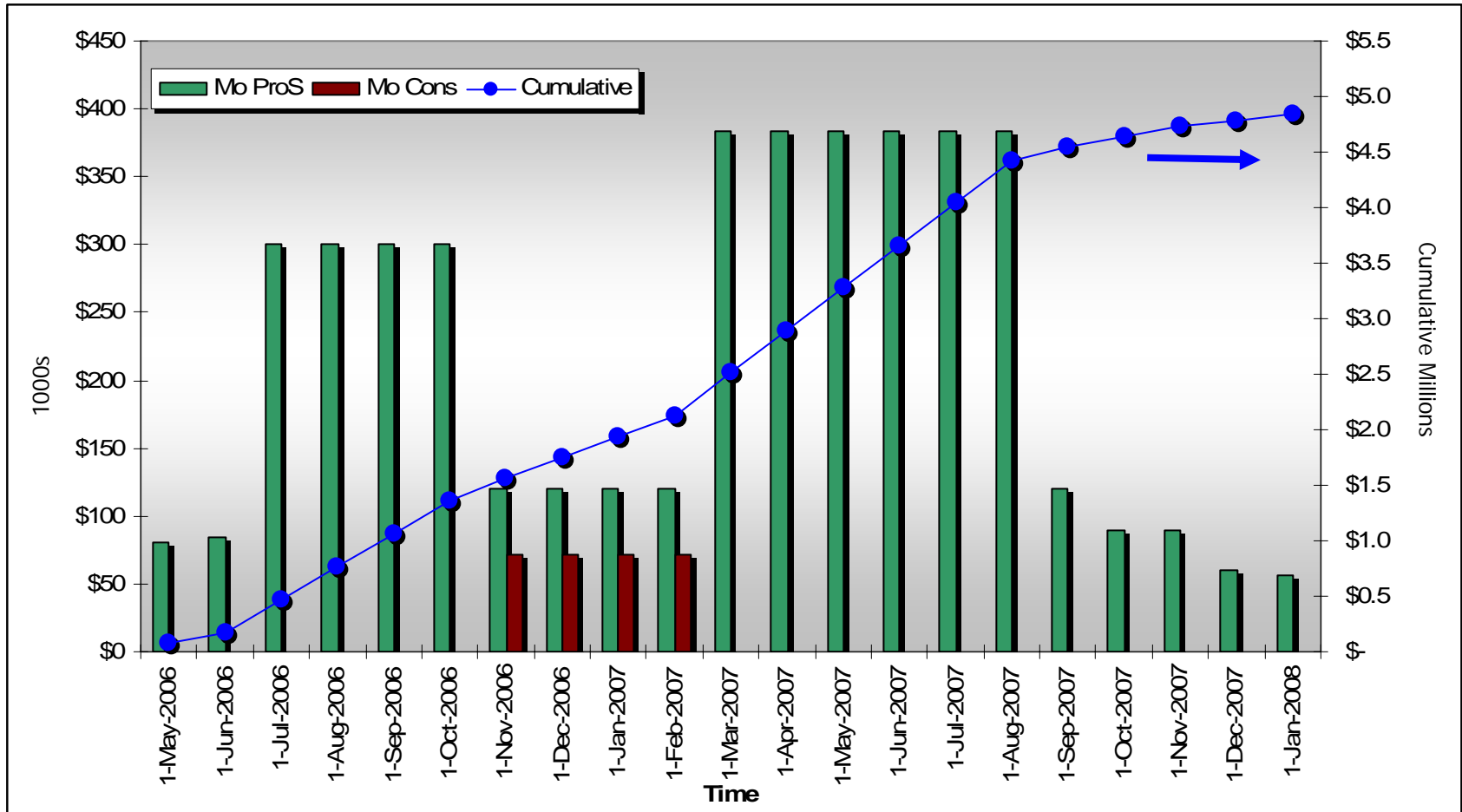
User Charge Perspective - Wisconsin



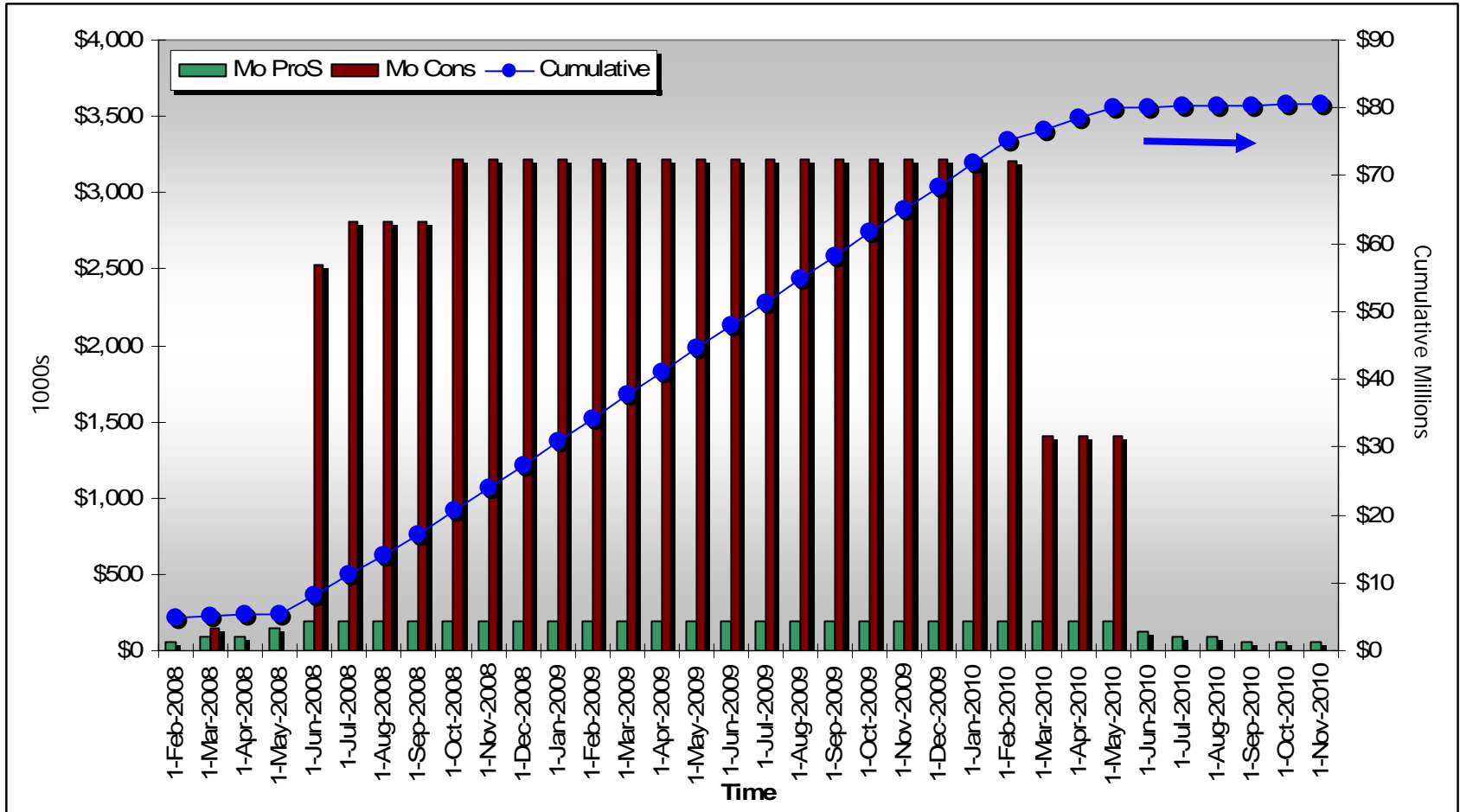
Cash Flow

- **Step 1 – Planning**
- **Step 2 – Design and Bidding**
- **Step 3 – Construction**

Example Design and Bidding Cash Flow



Example Construction Cash Flow



Purpose

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Menu of Cost-Reduction Measures

- Revisit Concept Development

The Next Step

- ?