CITY OF BATAVIA
100 N. Island Avenue, Batavia, IL 60510
630-454-2000 http://www.cityofbatavia.net

PUBLIC UTILITIES COMMITTEE AGENDA

Tuesday, February 19, 2013

7:30 p.m. Council Chamber 1st Floor

1. Roll Call
2. Approve Minutes-None
3. Resolution 13-29-R Authorizing Approval Of Amendment To The Power Sales Agreement Between NIMPA And The City Of Batavia (Gary Holm, 2/15/13)

   Documents: RESOLUTION 13-29-R AUTHORIZING APPROVAL OF AN AMENDMENT TO THE PSA BETWEEN NIMPA AND BATAVIA.PDF

4. Discussion – Prairie State Basic Concepts & Utility Financial Projections (Gary Holm, 2/14/13)

   Documents: PRAIRIE STATE.PDF

5. Discussion -- Industrial Customer Updates
6. Discussion – WWTF 2013 Rehabilitation Project Status
7. Discussion – WWTF Expansion Options (Gary Holm, 2/15/12)

   Documents: WWTF EXPANSION OPT.PDF

8. Executive Session: Acquisition Of Real Property
9. Other
10. Matters From The Public
11. Adjournment

CITY OF BATAVIA

DATE: February 15, 2013
TO: Public Utilities Committee
FROM: Gary Holm
SUBJECT: Resolution 13-29-R Authorizing Approval of Amendment #2 to the Power Sales Agreement between NIMPA and the City of Batavia

Prior to commencing with Prairie State, the City of Batavia entered into a Power Sales Agreement (PSA) with NIMPA. The PSA specifies that the delivery point for energy is the Batavia Hub (BAT HUB) within the PJM RTO. Through the course of the Brattle sales process it was agreed that the PSA would be modified to allow for possible delivery at some location other than BAT HUB.

The original PSA was drafted prior to completion of Batavia's 138 KV project. As such, the demarcation point between ComEd and Batavia was not well defined. It was agreed that the demarcation point should be better defined as part of the amendment to the PSA.

Attached please find Resolution 13-29-R authorizing approval of Amendment #2 to the Power Sales Agreement between NIMPA and the City of Batavia. **Staff is recommending that this Resolution be approved**.

CITY OF BATAVIA
RESOLUTION 13-29-R

Authorizing Approval of an Amendment to the Power Sales Agreement between NIMPA and the City of Batavia

WHEREAS, the City of Batavia owns and operates an electric utility; and

WHEREAS, the City previously entered into a Power Sales Agreement with the Northern Illinois Municipal Power Agency;

WHEREAS, the Power Sales Agreement has previously been amended to modify Batavia's entitlement share;

WHEREAS, it is in the best interest of both parties to further amend the Power Sales Agreement to allow for different delivery points and to better define Batavia's demarcation point;

NOW, THEREFORE, BE IT RESOLVED BY THE MAYOR AND CITY COUNCIL OF THE CITY OF BATAVIA AS FOLLOWS:

Section 1. That the Mayor and City Clerk are hereby authorized to execute Amendment #2 to the Power Sales agreement which is attached hereto as Exhibit A.

PRESENTED to the City Council of the City of Batavia, Illinois, on the ___ day of March, 2013.

PASSED by the City Council of the City of Batavia, Illinois, on the ____day of March, 2013.

APPROVED by me as Mayor of said City of Batavia, Illinois, on the ____day of March, 2013.

____
Mayor

Ward	Aldermen	Ayes	Nays	Absent	Abstain	Aldermen	Ayes	Nays	Absent	Abstain
1	O'Brien					Sparks				
2	Dietz					Wolff				
3	Jungles					Chanzit				
4	Volk					Stark				
5	Frydendall					Thelin Atac				
6	Liva					Clark				
7	Tenuta					Brown				
Mayor Schielke										

VOTE: Ayes 0 Nays Absent 0 Abstention(s) counted as ________ Total holding office: Mayor and 14 aldermen

ATTEST:

____

Heidi Wetzel, City Clerk

EXHIBIT A

AMENDMENT NUMBER TWO
TO THE
POWER SALES AGREEMENT
BETWEEN
THE NORTHERN ILLINOIS MUNICIPAL POWER AGENCY
AND THE
CITY OF BATAVIA, ILLINOIS

APPENDIX B is hereby amended to state as follows:

APPENDIX B

Delivery Point
(Batavia)

NIMPA shall deliver energy to

For commercial (cost) purposes
To the Batavia node (PJM Commercial Pricing Node Id 33092301) or such other nodes as may be designated by Batavia.

For physical interchange purposes
To the Batavia delivery points, at the point of demarcation of ownership between the Batavia and ComEd 138 kV transmission systems, ComEd Switch numbers 0385 and 0590.

Approved and Acknowledged by

______________________	______________________
Mike Buffington, President	, Mayor
NIMPA	City of Batavia
Attest:	
______________________	______________________
Joe Orlikowski, Secretary	, City Clerk
NIMPA	City of Batavia

Dated: March 6, 2013

CITY OF BATAVIA

DATE: February 14, 2013
TO: Public Utilities Committee
FROM: Gary Holm
SUBJECT: Prairie State Basic Concepts and Utility Financial Projections

Several aldermen have requested that we update our presentation of the basic concepts associated with Batavia's involvement in the Prairie State project. We've also received requests to update our five-year financial projections as they relate to the Utility and Prairie State.

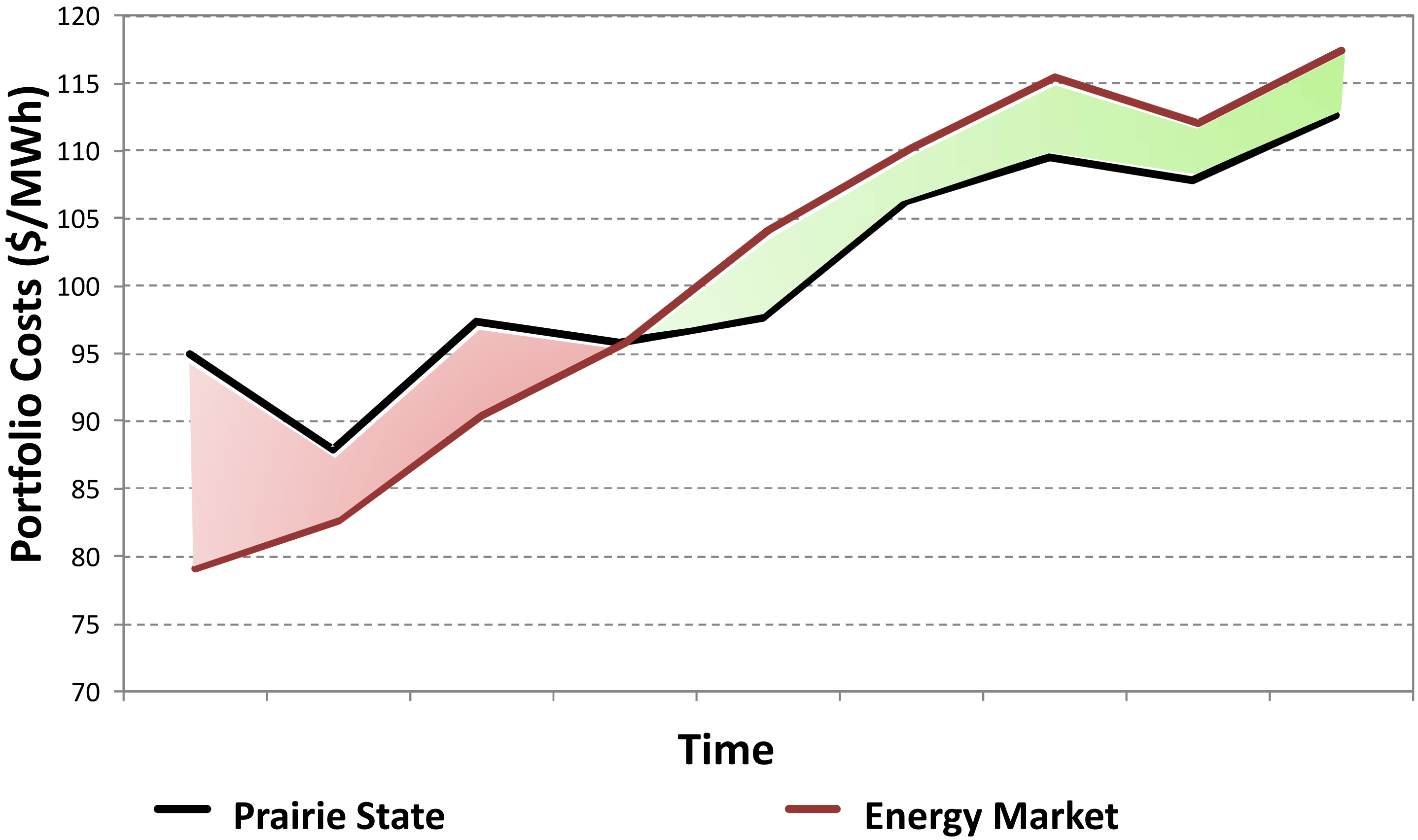
Please find attached a PDF entitled "Prairie State Basic Concepts 2_19_13". This document summarizes many of the basic concepts that we have discussed over the past few years. We plan to review the slides in detail at the Committee meeting and answer any questions you may have.

Also attached please find a PDF entitled "Five Year Financial Projections 2013-2017". This document will also be reviewed in detail at the meeting.

If upon your initial review you have questions, then please contact me so that I can be sure to address them at the meeting.

Guide to understanding Slide #1:

- This slide is for illustrative purposes only. The cost values shown are theoretical only.
- The black line is a theoretical representation of costs associated with Prairie State
- The red line is a theoretical representation of the price of energy market purchases
- The point at which the black line crosses the red line is commonly referred to as the “crossover” and is discussed in more detail on the next slides
- The red shaded area represents that period of time in which the cost of Prairie State exceeds the cost of energy on the market. During this time period:
    - The City is paying more for energy from Prairie State then it could otherwise purchase it from the market
    - The City is losing money on the sale of any excess power purchased from Prairie State and sold back into the market
- The green shaded area represents that period of time in which the cost of Prairie State is below the cost of energy on the market. During this time period:
    - The City is benefiting from ownership by receiving power at a lower cost then it could otherwise purchase on the market
    - The sale of any excess power purchased from Prairie State results in increased revenues for the utility



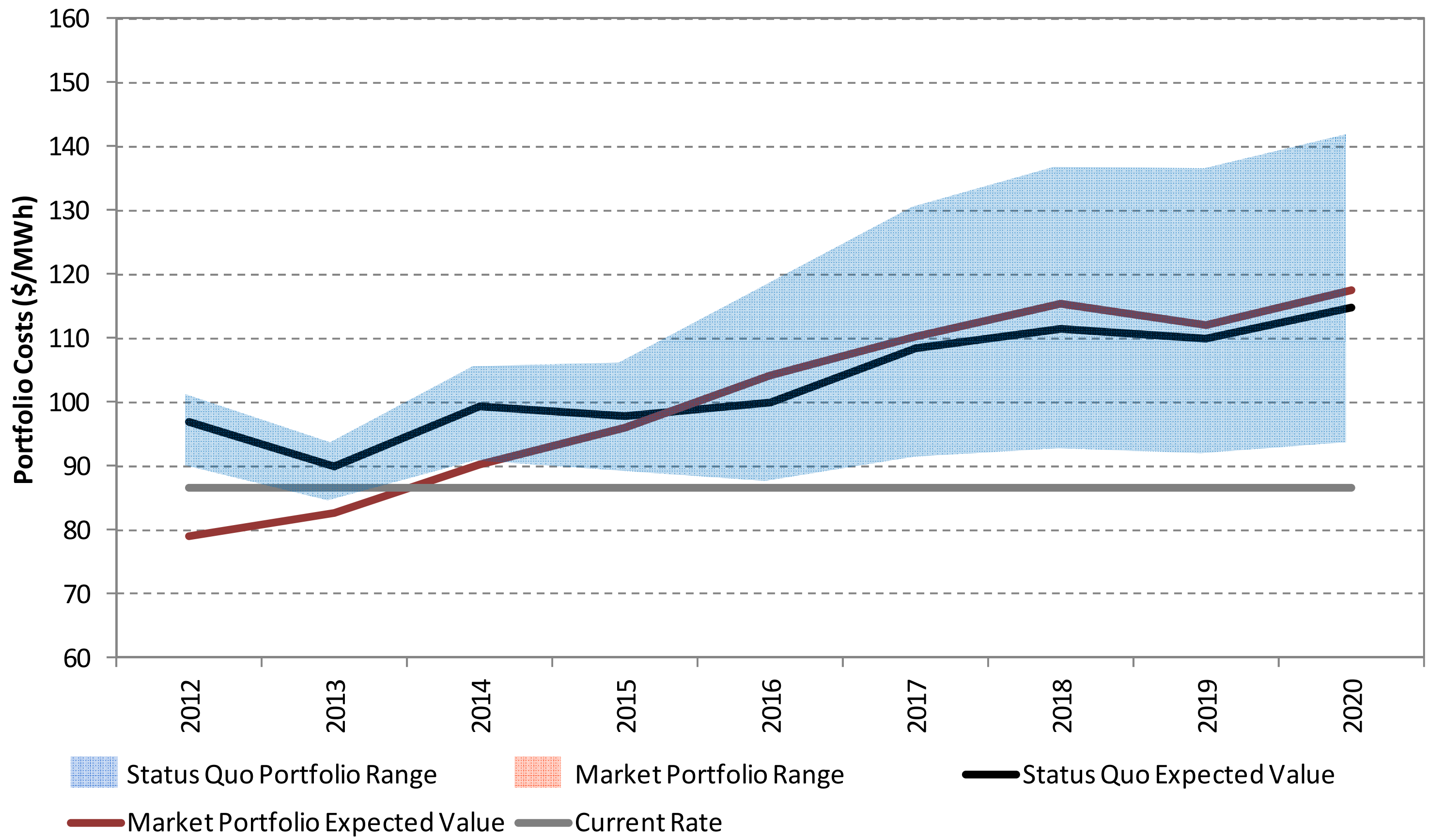
120
115
110
105
100
95
90
85
80
75
70
Portfolio Costs ($/MWh)
Time
Prairie State
Energy Market

Guide to understanding Slide #2

- This slide comes from data out of the Pace Global study which was completed in 2011

- A statistical analysis was performed to project the future cost of Batavia's portfolio, which consists primarily of Prairie State.

- The black line represents the expected cost of Batavia's portfolio and the shaded blue area represents the possible range within it may fall over time.



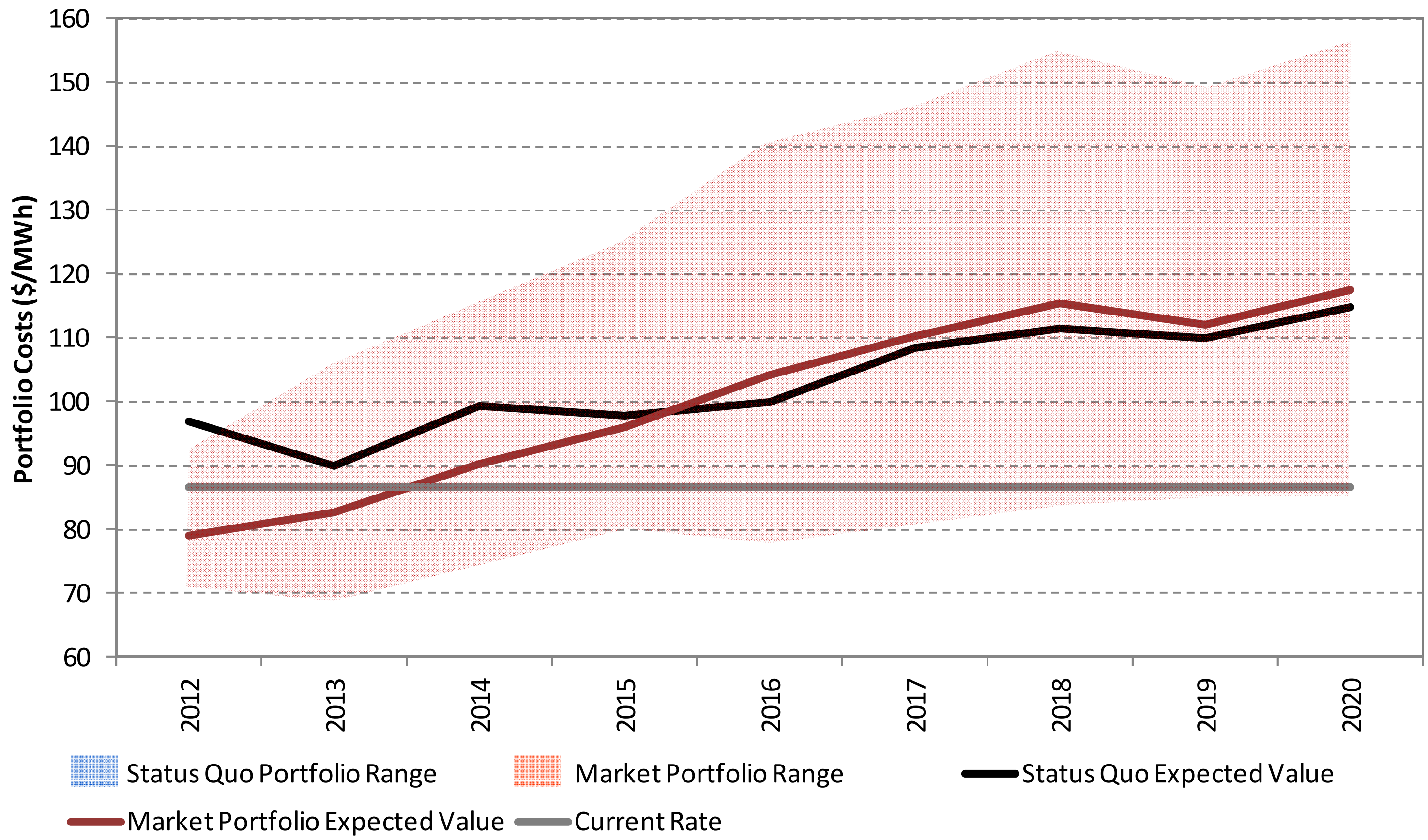
160
150
140
130
120
110
100
90
80
70
60
Portfolio Costs ($/MWh)
2012
2013
2014
2015
2016
2017
2018
2019
2020
Status Quo Portfolio Range
Market Portfolio Range
Status Quo Expected Value
Market Portfolio Expected Value
Current Rate

Guide to understanding Slide #3

- This slide comes from data out of the Pace Global study which was completed in 2011

- A statistical analysis was performed to project the cost of future energy market purchases

- The red line represents the expected cost of market purchases and the shaded pink area represents the possible range within the costs may fall over time.

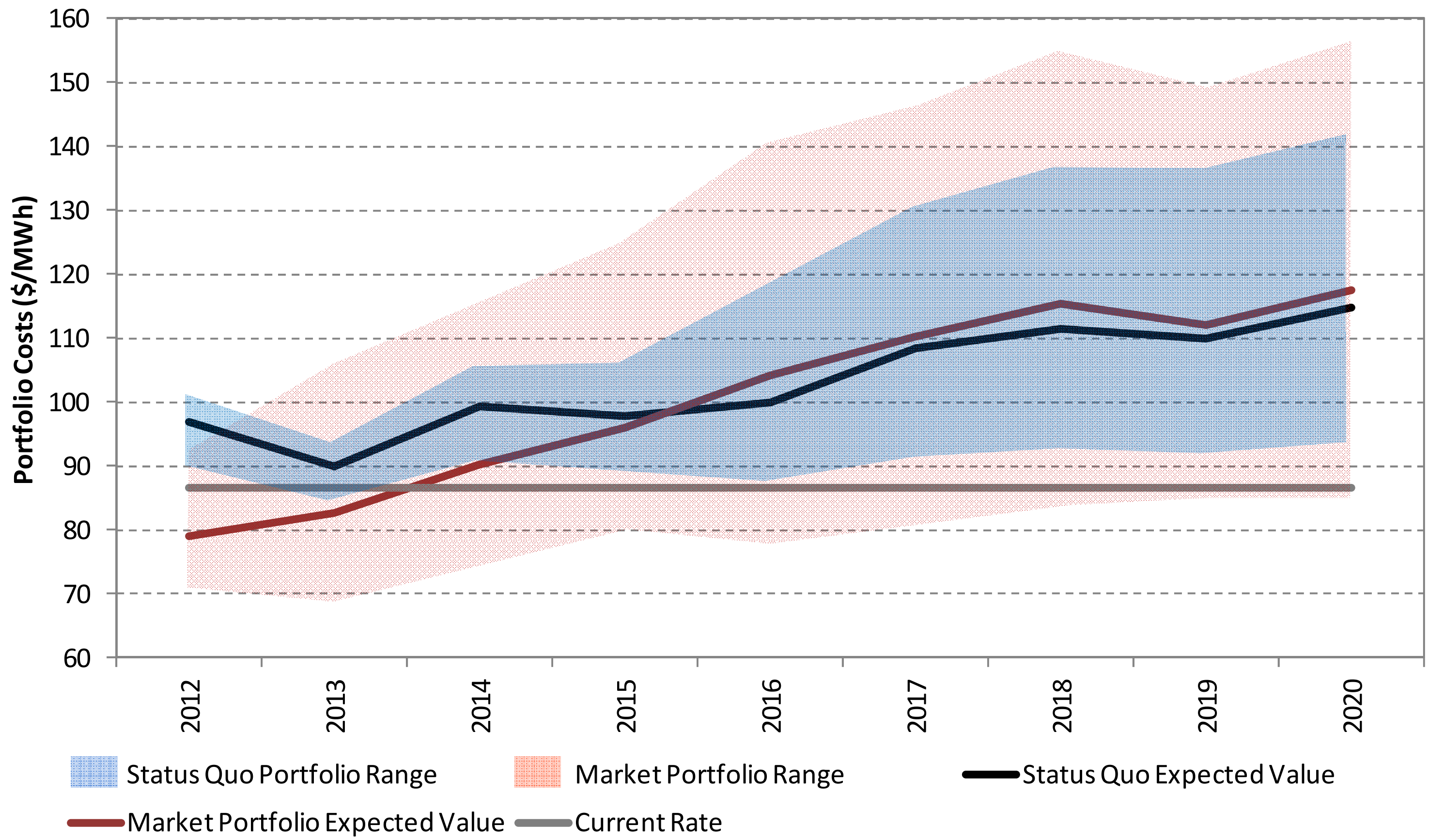


160
150
140
130
120
110
100
90
80
70
60
Portfolio Costs ($/MWh)
2012
2013
2014
2015
2016
2017
2018
2019
2020
Status Quo Portfolio Range
Market Portfolio Range
Status Quo Expected Value
Market Portfolio Expected Value
Current Rate

Guide to understanding Slide #4

- This slide comes from data out of the Pace Global study which was completed in 2011

- The keys to this slide are the black line (Prairie State cost) and the shaded pink area. Note that in the year 2020 it is projected that the black line will fall approximately in the center of the pink shaded area. This means that there's approximately a 50/50 chance that the cost of energy market purchases will be either more or less expensive than the cost of Prairie State.



Portfolio Costs ($/MWh)
160
150
140
130
120
110
100
90
80
70
60
2012
2013
2014
2015
2016
2017
2018
2019
2020
Status Quo Portfolio Range
Market Portfolio Range
Status Quo Expected Value
Market Portfolio Expected Value
Current Rate

Guide to understanding Slide #5

- This slide comes from the Brattle sale process using 1/9/2013 through 1/16/2013 market data.

- The Y axis is the cost of energy in $/MWh. The X axis is time in years from 2013 to 2024.

- General market wisdom is that futures energy prices and natural gas prices tend to track together during peak times.

- The two parallel black lines create a range of plus or minus one dollar around the Henry Hub futures price for natural gas.

- Henry Hub is the physical location tied to natural gas futures contracts that are traded on the NYSE. Henry Hub is typically referenced when analyzing the price of natural gas.

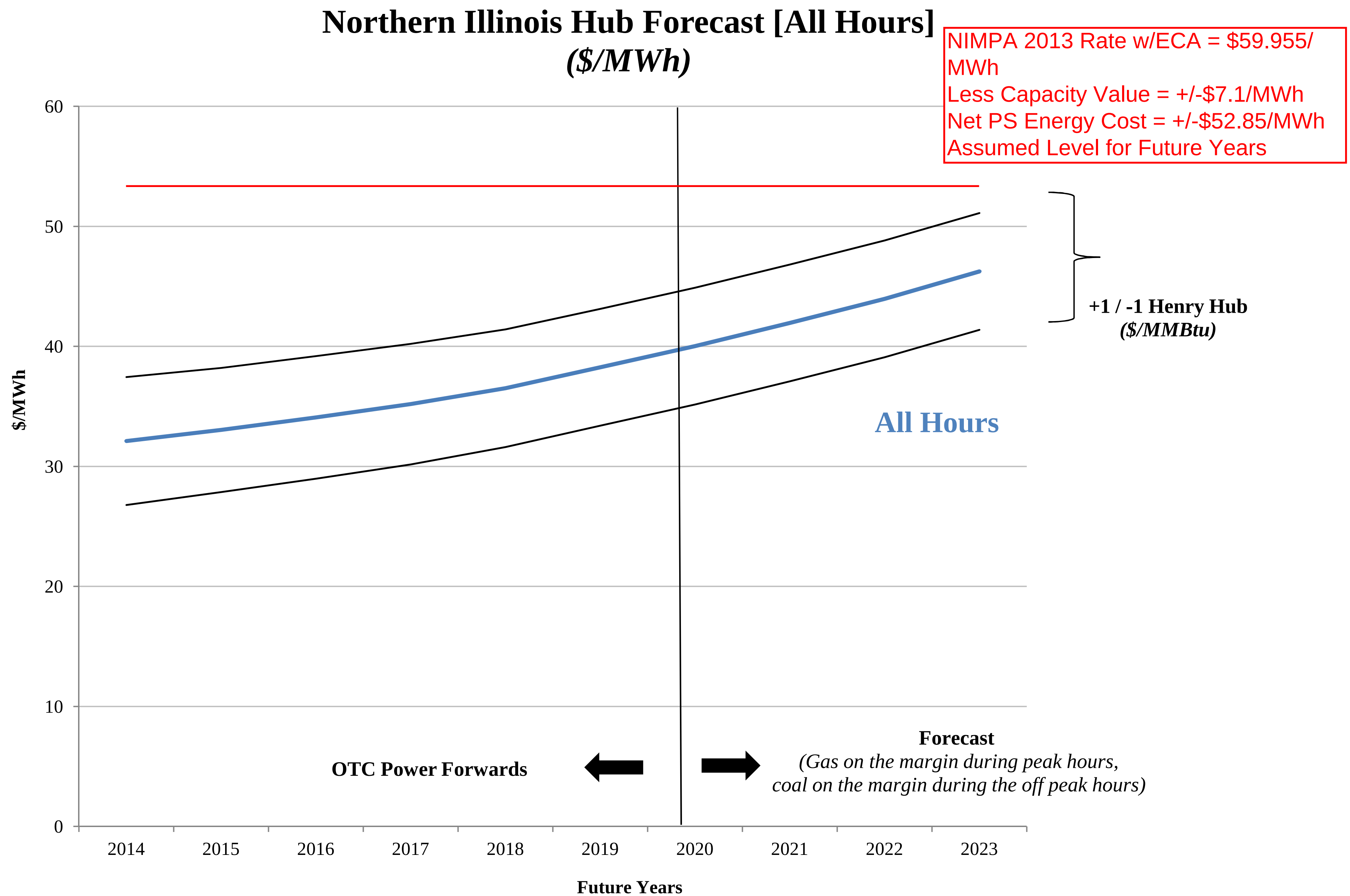
- The blue line represents a combination of known market forward prices for peak and off-peak energy and Brattle's projections for peak and off-peak energy. Peak energy is indexed to natural gas generation which generally controls during peak times. Off-peak energy is indexed to coal generation which generally controls during off-peak times.

- NIMPA has provided us with the 2013 cost for Prairie State power. This cost includes an Energy Cost Adjustment (ECA) factor which could vary throughout the year. This cost includes all power components, not just energy.

- In an effort to more accurately compare the red line to the blue line, the value of capacity from Prairie State was estimated. This value was estimated using known auction results and Brattle future projections.

- The value of capacity was subtracted from NIMPA's 2013 cost to create an estimated Prairie State energy cost and is plotted as the red line on the graph. For simplicity, the red line was plotted flat (no increase) for future years.

- Assuming no increase in Prairie State costs and using Brattle's future energy projections, the "crossover" is estimated to occur beyond 2024. This means that for the foreseeable future:
    - The City is paying more for energy from Prairie State then it could otherwise purchase it from the market
    - The City is losing money on the sale of any excess power purchased from Prairie State and sold back into the market


Northern Illinois Hub Forecast [All Hours]
($/MWh)
NIMPA 2013 Rate w/ECA = $59.955/MWh
Less Capacity Value = +/-$7.1/MWh
Net PS Energy Cost = +/-$52.85/MWh
Assumed Level for Future Years
60
50
40
30
20
10
0
$/MWh
+1 / -1 Henry Hub
($/MMBtu)
All Hours
Forecast
(Gas on the margin during peak hours,
coal on the margin during the off peak hours)
OTC Power Forwards
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Future Years

Attached is a summary of 5-year financial projections for the Electric Utility. Some items of note:

Expenses

- Expenses excluding purchase power are expected to rise modestly, or in some cases remain level, over the next five years. These expenses include items such as personnel, operations & maintenance, equipment, facilities, etc.

- Expenses for short-term summer peak purchase power are projected to remain relatively constant throughout the five-year period.

- Batavia was notified at the January NIMPA meeting that insufficient funds were collected by the agency in 2012. An additional $1.2M needs to be collected during the first six months of 2013 in order to make up the shortfall. This information was not accounted for in Batavia's 2013 budget.

- According to the most recent information provided by NIMPA, costs associated with Prairie State are projected to be level over the next five years.

Revenues

- Revenues excluding the sale of energy are expected to rise modestly over the next five years. These revenues include items such as interfund transfers, permit fees, reimbursements, investment revenues, etc.

- The amount of energy sold to our customers is expected to rise 1-2% annually over the next five years.

- The utility's Purchase Power Adjustment Factor (PPAF), which was established by Ordinance as part of the 138 KV bonds, will automatically adjust to cover the cost of purchase power. City Council has previously authorized the use of up to $2M in reserve funds to stabilize the PPAF and reduce impacts on our customers. It is anticipated that the PPAF will rise in 2013 despite the anticipated use of the entire $2M in stabilization funds.

Summary

- The future financial impact to rate payers is most clearly seen by looking back in time. The utility's annual cost of purchase power has increased approximately $6M from 2010 to the present. It is this increased cost that will continue to impact rate payers going forward.

- It is difficult to project best & worst case scenarios. Our long position in Prairie State means that we are exposed to variations of the power market. We are selling excess power back into the market on an almost daily basis. The result of these sales has a direct impact on the utility's financial performance. In the near term it appears that we will be selling back into the market at a loss. We've been advised by our consultants that over the long-term market costs will rise and there will be a "crossover". After that time we will be selling back excess power for a profit. The exact timing of the "crossover" is unknown.

- Additional revenues may be needed for 2013 and beyond. These revenues could come in the form of a higher PPAF and/or rate/fee increases. Based on information we already know, we are projecting the PPAF throughout the first half of 2013 to range between $0.01 and $0.02. This assumes utilization of the entire $2M in rate stabilization funds. For reference, the PPAF throughout 2012 was in the range of $0.00 to $0.01.

	2010	2011	2012	2013	2014	2015	2016	2017
	Actuals	Actuals	Estimated					
EXPENSES								
#21-61 Electric Improvements	$3,848,954	$1,556,307	$1,843,034	$3,470,000^	$3,500,000	$3,500,000	$3,500,000	$3,500,000
#21-62 Meter Reading / Locating	$386,958	$413,757	$426,700	$444,210	$450,000	$475,000	$475,000	$500,000
#21-64 Transmission & Distribution **Excluding** Purchase Power	$8,720,764	$8,141,820	$7,538,811	$8,097,608	$8,300,000	$8,600,000	$8,900,000	$9,200,000
#21-64 Purchase Power	$24,925,589	$24,197,197	$29,394,653	$32,400,000	$31,200,000	$31,200,000	$31,200,000	$31,200,000
#21-90 Interfund Transfer	$679,146	$661,904	$718,734	$721,582	$725,000	$725,000	$725,000	$725,000
#21-98 Revenue Bond Payments	$1,424,480	$1,423,805	$1,702,806	$1,703,606	$1,700,000	$1,700,000	$1,700,000	$1,700,000
Total Expenses	$39,985,891	$36,394,790	$41,624,738	$46,837,006	$45,875,000	$46,200,000	$46,500,000	$46,825,000
REVENUES								
Revenue **Excluding** Sale of Electricity	---	---	---	$550,000^	$600,000	$650,000	$700,000	$750,000
Revenue from Sale of Electricity	---	---	---	The cost of purchase power is automatically passed through to customers via the PPAF. Revenue increases proportionally with expenses per the PPAF formula. **The true impact on rate payers is more accurately determined by looking at the increase in expenses for purchase power**. The PPAF automatically collects more revenue as necessary to cover costs.				

^ - 2013 revenues/expenditures do not include Rubicon improvements

CITY OF BATAVIA

MEMO TO: Public Utilities Committee
FROM: Gary Holm
DATE: February 15, 2013
SUBJECT: Waste Water Treatment Facility Engineering
Task Order #2 – Treatment Options & Master Plan Update

Trotter and Associates has been working over the past several months to analyze various treatment options and to update the master facilities plan. A draft is attached for your reference.

Based on Trotter's presentation of the pros and cons of each option, as well as other considerations related to site layout, Staff is seeking direction from the Committee on a desired option and layout. Based on that direction, Staff will work with Trotter to define the scope for the next step in the process.

TROTTER and ASSOCIATES, INC.
ENGINEERS AND SURVEYORS

Memorandum

Date: February 15, 2013

To: Gary Holm, P.E.

From: Scott Trotter, P.E.

Subject: Wastewater Master Plan – Committee Update for 2/19/13

Gary,

We are looking forward to providing a progress report to the Public Utilities Committee next week. We have enclosed a draft copy of Section 6 and the potential process layouts. This information should provide the committee members within a strong understanding of the decisions made to date and allow them to provide feedback with respect to the alternatives.

As part of the first work order, Trotter and Associates, Inc. completed a thorough review of the existing wastewater facility. The recommendations and associated costs were provided in an updated Section 5. Many minor items requiring immediate attention have been incorporated into a rehabilitation project which is currently ongoing – 2013 Wastewater Treatment Facility Improvements. We anticipate proceeding with the bidding phase for this project within the next thirty days.

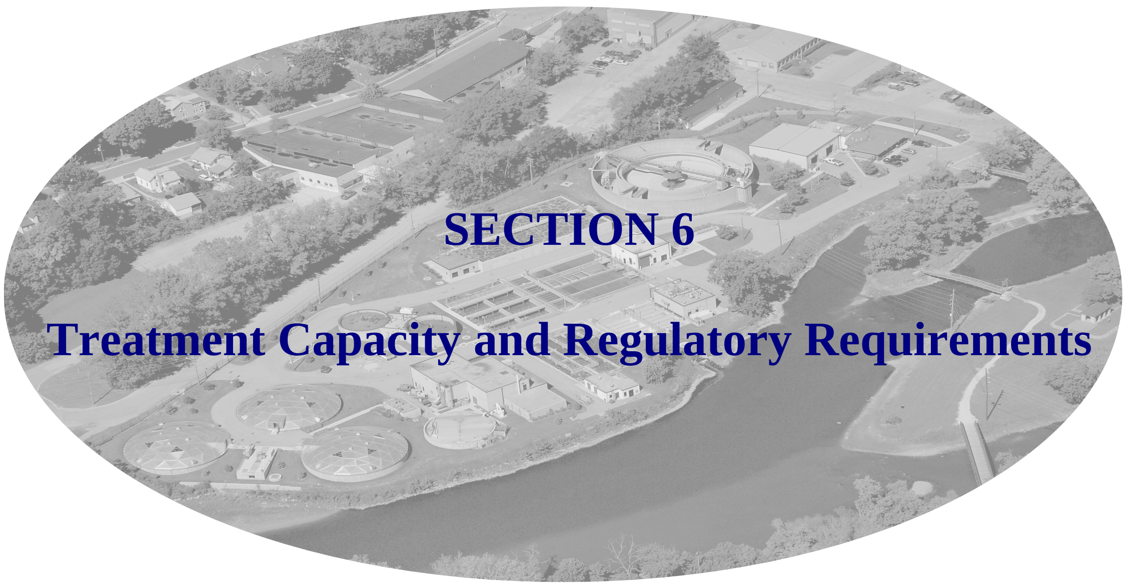
Section 5 of the Master Plan also identified several changes. The most significant change was the determination that the sludge handling building and the old aeration basin constructed in the 1930's and 1950's required demolition and replacement in one form or another. This change allowed for consideration of additional treatment strategies, and removed the need to utilize the emerging IFAS technology.

During our meeting next week, we will review the alternative presented in Section 6 with the Committee and seek input with respect to preferred layout.

40W201 Wasco Rd., Suite D
St. Charles, IL 60175
Phone 630.587.0470 ● Fax 630.587.0475

www.trotterandassociates.com

5415 Business Parkway
Ringwood, IL 60072
Phone 815.728.0068 ● Fax 815.728.1008



SECTION 6

Treatment Capacity and Regulatory Requirements

6. TREATMENT CAPACITY AND REGULATORY REQUIREMENTS

6.1 GENERAL DISCUSSION

The last major upgrade to the City of Batavia's wastewater treatment facility was completed in 1999. The project cost approximately $10 Million and addressed three major issues - rehabilitation, expansion needs, and regulatory requirements. The rehabilitation effort concentrated on equipment and structures that had reached the end of their design life. The expansion increased the plant capacity from 3.58 MGD to 4.2 MGD to address anticipated growth within the community. The regulatory compliance required that the biological process be expanded to incorporate nitrification of ammonia. The project was funded through an Illinois EPA low-interest loan and a cost analysis developed prior to the project demonstrated that the costs were split relatively evenly between the three issues.

Section 5 of this study provided an analysis of the wastewater treatment facility's operational performance, an assessment of the existing infrastructure, and prioritization for rehabilitation needs. The facility's operational performance has been within permit limits. The existing infrastructure is of varying age and condition, most of it predating the 1999 Expansion and some of it dating back to the 1930's. The recommendations included a short list of critical items that had failed or were failing. As of 2013, the City is moving forward with a limited rehabilitation project to address these issues. It was determined that non-critical issues could be addressed over the next 36 to 48 months as part of a comprehensive solution to the City's long term needs. This comprehensive solution will address future capacity and regulatory requirements.

The City has updated its comprehensive plan which identifies land use and anticipated population density within the community. During formation of the 1999 Wastewater Master Plan, the City determined that the wastewater treatment facility service area would be limited to its original boundaries, which are identified in Section 2. Section 2 also establishes population equivalents and future capacity requirements. The City anticipates that the facility will require capacity to treat 4.9 MGD.

Although the natural environment is able to assimilate some pollution, the environment becomes unable to convert pollutants as the surrounding population continues to increase. This leads to degradation of the water quality and wildlife habitat. In order to ensure stability within the environment, governmental agencies on the federal, state, and local levels are continuously evaluating the effectiveness of wastewater regulations. The regulatory issues that will be addressed within Section 6 include; nutrient removal, suspended solids effluent requirements, bio-solids stabilization, and wet weather flow treatment. Other issues also included are anti-degradation requirements.

6.2 REHABILITATION OF EXISTING WASTEWATER TREATMENT FACILITY.

Section 5 provided an overview of the existing wastewater treatment facility's strengths and limitations. The City's goal is to reuse as much of the existing infrastructure as practical and still meet the long-term needs of the community and the environment. In order to reuse the existing infrastructure, many mechanical components will need to be replaced as they are reaching the or have reached the end of their service life.

The cost estimate below represents the costs associated with rehabilitation of the existing treatment facility if it was not to be expanded and future regulatory requirements were not considered. However, straight replacement does not address the community's long term needs with respect to capacity or regulatory requirements.

BATAVIA WWTF REHABILITATION UPGRADE		
(WITH REPLACEMENT OF BIOLOGICAL PROCESS & INTERMEDIATE PUMP STATION)		
Description	**Total**	
SUMMARY		
GENERAL CONDITIONS	**$**	**3,161,000**
SITEWORK	**$**	**515,000**
EXCESS FLOW FACILITY	**$**	**927,800**
EXCESS FLOW CHLORINATION	**$**	**889,500**
HEADWORKS	**$**	**237,400**
PLANT DRAIN PUMP STATION	**$**	**237,400**
PRIMARY CLARIFIERS	**$**	**2,127,000**
BIOLOGICAL PROCESS (REPLACE)	**$**	**1,437,450**
INTERMEDIATE PUMP STATION	**$**	**1,900,000**
UV SYSTEM	**$**	**1,200,000**
SLUDGE HANDLING BUILDING	**$**	**5,200,000**
ANAEROBIC DIGESTERS	**$**	**1,779,875**
CONSTRUCTION SUBTOTAL	**$**	**19,612,500**
CONTINGENCY @ 20%	**$**	**3,922,500**
ESTIMATED CONSTRUCTION COST	**$**	**23,535,000**
ENGINEERING	**$**	**3,670,700**
PROJECT TOTAL	**$**	**27,205,700**

6.3 REGULATORY ISSUES AND ANALYSIS

6.3.1 Excess Flow / Blending

Under the facility's current NPDES permit, it is permissible to discharge some flow that has not received full treatment during wet weather events. The portion of the flow discharged without full treatment receives primary clarification in the excess flow clarifier and disinfection in the excess flow chlorine contact tank.

The USEPA and Illinois EPA are contemplating modifying the regulations to prohibit partial treatment. If this change occurs, the City of Batavia must either provide sufficient treatment to the effluent from the excess flow facilities to meet the dry weather NPDES permit standards or use the excess facilities only for flow equalization.

If the wet weather limits are simply eliminated and the dry weather limits remain unchanged then the facilities may not need to be modified. However, if a daily maximum is implemented for BOD_5 and suspended solids, then additional treatment would be required. There are several emerging technologies that would be capable of meeting the lower suspended solids and BOD_5 requirements. It is recommended that the City reserve space for construction of additional excess flow treatment process units.

6.3.2 Alternatives for Excess Flow Treatment

Under current conditions, the existing excess flow facilities are able to comply with the NPDES Permit standards. As explained above, these requirements could become stricter in the future. During previous studies, alternative technologies have been considered. Emerging technologies that would provide improved effluent quality include Ballasted Flocculation, Biologically Activated Ballasted Flocculation and Tertiary Filtration.

If the City determines that installation of tertiary filters are a component of future plant improvements, integration of the excess flow process is recommended. If not, then space should be reserved for implementation of an alternative process. Multiple locations should be considered.

- Food Pantry
- Existing Laboratory/ Garage
- Chlorination Building/ Contact Tanks

Based on current compliance, the ultimate removal of combined sewers and an uncertainty regarding future regulatory standards, it is recommended that the City determine the most cost effective approach in future studies.

6.3.3 Nutrient Removal Criteria

The City of Batavia discharges to the Fox River. According to the Illinois EPA Clean Water Act Section 303(d) List, the Fox River does not meet water quality standards for its intended use in the majority of the segments, including the segments immediately downstream of the Batavia Wastewater Treatment Facility. The impairment on the river for aquatic life is based on a low dissolved oxygen concentration. This low dissolved oxygen content is due to algal growth and exacerbated by the presence of pools upstream of the low head dams along the river.

In 2001, the Illinois EPA was contemplating performing a Total Maximum Daily Load (TMDL) study on the Fox River in an attempt to address the impairment. At that time, there was insufficient data available to support a TMDL and therefore would simply be a modeling exercise which would not reflect actual environmental conditions. Many of the communities along the Fox River (including Batavia) joined forces with other stakeholders, including Friends of the Fox and Sierra Club, to form the Fox River Study Group (FRSG). The FRSG determined that it was in the best interest of all the stakeholders if a comprehensive solution was developed and that solution was based on sound river monitoring data and modeling. The FRSG, in concert with the POTWs along the river, have monitored the river for numerous constituents including phosphorus, nitrogen, fecal coliform and chlorophyll a. This water quality data provided the basis for development of QUAL2K and HSPF models.

In 2004, the Illinois EPA implemented statewide nutrient removal criteria for wastewater treatment facilities that were proposing expansion of their hydraulic capacity. Two nutrients of concern were total nitrogen and phosphorus. The NPDES Permits issued for these facilities typically contained an interim 1 mg/l phosphorus limit and requirement to monitor total nitrogen.

In 2011, the Illinois EPA was receiving increased pressure by the USEPA and environmental stakeholders to address nutrient criteria on all POTWs, not only treatment plants undergoing expansion. Several NPDES permits along the Fox River had expired and were due to be reissued by the Illinois EPA. However, the Illinois EPA elected to delay reissuance so the NPDES permits could incorporate language agreed upon in ongoing discussions on nutrient criteria.

In January 2012, in an attempt to build consensus among all stakeholders, the Illinois EPA presented the FRSG with special conditions in draft form for nutrient criteria. The FRSG had not yet completed the low flow monitoring required to calibrate the HSPF and QUAL2K models. Therefore, determination of a water quality based phosphorus limit could not be determined at that time. The FRSG in conjunction with the Illinois EPA worked to develop a schedule for completion of the modeling effort and determination of water quality based phosphorus standards. During the drought in the summer of 2012, the FRSG was able to obtain low flow monitoring for the Fox River and is on schedule to present a calibrated model by May 2013.

In January 2013, the Illinois EPA and FRSG were able to agree on special conditions for all dischargers greater than 1 MGD. These conditions included a 1 mg/L interim phosphorus standard and a schedule for completion of the water quality modeling for the development of permanent phosphorus criteria. The permit language requires the FRSG to complete analysis of the alternatives and provide recommendations by January 2015. The permit also requires the POTWs to perform a study and determine the cost for compliance of phosphorus removal for a 1 mg/L standard as well as a 0.5 mg/L standard. It is the intent of the special conditions that all dischargers along the Fox River will meet the recommended standards by 2030.

The special conditions are outlined below:

All permits being renewed for publicly owned treatment works in the Fox River Watershed, south of the Chain of Lakes, with a Design Average Flow of 1.0 million gallons per day or more that receive primarily municipal or domestic wastewater will receive a 1 mg/L phosphorus effluent limitation and will be reissued with the following special conditions:

SPECIAL CONDITION (SPECIAL CONDITION NO.). This Permit may be modified to include alternative or additional final effluent limitations pursuant to either an approved Total Maximum Daily Load (TMDL) Study or an approved Fox River Watershed Water Quality Improvement Implementation Plan.
SPECIAL CONDITION (SPECIAL CONDITION NO.). The Permittee shall monitor the wastewater effluent for Total Phosphorus, Dissolved Phosphorus, Nitrate/Nitrite, Total Kjeldahl Nitrogen (TKN), Ammonia, Total Nitrogen (calculated), Alkalinity and Temperature at least once a month. The results shall be submitted on Discharge Monitoring Report (DMR) Forms or eDMRs to IEPA unless otherwise specified by the IEPA.
SPECIAL CONDITION (SPECIAL CONDITION NO.). The Permittee shall participate in the Fox River Study Group (FRSG) as a member of the FRSG including financial participation as defined by the bylaws of the FRSG. The Permittee shall work with other watershed members to determine the most cost effective means to alleviate dissolved oxygen (DO) violations and offensive conditions in the Fox River. The Permittee shall participate with other watershed members to the extent that the Permittee causes or contributes to such DO violations or offensive conditions. This Permit may be modified to include effluent limitations consistent with the Fox River Watershed Water Quality Improvement Implementation Plan (Implementation Plan) which will be developed after review of the findings of the Fox River Watershed Investigation and the recommendations of the FRSG. The following tasks will be completed during the life of this permit:

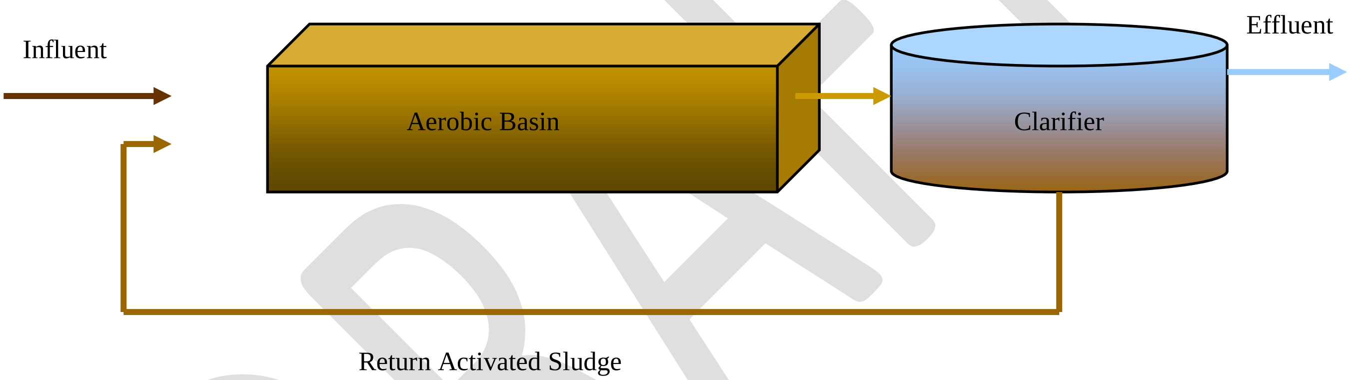
1. *The Permittee shall prepare a phosphorus removal feasibility report specific to its plant(s) on the method, time frame and costs for reducing its loading of phosphorus to levels equivalent to monthly average discharges of 1 mg/L and 0.5 mg/L. The feasibility report shall be submitted to the IEPA twelve (12) months from the effective date of the Permit. The feasibility report shall also be shared with the FRSG.*
2. *The Permittee shall submit the Fox River Study Group Watershed Investigation Phase III Report, which includes stream modeling, to the IEPA by August 1, 2013.*
3. *The FRSG will complete an evaluation of possible phosphorus input reductions by point source discharges, non-point source discharges and other measures needed to alleviate DO violations and offensive conditions in the Fox River with a goal of 2035 to complete the implementation of the Implementation Plan. The Implementation Plan shall be submitted to the IEPA by June 30, 2015. The Permittee shall implement the recommendations of the Implementation Plan that are applicable to said Permittee. This Permit may be modified to include additional pollutant reduction activities pursuant to the Implementation Plan.*

In summary, the Batavia Wastewater Treatment Facility must comply with a 1 mg/L phosphorus limit. It is likely that the treatment facility will need to achieve lower phosphorus effluent limits prior to 2030. In addition, the Batavia Wastewater Treatment Facility requires additional capacity and must be expanded to 4.9 MGD. This expansion triggers the anti-degradation portion of the 2004 requirements. Consequently, the expanded plant must remove total nitrogen as well. Therefore, the facility must be able to perform nutrient removal for both constituents.

6.3.4 Nitrogen Removal Alternatives

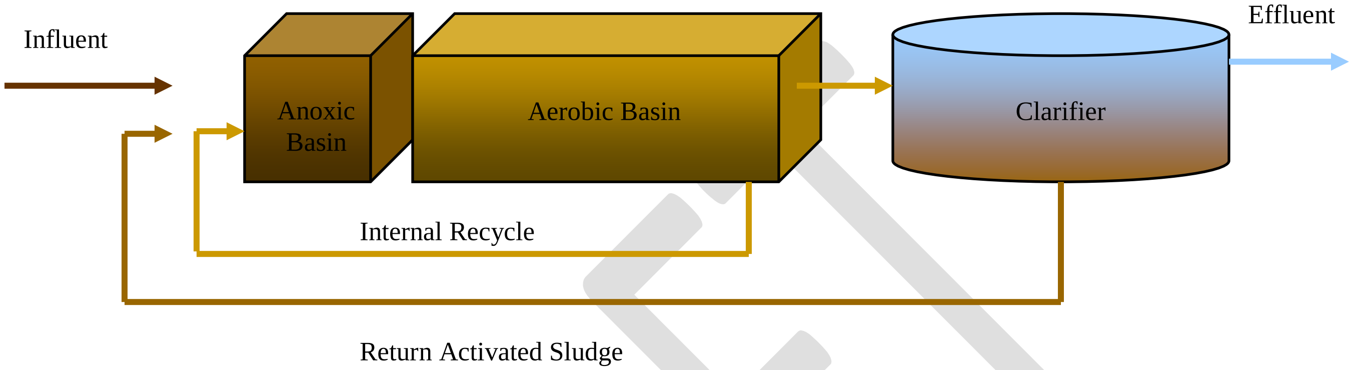
Nitrogen in wastewater can be found in several forms including ammonia (NH_3), ammonium (NH_4^+), nitrate (NO_3^-) and nitrite (NO_2^-). In the past, limits were placed only on the levels of ammonia discharged from wastewater treatment plants since that is the only form of nitrogen that is toxic to aquatic life. Even though they do not directly harm fish, nitrates and nitrites can contribute to algal bloom. Phosphorous, in the form of phosphates (PO_4^-), can also trigger algal growth if it is present in high enough concentrations. Limiting phosphorus and total nitrogen, the sum of all forms of soluble nitrogen, helps to preserve ecosystems in the surrounding watershed.

The City will need to modify this biological process to achieve total nitrogen removal. The removal of nitrogen is effected through the biological oxidation of nitrogen from ammonia to nitrate (nitrification), followed by denitrification, the reduction of nitrate to nitrogen gas. Nitrogen gas is released to the atmosphere and thus removed from the water.



The existing biological process was designed for conversion of soluble bio-degradable organic contaminants and nutrients, specifically ammonia nitrogen. Most aerobic biological processes are designed for the development of beneficial bacteria that are able to convert organic compounds and are capable of performing this task within a very short amount time. However, the conversion of ammonia nitrogen to nitrite (nitrification) is accomplished by *Nitrosomonas* bacteria. In order to develop and maintain a sufficient population of *Nitrosomonas* bacteria within the bio-mass, the process must maintain a low feed to mass ratio, with typical values ranging from 0.08 to 0.12. Since the plant cannot control the influent food source, operators control the bio-mass (MLSS) within the basins. There is a practical limit to the concentration of MLSS ranging from 2,000 to 3,000 mg/l. Therefore, the basins must be constructed large enough to allow the operators to develop a bio-mass population that is 10 to 12 times greater than the incoming food (soluble BOD). The operators maintain the ratio of food to mass by wasting the proper amount of solids from the process. The *Nitrosomonas* bacteria convert ammonia to nitrite, while *Nitrospira*, which are also present, convert the nitrite to nitrate.

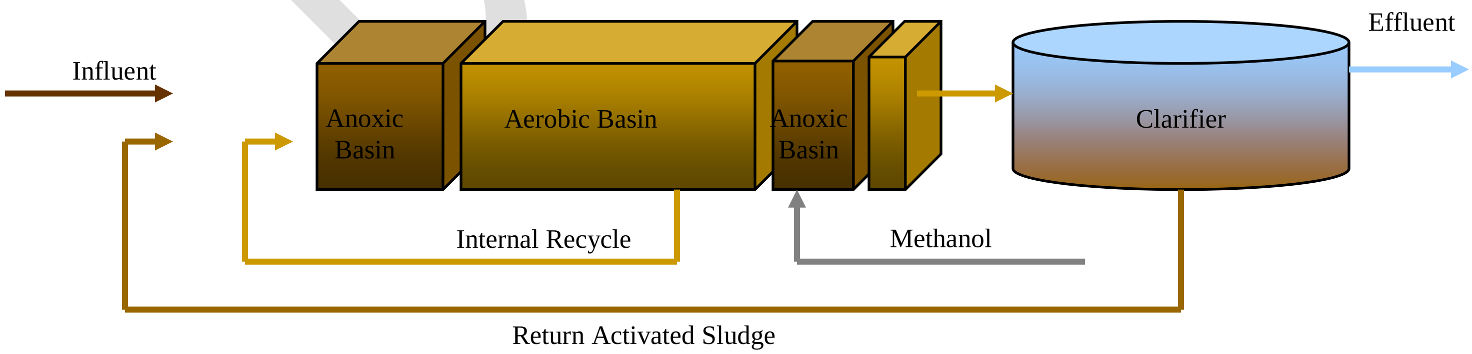
Denitrification is a biological process in which nitrite and nitrate, rather than oxygen, are converted into nitrogen gas in order to break down a food source. Denitrification is an alternative to respiration and is initiated by incorporating a zone that is rich in soluble BOD and operates at a dramatically low dissolved oxygen concentration, an anoxic zone. This zone is typically near the beginning of the biological process were the soluble BOD is plentiful. However, in order to convert the nitrate to nitrogen gas it must be first converted from ammonia to nitrate, which typically is near the end of the biological process. Therefore, most designs incorporate an internal loop, which brings the nitrate rich mixed liquor into contact with the high strength soluble organic matter.



The rate of flow of the internal recycle loop is a controlling factor in the efficiency of the nitrogen removal process. Simply stated, a recycle rate that equals the forward flow would equate to 50% removal, while a recycle rate that equates to twice the forward flow equates to 66% removal.

Recycle Rate = $(NH\text{-}N_{in} / NO_3\text{-}N_{out}) - 1$ - Assuming 66% TKN Removal
Recycle Rate = $(26 \text{ mg/l}/ (26 \times 0.34)) - 1 = 1.94$ or 2

Since the final effluent standard is unknown at this time, the design should incorporate the flexibility to achieve 90% total nitrogen removal. This could be accomplished by incorporating a loop that equates to nine times forward flow, however this recycle rate requires a significant amount of horsepower and increases the overall detention time to maintain anoxic conditions. A more common alternative is a recycle rate of four times the forward flow and construction of a second phase which provides an auxiliary carbon source (typically methanol) for polishing.



6.3.5 Phosphorus Removal Alternatives

Phosphorous removal in wastewater treatment plants was common in the 1970's. The most widespread method of phosphorous removal used at that time was the addition of chemical coagulants that cause phosphate compounds to settle out of solution. Phosphorous removal is possible through biological processes, but the amount of phosphorous that can be removed through such processes is limited.

All life forms utilize a food source and a source of oxidative potential, usually oxygen or nitrite, to absorb phosphates into their bodies as the molecule adenosine tri-phosphate (ATP). This process is known as metabolism. Phosphorous is released from ATP to provide energy for cellular growth and activities. When activated sludge is produced and collected, phosphates absorbed within the cells of microorganisms as ATP and other cellular components are removed from the wastewater flow. This is the basis for biological phosphorous removal, a small amount of which occurs in all activated sludge processes in which activated sludge is wasted.

Greater amounts of phosphorous can be removed through biological methods by creating an anaerobic zone, in which no oxygen or nitrate is available, within a treatment facility's suspended biological growth processes. Most microorganisms are not capable of storing large amounts of ATP and rely on a constant rate of metabolism to maintain cellular activity. Certain microorganisms known as Polyphosphate Accumulating Organisms (PAOs) can store significantly more phosphorous than other heterotrophic bacteria. PAOs are capable of survival in an anaerobic environment absent of nitrate and oxygen. As such, the percentage of PAOs within the microbiological community increases when the process includes an anaerobic zone. The larger PAO population ensures a higher concentration of phosphorus within the sludge wasted from the process.

Biological phosphorus removal requires rigid operational control in order to maximize the efficiency of the process. The process is sensitive to changes in temperature, flow and feed concentration. Biological phosphorous removal may not be able to continuously meet the interim 1 mg/L effluent standard set by the IEPA. Therefore, chemical polishing capabilities would be incorporated into a biological phosphorus removal design.

It is important to note that the phosphorous captured in biological phosphorous removal (Bio-P) process is simply stored in the bodies of microorganisms and can easily be returned to solution. The high phosphorus sludge is wasted from the biological process to a sludge stabilization process. Once stabilized, the sludge is then dewatered and disposed of through land application or land filling operations.

Chemical precipitation can be accomplished within either the primary or secondary treatment process. The City has several options for chemical selection. Lime addition is effective but produces a considerable amount of sludge. Alum and iron salts are more commonly recommended. The locally available iron salts include ferric chloride ($FeCl_3$) and ferrous sulfate ($FeSO_4$). Both are highly corrosive and should be stored in a separate, well-ventilated area.

Chemical precipitation within the primary clarifiers requires a higher dosage than secondary treatment due to the consumption of coagulant in competing reactions. Typically, the dosage requirement is determined by bench scale and field studies and is proportional to the influent flow. It is estimated that the sludge production from chemical precipitation in the primary clarifiers will yield four times the influent pounds of phosphorus removed, which would increase overall primary sludge production by roughly 50%. Other more conservative estimates indicate sludge yields increasing by 100%. The actual yield should be field verified. Benefits of adding iron salt or alum to the primary clarifiers include increased efficiency in solids and BOD_5 removal and precipitation of copper ions.

Chemical precipitation within the secondary process is slightly more predictable. Application points vary from site to site. Some facilities introduce the chemical to the RAS prior to entering the basins while others add the iron salt or alum in the MLSS diversion structure. Advantages of precipitation in the secondary process include lower chemical requirements, increased settleability of the flocs within the clarifiers, and lower sludge production. However, the sludge produced is a waste activated sludge and can reduce the efficiency of the anaerobic digestion system.

The estimated influent phosphorus concentration is 6 mg/l. The chemical precipitation required for phosphorus removal is estimated to be one mole of iron (Fe) for one mole phosphorus (P). However, an additional one to five moles of iron is required to satisfy competing reactions, such as hydroxide formation. For purposes of this evaluation, it was estimated that the plant would need to use five moles (1 mole + 4 moles additional) per mole of phosphorus for primary treatment. Similarly the estimate is based on three moles (1 mole + 2 moles additional) per mole of phosphorus for secondary treatment. The calculations for ferric chloride ($FeCl_3$) addition at 35% solution strength are as follows:

<u>$FeCl_3$ Dosage for Phosphorous Removal</u>

Molecular Weight of PO_4 = 95 g/mole

Moles / Pound of PO_4 = 453 g/lb / 95 g/mole = 4.768 moles of PO_4/ pound

Molecular Weight of $FeCl_3$ = 164 g /mole

Moles / Pound of $FeCl_3$ = 453 g/lb / 164 g/mole = 2.78 moles of $FeCl_3$/ pound

Weight of $FeCl_3$ per gal of solution = 11.23 lb/gal x 35% = 3.93 lb of $FeCl_3$/ gal

3.93 lb of $FeCl_3$/ gal x 2.78 moles / pound = 10.9 moles of $FeCl_3$ per gallon

Determine $FeCl_3$ dosage for Primary Treatment (use 5 moles Fe Cl_3 /1 mole PO_4)

5 mol $FeCl_3$ per mole of PO_4 x 4.768 mol PO_4/ lb PO_4 = 23.39 mol $FeCl_3$ /lb PO_4

23.39 mol $FeCl_3$ / lb PO_4 / 10.9 mol $FeCl_3$ / gal $FeCl_3$ = 2.15 gals $FeCl_3$/ lb PO_4

Use 2.5 gallons of FeCl per pound PO_4

Determine $FeCl_3$ dosage for Secondary Treatment (use 3 moles $FeCl_3$ / per mole PO_4)

3 mol $FeCl_3$ per mole of PO_4 x 4.768 mol PO_4/ lb PO_4 = 14.304 mol $FeCl_3$ /lb PO_4

14.304 mol $FeCl_3$ / lb PO_4 / 10.9 mol $FeCl_3$ / gal $FeCl_3$ = 1.31 gals $FeCl_3$/ lb PO_4

Use 1.5 gallons of FeCl per pound PO_4

The ferric chloride and ferric sulfate are commodities and the price is determined by supply and demand. Ferric chloride is a by-product of the steel industry. In the 1960's, 70's, and 80's, ferric chloride and ferric sulfate compounds used for phosphorus removal were abundant. The US steel industry has been in a significant production decline and the industry has begun to recycle iron salt compounds. The reemergence of phosphorus removal will result in an increased demand for the iron salts, while the current market trends indicate less will be produced. The current price of ferric chloride is roughly $1.00 per gallon delivered. The following chemical cost analysis was performed assuming an influent concentration of 6 mg/l and a dosage requirement of two and one half gallons per pound for primary treatment and one and one half gallons per pound for secondary treatment.

Cost Analysis - Ferric Chloride (FeCl) for Primary Treatment				
DAF (MGD)	Phosphorus (Lbs/day)	Phosphorus (Lbs/ Year)	FeCl (Gallons/year)	Estimated Annual Cost
3	150	54,750	136,875	$ 136,875
4	200	73,000	182,500	$ 182,500
5	250	91,250	228,125	$ 228,125

Cost Analysis - Ferric Chloride (FeCl) for Secondary Treatment				
DAF (MGD)	Phosphorus (Lbs/day)	Phosphorus (Lbs/ Year)	FeCl (Gallons/year)	Estimated Annual Cost
3	150	54,750	82,125	$ 82,125
4	200	73,000	109,500	$ 109,500
5	250	91,250	136,875	$ 136,875

When adding ferric chloride to the primary clarifiers, chemical precipitation will significantly increase sludge production from the primary treatment process. The suspended solids removal efficiency would be expected to increase from 55% to 70%. The chemical addition also generates solids by precipitating the phosphates, sulfates and other compounds.

Primary Sludge Production Estimate for Iron Salt Precipitation

The Ferric Chloride and Phosphate produce >>> $FePO_4$ + $Fe[OH]_3$

Molecular Weight of PO_4 = 95 g/mole
Moles / Pound = 453 g/lb / 95 g/mole = 4.768 moles / pound

Molecular Weight of $FePO_4$ = 151 g/mole
Moles / Pound = 151 g/mole / 453 g/lb = 0.33 pound/ mole

Molecular Weight of $Fe[OH]_3$ = 106 g/mole
Moles / Pound = 106 g/mole / 453 g/lb = 0.23 pound/ moles
4 moles $Fe[OH]_3$ / mole of PO_4 removed = 0.23 pound/ moles x 4 = 0.92 pounds /mole

0.33 pound/ mole + 0.92 pound/ moles = 1.25 pounds solids / mole PO_4

1.25 pounds solids/mole PO_4 x 4.768 moles PO_4 / pound PO_4 = 5.96 lb solids/ pound PO_4

Estimate of Increased Primary Sludge Production					
DAF (MGD)	Iron Sludge Production (lbs/day)	Primary Sludge Production @ 70% (lbs/day)	Total Sludge Production (lbs/day)	Traditional Pound of Primary Sludge Per Day @ 55%	Net Pounds of Increased Primary Sludge (lbs/day)
3	895	4,781	5,676	3,757	1,919
4	1,193	6,375	7,568	5,009	2,559
5	1,491	7,969	9,460	6,261	3,199

The estimated increase in primary sludge production is roughly 51% based on the previous calculations. However, the BOD_5 removal efficiency of the primary clarifiers slightly increases from 32% to 36%, thereby reducing the loading to the biological process.

In comparison, chemical precipitation of phosphorus in the secondary process utilizes 1.5 gallons per pound phosphorus and produces 3.77 pounds of solids per pound of phosphorus removed. The following table estimates the sludge production from the biological (secondary) process under four conditions – current design, chemical phosphorus removal in primary clarifiers, chemical phosphorus removal in the secondary process and biological phosphorus removal.

Estimate of Secondary Sludge Production				
DAF (MGD)	WAS Production without P Removal (lbs/day)	WAS Production using Chem-P in Primary (lbs/day)	WAS Production using Chem-P in Secondary (lbs/day)	WAS Production from Bio-P Process (lbs/day)
3	2,245	2,113	2,811	2,763
4	2,993	2,817	3,748	3,684
5	3,742	3,521	4,685	4,605

Comparison of the biological and chemical phosphorus removal processes should include a side by side analysis of the anticipated sludge production, operational cost, reliability, and effects on downstream processes.

The following table compares the current process (no phosphorus removal), Bio P and Chem P removal processes for primary and waste activated sludge production in pounds per day.

Comparison of Chemical and Biological Phosphorus Removal							
DAF (MGD)	Type of Phosphorus Removal	Primary Sludge (lbs/day)	Secondary Sludge (lbs/day)	Total Sludge (lbs/day)	Primary	WAS	Total
3	No Phosphorus Removal	3,757	2,245	6,002	63%	37%	100%
	Chem-P in Primary	5,511	2,113	7,624	72%	28%	127%
	Chem-P in Secondary	3,757	2,811	6,568	57%	43%	109%
	Biological P Removal	3,757	2,763	6,520	58%	42%	109%
4	No Phosphorus Removal	5,009	2,993	8,002	63%	37%	100%
	Chem-P in Primary	7,348	2,817	10,165	72%	28%	127%
	Chem-P in Secondary	5,009	3,748	8,757	57%	43%	109%
	Biological P Removal	5,009	3,684	8,693	58%	42%	109%
5	No Phosphorus Removal	6,261	3,742	10,003	63%	37%	100%
	Chem-P in Primary	9,185	3,521	12,706	72%	28%	127%
	Chem-P in Secondary	6,261	4,685	10,946	57%	43%	109%
	Biological P Removal	6,261	4,605	10,866	58%	42%	109%

The overall sludge production will increase with either removal process. It is anticipated that the overall sludge production will increase as much as 27% using chemical precipitation in the primary clarifiers and 9% using chemical precipitation in the secondary process or a biological phosphorus removal process.

As stated previously, chemical addition capabilities would be incorporated into the project for either Bio-P or Chem-P to ensure the facility can meet the proposed 1 mg/l standard. The biological process will be designed to incorporate anoxic zones for denitrification. In many cases, adding Bio-P capabilities to the nitrification/denitrification process would require only minor piping differences and construction of an additional wall to separate the anaerobic zone from the anoxic zone, but the aeration basins at the Batavia Wastewater Treatment Facility are not large enough to provide the detention time necessary for typical Bio-P configurations (14 hours). The current basins would need to be expanded or a new set of basins would need to be added to the facility in order to operate a biological growth process optimized for both phosphorous removal and denitrification.

6.3.6 Biosolids Stabilization

The Batavia Wastewater Treatment Facility currently utilizes anaerobic digestion to reduce the overall sludge volume to be disposed of. This process meets the Class B requirements for land application of biosolids. The digested sludge is dewatered and hauled to the Davis Junction Landfill.

The anaerobic digestion process operates more efficiently in the stabilization of primary sludge verses biological sludge. The table on the previous page provided ratios for primary verses biological sludge production for the different phosphorus removal processes. A second consideration in evaluation of these processes with anaerobic digestion is the fate of the phosphorus. Phosphorus that is chemically bound with iron will remain with the sludge in the stabilization and disposal process. Phosphorus from the biological sludge will become available as the microorganisms are converted in the digestion process. In addition, Bio-P waste activated sludge will release the phosphorus under anaerobic conditions and potentially create operational issues associated with the formation of struvite (a mineral like compound made up of N, P & Mg) within the digester. Therefore, phosphorus recycle must be addressed. Lastly, the existing anaerobic digesters are projected to be overloaded under future design conditions based on Illinois EPA requirements. Therefore, expansion of the plant's hydraulic capacity may require expansion of the digestion capacity as well.

The City has a long term contract for sludge disposal with the Davis Junction landfill. As such, the City's sludge disposal is regulated under Section 208, not Section 503 which requires sludge stabilization. Therefore, the City is not required to stabilize the sludge prior to disposal. The Davis Junction landfill is approximately 60 miles from the City and trucking costs are an important component. The trucking cost has been estimated to be $25 per wet ton. While stabilization should be considered for long term needs, the current landfill operations place a priority on economical volume reduction rather than regulatory stabilization criteria for land application.

Another consideration is odor control. While dewatering of waste activated sludge (WAS) from the biological process is relatively odor free, the material does not dewater easily and total cake volume is significantly greater than stabilized sludge. Conversely, primary sludge does dewater easily, but will likely result in a significant release of odor causing gases and is not recommended. Stabilized sludge tends to dewater much better than raw sludges and produce significantly less odors.

The table below is an estimate of total sludge volumes for raw and stabilized sludge alternatives for the current design as well as Chem-P and Bio-P alternatives. The first column estimates the cubic yards per day produced without utilizing anaerobic digestion. This alternative estimates that the primary sludge will dewater to 30% solids, while the waste activated sludge (WAS) will only dewater to 16% solids. The second column estimates the sludge production with stabilization of the primary sludge through anaerobic digestion. This alternative will minimize odor concerns and estimates that the primary digested sludge will dewater to 32% solids while the WAS will dewater to 14% solids. This alternative could be completed using the existing anaerobic digesters. The third alternative contemplates expansion of the anaerobic digesters to stabilize all of the solids and estimates their concentration at 27%. A fourth alternative would include anaerobic digestion of the Primary Sludge and aerobic digestion of the waste activated sludge.

Volume for Raw and Stabilized Sludge (Current Design/Chemical-P/Biological P)					
DAF (MGD)	Type of Phosphorus Removal	* No Stabilization (Cu Yds/ Day)	** Primary Stabilized Only (Cu Yds/Day)	*** Anaerobic Digestion (Cu Yds/Day)	**** Anaerobic & Aerobic Digestion (Cu Yds/Day)
3	No Phosphorus Removal	16	12	7	9
	Chem-P in Primary	19	13	9	11
	Chem-P in Secondary	18	14	8	11
	Biological P Removal	18	14	8	10
4	No Phosphorus Removal	21	16	10	12
	Chem-P in Primary	25	18	12	14
	Chem-P in Secondary	24	19	11	14
	Biological P Removal	24	19	10	14
5	No Phosphorus Removal	26	20	12	15
	Chem-P in Primary	31	22	15	18
	Chem-P in Secondary	30	24	13	18
	Biological P Removal	29	23	13	17

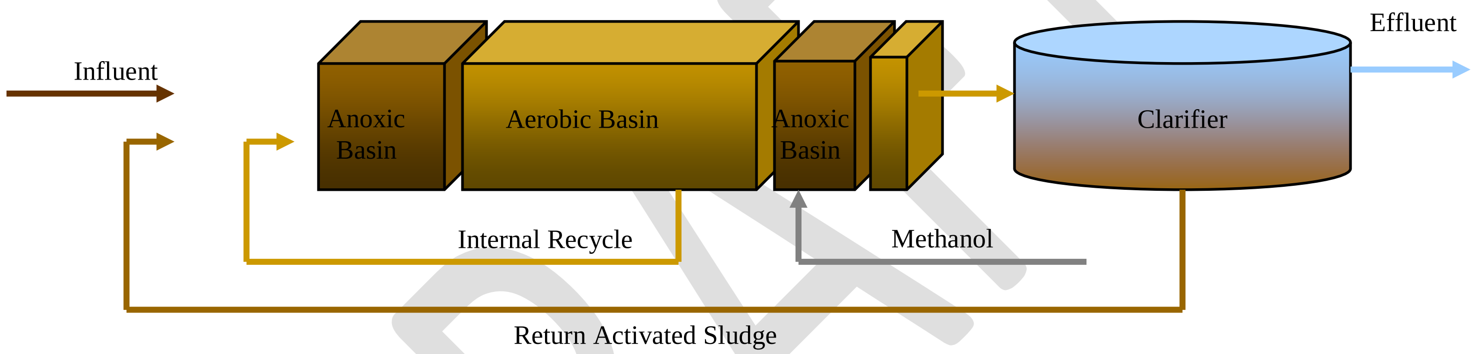
* No Stabilization assumes 30% Primary Cake & 16% WAS Cake
** Primary Stabilization Assumes 32% Primary Cake & 16% WAS Cake
*** All Sludge Stabilized assumes Blended Digested @ 27% Cake
**** Assumes Anaerobic @ 32% Cake & Aerobic at 18% Cake

Based on the above analysis, no stabilization of biosolids creates the largest volume of sludge to dispose of, therefore generating the greatest disposal cost. Not stabilizing the sludge is the most flexible option though because either Chem-P or Bio-P can be used. The stabilization of primary sludge only is very cost effective in that additional digestion capacity is not required. It can also be used in conjunction with Bio-P (reduced chemical cost) and will reduce the overall sludge production by four to five yards per day in comparison to no sludge stabilization. Anaerobic digestion of all sludge produces the least amount of sludge; however, this alternative requires that the Chem–P process be used (not Bio-P) in order to provide phosphorus control within the digesters. Anaerobically digesting both primary sludge and waste activated sludge may require expansion of the digestion system. The last stabilization alternative incorporates anaerobic and aerobic digestion methods. Stabilization of primary sludge in the anaerobic digesters and stabilization of the waste activated sludge in aerobic digesters (to be constructed) allows for sludge reduction with use of chemical for phosphorus control but avoids operational issues within the digesters.

In order to determine the most cost effective solution, an analysis of the three options where biosolids were stabilized was performed and the results are outlined on the following page. As proposed in the 2008 Wastewater Master Plan, the most cost effective solution continues to be disposal without digestion of the waste activated sludge. This is due to the low cost of disposal, $25 / Wet Ton. As disposal costs rise, the City should re-visit this issue to determine if a different option is more cost-effective.

COST SUMMARY OF SLUDGE STABILIZATION OPTIONS			
DESCRIPTION	ANAEROBIC DIGESTION OF PRIMARY SLUDGE ONLY	ANAEROBIC DIGESTION OF PRIMARY SLUDGE & WAS	ANAEROBIC DIGESTION OF PRIMARY SLUDGE & AEROBIC DIGESTION OF WAS
Chemical Addition	**$22,812.50**	**$136,875.00**	**$22,812.50**
Thickening			
Power	*$3,632.69*	*$3,632.69*	*$3,632.69*
Polymer	*$9,373.02*	*$9,373.02*	*$9,373.02*
Labor	*$150,021.52*	*$150,021.52*	*$150,021.52*
	$163,027.22	**$163,027.22**	**$163,027.22**
Anaerobic Digestion			
Boiler Power	*$10,451.73*	*$20,903.46*	*$10,451.73*
Pump Power	*$26,129.33*	*$52,258.66*	*$26,129.33*
	$36,581.06	***$73,162.12***	***$36,581.06***
Aerobic Digestion			
Blower Power	*$0.00*	*$0.00*	*$130,646.64*
Pump Power	*$0.00*	*$0.00*	*$0.00*
	$0.00	***$0.00***	***$130,646.64***
Anaerobically Digested Sludge Dewatering			
Power	*$3,984.15*	*$7,049.23*	*$3,984.15*
Polymer	*$14,365.39*	*$25,588.05*	*$14,365.39*
Labor	*$59,556.40*	*$77,294.14*	*$59,556.40*
	$77,905.94	**$109,931.42**	**$77,905.94**
Undigested/ Aerobic Sludge Dewatering			
Power	*$3,065.08*	*$0.00*	*$6,132.00*
Polymer	*$20,620.64*	*$0.00*	*$13,234.70*
Labor	*$54,237.74*	*$0.00*	*$71,986.11*
	$77,923.46	**$0.00**	**$91,352.81**
Disposal			
Anaerobically Digested Sludge Hauling	*$46,375.88*	*$97,903.48*	*$46,375.88*
Undigested Hauling	*$133,139.45*	*$0.00*	*$83,552.40*
	$179,515.34	**$97,903.48**	**$129,928.29**
TOTAL	**$557,765.51**	**$580,899.24**	**$652,254.46**

Assuming the City selects stabilization of primary sludge only (most cost-effective option in terms of disposal costs), the reduction of waste activated sludge volume should still be considered. While several sludge reduction processes are currently marketed, most require the construction of additional tankage, which is counter-productive based on land area limitations at the existing facility. A sludge reduction process that does not require additional tankage is the Lysis technology. Lysis is the process of oxidizing the microorganisms and destroying the cell wall, which results in converting the micro-organisms into a viable food source. This technology has been used in industrial applications for the harvesting of certain proteins, lipids and acids. Until recently, Lysis was considered too inefficient due to power consumption and process control requirements to be applied to the wastewater industry. Advancements in the technology have shown that it can be cost effective in certain applications. The process has a very small footprint and can convert the waste activated sludge from a by-product to a food source for the other processes on the site. This conversion could be used to offset the chemical cost for auxiliary carbon sources (methanol) within the denitrification process.



Therefore, further investigation and implementation of the Lysis technology should be considered, particularly if the City intends to employ chemical phosphorus removal within the secondary process. The estimated annual capital and operating cost for the system is estimated to be $75,000. In comparison, the reduction in overall volume of waste activated sludge would equate to a savings of $126,000, yielding a net savings of $51,000.

However, implementation of Chemical Phosphorus removal requires an annual expense of $137,000 in chemical costs. The Bio-P process would have annual expenses of $23,000 for chemical and an additional $21,000 for mixer power requirements, for a total $44,000. Therefore, the Bio-P process is $93,000 less expensive to operate.

Based on this analysis, the cost savings generated by implementing the Lysis technology would not offset the increased operational cost to implement Chemical Phosphorus Removal instead Bio-P removal.

Therefore, implementation of the Lysis system should only be considered if the City elects to implement Chemical Phosphorus removal in combination with Anaerobic Digestion. A comparison was completed for this alternative and the summary is provided on the following page.

COST SUMMARY OF ANAEROBIC DIGESTION - CHEM-P REMOVAL VS. BIO-P REMOVAL			
ANAEROBIC DIGESTION OF PRIMARY SLUDGE ONLY W/ BIO-P		**ANAEROBIC OF PRIMARY SLUDGE & WAS W/ CHEM-P**	
Bio-P Process		**Chem-P Process**	
Chemical Addition	$22,812.50	*Chemical Addition*	$136,875.00
Operation of Mixers	$21,000.00	*Operation of Lysis*	$75,000.00
	$43,812.50		**$211,875.00**
Thickening		**Thickening**	
Power	*$3,632.69*	*Power*	*$1,453.39*
Polymer	*$9,373.02*	*Polymer*	*$3,750.01*
Labor	*$150,021.52*	*Labor*	*$81,918.33*
	$163,027.22		**$87,121.73**
Anaerobic Digestion		**Anaerobic Digestion**	
Boiler Power	*$10,451.73*	*Boiler Power*	*$10,451.73*
Pump Power	*$26,129.33*	*Pump Power*	*$26,129.33*
	$36,581.06		***$36,581.06***
Anaerobically Digested Sludge Dewatering		**Anaerobically Digested Sludge Dewatering**	
Power	*$3,984.15*	*Power*	*$5,210.44*
Polymer	*$14,365.39*	*Polymer*	*$20,048.48*
Labor	*$59,556.40*	*Labor*	*$66,653.01*
	$77,905.94		**$91,911.93**
Undigested Sludge Dewatering		**Undigested Sludge Dewatering**	
Power	*$3,065.08*	*Power*	*$0.00*
Polymer	*$20,620.64*	*Polymer*	*$0.00*
Labor	*$54,237.74*	*Labor*	*$0.00*
	$77,923.46		**$0.00**
Disposal		**Disposal**	
Anaerobic Digested Sludge Hauling	*$46,375.88*	*Anaerobic Digested Sludge Hauling*	*$76,708.29*
Undigested Hauling	*$133,139.45*	*Undigested Hauling*	*$0.00*
	$179,515.34		**$76,708.29**
Anaerobic Digestion of Primary Sludge Only (Bio-P)	**$578,765.51**	**Anaerobic of Primary Sludge and WAS (Chem-P)**	**$504,198.01**

The result of the above analysis demonstrates that incorporation of the Lysis technology lowers the overall cost of operation and volume of waste to be disposed of. In addition, this technology would allow the City to meet Class B requirements without expansion of the digestion system. Therefore, it is recommended that the City consider incorporation of the Lysis technology into the proposed plant improvements.

6.4 EXPANSION REQUIREMENTS

Section 2 of this Study provides updated population projections based on the City's revised Comprehensive Plan. The Comprehensive Plan indicates annexation and land use designations for properties which are outside the current Sewer Service Area. The Comprehensive Planning Area was broken down into seven key growth areas and population projections were developed for each of these areas.

A table in Section 2.3 provided population equivalent estimates divided into three categories: existing P.E. served, proposed P.E. within the Sewer Service Area, and proposed P.E. within the entire Comprehensive Planning Area. The City currently serves an estimated 36,612 P.E. At build-out of the current Sewer Service Area the population equivalent to be served equates to 49,825 P.E. In contrast, build-out of Comprehensive Planning Area includes 88,374 P.E.

As discussed in Section 5, the existing wastewater treatment facility is rated for 4.2 MGD or 42,000 P.E. The plant site is located in the downtown region and space for expansion within the current site is very limited. During development of this Study, the City considered a parallel study which focused on development within the Southwest Basin. A separate "Mooseheart Report" was developed and the findings are provided below.

Three alternatives were investigated and conceptual cost estimates developed based on a series of assumptions. The alternatives included regionalization, satellite treatment and an intergovernmental agreement with Fox Metro Water Reclamation District. Below are brief descriptions of the Alternatives and their associated costs.

Alternative #1 - *Construction of conveyance from the Mooseheart area and expansion of the Main WWTP to 9.0 MGD.*
Construction = $76.7 M
Project = $108.5 M

Alternative #2 - *Construction of a new Mooseheart Facility and a limited expansion/upgrade of the Main WWTP.*
Construction = $61.6 M
Project = $84.3 M

Alternative #3 - *Enter into an intergovernmental agreement with the Fox Metro Water Reclamation District to provide service to the region that cannot be served by the City's Main WWTP.*
Construction = $42.5 M + FMWRD
Project = $61.6 M + FMWRD

While cost is a significant factor within the decision making process, other factors such as schedule, phasing and public acceptance must be considered. Based on the analysis *performed, it would be in the City's best interest to explore the opportunities for an intergovernmental agreement with the Fox Metro Water Reclamation District. Depending on the costs associated with obtaining sanitary service from the District, Alternative #3 may be the low cost alternative.*

If Alternative #3 is not publicly acceptable or does not meet with the City's long term goals, then Alternative #2 should be considered for implementation.

The City has elected to concentrate its efforts on providing service to areas within the Sewer Service Area, which excludes the Far West, Southwest Basin and Fermi-Lab Service Area. At this time, it is contemplated that the Far West Service Area will be low density development and be served by private sewer and water systems. The Southwest Basin will be served by either Fox Metro or a secondary facility constructed to replace the existing "Mooseheart Facility". The Fermi-Lab service area is currently owned by the Federal Government. If and when this area is redeveloped a future study to determine treatment alternatives will be developed. At this time it is proposed that the Fermi-Lab Service Area will be served by an on-site treatment facility, which is consistent with previous Facility Plan Amendments.

As detailed in Section 2, the build-out population projection within the Facility Planning Area has increased from 42,000 P.E. to over 49,000 P.E. through an update of the Comprehensive Plan, which will require expansion of the existing wastewater treatment facility.

The overall plan must address:

- Capacity Needs
- Rehabilitation Needs
- Regulatory Needs
  - Bio-solids Stabilization
  - Phosphorus Removal
  - Total Nitrogen Removal
  - Excess Flow Treatment

The treatment facility will be expanded from 4.2 MGD to 4.9 MGD. The project will incorporate replacement of components that have reached the end of their useful life. The City will continue to dispose of solids at Davis Junction Landfill and will not be required to expand its biosolids handling capacity; however, significant portions will be rehabilitated or replaced as part of the improvements.

Nutrient Removal for Phosphorus and Total Nitrogen will be required to meet water quality standards as well as anti-degradation requirements. Total Nitrogen Removal will require 10 to 11 hours detention time. The existing biological process includes approximately 2,000,000 gallons, which equates to 11.3 hours detention time at 4.2 MGD, but only provides 9.7 hours at the future 4.9 MGD. It is important to note that the existing aeration basins include an intermediate pump station and in order for the nitrification/denitrification process to be completed effectively, an internal recycle must be included which requires significantly more horsepower. In addition, it is anticipated that future Total Nitrogen regulations may set limits as low as 5 mg/l, which would require a second stage to the system requiring longer detention times of 12 to 13 hours.

Phosphorus removal alternatives presented in Section 6.3.5 demonstrate that the difference between Bio-P and Chem-P is related to operational costs and sludge production. Implementation of the Chem-P alternative will cost $80,000 to $140,000 per year as shown on page 6-10. However, Chem-P used in conjunction with Cell Lysis would reduce the overall sludge production and save the City roughly $80,000 per year considering all chemical, operational and disposal costs.

Taking all of the different nutrient removal processes and biosolids handling alternatives discussed above into consideration, two concepts were developed. The first concept is inclusion of the Chem-P process in the secondary treatment process. By also introducing the Lysis technology with this concept, the overall waste activated sludge volume will be reduced.

If the City chooses to implement the Chem-P process in the expanded plant, the process will require 12.5 hours of detention time. To reach 12.5 hours of detention at 4.9 MGD, a total of 2,550,208 gallons of tank volume is needed.

$$12.5 \text{ hours} / 24 \text{ hours} \times 4.9 \text{ MGD} = 2{,}550{,}208 \text{ gallons}$$

As stated in Section 5, the “old” aeration basins would be demolished and either new, larger aeration basins would be constructed at the same location or the nitrification basins constructed during the 2001 Expansion would be expanded. By reusing the existing “new” aeration basins (395,841 gallons) and the Nitrification Basins (1,098,461 gallons), an additional 1,055,906 gallons of tank volume will be required.

If the City elects not to pursue Chem-P and Cell Lysis, the additional tankage volume required to facilitate Bio-P equates to 1.5 hours of detention time or 306,250 gallons in addition to the 1,055,906 gallons of additional tank volume already required.

$$4{,}900{,}000 \text{ gallons per day} \times 1.5 \text{ hours} / 24 \text{ hours / day} = 306{,}250 \text{ gallons}$$

Taking these factors into consideration, a second concept incorporating the Bio-P process was developed. The concept includes a very conventional design based on expansion of the wastewater treatment facility utilizing the Bio-P process in conjunction with a five-stage BNR process with the last two stages dedicated to denitrification and polishing. The basic changes include conversion of the first aeration basins to anaerobic selector basins with submersible mixers. As stated in Section 5, the “old” aeration basins would be demolished and either new, larger aeration basins would be constructed at the same location or the nitrification basins constructed during the 2001 Expansion would be expanded to support the five-stage BNR process . A new intermediate pump station would also be constructed. Expanding the existing nitrification basins would require the purchase of additional property to accommodate construction of the added basins.

Attached are draft alternative layouts for discussion purposes for the February 19th, 2013 Public Utilities Board Meeting.