Viroqua
Growing Forward

Wastewater Treatment Facility Facilities Planning Document

City of Viroqua, Wisconsin

June 2015

TOWN & COUNTRY ENGINEERING, INC.

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Facilities Planning Document

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FACILITIES PLANNING DOCUMENT

City of Viroqua, Wisconsin

June 2015

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1. EXECUTIVE SUMMARY

1.1 General Overview

The City of Viroqua is undertaking facilities planning for its wastewater treatment facility (WWTF) to address equipment and process deficiencies, meet current and future permit requirements, and provide the staff with increased flexibility in dealing with daily operational conditions. This Facilities Planning Document establishes long term conditions for which the facility must be designed, and identifies processes and equipment that are to be upgraded or replaced to meet the overall goals set forth.

The City's current Wisconsin Pollutant Discharge Elimination System (WPDES) permit requires preparation of a Facilities Plan Phase 1 to assess discharge of effluent to the Springville Branch of the Bad Axe River. According to the Wisconsin Department of Natural Resources (WDNR), approximately 75% of the flow in the receiving stream is lost to fractured dolomite, resulting in WWTF effluent being discharged to groundwater. This Facilities Planning Document addresses options for moving or modifying the current outfall, as well as treatment upgrades for the WWTF.

This Facilities Planning Document also takes into consideration the need for process modifications and upgrades to meet new effluent phosphorus limits that will take effect with the next permit issuance, but does not include an ultimate selection of alternatives for phosphorus compliance. The current phosphorus compliance schedule requires the submittal of a Facilities Planning Status Report in August 2015, which is fulfilled by this Document. The City will continue to evaluate feasible alternatives for meeting the final phosphorus limits, which may include facility upgrading, Watershed Adaptive Management, Water Quality Trading, or a water quality standards variance. The selected phosphorus compliance option will be described in a Preliminary Facilities Plan Phase 2 that will be submitted by August 1, 2016 as an Addendum to this document, with a Final Plan submitted by January 2017. One goal of this Facility Planning Document is to recommend modifications to the existing treatment plant that will maximize the current biological treatment and nutrient removal to decrease the amount of phosphorus removal/reduction that will be required by other means.

The planning process necessarily depends on input from various sectors of the community including City staff, private citizens, industries, and the commercial sector to become a successful planning tool. Historical records have been evaluated and projections have been made to establish long term needs. The recommended alternative for implementation is summarized in the following sections included within this chapter, however for a more detailed look at all alternatives evaluated, reference should be made to the remaining chapters and appendices.

1.2 Conclusions

The existing WWTF was constructed in 1978 and originally consisted of primary clarifiers and two activated sludge package plant trains. The plant has undergone a number of upgrades and modifications, with the latest one in 2002 designed for a flow of 0.600 MDG, 1,215 lbs/day biochemical oxygen demand (BOD) and 1,168 lbs/day suspended solids. The WWTF currently provides treatment with influent screening, primary clarifiers, selector and aeration basins for secondary treatment and biological phosphorus removal, final clarifiers, ultraviolet disinfection of effluent and solids handling through anaerobic digestion, sludge storage, and land application of liquid sludge.

While the WWTF is currently operating well and meeting permit limits, there are several modifications needed to extend the life of plant for the next 20 years and provide adequate treatment for future wastewater generated in the City of Viroqua service area. The population within this service area is projected to grow by approximately 1% per year, for a projected year 2035 population of 5,346. In addition, modest growth (10-20% over 20 years) has been projected for the commercial, industrial, and public authority sectors based on the 2007 Comprehensive Plan and input from the City. Additional contributions come from future potential acceptance of leachate, septage and/or holding tank wastewater from outside sources. Currently the City facility accepts leachate from the Vernon County Landfill in the amount of 1 to 1.5 million gallons annually. Other hauled wastes are accepted on a case by case basis, but it is felt that the demand for this practice will become even greater in the future.

Chapter 3 of this Facilities Planning Document focuses on the condition of the existing plant and the current flows and loads. Chapter 4 presents the future design conditions based on the projected growth. Chapter 5 identifies alternatives for moving or modifying the current WWTF outfall, as well as plant upgrades to address the following issues:

- Processes/structures with current operational issues, at end of design life, or in need of repair.
- Processes/structures requiring upgrade/modifications to meet new permit limits.

- Processes/structures requiring upgrade/modifications to meet peak flows and future flow/loads.
- General plant issues.

It is the City's intent to use a phased approach to address these issues, with the first phase of design and construction to include the WWTF outfall modifications/relocation and the most pressing issues identified for the current processes and equipment. Subsequent phases will include upgrades to meet future design conditions and less immediate plant needs. The need for improved phosphorus removal to meet new permit requirements has been taken into consideration and will be more fully addressed in future planning and design submittals following the phosphorus compliance schedule in the WPDES permit.

1.3 Recommendations

Based on the economic and non-economic evaluations presented in Chapters 5 and 6, the recommended alternatives for the first phase of plant modifications and outfall modifications/relocation are as follows:

- Bypassing of the disappearing portion of the current receiving stream using an effluent lift station and force main (Outfall Alternative 2B). This alternative was chosen following discussions with the WDNR about options for stream bypassing, streambed rehabilitation, or increased treatment to meet groundwater discharge standards. The City has decided that bypassing the disappearing portion of the stream has the greatest degree of certainty for success and the least amount of future risk for the City. The force main option has a lower estimated capital cost than the gravity piping option that was also considered.

- Modifying the biological treatment portion of the existing WWTF to create a single biological treatment train (selectors and aeration basins) to be used with one or both final clarifiers (Phase 1 Alternative 3). While this alternative is estimated to be slightly higher in capital costs than the other two alternatives considered, it provides the most flexibility for operations, future expansion, and meeting current and future nutrient limits. The annual operating expenses for this alternative are expected to be less than the other alternatives due to reductions in electricity usage and chemicals for phosphorus removal. Additional modifications are needed for other treatment processes, as described below, and were assumed to be equal for all the alternatives considered.

Along with these recommendations, the following requests are made to the WDNR:

- **Approval of a design flow rate of 1,000 gpm (1.44 MGD) for the effluent lift station and force main with bypassing of treated effluent to the existing outfall during wet weather in the event that effluent flow exceeds 1,000 gpm.** During previous meetings with the WDNR this was discussed as a possibility because the baseflow in the receiving stream is expected to be significantly increased during wet weather events. Minor hydraulic modifications to the plant are recommended as part of Phase 1 to limit forward flow through the plant to 1,000 gpm during wet weather periods with diversion of excess flow to the equalization storage pond. Therefore, the likelihood of bypassing to the existing outfall will be reduced.
- **Approval of a 90-day extension on the completion date for the outfall relocation, from July 1, 2018 to September 30, 2018.** This extension is requested based on the proposed schedule for obtaining funding (Section 1.6).

A summary of the recommended improvements proposed for the first phase of construction at wastewater treatment facility are as follows:

- Construction of an effluent lift station and force main to relocate the outfall to Hwy B/Miller Rd
- Replacement of corroded primary clarifier skimmers
- Minor hydraulics/piping modifications to limit peak forward flow through the plant and improve diversion to equalization storage basin
- Modifications to biological treatment trains to allow for series operation of selector and aeration basins, with ability to bypass each basin, to improve biological nutrient removal
- Addition of flow splitting after the aeration basins to allow use of one or both final clarifiers, as needed
- Replacement of aging final clarifier mechanical equipment to improve reliability and performance
- Replacement of two aeration blowers to improve operational efficiency, energy usage and noise
- Addition of a new receiving station for hauled waste (holding tank and septage), with flexibility to feed to the front of the plant rather than just the digester
- Addition of sludge thickening facilities to extend the capacity of existing digester and sludge storage and eliminate digester supernatant recycle
- Minor exterior repairs for the sludge holding tank.

- Liner repairs for the equalization storage basin
- Modifications to the Control Building to create proper space for office/break room and laboratory
- Addition of a sludge pump as backup/replacement to the single 1970s vintage sludge pump
- Modifications to RAS/WAS pumps and/or piping to prevent loss of prime
- Replacement of aging/obsolete electrical controls and original MCCs

These improvements are recommended for Phase 1 of construction at the treatment plant, which is expected to begin in 2016 or 2017 depending on funding sources. A follow-up or concurrent phase of construction, designated Phase 1A, is recommended for the following improvements that are needed in the next 3-5 years to extend the life of these structures:

- Replacement of aging boiler/heat exchanger and gas handling system for anaerobic digester, along with exterior repairs and cover rehabilitation or replacement.
- Modifications to the building housing the headworks, primary clarifiers, and chemical feed equipment to meet current electrical and HVAC code requirements.

If Rural Development financing is obtained, it is recommended to do Phase 1A at the same time as Phase 1.

Subsequent phases of construction, designated as Phase 2 and 3, will depend on the selected alternative for phosphorus compliance, the actual growth in the City of Viroqua, the amount of I/I reduction that can be achieved by the City, and future changes to the plant flows and loadings, such as the addition of major industry. Possible components of Phase 2 and 3 are discussed in Section 5.4. For cost estimating purposes in this document, construction of a tertiary filtration system for phosphorus removal has been assumed for Phase 2, in the event that phosphorus compliance cannot achieved through other means. The City will continue to evaluate potential phosphorus compliance options, including treatment upgrades, Adaptive Management, Water Quality Trading, and a water quality standards variance.

1.4 Cost Summary of Selected Alternative

Refer to Chapter 6, Alternatives Comparison, and Appendix J for more detailed information on the cost breakout for all of the alternatives evaluated in this Document. Chapter 8 provides information about the effects of implementing the proposed projects on the City's user charge system. The pertinent costs for the selected alternatives are as follows:

Capital Costs:

Facility Upgrade - Phase 1	$3,800,800
Facility Upgrade - Phase 1A	$2,089,600
Outfall Relocation	$2,137,000
Total	**$8,027,400**

Depending on funding sources, Phase 1 and 1A may be performed together, Phase 1A may follow after Phase 1, or Phase 1 may be split into two projects.

The costs for Outfall Relocation are based on a design effluent flow rate for the lift station and force main of 1,500 gpm (2.16 MGD) but could be reduced if the flow rate is limited to 1,000 gpm (1.44 MGD), with approval by the WDNR for bypassing of treated effluent to the existing outfall location if needed.

1.5 Impacts to User Rates

To cover the cost of the recommended facility upgrades, the City's user charge rates will have to be increased. Current rates are approximately $24/month for an average residential user (using 2,624 gallons per month) and would increase to between $39 to $45 per month depending on the methodology of the user charge system and the amount of grant money included in the funding package. These user rates have been calculated assuming low-interest loan funding from the Wisconsin Clean Water Fund (CWF) program. Other potential revenue generating sources such as impact fees, grants, energy grants and other funding mechanisms are discussed in Chapter 8. It is the City's desire to obtain CWF Principal Forgiveness (PF), Rural Development, and Community Development Block Grant financing.

1.6 Implementation Schedule

The timeframe for project implementation is as follows:

Proposed Implementation Schedule

Submit Draft of Facilities Plan	May 2015
Proceed with Preliminary Design	May 2015
Public Hearing on Plan	June 2015
Proceed with Rural Development Application	June 2015
Proceed with Final Design	July 2015
Approval of Facilities Plan	August 2015

Submit Plans and Specifications	September 30, 2015*
Submit CWF Loan Application	September 30, 2015
Submit User Charge Rates/Ordinances	September 2015
Approval of Plans and Specifications	December 2015
Submit Block Grant Application	May 2016**
Advertise for Bids	October 2016**
Open Bids	December 2016**
Clean Water Fund Closing	January 2017**
Award Bids	February 2017**
Start Construction	March 2017**
Complete Outfall Relocation Construction	September 30, 2017***
Complete WWTF Construction	June 2018

* Submittal of plans and specification to meet CWF deadline for PF will include at the least the effluent lift station and force main and blower replacement or may be for the whole project.

** The schedule after September 30, 2015 will depend on financing obtained for the project.

*** The City is requesting a 90-day delay for the completion schedule on the outfall relocation (original completion date July 1, 2017).

2. INTRODUCTION

2.1 Planning Objectives

The intent of this Facilities Planning Document is to develop and evaluate viable alternatives for the upgrade of the existing wastewater treatment facility (WWTF) and effluent discharge options for the City of Viroqua. The Wisconsin Pollutant Discharge Elimination System (WPDES) permit that was issued to the City in 2012 (Appendix A) requires preparation of a Facilities Plan Phase 1 to assess discharge of effluent to the Springville Branch of the Bad Axe River. According to the Wisconsin Department of Natural Resources (WDNR), approximately 75% of the flow in the receiving stream is lost to fractured dolomite, resulting in WWTF effluent being discharged to groundwater. This Facilities Planning Document addresses options for moving or modifying the current outfall, as well as treatment upgrades for the WWTF.

The WPDES permit also requires the WWTF to evaluate options for complying with future phosphorus effluent limits that will take effect with the next permit issuance. The current phosphorus compliance schedule requires the submittal of a Facilities Planning Status Report in August 2015, which is fulfilled by this Document. Options for meeting the final phosphorus limits include facility upgrading, Watershed Adaptive Management, Water Quality Trading, consolidation with other facilities, outfall relocation, or a water quality standards variance, which are described in Chapter 5. The selected phosphorus compliance option will be presented in a Preliminary Facilities Plan Phase 2 that will be submitted by August 1, 2016 as an Addendum to this document, with a Final Plan submitted by January 2017. One goal of this Facility Planning Document is to recommend modifications to the existing treatment plant that will maximize the current biological treatment and nutrient removal to decrease the amount of phosphorus removal/reduction that will be required by other means.

As part of the planning process, a detailed evaluation of the existing facilities is made including a historical analysis of hydraulic and pollutant loadings. Using the historical data and appropriate demographic projections, future design parameters are established upon which the alternative design concepts are based. A comparison of the various alternatives is made to arrive at a viable and cost effective option that will meet the community's needs for the next 20 years.

It is necessary that the recommended alternatives have minimal negative environmental impacts and have the capacity to meet the anticipated water quality limits of the future discharge permit. An overall strategy is to be developed which encompasses the design recommendations made in this report, and establishment of a reasonable timetable for implementation. This will ensure that the project is implemented in an opportune manner to limit interim environmental concerns while concurrently allowing the community adequate time to gain the necessary resources to undertake the associated debt load.

2.2 Planning Area

The City of Viroqua is the county seat for Vernon County and is located in the southwest portion of Wisconsin at the intersection of State Highways 14, 27, 61 and 56. It is about ninety miles northwest of Madison, WI and about thirty miles southeast of La Crosse, WI.

The current sanitary sewer service area includes those areas within the existing municipal boundaries, as shown on Figure 2-1, the current zoning and land use map. The future sanitary sewer service area may include growth into undeveloped areas outside the City limits.

2.3 Facilities Plan Approach

The planning process will include evaluation of the existing loading data to the treatment facility and development of current baseline loading parameters for the facility. This will include values for flow; biochemical oxygen demand (BOD); suspended solids; ammonia; and phosphorus, all of which have limits included in the facility's current discharge permit, with the exception of ammonia. This is done in Chapter 3 of this report. A determination of new effluent limits to be made by the WDNR will coincide with the finalization of loading parameters. These projected loadings will take into consideration the needs of any local industries that to discharge to the City's facility.

Population projections will be used to determine future loading increases. This will be done utilizing information from the City's Comprehensive Plan with direction from the City's Public Works Committee, and with ultimate approval by the City Council. It is important that the projections are reviewed and approved by the City Council, since they have far reaching impacts for the City.

With the future loading parameters it is possible to formulate preliminary design alternatives that would accommodate the new loadings. Design alternatives are presented in Chapter 5 of this document. All alternatives presented will use existing structures and equipment to the greatest extent possible to minimize eventual construction costs. Typically a new site alternate is included in the evaluation; however, unless there are space constraints at the existing site, this will not be included.

Cost analyses of the selected alternatives are next determined and an evaluation of each is made to include economic, human resources and environmental impacts. Once a decision is made as to the selected alternative, financing methods and an implementation plan can be formulated. These evaluation and implementation considerations are presented in Chapters 6 – 8.

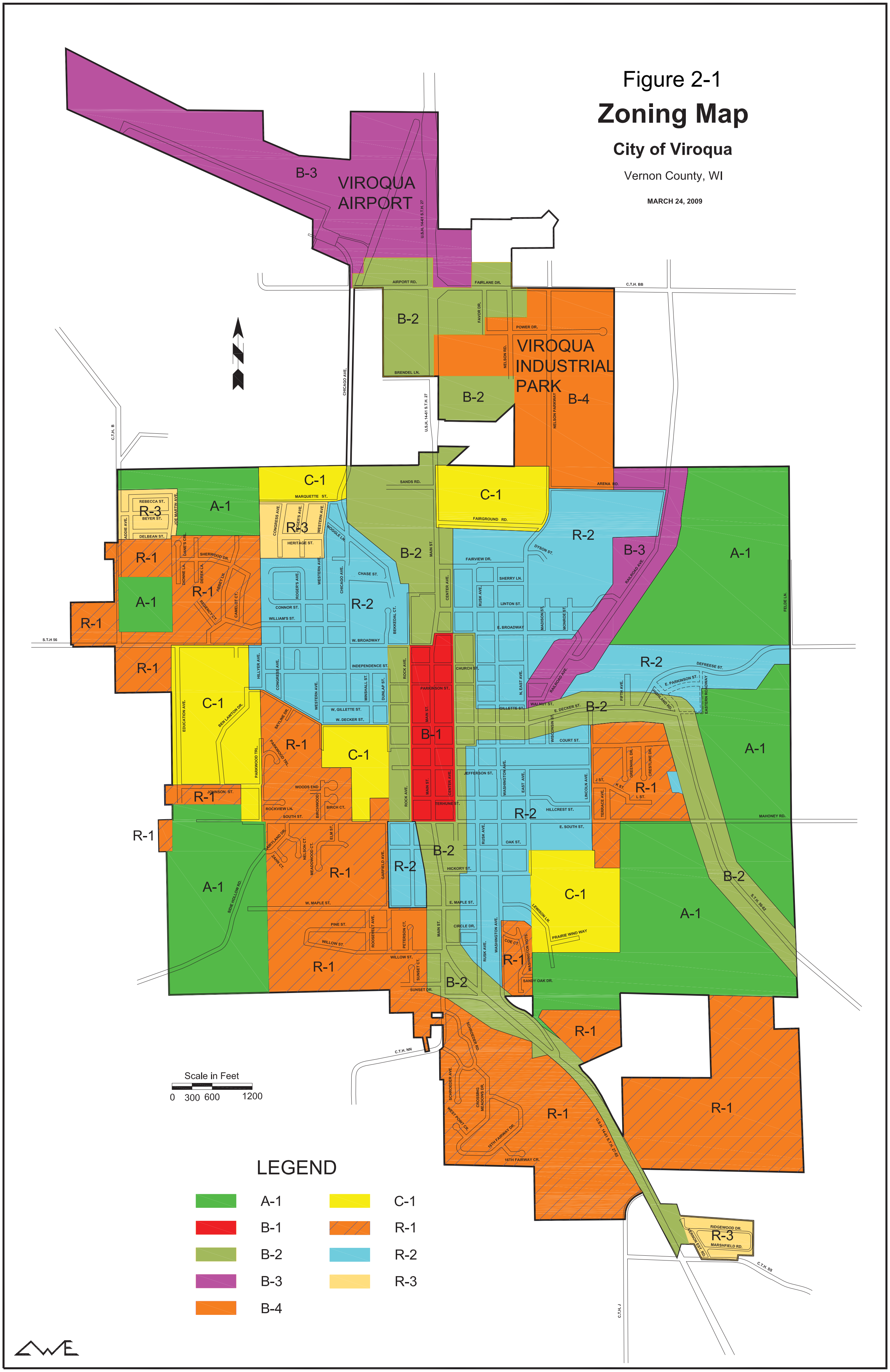


Figure 2-1
Zoning Map
City of Viroqua
Vernon County, WI

MARCH 24, 2009

3. EXISTING CONDITIONS

3.1 Description of Planning Area

The City of Viroqua is located on a ridge in the Western Upland area of Wisconsin also known as the "driftless" or "unglaciated" region. Viroqua is the largest City in Vernon County and serves as the government center of the county and as a major regional draw for commercial activity. The existing WWTF site is located on the northwest edge of the city and discharges to the Springville Branch of the Bad Axe River.

3.1.1 Climate

Typical of the Great Lakes region, the City of Viroqua experiences cold and snowy winters, hot summers, and moderate springs and autumns. The temperature ranges from an average of 14°F in January to 69°F in July. The average annual precipitation is 35 inches, the majority of which falls in April through September. Typically, the month of August is the wettest and January is the driest.

3.1.2 Physical Setting

The topography of the Viroqua area includes bluffs, rolling hills, steep slopes, and well-defined drainage ways, typical of the Driftless Area. Karst topography is found throughout the area, characterized by shallow limestone bedrock, caves, sinkholes, springs, and cold streams. Elevations in Viroqua proper typically range from 1,200 feet to 1,300 feet.

3.1.3 Soils

Area soils are related to the physical geography, climate, and vegetation. By reviewing soil maps and geotechnical information it is possible to determine the best uses for a particular area or determine if soils are suitable for a particular development. Over time, human activity affects soil formation by altering and accelerating natural soil processes. Clearing, burning, cultivating, and urbanization can affect soil structure, porosity, and soil nutrients.

The Natural Resources Conservation Service (NRCS) soil resource report for the existing WWTF site and the vicinity is included in Appendix B. Generally soils in this area can be classified as silty loams on slopes ranging from 2% to 12%, with some areas of steeper slopes.

3.1.4 Water Resources

Surface water resources within the City planning area include the Springville Branch of the Bad Axe River, the South Fork of the Bad Axe River, and Sidie Hollow Creek, which are part of the Bad Axe River Watershed in the Mississippi River Basin, and Maple Dale Creek and Cook Creek, which are part of the West Fork of the Kickapoo River Watershed in the Lower Wisconsin River Basin. The split between the Bad Axe River Watershed and the West Fork of the Kickapoo River Watershed runs north-south through the City of Viroqua east of Highway 14. The existing WWTF discharges to a tributary of the Springville Branch of the Bad Axe River approximately 2.75 miles upstream of the Springville Spring. The Springville Branch is classified as a cold (Class I Trout) water sport fish community from its mouth upstream to Springville (approximately 7.6 miles), and a limited aquatic life stream upstream of Springville to Viroqua, the current receiving stream for the WWTF. The subwatershed for the outfall is the Springville Branch of the Bad Axe River (HUC10 = 0706000103).

3.1.5 Floodplain Surveys

Flood Hazard Boundary Maps produced by the Federal Emergency Management Agency (FEMA) are available for the City of Viroqua and the vicinity. Floodplains in the Viroqua area are located outside of the City Limits and are associated with the Springville Branch of the Bad Axe River, the South Fork of the Bad Axe River, Sidie Hollow Creek, Maple Dale Creek and Cook Creek. Refer to Figure 3-1 for the approximate location of the floodplain and floodway designations for the existing WWTF site. The existing site lies outside of the 100-year flood plain delineation and the nearest floodplain is associated with the tributary of the Springville Branch of the Bad Axe River approximately 3,000 feet northwest of the WWTF site. Additional floodplain considerations for modifying or relocating the existing WWTF outfall are covered in Chapter 7.

3.1.6 Groundwater

Groundwater in Viroqua comes from deep sandstone aquifers. There currently are three active high capacity wells in the city, which yield 250 to 700 gallons per minute each. Well 4 is open to multiple aquifers, whereas Well 5 and 6 are only open to the deep Mount Simon sandstone aquifer. Static water levels ranging from 125 to 490 feet, with shallower static water levels associated with the multiple aquifer wells. Overall groundwater quality is good, thought the shallow aquifer system has experienced high nitrate and volatile organic contamination because of karst features in the shallow limestone bedrock. The water is considered hard at about 160 to 320 mg/L as $CaCO_3$. Iron and manganese concentrations are below upper limits established for secondary drinking water standards. The only treatment done on the water is the addition of chlorine.

3.1.7 Agriculture

There is no active agriculture at the existing wastewater treatment facility but land in the immediate vicinity is actively being farmed. Potential impacts to agriculture land should a decision be made to relocate the WWTF outfall are discussed in Chapter 7.

3.1.8 Historic and Cultural Assets

The extent of historic and cultural assets at the proposed work sites are covered in detail in Chapter 7 of this planning document.

3.1.9 Population and Land Use

The population of Viroqua was relatively stable during the 1970s and began to increase steadily during the 1980s and 1990s, as reported in the by the Wisconsin Department of Administration (DOA) census data and population estimates. The year 2000 census reported the City's population as 4,335 residents. Since that time there has been relatively slow growth in the residential sector. The 2010 census reported a population of 4,362, and the DOA estimate for 2013 is 4,361 people. The DOA projected 2015 population is 4,405. For this Facilities Planning Document, the base population for 2015 was assumed to be 4,455, which is slightly higher than the DOA 2015 projection but is consistent with the City's estimates. Projected population increases from this baseline figure will be used to estimate future flows and loadings in Chapter 4.

A Comprehensive Plan was prepared for the City of Viroqua and Town of Viroqua and was adopted by the City Common Council on February 27, 2007. The Comprehensive Plan presents land use for the main sectors of the community including residential, commercial, public, manufacturing/ industrial, and agricultural/woodland areas based on the City's calculations of zoning district areas as of 2004. Excerpts from the Comprehensive Plan are provided in Appendix C. The current population estimate, and demographic land use acreage is provided below in Table 3-1.

Table 3-1
Demographic Information

Sector	Totals
Estimated 2015 Population	4,455 people
Land Use:	
Residential	1,001 acres
Commercial	353 acres
Public	187 acres
Manufacturing/Industrial	353 acres
Agricultural/Woodland	483 acres

3.2 Description of Existing Facilities

3.2.1 Sanitary Sewer Collection System

The City's collection system includes seven lift stations and sanitary sewer pipes ranging in size from 6 to 18 inches in diameter. Pipe materials includes clay, PVC and cast iron. Table 3-2 lists the various pipes and lengths included in the sewerage system. The City has been replacing and upgrading these pipes during improvement projects implemented periodically. The overall emphasis of the projects is to replace defected pipelines and to modernize the existing pumping stations. The sanitary sewer map is shown on Figure 3-2.

Table 3-2
Existing Sanitary Sewer Inventory

Diameter (inches)		Length (feet)
Force Main	6	21,072
Collection Sewers	6	6,283
	8	129,778
	10	15,093
	15	2,456
	18	2,954

An 18-inch diameter interceptor extends from the former treatment plant site at Chicago Avenue and Marquette Street to the current WWTF site. The interceptor is approximately 3,000 feet long and has a slope of 0.12%. The estimated capacity of this interceptor is approximately 2.5 million gallons per day (MGD) when flowing full, which is less than the peak hourly flows that have been experienced at the plant (approximately 2.8 MGD in June 2014). This initial evaluation indicates that the interceptor size may need to be increased or the inflow and infiltration (I/I) that is contributing to peak flows needs to be reduced. I/I flows are discussed in Section 3.5.1.

Tributary to the main interceptor are two 15-inch primary gravity interceptors as well as four 8-inch gravity sewers that serve adjacent residential areas. A 10-inch interceptor that collects flow from the City's north/northwest side, including flow from Fairgrounds and Highway 14 N Lift Stations, changes to 15-inch just before connecting to the 18-inch interceptor at Sands Road. The other 15-inch interceptor collects flow from the majority of the city, including the downtown area and flow from the Lincoln Avenue/J Street and Highway 56 Lift Stations. Bypassing of the Lincoln Avenue Lift Station has been necessary during large storm events. The City has performed smoke testing in the downtown area tributary to the Lincoln Avenue Lift Station and is investigating sources of I/I throughout the system.

The Sidie Hollow Lift Station collects flow from the south/southeast portion of the City and repumps flow from the Vernon Estates Lift Station, which serves a mobile home park on Hwy 14 SE of country club, and the Crossing Meadows Lift Station, which serves a residential development near country club. Flow from the Sidie Hollow Lift Station is pumped northward and typically enters the 18-inch main interceptor in Abbey Addition residential area. During storm events, the collection system is full/surcharged in the Abbey Addition

3.2.2 Wastewater Treatment Facility

The City of Viroqua wastewater treatment facility treats the municipal and industrial wastewater collected by the sewerage system. The original trickling filter secondary treatment plant was built in the 1940s and was located on the City's northwest side. In 1977-1978, the plant was moved to the existing site, northwest of the previous facility. The plant consisted of primary clarifiers and two activated sludge package plant trains. The trains, designated East and West, included aeration, reaeration, clarifiers, chlorine contact, and aerobic digestion contained in one circular basin. The plant site also contained a 670,000 gallon holding pond for flow equalization and sludge drying beds. The control building housed office and laboratory space, a chlorine room, a standby generator, aeration blowers, and a sludge pump.

In 1994, the facilities were upgraded to include a new anaerobic digester, sludge storage tank, leachate and septage receiving facilities and new aeration equipment. The upgraded facility was designed for a flow of 0.600 MDG, 1,215 lbs/day BOD and 1,168 lbs/day suspended solids.

In 1999 the biological treatment process was modified to incorporate enhanced biological phosphorus removal (BPR) to comply with new phosphorus limits. The BPR upgrades included installation of wood baffles in the aeration basins to create selector basins. An alum feed system was installed as a backup to the BPR process. Additional modifications were made in 2002. A new metal pole-barn type enclosure for the primary clarifiers was built and the chemical addition facilities were upgraded. A digester supernatant tank was added to allow treatment of supernatant with alum to reduce phosphorus loading to the BPR system. The influent comminutors were replaced with a new mechanical screen and effluent UV treatment facilities were also added. The roof on the control building was replaced, the generator was removed from the control building, and a new building was constructed to house a new generator and three new blowers. The 2002 upgrade also included new fine bubble diffusers in aeration basins, addition of a submersible nitrate recycle pump, new RAS/WAS pumps in the control building, and new blower discharge and RAS suction and discharge piping.

Refer to Figure 3-3 for site plan of the existing WWTF. The existing processes are described in more detail in the following sections.

- <u>Flow Monitoring</u> - Flow measurement of the forward flow through the facility is monitored at three locations, the plant influent downstream of the screen and the effluent flow from each of the biological treatment trains. Ultrasonic flow devices mounted at metering flumes measure the total flow into the headworks and flow from each of the final clarifiers. The influent flume is 9-inch Parshall flume and the effluent flumes are 1-foot H-flumes that discharge to the Post Aeration Basin.

- <u>Sampling</u> – Raw wastewater samples are collected from near the influent Parshall flume by an ISCO Model 3710 sampler. The effluent sampler, a Quality Control Equipment Co. Model Century 2000-C, sits inside the West dome and collects samples from the post-aeration chamber.

- Preliminary Treatment - Preliminary treatment at the facility consists of mechanical screening, which replaced the original comminutors. A new Huber Rotamat fine mechanical screen (Model Ro9/500/6-Microstrainer) with a rated peak flow capacity of 2.74 MGD was installed in 2002, replacing the original comminutors. Screenings are washed and compacted and then discharged to a polyethylene bag in a trash can.

  A coarse bar screen located in a parallel channel is available for use when it is necessary to bypass the fine screen. The spacing between the bars is approximately 2 inches. Stop Gate S17 is set at 1195.0 and acts as an automatic bypass to the bar screen when the design flow of the microstrainer is exceeded. Flooding of the influent channel has occurred during peak flows in the range of 1,900 gpm (2.8 MGD), indicating that the hydraulics of the headworks may need modifications to better handle peak flows.

  There is anecdotal evidence that the grit removal may be needed at the facility with reports that grit is accumulating at the headworks (approximately 3 gallons of grit weekly) and in the digester from the primary sludge. Grit generally does not carry over to the downstream basins of the biological treatment process. The need for grit removal was evaluated in the 2000 Preliminary Report for the 2002 upgrade and it was determined that instead of spending money on grit removal facilities, the City should concentrate its efforts on collection system improvements to reduce grit entering the system. Grit removal was not recommended due to space constraints, head limitations, and the high cost and is not considered further in this facilities plan.

- Primary Treatment – The facility has two rectangular primary clarifiers, each measuring 13 feet wide by 39 feet long, with an average sidewater depth of 7 feet and chain driven flights for scum and sludge removal. The scum pit for clarifiers can be pumped to the digesters with the sludge pump. The mechanical components were replaced in 2002 with new plastic chains and flights and have no major problems, with the exception of the skimmer troughs. The toughs are badly corroded and in need of replacement with non-corrosive components. The enclosure for the clarifiers was also installed in 2002. The enclosure has significant ventilation issues and requires modifications to meet current electrical and HVAC code requirements.

At current average flows, surface overflow rates for the primary clarifiers are far less than the recommended 1,000 gallons per day/square foot (gpd/sf) for settling tanks, and are typically around 360 gpd/sf. At current peak hourly flows, estimated to be approximately 2.8 MGD, the surface overflow rates are 2,760 gpd/sf, which is higher than the recommended range of 1,500-2,000 gpd/sf. The clarifiers should be able to handle average design flows up to approximately 1 MGD and peak flows up to approximately 2.5 MGD.

In 2013, the City undertook a pilot study to test the addition of a supplemental carbon source to improve BPR and attempt to meet the more stringent phosphorus limits that will go into effect with the next permit issuance. Following a successful pilot study, a chemical feed system was installed to add EnhanceBio$^{P+N©}$, a molasses-based product manufactured by Quality Liquid Feeds (QLF). The chemical feed system is housed in a separate enclosure within the primary clarifier building and the product is added to the primary clarifier effluent.

Effluent from the clarifiers is split to the two biological treatment trains by the splitting structure downstream of the clarifiers. The effluent structure was also designed so that bypassing to the equalization holding pond would occur for flows greater than 1,000 gpm (1.44 MGD). Examination of current flow data for the plant shows that while flow is directed to the equalization pond during peak flows (corresponding to large storm events), that the forward flow through the plant is not limited to 1.44 MGD. As currently operated, the overflow structure and the equalization pond minimize the peak flows, but peak hourly flows as high as 2.49 MGD have been reported as passing through the plant.

The primary clarifiers can be bypassed either by diverting flow to the holding pond or by the piped bypass connection to the splitter structure downsteam of the clarifiers.

- Selector Basins – The selector basins, aeration basins, and final clarifiers are arranged in two separate process trains that are operated in parallel and are designated “East” and “West”. These trains are former package plant circular basins that have been modified to accommodate process changes. The fiberglass domes covering each of the trains have not been recoated since installation in 1978.

  Equalization of the flow split between the treatment trains has been difficult because the influent launders on the two selector basins are not at the same elevation, despite attempts at modifications and adjustment of the weirs. The west side launder is lower than the east.

  Three selector basins were created in 1998 by installing wooden baffle walls in the former aerobic digestion basin of each train. The volume of each baffled zone is approximately 25,000 gallons, which was designed to provide approximately 1 hour of detention time at the design flow of 0.6 MGD plus settled and return activated sludge flows equaling 100% of the forward flow. The basins were designed with the intent that one would be operated as an anaerobic zone and one as an anoxic zone, with the flexibility to use the third basin as needed. The selector basins have 2 hp Brawn mixers in first zone and floating Aqua-Aerobic AquaDDM 3 hp mixers in the other two zones. Oxidation-Reduction Potential (ORP) monitors were previously installed in all three basins but have since been removed due to maintenance issues and replaced with a portable unit.

  The effectiveness of the selector basins are directly related to the detention times achieved in these basins, recycle of denitrified mixed liquor in the process, and achieving a satisfactory BOD to phosphorus ratio in the influent. As a practical guideline, the detention time through the anaerobic basin based on the forward flow should be kept at or above one hour, and the effluent from the primary clarifiers should have a minimum BOD to phosphorus ratio of 20:1.

Primary effluent, return activated sludge (RAS) from the final clarifier, and mixed liquor recycle from the aeration zone can be discharged to each zone separately or in any combination. Primary effluent flows by gravity to the effluent launder and can be directed to the desired zone(s) by slide gates. RAS is pumped by the RAS/waste activated sludge (WAS) pumps located in the Control Building and is controlled by gate valves on the PVC piping to the selector basins and by pumping rates. Submersible nitrate recycle pumps were installed in the East and West aeration zone to recycle mixed liquor back to the anoxic zone. These 7 hp Hydromatic pumps were pulled and are no longer in use due to repeated seal failures and impeller wear. Additionally, it was believed that nitrate return was not improving BPR.

- Aeration Basins – The aeration basins in each treatment train are divided into two zones of approximately 90,600 gallons and 49,600 gallons each, for a total aeration volume of 280,400 gallons between the two trains, with a side water depth of 14 feet. Air is supplied to the basins through pipe manifolds and floor-mounted diffusers, with 2 drop pipes in the main aeration basin and 1 drop pipe in the reaeration basin. EDI fine bubble diffusers are installed on the basin piping grid. The drop pipes and diffusers were installed in 2002 and the diffuser sleeves were last replaced in 2010. There are no known issues with the existing diffusers and piping, but diffuser sleeves will need to be replaced in the near future and eventually the diffusers will need also replacement.

  Three 100-HP rotary lobe positive displacement blowers with VFDs are available for supply of oxygen, including two Model 624 RAM blowers manufactured by Dresser Roots Industries (installed with the 2002 upgrade) and one Eurus blower (recent replacement) each rated at 1,151 scfm of air at 7.3 psig. The blowers are located in the blower building, constructed in 2002, and each is housed in a sound attenuating enclosure. The blowers are all capable of providing air to either or both of the East or West process trains. The DO monitoring system automatically controls blower speeds based on readings from the DO probes (membrane type) in the aeration basins.

The current BOD loading to the activated sludge process is well below the conventional rating of 40 pounds per 1,000 cubic feet of aerated volume. The process is often under-loaded and experiences low food to microorganism (F/M) ratios, particularly at night. The process is often over-aerated as well, because the existing large positive displacement blowers cannot be turned down low enough to match minimum loads. Replacement of one or more blowers to allow for greater turn-down should be considered to optimize energy use and efficiency.

Assuming a maximum load of 40 pounds per 1,000 cubic feet of basin volume, the biological treatment process as now operated should be capable of effectively treating a sustained BOD loading to the basins of approximately 1,500 pounds per day (2,100 lbs/day total load to the head of the plant, assuming 30% removal in the primaries), with higher loading possible if conditions are optimized.

- <u>Final Clarifiers</u> - The final clarifiers are circular tanks located at the center of the two biological treatment structures. The tanks measure 31 feet in diameter with a 12-foot side water depth and inboard effluent launders. The structure, weirs, scum skimming, and sludge scraping equipment dating back to the original package plant from the 1970s (manufactured by Cantex). The drives were replaced in late 2000s and the remaining clarifier equipment has reached the end of its useful life and is i7n need of replacement.

  The scum trough was modified and a scum flushing system and scum manhole were added during the 1994 upgrade. The scum is flushed to the scum collection manhole between the East and West domes. Collected scum is pumped to the anaerobic digester by the sludge pump.

  The sludge collected in the clarifier sludge hoppers is pumped out by the RAS/WAS pumps that were installed in the Control Building in 2002. There is a dedicated pump for each of the secondary treatment trains and one standby pump. These pumps are 3 hp Fairbanks Morse Model B5431K vertical solids handling pumps. VFDs control the speed of the pumps and magnetic flow meters determine the pumping rates. Motorized valves control whether sludge is returned to the selector basins or and wasted to the anaerobic digester. WAS flows average approximately 14,200 gpd and RAS flows average approximately 168,000 gpd. The current RAS flows are approximately 50% of the plant influent flow, but future return rates up to 100% will be assumed for planning purposes. The RAS/WAS pumps have had chronic problems with loosing prime/air locking at low flower rates and higher solids contents.

At current average flows and loads, the average solids loading rates on the clarifiers are typically less 12 lbs/d/sf and surface overflow rates are less than 300 gpd/sf. At a flow of 1,000 gpm (the rate at which overflow to the equalization storage basin is supposed to occur), the surface overflow rates for the clarifiers are approximately 1,000 gpd/sf; however, plant data shows that peak hourly flows as high as 2.49 MGD has passed through the plant, which would yield final clarifier overflow rates of 1,650 gpd/sf. The clarifiers should be able to handle average design flows up to approximately 0.6 MGD and peak flows up to approximately 1.8 MGD at design overflow rates of 400 gpd/sf and 1,200 gpd/sf, respectively.

- Post Aeration – Effluent from each of final clarifiers is conveyed by 12-inch PVC pipe to the post-aeration basin between the East and West domes and is and discharged via H-flumes. From the post-aeration basin, effluent flows by gravity to the manhole upstream of the UV disinfection system.

- UV Disinfection – The UV disinfection system installed in 2002 is a Trojan Model 3000B including two banks of lamps with four UV modules per bank and 6 lamps per module (total 48 lamps) installed in a 32-foot long, 42-inch deep, 12-inch wide channel. The system was designed for a peak flow of 1.44 MGD (1,000 gpm) and was installed in 2002. An enclosure for the system was recently installed by the City to prevent deterioration to the control panels. While the system has no real issues, it is thirteen years old and should be considered for future replacement with newer equipment including an automatic cleaning system which should improve the efficiency of the system. Additionally, the peak flow capacity of the system may need to be increased if peak flows through the facility cannot be controlled/reduced.

- <u>Sludge Digestion</u> – Waste activated sludge from the final clarifiers is pumped to the anaerobic digester. The existing standard-rate, mesophilic, anaerobic digester is a 50-foot diameter concrete tank with floating cover, constructed in 1994. The bottom is tapered to the center for sludge removal. The maximum side water depth is 17 feet and the total volume of the tank is 249,700 gallons (excluding the 8'-4" bottom cone). The digester is mixed by discharging/recirculating sludge to one of two discharge points, a low level discharge and a high level discharge.

  The process digests the settled and sludge and scum pumped to digester from the primary and final clarifiers, with intermittent sludge feeding and withdrawal and operation of the heat exchanger to maintain proper process temperature. The heat exchanger is an Envirex Digester Combination Heater/Heat Exchanger Model #504 methane and LP gas-fired exchanger rated for 500,000 btu/hour. Hot water generated on the boiler side is conveyed, as required, to the heat exchanger side of the unit by a hot water transfer pump. The heat exchanger is nearing the end of its useful life and it has been difficult to acquire replacement parts/nozzles for it.

  Sludge is pumped from the digester to the heat exchanger by two 3 hp Fairbanks Morse/Chicago Pump vortex solids handling sludge recirculating pumps, capable of 150 gpm at 14 feet TDH. Operation of the pumps and the heat exchanger is automatic controlled to maintain the desired sludge temperature (generally 95 to 100 degrees F).

  The weight of the digester floating cover provides 10 inches water column (WC) methane gas pressure. Methane gas is used by the boiler until the gas pressure falls below 3 inches WC then the boiler switches over automatically to LP gas. The digester gas collection system (Envirex) includes a pressure regulating valve that will discharge excess methane to the waste gas burner at pressure of greater than 8 inches WC. Should the PRV fail, a second pressure relief valve is located on the cover and is set to open at 10 inches WC. The gas collection system is protected by flame arrestors and flame traps. The system is currently functional but may need significant repairs or replacement to extend the life of the digester.

The sludge pump located in the Control Building is used to pump the digested sludge to the sludge holding tank. This pump is a 3 hp Carter Model 800 duplex plunger positive displacement pump from the original plant construction. This pump is also used to pump to the digester from the primary clarifiers sludge hoppers, primary and final clarifier scum pits, plant lift station, and septage receiving station. The only backup for this pump that performs multiple functions for the plant is a 5 hp, gasoline engine portable 3-inch, self-priming trash pump.

Supernatant from the digester can be drawn off from two draw-off pipes with 6-inch height adjusting rings on the discharge to control flow. When the digester is full, the supernatant will discharge automatically as sludge is pumped into the digester. Supernatant is directed to an adjacent 10,000 gallon underground concrete tank that serves as temporary storage to equalization supernatant feed to the plant influent. This tank is provided with fine bubble diffused aeration with the air supply being provided by one rotary, positive displacement blower rated at 500 scfm (EAI) located in the primary clarifier building. However, the facility staff have stopped using the aeration system because it has led to a buildup of struvite in the structure. A 1-1/2-inch alum feed line is provided to the discharge manhole adjacent to the supernatant tank.

Volatile solids loadings to the anaerobic digester is well below the standard 40 pounds per 1,000 cubic feet for moderately mixed digesters and capacity is available for future loading. Current discharge of primary and waste activated sludge to the digester averages about 19,000 gpd, resulting in a hydraulic detention time of approximately 17 days. This detention time is near the minimum of 15 days required for anaerobic digestion (NR110.26(5)(b)(a)), which indicates that sludge thickening would be needed to reduce the volume of sludge sent to the digester as plant loadings increase.

If the existing digester is reused for any facility upgrade the existing boiler/heat exchanger and gas handling system will have to be considered for replacement as they are nearing their practical design life.

Sludge Thickening – Sludge thickening is performed by decanting from the anaerobic digester. Additional sludge thickening facilities are recommended to reduce the volume of sludge sent to the digester as plant loadings increase.

Liquid Sludge Storage – The existing covered, sludge storage tank is a 70 foot diameter Harvester glass-lined steel tank with a side water depth of 22.5 feet providing 685,000 gallons of storage. One 60 hp A.O. Smith vortex mixing pump (Slurrystore Model 1000) is used to mix the contents of the tank and pump sludge to the tanker connection. The pump is located outdoors on a concrete pad on the south side of the tank. A 12-inch fill and draw pipe allows withdrawal of sludge from the tank center and four other 6-inch pipes with adjustable nozzles are connected to the sludge pump for sludge discharge and mixing. The tank also has an over-the-top mixing gun.

The tank was installed in 1994 and sized to provide 180 days of sludge storage capacity at the design flow conditions. The tank currently provides almost a year of storage capacity, with approximately 16,000 gallons of sludge pumped to the tank each week. The tank is in good condition, with only minor exterior repairs needed.

- Sludge Disposal – All of the sludge from the existing facility is land applied as a Class B liquid on agricultural fields. This is done prior to crops being planted in the spring and after harvest in the autumn. The majority of the sludge disposal operation is contracted to a private company. The City has ample acreage available for sludge spreading.

- Septage/Holding Tank Receiving – The septage receiving station was installed in 1994 and consists of an intake structure with 2' wide bar screen (2" openings) and two 8'-diameter concrete holding tanks. The sludge pump is used to pump septage to the anaerobic digester.

- Leachate Receiving – The leachate receiving station was installed in 1994 and consists of a receiving manhole/sump, two 10,000 gallon precast concrete holding tanks, and a feed control structure (manhole with 2 gate valves) that controls gravity flow to WWTF headworks. Leachate is currently fed to the head of the plant, upstream of metering and sampling, using a submersible pump and hose because the control valves are not functional.

- Chemical Feed – The chemical feed system was installed in 2002 and consists of three metering diaphragm pumps capable of manual or automatic (flow-paced) operation, two 2,500 gallon tanks, three 300 gallon polyethylene day tanks, a chemical transfer pump, calibration cylinder, and chemical feed lines to the primary clarifiers, final clarifiers, and digester supernatant equalization tank. The east and west effluent flow meters control the east and west pumps, respectively, and the digester supernatant equalization tank flow meter controls the third pump. One of the three original LMI metering pumps was replaced in 2014 with a Prominent metering pump to serve the supernatant tank. The system is capable of feeding any of the conventional phosphorus removal chemicals; however, alum has been successfully used since the system was installed. Under current normal operations, alum is added only to the digester supernatant.

- Equalization Storage Basin – The storage basin is constructed to hold 1,020,000 gallons before it overflows, although at its normal depth of 6 feet it contains 670,000 gallons. According to design information, the basin liner is composed of 1 foot of clay, 6 inches of base course and 2 inches of hot mix asphalt. The integrity of the basin's asphalt liner is poor, with cracks down to the base course layer.

  The weirs and stop gate after the primary clarifiers were designed so that when primary effluent flow exceeds 1,000 gpm, excess would be diverted to the storage basin. However, recent plant flow data indicates that the overflow reduces peaks but does not limit the peak forward flow though the plant to less than 1000 gpm (1.44 MGD). Peak hourly flows as high as 2.49 MGD have passed through the plant.

  The equalization storage basin is pumped out by a lift station (manually controlled) to a splitter box the head of the primary clarifiers, after the influent screen and flow metering. The splitter box can be manually adjusted to allow a fixed percentage of flow to the primaries and directs the rest back to the pond. New 3 hp ABS submersible pumps rated at 250 gpm were installed in the lift station in 2014.

- Standby Generator – The standby generator is a Kohler 355 KW, 44 KVA, 60 hz, 277/480 Volt, 534 amp generator set powered by a 550 hp, 6 cylinder, 4 cycle turbocharged, water cooled, diesel engine by Detroit Diesel. The engine is stopped and started by an 800 amp automatic transfer switch. The generator and the automatic transfer switch were installed in 2002.

- Electrical Service - The electrical service to the plant was upgraded from 400 amps to 600 amps in 2002. A new MCC was installed in the Control Building with a 600 amp breaker and a 250-amp feeder to the original MCC. The new main MCC controls the three VFDs for the blowers, three starters for the RAS/WAS pumps, DO control system, and RAS flow meter/control system. The original MCC, located in the Control Building laboratory, controls the equalization basin lift station, the Carter sludge pump, microstrainer, mixers, clarifier drives, automatic telephone dialer, and lighting panel. The original MCC is nearing the end of its useful life and should be considered for replacement.

3.2.3 Effluent Outfall

As described in Section 3.1.4, the Viroqua WWTF discharges to a tributary of the Springville Branch of the Bad Axe River approximately 2.75 miles upstream of the Springville Spring. According to the WDNR, *"the Springville Branch flows for approximately eight miles in a westerly direction before reaching the North Fork of the Bad Axe River. It has a moderate gradient of 40 feet per mile and drains steep forests, lowland pasture, agricultural land and a portion of the City of Viroqua. The natural origin of Springville Branch is in the small village of Springville where springs well up in the stream bed creating a quicksand like stream bottom. However, since the City of Viroqua discharges stormwater and treated wastewater to a natural channel that eventually reaches the Springville Branch at Springville, the length of the perennial flowing stream has increased. The downstream end of Springville Branch flows through Duck Egg, a Vernon County park, where a wet flood control structure is owned and maintained by Vernon County."*

The 2007 Effluent Outfall Investigation prepared by Davy Engineering suggests that about 83% of the receiving stream flow is lost between the WWTF discharge point and the County Highway (CTH) B culvert to the west of Miller Road, which is about 1,300 feet upstream of the Springville Spring. Subsequent investigation by Town & Country Engineering in 2013 showed that the Davy study results are more representative of drought conditions in the stream, which suggests flow loss on the Springville Branch of the Bad Axe River upstream of the spring, on average, is considerably less than 83%. Portions of these investigation reports are provided in Appendix D. Regardless of the amount of flow lost, the WDNR considers the receiving stream to be a "disappearing" or "losing" stream, with flow entering the fractured dolomite streambed and mixing with groundwater.

Both investigations have identified portions of the stream that are likely loosing flow to groundwater. Sections of the stream with deeper flow depths may represent partial collapse of the geology below the stream, which could indicate areas where the stream is losing flow to groundwater. This observation suggests there are six separated sections along that stream that could be losing flow to groundwater, each varying in length from 200 to 400 feet long. In particular, the visual inspection of the streambed indicated that an open fracture, called a swallet, is located approximately 75 feet upstream of the CTH B bridge near the intersection of CTH B and Miller Road.

The current WPDES permit for the WWTF requires that discharge to the disappearing stream be addressed in a facilities plan to compare options associated with continued discharge of effluent to the stream at its current location with relocating the discharge to beyond the fractured bedrock. A meeting was held with the WDNR on July 15, 2014 to review the results of in-stream investigations and discuss possible options for the City's outfall. The WDNR has stated that if the facility continues to discharge to the disappearing stream in the current location, the wastewater would have to meet more stringent groundwater discharge standards, presented in Section 4.5. The WDNR has also stated that discharge to a swallet or sinkhole is not permitted.

Options for relocating the outfall, meeting the groundwater discharge standards, or preventing loss in the stream are evaluated in Chapter 5.

3.3 Existing Facility Evaluation

According to the design information for the 2002 modifications, the WWTF is designed for the following loadings:

Table 3-3
Existing Facility Capacities

Parameter	Design Value
Flow (MGD)	0.600
BOD (lbs/day)	1,215
Suspended Solids (lbs/day)	1,168

As described further in Section 3.5, the current flows and loadings to the plant are within the design capacity. The plant has been performing well, but several issues have been identified for further consideration in this facilities plan, as follows:

- Processes/structures with current operational issues, at end of design life, or in need of repair:
  - Corroded primary clarifier skimmers
  - Uneven flow split between East and West treatment trains due to difference in influent launder elevations
  - Aging final clarifier mechanical equipment
  - Inefficient aeration because blowers cannot be turned down adequately for efficient energy use
  - Problems with RAS/WAS pumps loosing prime
  - Only one 1970s vintage sludge pump that is relied on for multiple functions
  - Aging controls and VFDs
  - Flexibility needed to feed hauled waste (holding tank and septage) to the front of the plant rather than the digester
  - Aging boiler/heat exchanger, cover, mixing/recirculation, and gas handling system for anaerobic digester
  - Tuck-pointing needed for digester brick exterior
  - Minor exterior repairs needed for sludge holding tank
  - Liner repairs needed for equalization storage basin

- Processes/structures requiring upgrade/modifications to meet future permit limits:
  - Greater flexibility desired for operation of selector and aeration basins to improve and maximize biological nutrient removal

  - Minimization or elimination of high-strength recycle of digester supernatant to the head of the plant.

- General plant issues:
  - Additional space desired in the Control Building for office/break room and additional laboratory space
  - Sending dilute WAS sludge to the anaerobic digester reduces digester capacity
  - Current bypass to the equalization storage basin does not appear to limit forward flow to 1,000 gpm as previously designed
  - Electrical, structural, and HVAC evaluation and modifications needed for the building that houses the headworks, primary clarifiers, and chemical feed equipment. Major electrical and HVAC work is needed to meet current code requirements.

Additionally, several processes may need upgrading in the future if peak flows through the plant cannot be reduced through clear water infiltration and inflow minimization efforts. The influent screen and bypass channel has experienced flooding during peak flows and may require modifications.

3.4 Existing WPDES Summary

The discharge limits in the 2012 permit for the City of Viroqua WWTF are summarized in Table 3-4. See Appendix A for a copy of the complete permit.

Table 3-4
Existing WPDES Permit Limits

Parameter	Limit
BOD (monthly average)	20 mg/l
BOD (weekly average)	30 mg/l
SS (monthly average)	20 mg/l
SS (weekly average)	30 mg/l
Phosphorus (monthly average)	1.0 mg/l
pH (daily min – max)	6.0 – 9.0 s.u.
Fecal coliforms (geometric mean)	400# / 100 ml

The limit for total phosphorus is noted as an interim limit with a final effluent limitation scheduled to be included in the next permit issuance in 2017. The final limit calculation included for informational purposes only was noted as 0.43 mg/L as a monthly average. These numbers may be recalculated if relevant additional information or data is submitted before the next permit issuance.

3.5 Wastewater Flows and Loadings

3.5.1 Wastewater Flow

In order to differentiate between actual wastewater flow and infiltration and inflow (I/I), historical water use and facility influent records are evaluated. After separating I/I as a quantified component in the overall influent flow value, future flow increases can be better determined for actual wastewater flows from the residential, commercial, public and general industrial sectors of the community.

Water use information for the period 2010 through 2012 is provided below in Table 3-5. The water consumption averages for the residential, commercial, and industrial sectors have been adjusted for water purchased but not discharged to the City's collection system. This is determined by City staff with the use of deduct meters for specific locations. Water use records for the period of evaluation can be found in Appendix E.

Table 3-5
Summary of Water Consumption

Sector	Water Consumption (MGD)			Annual Average
	2010	2011	2012	
Residential	0.158	0.155	0.159	0.157
Commercial	0.095	0.112	0.111	0.106
Public	0.027	0.028	0.028	0.028
Industrial	0.013	0.019	0.019	0.017
Total Average City				0.308

The difference between the total annual average City water value shown above and the actual recorded flow at the plant should provide an indication of the total I/I entering the collection system. Recorded wastewater flows at the City's treatment plant are provided in Appendix F and summarized in Table 3-6.

Table 3-6
Facility Wastewater Flows

Year	WWTF Influent Flows (MGD)					
	Annual Average	Max Month	Sustained Minimum	Sustained Maximum	Max Week	Max Day
2010	0.361	0.427	0.304	0.510	0.570	1.197
2011	0.343	0.451	0.294	0.574	0.739	1.284
2012	0.315	0.350	0.275	0.412	0.446	0.694
2013	0.345	0.464	0.292	0.568	0.780	1.575
2014	0.345	0.501	0.285	0.522	0.559	1.253
Average	0.342	0.438	0.290	0.517	0.619	1.201
3-Highest Averages				0.555	0.696	1.371

Influent flows to the City's wastewater facility included in Table 3-6 are annual averages, sustained averages, and maximum monthly, weekly, and daily flows. Sustained averages are defined as the maximum average wet weather flows and the minimum average dry weather flows for each year being evaluated. The sustained maximums are longer term wet weather flows at least two weeks in duration which could impact the biological treatment capacity of the plant. The maximum daily flow values are as the name implies the peak daily flows on record for each year.

The dry weather, annual average, sustained wet weather and maximum daily I/I were calculated by subtracting the City water usage for the corresponding months from the various WWTF flows in Table 3-6. In calculation of wet weather I/I, the results from 2012, a drought year, were excluded and the average of the flows from 2010, 2011 and 2013 was used. The calculations are provided in Appendix G and the results are summarized below in Table 3-7.

Table 3-7
I/I Values

	I/I Flow (MGD)
Dry Weather Infiltration (Sustained Minimum)	0.007
Wet Weather Infiltration and Inflow	
Maximum Daily	1.029
Maximum Weekly	0.383
Maximum Sustained (2 week)	0.252
Maximum Monthly	0.141
Annual Average	0.040

The average annual City Base Flow over the five year period of evaluation is determined by adding the residential water flow to the average annual I/I amount. For average residential water use of 0.157 MGD (Table 3-5) and an annual average I/I of 0.040 MGD this will equal 44 gallons per capita per day at the current population of 4,455. This falls well under the limit for excessive dry weather infiltration stablished by the EPA which is 120 gallons per capita per day.

The EPA further defines non-excessive inflow if the maximum daily flow (excluding non-residential contributions) does not exceed 275 gallons per capita per day. Adding the daily residential water use to the maximum daily I/I will result in a flow of 1.186 MGD. The resultant daily inflow calculation is 266 gallons per capita per day, which is close to exceeding the EPA criteria.

While I/I flows to the plant are not considered excessive by these standards, recorded peak hourly flows to and through the plant have exceeded the peak design capacity for the influent interceptor, mechanical screen, final clarifiers, and UV system. Influent peak flows as high as approximately 2.8 MGD have been recorded at the plant and flooding of the influent channel upstream of the screen has occurred.

3.5.2 Organic and Suspended Solids Loading

Reference is made to Appendix F, Existing WWTF Flow and Loading Data for a listing of historical loading values recorded at the treatment facility and for the summary tables used as the basis for the following determinations. Annual average BOD and total suspended solids loadings to the City's facility are provided in Table 3-8 below along with the average of the three highest months for each year. Calculation of the existing base loading will be done by averaging the three highest months because the facility will have to handle the impact of sustained loads.

Table 3-8
Organic and Solids Loadings to WWTF

	BOD (lbs/day)		TSS (lbs/day)	
	Annual Average	Average 3 Highest Months	Annual Average	Average 3 Highest Months
2010	977	1,087	1,077	1,281
2011	990	1,121	1,132	1,227
2012	911	1,088	1,010	1,150
2013	915	1,101	1,098	1,445
2014	897	951	680	842
Average	938	1,070	999	1,189
Maximum	990	1,121	1,132	1,445
Average (without low and high)	**934**	**1,092**	**1,062**	**1,219**

Since the City has no major industries that must be accounted for, the City Base Loadings to be used in future BOD and TSS projections in Chapter 4 are those in Table 3-8.

3.5.3 Nitrogen and Phosphorus Loadings

Historical loading data for ammonia or total Kjeldal nitrogen (TKN) does not exist in sufficient quantity to make a reliable determination of existing loading rates. Ammonia data from June through December 2014 show that influent concentrations varied from 23 to 59 mg/L, with an average of 38 mg/L and an average influent loading of 98 lbs/day. These values are higher than typical wastewater values, but are considered representative of the plant influent without leachate, as leachate was not being accepted during that time.   TKN values are assumed to be 150% of the ammonia-N value, which is typical for municipal wastewater facilities.

Influent phosphorus data have been collected for the past 3 years and have been summarized for in Appendix F. Based on the available data, influent phosphorus loadings averaged about 20 - 25 lbs/day, with phosphorus concentrations varying from approximately 5 – 15 mg/l. The concentrations and loading for the most recent phosphorus data (2014) are on the lower end of these ranges and are considered more representative of current loads to the plant.

Table 3-9 summarizes the concentrations that will be used for design projections in Chapter 4. These concentrations are, in turn, are used in conjunction with established flows to determine the loadings for each sector. An influent concentration for ammonia-N for domestic strength wastewater is assumed at 40 mg/l, with corresponding TKN of 60 mg/L, and a total phosphorus concentration is assumed to be 7.5 mg/l based on the available data.

Table 3-9
Assumed Nitrogen and Phosphorus Influent Concentrations

Ammonia-N	TKN	Total-P
40 mg/L	60 mg/L	7.5 mg/L

Figure 3-1 Flood Insurance Rate Map

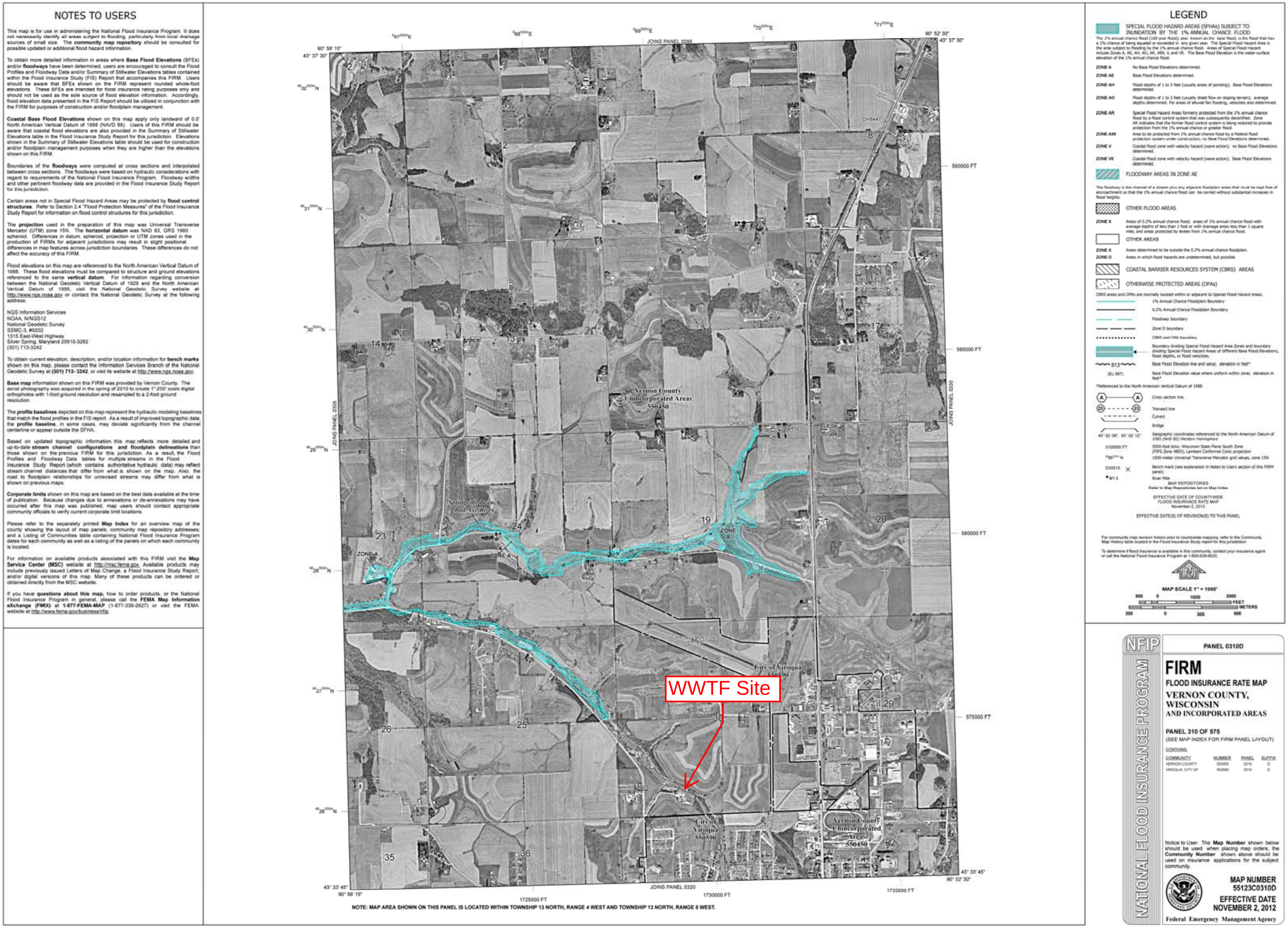
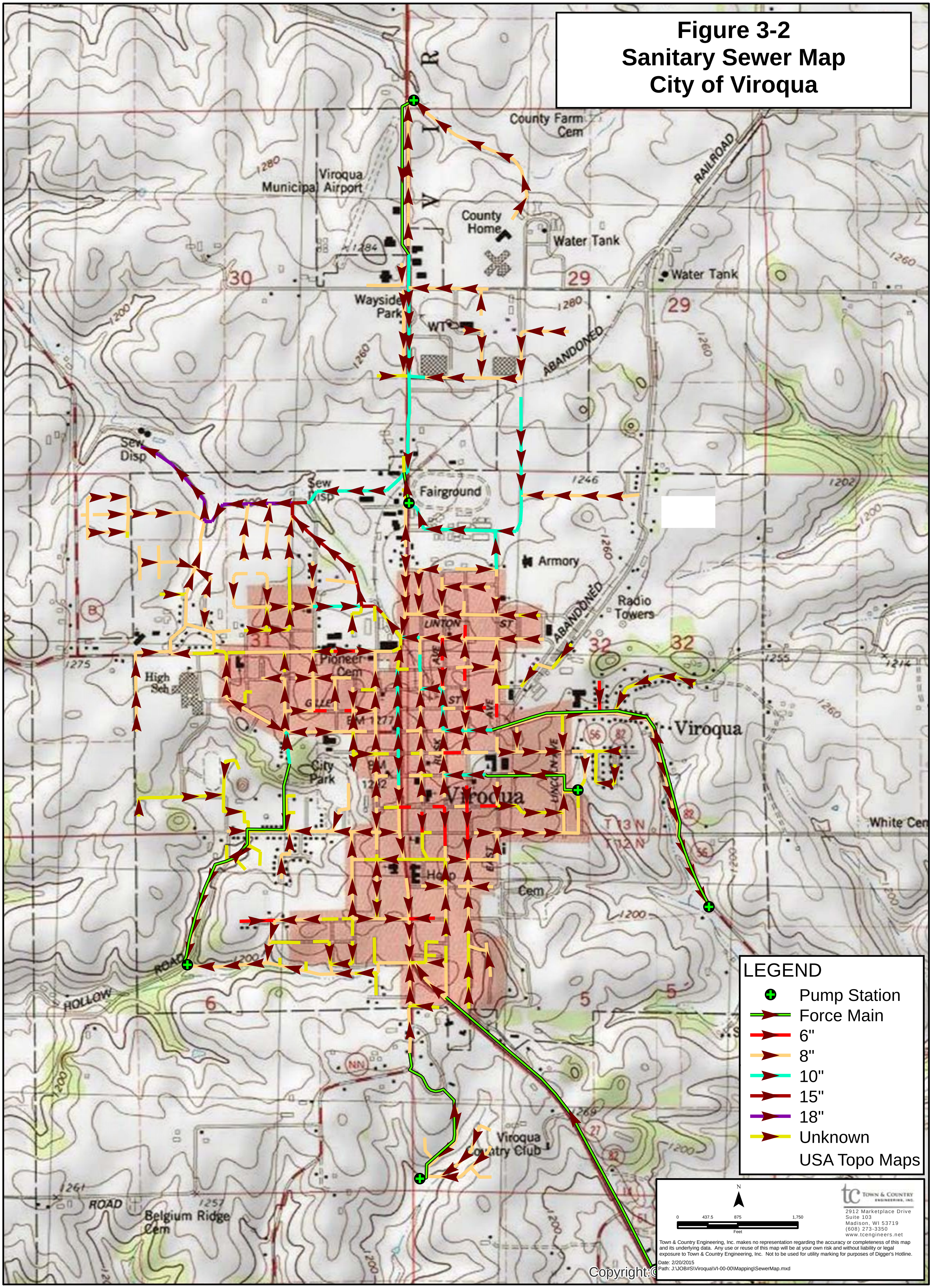
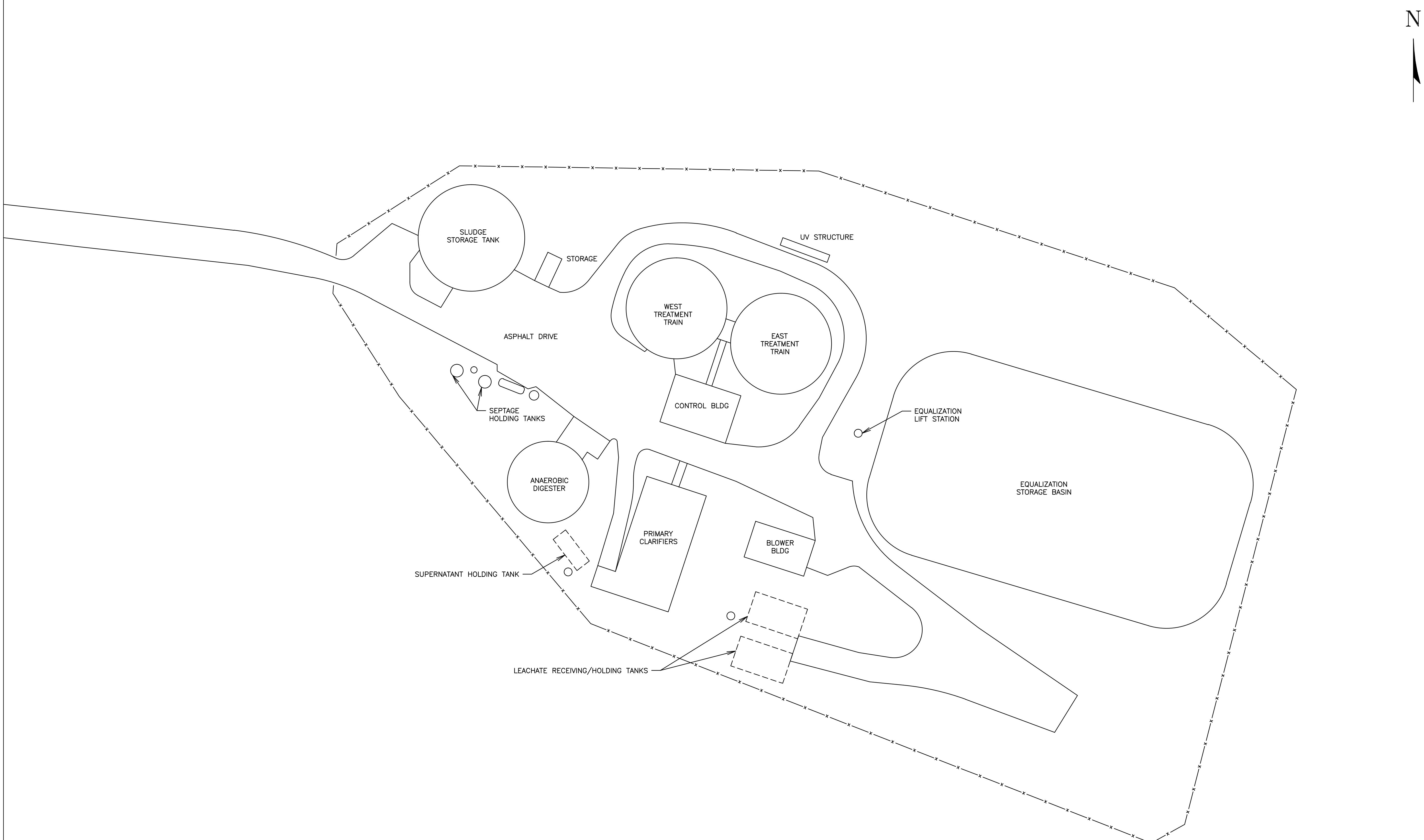


Figure 3-2
Sanitary Sewer Map
City of Viroqua





TOWN & COUNTRY ENGINEERING, INC.
2912 Marketplace Drive
Suite 103
Madison, WI 53719
(608) 273-3350
www.tcengineers.net

FIGURE 3-3
EXISTING WWTF SITE PLAN

WASTEWATER TREATMENT FACILITY UPGRADE

City of Viroqua, Wisconsin

PROJECT NO.: VI 05
DRAWING FILE: Treatment Basin Alternatives
DRAWN BY: D.D.E.
CHECKED BY: A.M.B.
DATE: 5-29-15
REVISIONS:
SCALE: 0 15 30
SHEET: SITE

4. FUTURE DESIGN CONDITIONS

4.1 Community Growth

The Wisconsin DOA formulated population projections in 2013 showing a roughly 13.3% total population increase for the City of Viroqua from 2010 to 2035, or 0.53% per year, for a 2035 population of 4,940. The DOA has also projected that Vernon County will be one of the ten fastest growing counties in Wisconsin from 2010 to 2040, with a projected growth of 22.7%. As noted in Chapter 3, the DOA population estimate for the City in 2013 is 4,361 and the projected 2015 population is 4,405. For this Facilities Planning Document, the base population for 2015 was assumed to be 4,455, which is slightly higher than the DOA 2015 projection but is consistent with the City's estimates.

The Comprehensive Plan that was adopted by the City in 2007 projected a 2010 population of 4,714 and a 2020 population of 5,126 for the City of Viroqua, with a projected net growth of 18.24% from 2000 to 2020, approximately 0.9% per year (See Appendix C). The Comprehensive Plan stated that the DOA projections provide a conservative population growth scenario and are not consistent with actual growth trends and opportunities which characterize the City and Town of Viroqua planning area. The availability of land for development and good accessibility to the La Crosse metro area via U.S. Highway 14/61 were cited as two factors encouraging growth in the area.

The future population estimate for this Facilities Planning Document is based on a projected growth of 1% per year and the estimated 2015 base population of 4,455, yielding a 2035 population of 5,346. It is felt that this 20% increase from 2015 to 2035 is consistent with the growth projected for Vernon County by the DOA and the Comprehensive Plan. The growth rate of 1% is also consistent with the City's growth from 1990 to 2000.

Growth in the commercial, industrial, and public authority sectors was projected based on the Comprehensive Plan and input from the City. Future commercial and industrial development is projected to occur mainly along the State Highway 14 corridor on the north side of the City on the City's northeast side along County Highway BB. The City did not have much land available for development within the City limits and plans to promote growth on 40 acres that was recently annexed on the northeast side. A summary of these projections is presented below in Table 4-1.

Table 4-1
Year 2035 Growth Projections

Sector	Increase
Residential	891 capita
Commercial	20%
Public	10%
General Industrial	20%

4.2 Wastewater Flows

The design flow rates for the City of Viroqua will include the main components listed below:

- Existing City Base Flow
- Future City Increases
- Future Major Industry Request
- Additional Contributions
- Existing Infiltration and Inflow

The existing City Base flow is as determined in Chapter 3. Future city increases, including residential, commercial, public and general industrial sectors will be based on the water consumption averages developed earlier and the expected increases shown in Table 4-1. An allocation for a future unidentified major industry was included to allow for some unforeseeable industrial growth. In accordance with NR 110, the allocated amount of 45,000 gpd is less than 10% of the total average design flow, excluding the allowance.

Additional contributions come from future potential acceptance of leachate, septage and/or holding tank wastewater from outside sources. Currently the City facility accepts leachate from the Vernon County Landfill in the amount of 1 to 1.5 million gallons annually. Other hauled wastes are accepted on a case by case basis, but it is felt that the demand for this practice will become even greater in the future. The future hauled waste contributions include 15,000 gallons per day of septage and 25,000 gallons per day of holding tank waste, as well as 5,000 gallons per day of leachate.

Infiltration and inflow quantities are taken from those values previously established in Table 3-7. Sustained wet weather infiltration is used to determine the average design flow because this clear water flow can be sustained for long periods of time which must be accommodated at the treatment facility with regards to system capacity.

The design average flow is calculated by summing the City Base flow, future city increases, industry projections, and the sustained and future additional I/I values. The maximum daily flow value is determined by summing the City Base flow, future city increases, and industry projections; multiplying this sum by a peaking factor of 2.0; and adding this value to the maximum daily inflow value and additional contributions. The peak hourly flow value is similar to the maximum daily flow with the exception that a peaking factor of 3.5 is used along with the peak hourly I/I number. The future flow projection calculations are provided in Appendix H and summarized in Table 4-2.

Table 4-2
Future Flow Projections

Contributor	Increase	Rate	Design Flow MGD
1. City Base Flow	(Table 3-5)		0.318
2. Future City Increases			
Residential	891 capita	60 gpcd	0.053
Commercial	20%	500 gpcd	0.027
Public	10%	1,000 gpcd	0.003
General Industrial	20%	1,550 gpcd	0.004
3. Future Industry Requests			
Unallocated	(City Survey)		0.045
1. Additional Contributors			
Septage Hauling	(See paragraph above)		0.015
Holding Tank Waste			0.025
Leachate			0.005
5. Infiltration and Inflow			
Sustained	(Table 3-7)		0.252
Future Additional	(Assumed reductions will		0
Future Reduction	cancel out future additions)		0
Maximum Daily Inflow	(Table 3-7)		1.029
Peak Hourly Inflow	(Max Day Inflow x 1.75)		1.801
Annual Average Flow (MGD)			0.535
Design Sustained Flow (MGD)			**0.747**
Maximum Month Flow (MGD)			0.637
Maximum Daily Flow (MGD)			1.929
Peak Hourly Flow (MGD)			3.309

4.3 Organic and Suspended Solids Loadings

Historical loading data from 2010 through 2014, as summarized in Table 3-8, were used to establish the current base loadings for BOD and total suspended solids being processed at the wastewater treatment facility. The average of the 3 highest months per year, excluding the lowest and highest years, were used for the base load. For future residential loads, the population increase is multiplied by a rate of 0.20 pounds of BOD and 0.22 pounds of solids. For the commercial, public, general industrial, and unallocated major industrial sectors the wastewater flow increase is multiplied by assumed concentrations of 250 mg/l for BOD and suspended solids which are typical for municipalities.

Additional contributions from holding tank or septage haulers are based on a total daily flow of 40,000 gpd which includes 15,000 gpd of septage and 25,000 gpd of holding tank waste as described previously. Assumed concentrations of 1,500 and 7,500 mg/L BOD for holding tank and septage respectively, and 1,000 and 10,000 mg/l suspended solids are used to calculate total loadings in pounds per day for each of these contributions. A summary of these projected design future loadings are given in Table 4-3.

Table 4-3
BOD and SS Loading Projections

	BOD (lbs/day)	**SS (lbs/day)**
1. City Base Loading (Table 3-8)		
Annual Average	934	1,062
Design Sustained	1,092	1,219
2. Future City Increases		
Residential	178	196
Commercial	57	57
Public	6	6
General Industrial	8	8
3. Future Industry Requests	94	94
4. Additional Contributions		
Septage Waste	938	1,251
Holding Waste	313	209
Leachate	4	2
Annual Average Loading (lbs/day)	2,532	2,884
Design Sustained Loading (lbs/day)	**2,690**	**3,041**

4.4 Nutrient Loadings

The same methodology used to project BOD and suspended solids loadings is utilized to calculate future nutrient loadings with the exception that typical values are used for ammonia and phosphorus concentrations due to the lack of sufficient historical data for influent loadings to the facility. For City base loadings, both existing and future, concentrations for TKN and phosphorus are assumed to be 60 mg/l and 7.5 mg/l respectively (Table 3-9). For additional contributions, concentrations of 400 mg/l and 250 mg/l are assumed for ammonia and phosphorus respectively for septage, 200 mg/l and 17 mg/l for holding tank waste, and 550 mg/l and 10 mg/l for leachate.

These assumed concentrations were multiplied by the flow rates established in Table 4-2 to determine the projected nutrient loadings. For this study, TKN values are assumed to be 150% of the ammonia loading, and a summary of these calculations is given below in Table 4-4.

Table 4-4
Future Nutrient Loadings

	TKN (lbs/day)	**P (lbs/day)**
1. City Base Loading		
Annual Average	159	20
Design Sustained	175	30
2. Future City Increases		
Residential	27	3.3
Commercial	14	1.7
Public	1	0.2
General Industrial	2	0.2
3. Future Industry Requests	23	2.8
4. Additional Contributions		
Septage and Holding Waste	50	31
Holding Waste	42	3.5
Leachate	23	0.4
Annual Average Loading (lbs/day)	340	63
Design Sustained Loading (lbs/day)	**356**	**74**

4.5 Future Effluent Limitations

The two locations being considered for the facility outfall are the existing location and a new location approximately two miles downstream of the current outfall, both on the Springville Branch of the Bad Axe River. As part of the facilities planning process, an effluent limit request for both of these locations was made to the Water Resources Section of the WDNR. Copies of correspondence regarding this issue are included in Appendix I and a summary of the preliminary effluent limits as calculated by the WDNR is given below in Table 4-5.

Table 4-5
Projected WPDES Permit Limits

Parameter	Existing Outfall Limits – Discharge to Groundwater	Existing Outfall Limits – With Stream Grouting	Relocated Outfall Limits
BOD (monthly average)	20 mg/l	20 mg/l	15 mg/l
BOD (weekly average)	30 mg/l	30 mg/l	
TSS (monthly average)	20 mg/l	20 mg/l	15 mg/l
TSS (weekly average)	30 mg/l	30 mg/l	
Total Nitrogen (monthly avg)	10 mg/l	--	--
Ammonia-N (weekly average)	--	Oct – Apr: 14 mg/l May – Sep: 16 mg/l	14 mg/l
Ammonia-N (monthly average)	--	Oct – Apr: 6.2 mg/l May – Sep: 6.9 mg/l	5.8 mg/l
Phosphorus (monthly average)	0.54 mg/l	0.54 mg/l	0.50 mg/l
Phosphorus (6-month average)	0.17 mg/l 0.80 lbs/day	0.17 mg/l 0.80 lbs/day	0.17 mg/l 0.75 lbs/day
Chlorides	250 mg/l	--	--
pH	6.0 – 9.0 s.u.	6.0 – 9.0 s.u.	6.0 – 9.0 s.u.
Dissolved Oxygen (daily min)	4.0 mg/l	4.0 mg/l	4.0 mg/l
Fecal coliforms (geometric mean)	0*	400# / 100 ml (May – Sep)	400# / 100 ml (May – Sep)
Max Temperature (weekly avg)	--	--	TBD

*Total coliform bacteria may not be present in any 100 ml sample using either membrane filter technique, the presence-absence coliform test, the minimum medium test or not present in any 10 ml portion of the 10-tube multiple tube fermentation technique.

The proposed limits were provided for three discharge options, as shown in Table 4-5. For the current outfall location, two sets of limits were developed. The first column shows the limits that would be imposed at the current outfall if there were no efforts made to mitigate the effects of the disappearing stream, which would result in discharge to both surface water and groundwater. The WDNR has stated that if the facility continues to discharge to the disappearing stream in the current location, the effluent would be required to be in strict compliance with groundwater discharge standards including zero total coliform bacteria count, 250 mg/L of chloride, and total nitrogen of less than 10 mg/L. The remaining limits for BOD, TSS, and phosphorus are similar to the other discharge scenarios. The second column shows the limits for the current outfall location assuming some method of stream repair (e.g., grouting of bedrock fractures) is performed to minimize loss to groundwater. The third discharge scenario is for relocation of the outfall to just upstream of the large spring near CTH B, where the coldwater portion of the Springville Branch of the Bad Axe River begins. Since the discharge is currently located on the same branch upstream of this point, this would be considered a relocated outfall, not a new discharge for the purposes of anti-degradation. The limits for the new location were developed to protect the coldwater reach downstream and are therefore slightly more stringent than the current limits and may include maximum temperature limits. If relocation of the outfall is the selected alternative, the WDNR has recommended that the City perform a site-specific temperature study for a dissipative cooling demonstration. This would include temperature monitoring of the WWTF effluent and the stream and estimation of in-stream temperature loss.

4.6 Design Summary

A summary of the projected design parameters established in the preceding sections are given in Table 4-6.

Table 4-6
Design Loading Summary

Projected Population	5,346
Flow Rates (MGD)	
Design Average	0.747
Maximum Daily	1.929
Peak Hourly	3.309
Pollutant Loadings (lbs/day)	
BOD	2,690
Suspended Solids	3,041
TKN	356
Phosphorus	74

5. PROJECT ALTERNATIVES

5.1 Overview

As noted in Section 2.1, the purpose of this Facilities Planning Document is to evaluate alternatives for moving or modifying the current WWTF outfall, as well as treatment upgrades to address equipment and process deficiencies, meet current and future permit requirements, and improve operational flexibility and efficiency.

It is the City's intent to use a phased approach to address these issues, with the first phase of design and construction to include the WWTF outfall modifications/relocation and the most pressing issues identified for the current processes and equipment. Subsequent phases will include upgrades to meet future design conditions and less immediate plant needs. The need for improved phosphorus removal to meet new permit requirements will be taken into consideration throughout facilities planning and design, but the specific planning and design submittals will follow the phosphorus compliance schedule in the WPDES permit. This document serves as the Facilities Planning Status Report for phosphorus that is required to be submitted by August 1, 2015. Section 5.3 describes phosphorus compliance options that will be evaluated by the City.

This Facilities Planning Document does not evaluate the construction of a new plant or major changes to the plant treatment process. These options were not evaluated because the existing tank structures are in relatively good condition and are expected to last for at least the next 20 years with the recommended repairs and modifications. The City wishes to maximize the use of existing structures/tankage to the greatest extent possible.

5.2 Description of Outfall Alternatives

The alternatives initially identified for the WWTF outfall were presented in the July 2014 Preliminary Stream Report by Town & Country Engineering (Appendix D) and were discussed with the WDNR and City of Viroqua at a July 15, 2014 meeting. The preliminary alternatives considered were as follows:

- Option 1: Maintain existing outfall location with improved treatment – Upgrade/optimize plant to meet groundwater discharge standards.
- Option 2: Pipe effluent from WWTF to spring - pipe all WWTF effluent to bypass the losing stream sections, discharging to the culvert at the intersection of CTH B and Miller Road.

- Option 3: Grout the stream bottom – maintain existing outfall location and attempt to seal the stream bottom by injecting grout into fractured bedrock below the stream.
- Option 4: Line the stream bottom - maintain existing outfall location and attempt to seal the stream bottom by installing a membrane liner in the stream.
- Option 5: Low-flow bypass of losing areas in-channel - construct in-channel controls and piping to divert low-flow periods past areas of the stream that lose flow.

The groundwater discharge standards for Option 1 are more stringent than the surface water discharge standards for the other options, as shown in Table 4-5, because total nitrogen, chloride, and zero total coliform bacteria standards would be applied. The City had requested a variance for the zero coliform count required for groundwater discharge because the stream is contributing considerably more than the discharge from the wastewater treatment facility. However, at the July 2014 meeting, the WDNR stated that it would not grant any variances, and that the WWTF discharge must be in strict compliance with the groundwater discharge standards. Based on these discussions with the WDNR, Option 1 is no longer considered feasible because this level of treatment is not considered economically viable and presents too much risk to the City.

The remaining alternatives include eliminating or minimizing the amount of flow across identified areas of potential stream loss. Construction of these alternates will require easements, riparian owner agreements, and in some cases will adversely affect the local farmers' watering rights for their livestock.

Bypassing options (Options 2 and 5) may face opposition from riparian owners because of loss of use of the current stream. There are a few homes along the stream that could claim loss of recreational use and/or loss of land value due to reduction/elimination of flow. In addition, there are four areas of apparent livestock use along the stream where animals use the stream for a water source. At the July 2014 meeting with the WDNR, the City noted that eliminating discharge to the disappearing stream would cause the stream to dry up during parts of the year and would cause hardship for the farmers, particularly regarding cattle watering. According to the WDNR, this does not factor in their decisions, as it is the City's discharge that is being controlled and intermittent flow in the stream would be naturally occurring. Other agencies/departments could see this as a negative impact for the stream, farmers and livestock. A partial bypass, Option 5, was deemed to be less desirable that a full bypass because the partial bypass has a high potential for plugging of the pipe and maintenance issues and it may ultimately not meet code requirements because infiltration of effluent will still occur during higher flows.

While lining or grouting the stream (Options 3 and 4), would likely be acceptable to riparian owners, it is difficult to determine whether these options would be successful and the actual cost of installation and maintenance because of unknown subterranean conditions. According to the WDNR, the City would have to provide assurance that the grouting or lining system is working properly, which may include performing stream flow monitoring. With Option 4, there are concerns about the longevity of the membrane and the potential for damage caused by burrowing animals.

Based on preliminary cost estimates and discussions of with the WDNR, the City has decided to consider only Option 2 further. While this alternative is expected to have higher construction costs, it provides the greatest degree of certainty for success and the least amount of future risk for the City.

For further evaluation, Option 2 has been divided into two alternatives, Alternative 2A – Gravity Sewer Bypass and Alternative 2B – Force Main Bypass. Figure 5-1 shows the approximate routes for each alternative. The actual route would be determined during the design phase and would depend on the availability of easements and subsurface conditions. Both alternatives would require road crossings, rock excavation and easement acquisitions.

- Alternative 2A: Gravity Sewer Bypass - A gravity sewer would be installed to provide a bypass from the treatment plant to the spring. For the purposes of this facilities plan, it is assumed that this would be accomplished using 18-inch diameter pipe running next to the stream. The CTH B road berm paralleling the stream would not allow gravity pipe to be economically constructed because the berm is approximately 15 to 20 feet higher than the stream in some parts.

- Alternative 2B: Force Main Bypass - A small lift station would be constructed at the treatment plant to pump effluent past the swallet areas to the spring. For the purposes of this facilities plan, it is assumed that a 12-inch diameter force main would be installed along CTH B.

Table 5-2 presents the capital cost estimates for each of these options, with detailed estimates provided in Appendix J.

Table 5-1
Capital Cost Estimates for Outfall Alternatives 2A and 2B

Alternatives	Estimated Capital Cost
Alternative 2A – Gravity Bypass Piping from WWTF to Spring	$2,688,898
Alternative 2B - Force Main Bypass Piping from WWTF to Spring	$2,136,755

These costs are based on an effluent flow rate of 1,500 gpm (2.16 MGD). It is being requested to reduce the flow rate to 1,000 gpm (1.44 MGD), with bypassing of treated effluent to the existing outfall location if needed. Continued use of the equalization storage pond could limit forward flow through the plant to 1,000 gpm during wet weather periods, but the hydraulics of the plant would need adjustment to have this occur. The other justification is that when the flows exceed 1,000 gpm, the stream carries runoff induced by rainfall or snowmelt and therefore the discharge will have little impact.

Alternative 2A is higher in cost due to rock excavation and the more difficult construction along the streambed, as well as the costs of easements and legal issues dealing with the multiple property owners along this route. Alternative 2B would be constructed almost entirely within the CTH B right-of-way and would have far fewer issues. For these reasons, Alternative 2B, the force main bypass of 1,000 gpm is the recommended alternative for the outfall relocation.

5.3 Phosphorus Compliance Alternatives

According to the planning effluent limits provided by the WDNR (Table 4-5), the Viroqua WWTF will be required to meet a 6-month average effluent limit for total phosphorus of 0.17 mg/l at either the current outfall location or the proposed new outfall location. This effluent limit is significantly lower than the plant's current interim limit of 1 mg/L and will require upgrades to the plant and/or other compliance alternatives. The 2014 effluent phosphorus concentrations for the WWTF are summarized in Table 5-2, with an average discharge concentration of 0.46 mg/L for the year.

Table 5-2
Effluent Total Phosphorus Summary for 2014

Month	Monthly Average Concentration (mg/L)
January	0.92
February	0.67
March	0.21
April	0.24
May	0.15
June	0.16
July	0.87
August	0.45
September	0.74
October	0.60
November	0.40
December	0.12
Average	**0.46**

As part of facilities planning for compliance with future phosphorus limits, the WDNR requires the City to evaluate the options described in the following sections.

5.3.1 Upgrades to the WWTF

The WWTF currently meets its phosphorus interim effluent limit through biological phosphorus removal and by chemical addition to the digester supernatant that is recycled to the head of the plant. In order to meet the more stringent limits, biological phosphorus removal would need to be optimized and recycle streams with high phosphorus content such as the digester supernatant would need to be minimized or eliminated. It is possible that upgrades/modifications to the biological phosphorus removal process and chemical addition will be sufficient to meet the final phosphorus WQBELs; however, additional treatment by tertiary filtration (or similar means) in conjunction with chemical coagulation and/or polymer additions may be necessary. Pilot testing at larger facilities has shown that low-level phosphorus effluent concentrations are achievable, though at significant cost, with current filtration technologies. Therefore, the City will proceed with evaluating the following tertiary treatment technologies:

- Conventional granular media filtration: Filtration using sand or anthracite (or a combination of both) has been used for many years for tertiary treatment of wastewater. Tertiary filtration aided by chemical addition can reduce total phosphorus concentrations in the final effluent to low levels. Chemicals, typically aluminum- or iron-based coagulants and polymer, must be added to wastewater to associate phosphorus with solids that can then be successfully removed through filtration. These units require significant infrastructure additions and available hydraulic head.

- Cloth media disc filtration: Disc filtration is becoming increasingly common as a replacement for traditional shallow bed sand filters. Nominal openings are typically 10 microns; though some units with 5 micron nominal openings are now being produced. Pilot testing at larger facilities has shown these new 5 micron units are capable of achieving low-level effluent phosphorus concentrations, however it is expected that high coagulant doses may be required.

The proposed effluent lift station will be designed to allow for the addition of a tertiary filter and the existing UV system would need to be replaced to the account for these changes in plant hydraulics if it is determined that filtration is needed in the future.

5.3.2 Consolidation With Nearby Sewerage System

Currently the Viroqua WWTF treats wastewater from only the City of Viroqua and accepts hauled waste from the Vernon County Landfill and a small number of septic and holding tank haulers. The closest communities with sewer systems and WPDES discharge permits are the City of Westby, the Village of Readstown and the Village of Viola, which are 6 to 12 miles away. Because of the current capacity available at Viroqua WWTF and the distance to other facilities, it does not appear that regionalization is a viable option and it will not be considered further.

5.3.3 Alternative Discharge Locations

The WDNR recommends the consideration of alternative discharge locations that may provide a WWTF with a less stringent phosphorus limit depending upon the receiving water classification and quality of the respective water body. Since the City and WDNR have already discussed the relocation WWTF outfall and the City has decided to move the outfall to a point further downstream, no other discharge options will be considered further. The relocated outfall does not provide less stringent phosphorus limits, but does bypass the disappearing portion of the current receiving stream and will meet WDNR requirements for effluent discharge.

5.3.4 Watershed Based Approaches

NR 217 allows for alternative compliance means through two watershed based approaches; water quality trading and watershed adaptive management. Both of these options involve working outside of the boundaries of the WWTF (and potentially the municipal limits) to reduce phosphorus discharges to the receiving stream, thereby allowing the WWTF to discharge more phosphorus than would be allowed with the proposed effluent limit of 0.17 mg/L.

Water Quality Trading

Water quality trading (WQT) involves working within the watershed of the respective receiving stream to reduce phosphorus runoff at a level commensurate with the required reduction in phosphorus load from the treatment facility to comply with water quality based effluent limits (i.e. an offset). WQT also requires "trade ratios" to be applied to provide certainty that water quality is being improved as a result of WQT. Trade ratios can vary between 1.1 and 5 (or higher) depending upon the type of practice installed, location within the watershed, and type of trade being performed (point to point, point to municipal separate storm sewer systems [MS4], point to nonpoint, etc.).

For the lowest possible trade ratio, trading would need to occur within the WWTF's HUC12 watershed and upstream of the WWTF outfall. The watershed area upstream of the current WWTF outfall is roughly 1.7 square miles according to WNDR PRESTO results table (Appendix D). Moving the outfall two miles downstream greatly increases the upstream watershed area.

The City will continue to evaluate WQT to determine its cost and environmental effectiveness. Further evaluation will include identifying possible phosphorus load reduction projects within the City of Viroqua as well as making contact with county land and water conservation departments in an attempt to quantify cost and feasibility of agricultural best management practices (BMP).

Watershed Adaptive Management

Watershed adaptive management follows a similar principal to WQT. Both programs target non-point source BMPs to reduce phosphorus runoff into water bodies. These programs differ in their respective means of compliance for the point source. Compliance with WQT is based upon theoretical reductions from BMPs and the actual mass of phosphorus discharged from the WWTF. Compliance with watershed adaptive management is based upon achieving the water quality criterion (0.075 mg/L) in the receiving water at the point of compliance. The permittee is given 20 years to meet the water quality criterion in the receiving water. In addition to achieving compliance within the receiving water the participating facility must also meet interim limits of 0.6 mg/L and 0.5 mg/l during the first and second permit terms of adaptive management, respectively.

A permittee is eligible for adaptive management as long as the following three requirements are met:

- The receiving water is exceeding the applicable phosphorus criteria.
- Nonpoint sources contribute at least 50% of the total phosphorus entering the receiving water.
- Filtration or equivalent technology would be required to meet the proposed/new phosphorus limit.

The City will continue to evaluate adaptive management to determine if it is feasible alternative and whether the City is eligible for this compliance option. Because the outfall, and therefore the compliance point for the receiving water, are being moved downstream, this will require further discussion with the WDNR.

5.3.5 Water Quality Variance

Wisconsin State Statute 283, paragraph 283.15 allows for variances to water quality standards. Paragraph 283.15 (4) states that a variance may be granted if "attaining water quality standards is not feasible". Likely the most prominent reason for obtaining a variance to water quality standards is "the standard, as applied to the permittee, will cause substantial and widespread adverse social and economic impacts in the area where the permittee is located". Per WDNR guidance, "if the resulting cost of implementing the phosphorus water quality based effluent limits is greater than 2% of the medium household income (MHI), it would generally be concluded that the economic impact is adverse enough to warrant granting of the variance."

The City will evaluate compliance options and compare with their MHI ($33,787 based on 2013 data) to determine if the 2% threshold (equivalent user rate of $56/month) is met and a variance application is feasible.

5.3.6 Statewide Multi-Discharger Phosphorus Variance

In the spring of 2014 the Wisconsin state legislature passed a bill which was then signed by the Governor, effectively granting a statewide variance to water quality based phosphorus limits if a point source discharger can show attainment of the standards is economically infeasible. The Department of Administration (DOA) has reviewed the variance and has determined that the water quality based phosphorus limits do indeed cause adverse economic burden to point source dischargers. Following public comment on the DOA determination, the variance must be approved by the U.S. Environmental Protection Agency. According to recent WDNR publications, the variance is expected to include the following:

- The duration of the variance will be for a maximum of 20 years (4 permit terms).
- Interim limits will be in effect and will subsequently be reduced each permit term. Initial values discussed included a limit of 0.8 mg/L during the first permit term, 0.6 mg/L during the second permit term, 0.5 mg/l during the third permit term, and finally WQBEL compliance.
- Watershed projects to reduce nonpoint source phosphorus are required. The discharger can enter into an agreement with the WDNR to implement a watershed project or can make payments to the county LCD for implementation of nonpoint source best management practices. The payments are expected to be $50 per pound of phosphorus for the difference between actual phosphorus discharged and 0.2 mg/L.

To be eligible for the variance, the point source discharger must require a major facility upgrade (i.e., addition of tertiary filtration) to comply with their phosphorus WQBELS and must meet primary and secondary indicators of substantial economic impact. The City will continue to monitor the progress of this variance legislation and evaluate participation in the variance if other alternatives are determined to be unacceptable.

5.3.7 Summary of Retained Options

The City will continue to evaluate feasible alternatives for meeting the final phosphorus limits, which may include facility upgrades, Watershed Adaptive Management, Water Quality Trading, or a water quality standards variance. Consolidation with other facilities and alternative discharge locations will not be considered further. The selected phosphorus compliance option will be described in a Preliminary Facilities Plan Phase 2 that will be submitted by August 1, 2016 as an Addendum to this document, with a Final Plan submitted by January 2017. The recommendations for this Facility Planning Document will focus on modifications to the existing treatment plant that will maximize the current biological treatment and nutrient removal to decrease the amount of phosphorus removal/reduction that will be required by other means.

5.4 Summary of WWTF Upgrade Requirements

In addition to the need for outfall modifications/relocation and improved phosphorus removal, Section 3.3 provides details on the following issues have been identified for the WWTF:

- Processes/structures with current operational issues, at end of design life, or in need of repair.
- Processes/structures requiring upgrade/modifications to meet future permit limits.
- General plant issues:

Based on the projected flows and loadings presented in Chapter 4, the following processes and structures may also require upgrades/modifications to meet peak flows and future flow/loads:

- Influent Interceptor – Estimated capacity of 2.5 MGD is less than the peak hourly flows that have been experienced at the plant (approximately 2.8 MGD in June 2014)
- Preliminary Treatment – Existing fine mechanical screen is rated for a peak flow of 2.74 MGD. Influent peak flows as high as approximately 2.8 MGD have been recorded at the plant and flooding of the influent channel has occurred.
- Primary Clarifiers – Adequately sized for average flows at current and future conditions but will have limited effectiveness if peak flows exceed 2.5 MGD.
- Overflow to the Equalization Pond - Reduces peaks but does not limit the peak forward flow though the plant to less than 1000 gpm (1.44 MGD) as

designed. Peak hourly flows as high as 2.49 MGD have passed through the plant.

- Secondary Treatment – Additional aeration basin capacity or separate selector basins will be needed as BOD load to the basins approaches 1,500 lbs/day (2,100 lbs/day total load to the head of the plant, assuming 30% removal in the primaries). A large portion of the projected design BOD load is attributed to hauled waste, which could be reduced if the City decides to accept less hauled waste rather than increase treatment capacity.
- Final Clarifiers - Addition of a final clarifier will be needed as average flows approach 0.7 MGD and if peak flows through the plant cannot be minimized. Existing clarifiers should be effective for peak flows up to approximately 1.8 MGD (overflow rate of 1,200 gpd/sf).
- Disinfection – Existing UV system is rated for a peak capacity of 1.44 MGD, which is less than peak hourly flows that have passed through the plant. Current system does not have intensity pacing or automatic cleaning system and controls will eventually be unsupported.
- Solids handling – Sludge thickening is recommended to extend the capacity of the anaerobic digester. Current hydraulic detention time for the digester is near the minimum of 15 days, which indicates that sludge thickening would be needed to reduce the volume of sludge sent to the digester as plant loadings increase.

5.5 Description of Plant Upgrade Alternatives

The following sections lay out the proposed phases of construction for the WWTF modifications along with potential alternatives for each phase. Table 5-3 lists the proposed components of each construction phase.

Table 5-3
Proposed Construction Phases

Phase 1 (1-2 years)
Outfall Relocation – Lift Station and Force Main • Construct effluent lift station and force main to move outfall to Hwy B/Miller Rd Headworks and Primary Clarifiers Building • Replacement of corroded primary clarifier skimmers • Minor hydraulics/piping modifications to limit peak forward flow through the plant and improve diversion to equalization storage basin Biological Treatment • Replacement of blowers to improve operational efficiency, energy usage and noise • Replacement of aging final clarifier mechanical equipment to improve reliability and performance • Maximize existing tankage for improved treatment and phosphorus removal • Piping and structural modifications to provide more flexible operation of selectors and aeration basins and ability to use one or two clarifiers • Removal of selector basin wooden baffle walls • Removal of influent launders for the aeration and selector basins • East and West dome recoating or replacement Hauled Waste Receiving Station • Addition of new receiving station for hauled waste (holding tank and septage), with flexibility to feed to the front of the plant rather than the digester Sludge Thickening • Addition of sludge thickening facilities to extend the capacity of existing digester and sludge storage and eliminate digester supernatant recycle Sludge Holding Tank • Minor exterior repairs needed Equalization Storage Basin • Liner repairs needed Lab/Process Control Building • Modifications to create proper space for office/break room and laboratory • Addition of a sludge pump as backup/replacement to the single 1970s vintage sludge pump • Replacement of aging/obsolete electrical controls and original MCCs • Modifications to RAS/WAS pumps and/or piping to prevent loss of prime

Table 5-3
Proposed Construction Phases (continued)

Phase 1A - Could be done concurrent with Phase 1 or Phase 2 (3-5 years)
• Replacement of aging heat exchanger, mixing system, and gas handling system for anaerobic digester • Digester cover rehabilitation and tuck-pointing of digester brick exterior • Electrical and HVAC modifications for Primary Clarifier building and chemical feed room
Phase 2 - If needed, construction in 3-5 years
• Modifications for improved phosphorus removal required to meet new permit limits (to be added by addendum to Facilities Plan) • Replacement of UV system for improved efficiency and possible hydraulics changes with phosphorus removal facilities
Phase 3 - As needed based on future flows/loads and infiltration/inflow
If peak flows cannot be decreased by reducing I/I: • Increase capacity of 18" plant interceptor by upsizing or twinning • Replacement of influent screen for increased peak capacity (current 2.74 MGD) • Modifications to primary clarifiers and overflow structure for increased peak capacity If future flows/loads increase to projected design values: • Addition of final clarifier as average flows approach 0.7 MGD • Addition of aeration basin or separate selector basins as plant BOD load approaches 2,100 lbs/day

5.5.1 Phases 1 and 1A

Phase 1 will address the most immediate needs at the treatment plant and construction will be performed in conjunction with the outfall relocation project, which is planned to take place in 2016-2017. Phase 1 will include the elements listed in Table 5-3. Another construction phase, designated Phase 1A, could be performed concurrently with Phase 1 or could be held until Phase 2 is performed. The decision on timing for Phase 1A will depend primarily on funding options discussed in Chapter 8. As shown in Table 5-3, Phase 1A consists of upgrades to the primary clarifier building and anaerobic digesters. While these modifications are not critical, they must be performed in the near future to extend the life of these structures. In particular the primary clarifier building is in need of significant modifications to meet current code requirements for electrical and HVAC.

For Phase 1, three main alternatives will be evaluated for the biological treatment process, as follows:

- Alternative 1 - Keeping the existing flow arrangement with two parallel biological treatment trains
- Alternative 2 – Keeping two biological treatment trains but changing the flow arrangement to allow operation of one treatment train with one or both final clarifiers
- Alternative 3 – Using existing tankage to create a single biological treatment train (selectors and aeration basins) to be used with one or both final clarifiers

Figures 5-2, 5-3, and 5-4 shown a schematic of the biological process for each of these alternatives. The cost estimates presented in Chapter 6 are based on the alternative components shown in the figures and outlined in Table 5-4. Alternatives 1 and 2 uses the existing tankage and piping with very little modification, with the addition of a splitter structure for Alternative 2. Alternative 3 also uses the existing tankage, but with more extensive modifications to allow for a single treatment train with series flow and bypassing of any basin.

The remaining components of Phase 1 are the same for all three alternatives and include modifications/repairs to the existing controls/laboratory building, equalization storage basin, and sludge storage tank, as described in Table 5-3. The only new construction proposed for Phase 1, in addition to the outfall relocation, is a hauled waste receiving station and sludge thickening facilities. Specific options for sludge thickening will be evaluated during the design phase. For purposes of facilities planning, a dissolved air flotation (DAF) unit is assumed. Sludge thickening will be used to thicken WAS prior to digestion, with an expected increase in solids concentrations from less than 0.5 percent up to 3-5 percent. This reduction in the amount of liquid sent to the digester and sludge storage tank will free up capacity for solids handling. It will also greatly reduce or eliminate the amount of digester supernatant that is sent back to the head of the plant. Since the digester supernatant is a high-strength recycle stream and a major source of phosphorus, this will decrease the overall loading to plant as well as the amount of chemical and biological phosphorus removal that must be achieved.

Table 5-4
Description of Phase 1 Alternatives

Component	Alternative 1	Alternative 2	Alternative 3
Buried Primary Effluent Piping	No change	No change	Replace with single 14" pipe
Primary Effluent Launders	Replace with piping to selector basins	Replace with piping to selector basins	Replace with piping to selector basins
Selector Basins	Use existing configuration (6 basins) with new concrete walls, install 2 new mixers in first zones	Use existing configuration (6 basins) with new concrete walls, install 2 new mixers in first zones	Convert 2 aeration basins to selectors (4 basins), reuse existing floating mixers
Aeration Basins	No change	Add weir gates to last basin on each side	Convert existing selector basins to aeration basins, provide bypass piping for all basins
Aeration Piping and Diffusers	Minor modifications	Minor modifications	New fine bubble diffusers in all aeration basins, piping modifications as needed
Aeration Blowers	Replace 2 blowers with more efficient models	Replace 2 blowers with more efficient models	Replace 2 blowers with more efficient models
RAS/Recycle Piping	Minor modifications	Minor modifications	New RAS piping to anoxic selectors, New recycle pump for denitrification
Flow Splitting	No change	New splitting chamber to either clarifier	New splitting chamber to either clarifier
Final Clarifiers	Replace mechanisms, launders, and weirs, no piping changes	Replace mechanisms, launders, and weirs, new influent and effluent piping	Replace mechanisms, launders, and weirs, new influent and effluent piping

5.5.2 Phase 2

Phase 2 will address improved phosphorus removal required to meet new permit limits, as shown in Table 5-3. It is expected that Phase 2 will follow after Phase 1, with construction occurring in 3 to 5 years from approval of this Facilities Planning Document. As discussed in Section 5.4.1, Phase 1A could be combined with Phase 2.

Preliminary capital cost estimates will be provided for Phase 2 but specific alternatives for various treatment processes will not be developed in this document. In accordance with the phosphorus compliance schedule in the WPDES permit, a Preliminary Facilities Plan Phase 2 will be submitted by August 1, 2016 as an Addendum to this document, with a Final Plan submitted by January 2017. The Addendum will contain cost estimates for phosphorus removal options and refinements to the Phase 2 cost estimates provided in this document. For cost estimating purposes in this document, construction of a tertiary filtration system for phosphorus removal has been assumed for Phase 2, in the event that phosphorus compliance cannot achieved through other means. The City will continue to evaluate potential phosphorus compliance options, including treatment upgrades, Adaptive Management, Water Quality Trading, and a water quality standards variance.

5.5.3 Phase 3

Phase 3 will address treatment plant modifications and interceptor capacity that may be needed to handle the projected future flows and loadings (Chapter 4). As shown in Table 5-3, all of the Phase 3 elements depend on either the peak flows to the plant or whether the projected design flows and loads are realized. The timing and need for Phase 3 will depend on the actual growth in the City of Viroqua, the amount of I/I reduction that can be achieved by the City, and future changes to the plant flows and loadings, such as the addition of major industry. If substantial reduction in I/I can be achieved, or if actual growth is slower than projected, some of the Phase 3 components may not be needed in the next 20 years. Due to the uncertainty in need and sizing, capital cost estimates for Phase 3 are not provided in this document.

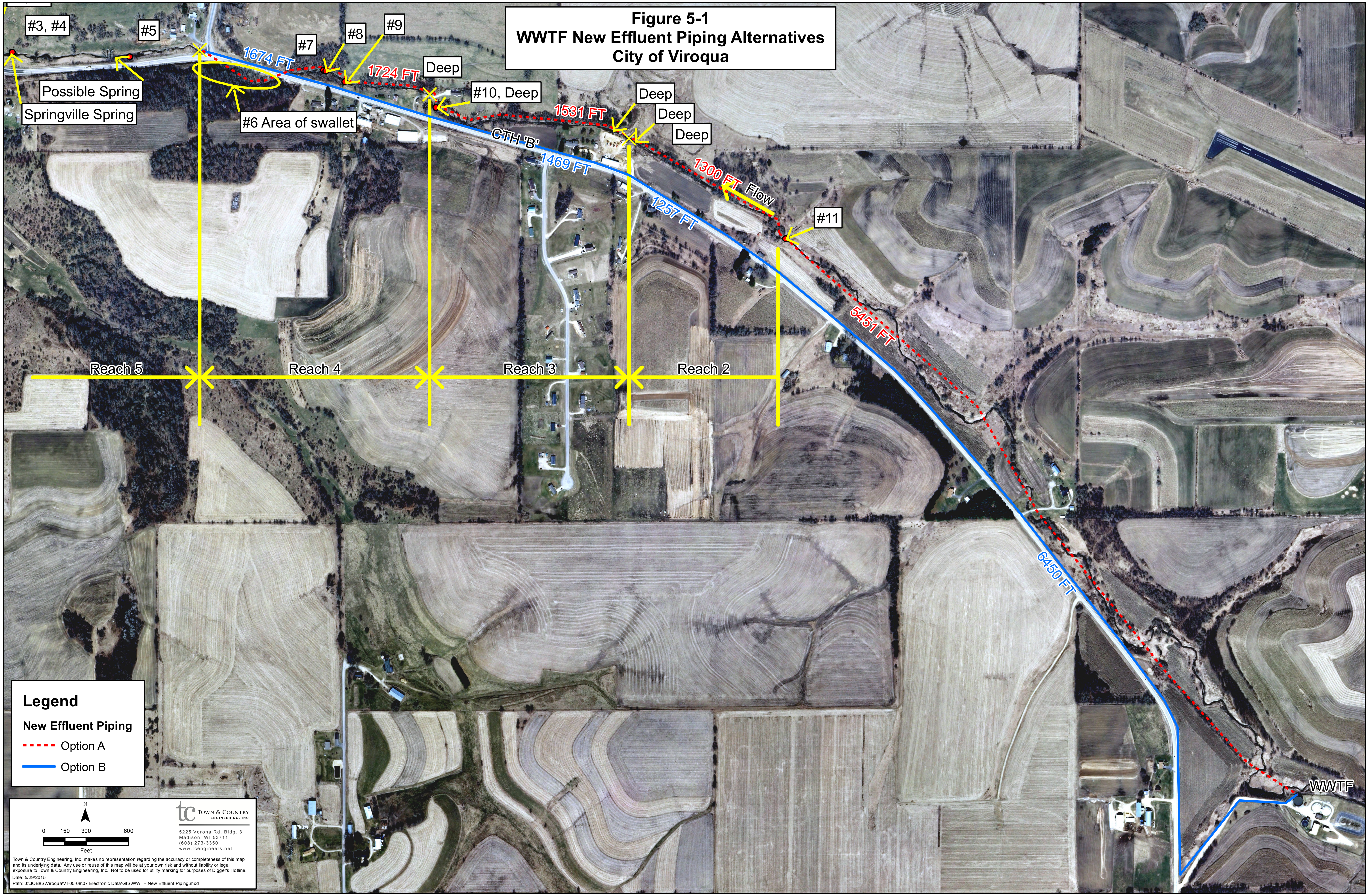
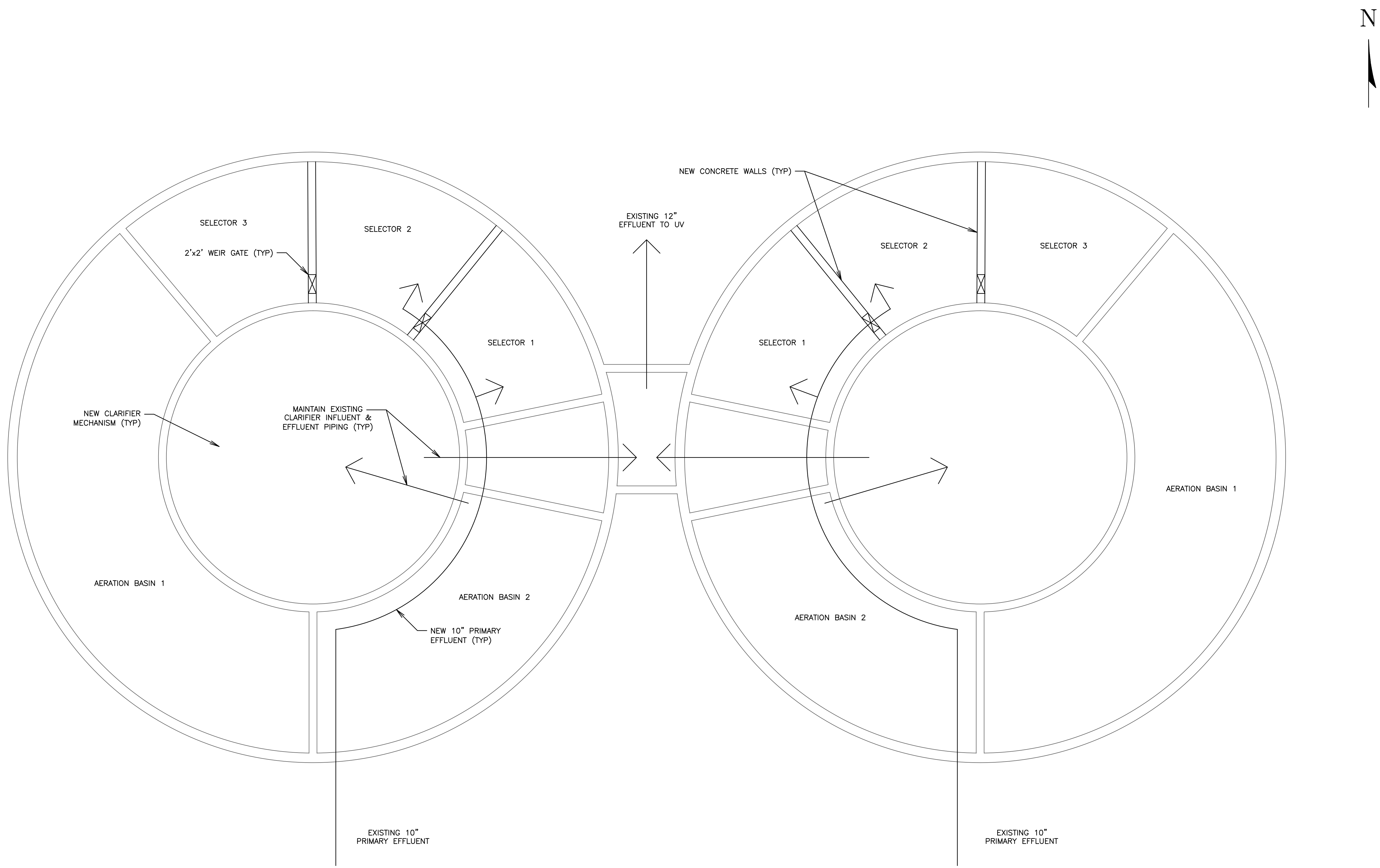


Figure 5-1
WWTF New Effluent Piping Alternatives
City of Viroqua



OTHER COMPONENTS

- REPLACE MIXERS IN SELECTOR 1 BASINS WITH NEW FLOATING MIXERS.

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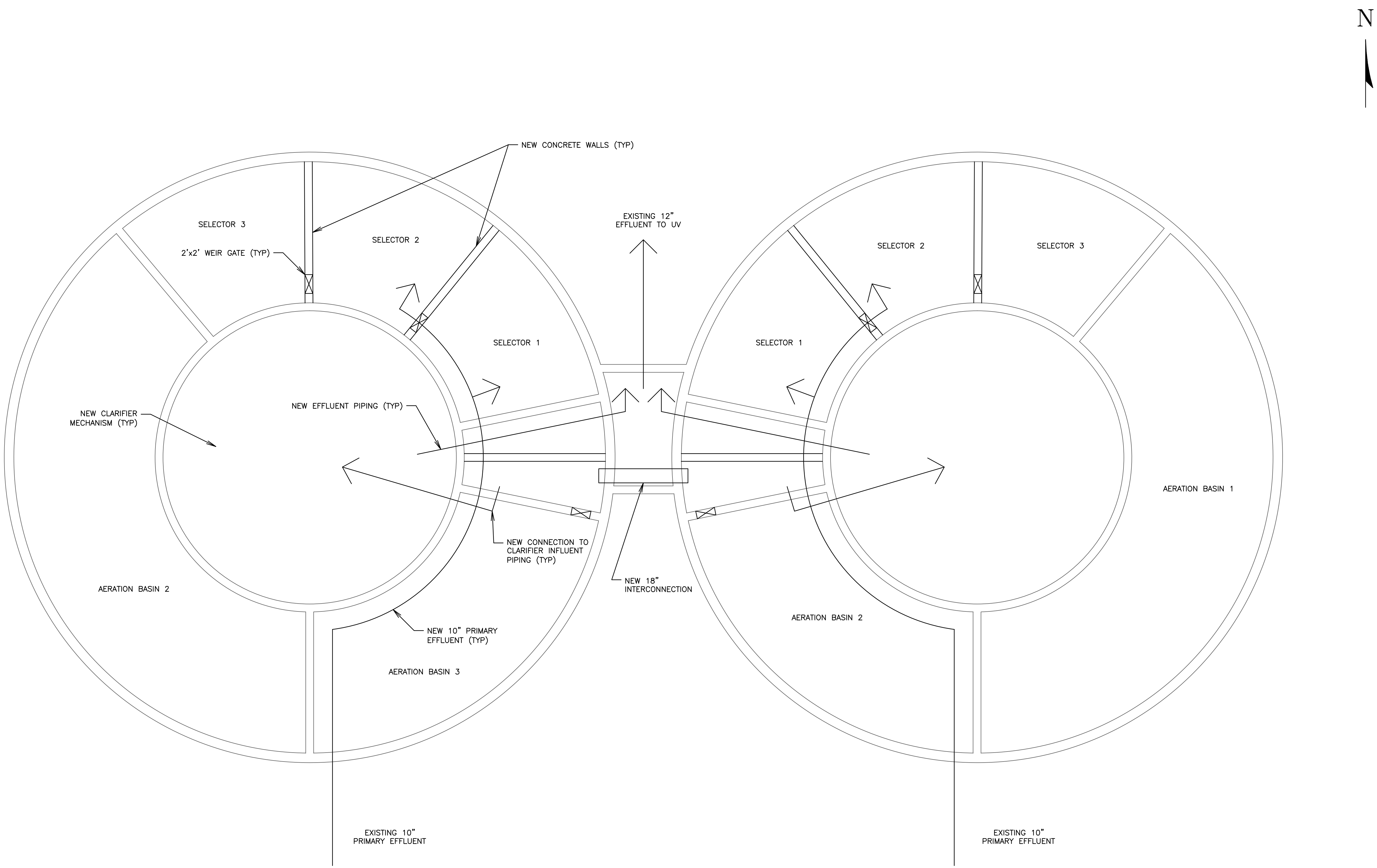
Suite 103
Madison, WI 53719
(608) 273-3350
www.tcengineers.net

FIGURE 5-2
BIOLOGICAL TREATMENT BASINS
ALTERNATIVE 1

WASTEWATER TREATMENT FACILITY UPGRADE

City of Viroqua, Wisconsin

PROJECT NO.: VI 05
DRAWING FILE: Treatment Basin Alternatives
DRAWN BY: D.D.E.
CHECKED BY: A.M.B.
DATE: 5-29-15
REVISIONS:
SCALE: 0 1 2 3 5 FEET
SHEET: ALT 1



OTHER COMPONENTS

- REPLACE MIXERS IN SELECTOR 1 BASINS WITH NEW FLOATING MIXERS.

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Suite 103
Madison, WI 53719
(608) 273-3350
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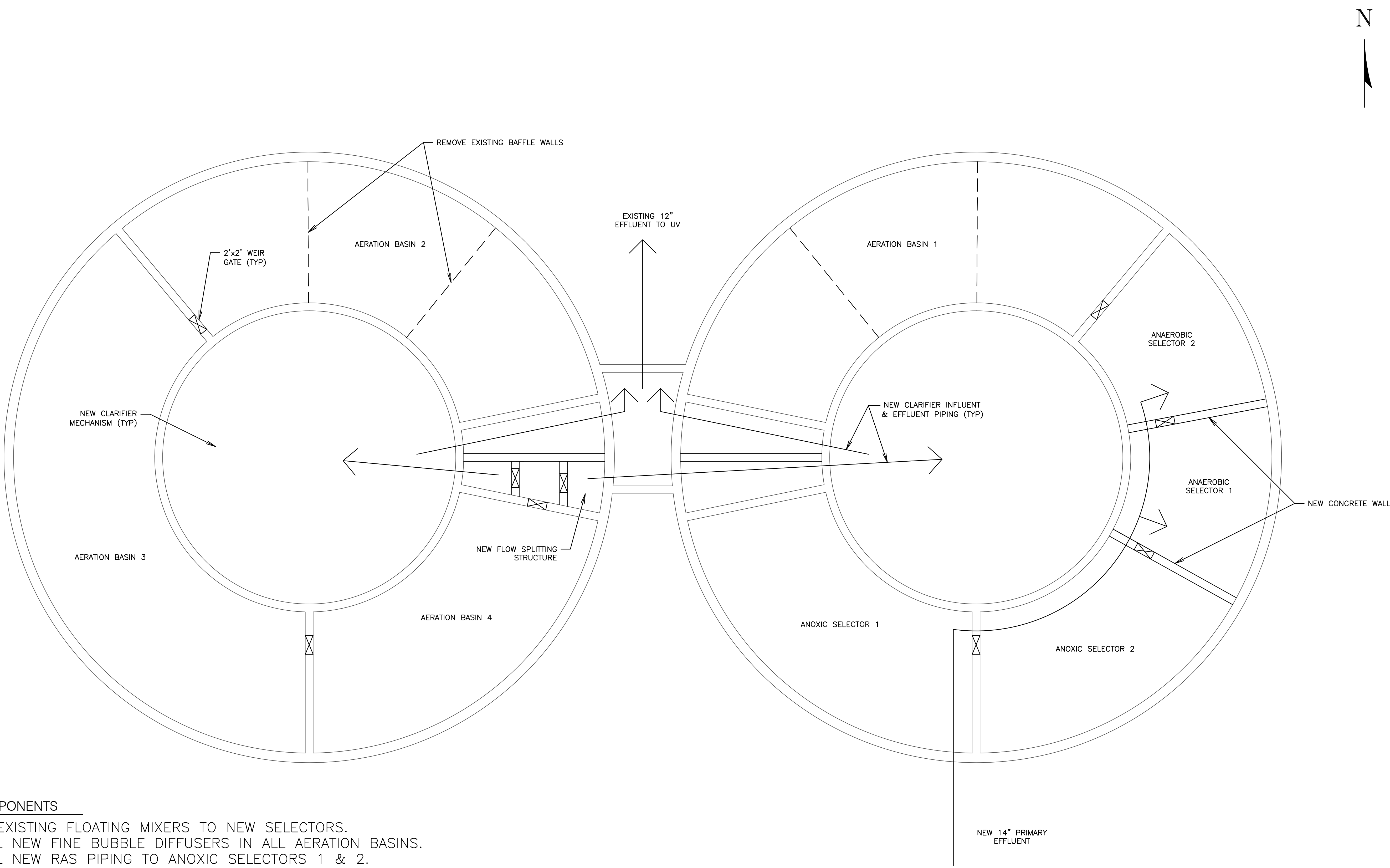
FIGURE 5-3
BIOLOGICAL TREATMENT BASINS
ALTERNATIVE 2

WASTEWATER TREATMENT FACILITY UPGRADE
City of Viroqua, Wisconsin

PROJECT NO.: VI 05
DRAWING FILE: Treatment Basin Alternatives
DRAWN BY: D.D.E.
CHECKED BY: A.M.B.
DATE: 5-29-15
REVISIONS:
SCALE: 0 1 2 3 5 FEET
SHEET: ALT 2



OTHER COMPONENTS

- MOVE EXISTING FLOATING MIXERS TO NEW SELECTORS.
- INSTALL NEW FINE BUBBLE DIFFUSERS IN ALL AERATION BASINS.
- INSTALL NEW RAS PIPING TO ANOXIC SELECTORS 1 & 2.
- INSTALL BYPASS PIPING FOR ALL SELECTORS/BASINS.
- INSTALL DENITE RECYCLE PUMP IN ANAEROBIC SELECTOR 1 OR 2 (RAILS IN BOTH LOCATIONS) WITH FLEXIBLE PIPING TO ANOXIC SELECTOR 1 OR 2.
- REPLACE AERATION PIPING AS NEEDED.

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FIGURE 5-4
BIOLOGICAL TREATMENT BASINS
ALTERNATIVE 3

WASTEWATER TREATMENT FACILITY UPGRADE
City of Viroqua, Wisconsin

PROJECT NO.: VI 05
DRAWING FILE: Treatment Basin Alternatives
DRAWN BY: D.D.E.
CHECKED BY: A.M.B.
DATE: 5-29-15
REVISIONS:
SCALE: 0 1 2 3 5 FEET
SHEET: ALT 3

6. ALTERNATIVES COMPARISON

6.1 General

In this chapter financial and non-economic analyses are presented for the three Phase 1 alternatives described in the previous chapter. The financial analyses will include capital, operation and maintenance and present worth cost evaluations for each alternative. Non-economic evaluations presented will include a qualitative analysis considering such factors as ease of operation, future growth potential, and an environmental assessment. Operation and maintenance costs will be based on the current utility budget for the facility with changes made as appropriate to account for each proposed upgrade. Additions and savings to the budget will be allocated as appropriate to account for changes in energy requirements and materials associated with the process changes described.

This chapter also includes capital costs for the new effluent lift station and force main and the proposed Phase 1A and Phase 2 improvements.

6.2 Capital Costs

Summarized capital costs for each of the Phase 1 alternatives are presented below in Table 6-1, Capital Cost Summary. Phase 1 costs include changes to the biological treatment train as well as the other modifications listed in Table 5-3 for other plant processes and structures. Table 6-1 also includes capital costs for Phase 1A and 2 based on the assumptions stated in Chapter 5. A more detailed cost breakout for each of these alternatives and phases is provided in Appendix J. The capital costs listed in the referenced table include costs for the eventual general contractor's scope of services; a contingency of 10% of the projected contractor's cost; and engineering, administration and legal work that will be necessary to plan, design, finance and manage the project.

The contractor's scope of services includes construction of the facility modifications with a cost being included for the contractor's mark up to accommodate overhead and profit, and contract administration. It must be kept in mind that construction and operations costs could change between the date of this facility planning document and the time when the eventual project is bid out.

Table 6-1
Capital Cost Summary

No.	Construction	Contingency	Engineering & Administration	Total
WWTF Phase 1 Alternatives				
1	$2,659,400	$266,000	$399,000	$3,324,400
2	$2,731,700	$273,200	$409,800	$3,414,700
3	$3,040,600	$304,100	$456,100	$3,800,800
Outfall Relocation				
2B	$1,669,400	$167,000	$300,600*	$2,137,000
Additional Phases				
Phase 1A	$1,671,600	$167,200	$250,800	$2,089,600
Phase 2	$2,678,900	$267,900	$401,900	$3,348,700

*Includes costs for easement surveys, descriptions, and legal services

For the Phase 1 alternatives the difference in costs between the lowest cost alternative, Alternative 1 and the highest, Alternative 3, is approximately 14% of the total, or $476,400. The difference in cost between the alternatives is tied to the proposed changes for the selector and aeration basins, final clarifiers, and splitter structure, which are shown in Figures 5-2 through 5-4, and some changes in associated yard piping. Costs for the remaining structures are the same for all Phase 1 alternatives.

6.3 Operation and Maintenance Costs

Annual O&M costs for each of the Phase 1 alternatives are summarized below in Tables 6-2 and 6-3. The first table includes costs for start-up conditions which are to be expected when the upgraded facility goes into operation in Year 2017, and the second table is for design year conditions which are expected twenty years after that. The City's general budget categories are used for the column headers and "Operations" and "Maintenance" costs will vary among the various alternatives. Categories such as customer accounts, administrative and general expenses will be similar for all alternatives and are lumped together in the column titled "Other".

Table 6-2
O&M Cost Summary at Start-Up Conditions

No.	Operations	Maintenance	Other	Total
WWTF Phase 1 Alternatives				
1	$264,500	$72,500	$190,100	$527,100
2	$260,700	$72,500	$190,100	$523,300
3	$248,300	$72,500	$190,100	$510,900

Table 6-3
O&M Cost Summary at Design Year Conditions

No.	Operations	Maintenance	Other	Total
WWTF Phase 1 Alternatives				
1	$382,600	$75,200	$190,100	$647,900
2	$375,100	$75,200	$190,100	$640,400
3	$366,900	$75,200	$190,100	$632,200

A detailed breakout of the O&M costs for each of the alternatives is given in the appropriate section of Appendix J. The detailed breakout uses the City's budgeted line item format as a template for listing these variations in cost. There are more than twenty different budgeted line items for the City's wastewater utility but there are only a few operating costs that vary among the alternatives.

Operating costs which differ among the Phase 1 alternatives include utilities such as electricity and natural gas consumption; chemicals used for the treatment processes; and sludge hauling. Electricity use varies among the alternatives primarily due to the number of selector basins and mixers associated with each alternative. The cost of chemicals includes the addition of alum for phosphorus precipitation and polymer for sludge thickening. Each alternative will have varying amounts of sludge production, but the amount of sludge hauling is assumed to be the same for alternatives at two hauling events per year, with the goal of minimal decanting of the sludge storage tank. The lowest overall O&M costs are for Alternative 3 due primarily to the reduced alum usage expected for this alternative.

6.4 Replacement Costs

Annual replacement costs are summarized for each alternative in Table 6-4. These costs have been separated into the two main categories of process and sludge. The process costs include equipment for the headworks building, primary clarifiers, selector basins, biological treatment, final clarifiers, UV disinfection, septage receiving, and laboratory equipment. The sludge replacement costs include all equipment for sludge processing, digestion and storage.

Individual replacement costs are calculated by considering the present day installed cost of the equipment and determining the annual contribution necessary to replace the item after an assumed equipment life. The annual cost is calculated assuming the same interest rate as that assumed for the present worth analysis provided later in this chapter. Projected inflation values have not been factored into the equipment costs which would increase the higher replacement costs at a greater net amount than the lower replacement costs. Detailed spreadsheets showing the replacement cost values for each of the equipment items for each alternative are presented along with the other cost information in Appendix J of this report.

Table 6-4
Annual Replacement Cost Summary

No.	Process	Sludge	Admin/Elec	Total
WWTF Phase 1 Alternatives				
1	$51,369	$25,366	$19,488	$96,223
2	$51,369	$25,366	$19,488	$96,223
3	$50,465	$25,366	$19,488	$95,318

The replacement costs for the alternatives are nearly equal because the same equipment is included for each alternative. The only major difference among the alternatives is how flow is split and routed through the biological treatment trains. Alternative 3 uses 4 selector basins and consequently fewer mixers than Alternatives 1 and 2, which have 6 selector basins.

6.5 Present Worth Analysis

A present-worth analysis is performed for each alternative by taking the capital cost and adding to it the present worth value of the average annual O&M costs and the annual replacement fund cost calculated over the evaluation period of twenty years. The capital, O&M, replacement are as outlined in the previous paragraphs of this chapter. Salvage costs are assumed to be the same for all alternatives and have not been including in the present worth calculations. The discount rate used for this analysis is 4.625%, the rate for Federal Fiscal Year 2015. A summary of the present-worth values is presented below in Table 6-6.

Table 6-6
Present Worth Values of Alternatives

No.	Capital	O&M	Replacement	PW
WWTF Phase 1 Alternatives				
1	$3,324,400	$587,450	$96,300	$12,123,100
2	$3,414,700	$581,800	$96,300	$12,140,700
3	$3,800,800	$571,550	$95,400	$12,383,300

The present-worth values range from approximately $12.2 million for Alternative 1 up to approximately $12.4 million for Alternative 3. The alternatives are within 2% of each other and can be considered essentially equal in present worth costs.

6.6 Non-Economic Considerations

In this section, an attempt is made to evaluate the three Phase 1 alternatives based on qualitative factors which have been identified as being important by Utility staff and by the local community. The factors identified as being important for the community at large include air quality issues with regards to odor control; noise; traffic; and future expansion capability. The City staff is concerned with the ability to meet existing and future permit limits and safety. Environmental impacts related to the facility construction are evaluated separately in a subsequent chapter and are not included in this section.

Air quality issues include odor control and corrosion as they impact room air conditions within the treatment facility, and migration of these odors to commercial and residential areas. Traffic issues concern the amount of truck traffic negotiating City streets and the impact on local traffic flow. Future expansion relates to the ability to add structures and technology for future upgrades. The ability to comply with existing and future permit requirements includes incorporating treatment technology that will be easy to operate and will be easily modified to meet future nutrient requirements. Noise concerns affect both nearby residential areas and City staff. Safety issues are self-explanatory.

In Table 6-7 a summary of the subjective quantification of the relative merits of each alternative is presented as it relates to these qualitative factors. A score of 1 to 5 is used for each category with the value of 1 being low or the worst rating, and 5 being the best score. The benefit of performing a qualitative evaluation such as this should be to identify the strengths of certain alternatives that may not necessarily impact a quantitative cost analysis.

Table 6-7
Qualitative Evaluation Summary

Category	Phase 1 WWTF Alternatives		
	Alternative 1	**Alternative 2**	**Alternative 3**
Air Quality	3	3	3
Traffic Issues	3	3	3
Future Facility Expansion	2	2	3
Future Permit Requirements	3	3	4
Noise	4	4	4
Safety	3	3	3
Total	**18**	**18**	**20**

Air quality issues, specifically odor control, are expected to be similar for all of the alternatives. Minimizing odors through adequate ventilation and odor control is considered crucial to acceptance by the community

Like air quality issues, traffic issues are expected to be similar for all alternatives. All options include liquid sludge disposal and there is not a significant difference in the quantity of sludge needing to be hauled among these alternatives.

Future facility expansion will be most easily accommodated by Alternative 3. By combining the primary effluent into one pipe, providing series flow through the selectors and aeration basins with bypassing, and splitting flow to either or both clarifiers, this option provides the greatest flexibility for adding tankage if needed in the future. Alternatives 1 and 2 have less flexibility because two separate treatment trains are maintained and flow splitting to future structures would require significant modifications.

All of the alternatives should be able to accommodate future permit requirements in terms of nutrient removal although Alternative 3 is expected to achieve the most biological phosphorus removal and require the least amount of chemical addition to meet permit limits.

Noise from plant operations is expected to be greatly reduced with the replacement of the existing blowers, which is common to all alternatives. Newer models of blowers are more efficient and significantly quieter than the current blowers.

The primary safety concerns with regards to work environment have to do with handling and application of potentially hazardous materials; operation of machinery; and minimizing room air issues. Hazardous materials that may be used at the plant include phosphorus precipitating chemicals such as alum; polymers for thickening and dewatering; and cleaning solutions. Also, alternatives with more machinery that have to be routinely maintained are considered a greater safety hazard. Room air conditions are impacted by open top storage vessels or processes located within structures. In all of these respects, the difference among all alternatives is not significant.

6.7 Recommendations

For Phase 1 modifications at the WWTF, Alternative 3 is recommended. While this alternative is estimated to be slightly higher in capital costs than the other two alternatives, it provides the most flexibility for operations, future expansion, and meeting current and future nutrient limits. The annual operating expenses for this alternative are expected to be less than the other alternatives due to reductions in electricity usage and chemicals for phosphorus removal. The present worth comparisons (Table 6-6) shows only a 2 percent difference between the recommended alternative and the lowest cost option, Alternative 1. According to WDNR guidance, alternative present worth costs within 10 percent of each other are considered essentially equal. The operational advantages presented by Alternative 3 outweigh any minor incremental increase in costs over the other two alternatives.

As discussed in Section 5.2, the force main bypass (Alternative 2B) is the recommended alternative for the outfall relocation. This alternative was chosen following discussions with the WDNR about options for stream bypassing, streambed rehabilitation, or increased treatment to meet groundwater discharge standards. The City has decided that bypassing the disappearing portion of the stream has the greatest degree of certainty for success and the least amount of future risk for the City. The force main option has a lower estimated capital cost than the gravity piping option that was also considered.

A summary of the recommendations proposed for the first phase of construction are as follows:

- Construction of an effluent lift station and force main to relocate the outfall to Hwy B/Miller Rd
- Replacement of corroded primary clarifier skimmers
- Minor hydraulics/piping modifications to limit peak forward flow through the plant and improve diversion to equalization storage basin

- Modifications to biological treatment trains to allow for series operation of selector and aeration basins, with ability to bypass each basin, to improve biological nutrient removal
- Addition of flow splitting after the aeration basins to allow use of one or both final clarifiers, as needed
- Replacement of aging final clarifier mechanical equipment to improve reliability and performance
- Replacement of two aeration blowers to improve operational efficiency, energy usage and noise
- Addition of a new receiving station for hauled waste (holding tank and septage), with flexibility to feed to the front of the plant rather than the digester
- Addition of sludge thickening facilities to extend the capacity of existing digester and sludge storage and eliminate digester supernatant recycle
- Minor exterior repairs for the sludge holding tank.
- Liner repairs for the equalization storage basin
- Modifications to the Control Building to create proper space for office/break room and laboratory
- Addition of a sludge pump as backup/replacement to the single 1970s vintage sludge pump
- Modifications to RAS/WAS pumps and/or piping to prevent loss of prime
- Replacement of aging/obsolete electrical controls and original MCCs

These improvements are recommended for Phase 1 of construction at the treatment plant, which is expected to begin in 2016 or 2017 depending on funding sources. A follow-on or concurrent phase of construction, designated Phase 1A, is recommended for the following improvements that are needed in the next 3-5 years to extend the life of these structures:

- Replacement of aging boiler/heat exchanger and gas handling system for anaerobic digester, along with exterior repairs (tuck-pointing) and cover rehabilitation or replacement.
- Modifications to the building housing the headworks, primary clarifiers, and chemical feed equipment to meet current electrical and HVAC code requirements.

Subsequent phases of construction, designated as Phase 2 and 3, will depend on the selected alternative for phosphorus compliance, the actual growth in the City of Viroqua, the amount of I/I reduction that can be achieved by the City, and future changes to the plant flows and loadings, such as the addition of major industry. For cost estimating purposes in this document, construction of a new filtration system for phosphorus removal has been assumed for Phase 2, but the hope is that phosphorus compliance can be achieved without installation of a filter. If substantial reduction in I/I can be achieved, or if actual growth is slower than projected, some of the Phase 3 components may not be needed in the next 20 years.

7. ENVIRONMENTAL IMPACTS

7.1 Project Identification

This chapter provides an analysis of the environmental impacts for the recommended upgrades to the existing WWTF and relocation of the WWTF's outfall. The selected alternative for relocation of the WWTF's outfall will require the construction of a new pumping station and force main to transfer treated effluent from the existing WWTF to the new outfall location approximately 2 miles northwest of the existing plant. The new force main would follow a route running in the right-of-way of CTH B to an outfall on the Springville Branch of the Bad Axe River just upstream of Springville, west of the intersection of CTH B and Miller Rd (Springville Road). This pipeline would be constructed almost entirely within the CTH B right-of-way, which will minimize the necessity to obtain a substantial number of easements and will be the most direct route to the proposed new outfall location.

7.2 Affected Environment

7.2.1 Land Use

The land immediately adjacent to the existing WWTF is currently used for agricultural purposes. There is a farmstead and two houses on Highway B within 900 feet of the WWTF site as well as a mobile/manufactured home community with the closest residence within 700 feet of the WWTF site. However, it is estimated this project will have minimal impact to surrounding homes, as the current site is isolated from adjacent residences by farmland.

No new land will be required for the proposed upgrades at the existing WWTF.

7.2.2 Soils

The soils at the remote site were examined by consulting the United States Department of Agriculture Natural Resources Conservation Service (NRCS) soil maps. The custom NRCS soils report indicates that the soils on the current WWTF site and along the force main route are primarily Ashdale silt loam and Mt. Carroll silt loams, with small portions of Seaton, Churchtown, Pepin, and Worthen silt loams. Refer to the NRCS provided in Appendix B.

7.2.3 Important Farmland, Prime Forest Land, and Prime Rangeland

The Farmland Protection Policy Act (FPPA), the USDA regulation implementing the FPPA (7 CFR Part 658), and USDA Departmental Regulation No. 9500-3, “Land Use Policy”, provide protection for important farmland and prime rangeland and forest land. As the proposed modifications to the WWTF and relocation of the outfall will take place on the existing site and within the CTH B right-of-way, they will not result in the conversion of prime farmland areas.

The Department of Agriculture, Trade and Consumer Protection (DATCP) must be notified of any project which may involve the acquisition of an interest in land from a farm operation through the use of eminent domain procedures (condemnation). The DATCP should be notified of such a project regardless of whether the proposing agency actually intends to use these powers in the acquisition of rights to proposed project lands. If a proposed project involves the actual or potential exercise of the powers of eminent domain in the acquisition of an interest in more than five acres of land from anyone farm operation, the DATCP is required to prepare an agricultural impact statement (AIS) which describes and analyzes the potential effects of the project on farm operations and agricultural resources. If a proposed project involves five acres or less from anyone farm operation, an AIS may be prepared at the DATCP's discretion. According to these guidelines from DATCP, an AIS will not be required for this project since no land will be acquired for the WWTF upgrades and the new force main will be constructed almost entirely within the CTH B right-of-way.

It should be noted that while loss of farmland is not a concern for this project, the relocation of the WWTF outfall may result in the loss of water for livestock along the stream reach from the current outfall to the intersection of CTH B and Miller Road. According to the steam investigation that was performed in 2013-2014 (Appendix D) there are four areas of apparent livestock use along the stream where animals use the stream for a water source. The City has noted that eliminating discharge to the disappearing stream would cause the stream to dry up during parts of the year and would cause hardship for the farmers, particularly regarding cattle watering. This concern was discussed with the WDNR at the July 2014 meeting for outfall options (See Section 5.2). According to the WDNR, intermittent flow in the stream would be naturally occurring;

therefore, and loss of stream flow due to outfall relocation is not their concern.

7.2.4 Formerly Classified Lands

There are certain properties that are either administered by Federal, State, or local agencies or have been accorded special protection through formal legislative designations. For the purposes of this report, these properties have been designated "formally classified lands." Examples include wild and scenic rivers, forestlands, scenic trails, national and state parks, and wildlife refuges. Visual impacts to formally classified land from proposed projects need to be considered as appropriate.

There are no known formally classified lands that will be affected by this project.

7.2.5 Floodplains

Excessive flooding in the Bad Axe River watershed in the 1950s and 1960s prompted the construction of many flood control structures on numerous streams. Some of these structures are designed to permanently detain water (wet dam) while many others impound water only during rain events (dry dam) then slowly release it over time. Vernon County is responsible for maintaining many of these flood control structures, which include a wet flood control structure at Duck Egg County Park on the Springville Branch.

The proposed force main route parallels the tributary of the Springville Branch of the Bad Axe River, which has 100-year floodplains identified for part of its reach. However, the construction of the force main will take place almost entirely within the CTH B right-of-way, only crossing the floodplain near the intersection with Miller Road and at the proposed outfall location. .Examination of the FEMA flood map for the region classifies this area as Zone A flood risk, which indicates there is risk of flood occurring, however the exact base flood elevation has not been determined in this area. Historic information for the Springville Branch indicates that the Springville Spring emanates from the Oneota Formation at an elevation of 1082.5 feet above MSL. No other structures other than the outfall pipe will be constructed within the floodplain.

7.2.6 Wetlands

Based on a review of available resources, there are not wetlands or hydric soils mapped along the proposed force main route or at the existing WWTF site. Refer to the environmental resources report in Appendix L.

If wetlands are determined to be present along the force main route during the design phase, appropriate permits will be applied for and obtained from the relevant regulating agencies, and strict adherence to the conditions of any permit will be required during construction. Any disturbed wetlands will be restored to pre-existing conditions, and therefore the long-term impacts to any wetlands are expected to be minimal.

7.2.7 Cultural Resources

The National Historic Preservation Act (NHPA) of 1966, as amended, and the Advisory Council on Historic Preservation's (ACHP) implementing regulations, 36 CFR Part 800 (Section 106 regulations), requires Federal agencies to take into account the effect their actions may have on historic properties that are within the proposed project's area of potential effect. To avoid harm to both known historic properties and archeological sites, and to undiscovered sites present in a project area, historic and archaeological sites within or near the project area must be identified, and the effects of the project on these sites must be assessed. A listing of all Wisconsin properties on the National and State Registers of Historic Places contains seven listings for Viroqua and the immediate vicinity, but none of these are located near the WWTF site or proposed force main route along CTH B. Since construction will take place only in previously disturbed locations, no impact to historic properties and archeological sites is anticipated.

7.2.8 Biological Resources

Throughout the United States there are many plant and animal species that are threatened with extinction or exist in greatly reduced numbers partly as a result of human activities. The Endangered Species Act (ESA) of 1973 establishes a national program for the conservation and protection of threatened and endangered species of plants and animals and the preservation of habitats upon which they depend. Under Section 7 of the ESA, Federal agencies are required to consult with the United States Fish and Wildlife Service (USFWS) and/or the National Marine Fisheries

Service for all threatened and endangered species. The consultation is to ensure that the proposed project does not jeopardize the continued existence of any federally-listed threatened or endangered species or result in the destruction or adverse modification of a critical habitat.

State agencies should also be contacted for information on State-listed species and concerns. In some instances, the State may have more detailed information on federally-listed or proposed species and/or critical habitat than the USFWS. Other biological resources which may be impacted by the project include fish and wildlife and vegetation.

Pursuant to these requirements, endangered resources reviews have been performed for the proposed force main route and submitted to both the local USFWS office (Green Bay, WI) and the WDNR. These reviews are provided in Appendix L.

There are two Federally-listed threatened and endangered species and one proposed endangered species listed for Vernon County. One of the species, Higgins eye pearly mussel are found in the Mississippi River, which is outside of the habitat for this proposed project. The remaining species, northern monkshood (threatened) and the northern long-eared bat (proposed as endangered) may be present in Vernon County, but a review conducted in accordance with USFWS guidelines concluded that there is no critical habitat in the vicinity of the project and there will be no impact to these species by the proposed project. According to USFWS guidelines, agency concurrence is not required for no effect determinations, but the review was submitted to USFWS on April 1, 2015 for record-keeping purposes.

An endangered resources review was performed by an ER Certified Reviewed and submitted to the WDNR Bureau of Endangered Resources on April 17, 2015. The only endangered resource identified within and around the project area is the Eastern Pipistrelle, a type of bat. The review recommends avoiding directly impacting individuals, locations, or known maternity colonies, or areas of suitable habitat. Any tree-cutting along the proposed force main route would be covered by the BITP for Cave Bats. While there are no restrictions for tree cutting, special considerations should be given to protecting snags or dying trees, particularly from June 1 to August 15.

7.2.9 Miscellaneous Impacts

Operational Impacts: Operational impacts for the upgraded WWTF are expected to be similar to current impacts. During operation the impact to traffic will be minimal, except when disposing of sludge in the spring and fall. The installation of new aeration blowers will reduce noise impacts from the existing facility. Subchapter 6.7 addresses further health and environmental impacts related to operation of the proposed new plant facility.

Construction Impacts: Modifications to the treatment facility and construction of the lift station and force main will have temporary impacts due to construction. These temporary impacts will include the increase of traffic and noise around the construction site and disturbance of dust and dirt during construction. Traffic along routes to the site will increase during construction.

Because the location of the remote site is outside of residential and commercial areas, this will minimize the impacts of construction. Construction of the force main in the highway right-of-way will minimize impacts to local residents and landowners. Construction of the new outfall near Springville will have temporary impacts to this area, which will be mitigated as described in Section 7.4.

The exact location for the new effluent outfall will be determined during the design phase and is anticipated to be near the culvert at the intersection of CTH B and Miller Road. The location will be placed in conjunction with coordination with WDNR chapter 30 requirements.

The proposed modifications to treatment facility will not have significant negative impacts on land use in the area and will improve the quality of effluent discharged to the receiving stream. Any improvement in effluent quality will have a positive influence on fishery resources. Relocation of the WWTF outfall will remove the discharge from the disappearing portion of the stream and prevent the discharge of effluent to groundwater.

If high groundwater conditions necessitate the use of high capacity wells (in excess of 70 gpm) for the dewatering, then the environmental impact will be evaluated by the WDNR's Bureau of Water Supply prior to installation of the wells.

Secondary Impacts: The construction or upgrade of any wastewater treatment facility may potentially encourage urbanization by making increased wastewater collection and treatment capacity available. By using foresight and careful planning, the City can successfully defend against unwanted urbanization.

7.3 Mitigative Measures

Primary impacts regarding operational and agricultural concerns will be minimal and do not require mitigative measures; likewise, secondary impacts regarding urbanization concerns will be minimal as well.

Those impacts which are of potential significance and which can be reasonably mitigated are as follows:

7.3.1 Construction, Temporary Controls

Temporary impacts during construction will be mitigated. Temporary traffic control barricades, signs, flagmen and detours will be implemented as necessary and in accordance with WisDOT standards. If conditions warrant control of dust then a combination of water, calcium chloride suppressant and other dust control measures in compliance with industry standard will be applied.

Erosion control and shoreline stabilization during and following construction are other important considerations during construction. The WDNR has stressed the importance of implementing and maintaining proper erosion control measures. If necessary, any disturbed river banks will be rip-rapped, seeded and mulched within 24 hours of completion. Any steep areas that will be disturbed and that would affect downstream river banks or wetlands will be stabilized with erosion control matting in accordance with WDNR guidelines. Erosion control requirements will be defined during design and in coordination with WDNR chapter 30, Notice of Intent and Corp of Engineers CFR 404 permitting.

7.3.2 Archaeological

If any undiscovered archeological sites or human remains are encountered in the course of investigations at the project area or during construction, the work will have to stop immediately and the Historic Preservations Division consulted.

7.3.3 Endangered Species

In the protection of flora, reasonable avoidance of impact areas will be made with the pipeline route during design of the effluent force main piping. Areas with lush vegetation will be surveyed and identified prior to routing the pipeline and during design routing of the pipeline, reasonable efforts will be made to avoid such areas.

The netting of erosion control matting can easily entrap snakes which are anticipated to be prevalent on the site. To mitigate this impact erosion mat with biodegradable netting and with independently moveable strands meeting WDNR guidelines will be used.

The endangered resources review (Appendix L) also provides recommendations for erosion and runoff prevention measures to protect aquatic species in the Springville Branch of the Bad Axe River and measures to prevent the spread of aquatic species. These recommendations will be taken into consideration during the design and construction of the force main.

7.3.4 Wetlands

There are no known wetlands along the proposed force main route and it is not likely that wetlands will be disturbed. If wetlands are identified along the route during the design phase, appropriate permits will be applied for and obtained from the relevant regulating agencies (in particular Corps of Engineers CFR 404 permit and WDNR Chapter 30 permit), and strict adherence to the conditions of any permit will be required. Any disturbed wetlands will be restored to pre-existing conditions, and therefore the long-term impacts to any wetlands are expected to be minimal.

7.4 Alternatives to the Proposed Action

Alternatives to the proposed outfall relocation are discussed in Section 5.2. While other options were considered and evaluated, the installation of the forcemain and relocation of the outfall were determined to be the most acceptable course of action by the City. This decision balances the requirements by the WDNR to address the current discharge to the disappearing stream, the current and future risks to the City, and the anticipated costs. The City has carefully considered the alternatives and potential impacts they may have on the community and will solicit community input during the public hearing period.

The alternatives for modifications to the WWTF are presented in Section 5.4.1. All of these alternatives require construction at the existing plant site and are considered equal in terms of environmental impacts. Cost comparisons of the alternatives are provided in Chapter 6 and in Appendix J. For health and environmental comparisons refer to subchapter 6.7.

8. FINANCES AND FUNDING

8.1 Parallel Cost Percentage

Reference is made to NR 162 of the Wisconsin Administrative Code and the WDNR web page guidance for the basis is calculating parallel cost percentages. The parallel cost percentage (PC) is calculated to determine that portion of the proposed total project cost eligible for below-market rate financing through the Clean Water Fund.

In order to calculate the value for PC, revised loading conditions are determined which reduce the total design loadings by those amounts associated with unsewered areas that aren't currently connected to the sanitary system; the reserve capacity for loadings which will be realized beyond ten years from the project completion date; and for current and future flows from industrial wastewater users.

An estimate has been made of those projected contributions from residential, commercial, and additional contributions which will not be realized until beyond ten years after the completion of the project. The future loadings described in Chapter 4 have been assumed to be added in a straight line projection over the course of the design period of twenty years. One-half of these future loads will not be included in the revised loading conditions. All loadings from industrial users have also been excluded for this exercise. A summary of the revised loadings with comparison to the total design capacity is given below in Table 8-1. For a more detailed examination of these loading projections refer to Appendix M. The column heading "DC" is used by the WDNR to indicate total design capacity, and "RC" is used for reduced capacity.

Table 8-1
Reduced Loading Conditions for PC Calculation

Parameter	Units	DC	RC
Flow	MGD	0.747	0.619
BOD	lbs/day	2,690	1,777
TS	lbs/day	3,041	2,007
TKN	lbs/day	356	255
Phosphorus	lbs/day	74	49

The current flow from the main industrial sector represents approximately 6% of the flow to the plant; therefore, current flows and loads for the RC condition have been reduced accordingly. Also, half of the future loads, including half of the projected design load septic and holding tank waste has been excluded.

The maximum daily flow value (used for determining the capacity of the disinfection system, and the peak hourly flow value (the basis for design of the forward flow hydraulics) are also not significantly lower for the reduced condition. From the loading data found in Appendix M, the maximum daily flow is 1.737 MGD for the RC condition, compared to 1.929 MGD for the full design condition. The peak hourly flow value for the RC condition is 3.022 MGD compared to 3.309 MGD for the DC condition. The relatively insignificant difference in flow values can be attributed to the large amount of clear water entering into the collection system.

The reduced loading conditions are then used to determine what changes would result in terms of structure sizing and equipment selection. Most of the construction proposed for Phase 1 is modifications to existing structures and replacement of existing equipment, which will not be impacted by reduced loading conditions. The biological treatment portion of Phase 1 (selectors, aeration basins, blowers, and final clarifiers) is limited by the size of the existing tanks and is not designed to meet the full design load projected for the plant. If additional capacity is needed in the future, it will be added as part of Phase 3, which may not occur for more than 10 years. Phase 1 also includes modifications to the existing primary clarifiers, equalization storage basin, and lab and process control building, which will not be affected by the reduced loadings.

The only new structures proposed for Phase 1 are a hauled waste receiving station and a sludge thickening building with DAF unit. The impacts to these structures are as follows:

- Preliminary sizing for the hauled waste receiving station has been based on the typical capacity of septage hauling trucks. While the number of hauled waste loads received is reduced for the RC condition, the capacity of the hauled waste receiving station would remain unchanged.
- Although sludge production will be reduced for the RC condition, the size of the proposed DAF unit (8-ft diameter) would not be changed because the reduction is not great enough to allow selection of the next smallest size of DAF unit (6-ft diameter). Therefore, the RC condition will not result in any change to the DAF unit or sludge thickening building

The effluent lift station and force main are discussed in Section 8.3.

Alternative 3 has been used as the basis for determining the impacts to the design for the project. Similar effects would be realized if other alternatives were evaluated. .

Using the design changes given in the table above a modified cost estimate is developed based on the original cost estimate for Alternative 3. A summary of the original and revised costs are given below in Table 8-3.

Table 8-3
Project Costs for PC Calculation

Item	DC Cost	RC Cost
1 Site Work	$218,600	$218,600
2 Headworks/Primary Clarifiers	$15,000	$15,000
3 Selector and Aeration Basins	$345,250	$345,250
4 Splitter Structure	$51,400	$51,400
5 Final Clarifiers	$352,300	$352,300
6 UV Structure	$0	$0
7 Blower Building	$108,300	$108,300
8 Phosphorus Removal	$0	$0
9 Digester Complex	$0	$0
10 Sludge Storage	$5,000	$5,000
11 Waste Receiving Station	$247,375	$247,375
12 Equalization Detention Basin	$143,250	$143,250
13 Lab/Process Building	$195,500	$195,500
14 Sludge Thickening	$551,150	$551,150
Electrical and Instrumentation	$558,300	$558,300
Contractor Costs	$249,100	$249,100
Contingencies	$304,100	$304,100
Engineering/Admin	$456,100	$456,100
Total Phase 1 Project Cost	$3,800,800	$3,800,800

The parallel cost percentage is then calculated by dividing the reduced capacity cost by the total design cost as shown below:

PC = RC/DC = $3,800,800/$3,800,800 = 100%

8.2 Septage Percentage

Reference is made to the resource paper entitled “Wisconsin DNR Program for Septage Considerations in Municipal Wastewater Facility Planning and for Application of Zero Percent Clean Water Fund Loans” dated June 7, 2006 and revised August 2012. The septage percentage (SP) is calculated to determine what portion of the below market rate financing through the Clean Water Fund program will be eligible for zero rate financing.

Separate revised loading conditions are determined which reduce the previously revised design loadings developed in Section 8.1 and labeled as RC. This second revised loading condition, labeled RC2, will be that loading associated without unsewered areas, reserve capacity expected beyond 10 years from the project completion date, industrial contributions, and without any septage loadings. A summary of the revised loadings (RC2) with comparison to the total design capacity (DC) and revised loadings (RC) are given below in Table 8-4. For a more detailed examination of these loading projections refer to Appendix M.

Table 8-4
Reduced Loading Conditions for SP Calculation

Parameter	Units	DC	RC	RC2
Flow	MGD	0.747	0.619	0.594
BOD	lbs/day	2,690	1,777	1,147
TS	lbs/day	3,041	2,007	1,275
TKN	lbs/day	356	255	186
Phosphorus	lbs/day	74	49	31

The difference in loading conditions between the revised loadings for the parallel cost ratio and that for the septage percentage are that portion of the septage and holding tank waste receiving expected within the first ten years of the new facility’s operation. These reduced loading conditions are used to determine what changes would result in terms of structure sizing and equipment selection. These potential changes are summarized below in Table 8-5.

Although there is a reduction in the total BOD, suspended solids and nutrient loadings, the only impacts will be to new proposed structures. As explained in Section 8.1, the remaining Phase 1 costs are for modifications to existing structures and replacement of existing equipment, which will not be impacted by reduced loading conditions. The overall aeration requirements are reduced for the RC2 condition; however, blower selection also depends on the current maximum and minimum loads may be unchanged. Impacts to the proposed hauled waste receiving station and sludge thickening building with DAF unit would be as follows:

- If holding tank and septage are removed from the projected plant load, then a new hauled waste receiving station would not be needed.
- The proposed DAF unit could be reduced in size from 8-ft diameter to 6-ft diameter, but the dimensions of the proposed sludge thickening building would remain unchanged.

The effluent lift station and force main are discussed in Section 8.3.

Alternative 3 has been used as the basis for determining the cost impacts for the project. Similar effects would be realized if other alternatives were evaluated. Using the design changes described above a modified cost estimate was developed based on the original cost estimate for Alternative 3. A summary of the original and revised costs are given below in Table 8-6.

Table 8-6
Cost Impacts for SP Calculation

Item	DC Cost	RC Cost	RC2 Cost
1 Site Work	$218,600	$218,600	$206,100
2 Headworks/Primary Clarifiers	$15,000	$15,000	$15,000
3 Selector and Aeration Basins	$345,250	$345,250	$345,250
4 Splitter Structure	$51,400	$51,400	$51,400
5 Final Clarifiers	$352,300	$352,300	$352,300
6 UV Structure	$0	$0	$0
7 Blower Building	$108,300	$108,300	$108,300
8 Phosphorus Removal	$0	$0	$0
9 Digester Complex	$0	$0	$0
10 Sludge Storage	$5,000	$5,000	$5,000
11 Waste Receiving Station	$247,375	$247,375	$0
12 Equalization Detention Basin	$143,250	$143,250	$143,250
13 Lab/Process Building	$195,500	$195,500	$195,500
14 Sludge Thickening	$551,150	$551,150	$493,650
Electrical	$558,300	$558,300	$479,000
Contractor Costs	$249,100	$249,100	$215,000
Contingencies	$304,100	$304,100	$261,000
Engineering/Admin	$456,100	$456,100	$391,500
Total Phase 1 Project Cost	$3,800,800	$3,800,800	$3,262,300

The septage percentage is then calculated by dividing the difference between the cost associated with RC and the cost associated with RC2 (RC – RC2) by the total design cost (DC) as shown below:

SP = (RC – RC2)/DC = ($3,800,800 - $3,262,300)/$3,800,800 = 14.2%

Therefore 14.2% of the cost eligible for below market rate financing through the Clean Water Fund will be eligible for zero percent financing.

8.3 Force Main Eligibility

The size of the force main and effluent lift station will be dictated by the peak pumping rate. The peak pumping rate is determined by the existing infiltration /inflow quantities, bypassing to the equalization storage basin, and the limitation of forward flow through the plant. Therefore, the design of the pump station and force main would not change significantly even for reduced loading conditions used for a parallel cost ratio. The parallel ratio for these units should be 100%.

8.4 Financial Considerations

The City of Viroqua sewer utility does not come under the jurisdiction of the Public Service Commission. The number of sewer users can be best represented by using data from the current sewer user charge system. Table 8-7 presents a summary of total Residential Equivalent Units (REUs) used in computing sewer service charges. The City calculates REUs based on the past year's water use. The total residential usage for the year is divided by the total number of residential accounts to determine the usage for one REU. The annual consumption for non-residential users is divided by this REU usage to determine the equivalent REUs.

The existing user charge system as of 2014 has a fixed charge of $11.00 per REU and a flow charge of $3.60/100 cubic feet of water ($4.80 per 1,000 gallons), which equals about $24 per month for 351 cubic feet of water per month (2,624 gallons) per month) for the average user (1 REU).

Table 8-7
Residential Equivalent Units for 2015

	Accounts	REUs
Residential	1676	1676
Commercial	241	1198
Multi Family	27	235
Industrial	10	247
Public Authority	31	250
Totals	1,985	3,606

8.5 Revenue Sources

Wisconsin Statutes empowers a City to construct, maintain, and expand a wastewater system, and further, to collect the revenues to support such a system. There are five potential sources of revenue available to the City for support of the wastewater treatment facilities. They are as follows: (1) special assessments, (2) general fund revenues, (3) impact fees, (4) TIF fees and (5) service charges.

8.5.1 Special Assessments

The levy of special assessments is provided for by Section 66.07 of the Wisconsin Statutes. Generally the special assessment principle is used primarily to recover the costs of services and facilities provided immediately adjacent to the property assessed. One additional use of the special assessment provision employed elsewhere from time to time is that of directly assessing the cost of major capital improvements. This is generally utilized in cases where no service charges are made but the governing body wishes to recover the cost of the improvements. It is more applicable to the financing of a collection system than to the treatment plant itself.

If the City were to provide the proposed wastewater treatment facilities as a general service, it would be possible to assess the costs of the improvement to the benefited parties. However, the City would not be able to do so unless the proper legal procedures were followed and the assessment did not exceed the benefit received by the property assessed. Because of the difficulty in determining the differences in benefits between users and user classes and because of the magnitude of this assessment to present property owners, only, special assessments are not recommended for this project.

8.5.2 General Fund Allocations

General Fund monies from general taxation sources and other routine sources of City income can be used to pay for the subject project. A direct tax levy to recover the costs of this project which are not funded by grants-in-aids is possible. The use of general fund monies on a debt service basis is a potential method of financing. This would be accomplished through issuance of general obligation bonds (to be discussed in later section). Generally this method of financing is reserved for street improvements, administration improvements and not for wastewater treatment facilities. This method of financing will not be used for this utility project.

8.5.3 Impact Fees

Wisconsin Statute 66.0617 allows cities, villages, towns, and counties to assess impact fees on developers to offset the capital costs for public facilities needed as a result of the new development. The law requires municipalities that wish to utilize the connection fee or connection charge concepts to base these fees on sound concepts. The City has the option to implement an impact fee to assist in paying for improvements that are a result of development. These fees cannot be used to finance deficiencies of any system but for replacement of systems that will not have adequate capacity to meet new user demands. Any implementation of impact fees will require a needs report (this facility plan will meet that requirement), breakout of costs to present and future users, an ordinance regulating the fees, development of an accounting system to segregate the fees and a public hearing on the ordinance. The City can utilize this system and may want to seriously consider this method. This method will not be used at this time for calculating the user charge rates. It should be noted that the same bond types can be used in conjunction with this system.

8.5.4 Tax Increment Finance District (TIF)

The City has the option to develop or utilize some of the existing tax increment finances districts to include the wastewater treatment facility to assist in financing this project. To utilize this approach, the City would have to identify some specific boundaries of land that is mostly undeveloped but is anticipated to be developed in the near future. The percentage of cost of this treatment facility that is related to the potential development of this area included in the TIF district can be paid by the increment of the TIF district. The tax increment is the amount of tax money collected between the value of district at the time of formation to value of the property after development. This tax increment can be used to pay off projects that have been included in the TIF Plan. This method of financing is a very viable alternative and should be seriously considered. This method of financing will not be used for calculating the revised user charge rates.

8.5.5 Service Charges

Wisconsin Statute 66.0821(3) empowers a City to establish service charges in such amount as to meet all the financial requirements for the construction, reconstruction, improvement, extension, operation, maintenance, repair, and depreciation of a wastewater system. Further, such service charges may be adjusted to cover the payment of all principal and interest of any indebtedness incurred thereof, including the replacement of funds advanced by or paid for the general fund of the municipality. These charges may include a reasonable excess. To date, the City of Viroqua has produced revenue to operate its wastewater treatment facilities chiefly by the service charge method. The actual basis of the charges is at the discretion of the City Council.

8.6 Financing Methods

There are six possible methods of financing the proposed improvements. These include general obligation bonds, revenue bonds, special assessment bonds, direct loans from private institutions, financing through government programs, and immediate payment. Immediate payment is not possible because of the lack of available City general funds. Assessment bonds are eliminated because of the financial impact of the customers. That leaves four major financing methods for the City.

8.6.1 General Obligation Bonds

General obligation bonds are readily saleable and the interest rate is relatively low. These bonds are not dependent on service charges although service charges can be used to provide the needed revenue. The total amount of general obligation bonds which can be issued by a City is limited by Wisconsin Statutes to 5% of the equalized valuation of the City. There are many serious disadvantages to this method of financing for projects such as this. First, it is possible that not all users of the new facilities would contribute to the support of the facilities. This would depend upon the method used to recover the payments for these bonds. Secondly, the use made of the wastewater treatment facilities will not necessarily be directly related to the value of a property utilizing the facilities. Third, the sale of general obligation bonds for a utility purpose can affect the credit rating issued to the City at the time of the sale of future bonds issues covering other general expenditures.

8.6.2 Revenue Bonds

The advantages of revenue bonds are that their sales do not affect the credit rating or bonding power of the City, and they are equitable in that the users of the system pay the capital cost of the facilities. Mortgage revenue bonds are very saleable in Wisconsin if the service charge is such that the net revenues of the utility, after expenses and depreciation, are approximately 1.25 times the debt retirement and operation and maintenance costs. The interest rate for these bonds generally is 1 to 2 percent greater than for general obligation bonds.

8.6.3 Direct Loans

The unfunded portion of the treatment plant improvements is quite a large amount, lessening the chance of direct loans from financial institutions or government agencies. Moreover, if available, the interest rates on direct loans may well be less than for either general obligation or mortgage revenue bonds. There are fewer restrictions on the method of revenue generation, and there is less effect on the bonding powers and credit rating of the community than with general obligation bonds.

8.6.4 Financing Through Government Programs

Past demand for improved wastewater treatment resulted in the institution of state and federal programs for financial assistance to communities undertaking the construction of wastewater treatment facilities improvements. The following paragraphs will summarize the government funding programs which may be available.

8.7 Funding Sources

8.7.1 Rural Development (RD)

Rural Development, formerly Farmers Home Administration (FmHA), of the U.S. Department of Agriculture provides financial assistance to small rural communities (those under a population of 10,000). RD has a program in which it provides financial assistance in the form of grants and low-interest loans for construction of wastewater collection and treatment systems.

Grants are available for up to 75% of eligible project costs. Although the grants are made to the City governmental unit the grant is intended to benefit only residential users and small commercial users. The portion of the project which might benefit larger commercial users and industrial users would be deducted from the eligible project cost. To receive a grant, the user charge rates are set on a median household income, based on the amount of water usage the residential population utilizes.

This governmental agency also provides loan funds to small rural communities to upgrade wastewater collection and treatment systems. The current interest rates range from 2.25% to 3.75% based on income levels. Based on Viroqua's current MHI, the City would likely qualify for the lowest interest rate loan with a 40 year payback period. These loans are classified as revenue bond type loans and are secured only by sewer use charges. The City intends to apply for grant and loan funding for this project from RD. For the user charge impacts described in subsequent paragraphs it will be assumed that the project will be funded through this source as one alternative for financial considerations.

8.7.2 Community Development Block Grant (CDBG)

The Community Development Block Grant (CDBG) program is a federal formula-allocated grant program under the U.S. Department of Housing and Urban Development (HUD). The State of Wisconsin, Department of Administration administers the state Community Development Block Grant program for public facilities (CDBG-PF), which provides grant money to expand and improve public infrastructure and facility projects critical to community vitality and sustainability. The City of Viroqua can qualify for this grant under several conditions, i.e., low and moderate income, urgent need or economic development. These grants are highly competitive, and may require multiple attempts before obtaining. The City's income levels make this grant viable especially for sewer replacement.

Under the State's 2015 CDBG–PF Program, the Department of Administration's Division of Housing will award grants for 50% of the total project cost, up to a maximum of $500,000 ($6,000 or up to 2 percent [a maximum of $10,000], whichever is greater, of the awarded CDBG-PF grant funds may be used for administration purposes). At least 90% of the CDBG-PF funds will be awarded to projects that meet the National Objective of benefitting low- to moderate-income persons. Communities that have received a CDBG-PF award in 2014 are not eligible for consideration in the 2015 CDBG-PF annual competition except in cases where the award is provided to meet an “Urgent Local Need” National Objective.

It is recommended that the City actively pursue this grant. For the purposes of the user charge calculations, no grant will be utilized.

8.7.3 State of Wisconsin Financial Assistance Programs (CWF)

The Wisconsin Clean Water Fund (CWF) is a revolving loan fund program now available. This loan fund is provided to finance the entire cost of wastewater treatment facility construction projects at 75% of the market rate of State of Wisconsin pays for its bonds. The effective interest rate is currently at 2.25% level for eligible parts of the treatment facility. The remaining proportion of the facility would be funded at full market rate. Only those communities whose treatment facilities are in basic compliance with effluent standards are eligible. For treatment plants in violation of effluent standards full financing is available, but at the full market rate. Additionally, the portion of projects for receiving and storing septage and capacity for treating septage can be financed at 0% interest through the CWF program.

There is a possibility for some communities that the program will provide "hardship assistance” where sewer use charges under the loan program will be unreasonably high. CWFP can provide hardship financial assistance in the form of a reduced interest rate loan, or award a grant of up to 70% of the municipality's project cost eligible for below-market interest rate. A project is eligible if all of the following apply:

- The project is a wastewater project for compliance maintenance, unsewered, or new/changed limits.
- The municipality's median household income (MHI) is 80 percent or less of the state's median household income.
- The estimated total annual charges per residential user for wastewater treatment in the municipality would, without hardship assistance, exceed 2 percent of the municipality's median household income.

The City is actively applying for grant and loan funding from the CWF program for Phase 1/1A construction. Based on the current Project Priority List for State Fiscal Year 2016, it is possible that the City will qualify for principal forgiveness in the amount of $500,000 to $650,000.

For the purposes of the user charge calculations, no principal forgiveness will be assumed.

8.7.4 Other:

Focus on Energy - Focus on Energy incentive programs are available to municipal customers of participating Wisconsin utilities to implement energy efficiency projects. Prescriptive incentives are offered for standard energy efficient technologies that have predictable and predetermined savings, including lighting, many HVAC measures, motors and drives, and others. Custom incentives are available for technologies such as energy efficient aeration and heat recovery and are calculated on a case-by-case basis based on the estimated first year energy savings associated with a project/technology. Custom incentives may pay up to 50 percent of a project's cost, for a maximum of $200,000 and are available for projects that have a payback between 1.5 and 10 years. The City intends to apply for Focus on Energy incentives for the blower upgrade portion of the proposed construction.

8.8 Summary of Probable Financing

Any of the four practical financing methods may be used, i.e., general obligations bonds, revenue bonds, direct loans from private sources, or government program financing. It is likely that the best interest rates will be achieved through the Wisconsin Clean Water Fund Loan program. Also, significant grant funding could be available through Rural Development and the CDBG programs. For the purposes of this Facilities Plan, a CWF loan is assumed, but the City will continue to pursue CDBG and Rural Development funding. Phase 1A could be performed concurrent with Phase 1 or could be held until Phase 2 is constructed. At this time, Phase 1A is planned to be included with Phase 1, but the City reserves the option to delay Phase 1A depending on financing.

8.9 Projected User Charge Rates

The projected user charge rate needs to take several components into consideration. These components include existing debt, future debt of the treatment facility expansion, debt or cost for future public works projects, collection system depreciation, replacement funds, total annual operation costs and alternate approaches in calculating user charges with a cash flow schedule.

The last increase in sewer user rates for City of Viroqua was enacted in 2010. Current rates are described in Section 8.4 and are approximately $24/month for an average residential user. Increased rates will be required to cover the costs of the Phase 1, 1A and 2 projects. It is also anticipated that the City will continue to perform sewer improvements. Revenue to cover the costs of sewer improvement will be collected through the user charge system. Besides the improvements, the system depreciation, new debt and total operation costs will be used for calculating user charges. Appendix N provides a summary of these numbers and a cash flow for a 7-year projection.

The final component of the user charge system is the methodology and implementation schedule of the rate increases. Stepped rate increases are recommended as presented in the cash flow calculations. The final rates will vary depending on the method developed.

The average monthly user rate will be between $39 to $45 per month depending on the methodology of the user charge system and the amount of grant money included in the funding package. This assumes an average user water use rate of 2,624 gallons per month. It should be noted that other revenue generating sources can be utilized such as impact fees, grants, energy grants and other funding mechanisms. If these methodologies are implemented, the rates presented would be reduced accordingly.

8.10 Implementation Steps

The following sequence of important steps is expected to be followed in the implementation of this Facilities Plan:

1. Submittal of this plan for review by the Wisconsin Department of Natural Resources.
2. Hold a Public Hearing.
3. Incorporation of comments from reviewing agencies and the public hearing into the Facilities Plan.
4. Investigate alternative funding sources for this project, specifically Rural Development.
5. Complete design, construction plans and specifications.
6. Submit plans and specifications for review by the Wisconsin Department of Natural Resources.
7. Update sewer use/user charge ordinance.
8. Incorporate comments from reviewing agencies into plans and specifications.
9. Submit applications for financial assistance.
10. Obtain approval of the funding agency(ies) to bid the project.
11. Advertisement of bids.

12. Receive bids.
13. Close on the loan documents.
14. Award bids.
15. Start construction.
16. Complete construction.
17. Develop an operation and maintenance manual.

APPENDIX A

Current WPDES Permit

WPDES PERMIT

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

PERMIT TO DISCHARGE UNDER THE WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM

City of Viroqua

is permitted, under the authority of Chapter 283, Wisconsin Statutes, to discharge from a facility located at
1315 CTH B, Viroqua, WI
to
the Springville Branch of the Bad Axe River, in the Bad Axe River Watershed of the Bad Axe / La Crosse Rivers Basin located in Vernon County

in accordance with the effluent limitations, monitoring requirements and other conditions set forth in this permit.

The permittee shall not discharge after the date of expiration. If the permittee wishes to continue to discharge after this expiration date an application shall be filed for reissuance of this permit, according to Chapter NR 200, Wis. Adm. Code, at least 180 days prior to the expiration date given below.

State of Wisconsin Department of Natural Resources
For the Secretary

By Paul LaLiberte
Paul LaLiberte
Wastewater Field Supervisor

8-9-2012
Date Permit Signed/Issued

PERMIT TERM: EFFECTIVE DATE – September 01, 2012 **EXPIRATION DATE - June 30, 2017**

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1 Influent Requirements

1.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
701	Representative influent samples shall be collected right after the Huber fine screen and prior to the influent partial flume.

1.2 Monitoring Requirements

The permittee shall comply with the following monitoring requirements.

1.2.1 Sampling Point 701 - AFTER SCREEN, PRIOR TO FLUME

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Continuous	Continuous	
BOD_5, Total		mg/L	3/Week	24-Hr Flow Prop Comp	
Suspended Solids, Total		mg/L	3/Week	24-Hr Flow Prop Comp	

2 Surface Water Requirements

2.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
001	Representative effluent samples shall be collected at the post aeration basin. Grab samples for fecal coliform should be collected after the UV treatment.

2.2 Monitoring Requirements and Effluent Limitations

The permittee shall comply with the following monitoring requirements and limitations.

2.2.1 Sampling Point (Outfall) 001 - POST AERATION BASIN, PRIOR UV

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Continuous	Continuous	
BOD_5, Total	Monthly Avg	20 mg/L	3/Week	24-Hr Flow Prop Comp	
BOD_5, Total	Weekly Avg	30 mg/L	3/Week	24-Hr Flow Prop Comp	
Suspended Solids, Total	Monthly Avg	20 mg/L	3/Week	24-Hr Flow Prop Comp	
Suspended Solids, Total	Weekly Avg	30 mg/L	3/Week	24-Hr Flow Prop Comp	
Phosphorus, Total	Monthly Avg	1.7 mg/L	3/Week	24-Hr Flow Prop Comp	Limit effective upon permit issuance until 06/30/2014. See Phosphorus footnote below and compliance schedule section.
Phosphorus, Total	Monthly Avg	1.0 mg/L	3/Week	24-Hr Flow Prop Comp	New interim limit effective 07/01/2014. See Phosphorus footnote below and compliance schedule section.
pH Field	Daily Max	9.0 su	Daily	Grab	
pH Field	Daily Min	6.0 su	Daily	Grab	
Dissolved Oxygen	Daily Min	4.0 mg/L	Daily	Grab	
Nitrogen, Ammonia (NH_3-N) Total		mg/L	Monthly	24-Hr Flow Prop Comp	
Copper, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Zinc, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Cadmium, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Fecal Coliform	Geometric Mean	400 #/100 ml	Weekly	Grab	Limit and monitoring effective year round.
Acute WET		TU_a	See Listed Qtr(s)	24-Hr Flow Prop Comp	See WET footnote below.
Chronic WET		rTU_c	See Listed Qtr(s)	24-Hr Flow Prop Comp	See WET footnote below.

2.2.1.1 Average Annual Design Flow

The average annual design flow of the permittee's wastewater treatment facility is 0.600 MGD.

2.2.1.2 Phosphorus Limitation(s)

See the Schedules section of this permit for more information on phosphorus effluent limitations.

Final Phosphorus Effluent Limitation: The final calculated effluent limitation for phosphorus is 0.43 mg/L monthly average. This final effluent limitation is included for informational purposes only and does not take effect until the next permit reissuance. The limitation may be recalculated at the next reissuance based on additional data or new information.

Interim Phosphorus Limitation: The interim effluent limitation for phosphorus 1.0 mg/L monthly average and becomes effective on July 1, 2014.

2.2.1.3 Whole Effluent Toxicity (WET) Testing

Primary Control Water: Springville Branch of the Bad Axe River

Instream Waste Concentration (IWC): 24%

Dilution series: At least five effluent concentrations and dual controls must be included in each test.

- **Acute:** 100, 50, 25, 12.5, 6.25% and any additional selected by the permittee.
- **Chronic:** 100, 30, 10, 3, 1% (if the IWC ≤30%) or 100, 75, 50, 25, 12.5% (if the IWC >30%) and any additional selected by the permittee.

WET Testing Frequency: Tests are required during the following quarters.

- **Acute:**

  1st Test: October – December 2013

  2nd Test: July – September 2015

- **Chronic:**

  1st Test: October – December 2013

  3Rd Test: July – September 2015

Reporting: The permittee shall report test results on the Discharge Monitoring Report form, and also complete the "Whole Effluent Toxicity Test Report Form" (Section 6, "*State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition*"), for each test. The original, complete, signed version of the Whole Effluent Toxicity Test Report Form shall be sent to the Biomonitoring Coordinator, Bureau of Watershed Management, 101 S. Webster St., P.O. Box 7921, Madison, WI 53707-7921, within 45 days of test completion. The original Discharge Monitoring Report (DMR) form and one copy shall be sent to the contact and location provided on the DMR by the required deadline.

Determination of Positive Results: An acute toxicity test shall be considered positive if the Toxic Unit - Acute (TU_a) is greater than 1.0 for either species. The TU_a shall be calculated as follows: If $LC_{50} \geq 100$, then $TU_a = 1.0$. If LC_{50} is < 100, then $TU_a = 100 \div LC_{50}$. A chronic toxicity test shall be considered positive if the Relative Toxic Unit - Chronic (rTU_c) is greater than 1.0 for either species. The rTU_c shall be calculated as follows: If $IC_{25} \geq IWC$, then $rTU_c = 1.0$. If $IC_{25} < IWC$, then $rTU_c = IWC \div IC_{25}$.

Additional Testing Requirements: Within 90 days of a test which showed positive results, the permittee shall submit the results of at least 2 retests to the Biomonitoring Coordinator on "Whole Effluent Toxicity Test Report Forms". The 90 day reporting period shall begin the day after the test which showed a positive result. The retests shall be completed using the same species and test methods specified for the original test (see the Standard Requirements section herein).

3 Land Application Requirements

3.1 Sampling Point(s)

The discharge(s) shall be limited to land application of the waste type(s) designated for the listed sampling point(s) on Department approved land spreading sites or by hauling to another facility.

Sampling Point Designation	
Sampling Point Number	Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)
002	Representative liquid sludge samples shall be collected from the holding tank mixer sample tap prior to hauling.

3.2 Monitoring Requirements and Limitations

The permittee shall comply with the following monitoring requirements and limitations.

3.2.1 Sampling Point (Outfall) 002 - HOLDING TANK LIQUID SLUDGE

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Solids, Total		Percent	Annual	Grab	
Arsenic Dry Wt	Ceiling	75 mg/kg	Annual	Grab	
Arsenic Dry Wt	High Quality	41 mg/kg	Annual	Grab	
Cadmium Dry Wt	Ceiling	85 mg/kg	Annual	Grab	
Cadmium Dry Wt	High Quality	39 mg/kg	Annual	Grab	
Copper Dry Wt	Ceiling	4,300 mg/kg	Annual	Grab	
Copper Dry Wt	High Quality	1,500 mg/kg	Annual	Grab	
Lead Dry Wt	Ceiling	840 mg/kg	Annual	Grab	
Lead Dry Wt	High Quality	300 mg/kg	Annual	Grab	
Mercury Dry Wt	Ceiling	57 mg/kg	Annual	Grab	
Mercury Dry Wt	High Quality	17 mg/kg	Annual	Grab	
Molybdenum Dry Wt	Ceiling	75 mg/kg	Annual	Grab	
Nickel Dry Wt	Ceiling	420 mg/kg	Annual	Grab	
Nickel Dry Wt	High Quality	420 mg/kg	Annual	Grab	
Selenium Dry Wt	Ceiling	100 mg/kg	Annual	Grab	
Selenium Dry Wt	High Quality	100 mg/kg	Annual	Grab	
Zinc Dry Wt	Ceiling	7,500 mg/kg	Annual	Grab	
Zinc Dry Wt	High Quality	2,800 mg/kg	Annual	Grab	
Nitrogen, Total Kjeldahl		Percent	Annual	Grab	
Nitrogen, Ammonium (NH_4-N) Total		Percent	Annual	Grab	
Phosphorus, Total Dry Wt		Percent	Annual	Grab	

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Phosphorus, Water Extractable		% of Tot P	Annual	Grab	
Potassium, Total Recoverable		Percent	Annual	Grab	
PCB Total Dry Wt	Ceiling	50 mg/kg	Once	Grab	Sample once in 2014.
PCB Total Dry Wt	High Quality	10 mg/kg	Once	Grab	Sample once in 2014.

Other Sludge Requirements	
Sludge Requirements	**Sample Frequency**
List 3 Requirements – Pathogen Control: The requirements in List 3 shall be met prior to land application of sludge.	**Annual**
List 4 Requirements – Vector Attraction Reduction: The vector attraction reduction shall be satisfied prior to, or at the time of land application as specified in List 4.	**Annual**

3.2.1.1 List 2 Analysis

If the monitoring frequency for List 2 parameters is more frequent than "Annual" then the sludge may be analyzed for the List 2 parameters just prior to each land application season rather than at the more frequent interval specified.

3.2.1.2 Changes in Feed Sludge Characteristics

If a change in feed sludge characteristics, treatment process, or operational procedures occurs which may result in a significant shift in sludge characteristics, the permittee shall reanalyze the sludge for List 1, 2, 3 and 4 parameters each time such change occurs.

3.2.1.3 Multiple Sludge Sample Points (Outfalls)

If there are multiple sludge sample points (outfalls), but the sludges are not subject to different sludge treatment processes, then a separate List 2 analysis shall be conducted for each sludge type which is land applied, just prior to land application, and the application rate shall be calculated for each sludge type. In this case, List 1, 3, and 4 and PCBs need only be analyzed on a single sludge type, at the specified frequency. If there are multiple sludge sample points (outfalls), due to multiple treatment processes, List 1, 2, 3 and 4 and PCBs shall be analyzed for each sludge type at the specified frequency.

3.2.1.4 Sludge Which Exceeds the High Quality Limit

Cumulative pollutant loading records shall be kept for all bulk land application of sludge which does not meet the high quality limit for any parameter. This requirement applies for the entire calendar year in which any exceedance of Table 3 of s. NR 204.07(5)(c), is experienced. Such loading records shall be kept for all List 1 parameters for each site land applied in that calendar year. The formula to be used for calculating cumulative loading is as follows:

[(Pollutant concentration (mg/kg) x dry tons applied/ac) ÷ 500] + previous loading (lbs/acre) = cumulative lbs pollutant per acre

When a site reaches 90% of the allowable cumulative loading for any metal established in Table 2 of s. NR 204.07(5)(b), the Department shall be so notified through letter or in the comment section of the annual land application report (3400-55).

3.2.1.5 Sludge Analysis for PCBs

The permittee shall analyze the sludge for Total PCBs one time during **2014**. The results shall be reported as "PCB Total Dry Wt". Either congener-specific analysis or Aroclor analysis shall be used to determine the PCB concentration. The permittee may determine whether Aroclor or congener specific analysis is performed. Analyses shall be performed in accordance with Table EM in s. NR 219.04, Wis. Adm. Code and the conditions specified in Standard Requirements of this permit. PCB results shall be submitted by January 31, following the specified year of analysis.

3.2.1.6 Lists 1, 2, 3, and 4

List 1 **TOTAL SOLIDS AND METALS** See the Monitoring Requirements and Limitations table above for monitoring frequency and limitations for the List 1 parameters
Solids, Total (percent)
Arsenic, mg/kg (dry weight)
Cadmium, mg/kg (dry weight)
Copper, mg/kg (dry weight)
Lead, mg/kg (dry weight)
Mercury, mg/kg (dry weight)
Molybdenum, mg/kg (dry weight)
Nickel, mg/kg (dry weight)
Selenium, mg/kg (dry weight)
Zinc, mg/kg (dry weight)

List 2 **NUTRIENTS** See the Monitoring Requirements and Limitations table above for monitoring frequency for the List 2 parameters
Solids, Total (percent)
Nitrogen Total Kjeldahl (percent)
Nitrogen Ammonium (NH4-N) Total (percent)
Phosphorus Total as P (percent)
Phosphorus, Water Extractable (as percent of Total P)
Potassium Total Recoverable (percent)

List 3 **PATHOGEN CONTROL FOR CLASS B SLUDGE** The permittee shall implement pathogen control as listed in List 3. The Department shall be notified of the pathogen control utilized and shall be notified when the permittee decides to utilize alternative pathogen control. The following requirements shall be met prior to land application of sludge.		
Parameter	**Unit**	**Limit**
Fecal Coliform*	MPN/gTS or CFU/gTS	2,000,000
OR, ONE OF THE FOLLOWING PROCESS OPTIONS		
Aerobic Digestion	Air Drying	
Anaerobic Digestion	Composting	
Alkaline Stabilization	PSRP Equivalent Process	
* The Fecal Coliform limit shall be reported as the geometric mean of 7 discrete samples on a dry weight basis.		

List 4 **VECTOR ATTRACTION REDUCTION** The permittee shall implement any one of the vector attraction reduction options specified in List 4. The Department shall be notified of the option utilized and shall be notified when the permittee decides to utilize an alternative option. One of the following shall be satisfied prior to, or at the time of land application as specified in List 4.		
Option	**Limit**	**Where/When it Shall be Met**
Volatile Solids Reduction	≥38%	Across the process
Specific Oxygen Uptake Rate	≤1.5 mg O_2/hr/g TS	On aerobic stabilized sludge
Anaerobic bench-scale test	<17 % VS reduction	On anaerobic digested sludge
Aerobic bench-scale test	<15 % VS reduction	On aerobic digested sludge
Aerobic Process	>14 days, Temp >40°C and Avg. Temp > 45°C	On composted sludge
pH adjustment	>12 S.U. (for 2 hours) and >11.5 (for an additional 22 hours)	During the process
Drying without primary solids	>75 % TS	When applied or bagged
Drying with primary solids	>90 % TS	When applied or bagged
Equivalent Process	Approved by the Department	Varies with process
Injection	-	When applied
Incorporation	-	Within 6 hours of application

3.2.1.7 Daily Land Application Log

Daily Land Application Log		
Discharge Monitoring Requirements and Limitations		
The permittee shall maintain a daily land application log for biosolids land applied each day when land application occurs. The following minimum records must be kept, in addition to all analytical results for the biosolids land applied. The log book records shall form the basis for the annual land application report requirements.		
Parameters	**Units**	**Sample Frequency**
DNR Site Number(s)	Number	Daily as used
Outfall number applied	Number	Daily as used
Acres applied	Acres	Daily as used
Amount applied	As appropriate * /day	Daily as used
Application rate per acre	unit */acre	Daily as used
Nitrogen applied per acre	lb/acre	Daily as used
Method of Application	Injection, Incorporation, or surface applied	Daily as used

*gallons, cubic yards, dry US Tons or dry Metric Tons

4 Schedules

4.1 Waterway Resolution

Required Action	Date Due
Submittal of Facilities Plan Phase 1: Submit a Facilities Plan Phase 1 comparing continued discharge to the existing locations to relocating the discharge to beyond the fractured bedrock.	08/01/2015
Submittal of Plans and Specs: Submit plans and/or specifications for groundwater protection within the waterway.	01/01/2016
Implementation of Facilities Plan Phase 1: Implement the portion of the facility plan with the groundwater protection methods.	07/01/2017

4.2 Phosphorus (Stringent Effluent Limit - Municipal Facility)

No later than 30 days following each compliance date, the permittee shall notify the Department in writing of its compliance or noncompliance with the required action.

Required Action	Date Due
Phosphorus Removal Optimization Study: During the permit term, the permittee shall evaluate collected effluent data, possible source reduction measures, operational improvements or other minor facility modifications to optimize the amount of phosphorus removed by the facility. The first step in this process is development of an optimization study plan including a schedule for investigating and implementing operational alternatives.	08/01/2013
Phosphorus Inteirm Limit: The phosphorus interim limit of 1.0 mg/L monthly average becomes effective July 1, 2014.	07/01/2014
Facilities Planning Status Report 2: Submit a Facilities Planning Status Report for Phase 2. This report shall provide an update on the permittee's progress in evaluating feasible alternatives for meeting the final phosphorus limit which may include: facility upgrading, consolidation with other sewerage systems, alternative effluent discharge locations, the Watershed Adaptive Management Option, Water Quality Trading plan or a water quality standards variance.	08/01/2015
Preliminary Facilities Plan Phase 2: Submit a preliminary Facilities Plan Phase 2 for upgrading the treatment facility (if upgrading is the identified alternative) which includes an implementation schedule that also specifies a final construction date during the next permit term. The Facilities Plan shall also include an evaluation of alternatives for meeting the final WQBEL for phosphorus.	08/01/2016
Final Facilities Plan Phase 2: Refine and submit the final Facilities Plan Phase 2 for approval. If the approved plan is for Adaptive Management or Water Quality Trading, the implementation of the plan shall commence up on Department approval.	01/01/2017
Construction Plans and Specifications: Submit construction plans and specifications for approval if the approved Facilities Plan Phase 2 concludes that facility upgrading is necessary.	04/01/2018
FOR INFORMATIONAL PURPOSES ONLY: The following required actions are included in this permit for informational purposes only and do not take effect until the next permit reissuance. These required actions and dates may be modified at the next permit reissuance based on additional data or new information.	

Progress Report (For Informational Purposes Only): Submit construction progress report.	08/01/2018
Progress Report (For Informational Purposes Only): Submit construction progress report.	08/01/2019
Progress Report (For Informational Purposes Only): Submit construction progress report.	08/01/2020
Complete Construction (For Informational Purposes Only): Complete construction and comply with final phosphorus WQBEL. Date Due: This is a range from 7-9 years because of new information that can be acquired before the next permit issuance.	

5 Standard Requirements

NR 205, Wisconsin Administrative Code: The conditions in ss. NR 205.07(1) and NR 205.07(2), Wis. Adm. Code, are included by reference in this permit. The permittee shall comply with all of these requirements. Some of these requirements are outlined in the Standard Requirements section of this permit. Requirements not specifically outlined in the Standard Requirement section of this permit can be found in ss. NR 205.07(1) and NR 205.07(2).

5.1 Reporting and Monitoring Requirements

5.1.1 Monitoring Results

Monitoring results obtained during the previous month shall be summarized and reported on a Department Wastewater Discharge Monitoring Report. The report may require reporting of any or all of the information specified below under 'Recording of Results'. This report is to be returned to the Department no later than the date indicated on the form. A copy of the Wastewater Discharge Monitoring Report Form or an electronic file of the report shall be retained by the permittee.

Monitoring results shall be reported on an electronic discharge monitoring report (eDMR) or in a form approved by the department for reporting results of monitoring of sludge use or disposal practices.

If the permittee monitors any pollutant more frequently than required by this permit, the results of such monitoring shall be included on the Wastewater Discharge Monitoring Report.

The permittee shall comply with all limits for each parameter regardless of monitoring frequency. For example, monthly, weekly, and/or daily limits shall be met even with monthly monitoring. The permittee may monitor more frequently than required for any parameter.

An Electronic Discharge Monitoring Report Certification sheet shall be signed and submitted with each electronic Discharge Monitoring Report submittal. This certification sheet, which is not part of the electronic report form, shall be signed by a principal executive officer, a ranking elected official or other duly authorized representative and shall be mailed to the Department at the time of submittal of the electronic Discharge Monitoring Report. The certification sheet certifies that the electronic report form is true, accurate and complete.

5.1.2 Sampling and Testing Procedures

Sampling and laboratory testing procedures shall be performed in accordance with Chapters NR 218 and NR 219, Wis. Adm. Code and shall be performed by a laboratory certified or registered in accordance with the requirements of ch. NR 149, Wis. Adm. Code. Groundwater sample collection and analysis shall be performed in accordance with ch. NR 140, Wis. Adm. Code. The analytical methodologies used shall enable the laboratory to quantitate all substances for which monitoring is required at levels below the effluent limitation. If the required level cannot be met by any of the methods available in NR 219, Wis. Adm. Code, then the method with the lowest limit of detection shall be selected. Additional test procedures may be specified in this permit.

5.1.3 Recording of Results

The permittee shall maintain records which provide the following information for each effluent measurement or sample taken:

- the date, exact place, method and time of sampling or measurements;
- the individual who performed the sampling or measurements;
- the date the analysis was performed;
- the individual who performed the analysis;
- the analytical techniques or methods used; and
- the results of the analysis.

5.1.4 Reporting of Monitoring Results

The permittee shall use the following conventions when reporting effluent monitoring results:

- Pollutant concentrations less than the limit of detection shall be reported as < (less than) the value of the limit of detection. For example, if a substance is not detected at a detection limit of 0.1 mg/L, report the pollutant concentration as < 0.1 mg/L.

- Pollutant concentrations equal to or greater than the limit of detection, but less than the limit of quantitation, shall be reported and the limit of quantitation shall be specified.

- For purposes of calculating NR 101 fees, the 2 mg/l lower reporting limits for BOD_5 and Total Suspended Solids shall be considered to be limits of quantitation

- For the purposes of reporting a calculated result, average or a mass discharge value, the permittee may substitute a 0 (zero) for any pollutant concentration that is less than the limit of detection. However, if the effluent limitation is less than the limit of detection, the department may substitute a value other than zero for results less than the limit of detection, after considering the number of monitoring results that are greater than the limit of detection and if warranted when applying appropriate statistical techniques.

5.1.5 Compliance Maintenance Annual Reports

Compliance Maintenance Annual Reports (CMAR) shall be completed using information obtained over each calendar year regarding the wastewater conveyance and treatment system. The CMAR shall be submitted by the permittee in accordance with ch. NR 208, Wis. Adm. Code, by June 30, each year on an electronic report form provided by the Department.

In the case of a publicly owned treatment works, a resolution shall be passed by the governing body and submitted as part of the CMAR, verifying its review of the report and providing responses as required. Private owners of wastewater treatment works are not required to pass a resolution; but they must provide an Owner Statement and responses as required, as part of the CMAR submittal.

A separate CMAR certification document, that is not part of the electronic report form, shall be mailed to the Department at the time of electronic submittal of the CMAR. The CMAR certification shall be signed and submitted by an authorized representative of the permittee. The certification shall be submitted by mail. The certification shall verify the electronic report is complete, accurate and contains information from the owner's treatment works.

5.1.6 Records Retention

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by the permit, and records of all data used to complete the application for the permit for a period of at least 3 years from the date of the sample, measurement, report or application. All pertinent sludge information, including permit application information and other documents specified in this permit or s. NR 204.06(9), Wis. Adm. Code shall be retained for a minimum of 5 years.

5.1.7 Other Information

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or correct information to the Department.

5.2 System Operating Requirements

5.2.1 Noncompliance Notification

- The permittee shall report the following types of noncompliance by a telephone call to the Department's regional office within 24 hours after becoming aware of the noncompliance:
  - any noncompliance which may endanger health or the environment;
  - any violation of an effluent limitation resulting from an unanticipated bypass;
  - any violation of an effluent limitation resulting from an upset; and
  - any violation of a maximum discharge limitation for any of the pollutants listed by the Department in the permit, either for effluent or sludge.

- A written report describing the noncompliance shall also be submitted to the Department's regional office within 5 days after the permittee becomes aware of the noncompliance. On a case-by-case basis, the Department may waive the requirement for submittal of a written report within 5 days and instruct the permittee to submit the written report with the next regularly scheduled monitoring report. In either case, the written report shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times; the steps taken or planned to reduce, eliminate and prevent reoccurrence of the noncompliance; and if the noncompliance has not been corrected, the length of time it is expected to continue.

NOTE: Section 292.11(2)(a), Wisconsin Statutes, requires any person who possesses or controls a hazardous substance or who causes the discharge of a hazardous substance to notify the Department of Natural Resources **immediately** of any discharge not authorized by the permit. The discharge of a hazardous substance that is not authorized by this permit or that violates this permit may be a hazardous substance spill. To report a hazardous substance spill, call DNR's 24-hour HOTLINE at **1-800-943-0003**

5.2.2 Flow Meters

Flow meters shall be calibrated annually, as per s. NR 218.06, Wis. Adm. Code.

5.2.3 Raw Grit and Screenings

All raw grit and screenings shall be disposed of at a properly licensed solid waste facility or picked up by a licensed waste hauler. If the facility or hauler are located in Wisconsin, then they shall be licensed under chs. NR 500-536, Wis. Adm. Code.

5.2.4 Sludge Management

All sludge management activities shall be conducted in compliance with ch. NR 204 "Domestic Sewage Sludge Management", Wis. Adm. Code.

5.2.5 Prohibited Wastes

Under no circumstances may the introduction of wastes prohibited by s. NR 211.10, Wis. Adm. Code, be allowed into the waste treatment system. Prohibited wastes include those:

- which create a fire or explosion hazard in the treatment work;
- which will cause corrosive structural damage to the treatment work;
- solid or viscous substances in amounts which cause obstructions to the flow in sewers or interference with the proper operation of the treatment work;
- wastewaters at a flow rate or pollutant loading which are excessive over relatively short time periods so as to cause a loss of treatment efficiency; and
- changes in discharge volume or composition from contributing industries which overload the treatment works or cause a loss of treatment efficiency.

5.2.6 Unscheduled Bypassing

Any unscheduled bypass or overflow of wastewater at the treatment works or from the collection system is prohibited, and the Department may take enforcement action against a permittee for such occurrences under s. 283.89, Wis. Stats., unless all of the following occur:

- The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage.
- There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance.
- The permittee notifies the department of the unscheduled bypass or overflow. The permittee shall notify the department <u>within 24 hours</u> of initiation of the bypass or overflow occurrence by telephone, voicemail, fax or e-mail. <u>Within 5 days</u> of conclusion of the bypass or overflow occurrence, the permittee shall submit to the department in writing, all of the following information:
  - Reason the bypass or overflow occurred, or explanation of other contributing circumstances that resulted in the overflow event. If the overflow or bypass is associated with wet weather, provide data on the amount and duration of the rainfall or snow melt for each separate event.
  - Date the bypass or overflow occurred.
  - Location where the bypass or overflow occurred.
  - Duration of the bypass or overflow and estimated wastewater volume discharged.
  - Steps taken or the proposed corrective action planned to prevent similar future occurrences.
  - Any other information the permittee believes is relevant.

5.2.7 Scheduled Bypassing

Any construction or normal maintenance which results in a bypass of wastewater is prohibited unless authorized by the Department in writing. If the Department determines that there is significant public interest in the proposed action, the Department may schedule a public hearing or notice a proposal to approve the bypass. Each request shall specify the following minimum information:

- Proposed date of bypass.
- Estimated duration of the bypass.
- Alternatives to bypassing.
- Measures to mitigate environmental harm caused by the bypass.
- Estimated volume of the bypass.

5.2.8 Ammonia Limit Not Needed - Continue to Optimize Removal of Ammonia

Applying the procedures in s. NR 106.05, Wis. Adm. Code, to ammonia data that is representative of the current operations of the wastewater treatment plant resulted in a determination that ammonia effluent limits are not necessary in this permit. Pursuant to NR 106.33, throughout the term of this permit, the wastewater treatment plant shall continue to be operated in a manner that optimizes the removal of ammonia within the design capabilities of the wastewater treatment plant.

5.2.9 Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control which are installed or used by the permittee to achieve compliance with the conditions of this permit. The wastewater treatment facility shall be under the direct supervision of a state certified operator as required in s. NR 108.06(2), Wis. Adm. Code. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training as required in ch. NR 114, Wis. Adm. Code, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the permit.

5.3 Surface Water Requirements

5.3.1 Permittee-Determined Limit of Quantitation Incorporated into this Permit

For pollutants with water quality-based effluent limits below the Limit of Quantitation (LOQ) in this permit, the LOQ calculated by the permittee and reported on the Discharge Monitoring Reports (DMRs) is incorporated by reference into this permit. The LOQ shall be reported on the DMRs, shall be the lowest quantifiable level practicable, and shall be no greater than the minimum level (ML) specified in or approved under 40 CFR Part 136 for the pollutant at the time this permit was issued, unless this permit specifies a higher LOQ.

5.3.2 Appropriate Formulas for Effluent Calculations

The permittee shall use the following formulas for calculating effluent results to determine compliance with average concentration limits and mass limits and total load limits:

Weekly/Monthly/Six-Month/Annual Average Concentration = the sum of all daily results for that week/month/six-month/year, divided by the number of results during that time period.

Weekly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the week.

Monthly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the month.

Annual Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the entire year.

Total Monthly Discharge: = monthly average concentration (mg/L) x total flow for the month (MG/month) x 8.34.

Total Annual Discharge: = sum of total monthly discharges for the calendar year.

5.3.3 Effluent Temperature Requirements

Weekly Average Temperature – The permittee shall use the following formula for calculating effluent results to determine compliance with the weekly average temperature limit (as applicable): Weekly Average Temperature = the sum of all daily maximum results for that week divided by the number of daily maximum results during that time period.

Cold Shock Standard – Water temperatures of the discharge shall be controlled in a manner as to protect fish and aquatic life uses from the deleterious effects of cold shock. 'Cold Shock' means exposure of aquatic organisms to a rapid decrease in temperature and a sustained exposure to low temperature that induces abnormal behavior or physiological performance and may lead to death.

Rate of Temperature Change Standard – Temperature of a water of the state or discharge to a water of the state may not be artificially raised or lowered at such a rate that it causes detrimental health or reproductive effects to fish or aquatic life of the water of the state.

5.3.4 Visible Foam or Floating Solids

There shall be no discharge of floating solids or visible foam in other than trace amounts.

5.3.5 Percent Removal

During any 30 consecutive days, the average effluent concentrations of BOD_5 and of total suspended solids shall not exceed 15% of the average influent concentrations, respectively. This requirement does not apply to removal of total suspended solids if the permittee operates a lagoon system and has received a variance for suspended solids granted under NR 210.07(2), Wis. Adm. Code.

5.3.6 Fecal Coliforms

The limit for fecal coliforms shall be expressed as a monthly geometric mean.

5.3.7 Year Round Disinfection

Disinfection shall be provided year round. Monitoring requirements and the limitation for fecal coliforms apply during the period in which disinfection is required. Whenever chlorine is used for disinfection or other uses, the limitations and monitoring requirements for residual chlorine shall apply. A dechlorination process shall be in operation whenever chlorine is used.

5.3.8 Whole Effluent Toxicity (WET) Monitoring Requirements

In order to determine the potential impact of the discharge on aquatic organisms, static-renewal toxicity tests shall be performed on the effluent in accordance with the procedures specified in the *"State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition" (PUB-WT-797,* November 2004) as required by NR 219.04, Table A, Wis. Adm. Code). All of the WET tests required in this permit, including any required retests, shall be conducted on the *Ceriodaphnia dubia* and fathead minnow species. Receiving water samples shall not be collected from any point in contact with the permittee's mixing zone and every attempt shall be made to avoid contact with any other discharge's mixing zone.

5.3.9 Whole Effluent Toxicity (WET) Identification and Reduction

Within 60 days of a retest which showed positive results, the permittee shall submit a written report to the Biomonitoring Coordinator, Bureau of Watershed Management, 101 S. Webster St., PO Box 7921, Madison, WI 53707-7921, which details the following:

- A description of actions the permittee has taken or will take to remove toxicity and to prevent the recurrence of toxicity;
- A description of toxicity reduction evaluation (TRE) investigations that have been or will be done to identify potential sources of toxicity, including some or all of the following actions:

(a) Evaluate the performance of the treatment system to identify deficiencies contributing to effluent toxicity (e.g., operational problems, chemical additives, incomplete treatment)
(b) Identify the compound(s) causing toxicity
(c) Trace the compound(s) causing toxicity to their sources (e.g., industrial, commercial, domestic)
(d) Evaluate, select, and implement methods or technologies to control effluent toxicity (e.g., in-plant or pretreatment controls, source reduction or removal)

- Where corrective actions including a TRE have not been completed, an expeditious schedule under which corrective actions will be implemented;

- If no actions have been taken, the reason for not taking action.

The permittee may also request approval from the Department to postpone additional retests in order to investigate the source(s) of toxicity. Postponed retests must be completed after toxicity is believed to have been removed.

5.4 Land Application Requirements

5.4.1 Sludge Management Program Standards And Requirements Based Upon Federally Promulgated Regulations

In the event that new federal sludge standards or regulations are promulgated, the permittee shall comply with the new sludge requirements by the dates established in the regulations, if required by federal law, even if the permit has not yet been modified to incorporate the new federal regulations.

5.4.2 General Sludge Management Information

The General Sludge Management Form 3400-48 shall be completed and submitted prior to any significant sludge management changes.

5.4.3 Sludge Samples

All sludge samples shall be collected at a point and in a manner which will yield sample results which are representative of the sludge being tested, and collected at the time which is appropriate for the specific test.

5.4.4 Land Application Characteristic Report

Each report shall consist of a Characteristic Form 3400-49 and Lab Report, unless approval for not submitting the lab reports has been given. Both reports shall be submitted by January 31 following each year of analysis.

The permittee shall use the following convention when reporting sludge monitoring results: Pollutant concentrations less than the limit of detection shall be reported as < (less than) the value of the limit of detection. For example, if a substance is not detected at a detection limit of 1.0 mg/kg, report the pollutant concentration as < 1.0 mg/kg .

All results shall be reported on a dry weight basis.

5.4.5 Calculation of Water Extractable Phosphorus

When sludge analysis for Water Extractable Phosphorus is required by this permit, the permittee shall use the following formula to calculate and report Water Extractable Phosphorus:
Water Extractable Phosphorus (% of Total P) =
[Water Extractable Phosphorus (mg/kg, dry wt) ÷ Total Phosphorus (mg/kg, dry wt)] x 100

5.4.6 Monitoring and Calculating PCB Concentrations in Sludge

When sludge analysis for "PCB, Total Dry Wt" is required by this permit, the PCB concentration in the sludge shall be determined as follows.

Either congener-specific analysis or Aroclor analysis shall be used to determine the PCB concentration. The permittee may determine whether Aroclor or congener specific analysis is performed. Analyses shall be performed in accordance with the following provisions and Table EM in s. NR 219.04, Wis. Adm. Code.

- EPA Method 1668 may be used to test for all PCB congeners. If this method is employed, all PCB congeners shall be delineated. Non-detects shall be treated as zero. The values that are between the limit of detection and the limit of quantitation shall be used when calculating the total value of all congeners. All results shall be added together and the total PCB concentration by dry weight reported. **Note:** It is recognized that a number of the congeners will co-elute with others, so there will not be 209 results to sum.
- EPA Method 8082A shall be used for PCB-Aroclor analysis and may be used for congener specific analysis as well. If congener specific analysis is performed using Method 8082A, the list of congeners tested shall include at least congener numbers 5, 18, 31, 44, 52, 66, 87, 101, 110, 138, 141, 151, 153, 170, 180, 183, 187, and 206 plus any other additional congeners which might be reasonably expected to occur in the particular sample. For either type of analysis, the sample shall be extracted using the Soxhlet extraction (EPA Method 3540C) (or the Soxhlet Dean-Stark modification) or the pressurized fluid extraction (EPA Method 3545A). If Aroclor analysis is performed using Method 8082A, clean up steps of the extract shall be performed as necessary to remove interference and to achieve as close to a limit of detection of 0.11 mg/kg as possible. Reporting protocol, consistent with s. NR 106.07(6)(e), should be as follows: If all Aroclors are less than the LOD, then the Total PCB Dry Wt result should be reported as less than the highest LOD. If a single Aroclor is detected then that is what should be reported for the Total PCB result. If multiple Aroclors are detected, they should be summed and reported as Total PCBs. If congener specific analysis is done using Method 8082A, clean up steps of the extract shall be performed as necessary to remove interference and to achieve as close to a limit of detection of 0.003 mg/kg as possible for each congener. If the aforementioned limits of detection cannot be achieved after using the appropriate clean up techniques, a reporting limit that is achievable for the Aroclors or each congener for the sample shall be determined. This reporting limit shall be reported and qualified indicating the presence of an interference. The lab conducting the analysis shall perform as many of the following methods as necessary to remove interference:

3620C – Florisil	3611B - Alumina
3640A - Gel Permeation	3660B - Sulfur Clean Up (using copper shot instead of powder)
3630C - Silica Gel	3665A - Sulfuric Acid Clean Up

5.4.7 Land Application Report

Land Application Report Form 3400-55 shall be submitted by January 31, following each year non-exceptional quality sludge is land applied. Non-exceptional quality sludge is defined in s. NR 204.07(4), Wis. Adm. Code.

5.4.8 Other Methods of Disposal or Distribution Report

The permittee shall submit Report Form 3400-52 by January 31, following each year sludge is hauled, landfilled, incinerated, or when exceptional quality sludge is distributed or land applied.

5.4.9 Approval to Land Apply

Bulk non-exceptional quality sludge as defined in s. NR 204.07(4), Wis. Adm. Code, may not be applied to land without a written approval letter or Form 3400-122 from the Department unless the Permittee has obtained permission from the Department to self approve sites in accordance with s. NR 204.06 (6), Wis. Adm. Code. Analysis of sludge characteristics is required prior to land application. Application on frozen or snow covered ground is restricted to the extent specified in s. NR 204.07(3) (l), Wis. Adm. Code.

5.4.10 Soil Analysis Requirements

Each site requested for approval for land application must have the soil tested prior to use. Each approved site used for land application must subsequently be soil tested such that there is at least one valid soil test in the four years prior to land application. All soil sampling and submittal of information to the testing laboratory shall be done in accordance with UW Extension Bulletin A-2100. The testing shall be done by the UW Soils Lab in Madison or Marshfield, WI or at a lab approved by UW. The test results including the crop recommendations shall be submitted to the DNR contact listed for this permit, as they are available. Application rates shall be determined based on the crop nitrogen recommendations and with consideration for other sources of nitrogen applied to the site.

5.4.11 Land Application Site Evaluation

For non-exceptional quality sludge, as defined in s. NR 204.07(4), Wis. Adm. Code, a Land Application Site Request Form 3400-053 shall be submitted to the Department for the proposed land application site. The Department will evaluate the proposed site for acceptability and will either approve or deny use of the proposed site. The permittee may obtain permission to approve their own sites in accordance with s. NR 204.06(6), Wis. Adm. Code.

5.4.12 Class B Sludge: Fecal Coliform Limitation

Compliance with the fecal coliform limitation for Class B sludge shall be demonstrated by calculating the geometric mean of at least 7 separate samples. (Note that a Total Solids analysis must be done on each sample). The geometric mean shall be less than 2,000,000 MPN or CFU/g TS. Calculation of the geometric mean can be done using one of the following 2 methods.

Method 1:
Geometric Mean = $(X_1 \times X_2 \times X_3 \ldots \times X_n)^{1/n}$
Where X = Coliform Density value of the sludge sample, and where n = number of samples (at least 7)

Method 2:
Geometric Mean = $\text{antilog}[(X_1 + X_2 + X_3 \ldots + X_n) \div n]$
Where X = $\log_{10}$ of Coliform Density value of the sludge sample, and where n = number of samples (at least 7)
Example for Method 2

Sample Number	Coliform Density of Sludge Sample	$\log_{10}$
1	6.0×10^5	5.78
2	4.2×10^6	6.62
3	1.6×10^6	6.20
4	9.0×10^5	5.95
5	4.0×10^5	5.60
6	1.0×10^6	6.00
7	5.1×10^5	5.71

The geometric mean for the seven samples is determined by averaging the $\log_{10}$ values of the coliform density and taking the antilog of that value.
$(5.78 + 6.62 + 6.20 + 5.95 + 5.60 + 6.00 + 5.71) \div 7 = 5.98$
The antilog of 5.98 = 9.5×10^5

5.4.13 Class B Sludge: Anaerobic Digestion

Treat the sludge in the absence of air for a specific mean cell residence time at a specific temperature. Values for the mean cell residence time and temperature shall be between 15 days at 35° C to 55° C and 60 days at 20° C. Straight-line interpolation to calculate mean cell residence time is allowable when the temperature falls between 35° C and 20° C.

5.4.14 Vector Control: Volatile Solids Reduction

The mass of volatile solids in the sludge shall be reduced by a minimum of 38% between the time the sludge enters the digestion process and the time it either exits the digester or a storage facility. For calculation of volatile solids reduction, the permittee shall use the Van Kleeck equation or one of the other methods described in "Determination of Volatile Solids Reduction in Digestion" by J.B. Farrell, which is Appendix C of EPA's *Control of Pathogens in Municipal Wastewater Sludge* (EPA/625/R-92/013). The Van Kleeck equation is:

$$VSR\% = \frac{VS_{IN} - VS_{OUT}}{VS_{IN} - (VS_{OUT} \times VS_{IN})} \times 100$$

Where: VS_{IN} = Volatile Solids in Feed Sludge (g VS/g TS)

VS_{OUT} = Volatile Solids in Final Sludge (g VS/g TS)

VSR% = Volatile Solids Reduction, (Percent)

6 Summary of Reports Due

FOR INFORMATIONAL PURPOSES ONLY

Description	Date	Page
Waterway Resolution -Submittal of Facilities Plan Phase 1	August 1, 2015	10
Waterway Resolution -Submittal of Plans and Specs	January 1, 2016	10
Waterway Resolution -Implementation of Facilities Plan Phase 1	July 1, 2017	10
Phosphorus (Stringent Effluent Limit - Municipal Facility) -Phosphorus Removal Optimization Study	August 1, 2013	10
Phosphorus (Stringent Effluent Limit - Municipal Facility) -Phosphorus Inteirm Limit	July 1, 2014	10
Phosphorus (Stringent Effluent Limit - Municipal Facility) -Facilities Planning Status Report 2	August 1, 2015	10
Phosphorus (Stringent Effluent Limit - Municipal Facility) -Preliminary Facilities Plan Phase 2	August 1, 2016	10
Phosphorus (Stringent Effluent Limit - Municipal Facility) -Final Facilities Plan Phase 2	January 1, 2017	10
Phosphorus (Stringent Effluent Limit - Municipal Facility) -Construction Plans and Specifications	April 1, 2018	10
Phosphorus (Stringent Effluent Limit - Municipal Facility) -FOR INFORMATIONAL PURPOSES ONLY	See Permit	10
Phosphorus (Stringent Effluent Limit - Municipal Facility) -Progress Report (For Informational Purposes Only)	August 1, 2018	11
Phosphorus (Stringent Effluent Limit - Municipal Facility) -Progress Report (For Informational Purposes Only)	August 1, 2019	11
Phosphorus (Stringent Effluent Limit - Municipal Facility) -Progress Report (For Informational Purposes Only)	August 1, 2020	11
Phosphorus (Stringent Effluent Limit - Municipal Facility) -Complete Construction (For Informational Purposes Only)	See Permit	11
Compliance Maintenance Annual Reports (CMAR)	by June 30, each year	13
General Sludge Management Form 3400-48	prior to any significant sludge management changes	18
Characteristic Form 3400-49 and Lab Report	by January 31 following each year of analysis	18
Land Application Report Form 3400-55	by January 31, following each year non-exceptional quality sludge is land	19

	applied	
Report Form 3400-52	by January 31, following each year sludge is hauled, landfilled, incinerated, or when exceptional quality sludge is distributed or land applied	19
Wastewater Discharge Monitoring Report	no later than the date indicated on the form	12

Report forms shall be submitted to the address printed on the report form. Any facility plans or plans and specifications for municipal, industrial, industrial pretreatment and non industrial wastewater systems shall be submitted to the Bureau of Watershed Management, P.O. Box 7921, Madison, WI 53707-7921. All <u>other</u> submittals required by this permit shall be submitted to:
West Central Region - LaCrosse, 3550 Mormon Coulee Road, La Crosse, WI 54601

APPENDIX B

Soils Information

United States Department of Agriculture

NRCS

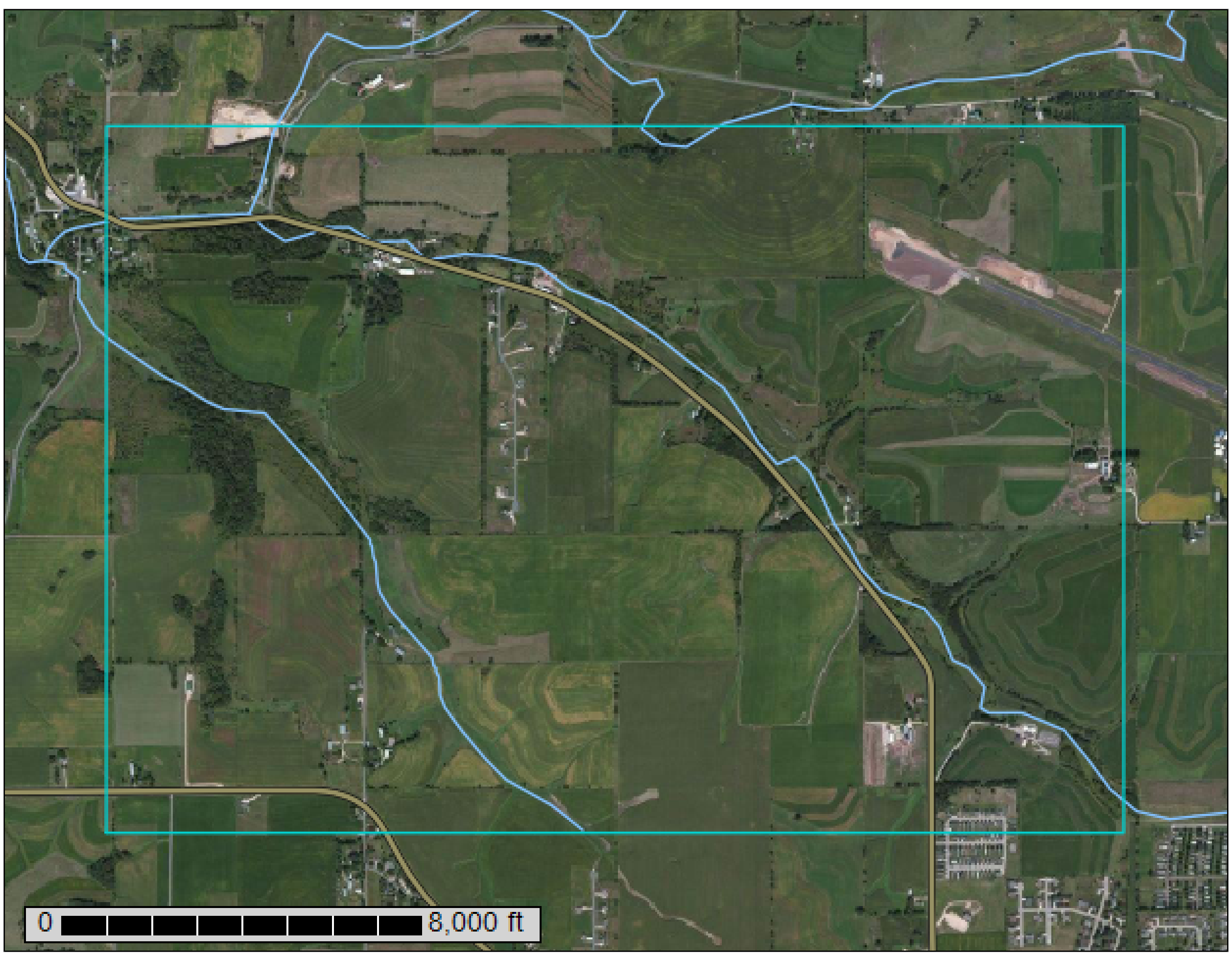
Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Vernon County, Wisconsin

City of Viroqua WWTP Facilties Plan



March 17, 2015

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

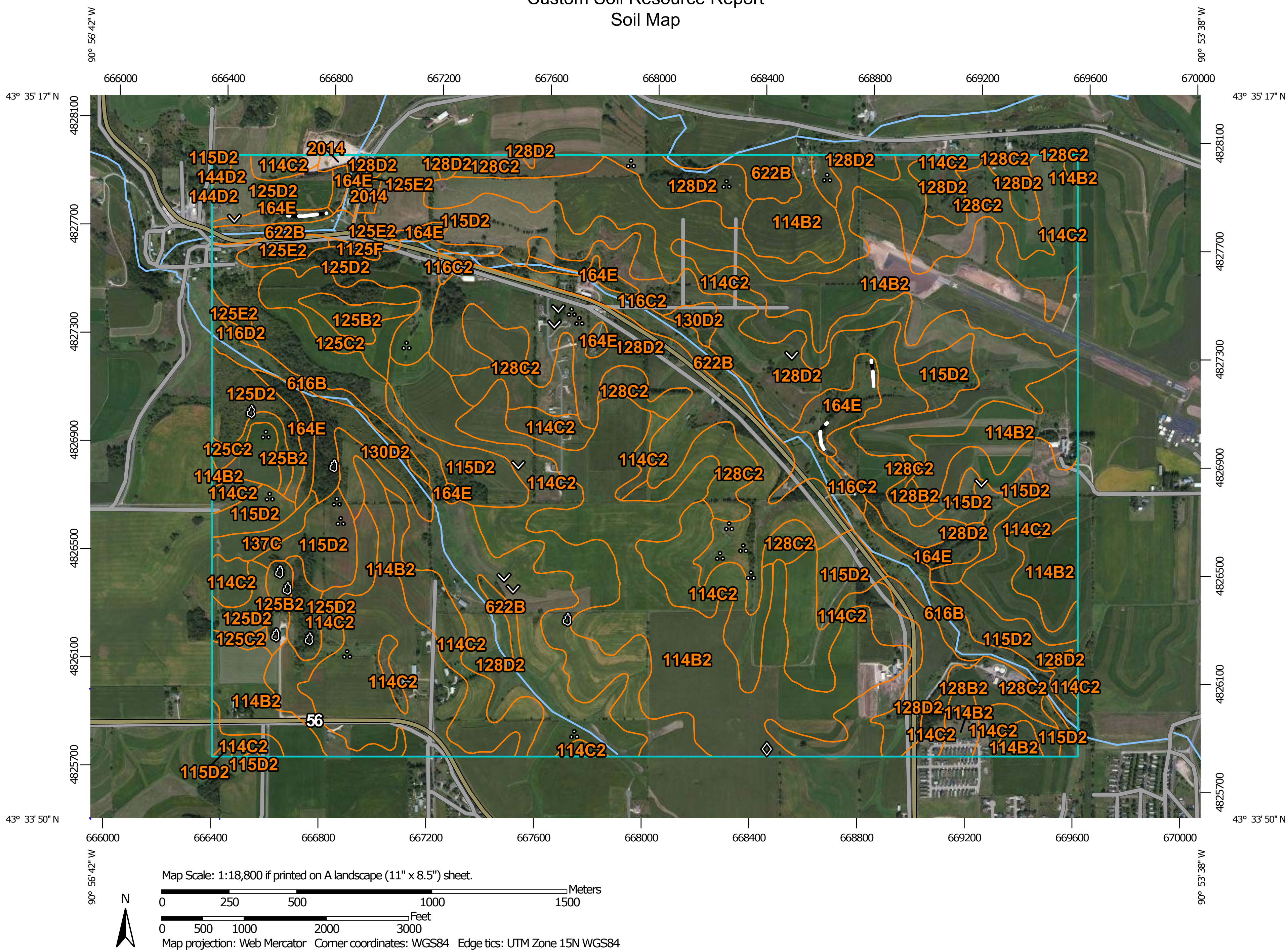
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map


90° 56' 42" W
90° 53' 38" W
43° 35' 17" N
43° 33' 50" N
666000
666400
666800
667200
667600
668000
668400
668800
669200
669600
670000
4828100
4827700
4827300
4826900
4826500
4826100
4825700
56
N
Map Scale: 1:18,800 if printed on A landscape (11" x 8.5") sheet.
Meters
0 250 500 1000 1500
Feet
0 500 1000 2000 3000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Vernon County, Wisconsin
Survey Area Data: Version 9, Sep 16, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 1, 2010—Oct 2, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Vernon County, Wisconsin (WI123)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
114B2	Mt. Carroll silt loam, 2 to 6 percent slopes, moderately eroded	399.7	22.5%
114C2	Mt. Carroll silt loam, 6 to 12 percent slopes, moderately eroded	437.5	24.7%
115D2	Seaton silt loam, 12 to 20 percent slopes, moderately eroded	138.0	7.8%
116C2	Churchtown silt loam, 6 to 12 percent slopes, moderately eroded	3.9	0.2%
116D2	Churchtown silt loam, 12 to 20 percent slopes, moderately eroded	1.3	0.1%
125B2	Pepin silt loam, 2 to 6 percent slopes, moderately eroded	23.9	1.3%
125C2	Pepin silt loam, 6 to 12 percent slopes, moderately eroded	30.2	1.7%
125D2	Pepin silt loam, 12 to 20 percent slopes, moderately eroded	112.0	6.3%
125E2	Pepin silt loam, 20 to 30 percent slopes, moderately eroded	11.1	0.6%
128B2	Ashdale silt loam, 2 to 6 percent slopes, very deep, moderately eroded	2.9	0.2%
128C2	Ashdale silt loam, 6 to 12 percent slopes, very deep, moderately eroded	99.8	5.6%
128D2	Ashdale silt loam, 12 to 20 percent slopes, very deep, moderately eroded	342.1	19.3%
130D2	Dodgeville silt loam, 12 to 20 percent slopes, very deep, moderately eroded	25.2	1.4%
137C	Mickle silt loam, 6 to 12 percent slopes	7.8	0.4%
144D2	NewGlarus silt loam, 12 to 20 percent slopes, moderately eroded	1.4	0.1%
164E	Elizabeth flaggy silt loam, 20 to 30 percent slopes	44.8	2.5%
616B	Chaseburg silt loam, 1 to 4 percent slopes, occasionally flooded	34.8	2.0%
622B	Worthen silt loam, 2 to 6 percent slopes, occasionally flooded	52.0	2.9%

Vernon County, Wisconsin (WI123)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1125F	Dorerton, very stony-Elbaville complex, 30 to 60 percent slopes	1.6	0.1%
2014	Pits, quarry, hard bedrock	4.1	0.2%
Totals for Area of Interest		**1,773.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Vernon County, Wisconsin

114B2—Mt. Carroll silt loam, 2 to 6 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 1lmw6
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Mt. carroll and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mt. Carroll

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess

Typical profile

Ap - 0 to 9 inches: silt loam
E - 9 to 12 inches: silt loam
Bt - 12 to 46 inches: silt loam
BC,C - 46 to 80 inches: silt loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Very high (about 12.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

114C2—Mt. Carroll silt loam, 6 to 12 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: g0vd
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Mt. carroll and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mt. Carroll

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess

Typical profile

Ap - 0 to 9 inches: silt loam
E - 9 to 12 inches: silt loam
Bt - 12 to 46 inches: silt loam
BC,C - 46 to 80 inches: silt loam

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Very high (about 12.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

115D2—Seaton silt loam, 12 to 20 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 2psvr
Elevation: 500 to 1,400 feet
Mean annual precipitation: 28 to 42 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 135 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Seaton and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Seaton

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess

Typical profile

Ap - 0 to 8 inches: silt loam
BE - 8 to 13 inches: silt loam
Bt - 13 to 55 inches: silt loam
BC - 55 to 80 inches: silt loam

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Very high (about 12.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained with limitations (G105XY009WI)

Minor Components

Timula

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: High AWC, adequately drained with limitations (G105XY009WI)

116C2—Churchtown silt loam, 6 to 12 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 1lmwb
Elevation: 800 to 1,100 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Churchtown and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Churchtown

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy slope alluvium over loess

Typical profile

Ap - 0 to 9 inches: silt loam
Bt - 9 to 26 inches: silt loam
2Bt - 26 to 63 inches: silt loam
2BC - 63 to 80 inches: silt loam

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Very high (about 12.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Minor Components

Norden

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

116D2—Churchtown silt loam, 12 to 20 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 1lmwc
Elevation: 700 to 1,340 feet
Mean annual precipitation: 28 to 34 inches
Mean annual air temperature: 43 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Churchtown and similar soils: 92 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Churchtown

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy slope alluvium over loess

Typical profile

Ap - 0 to 9 inches: silt loam
Bt - 9 to 26 inches: silt loam
2Bt - 26 to 63 inches: silt loam
2BC - 63 to 80 inches: silt loam

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Very high (about 12.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained with limitations (G105XY009WI)

Minor Components

Norden

Percent of map unit: 4 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Brownchurch

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Beavercreek

Percent of map unit: 2 percent
Landform: Alluvial fans on hills, drainageways on hills
Down-slope shape: Linear
Across-slope shape: Convex, concave
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

125B2—Pepin silt loam, 2 to 6 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: h6r9
Elevation: 800 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Pepin and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pepin

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over clayey pedisediment over loamy residuum

Typical profile

Ap - 0 to 9 inches: silt loam
Bt1-Bt4 - 9 to 48 inches: silt loam
2Bt5 - 48 to 58 inches: clay
3Bt6 - 58 to 66 inches: very channery loam
3Rt - 66 to 80 inches: weathered bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 45 to 80 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Available water storage in profile: High (about 11.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Minor Components

Newglarus

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Seaton

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Hersey

Percent of map unit: 2 percent
Landform: Till plains
Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

125C2—Pepin silt loam, 6 to 12 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: h6rb
Elevation: 800 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Pepin and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pepin

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over clayey pedisediment over loamy residuum

Typical profile

Ap - 0 to 9 inches: silt loam
Bt1-Bt4 - 9 to 48 inches: silt loam
2Bt5 - 48 to 58 inches: clay
3Bt6 - 58 to 66 inches: very channery loam
3Rt - 66 to 80 inches: weathered bedrock

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 45 to 80 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Available water storage in profile: High (about 11.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Minor Components

Newglarus

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Seaton

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Hersey

Percent of map unit: 2 percent
Landform: Till plains
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

125D2—Pepin silt loam, 12 to 20 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: h6rc
Elevation: 800 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Pepin and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pepin

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over clayey pedisediment over loamy residuum

Typical profile

Ap - 0 to 9 inches: silt loam
Bt1-Bt4 - 9 to 48 inches: silt loam
2Bt5 - 48 to 58 inches: clay
3Bt6 - 58 to 66 inches: very channery loam
3Rt - 66 to 80 inches: weathered bedrock

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: 45 to 80 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Available water storage in profile: High (about 11.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained with limitations (G105XY009WI)

Minor Components

Newglarus

Percent of map unit: 7 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Seaton

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: High AWC, adequately drained with limitations (G105XY009WI)

125E2—Pepin silt loam, 20 to 30 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: h6rd
Elevation: 800 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Pepin and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pepin

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over clayey pedisediment over loamy residuum

Typical profile

Ap - 0 to 9 inches: silt loam
Bt1-Bt4 - 9 to 48 inches: silt loam
2Bt5 - 48 to 58 inches: clay
3Bt6 - 58 to 66 inches: very channery loam
3Rt - 66 to 80 inches: weathered bedrock

Properties and qualities

Slope: 20 to 30 percent
Depth to restrictive feature: 45 to 80 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Available water storage in profile: High (about 11.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained with limitations (G105XY009WI)

Minor Components

Newglarus

Percent of map unit: 6 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Seaton

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: High AWC, adequately drained with limitations (G105XY009WI)

Fivepoints

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Low AWC, adequately drained with limitations (G105XY003WI)

128B2—Ashdale silt loam, 2 to 6 percent slopes, very deep, moderately eroded

Map Unit Setting

National map unit symbol: 2lc2k
Elevation: 680 to 1,360 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 140 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Ashdale, very deep to bedrock, and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ashdale, Very Deep To Bedrock

Setting

Landform: Hills
Landform position (two-dimensional): Summit
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over clayey pedisediment over loamy residuum

Typical profile

Ap,A1,A2 - 0 to 18 inches: silt loam
Bt1,Bt2 - 18 to 31 inches: silty clay loam
2Bt3 - 31 to 55 inches: clay
3Bt4 - 55 to 67 inches: very channery loam
3Rt - 67 to 80 inches: bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 60 to 80 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Available water storage in profile: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Minor Components

Dodgeville, very deep to bedrock

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Summit
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

128C2—Ashdale silt loam, 6 to 12 percent slopes, very deep, moderately eroded

Map Unit Setting

National map unit symbol: 2lc2l
Elevation: 680 to 1,360 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 140 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Ashdale, very deep to bedrock, and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ashdale, Very Deep To Bedrock

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over clayey pedisediment over loamy residuum

Typical profile

Ap,A1,A2 - 0 to 18 inches: silt loam
Bt1,Bt2 - 18 to 31 inches: silty clay loam
2Bt3 - 31 to 55 inches: clay
3Bt4 - 55 to 67 inches: very channery loam
3Rt - 67 to 80 inches: bedrock

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 60 to 80 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Available water storage in profile: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Minor Components

Dodgeville, very deep to bedrock

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

128D2—Ashdale silt loam, 12 to 20 percent slopes, very deep, moderately eroded

Map Unit Setting

National map unit symbol: 2lc2m
Elevation: 680 to 1,360 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 135 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Ashdale, very deep to bedrock, and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ashdale, Very Deep To Bedrock

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over clayey pedisediment over loamy residuum

Typical profile

Ap,A1,A2 - 0 to 18 inches: silt loam
Bt1,Bt2 - 18 to 31 inches: silty clay loam

2Bt3 - 31 to 55 inches: clay
3Bt4 - 55 to 67 inches: very channery loam
3Rt - 67 to 80 inches: bedrock

Properties and qualities
Slope: 12 to 20 percent
Depth to restrictive feature: 60 to 80 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Available water storage in profile: High (about 9.5 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: High AWC, adequately drained with limitations (G105XY009WI)

Minor Components

Dodgeville, very deep to bedrock
Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

130D2—Dodgeville silt loam, 12 to 20 percent slopes, very deep, moderately eroded

Map Unit Setting
National map unit symbol: 2m8gn
Elevation: 680 to 1,360 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 135 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition
Dodgeville, very deep to bedrock, and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dodgeville, Very Deep To Bedrock

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over clayey pedisediment over loamy residuum

Typical profile

Ap,A1 - 0 to 14 inches: silt loam
Bt1 - 14 to 18 inches: silt loam
2Bt2 - 18 to 65 inches: channery clay
3Bt3 - 65 to 71 inches: very channery loam
3R - 71 to 80 inches: bedrock

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: 60 to 80 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Minor Components

Ashdale, very deep to bedrock

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: High AWC, adequately drained with limitations (G105XY009WI)

137C—Mickle silt loam, 6 to 12 percent slopes

Map Unit Setting

National map unit symbol: 1q9nj
Elevation: 800 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Mickle and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mickle

Setting

Landform: Hills
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Silty slope alluvium

Typical profile

Ap - 0 to 12 inches: silt loam
BE - 12 to 18 inches: silt loam
Bt - 18 to 65 inches: silt loam
BC - 65 to 80 inches: silt loam

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 42 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very high (about 12.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Minor Components

Blackhammer

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Newglarus

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

144D2—NewGlarus silt loam, 12 to 20 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: h6rw
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 34 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Newglarus and similar soils: 93 percent
Minor components: 7 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Newglarus

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over clayey pedisediment over loamy residuum

Typical profile

Ap - 0 to 9 inches: silt loam
BE - 9 to 13 inches: silt loam
Bt1 - 13 to 23 inches: silty clay loam
2Bt2 - 23 to 35 inches: clay
3Bt3 - 35 to 45 inches: very channery loam
3Rt - 45 to 60 inches: weathered bedrock

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Available water storage in profile: Moderate (about 7.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Minor Components

Fivepoints

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Pepin

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: High AWC, adequately drained with limitations (G105XY009WI)

Brinkman

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: High AWC, adequately drained with limitations (G105XY009WI)

164E—Elizabeth flaggy silt loam, 20 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2lcg2
Elevation: 800 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Elizabeth, flaggy silt loam, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elizabeth, Flaggy Silt Loam

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Thin loess over loamy residuum weathered from dolomite

Typical profile

Oe,A1-A3 - 0 to 7 inches: flaggy silt loam
2R - 7 to 11 inches: bedrock

Properties and qualities

Slope: 20 to 30 percent
Depth to restrictive feature: 7 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Very low (about 1.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Other vegetative classification: Low AWC, adequately drained with limitations (G105XY003WI)

Minor Components

Dorerton, very stony

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Fivepoints

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Low AWC, adequately drained with limitations (G105XY003WI)

616B—Chaseburg silt loam, 1 to 4 percent slopes, occasionally flooded

Map Unit Setting

National map unit symbol: h6x7
Elevation: 700 to 1,200 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Chaseburg and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chaseburg

Setting

Landform: Drainageways on hills, alluvial fans on hills
Down-slope shape: Linear
Across-slope shape: Concave, convex
Parent material: Silty slope alluvium

Typical profile

A - 0 to 4 inches: silt loam
C1-C4 - 4 to 60 inches: silt loam

Properties and qualities

Slope: 1 to 4 percent
Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: Very high (about 12.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Minor Components

Arenzville

Percent of map unit: 3 percent
Landform: Drainageways on stream terraces
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Churchtown

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

622B—Worthen silt loam, 2 to 6 percent slopes, occasionally flooded

Map Unit Setting

National map unit symbol: 2pb5g
Elevation: 340 to 1,360 feet
Mean annual precipitation: 25 to 40 inches
Mean annual air temperature: 45 to 54 degrees F
Frost-free period: 135 to 190 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Worthen, occasionally flooded, and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Worthen, Occasionally Flooded

Setting

Landform: Alluvial fans on hills, drainageways on hills

Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Silty alluvium

Typical profile

Ap,A,AB - 0 to 29 inches: silt loam
Bw - 29 to 64 inches: silt loam
C - 64 to 80 inches: silt loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Available water storage in profile: Very high (about 13.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Minor Components

Huntsville, moderately well drained

Percent of map unit: 3 percent
Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Worthen, cherty silt loam

Percent of map unit: 2 percent
Landform: Alluvial fans, drainageways
Down-slope shape: Linear
Across-slope shape: Convex, concave
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

1125F—Dorerton, very stony-Elbaville complex, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 1lmyq
Elevation: 800 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F

Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Dorerton, very stony, and similar soils: 60 percent
Elbaville and similar soils: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dorerton, Very Stony

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy colluvium over loamy and sandy residuum weathered from dolomite

Typical profile

A - 0 to 3 inches: loam
E1, E2 - 3 to 15 inches: loam
BE,Bt1 - 15 to 18 inches: loam
2Bt2 - 18 to 30 inches: very channery clay loam
2C - 30 to 60 inches: very flaggy loamy sand

Properties and qualities

Slope: 30 to 60 percent
Percent of area covered with surface fragments: 2.0 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Description of Elbaville

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over loamy and clayey colluvium over loamy and sandy residuum weathered from dolomite

Typical profile

Oe,A - 0 to 5 inches: silt loam
E1, E2 - 5 to 11 inches: silt loam
B/E,Bt1 - 11 to 21 inches: silt loam
2Bt2 - 21 to 26 inches: silty clay
3Bt3 - 26 to 37 inches: very flaggy silty clay loam
3C - 37 to 60 inches: extremely flaggy sandy loam

Properties and qualities

Slope: 30 to 45 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Minor Components

Churchtown

Percent of map unit: 6 percent
Landform: Hills
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Other vegetative classification: High AWC, adequately drained with limitations (G105XY009WI)

Dorerton, nonstony

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Rockbluff

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Low AWC, adequately drained with limitations (G105XY003WI)

Brodale

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Low AWC, adequately drained with limitations (G105XY003WI)

2014—Pits, quarry, hard bedrock

Map Unit Setting

National map unit symbol: 1lmz0
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Pits, quarry, hard bedrock: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits, Quarry, Hard Bedrock

Setting

Parent material: Sandstone

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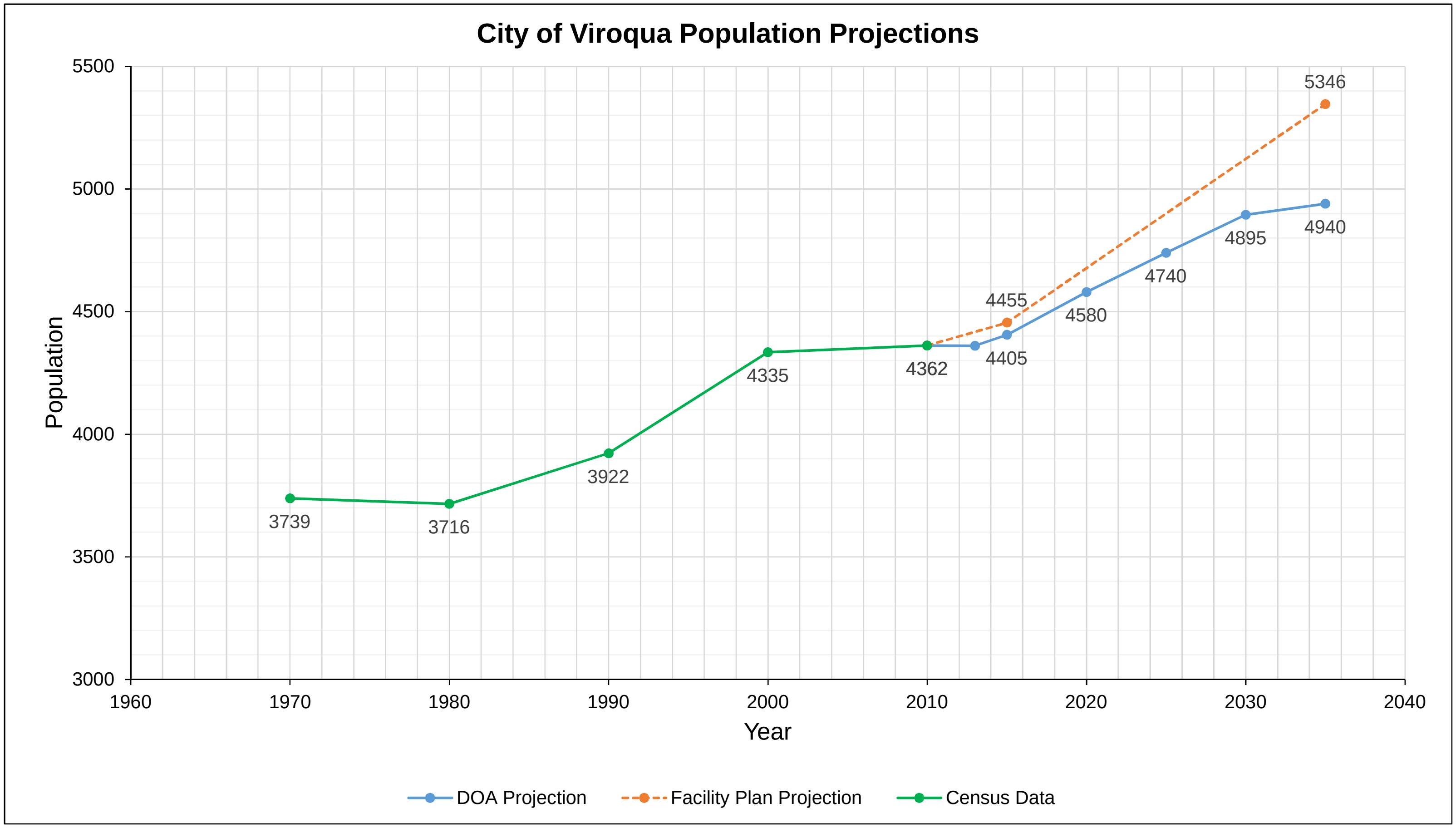
APPENDIX C

Population and Land Use

- **Population Projections**
- **2007 Comprehensive Plan Excerpts**



Wisconsin DOA Municipal Projections, 2010-2040
vintage 2013

Municipality	DOA Code	1970 Census	1980 Census	1990 Census	2000 Census	2010 Census	2013 Estimate	2015 Projection	2020 Projection	2025 Projection	2030 Projection	2035 Projection	% Change per Year	% Change 2010-2035
City of Viroqua	63286	3739	3716	3922	4335	4362	4361	4405	4580	4740	4895	4940	0.53%	13.3%
Town of Viroqua	63036	1544	1663	1499	1560	1718	1739	1780	1895	2010	2120	2190	1.10%	

Facilities Plan Projection

Municipality	DOA Code	1970 Census	1980 Census	1990 Census	2000 Census	2010 Census	2015 Projection	2035 Projection	% Change per Year	% Change 2015-2035
City of Viroqua	22226	3739	3716	3922	4335	4362	4455	5346	1.00%	20.0%
Town of Viroqua	22016	1544	1663	1499	1560	1718				

<u>Comprehensive Plan</u>

City of Viroqua and Town of Viroqua

Vernon County, Wisconsin

Planning Cluster A

Central Vernon County Planning Group

Adopted by the City of Viroqua Comprehensive Planning Commission on October 12, 2006

Adopted by the City of Viroqua Common Council on February 27, 2007

Prepared By:

City of Viroqua Comprehensive Planning Commission

Town of Viroqua Planning Committee

Cluster A Planning Committee

With the Assistance of:

Mead & Hunt, Inc.

City of Viroqua Mayor and Common Council

Larry Fanta, Mayor

Alderpersons
David Tryggestad
Marc Polsean
John Bjerke
Gary Krause
Wes Mack
Roger Hatlem
Gail Frie
Robert Suhr
Terry Noble

John Severson, City Clerk/Treasurer
Jeff Gohlke, City Administrator

Town of Viroqua Chairman and Town Board

Eugene Engh, Chairman
Nathan Larson
Michael Hanson

Patricia Olson, Town Clerk

Cluster A Planning Committee
(open membership)

Viroqua Comprehensive Planning Commission

Vernie Smith, Chairperson
Mike Bankes
Lynn Chakoian (alternate)
Marty Larson
Tom Wilson
Larry Fanta, Mayor
Gail Frie, City Council Member

Town Of Viroqua Planning Committee

Lea Lawrence, Chairperson
Nathan Larson
Tim Elbert
Jon Dehlin

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Introduction

Basis for Comprehensive Planning

This Comprehensive Plan has been prepared under the authority of Wisconsin state statutes 66.1001 and 16.965, and at the request of the City of Viroqua and Town of Viroqua. This Plan was produced within a two level, multi-jurisdictional planning framework. The overall process involved twelve units of government called the Central Vernon County Planning Group. This group was divided into five cluster planning areas. This Plan represents Cluster A, consisting of the City of Viroqua and the Town of Viroqua. **Map 1** illustrates the participants in the overall planning group and each of the five cluster planning areas. The planning process was guided by an Umbrella Planning Committee representing the Central Vernon County Planning Group, with detailed guidance by individual Cluster Planning Committees. Detailed local guidance and direction for Cluster A planning was provided by the City of Viroqua Comprehensive Planning Commission. The Town of Viroqua had the opportunity to provide similar input from a Town Planning Committee and Town Board. The final authorities in this planning process are the elected city, village and town governing bodies.

Plan Content

The functional planning elements of this Comprehensive Plan include the following elements:

1. Issues and Opportunities
2. Housing
3. Transportation
4. Utilities and Community Facilities
5. Agricultural, Natural and Cultural Resources
6. Economic Development
7. Intergovernmental Cooperation
8. Land Use
9. Implementation

Planning Recommendations - Goals, Objectives, Policies and Programs

The recommendations of this Plan are contained in the goals, objectives, policies and programs of each of the nine plan sections identified above. These four subjects in each chapter are the framework of the Plan. The recommendations contained in this framework are an outgrowth of the planning data, public input data, and the local official and citizen direction which composed the planning process. The definition of goals, objectives, policies and programs is provided below. These terms are applied in this Plan according to their intended use under the provisions of the state comprehensive planning law.

Goals: General statements and visions of idealized conditions and aspirations-- few in number
Objectives: Targeted subject areas to be dealt with to achieve goals
Policies: The position a unit of government takes on specific subject areas which will lead to implementation of goals and objectives
Programs: Specific actions and projects to implement goals, objectives and policies

Public Participation

A plan for public participation is a required part of the comprehensive planning process. The plan for this process was developed in cooperation with the planning committees and approved by the twelve participating governmental units. This public participation plan was adopted by The City of Viroqua Common Council on May 25, 2004, and by the Town of Viroqua Town Board on June 10, 2004. A copy of this public participation plan is attached hereto as **Appendix A**. The planning for the City and Town of Viroqua area was guided by the Cluster A Planning Committee which was open to all interested citizens and public officials throughout the entire planning process. The City of Viroqua provided additional input through a separate Comprehensive Planning Commission.

In addition to the committee structure of citizens and local officials that guided the planning process, there were other special opportunities for public participation in the development of this Plan, and they are:

- Surveys of citizen opinions and recommendations in each participating unit of government.
- *Issue & Opportunity Study Papers* -- three study papers were produced for this plan.
- Forms available at committee meetings to register statements of "reservation or dissent" regarding ideas or recommendations discussed during the planning process.
- Direct coordination between the consultant and the each of the elective governing bodies.
- Meetings with the City Council and the Town Board.
- Public hearing on the semi-final plan draft.

The survey results became part of the basis for forming the goals and development alternatives for this Plan.

The *Issue & Opportunity Study Papers* were a vehicle to expose the planning committees and units of government to a wide variety of ideas about the nine planning elements with the intent of starting committee considerations of these planning elements. The Study Papers were a working tool to stimulate free-ranging discussions and present diverse visions of the issues and opportunities associated with the various planning elements. Within the context of these *Papers,* the ideas and feedback were not constrained by having to develop or agree on specific recommendations. No recommendations or policy directions were presented in these *Papers*. The overall intention was to help assure that interested citizens and local officials had opportunities for direct involvement in the evaluation of the planning subject matter and development of plan content. An additional intent of the Papers was to help assure that the final planning recommendations would be locally developed and supported, thereby helping to assure the value of the Comprehensive Plan and strengthening its chances of implementation.

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Section 1 - Issues and Opportunities Element

Goal of This Element:

To identify overall goals, objectives, policies, and programs of the local governmental units and to establish them as the guide for future development and redevelopment of the planning area. This plan is intended to look forward 20 years. It is a dynamic document and should be updated every 36 to 60 months, always looking twenty years into the future.

Goals:

General planning goals were produced with the aid of *Issue & Opportunity Study Paper No. A-2,* entitled: G*rowth Projections, Alternatives & Goals.* Specific planning goals for the individual planning elements are contained in Sections 2 through 9 of this Plan. The “general” planning goals for the City of Viroqua and Town of Viroqua planning area are:

- Maintain our “sense of place” as a small city/rural community. This community sense includes positive aesthetics, support and development of local business, a sense of community that ranges from the nurture of youth to the support of the elderly, and the preservation and communication of our history.
- Preserve our quality of life in changing times. We find quality in our slower lifestyle (quiet, low traffic, walkable city, slower pace, stars in the night sky, shade trees), neighborliness (knowing each other, seeing value in difference), high quality public services (health, education, civil government, cultural activities), and affordability.
- Create the conditions for Viroqua to be an increasingly successful economic, social and cultural hub of activity including the enhancement of health and wellness.
- Coordinate and cooperate with overlapping and neighboring units of government and institutions.
- Implement a plan that promotes the general health, safety and welfare, and the economic sustainability of the City and Town of Viroqua and the region, in general.
- Respect for property rights and protection of community rights.
- Protect and enhance natural resources, scenic landscape, a rural lifestyle and regional agriculture.
- Make access to community news, direction, ordinances, policies, and processes readily available to all citizens, as well as prospective citizens, investors, tourists, and developers.

Objectives:

- Support local businesses and new entrepreneurs to maintain and expand the role of the City and Town of Viroqua as a hub for the region.
- Cooperate and coordinate with public service providers (health, education, civil government, cultural activities).
- Provide community facilities that promote continuing education, community values and recreation.
- Safeguard the affordability of living in this area.
- Create government process and procedures that ensure fair dealing, and a structure that does not favor or discriminate.

- Review new developments for impacts on aesthetics, natural and historic uniqueness and beauty.
- Work cooperatively with neighbors and pursue the ethic of neighborliness when conflicts arise.
- For the City and Town of Viroqua to become an “elder-ready” community where transportation, shopping, social services and wellness facilities are conveniently accessible as the baby-boom population moves through their elder years.

Policies:

- To maintain a comprehensive planning process for the City and Town of Viroqua and maintain an up-to-date Comprehensive Plan which guides development.
- The City and Town of Viroqua will partner with public service providers in health, education, and cultural service providers to help in their success and create a more vital community.
- Implementation of “good government” standards by the City of Viroqua.
- Create an official city website that tells all there is to know about Viroqua.
- Integrate health and wellness considerations in all local governmental decisions concerning public services and infrastructure development.

Programs:

The overall program elements of Section 1 consist of the following:

- Conducting and evaluating citizen input surveys for the City and the Town.
- Developing, distributing and evaluating *Issue & Opportunity Study Papers* in which planning and development issues and opportunities are identified. These Study Papers do not contain recommendations, so as to facilitate an open consideration of a broad range of planning ideas and alternatives without having to take official positions on such ideas.
- Identification by the Cluster Planning Committee of general goals and alternatives (growth scenarios) for future development.

Planning and Development Issues and Opportunities:

Categories of planning issues and opportunities were identified for the Cluster A planning area in the *Issues & Opportunities Study Paper No. A-1*, which is provided in **Appendix B** of this Plan. The information provided in this study paper was presented to the Cluster A Planning Committee to initiate an overall discussion of issues and opportunities related to planning. This initial discussion became the basis for identifying more detailed issues and opportunities as the planning process progressed into the functional elements (Sections 2 to 9) of the Comprehensive Plan. No recommendations were presented or acted on during the discussion paper phase of the comprehensive planning process.

<u>City of Viroqua</u>
In addition to the general issues and opportunities identified for the whole Cluster A planning area (**Appendix B**), the City of Viroqua has identified the following additional issues and opportunities:

Issues:

- We are in a changing situation with regard to land values, agricultural patterns, subcultures, regional and global economic forces out of our control.

- City resources are challenged by our commitments to transportation projects and other infrastructure improvements.
- Local businesses are in difficult economic times, and potential pressures from a bypass or other external forces may force a percentage of them to close.
- Successful local businesses can be sold and moved by the larger corporate entity not connected to the Viroqua Community.
- Community divisions.
- Aging community.

Opportunities:
- Small town life is becoming a scarce resource. If we understand its value and work to protect and enhance it, we will have many opportunities to attract new talent and capital.
- We have local businesses to build on and partner with.
- We have a successful public service sector (health, education, civil government, cultural activities).
- We have an honest civil government.
- Our aging community provides wisdom and knowledge of history for the community.
- We are a stable community with many local multigenerational families.
- We have natural beauty and historical structures to protect and enhance.

Background Information:

Regional Growth Context

The Cluster A planning area is located near the center of Vernon County, Wisconsin. This area is fifty two square miles and consists of the Town of Viroqua and the City of Viroqua. **Map 1** locates this planning area within the context of the Central Vernon County Planning Group. A detailed map of the Cluster A planning area is provided in **Map 2**.

Previous Comprehensive Planning

A Vernon County *General Plan* was produced by a consultant 1969 as part of a regional comprehensive planning program of the Mississippi River Regional Planning Commission. This Commission is composed of representatives from seven counties. This regional General Plan has not been updated; however, the Mississippi River Regional Planning Commission remains an active regional planning organization and continues to deliver a variety of planning assistance to Vernon County units of government. There is no current comprehensive plan for the City of Viroqua or Town of Viroqua.

Regional Growth Factors

The region within which the Viroqua area functions is composed of the following influences which significantly affect the area's growth outlook and the need for planning; these influences include:
- As a county seat community Viroqua is a governmental services center.
- Area is a sub-regional economic center, particularly for jobs and retail trade.
- The continuing health of the local and regional manufacturing sector.
- An agricultural service center.
- Good accessibility via Highway 14/61, classified as a Principal Arterial State Highway.
- Additional transportation assets include State Highways 56, 27, and 82 and a city airport.

- Within the labor shed commuting zone of the La Crosse metro job center.
- Center of a K-12 secondary school district, and the Waldorf school system.
- A complete range of municipal infrastructure.
- A sub-regional center for health and elder care.
- A sub-regional cultural center.
- In the center of a unique Midwest driftless landscape which provides a scenic location for housing, recreation and vacationing; see **Map 3**.
- A significant future growth factor of regional importance will be the expansion of Highway 14/61 between Viroqua and Westby and the later construction of a new by-pass of this highway east of the City of Viroqua.

The central implication and conclusion from the above regional characteristics is that the Viroqua area is well positioned for future growth. While the area has the essential ingredients to attract and support growth, these factors, by themselves, will not assure that growth will occur throughout the twenty year planning period.

A complete positioning for continued growth has two major requirements, one which this Plan can deal with and one which it cannot. These requirements are:

1. Combining the above regional growth influences with the other essential components of a comprehensive development plan; the balance of this Comprehensive Plan will satisfy this requirement.

2. The pre-conditions for growth, which this Plan cannot deal with, are the political and other institutional values and goals which determine what degree of growth is desirable; and, if desirable, how effectively it is pursued over a period of time. Growth in this planning area will also be effected by the degree of competition for growth from other communities within the region. This will be determined, in part, by the larger economic forces beyond local control, but also by how effectively local strategies tap these larger economic and cultural forces for local benefit.

Population Growth

A community (city/town) plan covering a twenty year period contains a projection of future population levels. Such population levels are not “predictions” of a hard-and-fast population that will be reached, but rather, represents a population growth level based on “assumed” conditions. Ideally, the assumed conditions are based, in part, on the development alternatives and goals the community adopts for itself. Other conditions may be the recognition of national, state and local conditions the community has no significant control over.

There is no scientific method of accurately projecting future population levels. Some methods are simple straight-line projections of past population levels. Other methods project future population based upon the “holding capacity” of developable land within a planning jurisdiction. Yet other methods are based on an economic development multiplier in which new jobs are projected, and from which a household or population equivalent is then multiplied. And, some communities have simply set an idealized future population goal (or limit) and then plan to do whatever is necessary to reach that population level.

State Population Projections

An obvious first step which the Cluster A community can take is to look at the pre-existing population projections available from the Wisconsin Department of Administration (DOA). These projections are made by five year increments to the year 2020. Their projections are based on what they call the "cohort component" method. According to the DOA, this method, "relies on historic data on births, deaths and migration to established base rates that are then adjusted based on higher level, (i.e. nation-to-state, state-to-county) projections of changes in these rates". State projections generally are designed to fit within national population projections. The DOA further states that their "methodology does not take development capability into account". This also means that their projections do not take into account the changing competitive advantages between communities, changes in housing preferences, and the access advantages of highway improvements. These state projections are basically not designed to be the basis for local planning and development programs, but rather amount to the allocation of population across the state from a fixed state total.

The state DOA projections for the City of Viroqua and Town of Viroqua are as follows:

	Year				
	2000*	2005	2010	2015	2020
City of Viroqua	4,335	4,432	4,538	4,646	4,745
Town of Viroqua	1,560	1,620	1,683	1,747	1,807

*Actual year 2000 US Census count; DOA estimates for 1/1/03 are 4,340 for the City and 1,599 for the Town.

State projection summary

City of Viroqua growth:	2000 to 2020	is	9.45%, or	410 persons,	20 persons per yr average
Town of Viroqua growth:	2000 to 2020	is	15.83%, or	247 persons,	12 persons per yr average

The above state projections are not consistent with actual growth trends and opportunities which presently characterize the City and Town of Viroqua planning area; however, this projection will constitute a conservative population growth scenario (alternative) for this planning cluster.

Population Projections

Selected Population Projection Scenario And Methodology

An important factor in projecting population growth is the interrelationship between the development capability of the planning area, the economic outlook for the area, ease of access and the living preferences of the population; in short: good land, jobs, highways and sociology. These factors are described below.

Good Land

In general, the lands available to the City and Town of Viroqua are free of any significant limitations to development, and there is an ample quantity of open lands available. No judgment is made here about governmental inducements or restrictions that could affect the amount of land that would actually be developed.

Jobs

Jobs are a principal foundation of population growth in most communities. This planning area can reasonably expect job growth from within the planning area and from the La Crosse metropolitan area. Viroqua is a county seat community and has the critical mass of services and infrastructure that will lead to continued job growth. A clear pattern of commuting out of this planning area to La Crosse area jobs has already been established and can be expected to continue. The convenience of commuting will contribute to local population growth. The increasing ease, and occasional necessity, of industry (jobs) to move to more profitable locations is an important uncertainty in projecting community and regional growth.

Highways

The City and Town of Viroqua already have very good accessibility to the La Crosse metro area via U.S. Highway 14/61, and this highway is scheduled for significant improvement in both Vernon and La Crosse Counties. Such improvements in accessibility can be expected to induce new growth.

Sociology

The preference of the public for home locations has a direct bearing on where population will be growing. A growing national preference is for rural, open space living. There are many social, economic, and technological reasons for this. Cities still remain the primary job centers; however, a large proportion of the urban labor force is increasingly choosing to reside within twenty to forty miles of their jobs, with population concentrations tending to locate in the nearest rural communities and on scenic rural lands near major highways. Numerous institutional studies and academic research has documented this pervasive trend. This population settlement pattern is evident within the commuter shed of the La Crosse metro area, and is evident within Cluster A planning area. While this trend has been going on for some time, it is believed that it has manifested itself in a significant way in Cluster A since about 1990, since the year 2000 U. S. Census has shown a clear turn-around in population growth for many units of government within this planning area during the decade of 1990 to 2000. Such recent patterns would not be reflected in historic population trends.

Assumptions

Projections of any future conditions are based on assumptions about the future. The projections of future population levels for this planning area incorporate the following basic assumptions about the future:

- The national and state economy will continue to experience relative growth and stability.
- Absence of destabilizing economic or energy problems.
- The regional economy, and particularly the La Crosse area economy, will remain healthy with continued growth.
- The City of Viroqua and the Town of Viroqua will remain receptive to growth.
- The capability will be available to finance the infrastructure required to attract and maintain growth.

- The Viroqua area will remain competitive for growth with other rural communities in the La Crosse commuting region.
- The regional agricultural economy will not experience any radical financial down-turns of a long-term nature, although continued economic stress and restructuring in this industry should be expected.

A population growth scenario for Cluster A that would be more likely than the above DOA projections would be the pattern of growth of 1990-2000, but within the framework of the above general assumptions.

The selected methodology for this plan takes the population growth rate of the total of the city and town populations for the decade of the 1990's (8.74 %), and applies it as the rate of growth for the years 2010 and 2020, with each of these two growth projections divided in half for the years 2005 and 2015. These figures function as a control total for the total planning cluster. This control total is then allocated to the City and Town in the same proportion that each unit had of the year 2000 total cluster area population; the city had 73.54 % and the town had 26.46 % of the year 2000 cluster population. This methodology uses year 2000 population proportions as documented by the U.S. Census Bureau to establish these future local jurisdictional populations. No additional assumptions or methods are used regarding which jurisdiction has how much population in future years.

The following calculation illustrates this methodology and produces population projections for the years: 2005, 2010, 2015, and 2020.

Selected Population Projection

	Population			% of "total" yr 2000	Projections			
	1990	2000	% growth	population	2005	2010	2015	2020
City of Viroqua	3,922	4,335	10.53	73.54	4,525	4,714	4,920	5,126
Town of Viroqua	1,499	1,560	4.07	26.46	1,628	1,696	1,770	1,844
Total	5,421	5,895	8.74	--	6,153	6,410	6,690	6,970

Summary of Population Forecast, 2000 to 2020

City of Viroqua	791	new persons or	18.24% = 40	persons per year average
Town of Viroqua	284	new persons or	18.20% = 14	persons per year average
Total Cluster A:	1,075	new persons or	18.23% = 54	persons per year average

It is important to keep in mind, that net new growth, as indicated above, is only that growth that is realized after deaths are accounted for and after out-migration of existing residents is accounted for. It's questionable if new births will counterbalance deaths during this period; and the size of the out-migration of the increasingly large number of retirement age persons will become an important factor in future population levels. Incentives for population growth may be necessary to achieve the above population growth.

While the planned highway bypass in this planning area may serve as an unusual inducement to growth, it is not planned to be in service until about half way into the planning period, so highway related growth would likely not be fully realized until after 2020. However, this plan is required to be reevaluated every ten years, or otherwise as needed, so these population projections would be reevaluated based on the actual growth effects of the bypass and other significant changes affecting growth projections.

Household Projections

Household projections are a direct product of population projections. Census figures report that the City of Viroqua had a person per household ratio of 2.10 in 2000, down from 2.14 in 1990 and 2.22 in 1980. In 2000, and the Town of Viroqua had 2.64 persons per household, down from 2.83 in 1990.

The county and state average household size in 2000 was 2.55 and 2.50 respectively. Household size has been declining due to families having fewer children and because of the growing number of young and elderly single person households. Household size does not include people in "group quarters", such as a health facility or jail. In 2000, the City and Town of Viroqua had 163 and 110 persons in group quarters respectively.

The projection of the number of future households for planning Cluster A assumes the continuation of the year 2000 household sizes for both the City and Town of Viroqua. It will be important for the ten year Comprehensive Plan updating to reevaluate household size factors based on updated numbers from the 2010 U.S. Census. Provided below are the household projections for this Plan, which are produced by dividing the population projections of the second growth scenario reported above by the year 2000 household sizes for both the city and the town.

Household Projections

	Household Size	2000*	2005	2010	2015	2020
City of Viroqua	2.10	1,990	2,155	2,245	2,343	2,441
Town of Viroqua	2.64	549	617	642	670	698
Total Cluster A	--	2,539	2,772	2,887	3,013	3,139

*Actual Census

Projected new households for the period 2000 to 2020:

City of Viroqua	451	new households or	22.6%	= 22.5 households per year average
Town of Viroqua	149	new households or	27.1%	= 7.5 households per year average
Total Cluster A	600	new households or	23.6%	= 30.0 households per year average

Employment Characteristics

See Section 6: Analysis of Economic Base & Labor Force

Employment Projections

Forecasting employment with any practical degree of reliability cannot be done for a small scale planning area such as Cluster A. The basis for this was addressed in *Issue & Opportunity Study Paper A-1*. The basic reason for this uncertainty is because this planning area functions within a much larger regional economy in which job types and locations affecting the Viroqua area are dispersed within this larger region. About half of all jobs in this planning cluster are held by persons commuting into this area, conversely, increasing numbers of cluster area residents are commuting to jobs outside this area, particularly to the La Crosse metro area. Reasonable employment projections can only be made for larger geographic areas, and even then, the amount of instability and change in the agricultural and industrial sectors due to national and global economic adjustment trends would cast considerable doubt on the reliability of any such long range projections. The smallest geographic area for which employment forecasts could be ventured would be the county unit; however, neither Vernon County nor La Crosse County have completed such forecasts. The economic sectors affecting future employment in the Cluster A which should be watched and continually evaluated include: agriculture, public services, medical/health and the local and La Crosse area industrial economies.

Age Distribution

The year 2000 age distribution within Cluster A is provided below along with geographic comparisons. The 85+ age range is reported separately because this is one of the fastest growing age groups. The population pyramid attached hereto illustrates Viroqua's significant elderly population compared to county and state levels.

Geographic Area	Under 18	%	18 to 65	%	65+	%	Total	%	85+	%	Median Age
City of Viroqua	1,029	23.7	3,060	70.6	1,137	26.2	4,335	100	246	5.7	43.6
Town of Viroqua	354	22.7	926	59.3	280	18.0	1,560	100	48	3.1	42.6
Vernon County	8,423	27.4	14,864	55.6	4,769	17.0	28,056	100	713	2.5	39.1
Wisconsin	--	25.5	--	61.4	--	13.1	--	100	--	1.5	32.9
United States	--	25.7	--	61.9	--	12.4	--	100	--	1.5	35.3

Income Levels

See Section 6, Analysis of Economic Base and Labor Force

Educational Levels

Basic U. S. Census educational data is reported here; the local school district is the primary source of other, more detailed educational data relevant to this planning area. The year 2000 U.S. Census data on school enrollment is not reported here because it would be considered obsolete, particularly since the school district maintains current enrollment data on an annual basis.

Educational Attainment -- % of population 25 years old and older	City of Viroqua	Town of Viroqua	Vernon County	State of Wisconsin
Population 25 yrs and older:	3,065	1,039	18,473	--
Less than 9th grade	12.0%	10.0%	11.5%	9.5%
9th to 12th grade, no diploma	10.5%	8.8%	9.6%	11.9%
High School graduate (includes equivalency)	37.8%	37.6%	38.5%	37.1%
Some college, no degree	19.1%	17.1%	18.8%	16.7%
Associate degree	5.6%	10.3%	7.6%	7.1%
Bachelor's degree	9.6%	9.9%	9.4%	12.1%
Graduate or professional degree	5.4%	6.3%	4.5%	5.6%
Percent high school grad or higher	77.5%	81.2%	78.9%	85.1%

Summary Demographic Trends

In general, the population of the City and Town of Viroqua planning area is largely urban, with 73% of the year 2000 combined population being within the City of Viroqua. The median age of the city and town population is about the same, but higher than county, state and national median ages. The city has a higher proportion of elderly population, 65+. The city's 85+ age population is significantly higher (5.7%) than that of the town, county, state and nation. This would be due to the concentration of elderly in institutional housing in the city and the presence of single person housing units and closeness of personal services.

Under present housing development patterns, the Town of Viroqua may end up with a younger population than the city. The educational attainment of the residents of the city and the town are quite similar. Most of the population of both the city and town is employed in white-collar jobs, with local educational, governmental and heath institutions providing most of this employment. Manufacturing and retail trade are also important sources of employment, focused mostly in the City of Viroqua.

Demographic trends indicate that the elderly component of the population will increase significantly in the next twenty years, and that there may be pressures to maintain an adequate size working age population depending on the magnitude of local population recruitment in this age category. Trends also indicate continued growth in white collar employment, and the likely continuation of employment losses in the agricultural sector.

Health and wellness concerns will become more important public policy concerns for all segments of the population, particularly the growing elderly component. Wellness facilities will become more important, including greater opportunities for youth, middle age and senior citizen outdoor activities.

APPENDIX D

Receiving Stream Investigation Report

PRELIMINARY STREAM REPORT

City of Viroqua, Wisconsin

July 2014

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PRELIMINARY STREAM REPORT

City of Viroqua, Wisconsin

July 2014

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Appendices

Appendix A – WWTF Effluent Study
Appendix B – LiDAR Information
Appendix C – Stream and Facility Testing Data

Introduction

The City of Viroqua Municipal Waste Water Treatment Facility (WWTF) discharges treated effluent to the headwaters of the Springville Branch of the Bad Axe River, approximately 2.75 miles upstream of the Springville Spring. The 2007 Effluent Outfall Investigation prepared by Davy Engineering suggests that about 83% of the stream flow is lost between the WWTF discharge point and CTH B culvert to the west of Miller road, which is about 1,300 feet upstream of the spring. According to the Wisconsin Department of Natural Resources, this loss in stream flow results in WWTF effluent being discharged to groundwater. The Wisconsin Department of Natural Resources (WDNR) has issued a new permit for the Viroqua WWTF that requires preparation of a Facilities Plan Phase 1 that addresses discharge of effluent to the Springville Branch of the Bad Axe River. The WDNR requires this facilities plan to compare options associated with continued discharge of effluent to the stream at its current location with relocating the discharge to beyond the fractured bedrock.

Site Inspection

On August 19, 2013, Ben Heidemann and Andy Jacque of Town & Country Engineering inspected a portion of the headwaters of the Springville Branch of the Bad Axe River to assess areas where the stream could be losing flow. Water quality data for grab samples taken while walking the stream are shown in Table 1. Most data were gathered using YSI Professional Plus handheld multi-parameter meters. Total phosphorous was determined by the WWTF operator using a HACH TNT total phosphorous reagent kit for a HACH DR 3900 spectrophotometer. The physical location for point numbers identified in Table 1 are shown in the attached map in Appendix A, titled “WWTF Effluent Study”, which also contains notes from the stream inspection. A discussion of observations follows.

Table 1. Water Quality Data

Point Number	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen, % Saturation	Specific Conductance (µS/cm)	Nitrate (mg/L)	Total Phosphorous (mg/L)
1	11.0	8.94	86	572	10.8	0.137
2	10.8	9.12	86	576	8.33	-
3	9.7	8.43	78	539	7.74	0.068
4	21.0	15.95	185	864	16.5	0.923
5	20.1	17.17	196	933	19.3	-
6	20.0	9.87	113	946	20.5	-
7	20.0	10.1	114	947	20.6	-
8	20.2	10.03	115	944	20.75	-
9	20.1	10.73	123	931	22.4	-
10	19.8	12.38	141	921	19.84	-
11	19.3	14.58	165	889	22.36	-
WWTF	-	-	-	-	-	2.84

Point #1 and #2. The location of each is about 100 feet down stream of the spring, and represents mixing conditions of the spring with WWTF effluent. Brook and Brown Trout were present. The stream consists of exposed bedrock. Data in Table 1 represent mixing of the spring with WWTF effluent.

Point #3. This location is just downstream of the spring discharge structure, and represents spring flow only (see Figure 1).

Figure 1. Picture of the spring structure on the Springville Branch of the Bad Axe River. Area to right shows the waterway upstream of the spring.

Point #4. This location was just upstream of the spring, and represents conditions just prior to the spring (Figure 1). No fish were seen upstream of this point. All data upstream from here showed photosynthetic activity where dissolved oxygen was present above the saturation limit.

Point #5. At this location there was a noticeable increase in flow. The area immediately west of this point had a gravel bottom with minimal algae, whereas the area to the east (upstream) contained considerable algae (Figure 2). The upstream area had a higher specific conductance and higher nitrate concentration. Depth was about 6 to 12 inches. The data suggest that the area with the gravel bottom remained clear because it was receiving groundwater discharge (a secondary spring).

Figure 2. Stream in the vicinity of Point #5. The left picture is looking east; right picture is looking west.

Point #6. This portion of the stream is located along the south side of CTH B, and was identified as having a swallet in the Davy Engineering study. The exposed stream bank and adjacent outcrop in the vicinity of Point #6 showed considerable horizontal and vertical fracturing (See Figure 3). There is about 400 feet of stream that could have fractured bottom and thus could be losing flow to groundwater. Compared to pictures in the Davy study, stream depth conditions were greater during the Town and Country inspection, which suggests less stream flow loss to groundwater. This observation suggests there could be variability in stream loss depending upon weather and groundwater conditions, where high groundwater conditions could lead to less stream loss (wet year) and low groundwater conditions could lead to more stream loss (drought year).

Figure 3. Stream bank in the vicinity of Point #6 showing fractured bedrock.

Point #7 and #8. The stream bottom, exposed stream bank and adjacent outcrop in the vicinity of Point #7 and #8 showed considerable horizontal and vertical fracturing (See Figure 4). There are two adjacent stream areas that could have a fractured bottom and thus could lose flow to groundwater (about 400 feet long). Fluorescent dye introduced just above the stream bottom appeared to hold at the bottom and slowly disappear into the streambed.

Figure 4. Stream bank in the vicinity of Point #7 showing fractured bedrock.

Point #9. This section of stream consisted of a fractured bedrock stream bed (about 200 feet long). The location is to the east of the electric fence running across the stream.

Point #10. This location is at the lower end of Reach 3 (Davy study). The stream was relatively deep upstream and downstream of this location compared to other sections of the stream.

Point #11. This location is in the middle of Reach 2 (Davy study). The stream had a firm clay bottom and relatively shallow depth of flow.

General Observations

There appears to be a correlation between deep flow sections of the stream (greater than 3-feet deep) and lineaments from LiDAR data (see attached LiDAR map in Appendix B). The lineaments, which appear on the LiDAR image as a distinct linear feature (possible fault), appear to cross the stream in areas where the stream was observed to be deeper. The lineament that intersects at the swallet also appears as crushed bedrock in the east wall of the quarry immediately to the north of the stream. Crushed bedrock was seen along the stream by the swallet. These observations suggest that deeper flow depths in the stream may represent partial collapse of the geology below the stream, which could indicate areas were the stream is losing flow to groundwater. In addition, the deeper stream areas appear to correlate with sections of the stream that were identified as losing flow in the Davy study. This observation suggests there are six separated sections along that stream that could be losing flow to groundwater, each varying in length from 200 to 400 feet long.

The Precambrian bedrock in the vicinity of Viroqua has a south-southwesterly slope (see LiDAR map and Figure 5). The Springville Spring is located where the Oneota dolomite thins or is fractured to expose the Jordan sandstone below, which is under artesian pressure. Assuming the Jordan sandstone follows the slope of the Precambrian surface, flow loss in the stream would likely enter the Jordan and flow in the general slope direction of the Precambrian. Fractured areas along the stream are likely located at a higher elevation where the artesian pressure is lower than the stream bottom, which allows flow to leave the stream.

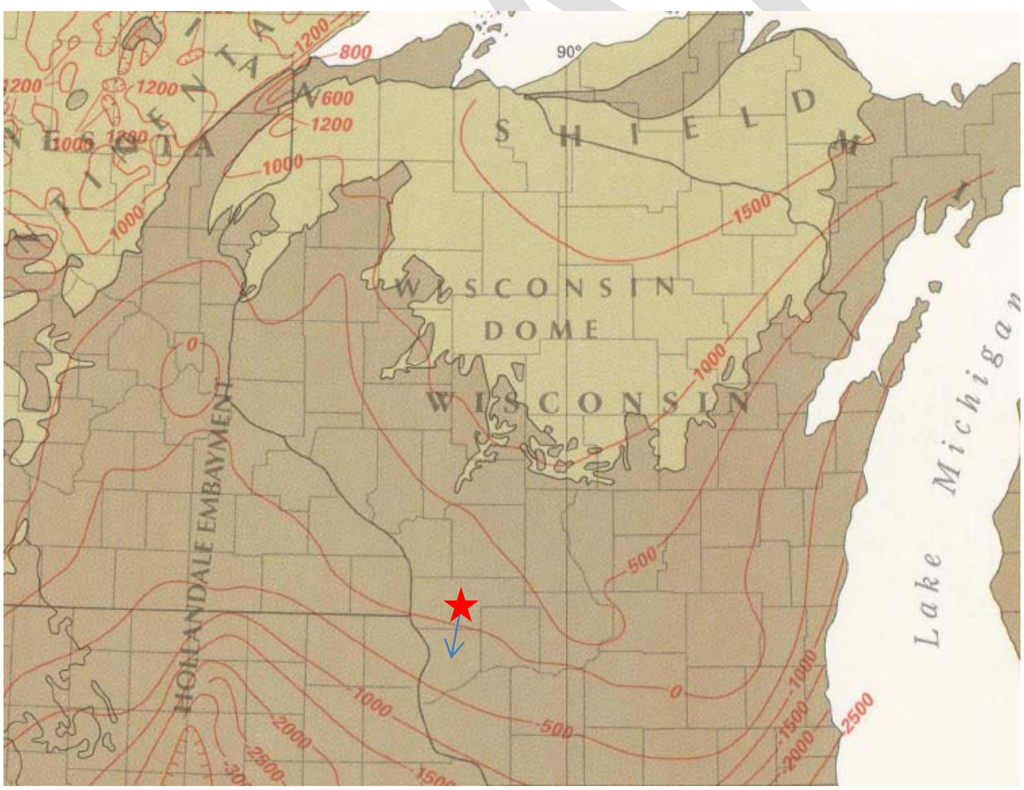


Figure 5. Contour map showing the Precambrian bedrock surface in Wisconsin (from Segment 9, Groundwater Atlas of the United States, Hydrologic Investigations Atlas 730-J). The "star" indicates the location of Viroqua, and the "arrow" shows the slope of the Precambrian surface and assumed groundwater flow direction in the Jordan Sandstone Aquifer.

Davy Engineering Study

The 2007 Effluent Outfall Investigation prepared by Davy Engineering suggests that the Springville Branch of the Bad Axe River upstream of the spring losses about 83% of its flow to groundwater. This conclusion was based a single day analysis of flow conditions in the stream, on data gathered from 12 pm on September 14, 2006 to 12 pm on September 15, 2006. While the study appears to show loss of flow, it may not represent average conditions in the stream. In other words, one datum point may not adequately represent conditions within the stream, conditions such as high groundwater during winter and spring (less stream loss) or year to year fluctuations in climate (drought versus excess rain).

The USGS gage for the Kickapoo River in Lafarge suggests 2006 was a dry year, with a base flow condition of about 120 CFS in September of that year (see Figure 6).

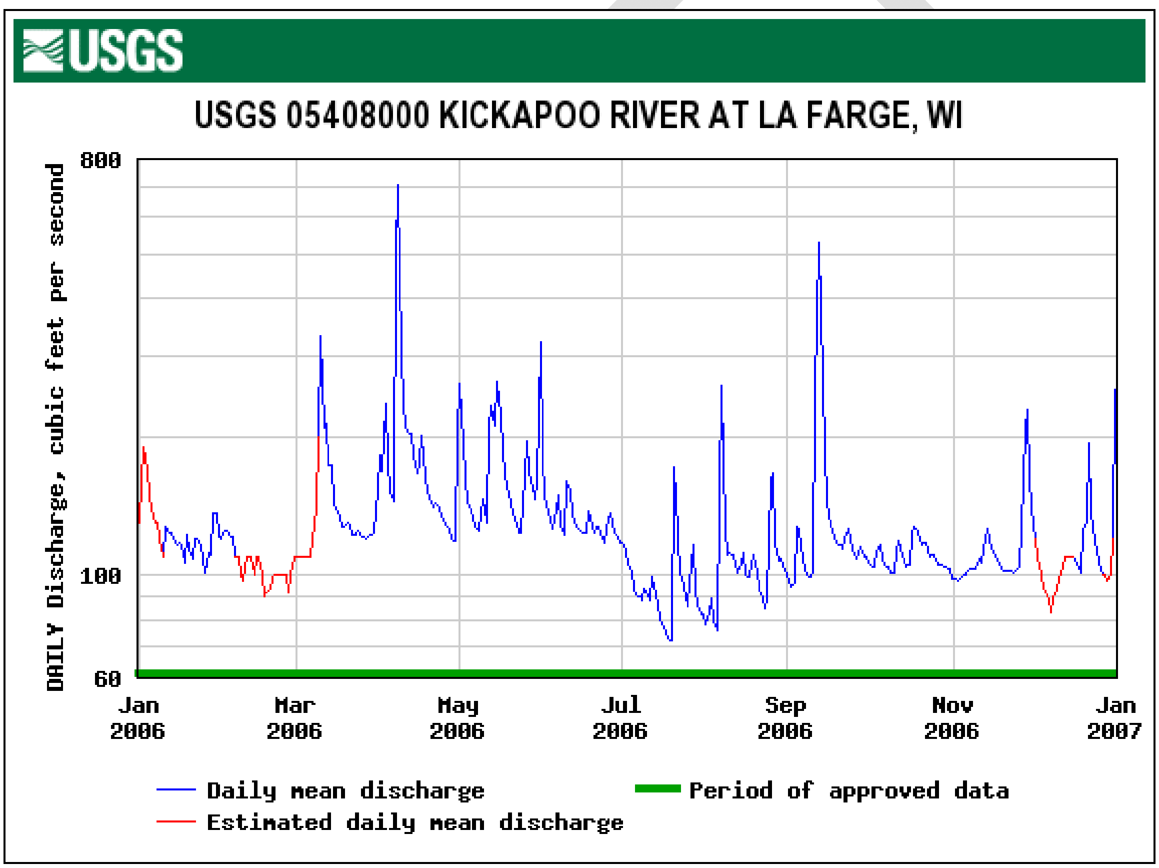


Figure 6. Flow data from the Kickapoo River at Lafarge Wisconsin for the year 2006.

For comparison, base flow in the Kickapoo River was about 190 to 200 CFS in September of 2008 (wet spring, see Figure 7), and 110 to 120 CFS in September of 2012 (year of drought, see Figure 8). Based on this information, the Davy study results are more representative of drought conditions in the stream, which suggests flow loss

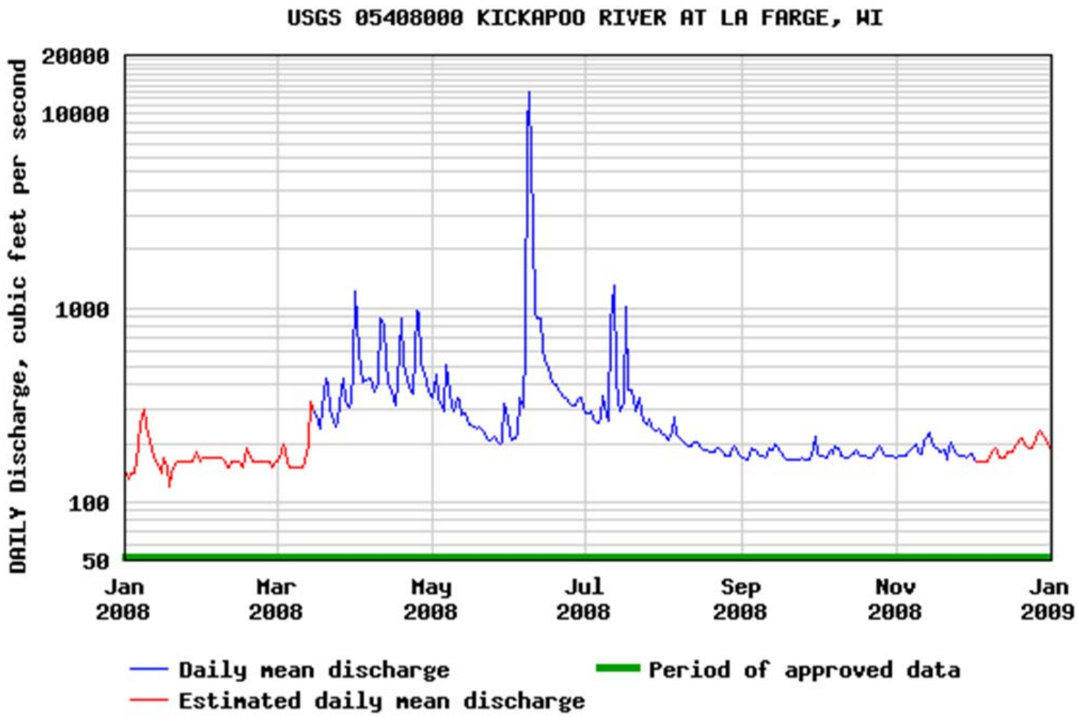


Figure 7. Flow data from the Kickapoo River at Lafarge Wisconsin for the year 2008, which was a wet year.

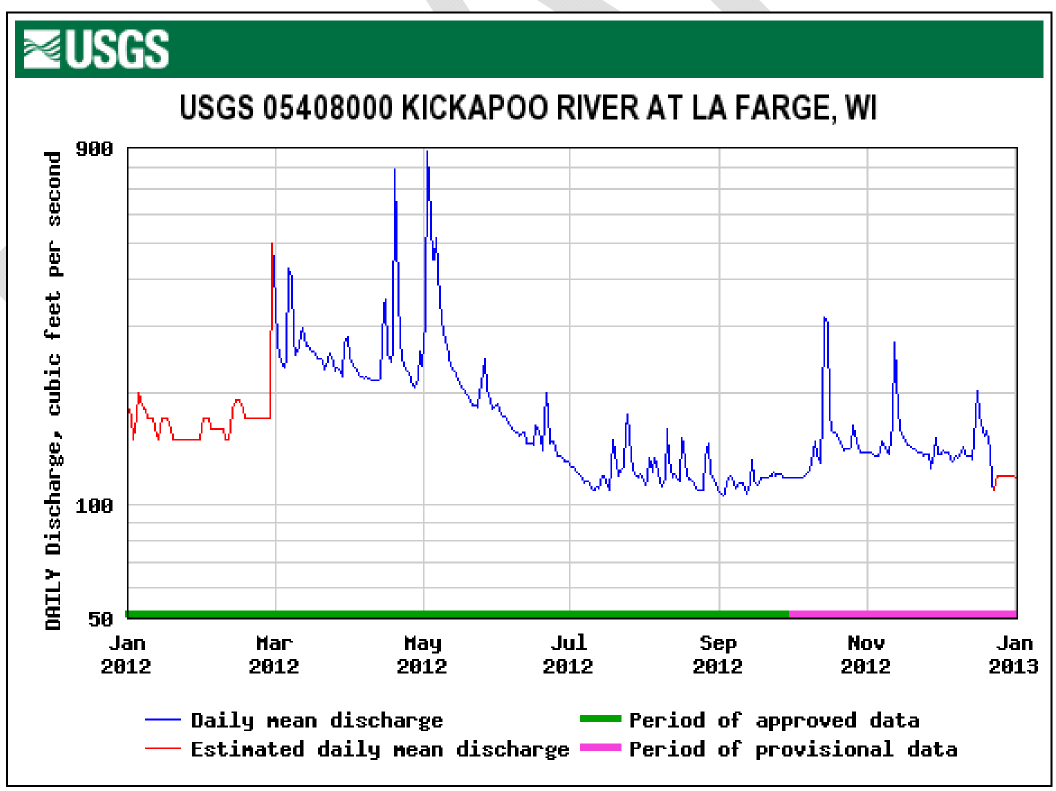


Figure 8. Flow data from the Kickapoo River at Lafarge Wisconsin for the year 2012, which was a drought year.

on the Springville Branch of the Bad Axe River upstream of the spring, on average, is considerably less than 83%.

If a loss of flow is occurring along the stream bed, it's very difficult to determine the percent of this loss at any given time. It can be reasonably assumed that any flow loss will vary depending on the time of year, groundwater levels, and stream flow conditions. Perhaps rather than trying to determine how much, if any, flow is being lost, it may be more beneficial to determine how the wastewater treatment facility discharge could impact the water quality of the receiving stream and potentially the groundwater.

Water Quality Testing

City staff has collected water samples upstream and downstream of the wastewater treatment facility's outfall and have had them tested for three of the contaminants relevant to drinking water standards. These include fecal coliforms, chlorides and total nitrogen. These test results can be compared to the facility's discharge water quality to provide insight into the potential impact the facility has on the overall water quality of the stream and groundwater.

Water collection sampling was done approximately 50 feet upstream of the outfall pipe, 250 feet downstream of the outfall, and at the bridge where the stream crosses under County B. Results from this testing are provided in Appendix C of this report.

Wastewater Treatment Facility Impacts

The discharge from the Viroqua WWTP combines with other surface water runoff to result in the total stream flow in the Springville Branch. If there was no stream loss the water quality standards set for the facility discharge would be regulated by typical receiving stream standards. Because there's the potential for loss to groundwater, the total water quality of the stream should be evaluated to determine what can and should be done to minimize the impact to groundwater.

Stream flow testing results for fecal coliforms indicates a wide variation in stream water quality. Minimum and maximum values for the stream are significantly impacted by the amount of surface runoff from adjacent properties and on the presence of animals in the stream. Average test results indicate the water quality from the facility being on the order of ten times better than normal stream quality. It would be logical to assume that this comparison would be even more pronounced if testing were done when animals were in the flow.

Chloride concentrations from the treatment facility are shown to average about 180 mg/L. This compares relatively close to average stream flow concentrations, although at any specific time one could be slightly higher or lower than the other. Surface runoff from pavements will have a significant impact on intermittent water entering the stream.

Total nitrogen loadings from the facility are shown to be higher than the stream flow in general. Typically the total nitrogen discharging from the facility will be mostly nitrates with low amounts of TKN.

Phase 1 Facilities Plan Options

The following options are available for addressing the losing stream in the facilities plan.

Option 1 – Maintain existing stream discharge with improved treatment.

This option involves continued discharge of effluent at its current location. For this option, the new WWTF permit may require a combination of receiving stream and drinking water standards to include effluent discharge limits of 0.43 mg/L total phosphorous, 10 mg/L total nitrogen, year-round disinfection, and chloride limits of less than 250 mg/L. To obtain the phosphorous and nitrogen limits, plant optimization will be required. The City would request an exemption from a zero fecal limit because even now the water quality of the facility discharge is significantly better than the receiving stream on any given day.

The phosphorous limit that recognizes 80% loss of flow to groundwater, assumes a spring phosphorous concentration of 0.054 mg/L based on nearby Hornby Creek, and a spring flow of 3.1 cubic feet per second. A more detailed study of the stream may show that there is less loss on average, which could result in more flow reaching the spring and thus a lower effluent phosphorous limit. The loss value used matches with low flow periods, which is the basis of permit limits. The background phosphorous level of Hornby Creek (0.052 mg/L) matches a 3/31/2010 sample obtained from the Springville Spring, which was 0.054 mg/L as P. The final assumption of percent stream loss will have an impact on this limit.

The chloride limit of 250 mg/L is perceived to be difficult to meet under all conditions. The stream chloride concentrations will be affected by surface runoff conditions which can have a greater impact than the discharge from the treatment facility. The City will request a variance to allow it to minimize chloride discharge impacts and not be held to the absolute limit of 250 mg/L. As seen in the testing data, stream conditions without discharge from the facility have periods that are higher than this limit.

The following alternatives include design for eliminating or minimizing the amount of flow across identified areas of potential stream loss. Sealing or bypassing the swallets will be difficult, and may introduce riparian rights issues that will be difficult to address. Construction of these alternates will require easements, and in some cases will adversely affect the local farmers' watering rights for their livestock. These factors must be considered when reviewing the alternatives.

Option 2 - Pipe effluent from WWTP to spring.
This option would involve piping of all WWTP effluent past the losing stream sections, discharging to the culvert at the intersection of CTH B and Miller Road. For this option, the new WWTF permit would likely require effluent discharge limits of 400/100 ml fecal (May to September), 0.15 mg/L total phosphorous (estimate), 14 mg/L BOD, and disinfection from May to September. To obtain the phosphorous and BOD limits, plant optimization and enhanced filtration may be required.

It is important to note that this option may face opposition from riparian owners because of loss of use of the current stream. There are a few homes along the stream that could claim loss of recreational use and/or loss of land value due to reduction/elimination of flow. In addition, there are four areas of apparent livestock use along the stream where animals use the stream for a water source.

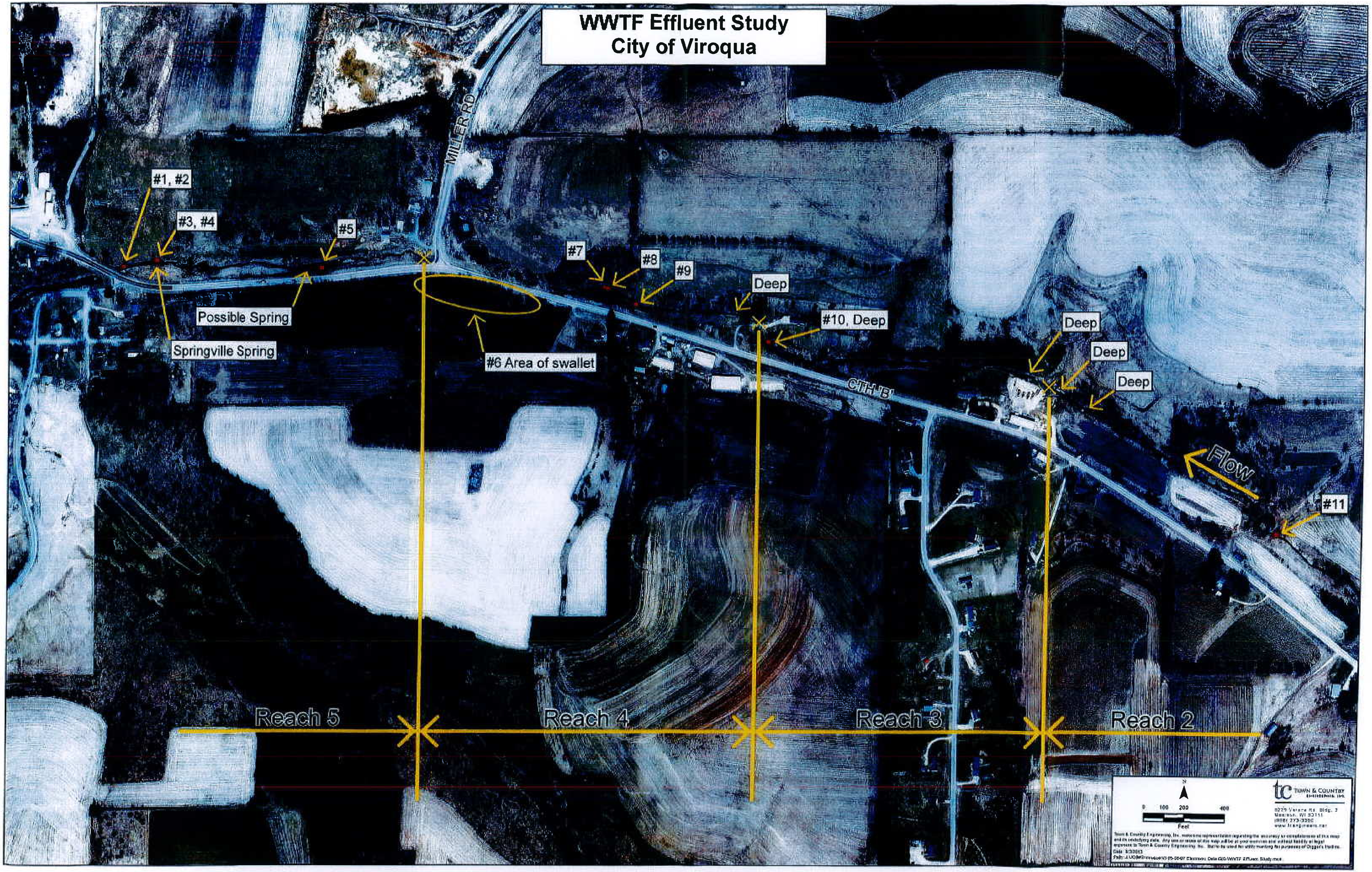
Option 3 - Grout stream bottom.
This option would attempt to seal the stream bottom by injecting grout into fractured bedrock below the stream. For this option, the new WWTF permit would be the same as for Option 2. While this would likely be acceptable to riparian owners, it is difficult to determine whether this would be successful and how much it would cost because of unknown subterranean conditions. This option could be a possible compromise provided that a 100% success rate is not required.

Option 4 - Line stream bottom.
This option would attempt to seal the stream bottom by installing a membrane liner in the stream. For this option, the new WWTF permit would be the same as for Option 2. Issues with this option include longevity of membrane and potential for damage caused by burrowing animals.

Option 5 – Low-flow bypass of losing areas in-channel.
This option would involve construction of in-channel controls and piping to divert low-flow periods past areas of the stream that lose flow. For this option, the new WWTF permit would be the same as for Option 2. This option would require riparian owner agreement, temporary easements for construction, and possibly land acquisition and/or permanent easements. There may be riparian opposition to this option, similar to those noted for Option 2.

Appendix A

WWTF Effluent Study

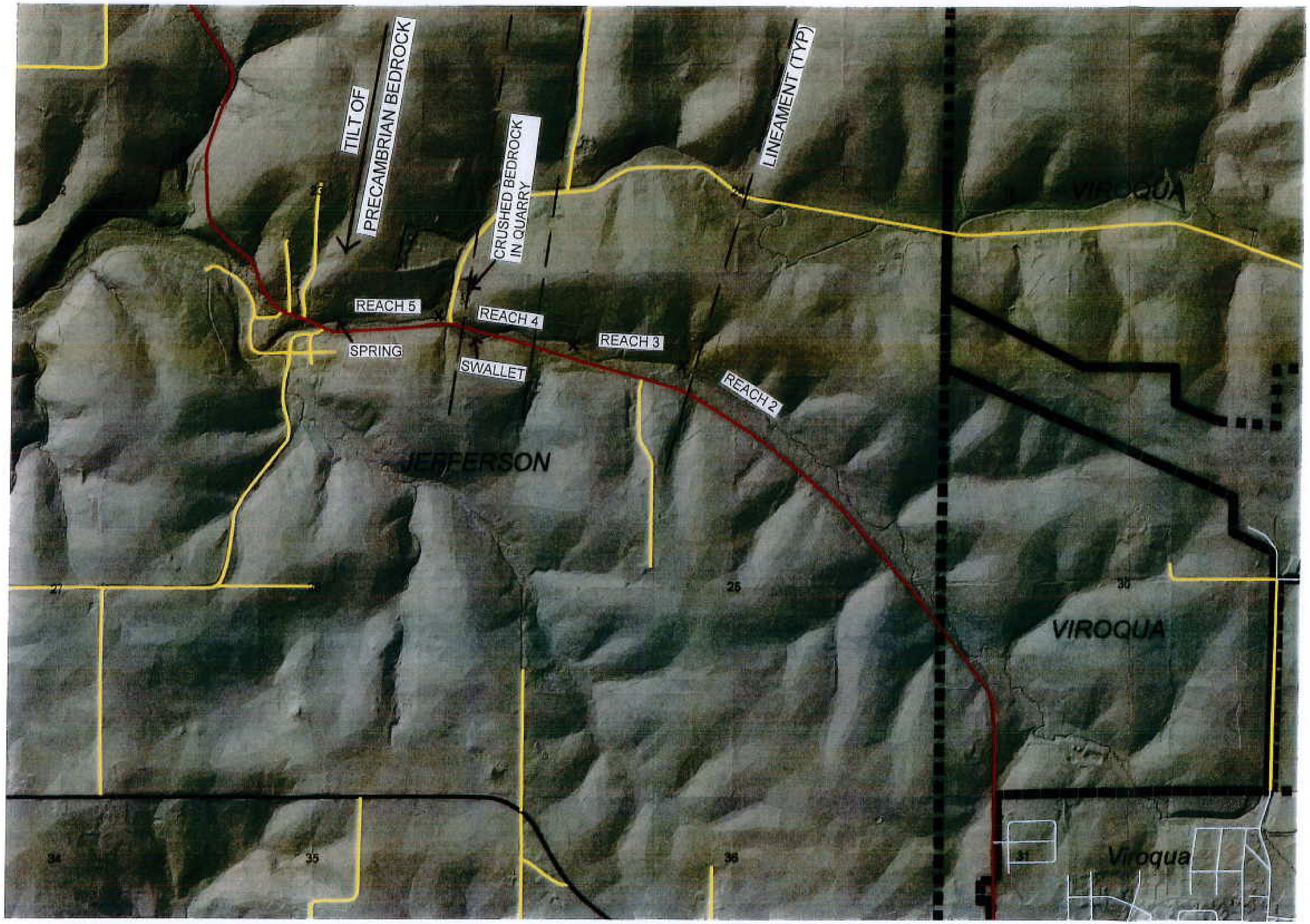


WWTF Effluent Study
City of Viroqua
MILLER RD
#1, #2
#3, #4
#5
Possible Spring
Springville Spring
#6 Area of swallet
#7
#8
#9
Deep
#10, Deep
Deep
Deep
Deep
CTH 'B'
Flow
#11
Reach 5
Reach 4
Reach 3
Reach 2
N
0
100
200
400
Feet
TOWN & COUNTRY

Appendix B

LiDAR Information

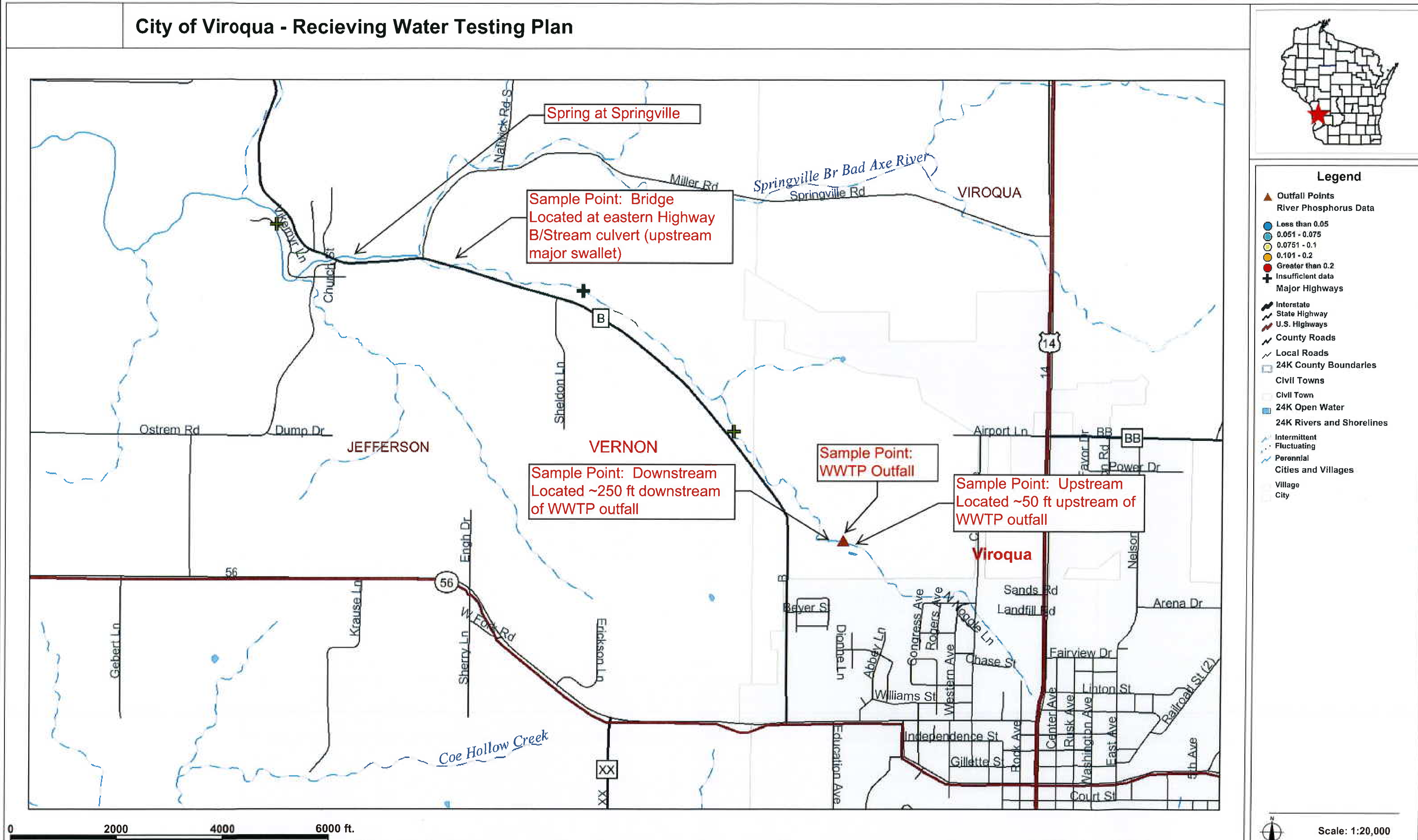
VERNON COUNTY – LiDAR



Appendix C

Stream and Facility Testing Data

City of Viroqua - Recieving Water Testing Plan



This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

City of Viroqua
Stream Testing - **Chlorides**

Date	Location				Weather	Notes
	Upstream	WWTP	Downstream	Bridge		
10-Sep-13					Hot 80F, drought	low flow
17-Sep-13					55 F	very low flow
24-Sep-13					60 F	low flow
1-Oct-13					68 F	very low flow
8-Oct-13					54 F, Sunny	very low flow
15-Oct-13					53F, raining	high flow
22-Oct-13					32 F, cool	no flow
29-Oct-13					39 F, cool	no flow
5-Nov-13			180	135	43 F	no flow
12-Nov-13			185	165	18F	no flow
19-Nov-13			170	125	30F	no flow
26-Nov-13			170	200	35F	no flow
22-Apr-14	131	176	176	128	60 F, 0.5 inch	medium flow
6-May-14	328	208	198	153	50F, dry	medium flow
20-May-14	167	209	212	149	60F, dry	no flow
3-Jun-14	54	89	118	56	65 F, 4 inch rain	high flow
17-Jun-14	36	218	112	49		
Max	328	218	212	200		
Min	36	89	112	49		
Avg	143	180	169	129		

City of Viroqua
Stream Testing - **Total Nitrogen**

Date	Location				Weather	Notes
	Upstream	WWTP	Downstream	Bridge		
10-Sep-13					Hot 80F, drought	low flow
17-Sep-13					55 F	very low flow
24-Sep-13					60 F	low flow
1-Oct-13					68 F	very low flow
8-Oct-13					54 F, Sunny	very low flow
15-Oct-13					53F, raining	high flow
22-Oct-13					32 F, cool	no flow
29-Oct-13					39 F, cool	no flow
5-Nov-13					43 F	no flow
12-Nov-13					18F	no flow
19-Nov-13					30F	no flow
26-Nov-13					35F	no flow
22-Apr-14	0.5	37.7	16.8	17.8	60 F, 0.5 inch	medium flow
6-May-14	0.7	41.1	39.2	24.4	50F, dry	medium flow
20-May-14	0.7	44.2	38.9	28.8	60F, dry	no flow
3-Jun-14	1.8	12.6	15.5	6.1	65 F, 4 inch rain	high flow
17-Jun-14	2.4	35.9	15.8	6.3		
Max	2.4	44	39	29		
Min	<0.5	12.6	15.5	6.1		
Avg	1.2	34	25	17		

City of Viroqua
Stream Testing - **Fecal Coliforms**

Date	Location				Weather	Notes
	Upstream	WWTP	Downstream	Bridge		
10-Sep-13	615	84	1,159	14,140	80 F, drought	low flow
17-Sep-13	3,973	29	497	2,851	55 F	very low flow
24-Sep-13	977	6	247	4,813	60 F	low flow
1-Oct-13	160	15	344	3,080	68 F	very low flow
8-Oct-13	122	65	1,226	2,599	54 F, Sunny	very low flow
15-Oct-13	3,266	50	2,599	6,212	53 F, raining	high flow
22-Oct-13	n/a	149	1,102	1,741	32 F, cool	no flow
29-Oct-13	n/a	449	5,199	1,302	39 F, cool	no flow
5-Nov-13	n/a	19	475	422	43 F	no flow
12-Nov-13	n/a	2	63	358	18F	no flow
19-Nov-13	n/a	10	46	137	30F	no flow
26-Nov-13	n/a	24	73	101	35F	no flow
22-Apr-14	74	112	307	30	60 F, 0.5"	medium flow
6-May-14	5	220	11,600	22	50 F, dry	medium flow
20-May-14	24	1,550	1,760	120	60 F, dry	no flow
3-Jun-14	137	24	1,105	25	65 F, 4" rain	high flow
17-Jun-14	1	3	1,160	2		
Max	3,973	1,550	11,600	14,140		
Min	1	2	46	2		
Avg	850	147	1,704	2,233		

Appendix E

Water Use Data

City of Viroqua
Water Use Summary
Average Daily Consumption

2010	Residential	Commercial	Industrial	Public	Total	
					GPD	MGD
January	149,366	96,685	5,694	29,196	280,942	0.281
February	166,119	98,683	14,399	29,092	308,292	0.308
March	144,364	87,033	5,212	23,478	260,087	0.260
April	159,939	95,644	10,796	27,776	294,155	0.294
May	154,595	109,884	8,349	29,124	301,951	0.302
June	172,522	64,129	8,477	25,931	271,058	0.271
July	154,353	90,894	11,630	27,097	283,975	0.284
August	167,262	97,192	18,024	23,091	305,570	0.306
September	164,460	100,459	19,947	30,793	315,658	0.316
October	157,756	95,862	16,094	28,014	297,726	0.298
November	156,689	104,446	17,728	27,576	306,439	0.306
December	149,568	99,001	17,252	26,204	292,026	0.292
Average	158,083	94,993	12,800	27,281	293,157	0.293
Max	172,522	109,884	19,947	30,793	315,658	0.316
Min	144,364	64,129	5,212	23,091	260,087	0.260
	Population	Customers	Customers	Customers		
Count	4,362	286	8	29		
GPCD	36	332	1,600	941		

City of Viroqua
Water Use Summary
Average Daily Consumption

2011	Residential	Commercial	Industrial	Public	Total	
					GPD	MGD
January	154,667	108,943	12,016	26,059	301,685	0.302
February	155,557	113,068	16,002	31,950	316,578	0.317
March	146,086	102,657	18,917	29,992	297,652	0.298
April	151,387	104,047	26,978	36,253	318,665	0.319
May	153,038	100,666	10,472	23,743	287,920	0.288
June	158,771	121,749	22,216	26,604	329,340	0.329
July	162,115	115,771	20,510	26,180	324,576	0.325
August	163,161	124,240	19,906	35,108	342,415	0.342
September	164,635	123,644	19,249	15,982	323,510	0.324
October	149,359	111,790	18,386	26,156	305,691	0.306
November	153,814	112,873	25,507	25,033	317,227	0.317
December	145,136	100,184	20,437	28,834	294,591	0.295
Average	154,810	111,636	19,216	27,658	313,321	0.313
Max	164,635	124,240	26,978	36,253	342,415	0.342
Min	145,136	100,184	10,472	15,982	287,920	0.288
	Population	Customers	Customers	Customers		
Count	4,439	260	10	28		
GPCD	35	429	1,922	988		

City of Viroqua
Water Use Summary
Average Daily Consumption

2012	Residential	Commercial	Industrial	Public	Total
January	154,836	105,540	8,445	26,204	295,026
February	165,575	115,326	19,448	27,008	327,357
March	132,292	107,567	17,976	25,601	283,436
April	150,298	115,067	17,952	32,912	316,229
May	157,152	110,294	17,240	26,397	311,084
June	177,251	121,226	18,625	20,994	338,096
July	189,799	119,728	13,006	35,832	358,364
August	171,171	117,339	16,939	32,019	337,469
September	158,426	121,218	23,761	33,835	337,240
October	155,777	110,306	26,687	28,424	321,194
November	155,235	104,072	23,936	25,382	308,625
December	144,082	89,495	18,193	23,815	275,586
Average	159,325	111,431	18,517	28,202	317,475
Max	189,799	121,226	26,687	35,832	358,364
Min	132,292	89,495	8,445	20,994	275,586
	Population	Customers	Customers	Customers	
Count	4,455	271	12	29	
GPCD	36	411	1,543	972	

Sector	Water Consumption (MGD)			Annual Average
	2010	2011	2012	
Residential	0.158	0.155	0.159	0.157
Commercial	0.095	0.112	0.111	0.106
Public	0.027	0.028	0.028	0.028
Industrial	0.013	0.019	0.019	0.017
	Total Average City Water			0.308

Appendix F

Existing WWTF Flow and Loading Data

- **Flow Data**
- **BOD and TSS**
- **Phosphorus and Ammonia**
- **Hauled Waste Summary**
- **Base Contributions**

City of Viroqua WWTP
Influent Flow Summary

2010	Minimums Day	Minimums Two-Week	Maximums Day	Maximums Week	Maximums Two-Week	Monthly Average
January	0.282	0.319	0.639	0.389	0.361	0.337
February	0.287	0.322	0.348	0.330	0.356	0.325
March	0.308	0.328	0.827	0.539	0.446	0.394
April	0.274	0.325	0.395	0.352	0.343	0.329
May	0.279	0.330	1.197	0.477	0.409	0.366
June	0.291	0.332	0.930	0.531	0.450	0.397
July	0.301	0.360	0.993	0.541	0.510	0.427
August	0.301	0.355	0.990	0.570	0.479	0.409
September	0.292	0.342	0.561	0.394	0.376	0.364
October	0.293	0.327	0.390	0.349	0.371	0.332
November	0.270	0.318	0.386	0.336	0.331	0.323
December	0.261	0.304	0.468	0.346	0.339	0.328

Sustained Bi-Weekly Min	0.304	December
Max Day	1.197	May
Sustained Weekly Max	0.570	August
Sustained 2-Week Max	0.510	July
Max Month	0.427	July
Annual Average	0.361	

2011	Minimums Day	Minimums Two-Week	Maximums Day	Maximums Week	Maximums Two-Week	Monthly Average
January	0.272	0.320	0.380	0.340	0.329	0.324
February	0.285	0.319	0.615	0.408	0.365	0.341
March	0.303	0.332	1.066	0.739	0.574	0.451
April	0.304	0.335	0.659	0.402	0.533	0.357
May	0.284	0.329	0.626	0.389	0.375	0.343
June	0.279	0.315	1.284	0.572	0.457	0.385
July	0.267	0.332	0.382	0.351	0.456	0.334
August	0.266	0.308	0.364	0.346	0.346	0.329
September	0.268	0.307	0.418	0.329	0.325	0.318
October	0.275	0.312	0.355	0.329	0.325	0.315
November	0.266	0.308	0.374	0.338	0.329	0.319
December	0.258	0.294	0.375	0.324	0.320	0.306

Sustained Bi-Weekly Min	0.294	December
Max Day	1.284	June
Sustained Weekly Max	0.739	March
Sustained 2-Week Max	0.574	March
Max Month	0.451	March
Annual Average	0.343	

City of Viroqua WWTP
Influent Flow Summary

2012	Minimums		Maximums			Monthly
	Day	Two-Week	Day	Week	Two-Week	Average
January	0.268	0.298	0.356	0.329	0.311	0.308
February	0.280	0.312	0.448	0.334	0.326	0.320
March	0.268	0.304	0.381	0.343	0.339	0.318
April	0.276	0.306	0.694	0.439	0.384	0.350
May	0.247	0.297	0.683	0.446	0.412	0.339
June	0.256	0.303	0.352	0.337	0.327	0.313
July	0.259	0.287	0.412	0.334	0.321	0.305
August	0.249	0.304	0.341	0.318	0.314	0.310
September	0.260	0.311	0.379	0.327	0.326	0.315
October	0.259	0.302	0.397	0.354	0.332	0.317
November	0.256	0.288	0.401	0.325	0.311	0.300
December	0.247	0.275	0.321	0.307	0.303	0.289

Sustained Bi-Weekly Min	0.275	December
Max Day	0.694	April
Sustained Weekly Max	0.446	May
Sustained 2-Week Max	0.412	May
Max Month	0.350	April
Annual Average	0.315	

2013	Minimums		Maximums			Monthly
	Day	Two-Week	Day	Week	Two-Week	Average
January	0.261	0.304	0.400	0.323	0.318	0.311
February	0.257	0.292	0.408	0.334	0.312	0.301
March	0.274	0.293	0.760	0.423	0.369	0.353
April	0.281	0.355	1.382	0.596	0.499	0.413
May	0.298	0.340	0.985	0.496	0.475	0.409
June	0.294	0.368	1.575	0.780	0.568	0.464
July	0.266	0.309	0.389	0.516	0.561	0.320
August	0.269	0.315	0.412	0.331	0.324	0.319
September	0.262	0.315	0.461	0.336	0.329	0.323
October	0.266	0.306	0.361	0.349	0.335	0.317
November	0.261	0.301	0.411	0.333	0.318	0.307
December	0.250	0.295	0.380	0.314	0.310	0.304

Sustained Bi-Weekly Min	0.292	February
Max Day	1.575	June
Sustained Weekly Max	0.780	June
Sustained 2-Week Max	0.568	July
Max Month	0.464	June
Annual Average	0.345	

City of Viroqua WWTP
Influent Flow Summary

2014	Minimums Day	Two-Week	Maximums Day	Week	Two-Week	Monthly Average
January	0.257	0.313	0.354	0.330	0.327	0.315
February	0.271	0.310	0.513	0.468	0.461	0.422
March	0.426	0.464	0.818	0.547	0.522	0.501
April	0.307	0.405	1.253	0.559	0.494	0.444
May	0.271	0.310	0.379	0.427	0.414	0.318
June	0.253	0.314	1.146	0.463	0.385	0.366
July	0.262	0.290	0.347	0.317	0.350	0.297
August	0.245	0.285	0.343	0.309	0.301	0.291
September	0.264	0.292	0.370	0.305	0.302	0.297
October	0.258	0.285	0.449	0.344	0.320	0.303
November	0.245	0.285	0.310	0.296	0.294	0.288
December	0.240	0.287	0.355	0.312	0.307	0.295

Sustained Bi-Weekly Min	0.285	August
Max Day	1.253	April
Sustained Weekly Max	0.559	April
Sustained 2-Week Max	0.522	March
Max Month	0.501	March
Annual Average	0.345	

2010 - 2014 Summary

	Minimum Two-Week	Maximums Day	Week	Two-Week	Month	Annual Average
2010	0.304	1.197	0.570	0.510	0.427	0.361
2011	0.294	1.284	0.739	0.574	0.451	0.343
2012	0.275	0.694	0.446	0.412	0.350	0.315
2013	0.292	1.575	0.780	0.568	0.464	0.345
2014	0.285	1.253	0.559	0.522	0.501	0.345
Average	0.290	1.201	0.619	0.517	0.438	0.342
Minimum	0.275	0.694	0.446	0.412	0.350	0.315
Maximum	0.304	1.575	0.780	0.574	0.501	0.361
Max 1		1.575	0.780	0.574	0.501	
Max 2		1.284	0.739	0.568	0.464	
Max 3		1.253	0.570	0.522	0.451	
3-Highest Avg		1.371	0.696	0.555	0.472	

City of Viroqua WWTP
Influent BOD and TSS Summary

	BOD			TSS		
	Monthly	Maximums		Monthly	Maximums	
2010	Average	Sustained	6-month	Average	Sustained	6-month
January	843	894		818	938	
February	903	956		1,039	1,271	
March	993	1,138		1,244	1,617	
April	922	983		1,092	1,174	
May	874	1,046		953	1,235	
June	983	1,100	920	1,106	1,102	1,042
July	1,062	1,242	956	982	1,499	1,069
August	941	975	962	771	814	1,025
September	982	1,069	961	1,074	1,342	996
October	1,027	1,064	978	1,256	1,493	1,024
November	1,017	1,246	1,002	1,268	1,407	1,076
December	1,172	1,356	1,033	1,318	1,816	1,111
Average	977	1,089	973	1,077	1,309	1,049
Maximums						
1	1,172	1,356	1,033	1,318	1,816	1,111
2	1,062	1,246	1,002	1,268	1,617	1,076
3	1,027	1,242	978	1,256	1,499	1,069
Average of 3 Maximums	1,087	1,281	1,004	1,281	1,644	1,086

	BOD			TSS		
	Monthly	Maximums		Monthly	Maximums	
2011	Average	Sustained	6-month	Average	Sustained	6-month
January	1,049	1,086		1,043	1,049	
February	1,099	1,238		1,074	1,212	
March	1,023	1,257		1,212	1,599	
April	1,215	1,258		1,203	1,405	
May	1,002	1,113		1,205	1,358	
June	993	1,220	1,064	1,103	1,176	1,140
July	913	1,095	1,041	1,080	1,286	1,146
August	985	1,007	1,022	1,210	1,293	1,169
September	939	1,029	1,008	1,260	1,565	1,177
October	844	1,085	946	1,126	1,739	1,164
November	920	944	932	1,155	1,427	1,156
December	900	922	917	908	962	1,123
Average	990	1,105	990	1,132	1,339	1,153
Maximums						
1	1,215	1,258	1,064	1,260	1,739	1,177
2	1,099	1,257	1,041	1,212	1,599	1,169
3	1,049	1,238	1,022	1,210	1,565	1,164
Average of 3 Maximums	1,121	1,251	1,042	1,227	1,634	1,170

City of Viroqua WWTP
Influent BOD and TSS Summary

	BOD			TSS		
	Monthly	Maximums		Monthly	Maximums	
2012	Average	Sustained	6-month	Average	Sustained	6-month
January	914	924		955	1025	
February	930	923		1044	1107	
March	983	1036		1045	1165	
April	1254	1651		1201	1400	
May	1027	1508		1166	1430	
June	907	1032	1,003	1081	1153	1,082
July	876	909	996	1051	1193	1,098
August	822	884	978	962	1082	1,084
September	798	860	947	964	1029	1,071
October	833	856	877	972	1056	1,033
November	769	846	834	777	890	968
December	823	864	820	903	958	938
Average	911	1,024	922	1,010	1,124	1,039
Maximums						
1	1,254	1,651	1,003	1,201	1,430	1,098
2	1,027	1,508	996	1,166	1,400	1,084
3	983	1,036	978	1,081	1,193	1,082
Average of 3 Maximums	1,088	1,398	992	1,150	1,341	1,088

	BOD			TSS		
	Monthly	Maximums		Monthly	Maximums	
2013	Average	Sustained	6-month	Average	Sustained	6-month
January	852	897		1077	1027	
February	847	900		1037	1374	
March	744	794		931	1024	
April	946	1148		1280	1782	
May	1250	1175		1671	1580	
June	1074	1502	952	1291	2101	1,215
July	973	1181	972	1189	1581	1,233
August	979	990	994	1372	1485	1,289
September	848	1048	1,012	880	1382	1,280
October	841	909	994	872	895	1,212
November	833	838	925	892	1055	1,083
December	796	876	879	683	815	981
Average	915	1,022	961	1,098	1,342	1,185
Maximums						
1	1,250	1,502	1,012	1,671	2,101	1,289
2	1,074	1,181	994	1,372	1,782	1,280
3	979	1,175	994	1,291	1,581	1,233
Average of 3 Maximums	1,101	1,286	1,000	1,445	1,821	1,268

City of Viroqua WWTP
Influent BOD and TSS Summary

2014	BOD			TSS		
	Monthly Average	Maximums Sustained	Maximums 6-month	Monthly Average	Maximums Sustained	Maximums 6-month
January	852	1037		709	735	
February	873	916		790	793	
March	935	954		927	985	
April	926	1035		607	873	
May	968	1116		632	723	
June	905	1033	910	568	671	706
July	951	1074	926	808	906	722
August	921	925	934	631	596	696
September	812	958	914	647	796	649
October	864	909	903	734	842	670
November	883	898	889	552	818	657
December	880	986	885	558	662	655
Average	897	987	909	680	783	679
Maximums						
1	968	1,116	934	927	985	722
2	951	1,074	926	808	906	706
3	935	1,037	914	790	873	696
Average of 3 Maximums	951	1,076	925	842	921	708

Year	Annual Averages		3 Highest Months Average		Minimum Days	
	BOD lbs/day	SS lbs/day	BOD lbs/day	SS lbs/day	BOD lbs/day	SS lbs/day
2010	977	1,077	1,087	1,281	346	297
2011	990	1,132	1,121	1,227	445	560
2012	911	1,010	1,088	1,150	424	141
2013	915	1,098	1,101	1,445	406	280
2014	897	680	951	842	504	193
Average	938	999	1,070	1,189	425	294
Maximum	990	1,132	1,121	1,445	504	560
Avg[1]	934	1,062	1,092	1,219	425	257

Avg[1] Average not considering high and low values

City of Viroqua WWTP
Influent Phosphorus and Ammonia Summary

Year	PHOSPHORUS Min Day PPD	Annual Avg PPD	Max 2 Week PPD	Max Week PPD	Max Day PPD
2008	20	28	31	34	46
2009*	16	28	33	38	45
2010					
2011					
2012					
2013					
2014	13	20	23	30	42
Max	20	28	33	38	46
Average	16	25	29	34	44

*2009 data through June

Year	AMMONIA Min Day PPD	Annual Avg PPD	Max 2 Week PPD	Max Week PPD	Max Day PPD
2014**	67	98	116	124	176

**2014 data July -Dec

City of Viroqua WWTP
Hauled Waste Summary

	Leachate									Holding Tank
		BOD		TSS		Ammonia		Phosphorus		
	Flow	Concentration	Load	Concentration	Load	Concentration	Load	Concentration	Load	Flow
2010	gal/month	mg/L	lbs/month	mg/L	lbs/month	mg/L	lbs/month	mg/L	lbs/month	gal/month
January	83,998	86	60	87	61	540	378	6.2	4.3	
February	76,623	25	16	84	54	488	312	6.4	4.1	
March	81,855	111	76	126	86	503	343	7.3	5.0	
April	110,876	60	55	119	110	471	436	6.1	5.6	12,000
May	99,573	43	36	25	21	342	284	7.4	6.1	9,700
June	159,384	88	117	63	84	573	762	7.7	10.2	20,200
July	106,030	613	542	234	207	479	424	8.1	7.1	35,700
August	229,390	276	528	65	124	536	1,025	8.7	16.7	12,200
September	158,116	109	144	228	301	619	816	11.5	15.2	4,000
October	119,108	93	92	60	60	559	555	9.4	9.3	
November	89,325	73	54	112	83	571	425	9.6	7.1	
December	81,754	90	61	60	41	561	383	9.2	6.3	
Average	116,336	139	149	105	103	520	512	8.1	8.1	15,633
Total	1,396,032		1,782		1,231		6,143		97	93,800
Maximums										
1	229,390	613	542	234	301	619	1,025	12	17	35,700
2	159,384	276	528	228	207	573	816	10	15	20,200
3	158,116	111	144	126	124	571	762	9	10	12,200
Average of 3 Maximums	182,297	333	405	196	211	588	868	10	14	22,700

City of Viroqua WWTP
Hauled Waste Summary

2011	Leachate Flow gal/month	BOD Concentration mg/L	BOD Load lbs/month	TSS Concentration mg/L	TSS Load lbs/month	Ammonia Concentration mg/L	Ammonia Load lbs/month	Phosphorus Concentration mg/L	Phosphorus Load lbs/month	Holding Tank Flow gal/month
January	109,769	73	67	48	44	563	515	8.4	7.7	
February	118,238	162	160	28	28	570	562	8.8	8.6	
March	167,830	54	76	43	60	464	649	7.7	10.7	4,200
April	152,122	64	81	33	42	595	755	9.5	12.1	12,000
May	184,796	53	82	57	88	498	768	8.1	12.5	
June	168,019	85	119	70	98	554	776	9.2	12.8	16,825
July	129,702	85	92	34	37	525	568	9.4	10.1	
August	169,769	93	132	18	25	533	755	11.6	16.4	375
September	105,416	89	78	35	31	526	462	9.7	8.5	1,125
October	71,336	83	49	21	12	653	388	10.2	6.0	
November	120,369	92	92	16	16	585	587	10.9	10.9	
December	102,291	71	61	13	11	575	491	12.7	10.8	
Average	133,305	84	91	35	41	553	606	9.7	10.6	6,905
Total	1,599,657		1,088		492		7,277		127	34,525
Maximums										
1	184,796	162	160	70	98	653	776	13	16	16,825
2	169,769	93	132	57	88	595	768	12	13	12,000
3	168,019	92	119	48	60	585	755	11	13	4,200
Average of 3 Maximums	174,195	116	137	58	82	611	766	12	14	11,008

City of Viroqua WWTP
Hauled Waste Summary

	Leachate									Holding Tank
		BOD		TSS		Ammonia		Phosphorus		
	Flow	Concentration	Load	Concentration	Load	Concentration	Load	Concentration	Load	Flow
2012	gal/month	mg/L	lbs/month	mg/L	lbs/month	mg/L	lbs/month	mg/L	lbs/month	gal/month
January	58,948	105	52	70	34	583	287	9.5	4.7	
February	84,005	81	57	28	20	423	296	11.5	8.1	
March	98,373	90	74	22	18	519	426	10.4	8.5	8,000
April	91,907	53	41	21	16	450	345	8.5	6.5	
May	117,031	34	33	25	24	342	334	7.4	7.2	8,250
June	93,793	75	59	9	7	581	454	8.7	6.8	2,000
July	154,109	104	134	16	21	445	572	11.0	14.1	700
August	126,330	98	103	16	17	545	574	11.8	12.4	2,100
September	62,818	88	46	17	9	496	260	10.3	5.4	1,800
October	65,222	82	45	26	14	728	396	10.4	5.7	200
November	50,852	68	29	25	11	547	232	11.4	4.8	200
December	65,222	111	60	20	11	613	333	12.7	6.9	150
Average	89,051	82	61	25	17	523	376	10.3	7.6	2,600
Total	1,068,610		732		202		4,509		91	23,400
Maximums										
1	154,109	111	134	70	34	728	574	13	14	8,250
2	126,330	105	103	28	24	613	572	12	12	8,000
3	117,031	104	74	26	21	583	454	12	9	2,100
Average of 3 Maximums	132,490	107	104	41	26	641	534	12	12	6,117

City of Viroqua WWTP
Hauled Waste Summary

	Leachate									Holding Tank
		BOD		TSS		Ammonia		Phosphorus		
	Flow	Concentration	Load	Concentration	Load	Concentration	Load	Concentration	Load	Flow
2013	gal/month	mg/L	lbs/month	mg/L	lbs/month	mg/L	lbs/month	mg/L	lbs/month	gal/month
January	65,511	87	48	14	8	849	464	12.8	7.0	
February	88,854	69	51	15	11	560	415	10.9	8.1	
March	89,050	62	46	17	13	575	427	9.5	7.0	400
April	121,373	54	55	18	18	427	432	7.6	7.7	200
May	92,581	83	64	23	17	535	413	8.8	6.8	11,800
June	110,658	163	150	28	26	632	583	11.9	11.0	9,250
July	111,686		0		0		0		0.0	1,150
August	103,389		0		0		0		0.0	2,275
September	83,306		0		0		0		0.0	2,200
October	94,347		0		0		0		0.0	1,200
November	85,875		0		0		0		0.0	150
December	72,118		0		0		0		0.0	
Average	93,229	86	35	19	8	596	228	10	4	3,181
Total	1,118,750		414		93		2,734		48	28,625
Maximums										
1	121,373	163	150	28	26	849	583	13	11	11,800
2	111,686	87	64	23	18	632	464	12	8	9,250
3	110,658	83	55	18	17	575	432	11	8	2,275
Average of 3 Maximums	114,573	111	90	23	21	685	493	12	9	7,775

City of Viroqua WWTP
Hauled Waste Summary

	Leachate									Holding Tank
		BOD		TSS		Ammonia		Phosphorus		
	Flow	Concentration	Load	Concentration	Load	Concentration	Load	Concentration	Load	Flow
2014	gal/month	mg/L	lbs/month	mg/L	lbs/month	mg/L	lbs/month	mg/L	lbs/month	gal/month
January	54,348									
February	76,991									
March	70,474									200
April	100,180									4,350
May	73,497									15,950
June	110,090									5,050
July	13,550									800
August										1,100
September										1,300
October										700
November										300
December	19,480									300
Average	64,826									3,005
Total	518,610									30,050
Maximums										
1	110,090									15,950
2	100,180									5,050
3	76,991									4,350
Average of 3 Maximums	95,754									8,450

City of Viroqua WWTP
Hauled Waste Summary

Year	Leachate Yearly Totals					Holding Tank
	Flow gal/year	BOD lbs/year	SS lbs/year	Ammonia lbs/year	Phosphorus lbs/year	Flow gal/year
2010	1,396,032	1,782	1,231	6,143	97.1	93,800
2011	1,599,657	1,088	492	7,277	127.3	34,525
2012	1,068,610	732	202	4,509	91.0	23,400
2013	1,118,750					28,625
2014	518,610					30,050
Average	1,140,332	1,201	642	5,977	105	42,080
Maximum	1,599,657	1,782	1,231	7,277	127	93,800
Daily	3,124	3.3	1.8	16.4	0.3	115

City of Viroqua
Base Contributions

	City Base (2010 - 2014)				
	Flow *MGD*	BOD *lbs/d*	TSS *lbs/d*	P *lbs/d*	TKN *lbs/d*
Annual Average	0.342	934	1,062	25	150
Average (3 highest months)		1,092	1,219	30	175

BASE LOAD ALLOCATIONS

	City Base (2013)		Flow		BOD		TSS	
	Quantity	*Units*	*Rate*	*mgd*	*Loading*	*lbs/day*	*Loading*	*lbs/day*
Residential	4,455	capita	36	0.160	0.17	757.4	0.20	891.0
Commercial	271	customers	411	0.111	250.0	232.2	250.0	232.2
Public Authority	29	customers	972	0.028	250.0	58.8	250.0	58.8
General Industrial	12	customers	1,543	0.019	250.0	38.6	250.0	38.6
Total City Base (w/o I & I flow)				**0.318**		**1,087**		**1,221**

Land Use	*2013 # of Parcels*	*2013 # of Acres*	*2012 Flow (gal/day)*	*Flow per Acre per Day*
Residential	1,451	182	159,325	875
Commercial	214	195	111,431	571
Manufacturing/industrial	7	28	18,517	661
Agricultural/Other	71	598	28,202	
Total	1,743	1,003	317,475	

	Increases		Flow		BOD		TSS	
Future Projections	*Future Growth*	*Units*	*Flow Rate (gal/unit/d)*	*Flow (mgd)*	*Loading*	*lbs/day*	*Loading*	*lbs/day*
Residential	891	capita	60	0.053	0.20	178.2	0.22	196.0
Commercial	54.2	customers	500	0.027	250.0	56.5	250.0	56.5
Public Authority	2.9	customers	1,000	0.003	250.0	6.0	250.0	6.0
General Industrial	2.4	customers	1,550	0.004	250.0	7.8	250.0	7.8
Future City Base (w/o I & I flow)				**0.087**		**249**		**266**

Notes:
Base City values from 2010 - 2014 WWTP data - averages without high and low values
2013 Parcel (improved parcels) and acreage data from 2013 Wisconsin Department of Revenue Statement
2013 Flow from City water billing summary
Future Projections based on values agreed upon with the City - 20% for Commercial and Industrial, 10% for Public

Appendix G

Infiltration and Inflow Calculations

City of Viroqua WWTP

I/I Determination

	WWTP Flow MGD	Base Flow[1] MGD	I/I
Dry Weather Infiltration			
Minimum Bi-Weekly Values			
2010 - December	0.304	0.277	0.027
2011 - December	0.294	0.295	-0.001
2012 - December	0.275	0.2756	0.000
2013 - February	0.292	0.289	0.003
Average			0.007
Wet Weather I and I			
Maximum Daily Value			
2010 - May	1.197	0.302	0.895
2011 - June	1.284	0.329	0.955
2012 - April	0.694	0.316	0.378
2013 - June	1.575	0.337	1.238
Average w/o 2012			1.029
Maximum Weekly Value			
2010 - August	0.570	0.306	0.264
2011 - March	0.739	0.298	0.441
2012 - May	0.446	0.311	0.135
2013 - June	0.780	0.337	0.443
Average w/o 2012			0.383
Maximum Bi-Weekly Values			
2010 - July	0.515	0.284	0.231
2011 - March	0.574	0.298	0.276
2012 - May	0.417	0.311	0.106
2013 - July	0.599	0.350	0.250
Average w/o 2012			0.252
Maximum Monthly Values			
2010 - July	0.427	0.284	0.143
2011 - March	0.451	0.298	0.153
2012 - April	0.350	0.316	0.034
2013 - June	0.464	0.337	0.127
Average w/o 2012			0.141
Annual Average			
2010	0.361	0.293	0.068
2011	0.343	0.313	0.030
2012	0.315	0.317	-0.002
2013	0.345	0.324	0.021
Average w/o 2012			0.040

[1] Base flow from Water Usage Data

Appendix H

Future Loading Projections

Future Loadings Projections
City of Viroqua WWTP

Maximum Weekly PF	125%
Maximum Daily PF	200%
Peak Hourly PF	350%

		Data Base		Flow		BOD			SS			TKN			Phosphorus		
		Quantity	Units	Rate	Flow	Rate	Units	Loading	Rate	Units	Loading	Rate	Units	Loading	Rate	Units	Loading
					mgd			lbs/day			lbs/day			lbs/day			lbs/day
1	City Base Loadings							934			1,062						
	Residential	4,455	capita	36	0.160												
	Wastewater/Water Ratio			100%	0.160												
	Commercial	271	customer	411	0.111												
	Public	29	customer	972	0.028												
	General Industrial	12	customer	1,543	0.019												
	Annual Average				0.318			934			1,062	60	mg/l	159	7.5	mg/l	20
	Design Sustained Loading				0.318			1,092			1,219			175			30
2	Future City Increases																
	Population Growth	891	capita	60	0.053	0.20	ppcd	178	0.22	ppcd	196	60	mg/l	27	7.5	mg/l	3.3
	Commercial Expansion (20%)	54	customer	500	0.027	250	mg/l	57	250	mg/l	57	60	mg/l	14	7.5	mg/l	1.7
	Public Sector Increase (10%)	3	customer	1,000	0.003	250	mg/l	6.0	250	mg/l	6	60	mg/l	1	7.5	mg/l	0.2
	Industrial Expansion (20%)	2	customer	1,550	0.004	250	mg/l	7.8	250	mg/l	8	60	mg/l	2	7.5	mg/l	0.2
	Subtotal				0.087			249			266			44			5.5
3	Future Major Industry Request																
	Unallocated				0.045	250	mg/l	94	250	mg/l	94	60	mg/l	23	7.5	mg/l	2.8
	Subtotal				0.045			94			94			23			2.8
4	Additional Contributors																
	Septage Hauling				0.015	7,500		938	10,000		1,251	400	mg/l	50	250	mg/l	31.3
	Holding Tank Waste				0.025	1,500		313	1,000		209	200	mg/l	42	17	mg/l	3.5
	Leachate				0.005	100		4.2	50		2	550	mg/l	23	10	mg/l	0.4
	Subtotal				0.045			1,255			1,462			115			35.2
5	Clear Water Infiltration/Inflow																
	Min Dry Weather Infiltration				0.007												
	Annual Average				0.040												
	Existing Sustained I/I				0.252												
	Future Sustained I/I	891	capita	0	0.000												
	Projected Sustained I/I Reduction				0.000												
	Daily Wet Weather I and I				1.029												
	Instantaneous Inflow Factor	(multiplied x daily I/I)		1.75	1.801												
	Maximum Weekly I/I				0.383												
6	Loadings Projections																
	Average Annual				**0.535**			**2,532**			**2,884**			**340**			**63**
	Design (Max Sustained)				**0.747**			**2,690**			**3,041**			**356**			**74**
	Maximum Weekly				**0.979**												
	Maximum Daily				**1.929**												
	Peak Hourly				**3.309**												
	Design without Hauled Waste				**0.702**			**1434**			**1579**			**241**			**38**

Appendix I

Regulatory Agency Correspondence

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
101 S. Webster Street
Box 7921
Madison WI 53707-7921

Scott Walker, Governor
Cathy Stepp, Secretary
Telephone 608-266-2621
Toll Free 1-888-936-7463
TTY Access via relay - 711

April 2, 2015

Ms. Lori Polhamus, City Clerk
City of Viroqua
202 North Main Street
Viroqua, WI 54665

Subject: Recommended Planning Effluent Limitations For Evaluation of Proposed Wastewater Treatment System Improvements -- City of Viroqua, Wisconsin

Dear Ms. Polhamus:

The Department of Natural Resources has determined the recommended planning effluent limitations for use in evaluation of the proposed wastewater treatment improvements for the Village of Kendall. Please refer to the attached memo from Pat Oldenburg addressing the recommended planning limits. **Additionally, for scenario 3, discharge of wastewater under current conditions, please also refer to the memo from Jim Boettcher regarding limits for groundwater discharge.**

The planning effluent limit recommendations are based on the projected 20-year design flows and effluent discharge options as summarized below:

Design Effluent / Discharge Flow Rates:

Design Flow Condition	Design Year 2035 Flow Value (mgd)
Design Average Annual	0.535
Design Max. Month	---
Design Max. Week	0.979
Design Max. Day	1.929

Effluent Discharge Options:

1. Surface water discharge to the Springville Branch of the Bad Axe River at the current outfall location after grouting the streambed to mitigate effects of the disappearing stream
2. Surface water discharge to the Springville Branch of the Bad Axe River near CTH B
3. Groundwater discharge and surface water discharge to the Springville Branch of the Bad Axe River at the current outfall location without efforts to mitigate effects of the disappearing stream.

If you should have any questions concerning this effluent limit recommendations transmittal, please feel free to contact Pat Oldenburg (WDNR Eau Claire Service Center, 715/831-3262) or me (WDNR Madison office, 608/267-7894).

Sincerely,

Jason Knutson
Wastewater Section
Bureau of Water Quality

Cc: Sarah Grainger, City of Viroqua

Mr. Michael Cullen, P.E., Town and Country Engineering, Inc. (Madison Office)
Ms. Amy Bares, P.E., Town and Country Engineering, Inc. (Madison Office)
Julia Stephenson – LaCrosse Service Center
Pat Oldenburg – Eau Claire Service Center
Jim Boettcher – Eau Claire Service Center

CORRESPONDENCE / MEMORANDUM **State of Wisconsin**

DATE: March 31, 2015

TO: Jason Knutson - WQ/3

FROM: Pat Oldenburg – Eau Claire

SUBJECT: Water Quality-Based Effluent Limitations for the City of Viroqua (WI-0021920)

This is in response to a request for an evaluation of water quality-based effluent limitations for facility planning purposes using chs. NR 102, 104, 105, 106, 207 and 210 of the Wisconsin Administrative Code (where applicable), for the City of Viroqua's discharge to the Springville Branch of the Bad Axe River. The discharge is located in the Bad Axe River Watershed of the Bad Axe - La Crosse Rivers Basin in Vernon County.

This evaluation specifically addresses the so-called "conventional pollutants" as well as ammonia, phosphorous, the need for disinfection and temperature. The evaluation of the recommendations is discussed in more detail in the attached report.

Based on our review, the following recommendations are made on a chemical-specific basis for three alternate discharge scenarios:

Scenario 1: Discharge to the current outfall location after grouting the streambed to mitigate effects of the disappearing stream

Parameter	**Limit Type**	**Limit and Units**	**Notes**
Flow Rate		MGD	
BOD_5, Total	Monthly Avg	20 mg/L	
BOD_5, Total	Weekly Avg	30 mg/L	
Suspended Solids, Total	Monthly Avg	20 mg/L	
Suspended Solids, Total	Weekly Avg	30 mg/L	
pH Field	Daily Max	9.0 su	
pH Field	Daily Min	6.0 su	
Dissolved Oxygen	Daily Min	4.0 mg/L	
Fecal Coliform	Geometric Mean	400 #/100 ml	1
Chlorine, Total Residual	Daily Max	38 µg/L	1
Chlorine, Total Residual	Weekly Avg	7.3 µg/L	1
Nitrogen, Ammonia (NH_3-N) Total	Weekly Avg	14 mg/L	2
Nitrogen, Ammonia (NH3-N) Total	Monthly Avg	6.2 mg/L	2
Nitrogen, Ammonia (NH3-N) Total	Weekly Avg	16 mg/L	3
Nitrogen, Ammonia (NH3-N) Total	Monthly Avg	6.9 mg/L	3
Phosphorus, Total	Monthly Avg	0.54 mg/L	
Phosphorus, Total	6 Month Avg	0.17 mg/L; 0.80 lbs/day	

1. Limit in effect May – September. Chlorine limits apply only if chlorine is used for disinfection.
2. Limit in effect October – April.
3. Limit in effect May – September.

Scenario 2: Discharge to the Springville Branch of the Bad Axe River near CTH B

Parameter	Limit Type	Limit and Units	Notes
BOD_5, Total	Weekly Avg	15 mg/L	
Suspended Solids, Total	Weekly Avg	15 mg/L	
pH Field	Daily Max	9.0 su	
pH Field	Daily Min	6.0 su	
Nitrogen, Ammonia (NH_3-N) Total	Weekly Avg	14 mg/L	
Nitrogen, Ammonia (NH3-N) Total	Monthly Avg	5.8 mg/L	
Phosphorus, Total	Monthly Avg	0.50 mg/L	
Phosphorus, Total	6 Month Avg	0.17 mg/L; ~~0.049 lbs/day~~	
Fecal Coliform	Geometric Mean	400 #/100 ml	
Chlorine, Total Residual	Daily Max	38 µg/L	
Chlorine, Total Residual	Weekly Avg	12 µg/L	
Temperature, Maximum	Weekly Avg		2

Correction - Phosphorus,Total 6 Month Avg should be 0.75 lb/day

1. Limit in effect May – September. Chlorine limits apply only if chlorine is used for disinfection.
2. See attached report regarding potential weekly average temperature limitations and dissipative cooling.

Scenario 3: Discharge to the current outfall location without efforts to mitigate effects of the disappearing stream

Parameter	Limit Type	Limit and Units	Notes
Flow Rate		MGD	
BOD_5, Total	Monthly Avg	20 mg/L	
BOD_5, Total	Weekly Avg	30 mg/L	
Suspended Solids, Total	Monthly Avg	20 mg/L	
Suspended Solids, Total	Weekly Avg	30 mg/L	
pH Field	Daily Max	9.0 su	
pH Field	Daily Min	6.0 su	
Dissolved Oxygen	Daily Min	4.0 mg/L	
Phosphorus, Total	Monthly Avg	0.54 mg/L; 0.80 lbs/day	
Chlorine, Total Residual	Daily Max	38 µg/L	1
Chlorine, Total Residual	Weekly Avg	7.3 µg/L	1
Other parameters			

1. Chlorine limits apply only if chlorine is used for disinfection.
2. See attached file memo from Jim Boettcher regarding limitations on other parameters designed to protect groundwater quality.

If there are any questions or comments, regarding the development of limitations designed to protect surface water quality please contact Pat Oldenburg at (715) 831-3262 or via e-mail at Patrick.Oldenburg@dnr.state.wi.us.

e-cc: Julia Stephenson - La Crosse
Kurt Rasmussen - La Crosse
Jim Boettcher – Eau Claire

Addendum 1:
Water Quality-Based Effluent Limitations for
City of Viroqua (WI-0021920)

Prepared by:
Pat Oldenburg - WCR
March 30, 2015

Facility Description

The City of Viroqua owns and operates a 0.60 MGD activated sludge type wastewater treatment facility with seasonal UV disinfection. The annual average design flow of the facility is 0.60 MGD. The facility discharges to the Springville Branch of the Bad Axe River. Wastewater treatment includes a conventional activated sludge process, fine screening, primary clarification, anaerobic digestion, and UV disinfection prior to discharge.

Information for Effluent Limits Evaluation:

Effluent Information

The recent request for facility planning limits listed the following design flows:

Annual Average Flow – 0.535 MGD
Maximum Month Flow – TBD
Maximum Week Flow – 0.979 MGD
Peak Daily Flow – 1.929 MGD

The proposed discharge location would either be at the current outfall location or downstream near CTH B. At the current outfall location, the receiving water is classified as limited aquatic life, downstream near CTH B the classification changes to coldwater. In 2007 the City conducted a waterway investigation that revealed that it takes only about 8 hours for the effluent to reach the coldwater segment at Springville, but ~80% of the wastewater is lost to groundwater seepage prior to that point. The seepage loss also raises groundwater concerns, particularly since much of it occurs in a region where fractured bedrock is at the surface. These issues will not be directly addressed as part of this memo. At this point the City is focusing on two options, maintaining the outfall at its existing location and attempting to grout the stream bottom to prevent effluent from entering the groundwater via the fractured bedrock (Scenario 1), or relocating the outfall downstream to a site near CTH B (Scenario 2). In addition to these options, a further request was made to clarify appropriate limits if the outfall were maintained at the existing location and no steps were taken to prevent effluent from entering the groundwater via the fractured bedrock (Scenario 3).

Scenario 1: Discharge to the current outfall location after grouting the streambed to mitigate effects of the disappearing stream.

At the current discharge location, the Springville Branch of the Bad Axe River is classified as Limited Aquatic Life in ch. NR 104. This scenario includes the supposition of grouting bedrock fractures to minimize loss to groundwater. However, there are losses to stream bed seepage prior to the exposed bedrock. Based on the 2007 Effluent Outfall Investigation submitted on behalf of the City by Davey Engineering, a loss of 11% occurred prior to the exposed bedrock reaches (based on flow at weir #2). That same report estimated the travel time from the current outfall location to the spring at 8.1 hours (0.34 days).

BOD_5 and TSS:

Based on the receiving water classification, the recommended limitations for BOD_5 and TSS are 30 mg/L weekly average and 20 mg/L monthly average. In order to maintain adequate dissolved oxygen above and below the spring, a dissolved oxygen limit of 4.0 mg/L daily minimum is recommended.

pH:

No changes are recommended from the existing pH limitations of 6.0 s.u. as a daily minimum and 9.0 s.u. as a daily maximum.

Ammonia:

Historically, discharges to limited aquatic life (LAL) waters did not typically receive ammonia effluent limitations. However, the Department recently revised its surface water quality standards for ammonia. These revisions included the development of acute and chronic toxicity criteria and associated effluent limits for LAL waters along with revisions to the criteria for other waters. Based on relative low mean (6.9 s.u.) and maximum (7.5 s.u.) effluent pH results, and resultant ammonia limitations, no ammonia limits would be recommended based on the limited aquatic life reach. These calculations are detailed during in the January 10, 2012 memo *Water Quality-Based Effluent Limitations for the City of Viroqua (WI-0021920)* from Pat Oldenburg to Angela Parkhurst.

However, section NR 106.32(1)(b) specifies that ammonia effluent limitations shall be established to protect downstream waters. The factors that impact whether downstream uses will control the ammonia limits are the ammonia decay rate, travel time to the downstream classification and the available dilution in the downstream water. Given the amount of available dilution downstream and travel time, limitations to protect the downstream water will be more restrictive. The first step in the evaluation is to estimate the limitations needed to protect the downstream fish and aquatic life reach.

The chronic criteria for full fish and aquatic life waters state that the thirty-day average concentration of total ammonia nitrogen (in mg N/L) should not exceed, more than once every three years on the average, the chronic criterion (CTC) calculated using the following equations:

When early life stages are present:

$$\mathrm{CTC} = 0.854 * \left(\frac{0.0676}{1+10^{7.688-\mathrm{pH}}} + \frac{2.912}{1+10^{\mathrm{pH}-7.688}} \right) * \mathrm{MIN}\left(2.85, 1.45 * 10^{0.028*(25-T)}\right)$$

Where:

pH = receiving water pH in standard units

T = Stream Temperature in °C

In addition to the 30-day chronic criteria, the highest four-day average within that 30-day period should not exceed 2.5 times the CTC.

Limitations are then based on mass balance approach:

$$(NH_{3T})_{effluent} = \frac{Q_{mix} * WQC - Q_S * C_S}{Q_E}$$

where: $(NH_{3T})_{effluent}$ = Total ammonia limitation
C_S = Background total ammonia concentration
WQC = Water quality criteria
Q_S= Allowable dilution (25 to 100% of appropriate stream flow)
Q_E = Effluent flow
$Q_{mix} = Q_S + Q_E$

Since the Springville Branch of the Bad Axe is a trout stream, the early life stages present criteria are in effect throughout the year. The effluent flow is adjusted downwards to account for streambed seepage as it was for the phosphorus limit calculation. The background pH and temperature values are based on data collected at CTH B. The table on the below summarizes the ammonia limit calculations:

Effluent Flow (mgd):	0.476	
Effluent Flow (cfs):	0.736	
BACKGROUND INFORMATION:		
	summer	***winter***
4Q3 (cfs)		
7Q10 (cfs)	2.4	2.4
30Q5 (cfs)	2.9	2.9
7Q2 (cfs)	3.1	3.1
Ammonia (mg/L) (1)	0.1	0.1
Temperature (deg C) (2)	10	8.6
pH (std. units) (3)	7.8	7.8
% of river flow used:	25	25
Reference weekly flow:	0.6	0.6
Reference monthly flow:	0.725	0.725
CRITERIA (in mg/L):		
4-day Chronic (@ backgrd. pH):		
early life stages present	7.96	7.96
early life stages absent	10.65	11.65
30-day Chronic (@ backgrd. pH)		
early life stages present	3.18	3.18
early life stages absent	4.26	4.66

EFFLUENT LIMITS (in mg/L):		
Weekly average		
early life stages present	14	14
Monthly average		
early life stages present	6.2	6.2

(1) Default Data

(2) Based on continuous monitoring data 2002-2004

(3) Based on data at Springville

Once the appropriate limit is calculated at the downstream location, in-stream decay must be taken into account:

$$N_{Limit} = \left(\frac{N_{down}}{EXP(-k_t T)} \right)$$

Where:
- N_{Limit} = Ammonia limit needed to protect downstream use (mg/L)
- N_{down} = Ammonia Criteria for downstream use (mg/L)
- $-k_t$ = Ammonia decay rate at background stream temperature (day^{-1})
- T = Travel time from outfall to downstream use (day)

Ammonia decay rates are dependent on temperature with in-stream nitrification essentially non-existent in the winter. For temperatures below 10°C no decay is expected so the limits to protect the coldwater reach would remain unadjusted (14 mg/L weekly average, 6.2 mg/L monthly average) for the months of October- April. For the summer conditions in-stream decay is expected so a first order decay model will be used. Based on the available literature, a decay rate of 0.25 day^{-1} at 20°C has been suggested as a default rate. A temperature correction factor of θ = 1.08 is used for temperatures above 10°C ($k_{-t} = k_{20}\, \theta^{(T-20)}$). Based on the 2007 report the travel time is 8.1 hrs (0.34 days). Information from other municipal WWTPs indicates that a mean effluent temperature of 22ºC is a reasonable estimate of temperature in the effluent dominated reach during the warmer weather months.

Compiling the above information it was determined that the following effluent limits should be applied for May through September: 16 mg/L weekly average, 6.9 mg/L monthly average.

Phosphorus:

Changes to chs. NR 102 and 217 include new phosphorus criteria and related procedures for calculating water quality based effluent limitations for phosphorus. These rule changes became effective on December 1st, 2010. The discharge location is classified as limited aquatic life at the point of discharge. Currently there are no applicable phosphorus criteria for ephemeral streams, limited aquatic life systems, and wetlands. However, a discharge to these waters may be subject to phosphorus limits in the WPDES permit to ensure that applicable phosphorus criteria downstream are being attained. Given the short travel time down to the coldwater segment it can be safely assumed that apart from the portion that is lost to stream bed seepage, the phosphorus will be transported to the downstream reach.

There are not enough recent phosphorus data from the Springville Branch of the Bad Axe River to calculate an upstream concentration according to the procedures in s. NR 217(2)9(d). However, there are data from nearby sites:

SWIMS ID	10010233	10028744	10013738
Station Name	Hornby Creek - Hornby Creek Li-13	Seas Branch Near Sth Y	Spring Coulee Sta.2 At Spring Coulee Rd. Us In S10
Waterbody	Hornby Creek	Seas Branch	Spring Coulee Creek
Sample Count	6	6	6
First Sample	05/20/2008	05/20/2008	05/23/2001
Last Sample	10/14/2008	10/15/2008	10/17/2001
Mean	0.054	0.07	0.042
Median	0.05	0.068	0.04
NR 217 Median	0.052	0.07	0.043
SWIMS ID	10010233	10028744	10013738

In addition, there is one sample from the Springville Spring (03/31/2010) which had a phosphorus concentration of 0.054 mg/L. So at this time it appears that the median background data from Hornby Creek best represents the ambient phosphorus concentration at Springville.

For discharges of phosphorus to flowing streams and rivers, water quality based effluent limitations are calculated using the same conservation of mass equation used in ch. NR 106:

$$\text{Limitation} = [(WQC)(Qs+(1-f)Qe) - (Qs - fQe)(Cs)]/Qe$$
$$= [(0.075)(3.1+(1-0)\,0.845) - (3.1 - 0*0.845)(0.052)]/\,0.845$$
$$= 0.43 \text{ mg/L}$$

Where:

Limitation = Water quality based effluent limitation (mg/L),
WQC = The water quality criterion concentration (0.075 mg/L),
Qs = Receiving water design flow at CTH B (3.1 cfs)
Qe = Effluent flow (0.476 MGD (0.535MGD-11% seepage loss) or 0.737 cfs)
f = Fraction of the effluent flow that is withdrawn from the receiving water (0), and
Cs = Upstream concentration (0.054 mg/L)

The calculated limitation is 0.18 mg/L. For the reasons explained in the April 30, 2012 paper entitled *Justification for Use of Monthly, Growing Season and Annual Average Periods for Expression of WPDES Permit Limits for Phosphorus Discharges in Wisconsin*, WDNR has determined that it is impracticable to express the phosphorus WQBEL for the permittee as maximum daily, weekly, or monthly values. The final effluent limit for phosphorus is expressed as a six-month average (0.17 mg/L). It is also expressed as a monthly average equal to three times the derived WQBEL (0.54 mg/L). This final effluent limit was derived from and complies with the applicable water quality criterion. Since the discharge is upstream of a phosphorus impaired portion of the Bad Axe River, a mass limit is also recommended. The recommend mass limit is 0.80 lbs/day 6 month average and is based on the 6 month concentration limit and the proposed design flow of 0.535 MGD.

Disinfection and Chlorine:

Disinfection would be required during recreational use from May through September due to the presence of several residences adjacent to the stream. The limit for fecal coliform bacteria would be the categorical limit of 400 cfu/100 mL from ch. NR 210.

Chlorine limits would be recommended if there was a change to chlorine as a disinfectant. The recommended effluent limitations would be 38 µg/L daily maximum and 7.3 µg/L as a weekly average.

Temperature

Changes to chs. NR 102 and 106 include new temperature criteria and related procedures for calculating water quality based effluent limitations for temperature. These rule changes became effective on October 1st, 2010. The rule specifies that the limitation for limited aquatic life waters is 86°F, daily maximum. There are no significant sources of heated wastewater to the Viroqua WWP. Data from similar municipal treatment systems indicate that there is no reasonable potential for the effluent limitation to be exceeded. Given the travel time and available dilution at the start of the coldwater reach, there is no reasonable potential for the discharge to cause an exceedance of the downstream coldwater temperature criteria.

Scenario 2: Discharge to the Springville Branch of the Bad Axe River near CTH B.

The coldwater portion of the Springville Branch of the Bad Axe River essentially begins at a large spring approximately 80 yards upstream of CTH B. Due to the large volume of groundwater coming from the spring, the stream temperature varies very little at CTH B. The proposed outfall location is approximately 250 yards upstream of the spring, which would leave very little opportunity for pollutant decay prior to reaching the coldwater portion. Based on the 2007 Effluent Outfall Investigation submitted on behalf of the City by Davey Engineering, the travel time in this portion of the waterway is estimated at 27 ft/min, which translates into a travel time of ~30 minutes from the proposed outfall location to the spring. Therefore limitations will be based on protecting the downstream reach.

Since the discharge is currently located on the Springville Branch of the Bad Axe River upstream this would be considered a relocated outfall, not a new discharge for purposes of anti-degradation. All of the recommended limits for discharge at the new location are either first time imposition of a limit, identical to the current limits, or more restrictive than the current limits, so this would not be considered an increased discharge under ch.NR 207.

Stream Flows (cfs):

7Q10	7Q2	30Q5
2.4	3.1	2.9

Effluent Limit Recommendations:

BOD_5 and TSS:

In establishing BOD_5 (Biochemical Oxygen Demand) limitations, the primary intent is to prevent a lowering of dissolved oxygen levels in the receiving water below water quality standards as specified in s. NR 102.04(4)(e). The 26-lb method is the most frequently used approach for calculating BOD_5 limits when resources are not available to develop a detailed water quality model. This simplified model was developed in the 1970's by the Wisconsin Committee on Water Pollution on the Fox, Wisconsin, Oconto, and Flambeau Rivers. Further studies throughout the 1970's proved this model to be relatively accurate. The model has since then been used by the Department on many occasions when resources are not available to perform a site-specific model. The "26" value stems from the following equation:

$$\frac{26\ ^{\text{lbs}}/_{\text{day}}}{^{\text{ft}^3}/_{\text{sec}}} * \frac{1\,\text{day}}{86{,}400\,\text{sec}} * \frac{454{,}000\,\text{mg}}{\text{lbs}} * \frac{1\,\text{ft}^3}{28.32\,\text{L}} = 4.8 = 2.4 * 2\ ^{\text{mg}}/_{\text{L}}$$

The 4.8 has been calculated by taking 2.4 which is the number one receives when converting 26 lbs of BOD/day/cfs into mg/L, multiplied by 2.0 which is the change in the DO level. A typical background DO level for Wisconsin waters is 7 mg/L, so a 2 mg/L decrease is allowed in order to meet the 5 mg/L criteria for warm water streams (note the criteria for cold water streams is 6.0 mg/L). The above relationship is temperature dependent and an appropriate temperature correction factor is applied. The 26-lb method is based on a typical 20°C summer value for cold water streams. Adjustments for temperature are made using the following equation:

$$k_t = k_{24}\left(0.967^{(T-24)}\right)$$

Where k_{24} = 26 lbs of BOD/day/cfs

Effluent limits are then developed based on a mass balance approach:

$$Limitation\,(mg/L) = 2.4\left(DO_{stream} - DO_{std}\right)\left(\frac{\left(Q_{stream} + Q_{eff}\right)}{Q_{eff}}\right)\left(0.967^{(T-24)}\right)$$

Where:

Q_{eff} = Effluent Flow

Q_{stream} = Stream Flow

DO_{stream} = Stream Dissolved Oxygen (8.0 mg/L based on data collected at CTH B)

DO_{dtd} = Dissolved oxygen standard (6.0 mg/L for cold water fisheries)

T = Stream Temperature (°C)

	May-Oct	Nov-Apr
Proposed Design Flow (MGD)	0.535	0.535
River Flow 7Q10 (cfs)	2.4	2.4
River Temperature	9.1	9.1
Effluent DO (mg/L)	4.0	4.0
Background DO (mg/L)	8.0	8.0
Mix DO (mg/L)	7.0	7.0
DO Criterion (mg/L)	6.0	6.0
BOD_5 Concentration Limits (mg/L)	15	15
Mass (lbs/d)	66	66

Based on the calculations above, the recommended limitations for BOD_5 are 15 mg/L and 66 lbs/day weekly average. TSS limitations are primarily given to maintain or improve water clarity and are not water quality based. For municipal facilities, suspended solids limitations are typically established at the same concentration as the BOD_5 limitations. Finally, in order to maintain adequate dissolved oxygen above and below the spring, a dissolved oxygen limit of 4.0 mg/L daily minimum is recommended.

pH:

No changes are recommended from the existing pH limitations of 6.0 s.u. as a daily minimum and 9.0 s.u. as a daily maximum.

Ammonia:

The methodology used to calculate ammonia limitations in order to protect the coldwater reach were discussed earlier. The earlier calculation procedures and stream information are the same, the major difference being that no adjustment is made for stream bed seepage or pollutant decay. The following table summarizes the ammonia limit calculations:

Effluent Flow (mgd):	0.546	
Effluent Flow (cfs):	0.845	
BACKGROUND INFORMATION:		
	summer	***winter***
4Q3 (cfs)		
7Q10 (cfs)	2.4	2.4
30Q5 (cfs)	2.9	2.9
7Q2 (cfs)	3.1	3.1
Ammonia (mg/L) (1)	0.1	0.1
Temperature (deg C) (2)	10	8.6
pH (std. units) (3)	7.8	7.8
% of river flow used:	25	25
Reference weekly flow:	0.6	0.6
Reference monthly flow:	0.725	0.725

CRITERIA (in mg/L):		
4-day Chronic (@ backgrd. pH):		
early life stages present	7.96	7.96
early life stages absent	10.65	11.65
30-day Chronic (@ backgrd. pH)		
early life stages present	3.18	3.18
early life stages absent	4.26	4.66
EFFLUENT LIMITS (in mg/L):		
Weekly average		
early life stages present	14	14
Monthly average		
early life stages present	5.8	5.8

(1) Default Data

(2) Based on continuous monitoring data 2002-2004

(3) Based on limited data at Springville

Daily maximum ammonia limits are based on effluent pH, based on the current mechanical plant and presuming full nitrification (due to the recommended weekly and monthly average ammonia limits), one would expect that effluent pH values would be similar to those of the existing treatment system (max= 7.5 s.u.). Under those circumstances the need for daily maximum ammonia limitations would be unlikely. The following table describes the relationship between effluent pH and daily maximum ammonia limitations:

Effluent pH (s.u.)	NH_3-N Limit (mg/L)	Effluent pH (s.u.)	NH_3-N Limit (mg/L)
pH ≤ 7.5	No Limit	8.2 < pH ≤ 8.3	9.4
7.5 < pH ≤ 7.6	34*	8.3 < pH ≤ 8.4	7.8
7.6 < pH ≤ 7.7	29*	8.4 < pH ≤ 8.5	6.4
7.7 < pH ≤ 7.8	24*	8.5 < pH ≤ 8.6	5.3
7.8 < pH ≤ 7.9	20*	8.6 < pH ≤ 8.7	4.4
7.9 < pH ≤ 8.0	17	8.7 < pH ≤ 8.8	3.7
8.0 < pH ≤ 8.1	14	8.8 < pH ≤ 8.9	3.1
8.1 < pH ≤ 8.2	11	8.9 < pH ≤ 9.0	2.6

* During the months of May through October if the pH is less than or equal to 7.9 there is no daily maximum limit for NH3-N. Limits shown in the table above with an asterisk* apply from November through April only.

Phosphorus:

Similar to ammonia, phosphorus limitations were evaluated under Scenario 1. The only difference for this scenario is that there is no adjustment in effluent flow to account for streambed seepage.

The calculated limitation is 0.17 mg/L. The recommended limits would be 0.17 mg/L and 0.75 lbs/day six-month average and 0.51 mg/L as a monthly average.

Disinfection and Chlorine:

Disinfection would be required during recreational use from May through September. The limit for fecal coliform bacteria would be the categorical limit of 400 cfu/100 mL from ch. NR 210.

Chlorine limits would be recommended if there was a change to chlorine as a disinfectant. The recommended effluent limitations would be 38 µg/L daily maximum and 12 µg/L as a weekly average.

Temperature:

As noted earlier, changes to chs. NR 102 and 106 include new temperature criteria and related procedures for calculating water quality based effluent limitations for temperature. These rule changes became effective on October 1st, 2010.

The general procedure for calculating temperature limits to fish and aquatic life stream are based on several factors, actual effluent flow rates, ambient stream temperatures (default or site-specific) and available dilution. Based on the receiving water classification, default ambient stream temperatures and available dilution, summary of the calculated limitations would be as follows (more detailed information included at the end of this addendum):

Month	Weekly Ave Limit (°F)	Daily Max Limit (°F)	Month	Weekly Ave Limit (°F)	Daily Max Limit (°F)
Jan	74	116	Jul	**71**	81
Feb	67	117	Aug	**68**	81
Mar	65	91	Sep	**66**	93
Apr	70	83	Oct	**62**	106
May	74	83	Nov	65	120
Jun	72	77	Dec	69	120

At this time there is no representative temperature data from Viroqua, however there are data from a similar facility (Village of Holmen) that indicate that weekly average temperature limits are necessary from the months of July – October.

However, municipal facilities can take advantage of dissipative cooling. Dissipative cooling, by definition in s. NR 106.59, Wis. Adm. Code, is the cooling effect associated with heat loss to the ambient water, the atmosphere and the surrounding environment. The primary objective of establishing temperature limitations is to ensure there is no point in the receiving water where elevated effluent temperature will result in lethality or otherwise significantly impair the existence of a balanced fish and aquatic life community. Dissipative cooling can be used to drop sub-lethal effluent temperature limits from the WPDES permit, however, pursuant to ss. NR 106.59 (4) and (6), Wis. Adm. Code.

Based on the calculation procedures using default data, dissipative cooling may be more difficult to demonstrate due to the fact that warm air temperatures in summer may not be conducive to heat loss to the environment. However, as noted earlier there are data from the stream that indicate that the ambient stream temperatures at CTH B are quite a bit different from the default temperatures. Temperature data were collected at CTH B at hourly intervals from September 2002 to April 2004. If these data are used to calculate temperature limitations a different picture emerges:

Month	Weekly Ave Limit (°F)	Daily Max Limit (°F)	Month	Weekly Ave Limit (°F)	Daily Max Limit (°F)
Jan	**48**	103	Jul	92	88
Feb	49	108	Aug	83	87
Mar	57	88	Sep	75	99
Apr	70	82	Oct	**59**	108
May	84	84	Nov	**48**	117
Jun	82	80	Dec	**50**	114

Using site-specific temperature data switches the months when a temperature limit is indicated to the cold weather months of October – January. Demonstration of dissipative cooling should be much easier to accomplish during these months as ambient air temperatures are generally cooler than either the stream or effluent.

If relocation of the outfall becomes the selected alternative in the facility plan, it is recommended that the facility undertake the steps necessary to provide adequate information for a dissipative cooling demonstration. Much of the information needed can be developed in a short time frame (e.g. description of physical stream and proposes outfall design). However, some pieces of information will take longer to develop. More specifically:

- Development of site-specific stream temperature data: While the department has generated considerable data at CTH B, it does not meet the requirements of s. NR 102.26(1), in that there are not the two full years of data required under that portion of the rule.
- Development of temperature effluent data: It is this reviewer's understanding that the facility currently has the capability of recording continuous temperature data. The department will provide additional information on data collection and make changes to the DMRs such that the effluent temperature data can be captured.
- Estimation of in-stream temperature loss from the proposed outfall location to the spring: While the estimated travel time from the proposed outfall location to the spring is relatively short (30 minutes), monitoring of the effluent at a comparable distance downstream of the current outfall may be worth investigating as it could afford some additional opportunity for cooling during the cold weather months.

The permittee is strongly encouraged to discuss site-specific study design further with DNR staff. Additional information regarding temperature limitations, dissipative cooling demonstrations, effluent temperature monitoring, and stream temperature monitoring can be found in the Department's *Guidance for Implementation of Wisconsin's Thermal Water Quality Standards* available at http://dnr.wi.gov/topic/surfacewater/thermal.html.

Scenario 3: Discharge to the current outfall location without efforts to mitigate effects of the disappearing stream.

At the current discharge location, the Springville Branch of the Bad Axe River is classified as

Limited Aquatic Life in ch. NR 104. This scenario includes the supposition of no actions being taken to minimize loss to groundwater. In such a case the discharge is considered both a surface water discharge and a discharge to groundwater.

Based on the 2007 Effluent Outfall Investigation submitted on behalf of the City by Davey Engineering, a loss of ~80% occurred prior to the exposed bedrock reaches (based on flow at weir #2). That same report estimated the travel time from the current outfall location to the spring at 8.1 hours (0.34 days).

The attached March 24, 2015 file memo from Jim Boettcher discusses the limitations necessary to protect ground water quality.

BOD_5 and TSS:

Based on the receiving water classification, the recommended limitations for BOD_5 and TSS are 30 mg/L weekly average and 20 mg/L monthly average. In order to maintain adequate dissolved oxygen above and below the spring, a dissolved oxygen limit of 4.0 mg/L daily minimum is recommended.

pH:

No changes are recommended from the existing pH limitations of 6.0 s.u. as a daily minimum and 9.0 s.u. as a daily maximum.

Ammonia:

Based on relative low mean (6.9 s.u.) and maximum (7.5 s.u.) effluent pH results, and resultant ammonia limitations, no ammonia limits would be recommended based on the limited aquatic life reach. Meeting a 10 mg/L total nitrogen limit in order to protect groundwater quality would require the treatment facility to nitrify (and denitrify) the effluent, and given the reduced volume of effluent reaching the downstream trout reach under this scenario, ammonia limits would not be required for this scenario.

Phosphorus:

The calculation of phosphorus limitations for this scenario is similar to that of Scenario 1, the only difference being the proportion of the effluent reaching the coldwater reach.

Limitation = [(WQC) (Qs+(1−f)Qe) − (Qs− fQe) (Cs)]/Qe
= [(0.075) (3.1+(1−0) 0.845) − (3.1− 0*0.845) (0.052)]/ 0.845
= 0.43 mg/L

Where:

Limitation = Water quality based effluent limitation (mg/L),
WQC = The water quality criterion concentration (0.075 mg/L),
Qs = Receiving water design flow at CTH B (3.1 cfs)
Qe = Effluent flow (0.107 MGD (0.535 MGD-80% seepage loss) or 0.17 cfs)
f = Fraction of the effluent flow that is withdrawn from the receiving water (0), and
Cs = Upstream concentration (0.054 mg/L)

The calculated limitation is 0.47 mg/L, monthly average. Since the discharge is upstream of a phosphorus impaired portion of the Bad Axe River, a mass limit is also recommended. The recommend mass limit is 2.1 lbs/day monthly average and the proposed design flow of 0.535 MGD.

Disinfection and Chlorine:

Disinfection would be required throughout the year based on protection of groundwater. Chlorine limits would be recommended if there was a change to chlorine as a disinfectant. The recommended effluent limitations would be 38 µg/L daily maximum and 7.3 µg/L as a weekly average.

Temperature

The temperature recommendations are the same as Scenario 1 (no limit needed).

Temperature limits for receiving waters with unidirectional flow

(calculation using default ambient temperature data)

Facility:	Viroqua	**Data Range**		**7Q10 or 4Q3:**	2.4 cfs
Outfall(s):	001	**Start:**	01/01/10	**Dilution:**	50%
Date Prepared:	5-Feb-15	**End:**	12/31/14	**f:**	0
Design Flow (Qe):	0.546 mgd			**Stream type:**	Cold water community
				Qs:Qe ratio:	1.4 :1
				Calculation Needed?	**YES**

Month	Water Quality Criteria			Receiving Water Flow Rate (Qs)	Representative Highest Effluent Flow Rate (Qe)		Representative Highest Monthly Effluent Temperature		99th Percentile of Representative Data		**Calculated Effluent Limits**	
	Ta (default) (°F)	Sub-Lethal WQC (°F)	Acute WQC (°F)	(cfs)	7-day Rolling Ave (Qesl) (mgd)	Daily Max Flow Rate (Qea) (mgd)	Weekly Ave (°F)	Daily Max (°F)	Weekly Ave (°F)	Daily Max* (°F)	**Weekly Ave Limit** (°F)	**Daily Max Limit** (°F)
JAN	35	47	68	1.20	0.344	0.532	54	55			74	116
FEB	36	47	68	1.20	0.436	0.506	49	50			67	117
MAR	39	51	69	1.20	0.688	1.057	54	54			65	91
APR	47	57	70	1.20	0.610	1.382	56	57			70	83
MAY	56	63	72	1.20	0.493	1.167	61	64			74	83
JUN	62	67	72	1.20	0.800	1.545	67	69			72	77
JUL	64	67	73	1.20	0.546	0.914	**74**	75			**71**	81
AUG	63	65	73	1.20	0.570	1.012	**74**	75			**68**	81
SEP	57	60	72	1.20	0.379	0.553	**72**	73			**66**	93
OCT	49	53	70	1.20	0.341	0.447	**66**	67			**62**	106
NOV	41	48	69	1.20	0.315	0.381	58	59			65	120
DEC	37	47	69	1.20	0.351	0.418	56	58			69	120

*Temperature data from Holmen WWTP

Temperature limits for receiving waters with unidirectional flow

(calculation using default ambient temperature data)

Facility:	Viroqua	**Data Range**	**7Q10 or 4Q3:**	2.4 cfs
Outfall(s):	001	**Start:** 01/01/10	**Dilution:**	50%
Date Prepared:	5-Feb-15	**End:** 12/31/14	**f:**	0
Design Flow (Qe):	0.546 mgd		**Stream type:**	Cold water community
			Qs:Qe ratio:	1.4 :1
			Calculation Needed?	**YES**

Month	Water Quality Criteria			Receiving Water Flow Rate (Qs)	Representative Highest Effluent Flow Rate (Qe)		Representative Highest Monthly Effluent Temperature		99th Percentile of Representative Data		**Calculated Effluent Limits**	
	Ta (default)	Sub-Lethal WQC	Acute WQC		7-day Rolling Ave (Qesl)	Daily Max Flow Rate (Qea)	Weekly Ave	Daily Max	Weekly Ave	Daily Max*	**Weekly Ave Limit**	**Daily Max Limit**
	(°F)	(°F)	(°F)	(cfs)	(mgd)	(mgd)	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)
JAN	48	48	70	1.25	0.344	0.532	**54**	55			**48**	103
FEB	46	47	70	1.25	0.436	0.506	49	50			49	108
MAR	46	51	70	1.25	0.688	1.057	54	54			57	88
APR	49	58	70	1.25	0.610	1.382	56	57			70	82
MAY	50	63	70	1.25	0.493	1.167	61	64			84	84
JUN	50	66	70	1.25	0.800	1.545	67	69			82	80
JUL	50	67	70	1.25	0.546	0.914	74	75			92	88
AUG	49	63	70	1.25	0.570	1.012	74	75			83	87
SEP	50	58	70	1.25	0.379	0.553	72	73			75	99
OCT	49	52	70	1.25	0.341	0.447	**66**	67			**59**	108
NOV	48	48	70	1.25	0.315	0.381	**58**	59			**48**	117
DEC	47	48	70	1.25	0.351	0.418	**56**	58			**50**	114

*Temperature data from Holmen WWTP

DATE: March 24, 2015 FILE REF: 3400

TO: File

FROM: Jim Boettcher - WCR

SUBJECT: Limits for Groundwater with the point of discharge at the current outfall location at the WWTP

Limits for Groundwater with the point of discharge at the current outfall location at the WWTP.

At the current outfall location the discharge is both a surface water discharge and a discharge to groundwater.

PARAMETER	Limit	Source
BOD_5	50 mg/L	NR 206.08(1)(b)1. and Table 1, NR 206
Total Nitrogen	10 mg/L monthly average	NR 206.08(1)(b)3.a. and Table 1, NR 206
Chlorides	250 mg/L	NR 206.08(1)(b)3.c. and Table 1, NR 206
TDS	500 mg/L	NR 206.08(1)(b)3.b. and Table 1, NR 206
Bacteria, Total Coliform	0	Table 1, NR 140

From NR 140, Table 1, Footnote 3

3 Total coliform bacteria may not be present in any 100 ml sample using either the membrane filter (MF) technique, the presence−absence (P−A) coliform test, the
minimal medium ONPG−MUG (MMO−MUG) test or not present in any 10 ml portion of the 10−tube multiple tube fermentation (MTF) technique.

Based on a January 2007 report by Davy Engineering approximately 380,000 gallons of flow is lost to groundwater between the point of discharge and the second CTH B bridge downstream of the WWTP, a distance of about 13,000 feet.

Approximately 320,000 gallons of flow was lost in the 3,800 feet of stream bed upstream of the second CTH B bridge downstream of the WWTP, a reach in which fractured dolomite is visible in the stream bed.

While the actual flow in gallons lost to the stream bed and the percentage of flow lost between the WWTP and the second CTH B bridge downstream of the WWTP may vary from measurement to measurement there is a substantial loss of flow to groundwater through visible fractures in dolomite bedrock in the streambed.

There is no soil filter between the open fractures and the effluent to provide a mechanism to protect groundwater as required for absorption ponds, therefore the stringent disinfection requirement.

Appendix J

Cost Evaluations

- **Capital Costs – Outfall Options**
- **Capital Costs – WWTF Options**
- **O&M Costs**
- **Replacement Costs**
- **Present Worth Analysis**

City of Viroqua
WWTP Facilities Planning
Capital Cost for Outfall Modifications

	Units	Qty	Rate	Total
Option 2A - WWTP Bypass Piping - Gravity				
Easements	EA	10	$12,500	$125,000
Permits	LS	1	$10,000	$10,000
Mobilization	LS	1	$15,000	$15,000
Effluent Box				
Excavation and fill	CY	30	$75	$2,250
Concrete base	CY	3	$400	$1,200
Concrete walls	CY	10	$900	$9,000
Weir gates	EA	2	$5,000	$10,000
Pipelines				
18" PVC	LF	10,000	$145	$1,450,000
18" Ductile	LF	100	$200	$20,000
Rock exacavation-Assumes 2 feet	CY	2,222	$125	$277,778
Manholes	EA	16	$2,000	$32,000
Outfall structure	EA	1	$25,000	$25,000
Road Crossings				
Excavation	CY	240	$50	$12,000
Slurry fill	CY	80	$250	$20,000
Asphalt pavement	SY	75	$100	$7,500
Traffic control	LS	1	$5,000	$5,000
Subtotal				$2,021,728
Contingency			10%	$202,173
Survey and easements			3%	$60,652
Legal			5%	$101,086
Engineering			15%	$303,259
Total				**$2,688,898**

City of Viroqua
WWTP Facilities Planning
Capital Cost for Outfall Modifications

	Units	Qty	Rate	Total
Option 2B - WWTP Bypass Piping - Lift Station and Force Main				
Easements	EA	1	$10,000	$10,000
Permits	LS	1	$7,500	$7,500
Mobilization	LS	1	$15,000	$15,000
Lift station				
Excavation and fill	LS	1	$20,000	$20,000
Dewatering	LS	1	$18,000	$18,000
Concrete base	CY	10	$600	$6,000
Wetwell Structure-10 ft diameter MH	VF	20	$2,000	$40,000
Pumps and installation	EA	3	$25,000	$75,000
Controls and panel	LS	1	$50,000	$50,000
Piping	LS	1	$22,500	$22,500
Power	LS	1	$3,000	$3,000
Pipelines				
12" FM-Reach 1	LF	6,450	$95	$612,750
12" FM-Reach 2	LF	1,257	$90	$113,130
12" FM-Reach 3	LF	1,469	$90	$132,210
12" FM-Reach 4	LF	1,674	$125	$209,250
Rock exacavation-Reach 4	CY	1,116	$125	$139,500
Air relief Manholes	EA	7	$18,000	$126,000
Outfall structure	EA	1	$25,000	$25,000
Road Crossings				
Excavation	CY	240	$50	$12,000
Slurry fill	CY	80	$250	$20,000
Asphalt pavement	SY	75	$100	$7,500
Traffic control	LS	1	$5,000	$5,000
Subtotal				$1,669,340
Contingency			10%	$166,934
Survey and easements			1%	$16,693
Legal			2%	$33,387
Engineering			15%	$250,401
Total				**$2,136,755**

City of Viroqua WWTP Upgrade
Capital Cost Summary

	Phase 1			Phase 1A	Phase 2
	Alternative 1	Alternative 2	Alternative 3		
1 Site Work	$178,250	$178,250	$218,600	$5,150	$48,100
2 Headworks/Primary Clarifiers	$15,000	$15,000	$15,000	$740,000	$0
3 Selector and Aeration Basins	$161,575	$161,575	$345,250	$0	$0
4 Splitter Structure	$7,000	$61,200	$51,400	$0	$0
5 Final Clarifiers	$340,000	$352,300	$352,300	$0	$0
6 UV Structure	$0	$0	$0	$0	$361,500
7 Blower Building	$108,300	$108,300	$108,300	$0	$0
8 Phosphorus Removal	$0	$0	$0	$0	$1,627,500
9 Digester Complex	$0	$0	$0	$519,050	$0
10 Sludge Storage	$5,000	$5,000	$5,000	$0	$0
11 Waste Receiving Station	$247,375	$247,375	$247,375	$0	$0
12 Equalization Detention Basin	$143,250	$143,250	$143,250	$0	$0
13 Lab/Process Building	$195,500	$195,500	$195,500	$0	$0
14 Sludge Thickening	$551,150	$551,150	$551,150	$0	$0
Subtotal	$1,952,400	$2,018,900	$2,233,125	$1,264,200	$2,037,100
Electrical and Instrumentation	$488,100	$488,100	$558,300	$252,900	$407,500
Contractor Management	$218,900	$224,700	$249,100	$154,500	$234,300
Total Construction Cost	$2,659,400	$2,731,700	$3,040,600	$1,671,600	$2,678,900
Contingencies	$266,000	$273,200	$304,100	$167,200	$267,900
Engineering, Legal, Admin	$399,000	$409,800	$456,100	$250,800	$401,900
Capital Cost - WWTP	$3,324,400	$3,414,700	$3,800,800	$2,089,600	$3,348,700
Capital Cost - Effluent LS and FM	$2,137,000	$2,137,000	$2,137,000		
Total Capital Cost	**$5,461,400**	**$5,551,700**	**$5,937,800**	**$2,089,600**	**$3,348,700**

Notes:
Phase 1A includes Primary/Headworks structure upgrade with HVAC modifications and possible screen replacement and Digester rehab and equipment replacement.
Phase 2 includes a filtration system for phosphorus removal and UV system replacement, which would be needed if a filter is required. The goal is to do only a small portion of Phase 2, not to install the phosphorus removal filter.

City of Viroqua
WWTP Facilities Planning
Capital Costs for WWTP Upgrade Alternatives

	PHASE 1										
	Qty				Unit Cost			Install	Total Cost		
	Alt 1	Alt 2	Alt 3	Units	Alt 1	Alt 2	Alt 3	Factor	Alt 1	Alt 2	Alt 3
1 Site Work											
Erosion Control	1	1	1	LS	$1,000	$1,000	$2,500	1.00	$1,000	$1,000	$2,500
Site Grading	1	1	1	LS	$1,000	$1,000	$2,500	1.00	$1,000	$1,000	$2,500
Site Fencing	1,000	1,000	1,000	LF	$20	$20	$20	1.00	$20,000	$20,000	$20,000
Front Gate Security	1	1	1		$20,000	$20,000	$20,000	1.00	$20,000	$20,000	$20,000
Dewatering and Sheeting	1	1	1	LS	$10,000	$10,000	$10,000	1.00	$10,000	$10,000	$10,000
Site Conditions/Constraints	1	1	1	LS	$10,000	$10,000	$20,000	1.00	$10,000	$10,000	$20,000
Asphalt Paving	500	500	650	SY	$40	$40	$40	1.00	$20,000	$20,000	$26,000
Sidewalks	100	100	180	SF	$7.50	$7.50	$7.50	1.00	$750	$750	$1,350
Site Piping											
Primary to Selectors			90	LF	$75	$75	$75	1.00	$0	$0	$6,750
UV to New Lift Station	100	100	100	LF	$100	$100	$100	1.00	$10,000	$10,000	$10,000
Septage Receiving	250	250	250	LF	$50	$50	$50	1.00	$12,500	$12,500	$12,500
RAS Connection			1	LS	$5,000	$5,000	$5,000	1.00	$0	$0	$5,000
Air Connection			1	LS	$5,000	$5,000	$5,000	1.00	$0	$0	$5,000
Site Piping Valves	8	8	8	EA	$1,500	$1,500	$1,500	1.00	$12,000	$12,000	$12,000
Dome Removal/Reinstall	2	2	2	EA	$10,000	$10,000	$10,000	1.00	$20,000	$20,000	$20,000
Dome Recoating	2	2	2	EA	$15,000	$15,000	$15,000	1.00	$30,000	$30,000	$30,000
Painting				LS	$10,000	$10,000	$10,000	1.00	$0	$0	$0
Landscaping	2,500	2,500	2,500	SF	$2	$2	$2	1.00	$5,000	$5,000	$5,000
Seed, Fertilizer, Mulch	1,200	1,200	2,000	SY	$5	$5	$5	1.00	$6,000	$6,000	$10,000
									$178,250	**$178,250**	**$218,600**
2 Headworks/Primary Clarifiers											
Skimmer Replacement	1	1	1	LS	$10,000	$10,000	$10,000	1.00	$10,000	$10,000	$10,000
Structure Upgrade				LS				1.00	$0	$0	$0
Chemical Room Modifications				LS				1.00	$0	$0	$0
Piping/Hydraulics Modifications	1	1	1	LS	$5,000	$5,000	$5,000	1.00	$5,000	$5,000	$5,000
Screen Replacement				LS				1.20	$0	$0	$0
HVAC/Electrical Modifications				LS				1.00	$0	$0	$0
									$15,000	**$15,000**	**$15,000**
3 Selector and Aeration Basins											
Demolition											
Baffle walls	4	4	4	EA	$2,500	$2,500	$2,500	1.00	$10,000	$10,000	$10,000
Launders	1	1	1	LS	$2,500	$2,500	$2,500	1.00	$2,500	$2,500	$2,500
Concrete	10	10	10	CY	$1,250	$1,250	$1,250	1.00	$12,500	$12,500	$12,500
Concrete Coring Thru Wall	4	4	7	EA	$1,500	$1,500	$1,500	1.00	$6,000	$6,000	$10,500
Mixer Removal	6	6	6	EA	$500	$500	$500	1.00	$3,000	$3,000	$3,000
Diffusers			1,470	SF	$7.50	$8	$8	1.00	$0	$0	$11,025
Piping			40	LF	$15	$15	$15	1.00	$0	$0	$600
Concrete											
Structural fill	15	15	15	CY	$25	$25	$25	1.00	$375	$375	$375
Straight walls	32	32	16	CY	$675	$675	$675	1.00	$21,700	$21,700	$10,850
Weir Gate installation	4	4	7	EA	$3,500	$3,500	$3,500	1.20	$16,800	$16,800	$29,400
Stairs and railings				LF	$75	$75	$75	1.00	$0	$0	$0
Mixer Install	2	2	2	EA	$12,500	$12,500	$12,500	1.20	$30,000	$30,000	$30,000
Diffuser Grid Install			2,785	SF	$30	$30	$30	1.00	$0	$0	$83,550
Denite Recycle Pump	2	2	1	EA	$3,000	$3,000	$3,000	1.20	$7,200	$7,200	$3,600
Valves											
Telescoping valves	4	4		EA	$7,500	$7,500	$7,500	1.00	$30,000	$30,000	$0
Bypass valves or gates			6	EA	$3,500	$3,500	$3,500	1.00	$0	$0	$21,000
Primary Eff valves			2	EA	$3,500	$3,500	$3,500	1.00	$0	$0	$7,000
RAS valves			2	EA	$2,000	$2,000	$2,000	1.00	$0	$0	$4,000
Aeration Automated Valves			4	EA	$3,500	$3,500	$3,500	1.00	$0	$0	$14,000
Piping											
Primary to Selectors	90	90	40	LF	$200	$200	$250	1.00	$18,000	$18,000	$10,000
Bypass			225	LF	$200	$200	$250	1.00	$0	$0	$56,250
RAS			40	LF	$125	$125	$150	1.00	$0	$0	$6,000
Between E and W (14")			18	LF	$200	$200	$200	1.00	$0	$0	$3,600
Denite Recycle	70	70	60	LF	$50	$50	$50	1.00	$3,500	$3,500	$3,000
Aeration			50	LF	$225	$225	$250	1.00	$0	$0	$12,500
									$161,575	**$161,575**	**$345,250**
4 Splitter Structure											
Demolition											
Piping and Flume		20	20	LF	$15	$15	$15	1.00	$0	$300	$300
Concrete Coring Thru Wall		4	4	EA	$1,250	$1,250	$1,250	1.00	$0	$5,000	$5,000
Concrete											
Straight walls		16	21	CY	$675	$675	$675	1.00	$0	$10,850	$14,350
Concrete patching/repairs		1	1	LS	$2,000	$2,000	$2,000	1.00	$0	$2,000	$2,000
Weir Gate installation		2	3	EA	$3,500	$3,500	$3,500	1.20	$0	$8,400	$12,600

City of Viroqua
WWTP Facilities Planning
Capital Costs for WWTP Upgrade Alternatives

	PHASE 1										
	Qty				Unit Cost			Install	Total Cost		
	Alt 1	Alt 2	Alt 3	Units	Alt 1	Alt 2	Alt 3	Factor	Alt 1	Alt 2	Alt 3
Bypass Gate (18")		1			$4,500	$4,500	$4,500	1.20	$0	$5,400	$0
Telescoping Valves		2			$7,500	$7,500	$7,500	1.20	$0	$18,000	$0
Grating and railings	350	350	350	SF	$20	$20	$20	1.00	$7,000	$7,000	$7,000
Piping											
Between Trains (18")		10		LF	$250	$250	$250	1.00	$0	$2,500	$0
To Clarifiers (12")		10	58	LF	$175	$175	$175	1.00	$0	$1,750	$10,150
									$7,000	**$61,200**	**$51,400**
5 Final Clarifiers											
Demolition											
Mechanism Removal	2	2	2	EA	$15,500	$15,500	$15,500	1.00	$31,000	$31,000	$31,000
Concrete Coring Thru Wall		4	4	EA	$1,500	$1,500	$1,500	1.00	$0	$6,000	$6,000
Concrete											
Clarifier Mechanism	2	2	2	EA	$95,000	$95,000	$95,000	1.20	$228,000	$228,000	$228,000
Walkways and railings	280	280	280	LF	$75	$75	$75	1.00	$21,000	$21,000	$21,000
Painting	2	2	2	EA	$30,000	$30,000	$30,000	1.00	$60,000	$60,000	$60,000
Piping											
To Post Aeration		36	36	LF	$175	$175	$175	1.00	$0	$6,300	$6,300
									$340,000	**$352,300**	**$352,300**
6 UV Structure											
Demolition											
Concrete				CY	$1,250	$1,250	$1,250	1.00	$0	$0	$0
Equipment				EA	$500	$500	$500	1.00	$0	$0	$0
Electrical				LS	$2,500	$2,500	$2,500	1.00	$0	$0	$0
Excavation				CY	$30	$30	$30	1.00	$0	$0	$0
Concrete											
Structural fill				CY	$25	$25	$25	1.00	$0	$0	$0
Slab on soil					$450	$450	$450	1.00	$0	$0	$0
Straight walls				CY	$675	$675	$675	1.00	$0	$0	$0
Misc concrete				CY	$500	$500	$500	1.00	$0	$0	$0
Steel Superstructure				LS	$50,000	$50,000	$50,000				
UV Equipment install				EA	$175,000	$175,000	$175,000	1.20	$0	$0	$0
Grating				LF	$50	$50	$50	1.00	$0	$0	$0
Bypass piping				LF	$125	$125	$125	1.00	$0	$0	$0
Bypass valves or gates				EA	$3,750	$3,750	$3,750	1.20	$0	$0	$0
									$0	**$0**	**$0**
7 Blower Building											
Demolition											
Blower removal	2	2	2	EA	$1,250	$1,250	$1,250	1.00	$2,500	$2,500	$2,500
Aeration piping				LF	$15	$15	$15	1.00	$0	$0	$0
Blower installation	2	2	2	EA	$42,000	$42,000	$42,000	1.20	$100,800	$100,800	$100,800
Aeration piping	1	1	1	LS	$5,000	$5,000	$5,000	1.00	$5,000	$5,000	$5,000
									$108,300	**$108,300**	**$108,300**
8 Phosphorus Removal											
Site Work				LS	$65,000	$65,000	$65,000	1.00	$0	$0	$0
Building and Equipment				EA	$1,238,500	$1,238,500	$1,238,500	1.00	$0	$0	$0
Chemical additions				LS	$224,000	$224,000	$224,000	1.00	$0	$0	$0
Piping				LS	$100,000	$100,000	$100,000	1.00	$0	$0	$0
									$0	**$0**	**$0**
9 Digester Complex											
Demolition											
Boiler/Heat Xchgr				LS	$2,500	$2,500	$2,500	1.00	$0	$0	$0
Gas train				LS	$4,000	$4,000	$4,000	1.00	$0	$0	$0
Digester mixing system				EA	$1,500	$1,500	$1,500	1.00	$0	$0	$0
Equipment Install											
Boiler/Heat Xchgr				EA	$175,000	$175,000	$175,000	1.20	$0	$0	$0
Gas train				EA	$45,000	$45,000	$45,000	1.20	$0	$0	$0
Digester mixing system				EA	$90,000	$90,000	$90,000	1.20	$0	$0	$0
Sludge Pumps				EA	$15,000	$15,000	$15,000	1.20	$0	$0	$0
Cover Rehabilitation				EA	$75,000	$75,000	$75,000	1.00	$0	$0	$0
Tuckpointing/Exterior Repairs				LS	$7,500	$7,500	$7,500	1.00	$0	$0	$0
Process Piping											
Sludge Feed				LF	$100	$100	$100	1.00	$0	$0	$0
Valves				EA	$950	$950	$950	1.00	$0	$0	$0
Plumbing											
New Water Connections				EA	$500	$500	$500	1.00	$0	$0	$0
Drains/Vents				EA	$550	$550	$550	1.00	$0	$0	$0
Painting				SF	$5	$5	$5	1.00	$0	$0	$0
									$0	**$0**	**$0**
10 Sludge Storage											
Exterior Repairs	1	1	1	LS	$5,000	$5,000	$5,000	1.00	$5,000	$5,000	$5,000
									$5,000	**$5,000**	**$5,000**

City of Viroqua
WWTP Facilities Planning
Capital Costs for WWTP Upgrade Alternatives

	PHASE 1										
	Qty				Unit Cost			Install	Total Cost		
	Alt 1	Alt 2	Alt 3	Units	Alt 1	Alt 2	Alt 3	Factor	Alt 1	Alt 2	Alt 3
11 Waste Receiving Station											
Excavation	2,400	2,400	2,400	CY	$30	$30	$30	1.00	$72,000	$72,000	$72,000
Concrete											
Structural fill	25	25	25	CY	$25	$25	$25	1.00	$625	$625	$625
Straight walls	110	110	110	CY	$675	$675	$675	1.00	$74,250	$74,250	$74,250
Slab on grade	40	40	40		$450	$450	$450	1.00	$18,000	$18,000	$18,000
Shored slab	30	30	30	CY	$1,100	$1,100	$1,100	1.00	$33,000	$33,000	$33,000
Misc concrete	10	10	10	CY	$500	$500	$500	1.00	$5,000	$5,000	$5,000
Equipment Install											
Submersible pumps	2	2	2	EA	$7,500	$7,500	$7,500	1.00	$15,000	$15,000	$15,000
Diffusers	8	8	8	EA	$250	$250	$250	1.00	$2,000	$2,000	$2,000
Blower	1	1	1	EA	$3,750	$3,750	$3,750	1.20	$4,500	$4,500	$4,500
Stairs and railings	0	0	0	EA	$75	$75	$75	1.00	$0	$0	$0
Access hatches	5	5	5	EA	$1,250	$1,250	$1,250	1.20	$7,500	$7,500	$7,500
Mechanical gates	2	2	2	EA	$3,750	$3,750	$3,750	1.20	$9,000	$9,000	$9,000
Piping and valves	1	1	1	LS	$6,500	$6,500	$6,500	1.00	$6,500	$6,500	$6,500
									$247,375	**$247,375**	**$247,375**
12 Equalization Storage Basin											
Demolition											
Liner removal	3,725	3,725	3,725	SY	$10	$10	$10	1.00	$37,250	$37,250	$37,250
Lining											
Clay liner	3,725	3,725	3,725	SY	$15	$15	$15	1.00	$55,875	$55,875	$55,875
Compacted Gravel	3,725	3,725	3,725	SY	$5	$5	$5	1.00	$18,625	$18,625	$18,625
Asphalt	450	450	450	TON	$70	$70	$70	1.00	$31,500	$31,500	$31,500
									$143,250	**$143,250**	**$143,250**
13 Lab/Process Building											
Demolition	1	1	1	LS	$10,000	$10,000	$10,000	1.00	$10,000	$10,000	$10,000
Convert Chlorine Rm to Office	1	1	1	LS	$20,000	$20,000	$20,000	1.00	$20,000	$20,000	$20,000
Lab upgrade	1	1	1	LS	$20,000	$20,000	$20,000	1.00	$20,000	$20,000	$20,000
HVAC	1	1	1	LS	$20,000	$20,000	$20,000	1.00	$20,000	$20,000	$20,000
Windows and Doors	1	1	1	LS	$8,500	$8,500	$8,500	1.00	$8,500	$8,500	$8,500
Sludge Pump	1	1	1	LS	$17,500	$17,500	$17,500	1.20	$21,000	$21,000	$21,000
MCC Lineup Upgrade	1	1	1	LS	$80,000	$80,000	$80,000	1.20	$96,000	$96,000	$96,000
									$195,500	**$195,500**	**$195,500**
14 Sludge Thickening											
Construction											
Excavation	625	625	625	CY	$30	$30	$30	1.00	$18,750	$18,750	$18,750
Structural Fill	90	90	90	CY	$25	$25	$25	1.00	$2,250	$2,250	$2,250
Footings	15	15	15	CY	$400	$400	$400	1.00	$6,000	$6,000	$6,000
Slab on soil	20	20	20	CY	$550	$550	$550	1.00	$11,000	$11,000	$11,000
Foundation walls	25	25	25	CY	$650	$650	$650	1.00	$16,250	$16,250	$16,250
Stoops	5	5	5	CY	$750	$750	$750	1.00	$3,750	$3,750	$3,750
Block wall - split face	1,300	1,300	1,300	SF	$35	$35	$35	1.00	$45,500	$45,500	$45,500
Concrete planking	750	750	750	SF	$18	$18	$18	1.00	$13,125	$13,125	$13,125
Roofing	750	750	750	SF	$22	$22	$22	1.00	$16,500	$16,500	$16,500
Architectural	750	750	750	SF	$20	$20	$20	1.00	$15,000	$15,000	$15,000
Stairs	12	12	12	LF	$150	$150	$150	1.25	$2,250	$2,250	$2,250
Railings	32	32	32	LF	$50	$50	$50	1.25	$2,000	$2,000	$2,000
Equipment											
Polymer System	1	1	1	EA	$14,000	$14,000	$14,000	1.30	$18,200	$18,200	$18,200
Polymer spare parts	1	1	1	LS	$5,000	$5,000	$5,000	1.00	$5,000	$5,000	$5,000
DAF Thickener	1	1	1	EA	$225,000	$225,000	$225,000	1.15	$258,750	$258,750	$258,750
TWAS Pumps	2	2	2	EA	$17,500	$17,500	$17,500	1.25	$43,750	$43,750	$43,750
Beam and hoist	1	1	1	EA	$12,500	$12,500	$12,500	1.25	$15,625	$15,625	$15,625
Process Piping											
Sludge Feed	100	100	100	LF	$100	$100	$100	1.00	$10,000	$10,000	$10,000
Process Drain	100	100	100	LF	$100	$100	$100	1.00	$10,000	$10,000	$10,000
TWAS	125	125	125	LF	$100	$100	$100	1.00	$12,500	$12,500	$12,500
Polymer Feed	30	30	30	LF	$25	$25	$25	1.00	$750	$750	$750
Valves	6	6	6	EA	$900	$900	$900	1.00	$5,400	$5,400	$5,400
Plumbing											
New Water Connections	6	6	6	EA	$500	$500	$500	1.00	$3,000	$3,000	$3,000
Drains/Vents	6	6	6	EA	$550	$550	$550	1.00	$3,300	$3,300	$3,300
Painting	2,500	2,500	2,500	SF	$5	$5	$5	1.00	$12,500	$12,500	$12,500
									$551,150	**$551,150**	**$551,150**

City of Viroqua
WWTP Facilities Planning
Capital Costs for WWTP Upgrade Alternatives

	PHASE 1										
	Qty				Unit Cost			Install	Total Cost		
	Alt 1	Alt 2	Alt 3	Units	Alt 1	Alt 2	Alt 3	Factor	Alt 1	Alt 2	Alt 3
Construction Cost									**$1,952,400**	**$2,018,900**	**$2,233,200**
Electrical					25%	Same as 1	25%		**$488,100**	**$488,100**	**$558,300**
Construction Cost w/Elec									**$2,440,500**	**$2,507,000**	**$2,791,500**
Additional Contractor Costs											
Contractor Administration				LS	2.5%	2.5%	2.5%		$61,013	$62,675	$69,788
Mobilization				LS	2%	2%	2%		$48,810	$50,140	$55,830
Bonds, Permits, Insurance				LS	1%	1%	1%		$24,405	$25,070	$27,915
Project Documentation				LS	0.3%	0.3%	0.3%		$7,322	$7,521	$8,375
Testing				LS	0.3%	0.3%	0.3%		$7,322	$7,521	$8,375
Temporary Facilities	3	3	3	months	$3,000	$3,000	$3,000		$9,000	$9,000	$9,000
Equipment and Safety				LS	2.5%	2.5%	2.5%		$61,013	$62,675	$69,788
					8.60%	8.60%	8.60%				
Total Construction Cost									**$2,659,400**	**$2,731,700**	**$3,040,600**
Addtl. Design & Management Costs											
Contingencies					10%	10%	10%		$266,000	$273,200	$304,100
Engineering, Admin, Legal					15%	15%	15%		$399,000	$409,800	$456,100
Total Project Cost									**$3,324,400**	**$3,414,700**	**$3,800,800**

City of Viroqua
WWTP Facilities Planning
Capital Costs for WWTP Upgrade Alt

	Phase 1A and 2							
	Qty		Units	Unit Cost	Unit Cost	Install	Total Cost	
	Phase 1A	Phase 2		Phase 1A	Phase 2	Factor	Phase 1A	Phase 2
1 Site Work								
Erosion Control	1	1	LS	$500	$2,000	1.00	$500	$2,000
Site Grading	1	1	LS	$500	$2,000	1.00	$500	$2,000
Site Fencing	0	0	LF	$20	$20	1.00	$0	$0
Front Gate Security	0	0	LS	$20,000	$20,000	1.00	$0	$0
Dewatering and Sheeting	0	1	LS	$10,000	$10,000	1.00	$0	$10,000
Site Conditions/Constraints	1	1	LS	$2,000	$18,000	1.00	$1,000	$19,000
Asphalt Paving	50	200	SY	$40	$40	1.00	$2,000	$8,000
Sidewalks	20	80	SF	$7.50	$7.50	1.00	$150	$600
Site Piping								
Primary to Selectors	0	0	LF	$75	$75	1.00	$0	$0
UV to New Lift Station	0	0	LF	$100	$100	1.00	$0	$0
Septage Receiving	0	0	LF	$50	$50	1.00	$0	$0
RAS Connection	0	0	LS	$5,000	$5,000	1.00	$0	$0
Air Connection	0	0	LS	$5,000	$5,000	1.00	$0	$0
Site Piping Valves	0	0	EA	$1,500	$1,500	1.00	$0	$0
Dome Removal/Reinstall	0	0	EA	$10,000	$10,000	1.00	$0	$0
Dome Recoating	0	0	EA	$15,000	$15,000	1.00	$0	$0
Painting	0	0	LS	$10,000	$10,000	1.00	$0	$0
Landscaping	0	0	SF	$2	$2	1.00	$0	$0
Seed, Fertilizer, Mulch	200	1,300	SY	$5	$5	1.00	$1,000	$6,500
							$5,150	**$48,100**
2 Headworks/Primary Clarifiers								
Skimmer Replacement			LS	$10,000	$10,000	1.00	$0	$0
Structure Upgrade	1		LS	$500,000	$200,000	1.00	$500,000	$0
Chemical Room Modifications	1		LS	$50,000	$50,000	1.00	$50,000	$0
Piping/Hydraulics Modifications			LS	$25,000	$25,000	1.00	$0	$0
Screen Replacement	1		LS	$75,000	$75,000	1.20	$90,000	$0
HVAC/Electrical Modifications	1		LS	$100,000	$100,000	1.00	$100,000	$0
							$740,000	**$0**
3 Selector and Aeration Basins								
Demolition								
Baffle walls			EA	$2,500	$2,500	1.00	$0	$0
Launders			LS	$2,500	$2,500	1.00	$0	$0
Concrete			CY	$1,250	$1,250	1.00	$0	$0
Concrete Coring Thru Wall			EA	$1,500	$1,500	1.00	$0	$0
Mixer Removal			EA	$500	$500	1.00	$0	$0
Diffusers			SF	$7.50	$7.50	1.00	$0	$0
Piping			LF	$15	$15	1.00	$0	$0
Concrete								
Structural fill			CY	$25	$25	1.00	$0	$0
Straight walls			CY	$675	$675	1.00	$0	$0
Weir Gate installation			EA	$3,500	$3,500	1.20	$0	$0
Stairs and railings			LF	$75	$75	1.00	$0	$0
Mixer Install			EA	$12,500	$12,500	1.20	$0	$0
Diffuser Grid Install			SF	$30	$30	1.00	$0	$0
Denite Recycle Pump			EA	$3,000	$3,000	1.20	$0	$0
Valves								
Telescoping valves			EA	$7,500	$7,500	1.00	$0	$0
Bypass valves or gates			EA	$3,500	$3,500	1.00	$0	$0
Primary Eff valves			EA	$3,500	$3,500	1.00	$0	$0
RAS valves			EA	$2,000	$2,000	1.00	$0	$0
Aeration Automated Valves				$3,500	$3,500	1.00	$0	$0
Piping								
Primary to Selectors			LF	$200	$200	1.00	$0	$0
Bypass			LF	$200	$200	1.00	$0	$0
RAS			LF	$125	$125	1.00	$0	$0
Between E and W (14")			LF	$200	$200	1.00	$0	$0
Denite Recycle			LF	$50	$50	1.00	$0	$0
Aeration			LF	$225	$225	1.00	$0	$0
							$0	**$0**
4 Splitter Structure								
Demolition								
Piping and Flume			LF	$15	$15	1.00	$0	$0
Concrete Coring Thru Wall			EA	$1,250	$1,250	1.00	$0	$0
Concrete								
Straight walls			CY	$675	$675	1.00	$0	$0
Concrete patching/repairs			LS	$2,000	$2,000	1.00	$0	$0
Weir Gate installation			EA	$3,500	$3,500	1.20	$0	$0

	Phase 1A and 2							
	Qty		Units	Unit Cost	Unit Cost	Install	Total Cost	
	Phase 1A	Phase 2		Phase 1A	Phase 2	Factor	Phase 1A	Phase 2
Bypass Gate (18")			EA	$4,500	$4,500	1.20	$0	$0
Telescoping Valves			EA	$7,500	$7,500	1.20	$0	$0
Grating and railings			SF	$20	$20	1.00	$0	$0
Piping								
Between Trains (18")			LF	$250	$250	1.00	$0	$0
To Clarifiers (12")			LF	$175	$175	1.00	$0	$0
							$0	**$0**
5 Final Clarifiers								
Demolition								
Mechanism Removal			EA	$15,500	$15,500	1.00	$0	$0
Concrete Coring Thru Wall			EA	$1,500	$1,500	1.00	$0	$0
Concrete								
Clarifier Mechanism			EA	$95,000	$95,000	1.20	$0	$0
Walkways and railings			LF	$75	$75	1.00	$0	$0
Painting			EA	$30,000	$30,000	1.00	$0	$0
Piping								
To Post Aeration			LF	$175	$175	1.00	$0	$0
							$0	**$0**
6 UV Structure								
Demolition								
Concrete		15	CY	$1,250	$1,250	1.00	$0	$18,750
Equipment		5	EA	$500	$500	1.00	$0	$2,500
Electrical		1	LS	$2,500	$2,500	1.00	$0	$2,500
Excavation		750	CY	$30	$30	1.00	$0	$22,500
Concrete								
Structural fill		25	CY	$25	$25	1.00	$0	$625
Slab on soil		10	CY	$450	$450	1.00	$0	$4,500
Straight walls		50	CY	$675	$675	1.00	$0	$33,750
Misc concrete		5	CY	$500	$500	1.00	$0	$2,500
Steel Superstructure		1	LS	$50,000	$50,000	1.00	$0	$50,000
UV Equipment install		1	EA	$175,000	$175,000	1.15	$0	$201,250
Grating		325	SF	$50	$50	1.00	$0	$16,250
Bypass piping		15	LF	$125	$125	1.00	$0	$1,875
Bypass valves or gates		1	EA	$3,750	$3,750	1.20	$0	$4,500
							$0	**$361,500**
7 Blower Building								
Demolition								
Blower removal			EA	$1,250	$1,250	1.00	$0	$0
Aeration piping			LF	$15	$15	1.00	$0	$0
Blower installation			EA	$38,000	$38,000	1.20	$0	$0
Aeration piping			LS	$5,000	$5,000	1.00	$0	$0
							$0	**$0**
8 Phosphorus Removal								
Site Work		1	LS	$65,000	$65,000	1.00	$0	$65,000
Building and Equipment		1	EA	$1,238,500	$1,238,500	1.00	$0	$1,238,500
Chemical additions		1	LS	$224,000	$224,000	1.00	$0	$224,000
Piping		1	LS	$100,000	$100,000	1.00	$0	$100,000
							$0	**$1,627,500**
9 Digester Complex								
Demolition								
Boiler/Heat Xchgr	1		LS	$2,500	$2,500	1.00	$2,500	$0
Gas train	1		LS	$4,000	$4,000	1.00	$4,000	$0
Digester mixing system	1		EA	$1,500	$1,500	1.00	$1,500	$0
Equipment Install								
Boiler/Heat Xchgr	1		EA	$175,000	$175,000	1.20	$210,000	$0
Gas train	1		EA	$45,000	$45,000	1.20	$54,000	$0
Digester mixing system	1		EA	$90,000	$90,000	1.20	$108,000	$0
Sludge Pumps	1		EA	$15,000	$15,000	1.20	$18,000	$0
Cover Rehabilitation	1		EA	$75,000	$75,000	1.00	$75,000	$0
Tuckpointing/Exterior Repairs	1		LS	$7,500	$7,500	1.00	$7,500	$0
Process Piping								
Sludge Feed	100		LF	$125	$125	1.00	$12,500	$0
Valves	6		EA	$1,250	$1,250	1.00	$7,500	$0
Plumbing								
New Water Connections	1		EA	$500	$500	1.00	$500	$0
Drains/Vents	1		EA	$550	$550	1.00	$550	$0
Painting	3,500		SF	$5	$5	1.00	$17,500	$0
							$519,050	**$0**
10 Sludge Storage								
Exterior Repairs			LS	$5,000	$5,000	1.00	$0	$0
								$0

City of Viroqua
WWTP Facilities Planning
Capital Costs for WWTP Upgrade Alt

	Phase 1A and 2							
	Qty		Units	Unit Cost	Unit Cost	Install	Total Cost	
	Phase 1A	Phase 2		Phase 1A	Phase 2	Factor	Phase 1A	Phase 2
11 Waste Receiving Station								
Excavation			CY	$30	$30	1.00	$0	$0
Concrete								
Structural fill			CY	$25	$25	1.00	$0	$0
Straight walls			CY	$675	$675	1.00	$0	$0
Slab on grade			CY	$450	$450	1.00	$0	$0
Shored slab			CY	$1,100	$1,100	1.00	$0	$0
Misc concrete			CY	$500	$500	1.00	$0	$0
Equipment Install								
Submersible pumps			EA	$7,500	$7,500	1.00	$0	$0
Diffusers			EA	$250	$250	1.00	$0	$0
Blower			EA	$3,750	$3,750	1.20	$0	$0
Stairs and railings			EA	$75	$75	1.00	$0	$0
Access hatches			EA	$1,250	$1,250	1.20	$0	$0
Mechanical gates			EA	$3,750	$3,750	1.20	$0	$0
Piping and valves			LS	$6,500	$6,500	1.00	$0	$0
							$0	**$0**
12 Equalization Storage Basin								
Demolition								
Liner removal			SY	$10	$10	1.00	$0	$0
Lining								
Clay liner			SY	$15	$15	1.00	$0	$0
Compacted Gravel			SY	$5	$5	1.00	$0	$0
Asphalt			SY	$40	$40	1.00	$0	$0
							$0	**$0**
13 Lab/Process Building								
Demolition			LS	$10,000	$10,000	1.00	$0	$0
Convert Chlorine Rm to Office			CY	$1,500	$1,500	1.00	$0	$0
Lab upgrade			LS	$20,000	$20,000	1.00	$0	$0
HVAC			LS	$15,000	$15,000	1.00	$0	$0
Windows and Doors			LS	$7,500	$7,500	1.00	$0	
Sludge Pump			LS	$17,500	$17,500	1.20	$0	$0
MCC Lineup Upgrade			LS	$17,500	$17,500	1.20	$0	$0
							$0	**$0**
14 Sludge Thickening								
Construction								
Excavation			CY	$30	$30	1.00	$0	$0
Structural Fill			CY	$25	$25	1.00	$0	$0
Footings			CY	$400	$400	1.00	$0	$0
Slab on soil			CY	$550	$550	1.00	$0	$0
Foundation walls			CY	$650	$650	1.00	$0	$0
Stoops			CY	$750	$750	1.00	$0	$0
Block wall - split face			SF	$35	$35	1.00	$0	$0
Concrete planking			SF	$18	$18	1.00	$0	$0
Roofing			SF	$22	$22	1.00	$0	$0
Architectural			SF	$20	$20	1.00	$0	$0
Stairs			LF	$150	$150	1.25	$0	$0
Railings			LF	$50	$50	1.25	$0	$0
Equipment								
Polymer System			EA	$14,000	$14,000	1.30	$0	$0
Polymer spare parts			LS	$5,000	$5,000	1.00	$0	$0
DAF Thickener			EA	$225,000	$225,000	1.15	$0	$0
TWAS Pumps			EA	$17,500	$17,500	1.25	$0	$0
Beam and hoist			EA	$12,500	$12,500	1.25	$0	$0
Process Piping								
Sludge Feed			LF	$100	$100	1.00	$0	$0
Process Drain			LF	$100	$100	1.00	$0	$0
TWAS			LF	$100	$100	1.00	$0	$0
Polymer Feed			LF	$25	$25	1.00	$0	$0
Valves			EA	$900	$900	1.00	$0	$0
Plumbing								
New Water Connections			EA	$500	$500	1.00	$0	$0
Drains/Vents			EA	$550	$550	1.00	$0	$0
Painting			SF	$5	$5	1.00	$0	$0
							$0	**$0**

City of Viroqua
WWTP Facilities Planning
Capital Costs for WWTP Upgrade Alt

	Phase 1A and 2							
	Qty		Units	Unit Cost	Unit Cost	Install	Total Cost	
	Phase 1A	Phase 2		Phase 1A	Phase 2	Factor	Phase 1A	Phase 2
Construction Cost							**$1,264,200**	**$2,037,100**
Electrical				20%	20%		**$252,900**	**$407,500**
Construction Cost w/Elec							**$1,517,100**	**$2,444,600**
Additional Contractor Costs								
Contractor Administration			LS	2.5%	2.5%		$37,928	$61,115
Mobilization			LS	2%	2%		$30,342	$48,892
Bonds, Permits, Insurance			LS	1%	1%		$15,171	$24,446
Project Documentation			LS	0.3%	0.3%		$4,551	$7,334
Testing			LS	0.3%	0.3%		$4,551	$7,334
Temporary Facilities	8	8	months	$3,000	$3,000		$24,000	$24,000
Equipment and Safety			LS	2.5%	2.5%		$37,928	$61,115
				8.60%	8.60%			
Total Construction Cost							**$1,671,600**	**$2,678,900**
Addtl. Design & Management Costs								
Contingencies				10%	10%		$167,200	$267,900
Engineering, Admin, Legal				15%	15%		$250,800	$401,900
Total Project Cost							**$2,089,600**	**$3,348,700**

City of Viroqua
WWTP Facilities Planning
O&M Cost Analysis - Base and Alternates

Acct		2012 Base Budget	2013 Base Budget	2014 Base Budget	Alternative 1 2016/2017 Startup	Alternative 1 2035 Design	Alternative 2 2016/2017 Startup	Alternative 2 2035 Design	Alternative 3 2016/2017 Startup	Alternative 3 2035 Design
	Personnel	2	2	2	2	2	2	2	2	2
	Annual Average Flow (MGD)	0.315	0.345	0.345	0.350	0.535	0.350	0.535	0.350	0.535
	Design/Sustained Flow (MGD)	0.412	0.568	0.522	0.560	0.747	0.560	0.747	0.560	0.747
	BOD Load (lbs/day)	1,088	1,101	951	1,092	1,434	1,092	1,434	1,092	1,434
	Phosphorus Load (lbs/day)			23	30	74	30	74	30	74
	Alum Required (gal/day)				13	63	9	55	2	48
	WAS solids (lbs/day)				448	903	437	892	427	881
	Liquid biosolids hauled (gal/year)		663,000	288,500	1,168,000	1,300,000	1,168,000	1,300,000	1,168,000	1,300,000
	Building Square Feet	1,860	1,860	1,860	2,964	2,964	2,964	2,964	2,964	2,964
	Operation									
64000-110	Supervision and Labor	$ 115,900	$ 119,700	$ 122,100	$ 125,763	$ 125,763	$ 125,763	$ 125,763	$ 125,763	$ 125,763
62200-221	Electrical - WWTP	$ 33,726	$ 37,230	$ 39,639	$ 51,362	$ 115,388	$ 51,362	$ 115,388	$ 45,581	$ 113,812
	Electrical - Lift Stations	$ 12,474	$ 13,770	$ 14,580	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000
65130-342	Chemicals - phosphorus removal	$ 11,800	$ 11,600	$ 11,800	$ 11,863	$ 57,488	$ 8,213	$ 50,188	$ 1,825	$ 43,800
	Chemicals - polymer for thickening				$ 613	$ 1,236	$ 598	$ 1,221	$ 584	$ 1,206
64100-340	Operating supplies and expenses	$ 31,300	$ 44,800	$ 31,806	$ 31,806	$ 31,806	$ 31,806	$ 31,806	$ 31,806	$ 31,806
	Water			$ 6,589	$ 6,589	$ 6,589	$ 6,589	$ 6,589	$ 6,589	$ 6,589
	Natural gas at WWTP	$ 7,900		$ 12,207	$ 7,685	$ 15,490	$ 7,496	$ 15,301	$ 7,324	$ 15,111
	QLF/Molasses			$ 3,698	$ 3,698	$ 3,698	$ 3,698	$ 3,698	$ 3,698	$ 3,698
93300-341	Transporation	$ 13,700	$ 11,400	$ 10,100	$ 10,100	$ 10,100	$ 10,100	$ 10,100	$ 10,100	$ 10,100
	Maintenance									
65100-350	Maintenance of collection system	$ 8,600	$ 38,800	$ 33,500	$ 33,500	$ 33,500	$ 33,500	$ 33,500	$ 33,500	$ 33,500
65000-350	Maintenance of LS pumping equipment	$ 12,600	$ 1,500	$ 3,100	$ 3,100	$ 3,100	$ 3,100	$ 3,100	$ 3,100	$ 3,100
65500-350	Maintenance of general plant equipment	$ 20,000	$ 13,400	$ 10,700	$ 10,700	$ 10,700	$ 10,700	$ 10,700	$ 10,700	$ 10,700
62500-350	Maintenance of WWTP equipment	$ 13,800	$ 2,540	$ 1,830	$ 1,830	$ 1,830	$ 1,830	$ 1,830	$ 1,830	$ 1,830
	Sludge Hauling		$ 13,260	$ 5,770	$ 23,360	$ 26,000	$ 23,360	$ 26,000	$ 23,360	$ 26,000
	Customer Accounts									
90200-110	Accounting and collecting	$ 36,800	$ 37,600	$ 38,200	$ 38,200	$ 38,200	$ 38,200	$ 38,200	$ 38,200	$ 38,200
90300-340	Customer billing expenses	$ 4,800	$ 4,500	$ 4,700	$ 4,700	$ 4,700	$ 4,700	$ 4,700	$ 4,700	$ 4,700
	Administrative and General Expenses									
92400-510	Property Insurance	$ 14,600	$ 16,100	$ 16,100	$ 16,100	$ 16,100	$ 16,100	$ 16,100	$ 16,100	$ 16,100
92500-131	Workmen's Compensation Insurance	$ 6,800	$ 7,400	$ 7,400	$ 7,400	$ 7,400	$ 7,400	$ 7,400	$ 7,400	$ 7,400
92000-110	Administrative salaries	$ 13,900	$ 14,200	$ 14,400	$ 14,400	$ 14,400	$ 14,400	$ 14,400	$ 14,400	$ 14,400
92100-340	Office supplies	$ 10,300	$ 11,500	$ 10,900	$ 10,900	$ 10,900	$ 10,900	$ 10,900	$ 10,900	$ 10,900
92600-130	Employee pension and benefits	$ 51,600	$ 55,100	$ 65,900	$ 65,900	$ 65,900	$ 65,900	$ 65,900	$ 65,900	$ 65,900
92300-210	Outside services	$ 9,800	$ 12,900	$ 12,900	$ 12,900	$ 12,900	$ 12,900	$ 12,900	$ 12,900	$ 12,900
93100-390	Miscellaneous	$ 6,400	$ 6,800	$ 6,800	$ 6,800	$ 6,800	$ 6,800	$ 6,800	$ 6,800	$ 6,800
	Taxes	$ 15,200	$ 16,500	$ 12,800	$ 12,800	$ 12,800	$ 12,800	$ 12,800	$ 12,800	$ 12,800
Total		**$ 452,000**	**$ 490,600**	**$ 497,600**	**$ 527,100**	**$ 647,800**	**$ 523,300**	**$ 640,300**	**$ 510,900**	**$ 632,200**

	Alternative 1	Alternative 2	Alternative 3
Average O&M Costs (for PW Calcs):	$587,450	$581,800	$571,550

City of Viroqua
WWTP Facilities Planning
Estimated Electrical Use - Alternative 3

Utility Rate $0.080 per kWH

Description	BHP Current	BHP Start Up	BHP Design	Total kW Current	Total kW Start Up	Total kW Design	Hrs/d Current	Hrs/d Start Up	Hrs/d Design	Annual kwh Current	Annual kwh Start Up	Annual kwh Design
Headworks												
Mechanical screen	3	3	3	2.25	2.25	2.25	6	7	10	4,928	5,749	8,213
Air Blowers												
Activated sludge	45	20	100	33.75	15.00	75.00	24	24	24	295,650	131,400	657,000
Supernatant holding	20	20	20	15.00	15.00	15.00	0	3	5	0	16,425	27,375
Pumping												
Primary sludge	2.7	2.7	2.7	2.03	2.03	2.03	1.5	2	3	1,109	1,478	2,217
RAS/WAS	2	2	5	1.50	1.50	3.75	24	24	24	13,140	13,140	32,850
Recycle	3	3	3	2.25	2.25	2.25	0	24	24	0	19,710	19,710
TWAS	15	15	15	11.25	11.25	11.25	0	2	3	0	8,213	12,319
Sludge Recirc	5	6	6	3.75	4.50	4.50	10	12	12	13,688	19,710	19,710
Storage tank	55	55	60	41.25	41.25	45.00	0.01	0.01	0.5	151	151	8,213
Effluent Lift Station	25	25	30	18.75	18.75	22.50	0	12	18	0	82,125	147,825
Storage Basin Lift Station	2.5	2.5	2.5	1.88	1.88	1.88	1	1	3	684	684	2,053
Supernatant Pump	2	3	3	1.50	2.25	2.25	10	0	0	5,475	0	0
Waste receiving	3	3	3	2.25	2.25	2.25	0	2	3	0	1,643	2,464
Sludge Processing												
WAS thickening	5	5	5	3.75	3.75	3.75	0	24	24	0	32,850	32,850
Air compressors	10	10	10	7.50	7.50	7.50	0	8	12	0	21,900	32,850
Mixing												
Selectors	14	11	11	10.50	8.25	8.25	24	24	24	91,980	72,270	72,270
Digester	20	20	20	15.00	15.00	15.00	0	0	24	0	0	131,400
Clarification												
Primary scrapers	1	1	1	0.75	0.75	0.75	24	24	24	6,570	6,570	6,570
Finals scrapers	1	1	2	0.75	0.75	1.50	24	24	24	6,570	6,570	13,140
Disinfection												
UV				5.00	5.00	10.00	16	16	24	29,200	29,200	87,600
General	W/sf	W/sf	W/sf	sf	sf	sf						
Lighting	1.25	1.25	1.25	6,260	6,260	7,364	12	12	12	34,274	34,274	40,318
Miscellaneous kW*				3.00	7.50	7.50	24	24	24	26,280	65,700	65,700
Total Energy (kWH)										529,697	569,760	1,422,646
Total Energy Electrical Cost										**$42,376**	**$45,581**	**$113,812**
2014 Energy Electrical Cost										$39,692		

*Assume Misc includes electrical heating for control bldg, chemical feed room
Digester/digester building heated with natural gas

Electrical Costs for Blowers			
	Current	Start Up	Design
	$23,652	$10,512	$52,560
Savings		$13,140	($28,908)

Difference between Alternative 3 and Alternatives 1 and 2 is only the electrical savings for selectors,
Assume no savings for Alternatives 1 and 2

Electrical Costs for Selectors			
	Current	Start Up	Design
	$7,358	$5,782	$5,782
Savings		$1,577	$1,577

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5/22/2015

City of Viroqua
WWTP Facilities Planning
Replacement Fund Calculation **Phase 1 Alternatives 1 and 2**

Inflation Rate for Future Equipment Cost 0.00%
Interest Rate for Calculation 4.625%

Description	Purchase Cost	Quantity	Equip Life	Inflated Cost	Annual Fund $	
10-Headworks						
Mechanical screen	$75,000	1	15	$75,000	$3,575	
Air compressor	$7,500	1	20	$7,500	$236	
Sampling equipment	$7,500	1	20	$7,500	$236	
Chemical feed pumps	$2,500	3	10	$7,500	$607	
Chemical storage tanks	$2,250	2	20	$4,500	$142	
Chemical day tanks	$1,000	2	20	$2,000	$63	$4,858
20-Primary Clarifiers						
Motorized valves	$3,750	4	15	$15,000	$715	
Scraper assemblies	$30,000	2	15	$60,000	$2,860	
Weirs and baffles	$15,000	2	20	$30,000	$944	$4,519
30-Selector/Aeration Basins						
Cover rehab	$30,000	2	15	$60,000	$2,860	
Mixers	$12,500	6	20	$75,000	$2,360	
Recycle pump	$3,000	1	20	$3,000	$94	
Primary Eff and Bypass valves	$3,500	8	20	$28,000	$881	
RAS Valves	$2,000	2	20	$4,000	$126	
Weir Gates	$3,500	10	20	$35,000	$1,101	
Automated aeration valves	$3,500	4	20	$14,000	$440	
Aeration grids	$15	2,785	20	$41,775	$1,314	$9,177
35-Final Clarifiers						
Clarifier Mechanism	$95,000	2	20	$190,000	$5,978	
Weirs and baffles	$22,500	2	20	$45,000	$1,416	$7,393
40-UV Structure						
Sampling Equipment	$7,500	1	20	$7,500	$236	
Bypass valve or gates	$3,750	1	20	$3,750	$118	
UV Equipment	$110,000	1	20	$110,000	$3,461	$3,815
45-Effluent Lift Station						
Pumps	$25,000	3	20	$75,000	$2,360	
Monorail and Hoist	$20,000	1	20	$20,000	$629	$2,989
50-Contol Building/Pumps						
RAS/WAS Pumps and VFDs	$15,000	3	10	$45,000	$3,641	
Motorized valves	$2,500	3	15	$7,500	$357	
Raw Sludge Pump	$17,500	2	20	$35,000	$1,101	
Laboratory equipment	$20,000	1	20	$20,000	$629	$5,729
55-Blower Building						
Aeration Blowers	$42,000	3	20	$126,000	$3,964	
Generator	$50,000	1	20	$50,000	$1,573	$5,537

City of Viroqua
WWTP Facilities Planning
Replacement Fund Calculation **Phase 1 Alternatives 1 and 2**

Inflation Rate for Future Equipment Cost	0.00%
Interest Rate for Calculation	4.625%

Description	Purchase Cost	Quantity	Equip Life	Inflated Cost	Annual Fund $	
60-Sludge Thickening Building						
DAF System	$225,000	1	20	$225,000	$7,079	
Thickened WAS (TWAS) Pumps	$17,500	2	20	$35,000	$1,101	
Valves	$900	6	20	$5,400	$170	
Hoist	$12,500	1	20	$12,500	$393	
Polymer Feed System	$14,000	1	20	$14,000	$440	$9,183
70-Digester Building						
Recirculating Sludge Pumps	$15,000	1	20	$15,000	$472	
Valves	$950	6	20	$5,700	$179	
Mixers	$90,000	1	20	$90,000	$2,831	
Combination Boiler/Heat Exchanger	$175,000	1	20	$175,000	$5,506	
Gas Handling Equipment	$45,000	1	20	$45,000	$1,416	
Cover Rehabilitation	$75,000	1	20	$75,000	$2,360	$12,764
75-Sludge Storage Tank						
Mixer Pump Motor	$3,500	1	20	$3,500	$110	$110
80-Waste Receiving Station						
Air Diffusers	$250	8	20	$2,000	$63	
Regenerative blower	$3,750	1	20	$3,750	$118	
Submersible pumps	$7,500	2	20	$15,000	$472	$653
Allowance Equipment						
Vehicles/Vac Truck	$200,000	1	20	$200,000	$6,292	
Safety Equipment	$25,000	1	20	$25,000	$787	$7,079
Electrical Equipment						
MCCs and control panels	$200,000	1	20	$200,000	$6,292	
Instrumentation	$75,000	1	15	$75,000	$3,575	$9,867
Subtotal					$83,672	$83,672
Equipment Installation	15%				$12,551	
Total Annual Replacement Fund					**$96,300**	

City of Viroqua
WWTP Facilities Planning
Replacement Fund Calculation **Phase 1 Alternative 3**

Inflation Rate for Future Equipment Cost	0.00%
Interest Rate for Calculation	4.625%

Description	Purchase Cost	Quantity	Equip Life	Inflated Cost	Annual Fund $	
10-Headworks						
Mechanical screen	$75,000	1	15	$75,000	$3,575	
Air compressor	$7,500	1	20	$7,500	$236	
Sampling equipment	$7,500	1	20	$7,500	$236	
Chemical feed pumps	$2,500	3	10	$7,500	$607	
Chemical storage tanks	$2,250	2	20	$4,500	$142	
Chemical day tanks	$1,000	2	20	$2,000	$63	$4,858
20-Primary Clarifiers						
Motorized valves	$3,750	4	15	$15,000	$715	
Scraper assemblies	$30,000	2	15	$60,000	$2,860	
Weirs and baffles	$15,000	2	20	$30,000	$944	$4,519
30-Selector/Aeration Basins						
Cover rehab	$30,000	2	15	$60,000	$2,860	
Mixers	$12,500	4	20	$50,000	$1,573	
Recycle pump	$3,000	1	20	$3,000	$94	
Primary Eff and Bypass valves	$3,500	8	20	$28,000	$881	
RAS Valves	$2,000	2	20	$4,000	$126	
Weir Gates	$3,500	10	20	$35,000	$1,101	
Automated aeration valves	$3,500	4	20	$14,000	$440	
Aeration grids	$15	2,785	20	$41,775	$1,314	$8,390
35-Final Clarifiers						
Clarifier Mechanism	$95,000	2	20	$190,000	$5,978	
Weirs and baffles	$22,500	2	20	$45,000	$1,416	$7,393
40-UV Structure						
Sampling Equipment	$7,500	1	20	$7,500	$236	
Bypass valve or gates	$3,750	1	20	$3,750	$118	
UV Equipment	$110,000	1	20	$110,000	$3,461	$3,815
45-Effluent Lift Station						
Pumps	$25,000	3	20	$75,000	$2,360	
Monorail and Hoist	$20,000	1	20	$20,000	$629	$2,989
50-Contol Building/Pumps						
RAS/WAS Pumps and VFDs	$15,000	3	10	$45,000	$3,641	
Motorized valves	$2,500	3	15	$7,500	$357	
Raw Sludge Pump	$17,500	2	20	$35,000	$1,101	
Laboratory equipment	$20,000	1	20	$20,000	$629	$5,729
55-Blower Building						
Aeration Blowers	$42,000	3	20	$126,000	$3,964	
Generator	$50,000	1	20	$50,000	$1,573	$5,537

City of Viroqua
WWTP Facilities Planning
Replacement Fund Calculation **Phase 1 Alternative 3**

Inflation Rate for Future Equipment Cost 0.00%
Interest Rate for Calculation 4.625%

Description	Purchase Cost	Quantity	Equip Life	Inflated Cost	Annual Fund $	
60-Sludge Thickening Building						
DAF System	$225,000	1	20	$225,000	$7,079	
Thickened WAS (TWAS) Pumps	$17,500	2	20	$35,000	$1,101	
Valves	$900	6	20	$5,400	$170	
Hoist	$12,500	1	20	$12,500	$393	
Polymer Feed System	$14,000	1	20	$14,000	$440	$9,183
70-Digester Building						
Recirculating Sludge Pumps	$15,000	1	20	$15,000	$472	
Valves	$950	6	20	$5,700	$179	
Mixers	$90,000	1	20	$90,000	$2,831	
Combination Boiler/Heat Exchanger	$175,000	1	20	$175,000	$5,506	
Gas Handling Equipment	$45,000	1	20	$45,000	$1,416	
Cover Rehabilitation	$75,000	1	20	$75,000	$2,360	$12,764
75-Sludge Storage Tank						
Mixer Pump Motor	$3,500	1	20	$3,500	$110	$110
80-Waste Receiving Station						
Air Diffusers	$250	8	20	$2,000	$63	
Regenerative blower	$3,750	1	20	$3,750	$118	
Submersible pumps	$7,500	2	20	$15,000	$472	$653
Allowance Equipment						
Vehicles/Vac Truck	$200,000	1	20	$200,000	$6,292	
Safety Equipment	$25,000	1	20	$25,000	$787	$7,079
Electrical Equipment						
MCCs and control panels	$200,000	1	20	$200,000	$6,292	
Instrumentation	$75,000	1	15	$75,000	$3,575	$9,867
Subtotal					$82,886	$82,886
Equipment Installation	15%				$12,433	
Total Annual Replacement Fund					**$95,400**	

City of Viroqua WWTP Upgrade
Present Worth Values of Alternatives

Current Discount Rate	4.625%
Number of Years	20

No.	Capital Cost	Average Annual O&M	Annual Replacement	Present Worth
WWTP Alternatives				
1	$3,324,400	$587,450	$96,300	$12,123,100
2	$3,414,700	$581,800	$96,300	$12,140,700
3	$3,800,800	$571,550	$95,400	$12,383,300

% Difference
2.1%

Appendix K

Design Data and Models for Alternatives

City of Viroqua WWTP
Facility Plan Process Model

WWTP Loadings - Based on Future Loading Projections

	Current (Average)				Current (Sustained)				Design (Sustained)				Max Day	Peak Hr
Flow	mgd	0.338			mgd	0.513			mgd	0.702			1.929	3.309
BOD	mg/L		ppd	931	mg/L		ppd	1,089	mg/L		ppd	1,435		
SS	mg/L		ppd	1,060	mg/L		ppd	1,217	mg/L		ppd	1,579		
VSS	%	75%	ppd	795	%	75%	ppd	913	%	75%	ppd	1,184		
TKN	mg/L		ppd	150	mg/L		ppd	157	mg/L		ppd	242		
Phos	mg/L		ppd	25	mg/L		ppd	30	mg/L		ppd	38		

Holding Tank

Flow	mgd	0.000			mgd	0.000			mgd	0.025		
BOD	mg/L	1,500	ppd	0	mg/L	1,500	ppd	0	mg/L	1,500	ppd	313
SS	mg/L	1,000	ppd	0	mg/L	1,000	ppd	0	mg/L	1,000	ppd	209
VSS	%	75%	ppd	0	%	75%	ppd	0	%	75%	ppd	156
TKN	mg/L	200	ppd	0	mg/L	200	ppd	0	mg/L	200	ppd	42
Phos	mg/L	17	ppd	0	mg/L	17	ppd	0	mg/L	17	ppd	4

Septage

Flow	mgd	0.000			mgd	0.000			mgd	0.015		
BOD	mg/L	7,500	ppd	0	mg/L	7,500	ppd	0	mg/L	7,500	ppd	938
SS	mg/L	10,000	ppd	0	mg/L	10,000	ppd	0	mg/L	10,000	ppd	1,251
VSS	%	75%	ppd	0	%	75%	ppd	0	%	75%	ppd	938
TKN	mg/L	400	ppd	0	mg/L	400	ppd	0	mg/L	400	ppd	50
Phos	mg/L	250	ppd	0	mg/L	250	ppd	0	mg/L	250	ppd	31

Leachate

Flow	mgd	0.004			mgd	0.004			mgd	0.005		
BOD	mg/L	100	ppd	3	mg/L	100	ppd	3	mg/L	100	ppd	4
SS	mg/L	50	ppd	2	mg/L	50	ppd	2	mg/L	50	ppd	2
VSS	%	75%	ppd	1	%	75%	ppd	1	%	75%	ppd	2
TKN	mg/L	550	ppd	18	mg/L	550	ppd	18	mg/L	550	ppd	23
Phos	mg/L	10	ppd	0.3	mg/L	10	ppd	0.3	mg/L	10	ppd	0

Total

Flow	mgd	0.342			mgd	0.517			mgd	0.747		
BOD	mg/L	327	ppd	934	mg/L	253	ppd	1,092	mg/L	432	ppd	2,690
SS	mg/L	372	ppd	1,062	mg/L	283	ppd	1,219	mg/L	488	ppd	3,041
VSS	%	279	ppd	797	%	212	ppd	914	%	366	ppd	2,280
TKN	mg/L	59	ppd	168	mg/L	41	ppd	175	mg/L	57	ppd	357
Phos	mg/L	9	ppd	25	mg/L	7	ppd	30	mg/L	12	ppd	74

City of Viroqua WWTP Design Model

Influent Loadings		Current - Annual Average	From Model:	Current - Sustained	From Model:
Flow	mgd	0.338		0.513	
Recycle	gpd	11,522	11,444	14,068	14,051
BOD	lbs/day	931		1,089	
Recycle	lbs/day	1.1	1.1	13.7	13.7
TS	lbs/day	1,060		1,217	
Recycle	lbs/day	21	21	61	61
VSS	lbs/day	795		913	
Recycle	lbs/day	16	16	45	45
TKN	lbs/day	150		157	
Recycle	lbs/day	0.1	0.1	6.4	6.4
Total Phosphorus	lbs/day	25		30	
Recycle	lbs/day	1.7	1.7	5.6	5.6
Holding Tank					
Flow	mgd	0.000		0.000	
BOD	lbs/day	0		0	
TS	lbs/day	0		0	
VSS	lbs/day	0		0	
TKN	lbs/day	0		0	
Total Phosphorus	lbs/day	0		0	
Waste to Headworks or Digester	H or D	D		D	
Septage					
Flow	mgd	0.000		0.000	
BOD	lbs/day	0		0	
TS	lbs/day	0		0	
VSS	lbs/day	0		0	
TKN	lbs/day	0		0	
Total Phosphorus	lbs/day	0		0	
Waste to Headworks or Digester	H or D	D		D	
Leachate					
Flow	mgd	0.004		0.004	
BOD	lbs/day	3.3		3.3	
TS	lbs/day	1.7		1.7	
VSS	lbs/day	1.3		1.3	
TKN	lbs/day	18.3		18.3	
Total Phosphorus	lbs/day	0.3		0.3	
Waste to Headworks or Digester	H or D	H		H	

Primary Clarifiers							
No. of Clarifiers in Use		2			2		
Influent - per clarifier							
Flow	MGD	0.177	123	gpm	0.266	184	gpm
BOD	lbs/day	468	317	mg/L	553	250	mg/L
TSS	lbs/day	542	367	mg/L	640	289	mg/L
VSS	lbs/day	406	276	mg/L	480	217	mg/L
TKN	lbs/day	84	57	mg/L	91	41	mg/L
Total Phosphorus	lbs/day	14	9.2	mg/L	18	8.0	mg/L
Tank Dimensions							
Length	ft	39			39		
Width	ft	13			13		
SWD	ft	7			7		
Surface Area	sf	507			507		
Total Volume	gal	26,547			26,547		
Removal Rates			TYP			TYP	
BOD	%	30%	30%		30%	30%	
TS	%	60%	60%		60%	60%	
TKN	%	20%	20%		20%	20%	
Phosphorus	%	20%	20%		20%	20%	
Estimated Solids Concentration	%	4.0%	4%		4.0%	4%	
Surface Overflow Rate	gpd/sf	349			524		
BOD Fermentation Reduction	%	10%			10%		
Scum							
Flow	gpd	50			50		
Total Sludge Production							
Flow (includes scum)	gpd	1,998			2,352		
BOD	lbs/day	252			299		
TSS	lbs/day	650	3.9%		768	3.9%	
VSS	lbs/day	488			576		
TKN	lbs/day	34			36		
Total Phosphorus	lbs/day	5			7		
Total Effluent							
Flow	mgd	0.352	244	gpm	0.529	367	gpm
BOD	lbs/day	708	241	mg/L	837	190	mg/L
TSS	lbs/day	433	148	mg/L	512.0	116	mg/L
VSS	lbs/day	325	111	mg/L	384	87	mg/L
TKN	lbs/day	135	46	mg/L	145	33	mg/L
Total Phosphorus	lbs/day	22	7.4	mg/L	28	6.5	mg/L

Biological Treatment Parameters							
Desired MLSS	mg/L	2,000			2,000		
RAS Concentration	mg/L	4,000			4,000		
Average RAS Flowrate (Total)	GPM	244	104%		367	103%	
	MGD	0.352			0.529		
Desired Sludge Age	days	10.0			10.0		
No. of Biological Trains Operating		1			1		

Selector Basins							
Influent							
Flow	MGD	0.352	244	gpm	0.529	367	gpm
BOD	lbs/day	708	241	mg/L	837	190	mg/L
TSS	lbs/day	433	148	mg/L	512	116	mg/L
VSS	lbs/day	325	111	mg/L	384	87	mg/L
TKN	lbs/day	135	46	mg/L	145	33	mg/L
Total Phosphorus	lbs/day	22	7.4	mg/L	28	6.5	mg/L
RAS							
Flow	MGD	0.352	244		0.529	367	
BOD (10 mg/L)	lbs/day	29			44		
TS	lbs/day	11,727			17,638		
VS	%	75%			75%		
VS	lbs/day	8,795			13,228		
TKN (1 mg/L)	lbs/day	3			4		
Nitrate/Nitrite	lbs/day	52			55		
Total P (biological and RAS water)	lbs/day	560			1,002		
Anoxic Recycle	gpm	24	10%		37	10%	
Common Basin Depth	ft	14.00			14.00		
Anoxic Basins							
Combined Flow (RAS + Recycle)							
Flow	MGD	0.387	269	gpm	0.582	404	gpm
BOD	lbs/day	29	9	mg/L	44	9	mg/L
TS	lbs/day	11,727	3,636	mg/L	17,638	3,636	mg/L
VS	lbs/day	22	7	mg/L	28	6	mg/L
TKN	lbs/day	3	1	mg/L	4	1	mg/L
Nitrates	lbs/day			mg/L			mg/L
Total P	lbs/day	560	2	mg/L	1,002	3	mg/L
Basin No. 1							
In Service?	yes/no	yes			yes		
Basin Area	sf	460.0			460.0		
Basin Volume	gal	48,171			48,171		
Detention Time	hrs	2.99			1.99		
Basin No. 2							
In Service?	yes/no	yes			yes		
Length	ft	412.6			412.6		
Basin Volume	gal	43,207			43,207		
Detention Time	hrs	2.68			1.78		
Anaerobic Basins							
Combined Flow (Influent + RAS + Recycle)							
Flow	MGD	0.738	513	gpm	1.110	771	gpm
BOD	lbs/day	737	120	mg/L	881	95	mg/L
TS	lbs/day	12,160	1,975	mg/L	18,150	1,960	mg/L
VS	lbs/day	9,120	1,481	mg/L	13,612	1,470	mg/L
TKN	lbs/day	138	22	mg/L	149	16	mg/L
Nitrates	lbs/day	52	9	mg/L	55	6	mg/L
Total P	lbs/day	582	95	mg/L	1,030	111	mg/L
Basin No. 3							
In Service?	yes/no	yes			yes		
Basin Area	sf	206.3			206.3		
Basin Volume	gal	21,604			21,604		
Detention Time	hrs	0.70			0.47		
Basin No. 4							
In Service?	yes/no	yes			yes		
Basin Area	sf	206			206		
Basin Volume	gal	21,604			21,604		
Detention Time	hrs	0.70			0.47		
Total Operational Selector Volume	gal	134,586			134,586		
	cf	17,993			17,993		
Total Selector Detention	hrs	7.08			4.70		
Water Temperature	^{0}C	15			15		
Denitrification Rate	lbs/lbVSS/d	0.062			0.062		
Active Biomass (55% of VS)	lbs/day	5,016			7,487		
Detention Time Required for Denite	hrs	4.1			2.8		
Remaining Time for Anaerobic	hrs	3.0			1.9		
Nitrates Removed	lbs	52			55		
BOD Removed	lbs	313			327		

Effluent							
Flow	mgd	0.703	488	gpm	1.057	734	gpm
BOD	lbs/day	425	72	mg/L	554	63	mg/L
TKN	lbs/day	138	23	mg/L	149	17	mg/L
Without RAS							
TSS	lbs/day	433			512		
VSS	lbs/day	325			384		
TP	lbs/day	22			28		

Aeration Basins							
Common Basin Depth	ft	14.00			14.00		
Aeration Basin No. 1							
In Service?	yes/no	yes			yes		
Basin Area	sf	733.8			733.8		
Basin Volume	gal	76,844			76,844		
Detention Time (w/o RAS)	hrs	2.62			1.74		
Aeration Basin No. 2							
In Service?		yes			yes		
Basin Area	sf	733.8			733.8		
Basin Volume	gal	76,844			76,844		
Detention Time (w/o RAS)	hrs	2.62			1.74		
Aeration Basin No. 3							
In Service?		yes			yes		
Basin Area	ft	855.0			855.0		
Basin Volume	sf	89,536			89,536		
Detention Time (w/o RAS)	gal	3.06			2.03		
Aeration Basin No. 4							
In Service?		yes			yes		
Basin Area	sf	460.0			460.0		
Basin Volume	gal	48,171			48,171		
Detention Time (w/o RAS)	gal	1.64			1.09		
Total Aeration Volume	gal	291,394			291,394		
	cf	38,956			38,956		
Influent P concentration (to selectors)	mg/L	7.38			6.46		
Assumed Bio-P Removal	mg/L	7.38	100%		6.46	100%	
BOD Loading Rate	lbs/kcf	11			14		
F/M Ratio		0.12			0.15		
Detention Time	hours	9.9			6.6		
AOR	lbs/day	1,100			1,297		
Phosphorus not removed biologically	lbs/day	0	0.0	mg/L	0	0.0	mg/L
Est WAS (Cell Yield)	lbs/day	356			438		
EST WAS (Aeration Volume)	lbs/day	487			487		
Est WAS (max)	gpd	12,646			13,869		
Final Clarifiers							
No. of Clarifiers in Use		2			2		
Diameter	ft	31			31		
Surface Area	sf	755			755		
Surface Overflow Rate	gpd/sf	233			350		
Solids Loading Rate	lbs/d/sf	8			12		
WAS							
Chemical Sludge (10 lb/lb P Removed)	lbs/day	0			0		
Flow	gpd	12,646			13,869		
BOD (10 mg/L)	lbs/day	1			1		
TS	lbs/day	422	0.40%		463	0.40%	
VS	lbs/day	316			347		
TKN (1 mg/L)	lbs/day	0			0		
Total Phosphorus	lbs/day	22			28		
Total Effluent							
Flow	mgd	0.339			0.515		
BOD (10 mg/L)	lbs/day	28			43		
TSS (10 mg/L)	lbs/day	28			43		
TKN (1 mg/L)	lbs/day	3			4		
Total Phosphorus (1 mg/L)	lbs/day	3			4		

WAS Thickening - DAF Unit			
Sludge Production			
Flow	gpd	12,646	13,869
BOD	lbs/day	1	1
TSS	lbs/day	422	463
VSS	lbs/day	316	347
TKN	lbs/day	0	0
Total Phosphorus	lbs/day	22	28
Soluble Phosphorus	lbs/day		
Number of Thickening Units		1	1
Operation Schedule	hrs/day	24.00	24.00
Estimated Solids Concentration	%	4.00%	4.00%
Solids Capture Rate	%	95%	95%
Wash Water	gpm	0.00	0.00

City of Viroqua WWTP Design Model

Average Flow Rate	gpm	9		10	
Solids Loading Rate	lb/hr	18		19	
Assumed Diameter	ft	8		8	
Unit Loading Rate	lb/sf/hr	0.35		0.38	
Thickened Sludge					
Flow	gpd	1,201		1,318	
TS	lbs/day	401	4.00%	440	4.00%
VS	lbs/day	301		330	
Recycle			mg/L		mg/L
Flow	gpd	11,444		12,551	
BOD	lbs/day	1		1	
TS	lbs/day	21		23	
VS	lbs/day	16		17	
TKN	lbs/day	0		0	
Phos	lbs/day	2		2	

Sludge Digestion

Total Sludge Production					
Flow	gpd	3,199		3,670	
TS	lbs/day	1,051	3.94%	1,208	3.95%
VS	lbs/day	788		905	
Mesophilic Digester					
Tank Diameter	ft	50		50	
Bottom Cone Depth	ft	8.33		8.33	
SWD	ft	17		17	
Volume	kcf	39		39	
	gal	290,459		290,459	
Decant	gpd	0		0	
Loading Rate	lbsVS/kcf	20		23	
Detention Time	days	91		79	
Hydraulic Detention Time (excluding decant)	days	91			
VS Destruction	%	50%		50%	
Decant					
BOD (1000 mg/L)	lbs/day	0		0	
TSS (3000 mg/L)	lbs/day	0		0	
NH3 (500 mg/L)	lbs/day	0		0	
TP (300 mg/L)	lbs/day	0		0	
Sludge Discharge					
Flow	gpd	3,199		3,670	
TS	lbs/day	657	2.46%	755	2.47%
VS	lbs/day	394		453	
Volatile Fraction	%	60%		60%	

Sludge Storage

Total Sludge Production					
Flow	gpd	3,199		3,670	
TS	lbs/day	657	2.46%	755	2.47%
VS	lbs/day	394		453	
Tank Diameter	ft	70		70	
SWD	ft	23		23	
Volume	kcf	87		87	
	gallons	647,694		647,694	
Decant	gpd	0		1,500	
BOD (1000 mg/L)	lbs/day	0		13	
TSS (3000 mg/L)	lbs/day	0		38	
NH3 (500 mg/L)	lbs/day	0		6	
TP (300 mg/L)	lbs/day	0		4	
Days of Storage	days	202		299	
Total Sludge to Storage	gal/yr	1,167,696		1,339,430	
Total Sludge Hauled	gal/yr	1,167,696		791,930	

Influent Loadings		**Design - No Septic & Holding**		**Design - Septic and Holding to Headworks**	
Flow	mgd	0.702	From Model:	0.702	From Model:
Recycle	gpd	16,895	16,886	26,871	26,836
BOD	lbs/day	1,435		1,435	
Recycle	lbs/day	24.7	24.7	40.4	40.4
TS	lbs/day	1,579		1,579	
Recycle	lbs/day	96	96	156	156
VSS	lbs/day	1,184		1,184	
Recycle	lbs/day	72	72	117	117
TKN	lbs/day	242		242	
Recycle	lbs/day	11.8	11.8	19.4	19.4
Total Phosphorus	lbs/day	38		38	
Recycle	lbs/day	9.1	9.1	14.7	14.7
Holding Tank					
Flow	mgd	0.000		0.025	
BOD	lbs/day	0		313	
TS	lbs/day	0		209	
VSS	lbs/day	0		156	
TKN	lbs/day	0		42	
Total Phosphorus	lbs/day	0		4	
Waste to Headworks or Digester	H or D	D		H	
Septage					
Flow	mgd	0.000		0.015	
BOD	lbs/day	0		938	
TS	lbs/day	0		1,251	
VSS	lbs/day	0		938	
TKN	lbs/day	0		50	
Total Phosphorus	lbs/day	0		31	
Waste to Headworks or Digester	H or D	D		H	
Leachate					
Flow	mgd	0.005		0.005	
BOD	lbs/day	4.2		4.2	
TS	lbs/day	2.1		2.1	
VSS	lbs/day	1.6		1.6	
TKN	lbs/day	22.9		22.9	
Total Phosphorus	lbs/day	0.4		0.4	
Waste to Headworks or Digester	H or D	H		H	

Primary Clarifiers							
No. of Clarifiers in Use		2			2		
Influent - per clarifier							
Flow	MGD	0.362	251	gpm	0.387	269	gpm
BOD	lbs/day	732	242	mg/L	1365	423	mg/L
TSS	lbs/day	839	278	mg/L	1598	495	mg/L
VSS	lbs/day	629	208	mg/L	1199	371	mg/L
TKN	lbs/day	138	46	mg/L	188	58	mg/L
Total Phosphorus	lbs/day	24	7.9	mg/L	44	13.7	mg/L
Tank Dimensions							
Length	ft	39			39		
Width	ft	13			13		
SWD	ft	7			7		
Surface Area	sf	507			507		
Total Volume	gal	26,547			26,547		
Removal Rates			TYP			TYP	
BOD	%	30%	30%		30%	30%	
TS	%	60%	60%		60%	60%	
TKN	%	20%	20%		20%	20%	
Phosphorus	%	20%	20%		20%	20%	
Estimated Solids Concentration	%	4.0%	4%		4.0%	4%	
Surface Overflow Rate	gpd/sf	714			763		
BOD Fermentation Reduction	%	10%			10%		
Scum							
Flow	gpd	50			50		
Total Sludge Production							
Flow (includes scum)	gpd	3,066			5,799		
BOD	lbs/day	395			737		
TSS	lbs/day	1,006	3.9%		1,918	4.0%	
VSS	lbs/day	755			1,438		
TKN	lbs/day	55			75		
Total Phosphorus	lbs/day	10			18		
Total Effluent							
Flow	mgd	0.721	501	gpm	0.768	533	gpm
BOD	lbs/day	1,108	184	mg/L	2,067	323	mg/L
TSS	lbs/day	670.8	112	mg/L	1,278.6	200	mg/L
VSS	lbs/day	503	84	mg/L	959	150	mg/L
TKN	lbs/day	221	37	mg/L	301	47	mg/L
Total Phosphorus	lbs/day	38	6.4	mg/L	71	11.0	mg/L

Biological Treatment Parameters							
Desired MLSS	mg/L	2,000			2,000		
RAS Concentration	mg/L	4,000			4,000		
Average RAS Flowrate (Total)	GPM	501	103%		533	109%	
	MGD	0.721			0.768		
Desired Sludge Age	days	10.0			10.0		
No. of Biological Trains Operating		1			1		

Selector Basins							
Influent							
Flow	MGD	0.721	501	gpm	0.768	533	
BOD	lbs/day	1,108	184	mg/L	2,067		
TSS	lbs/day	671	112	mg/L	1,279		
VSS	lbs/day	503	84	mg/L	959		
TKN	lbs/day	221	37	mg/L	301		
Total Phosphorus	lbs/day	38	6.4	mg/L	71	11.0	
RAS							
Flow	MGD	0.721	501		0.768	533	
BOD (10 mg/L)	lbs/day	60			64		
TS	lbs/day	24,047			25,623		
VS	%	75%			75%		
VS	lbs/day	18,035			19,217		
TKN (1 mg/L)	lbs/day	6			6		
Nitrate/Nitrite	lbs/day	87			107		
Total P (biological and RAS water)	lbs/day	1,632			2,107		
Anoxic Recycle	gpm	50	10%		53	10%	
Common Basin Depth	ft	14.00			14.00		
Anoxic Basins							
Combined Flow (RAS + Recycle)							
Flow	MGD	0.793	551	gpm	0.845	587	gpm
BOD	lbs/day	60	9	mg/L	64	9	mg/L
TS	lbs/day	24,047	3,636	mg/L	25,623	3,636	mg/L
VS	lbs/day	38	6	mg/L	71	10	mg/L
TKN	lbs/day	6	1	mg/L	6	1	mg/L
Nitrates	lbs/day			mg/L			mg/L
Total P	lbs/day	1,632	3	mg/L	2,107	4	mg/L
Basin No. 1							
In Service?	yes/no	yes			yes		
Basin Area	sf	460.0			460.0		
Basin Volume	gal	48,171			48,171		
Detention Time	hrs	1.46			1.37		
Basin No. 2							
In Service?	yes/no	yes			yes		
Length	ft	412.6			412.6		
Basin Volume	gal	43,207			43,207		
Detention Time	hrs	1.31			1.23		
Anaerobic Basins							
Combined Flow (Influent + RAS + Recycle)							
Flow	MGD	1.514	1051	gpm	1.613	1120	gpm
BOD	lbs/day	1,168	93	mg/L	2,131	158	mg/L
TS	lbs/day	24,718	1,958	mg/L	26,902	2,000	mg/L
VS	lbs/day	18,538	1,468	mg/L	20,176	1,500	mg/L
TKN	lbs/day	227	18	mg/L	307	23	mg/L
Nitrates	lbs/day	87	7	mg/L	107	8	mg/L
Total P	lbs/day	1,671	132	mg/L	2,177	162	mg/L
Basin No. 3							
In Service?	yes/no	yes			yes		
Basin Area	sf	206.3			206.3		
Basin Volume	gal	21,604			21,604		
Detention Time	hrs	0.34			0.32		
Basin No. 4							
In Service?	yes/no	yes			yes		
Basin Area	sf	206			206		
Basin Volume	gal	21,604			21,604		
Detention Time	hrs	0.34			0.32		
Total Operational Selector Volume	gal	134,586			134,586		
	cf	17,993			17,993		
Total Selector Detention	hrs	3.45			3.24		
Water Temperature	^{0}C	15			15		
Denitrification Rate	lbs/lbVSS/d	0.062			0.062		
Active Biomass (55% of VS)	lbs/day	10,196			11,097		
Detention Time Required for Denite	hrs	3.3			3.7		
Remaining Time for Anaerobic	hrs	0.1			0.0		
Nitrates Removed	lbs	87			92		
BOD Removed	lbs	521			552		

Effluent							
Flow	mgd	1.442	1001	gpm	1.536	1067	gpm
BOD	lbs/day	647	54	mg/L	1,579	123	mg/L
TKN	lbs/day	227	19	mg/L	307	24	mg/L
Without RAS							
TSS	lbs/day	671			1,279		
VSS	lbs/day	503			959		
TP	lbs/day	38			71		

Aeration Basins

Common Basin Depth	ft	14.00			14.00		
Aeration Basin No. 1							
In Service?	yes/no	yes			yes		
Basin Area	sf	733.8			733.8		
Basin Volume	gal	76,844			76,844		
Detention Time (w/o RAS)	hrs	1.28			1.20		
Aeration Basin No. 2							
In Service?		yes			yes		
Basin Area	sf	733.8			733.8		
Basin Volume	gal	76,844			76,844		
Detention Time (w/o RAS)	hrs	1.28			1.20		
Aeration Basin No. 3							
In Service?		yes			yes		
Basin Area	ft	855.0			855.0		
Basin Volume	sf	89,536			89,536		
Detention Time (w/o RAS)	gal	1.49			1.40		
Aeration Basin No. 4							
In Service?		yes			yes		
Basin Area	sf	460.0			460.0		
Basin Volume	gal	48,171			48,171		
Detention Time (w/o RAS)	gal	0.80			0.75		
Total Aeration Volume	gal	291,394			291,394		
	cf	38,956			38,956		
Influent P concentration (to selectors)	mg/L	6.36			11.02		
Assumed Bio-P Removal	mg/L	6.36	100%		11.02	100%	
BOD Loading Rate	lbs/kcf	17			41		
F/M Ratio		0.18			0.43		
Detention Time	hours	4.9			4.6		
AOR	lbs/day	1,758			3,151		
Phosphorus not removed biologically	lbs/day	0	0.0	mg/L	0	0.0	mg/L
Est WAS (Cell Yield)	lbs/day	551			1,152		
EST WAS (Aeration Volume)	lbs/day	487			487		
Est WAS (max)	gpd	15,565			24,570		

Final Clarifiers

No. of Clarifiers in Use		2			2		
Diameter	ft	31			31		
Surface Area	sf	755			755		
Surface Overflow Rate	gpd/sf	478			509		
Solids Loading Rate	lbs/d/sf	16			17		
WAS							
Chemical Sludge (10 lb/lb P Removed)	lbs/day	0			0		
Flow	gpd	15,565			24,570		
BOD (10 mg/L)	lbs/day	1			2		
TS	lbs/day	519	0.40%		820	0.40%	
VS	lbs/day	389			615		
TKN (1 mg/L)	lbs/day	0			0		
Total Phosphorus	lbs/day	38			71		
Total Effluent							
Flow	mgd	0.705			0.744		
BOD (10 mg/L)	lbs/day	59			62		
TSS (10 mg/L)	lbs/day	59			62		
TKN (1 mg/L)	lbs/day	6			6		
Total Phosphorus (1 mg/L)	lbs/day	6			6		

WAS Thickening - DAF Unit

Sludge Production			
Flow	gpd	15,565	24,570
BOD	lbs/day	1	2
TSS	lbs/day	519	820
VSS	lbs/day	389	615
TKN	lbs/day	0	0
Total Phosphorus	lbs/day	38	71
Soluble Phosphorus	lbs/day		
Number of Thickening Units		1	1
Operation Schedule	hrs/day	24.00	24.00
Estimated Solids Concentration	%	4.00%	4.00%
Solids Capture Rate	%	95%	95%
Wash Water	gpm	0.00	0.00

Average Flow Rate	gpm	11		17	
Solids Loading Rate	lb/hr	22		34	
Assumed Diameter	ft	8		8	
Unit Loading Rate	lb/sf/hr	0.43		0.68	
Thickened Sludge					
Flow	gpd	1,479		2,334	
TS	lbs/day	493		779	
VS	lbs/day	370		584	
Recycle			mg/L		mg/L
Flow	gpd	14,086		22,236	
BOD	lbs/day	1		2	
TS	lbs/day	26		41	
VS	lbs/day	19		31	
TKN	lbs/day	0		0	
Phos	lbs/day	2		3	

Sludge Digestion

Total Sludge Production					
Flow	gpd	4,545		8,133	
TS	lbs/day	1,500	3.96%	2,697	3.98%
VS	lbs/day	1,125		2,022	
Mesophilic Digester					
Tank Diameter	ft	50		50	
Bottom Cone Depth	ft	8.33		8.33	
SWD	ft	17		17	
Volume	kcf	39		39	
	gal	290,459		290,459	
Decant	gpd	0		0	
Loading Rate	lbsVS/kcf	29		52	
Detention Time	days	64		36	
Hydraulic Detention Time (excluding decant)	days				
VS Destruction	%	50%		50%	
Decant					
BOD (1000 mg/L)	lbs/day	0		0	
TSS (3000 mg/L)	lbs/day	0		0	
NH3 (500 mg/L)	lbs/day	0		0	
TP (300 mg/L)	lbs/day	0		0	
Sludge Discharge					
Flow	gpd	4,545		8,133	
TS	lbs/day	937	2.47%	1,685	2.48%
VS	lbs/day	562		1,011	
Volatile Fraction	%	60%		60%	

Sludge Storage

Total Sludge Production					
Flow	gpd	4,545		8,133	
TS	lbs/day	937	2.47%	1,685	2.48%
VS	lbs/day	562		1,011	
Tank Diameter	ft	70		70	
SWD	ft	23		23	
Volume	kcf	87		87	
	gallons	647,694		647,694	
Decant	gpd	2,800		4,600	
BOD (1000 mg/L)	lbs/day	23		38	
TSS (3000 mg/L)	lbs/day	70		115	
NH3 (500 mg/L)	lbs/day	12		19	
TP (300 mg/L)	lbs/day	7		12	
Days of Storage	days	371		183	
Total Sludge to Storage	gal/yr	1,658,915		2,968,683	
Total Sludge Hauled	gal/yr	636,915		1,289,683	

City of Viroqua WWTP Capacity Evaluation

				Notes:	
Primary Clarifiers					
Tank Dimensions					
Length	ft	39			
Width	ft	13			
SWD	ft	7			
Surface Area	sf	507			
Total Volume	gal	26,547			
No. of Clarifiers in Use		2			
Design Average Surface Overflow Rate	gpd/sf	800	1,000	*NR 110 Maximum = 1,000 gpd/sf*	
Flow per Clarifier	MGD	0.406	0.507		
Total Design Average Flow	**MGD**	**0.811**	**1.014**		
Peak Hour Surface Overflow Rate	gpd/sf	1,200	2,500	*NR 110 Maximum = 1,500 gpd/sf, 10 States 1,500-2,000 gpd/sf*	
Peak Hour Flow per Clarifier	MGD	0.608	1.268		
Total Peak Hour Flow	**MGD**	**1.217**	**2.535**		
Estimated Weir Length	ft	39	39		
Average Weir Overflow Rate	gpd/f	10,400	13,000	*NR 110 Maximum = 10,000 gpd/f*	
Peak Hour Weir Overflow Rate	gpd/f	31,200	65,000	*Ten States Recommended = 20,000 gpd/f*	
Aeration Basins					
No. of Treatment Trains in Use		2		1	
Tank Dimensions					
Common Channel Width	ft	14.92		14.92	
Common Channel Depth	ft	14.00		14.00	
Aeration Basin No. 1					
Channel Length	ft	58.00		58.00	
Total Volume	gal	90,620		90,620	
Aeration Basin No. 2					
Channel Length	ft	31.75		31.75	
Total Volume	gal	49,607		49,607	
Total Aeration Volume per Train	gal	140,227		140,227	
Total Aeration Volume per Train	cf	18,747		18,747	
Design BOD Loading Rate	lbs/kcf	30	40	40	*NR 110 Maximum = 40 lbs/kcf*
Aeration Basin BOD Loading Capacity/Train	lbs/d	562	750	750	
Total Aeration Basin BOD Loading Capacity	lbs/d	1,125	1,500	750	
Assumed BOD Reduction in Primaries	%	30%	30%	30%	
Plant BOD Loading Capacity	**lbs/d**	**1,607**	**2,143**	**1,071**	
Final Clarifiers					
Tank Dimensions					
Diameter	ft	31			
Surface Area	sf	755			
No. of Clarifiers in Use		2			
Design Average Surface Overflow Rate	gpd/sf	300	400	*Typical Design 200-300 gpd/sf, 400-500 gpd/sf acceptable*	
Flow per Clarifier	MGD	0.226	0.302		
Total Design Average Flow	**MGD**	**0.453**	**0.604**		
Peak Hour Surface Overflow Rate	gpd/sf	1,000	1,200	*NR 110 Maximum = 1,200 gpd/sf based on influent flow*	
Peak Hour Flow per Clarifier	MGD	0.755	0.906		
Total Peak Hour Flow	**MGD**	**1.510**	**1.811**		
Desired MLSS	mg/L	2,350	2,350		
Average Solids Loading Rate	lbs/sf/h	0.49	0.65	*NR 110 Maximum = 1.4 including Max RAS rate*	
Peak Solids Loading Rate	lbs/sf/h	0.98	1.31	*NR 110 Maximum = 2.0 including Max RAS rate*	
Estimated Weir Length (Inboard)	ft	170	170		
Average Weir Overflow Rate	gpd/f	1,332	1,776	*NR 110 Maximum = 10,000 gpd/f*	
New Weir Length (Single)	ft	91	91		
Average Weir Overflow Rate	gpd/f	2,485	3,314	*NR 110 Maximum = 10,000 gpd/f*	
Anaerobic Digester					
Tank Dimensions					
Tank Diameter	ft	50			
Bottom Cone Depth	ft	8.33			
SWD	ft	17			
Volume	kcf	39			
Volume	gallons	290,459			
Design Detention Time	days	15	20	*NR 110 Minimum = 15 days at design flows*	

City of Viroqua WWTP Capacity Evaluation

				Notes:
Sludge Capacity	gpd	19,364	14,523	
Design Solids Loading Rate	lbsVS/kcf	40	80	*NR 110 Maximum = 40 lbs/kcf moderately mixed (sludge recirc only), 80 lbs/kcf completely mixed*
Digester Volatile Solids Loading Capacity	lbs/d	1,553	3,107	
Assumed Volatile Solids/Total Solids	%	75%	75%	
Digester Total Solids Loading Capacity	lbs/d	2,071	4,142	

Sludge Storage

Tank Dimensions		
Tank Diameter	ft	50
Bottom Cone Depth	ft	8.33
SWD	ft	17
Volume	kcf	39
Volume	gallons	290,459

City of Viroqua WWTP Design Model
Chemical Phosphorus Removal

Design Parameters	Units	Typical	Alt 1 Startup	Alt 2 Startup	Alt 3 Startup	Alt 1 Design	Alt 2 Design	Alt 3 Design
Design Forward Flow	MGD		0.352	0.352	0.352	0.768	0.768	0.768
P Concentration in Aeration Basin	mg/l		7.38	7.38	7.38	11.02	11.02	11.02
Desired Effluent P Concentration	mg/l		0.9	0.9	0.9	0.15	0.15	0.15
Effluent P Conc achieved with BioP removal	mg/L		2.0	1.5	1.0	1.0	0.75	0.5
P Removed Biologically	mg/l		5.38	5.88	6.38	10.02	10.27	10.52
Total P to be removed by Chemical	mg/l		1.10	0.60	0.10	0.85	0.60	0.35
	lbs/day		3.2	1.8	0.3	5.4	3.8	2.2
Low Level P Removal (<0.5 mg/L)	mg/l		0	0	0	0.35	0.35	0.35
Standard P Removal (>0.5 mg/L)	mg/l		1.10	0.60	0.10	0.50	0.25	0.00
Chemical Properties								
Percent chemical in solution	%	see below	48.50%	48.50%	48.50%	48.50%	48.50%	48.50%
Alum		0.485						
Ferric Chloride		0.39						
Molecular wt of solution	mw	see below	666.7	666.7	666.7	666.7	666.7	666.7
Al2(SO4)3-18H2O		666.7						
Al2(SO4)3-14H2O		594.3						
FeCl3		162.1						
Density of chemical solution	lb/cf		79.0	79.0	79.0	79.0	79.0	79.0
Weight of solution per gallon	lb/gal		10.6	10.6	10.6	10.6	10.6	10.6
Weight of chemical per gallon	lb/gal		5.1	5.1	5.1	5.1	5.1	5.1
Weight of metal per gallon	lb/gal		0.415	0.415	0.415	0.415	0.415	0.415
Design Values								
Mole ratio of metal:P for standard removal (>0.5 mg/L)		see below	2.25	2.25	2.25	2.25	2.25	2.25
Mole ratio of metal:P for low level removal (<0.5 mg/L)		see below	10.00	10.00	10.00	10.00	10.00	10.00
Alum								
90% removal		1.75						
95% removal		2.25						
Removal under 0.5 mg/L		10						
Ferric Chloride								
90% removal		2.85						
95% removal		3.25						
Standard P Removal (>0.5 mg/L)								
Phosphorus to be removed per day	lb/day		3.2	1.8	0.3	3.2	1.6	0.0
Qty of solution req'd per lb P	gal		4.73	4.73	4.73	4.73	4.73	4.73
Qty of solution req'd per day	**gpd**		**15.2**	**8.3**	**1.4**	**15.1**	**7.6**	**0.0**
Qty of alkalinity req'd for secondary precip	mg/l		6.7	3.6	0.6	3.0	1.5	0.0
Chemical precipitated solids	**lb/day**		**23**	**12**	**2**	**23**	**11**	**0**
Low Level P Removal (<0.5 mg/L)								
Phosphorus to be removed per day	lb/day		0.0	0.0	0.0	2.2	2.2	2.2
Qty of solution req'd per lb P	gal		21.01	21.01	21.01	21.01	21.01	21.01
Qty of solution req'd per day	**gpd**		**0.0**	**0.0**	**0.0**	**47.1**	**47.1**	**47.1**
Qty of alkalinity req'd for secondary precip	mg/l		0.0	0.0	0.0	15.3	15.3	15.3
Chemical precipitated solids	**lb/day**		**0**	**0**	**0**	**60**	**60**	**60**
Total Chemical Required	**gpd**		**15.2**	**8.3**	**1.4**	**62.3**	**54.7**	**47.1**
Total Chemical Solids Produced	**lb/day**		**23**	**12**	**2.1**	**82**	**71**	**60**
WAS Solids - Without Chemical P	**lb/day**		**425**	**425**	**425**	**821**	**821**	**821**
Total Solids WAS + Chem P	**lb/day**		**448**	**437**	**427**	**903**	**892**	**881**

Notes:
Future eflfuent limits at new outfall location = 0.17 mg/L 6-month average, 0.5 mg/L monthly average
Startup chemical usage assumes an interim limit of 1 mg/L still applies

Appendix L

Environmental Impacts

- Endangered Resources Preliminary Review
- Endangered Resources Review
- Threatened and Endangered Resources Review Letter to USFWS
- Wetlands Inventory

Endangered Resources Preliminary Assessment

Created on **Thursday, March 12, 2015**. This report is good for one year after the created date.

Results

Endangered resources are present and the species present are legally protected. **Further actions are required to ensure compliance** with Wisconsin's Endangered Species Law (s. 29.604 Wis. Stats.) and the Federal Endangered Species Act (16 USC ss 1531-43). Therefore you should request an Endangered Resources Review http://dnr.wi.gov/topic/ERReview/Review.html.

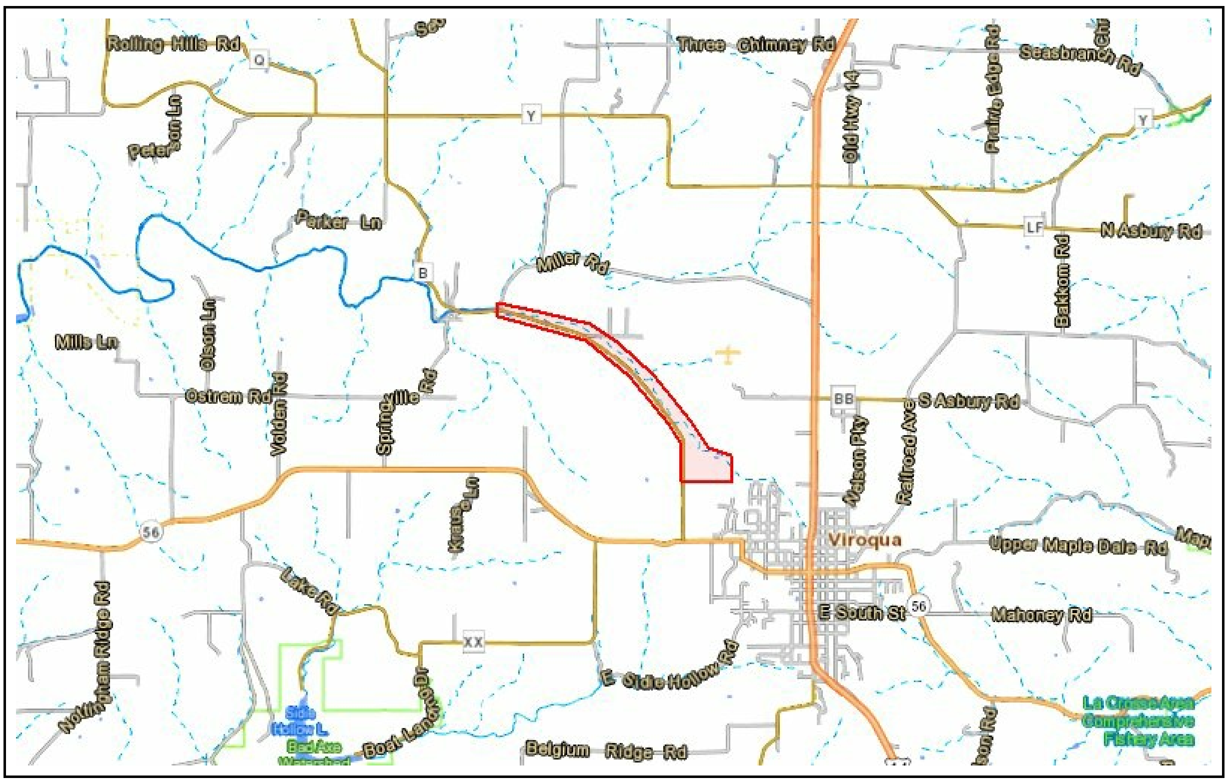
Project Information

Landowner name	
Project address	
Project description	City of Viroqua WWTP Outfall Relocation

Project Questions

Does the project involve a public property?	Yes
Is the project on a federal property?	No
Is the project federally funded?	Yes
Is the project a utility, agricultural, forestry or bulk sampling (associated with mining) project?	Yes
Is the project property in Managed Forest Law or Managed Forest Tax Law?	No

Project Area Maps



https://dnrx.wisconsin.gov/nhiportal/public

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Endangered Resource Review for the Proposed Viroqua WWTF Force Main, Vernon County (ER Log # 15-322)

Section A. Location and brief description of the proposed project

Based on information provided by in the ER Certified Reviewer and attached materials, the proposed project consists of the following:

Location	Vernon County - 13N 04W 30, 13N 05W 24, 13N 05W 23, 13N 05W 25
Project Description	The City of Viroqua is in the planning stages for improvements to the City's Wastewater Treatment Facility's (WWTF) outfall. The City proposes to upgrade the existing facility on the existing site and construct a pressurized pipeline (force main) to a new outfall location approximately 2 miles northwest of the existing WWTF. The proposed new force main would be installed using open-cut methods in the road right-of-way (ROW) of CTH B to an outfall on the Springville Branch of the Bad Axe River just upstream of Springville, west of the intersection of CTHB and Miller/Springville Road. The proposed outfall is to be located just west of the intersection near an existing culvert.
Project Timing	April - December 2016
Current Habitat	Cleared, established road ROW within an agricultural landscape, dominated by common roadside grasses, herbaceous species, and shrubs.
Impacts to Wetlands or Waterbodies	Based on a review of available resources, there are no wetlands or hydric soils mapped along the proposed Project route. The route, as proposed, does cross an unnamed tributary to the Springville Branch of the Bad Axe River which will be crossed using open-cut methods.
Property Type	Private, Public

It is best to request ER Reviews early in the project planning process. However, some important project details may not be known at that time. Details related to project location, design, and timing of disturbance are important for determining both the endangered resources that may be impacted by the project and any necessary follow-up actions. Please contact the Certified Coordinators whenever project plans change or new details become available to confirm if results of this ER Review are still valid.

Section B. Endangered resources recorded from within the project area and surrounding area

	Group	State Status	Federal Status
Eastern Pipistrelle *(Perimyotis subflavus)*	Mammal~	THR	
Bat Hibernaculum	Other	SC	

For additional information on the rare species, high-quality natural communities, and other endangered resources listed above, please visit our Biodiversity (http://dnr.wi.gov/topic/EndangeredResources/biodiversity.html) page.

Section C. Follow-up actions

Actions that need to be taken to comply with state and/or federal endangered species laws: None

Actions recommended to help conserve Wisconsin's Endangered Resources:

• **Eastern Pipistrelle (*Perimyotis subflavus*) - Mammal~**

State Status: THR

Impact Type	Impact possible
Recommended Measures	Time of year restriction,Other
Description of Recommended Measures	Suitable habitat for the Eastern Pipistrelle may be present in the Project area. Reproductive females and their young are highly vulnerable to mass mortality during their maternity period (June 1 - August 15), The simplest and preferred method to avoid take of these threatened bats is to avoid directly impacting individuals, locations of known maternity colonies, or areas of suitable habitat. Any tree cutting along the proposed Project route would be covered under the BITP for Cave Bats. While there are no restrictions for tree cutting, special consideration should be given to protecting snags or dying trees, particularly from June 1 - August 15.

Remember that although these actions are not required by state or federal endangered species laws, they may be required by other laws, permits, granting programs, or policies of this or another agency. Examples include the federal Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, State Natural Areas law, DNR Chapter 30 Wetland and Waterway permits, DNR Stormwater permits, and Forest Certification.

Additional Recommendations

• This project has the potential to impact the Springville Branch of the Bad Axe River, located downstream from the Project's waterway crossing. As a result, erosion and runoff prevention measures must be implemented during the course of the project to avoid take of protected aquatic species. Please note that plastic or polypropylene netting associated with erosion matting (also known as an erosion control blankets or erosion mesh netting) without independent movement of strands can easily entrap snakes and other wildlife moving through the area, and cause dehydration, desiccation, and eventually mortality. Biodegradable jute/twine netting with the "leno" or "gauze" weave (contains strands that are able to move independently) has the least impact on snakes. If erosion matting will be used for this project, use the following matting (or something similar): American Excelsior "FibreNet" or "NetFree" products; East Coast Erosion biodegradable jute products; Erosion Tech biodegradable jute products; ErosionControlBlanket.com biodegradable leno weave products; North American Green S75BN, S150BN, SC150BN or C125BN; or Western Excelsior "All Natural" products. One of the most significant potential impacts to the threatened, endangered, and special concern species in proximity to the project site is invasive species. Additional information on invasive/exotic plant and animal species is available at http://dnr.wi.gov/topic/Invasives/. Roads and trails are well documented vectors for the spread of invasive species, particularly plants. Invasive species can be spread during the construction of the trail by materials or equipment or during its use upon completion of the trail. All surfaces of construction equipment should be thoroughly cleaned of mud and debris from previous work sites to prevent the spread of invasive species. When reseeding impacted areas, be sure to use native local seed mix that does not contain invasive species. If you need contact information for local distributors we can provide you with some suggestions. Further, when deciding on what species you will use for your prairie, wildlife garden, and other landscaping, be sure not to include invasive species like buckthorn, honeysuckle, or any of the species listed on the DNR non-native plant list. We recommend the use of certified noxious-weed-free forage and mulch as a preventive measure to limit the spread of noxious weeds. This voluntary certification program, operated by the Wisconsin Crop Improvement Association, is designed to assure that certified mulch meets minimum standards designed to limit the spread of noxious weeds. The applicant, contractor, and all sub-contractors shall ensure that all equipment used for the project has been adequately cleaned of aquatic and terrestrial invasive species prior to being used in waters or wetlands of the state. Equipment shall be cleaned when invasive species are present in one area of the project before working in an area where invasive species are not present.

No actions are required or recommended for the following endangered resources:

• Bat Hibernaculum - Other

State Status: SC

Impact Type	No impact
Reason	Other - Justification Required

No Impact - Other - Justification	The known bat hibernaculum is located approximately one-half mile from the easternmost extent of the Project area. As a result, no impacts to the known bat hibernaculum are anticipated.

Section D. Next Steps

1. Evaluate whether the **'Brief description of the proposed project'** is still accurate. All recommendations in this ER Review are based on the information supplied in this ER Review letter and additional attachments. If the proposed project has changed, please contact the ER Review Program to determine if the information in this ER Review is still valid.
2. Determine whether the project can incorporate and implement the **'Follow-up actions'** identified above:
   - 'Actions that need to be taken to comply with state and/or federal endangered species laws' represent the Department's best available guidance for complying with state and federal endangered species laws based on the project information that you provided and the endangered resources information and data available to us. If the proposed project has not changed from the description that you provided us and you are able to implement all of the 'Actions that need to be taken to comply with state and/or federal endangered species laws', your project should comply with state and federal endangered species laws. Please remember that if a violation occurs, the person responsible for the taking is the liable party. Generally this is the landowner or project proponent. For questions or concerns about individual responsibilities related to Wisconsin's Endangered Species Law, please contact the ER Review Program.
   - If the project is unable to incorporate and implement one or more of the 'Actions that need to be taken to comply with state and/or federal endangered species laws' identified above, the project may potentially violate one or more of these laws. Please contact the ER Review Program immediately to assist in identifying potential options that may allow the project to proceed in compliance with state and federal endangered species laws.
   - 'Actions recommended to help conserve Wisconsin's rare species and high-quality natural communities' may be required by another law, a policy of this or another Department, agency or program; or as part of another permitting, approval or granting process. Please make sure to carefully read all permits and approvals for the project to determine whether these or other measures may be required. Even if these actions are not required by another program or entity for the proposed project to proceed, the Department strongly encourages the implementation of these conservation measures on a voluntary basis to help prevent future listings and protect Wisconsin's biodiversity for future generations.
3. No federally-protected species or habitats are involved.

Section E. Contact Information

The Proposed ER Review for this project was requested and conducted by the following:

> Requester: Amy M. Bares, P.E.; Sarah Grainger, P.E., Amy Bares: Town and Country Engineering, Inc., 2912 Marketplace Drive, Suite 103, Madison, WI 53719; abares@tcengineers.net; Sarah Grainger: City Engineer, City of Viroqua, 202 N. Main Street, Viroqua, WI 54665; sgrainger@viroqua-wisconsin.com
>
> Invoice will be sent to: Kate Remus, Stantec Consulting Services, Inc.; kate.remus@stantec.com
>
> Proposed ER REVIEW conducted by: Kate Remus, kate.remus@stantec.com, Stantec Consulting Services, Inc., 608-839-2036

The Proposed ER Review was subsequently reviewed, modified (if needed), and approved by Wisconsin Department of Natural

Resources (DNR):

> Proposed ER REVIEW approved by: Stacy Rowe, stacy.rowe@wi.gov, ER Review Program, WDNR, 101 S. Webster St., PO Box 7921, Madison, Wisconsin 53707

DNR Signature:	*Stacy Rowe*	04/17/15

Section F. Standard Information to help you better understand this ER Review

Endangered Resources (ER) Reviews are conducted according to the protocols in the guidance document Conducting Proposed Endangered Resources Reviews: A Step-by-Step Guide for Certified ER Reviewers. A copy of this document is available upon request by contacting the ER Certification Coordinator at 608-266-5241

How endangered resources searches are conducted for the proposed project area: An endangered resources search is performed as part of all ER Reviews. A search consists of querying the Wisconsin Natural Heritage Inventory (NHI) database for endangered resources records for the proposed project area. The project area evaluated consists of both the specific project site and a buffer area surrounding the site. The size of the buffer considered varies depending on the ecological and land use characteristics of the site and surrounding area. Generally a 1-mile buffer is considered for terrestrial species, and a 2 mile buffer for aquatic species. Endangered resources records from the buffer area are considered because most lands and waters in the state, especially private lands, have not been surveyed. Considering records from the entire project area (also sometimes referred to as the search area) provides the best picture of species and communities that may be present on your specific site if suitable habitat for those species or communities is present.

Categories of endangered resources considered in ER Reviews and protections for each: Endangered resources records from the NHI database fall into one of the following categories:

- Federally-protected species include those federally-listed as Endangered or Threatened, those Proposed for federal listing, and their Proposed or Designated Critical Habitats. Federally-protected animals are protected on all lands; federally-protected plants are protected only on federal lands and in the course of projects that include federal funding (see Federal Endangered Species Act of 1973 as amended).

- Animals (vertebrate and invertebrate) listed as Endangered or Threatened in Wisconsin are protected by Wisconsin's Endangered Species Law on all lands and waters of the state (s. 29.604, Wis. Stats.).

- Plants listed as Endangered or Threatened in Wisconsin are protected by Wisconsin's Endangered Species Law on public lands and on land that the person does not own or lease, except in the course of forestry, agriculture, utility, or bulk sampling actions (s. 29.604, Wis. Stats.).

- Special Concern species, high-quality examples of natural communities (sometimes called High Conservation Value areas), and natural features (e.g., caves and animal aggregation sites) are also included in the NHI data-base. These endangered resources are not legally protected by state or federal endangered species laws. However, other laws, policies (e.g., related to Forest Certification), or granting/permitting processes may require or strongly encourage protection of these resources. The main purpose of the Special Concern classification is to focus attention on species about which some problem of abundance or distribution is suspected before they become endangered or threatened.

- State Natural Areas (SNAs) are also included in the NHI database. SNAs protect outstanding examples of Wisconsin's native landscape of natural communities, significant geological formations, and archeological sites. Endangered species are often found within SNAs. SNAs are protected by law from any use that is inconsistent with or injurious to their natural values (s. 23.28, Wis. Stats.).

Please remember the following:

1. This ER Review is provided as information to comply with state and federal endangered species laws. By following the protocols and methodologies described above, the best information currently available about endangered resources that may be present in the proposed project area has been provided. However, the NHI database is not all inclusive; systematic surveys of most public lands have not been conducted, and the majority of private lands have not been surveyed. As a result, NHI data for the project area may be incomplete. Occurrences of endangered resources are only in the NHI database if the site has been previously surveyed for that species or group during the appropriate season, and an observation was reported to and entered into the NHI database. As such, absence of a record in the NHI database for a specific area should not be used to infer that no endangered resources are present in that area. Similarly, the presence of one species does not imply that surveys have been conducted for other species. Evaluations of the possible presence of rare species on the project site should always be based on whether suitable habitat exists on site for that species.

2. This ER Review provides an assessment of endangered resources that may be impacted by the project and measures that can be taken to avoid negatively impacting those resources based on the information that has been provided to ER Review Program at this time. Incomplete information, changes in the project, or subsequent survey results may affect our assessment and indicate the need for additional or different measures to avoid impacts to endangered resources.

3. This ER Review does not exempt the project from actions that may be required by Department permits or approvals for the project.

TOWN & COUNTRY
ENGINEERING, INC.

April 1, 2015

Peter Fasbender
U.S. Fish and Wildlife Service
Green Bay Ecological Services Field Office
2661 Scott Tower Drive
New Franken, Wisconsin 54229

SUBJECT: Proposed City of Viroqua Force Main, Vernon County, WI

To the Endangered Species Review Program,

We have conducted a Proposed Endangered Resources (ER) Review for the above-referenced project according to the US Fish and Wildlife technical assistance website and have concluded that it will have no effect on threatened or endangered resources. I am submitting this letter to document the review and request concurrence by the US Fish and Wildlife Service.

Location and Description of the Proposed Project

Location of proposed project:
T13N R5W Sections 23, 24, 25, and 26; T13N R4W Sections 30 and 31 in Vernon County, WI.

Detailed description of the proposed project and associated disturbance:
The City of Viroqua is planning improvements to the City's wastewater treatment facility and modifications to the facility's discharge of treated effluent. The existing effluent outfall will be moved to a new outfall location approximately 2 miles northwest of the existing treatment plant to avoid potential discharge to a groundwater from the disappearing stream that is the current receiving water. A pressurized pipeline (force main) will be constructed to convey the effluent to the new outfall location on the Springville Branch of the Bad Axe River just upstream of Springville, west of the intersection of CTH B and Miller Rd (Springville Road). The new force main would follow a route running in the right-of-way of CTH B to the intersection of Miller Rd (see **Option B** on the attached figure). The proposed trench will be approximately 25 feet wide. In addition, short sections of the corridor will be constructed using horizontal directional drill (HDD) method. The trenchless methods are expected to be employed at road crossings and sensitive environmental areas.

Start date (on site disturbance): April 2016

End date: Construction of the force main is slated to finish by December 2016.

2912 Marketplace Drive · Suite 103 · Madison, WI 53719 · phone: (608) 273-3350 · fax: (608) 273-3391 · www.tcengineers.net
Madison, Wisconsin • Rhinelander, Wisconsin

Detailed description of the habitat types and current land use within the proposed impact area:

The proposed corridor is a public road ROW. The corridor parallels the unnamed tributary to the Springville Branch of the Bad Axe River, with a crossing of this tributary just upstream of the outfall location. Terrain along the ROW is generally flat with rolling hills on either side. The surrounding land use includes rural residential, forest, row crops and pasture.

Wetlands and waterbodies within one mile of the project area, and any known or suspected impacts of the proposed project to these wetlands and waterbodies:

The following waterbodies occur within or adjacent to the project area: Springville Branch of the Bad Axe River and an unnamed tributary. No wetlands have been identified within the proposed project corridor.

Endangered Resources Recorded within the Project Area and/or Surrounding Area

Review of the US Fish and Wildlife species list by county is provided on the following website: http://www.fws.gov/midwest/endangered/section7/s7process/index.html

This website identified the following species as endangered, threatened, proposed, or candidate species for Vernon County, Wisconsin:

Species	Status	Habitat
Northern long-eared bat *Myotis septentrionalis*	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. Roosts and forages in upland forests and woods.
Higgins eye pearly mussel *(Lampsilis higginsii)*	Endangered	Mississippi River
Northern monkshood *(Aconitum noveboracense*)	Threatened	North facing slopes

The habitat along the project corridor was compared to that found in the US Fish & Wildlife Fact Sheets and analysis of this information is as follows:

- Northern Long-eared Bat – The northern long-eared bat is a medium-sized bat that spends winter hibernating in caves and mines called hibernacula. They typically use large caves or mines with large passages and entrances; constant temperatures; and high humidity with no air currents. During summer, northern long-eared bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. Males and non-reproductive females may also roost in cooler places, like caves and mines. It has also been found, rarely, roosting in structures like barns and sheds. There are no caves, mines, or upland forest areas present along the project corridor, which consists of a county highway right-of-way. Forested areas are located adjacent to the CTH B ROW but will not be disturbed during construction.

- Higgins Eye Pearly Mussel - The Higgins eye is a freshwater mussel of larger rivers where it is usually found in deep water with moderate currents. In Vernon County this species has been identified in the Mississippi River. Along the project corridor there are no larger rivers, only a small disappearing stream that is tributary to the Springville Branch of the Bad Axe River.

- Northern monkshood - Northern monkshood is typically found on shaded to partially shaded cliffs, algific talus slopes, or on cool, streamside sites. These areas have cool soil conditions, cold air drainage, or cold groundwater flowage. On algific talus slopes, these conditions are caused by the outflow of cool air and water from ice contained in underground fissures. These fissures are connected to sinkholes and are a conduit for the air flows. These conditions are not apparent along the pipeline corridor except possibly along the banks of the Springville Branch of the Bad Axe River at the terminus of the force main where a spring is present. The only construction activity in this area will be the installation the outfall pipe. During the upcoming growing season, this area will be surveyed to determine whether Northern monkshood is present in the proposed outfall location and, if necessary, the outfall location or construction methods will be adjusted to avoid impacts to the threatened species.

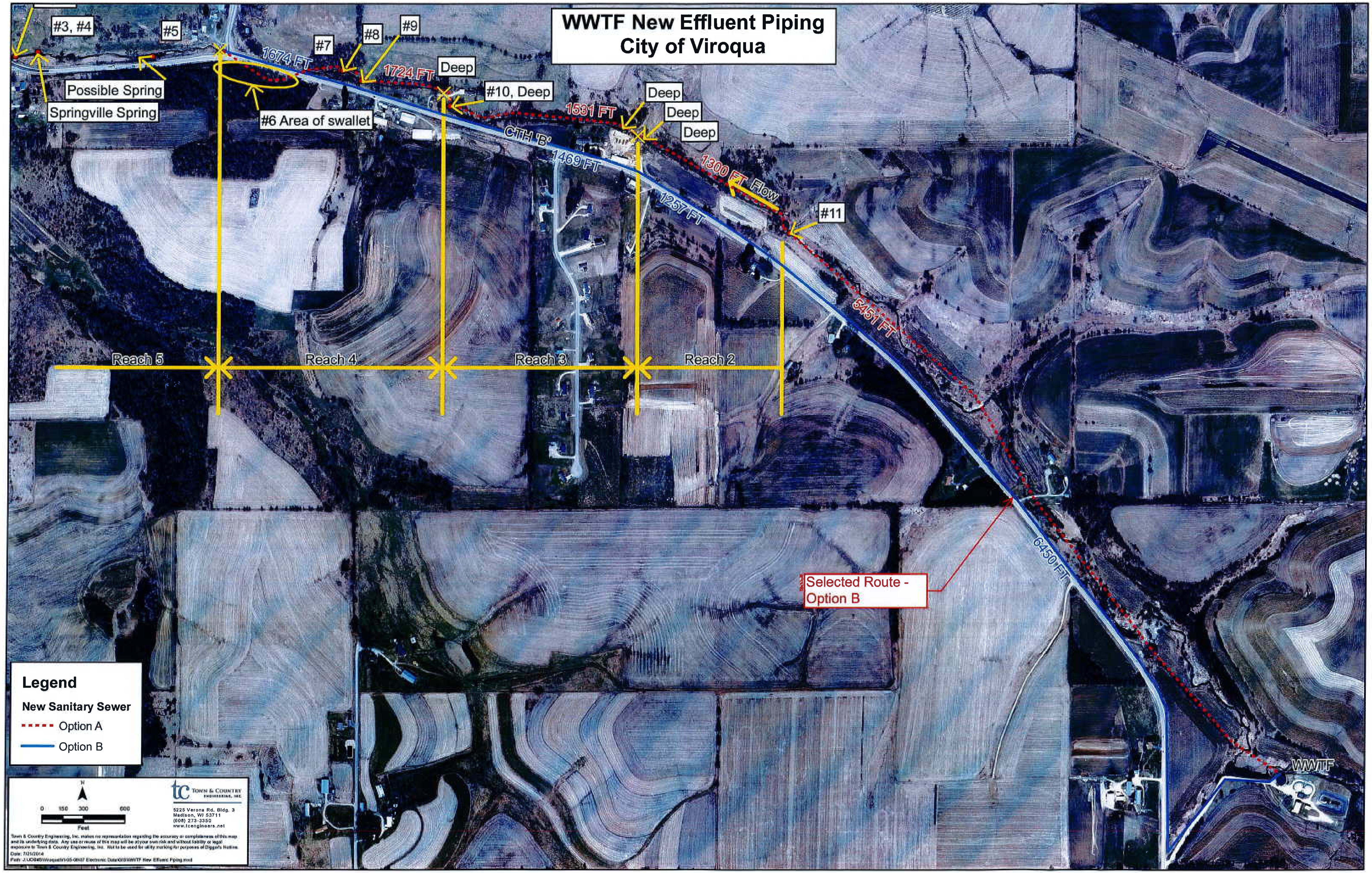
Based on this analysis of habitats we have concluded that the proposed project it will have no effect on threatened or endangered resources. If there are concerns or questions regarding this review, please free to give me a call at 608-273-3350.

Sincerely,
TOWN & COUNTRY ENGINEERING, INC.

Amy M. Bares, P.E.
Project Engineer

Enclosures
cc: Ms. Sarah Grainger, City Engineer, City of Viroqua *(202 North Main Street, Viroqua, WI 54665)*

Lisa Mandell, Deputy Field Supervisor-Twin Cities Ecological Services Field Office *(4101 American Boulevard, East Bloomington, MN 55425)*

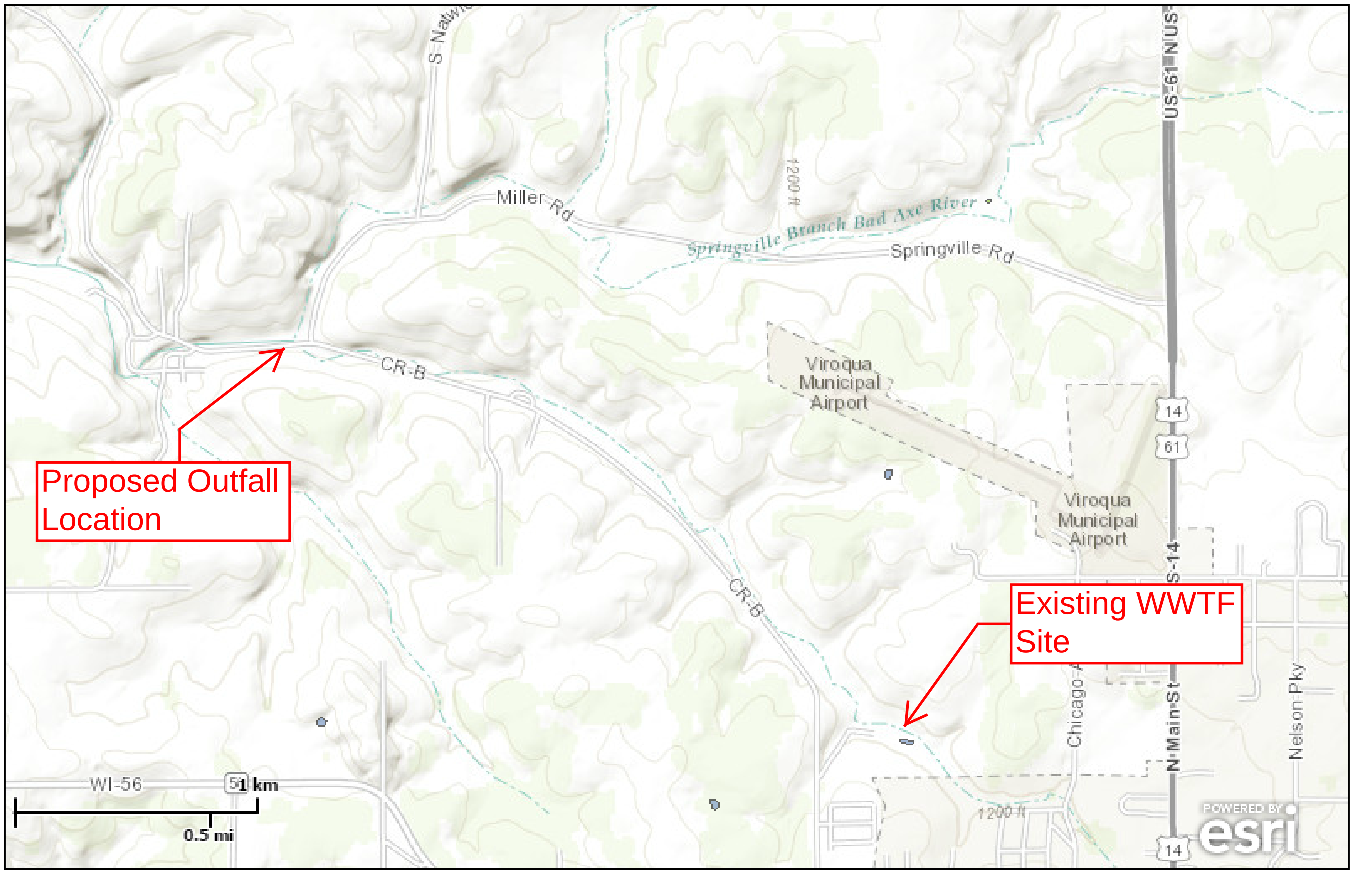

WWTF New Effluent Piping
City of Viroqua
#3, #4
#5
Possible Spring
Springville Spring
#6 Area of swallet
#7
#8
#9
1674 FT
1724 FT
Deep
#10, Deep
1531 FT
Deep
Deep
Deep
CTH 'B'
1469 FT
1300 FT
Flow
1257 FT
#11
5451 FT
Reach 5
Reach 4
Reach 3
Reach 2
6450 FT
Selected Route - Option B
WWTF
Legend
New Sanitary Sewer
Option A
Option B
N
0 150 300 600
Feet
Town & Country Engineering, Inc.
5225 Verona Rd. Bldg. 3
Madison, WI 53711
(608) 273-3350
www.tcengineers.net

U.S. Fish and Wildlife Service

National Wetlands Inventory

City of Viroqua WWTP Wetlands Inventory

Mar 16, 2015



Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

User Remarks:

Appendix M

Parallel Cost Ratio and Septage Percentage Calculations

- **Parallel Cost – RC Loading**
- **Septage Percentage – RC2 Loading**
- **RC2 Capital Costs**

Future Loadings Projections - Parallel Cost Calculations
City of Viroqua WWTP

Maximum Weekly PF	125%
Maximum Daily PF	200%
Peak Hourly PF	350%

		Data Base		Flow		BOD			SS			TKN			Phosphorus		
		Quantity	Units	Rate	Flow	Rate	Units	Loading	Rate	Units	Loading	Rate	Units	Loading	Rate	Units	Loading
					mgd			lbs/day			lbs/day			lbs/day			lbs/day
1	City Base Loadings							934			1,062						
	Residential	4,455	capita	36	0.160												
	Wastewater/Water Ratio			100%	0.160												
	Commercial	271	customer	411	0.111												
	Public	29	customer	972	0.028												
	General Industrial																
	Annual Average				0.300			878			998	60	mg/l	150	7.5	mg/l	19
	Design Sustained Loading				0.300			1,026			1,146			165			28
2	Future City Increases																
	Population Growth	446	capita	60	0.027	0.20	ppcd	89	0.22	ppcd	98	60	mg/l	13	7.5	mg/l	1.7
	Commercial Expansion (20%)	27	customer	500	0.014	250	mg/l	28	250	mg/l	28	60	mg/l	7	7.5	mg/l	0.8
	Public Sector Increase (10%)	1	customer	1,000	0.001	250	mg/l	3.0	250	mg/l	3	60	mg/l	1	7.5	mg/l	0.1
	Industrial Expansion (20%)					250	mg/l	0.0	250	mg/l	0	60	mg/l	0	7.5	mg/l	0.0
	Subtotal				0.042			120			129			21			2.6
3	Future Major Industry Request																
	Unallocated				0.000	250	mg/l	0	250	mg/l	0	60	mg/l	0	7.5	mg/l	0.0
	Subtotal				0.000			0			0			0			0.0
4	Additional Contributors																
	Septage Hauling				0.008	7,500		469	10,000		626	400	mg/l	25	250	mg/l	15.6
	Holding Tank Waste				0.013	1,500		156	1,000		104	200	mg/l	21	17	mg/l	1.8
	Leachate				0.005	100		4.2	50		2	550	mg/l	23	10	mg/l	0.4
	Subtotal				0.025			630			732			69			17.8
5	Clear Water Infiltration/Inflow																
	Min Dry Weather Infiltration				0.007												
	Annual Average				0.040												
	Existing Sustained I/I				0.252												
	Future Sustained I/I	446	capita	0	0.000												
	Projected Sustained I/I Reduction				0.000												
	Daily Wet Weather I and I				1.029												
	Instantaneous Inflow Factor	(multiplied x daily I/I)		1.75	1.801												
	Maximum Weekly I/I				0.383												
6	Loadings Projections																
	Average Annual				**0.407**			**1,628**			**1,859**			**240**			**39**
	Design (Max Sustained)				**0.619**			**1,777**			**2,007**			**255**			**49**
	Maximum Weekly				**0.835**												
	Maximum Daily				**1.737**												
	Peak Hourly				**3.022**												

No current and future indsutrial loads, half of future loads (includes half septic and holding tank waste, all leachate). Current BOD and SS loads reduced by 6% (percentage of industrial flow)

Future Loadings Projections - Septage Percentage Calculations
City of Viroqua WWTP

Maximum Weekly PF	125%
Maximum Daily PF	200%
Peak Hourly PF	350%

	Data Base		Flow		BOD			SS			TKN			Phosphorus		
	Quantity	Units	Rate	Flow	Rate	Units	Loading	Rate	Units	Loading	Rate	Units	Loading	Rate	Units	Loading
				mgd			lbs/day			lbs/day			lbs/day			lbs/day
1 City Base Loadings							934			1,062						
Residential	4,455	capita	36	0.160												
Wastewater/Water Ratio			100%	0.160												
Commercial	271	customer	411	0.111												
Public	29	customer	972	0.028												
General Industrial																
Annual Average				0.300			878			998	60	mg/l	150	7.5	mg/l	19
Design Sustained Loading				0.300			1,026			1,146			165			28
2 Future City Increases																
Population Growth	446	capita	60	0.027	0.20	ppcd	89	0.22	ppcd	98	60	mg/l	13	7.5	mg/l	1.7
Commercial Expansion (20%)	27	customer	500	0.014	250	mg/l	28	250	mg/l	28	60	mg/l	7	7.5	mg/l	0.8
Public Sector Increase (10%)	1	customer	1,000	0.001	250	mg/l	3.0	250	mg/l	3	60	mg/l	1	7.5	mg/l	0.1
Industrial Expansion (20%)					250	mg/l	0.0	250	mg/l	0	60	mg/l	0	7.5	mg/l	0.0
Subtotal				0.042			120			129			21			2.6
3 Future Major Industry Request																
Unallocated				0.000	250	mg/l	0	250	mg/l	0	60	mg/l	0	7.5	mg/l	0
Subtotal				0.000			0			0			0			0
4 Additional Contributors																
Septage Hauling				0.000	7,500		0	10,000		0	400	mg/l	0	250	mg/l	0
Holding Tank Waste				0.000	1,500		0	1,000		0	200	mg/l	0	17	mg/l	0
Leachate				0.000	100		0	50		0	550	mg/l	0	10	mg/l	0
Subtotal				0.000			0			0			0			0
5 Clear Water Infiltration/Inflow																
Min Dry Weather Infiltration				0.007												
Annual Average				0.040												
Existing Sustained I/I				0.252												
Future Sustained I/I	446	capita	0	0.000												
Projected Sustained I/I Reduction				0.000												
Daily Wet Weather I and I				1.029												
Instantaneous Inflow Factor	(multiplied x daily I/I)		1.75	1.801												
Maximum Weekly I/I				0.383												
6 Loadings Projections																
Average Annual				**0.382**			**998**			**1,128**			**171**			**21**
Design (Max Sustained)				**0.594**			**1,147**			**1,275**			**186**			**31**
Maximum Weekly				**0.810**												
Maximum Daily				**1.712**												
Peak Hourly				**2.997**												

No current and future indsutrial loads, half of future loads, no hauled waste. Current BOD and SS loads reduced by 6% (percentage of industrial flow)

City of Viroqua WWTP Upgrade
Parallel Cost and Septage Percentage Summary

	DC Cost	RC Cost	RC2 Cost
1 Site Work	$218,600	$218,600	$206,100
2 Headworks/Primary Clarifiers	$15,000	$15,000	$15,000
3 Selector and Aeration Basins	$345,250	$345,250	$345,250
4 Splitter Structure	$51,400	$51,400	$51,400
5 Final Clarifiers	$352,300	$352,300	$352,300
6 UV Structure	$0	$0	$0
7 Blower Building	$108,300	$108,300	$108,300
8 Phosphorus Removal	$0	$0	$0
9 Digester Complex	$0	$0	$0
10 Sludge Storage	$5,000	$5,000	$5,000
11 Waste Receiving Station	$247,375	$247,375	$0
12 Equalization Detention Basin	$143,250	$143,250	$143,250
13 Lab/Process Building	$195,500	$195,500	$195,500
14 Sludge Thickening	$551,150	$551,150	$493,650
Electrical and Instrumentation	$558,300	$558,300	$479,000
Contractor Management	$249,100	$249,100	$215,000
Contingencies	$304,100	$304,100	$261,000
Engineering, Legal, Admin	$456,100	$456,100	$391,500
Total Project Cost	$3,800,800	$3,800,800	$3,262,300

Notes:

DC (Design Capacity) cost is based on Alternative 3

RC (Reduced Capacity) cost is for Parallel Cost percentage calculation

PC = RC/DC = 100%

RC2 (Reduced Capacity 2) cost is for Septage Percentage calculation

SP = (RC-RC2)/DC = 14.2%

City of Viroqua
WWTP Facilities Planning
Capital Costs for PC/SP Calculations

	PHASE 1										
	Qty				Unit Cost			Install	Total Cost		
	Alt 3	PC	SP	Units	Alt 3	PC	SP	Factor	Alt 3	PC	SP
1 Site Work											
Erosion Control	1	1	1	LS	$2,500	$2,500	$2,500	1.00	$2,500	$2,500	$2,500
Site Grading	1	1	1	LS	$2,500	$2,500	$2,500	1.00	$2,500	$2,500	$2,500
Site Fencing	1,000	1,000	1,000	LF	$20	$20	$20	1.00	$20,000	$20,000	$20,000
Front Gate Security	1	1	1		$20,000	$20,000	$20,000	1.00	$20,000	$20,000	$20,000
Dewatering and Sheeting	1	1	1	LS	$10,000	$10,000	$10,000	1.00	$10,000	$10,000	$10,000
Site Conditions/Constraints	1	1	1	LS	$20,000	$20,000	$20,000	1.00	$20,000	$20,000	$20,000
Asphalt Paving	650	650	650	SY	$40	$40	$40	1.00	$26,000	$26,000	$26,000
Sidewalks	180	180	180	SF	$7.50	$7.50	$7.50	1.00	$1,350	$1,350	$1,350
Site Piping											
Primary to Selectors	90	90	90	LF	$75	$75	$75	1.00	$6,750	$6,750	$6,750
UV to New Lift Station	100	100	100	LF	$100	$100	$100	1.00	$10,000	$10,000	$10,000
Septage Receiving	250	250	0	LF	$50	$50	$50	1.00	$12,500	$12,500	$0
RAS Connection	1	1	1	LS	$5,000	$5,000	$5,000	1.00	$5,000	$5,000	$5,000
Air Connection	1	1	1	LS	$5,000	$5,000	$5,000	1.00	$5,000	$5,000	$5,000
Site Piping Valves	8	8	8	EA	$1,500	$1,500	$1,500	1.00	$12,000	$12,000	$12,000
Dome Removal/Reinstall	2	2	2	EA	$10,000	$10,000	$10,000	1.00	$20,000	$20,000	$20,000
Dome Recoating	2	2	2	EA	$15,000	$15,000	$15,000	1.00	$30,000	$30,000	$30,000
Painting				LS	$10,000	$10,000	$10,000	1.00	$0	$0	$0
Landscaping	2,500	2,500	2,500	SF	$2	$2	$2	1.00	$5,000	$5,000	$5,000
Seed, Fertilizer, Mulch	2,000	2,000	2,000	SY	$5	$5	$5	1.00	$10,000	$10,000	$10,000
									$218,600	**$218,600**	**$206,100**
2 Headworks/Primary Clarifiers											
Skimmer Replacement	1	1	1	LS	$10,000	$10,000	$10,000	1.00	$10,000	$10,000	$10,000
Structure Upgrade				LS				1.00	$0	$0	$0
Chemical Room Modifications				LS				1.00	$0	$0	$0
Piping/Hydraulics Modifications	1	1	1	LS	$5,000	$5,000	$5,000	1.00	$5,000	$5,000	$5,000
Screen Replacement				LS				1.20	$0	$0	$0
HVAC/Electrical Modifications				LS				1.00	$0	$0	$0
									$15,000	**$15,000**	**$15,000**
3 Selector and Aeration Basins											
Demolition											
Baffle walls	4	4	4	EA	$2,500	$2,500	$2,500	1.00	$10,000	$10,000	$10,000
Launders	1	1	1	LS	$2,500	$2,500	$2,500	1.00	$2,500	$2,500	$2,500
Concrete	10	10	10	CY	$1,250	$1,250	$1,250	1.00	$12,500	$12,500	$12,500
Concrete Coring Thru Wall	7	7	7	EA	$1,500	$1,500	$1,500	1.00	$10,500	$10,500	$10,500
Mixer Removal	6	6	6	EA	$500	$500	$500	1.00	$3,000	$3,000	$3,000
Diffusers	1,470	1,470	1,470	SF	$7.50	$8	$8	1.00	$11,025	$11,025	$11,025
Piping	40	40	40	LF	$15	$15	$15	1.00	$600	$600	$600
Concrete											
Structural fill	15	15	15	CY	$25	$25	$25	1.00	$375	$375	$375
Straight walls	16	16	16	CY	$675	$675	$675	1.00	$10,850	$10,850	$10,850
Weir Gate installation	7	7	7	EA	$3,500	$3,500	$3,500	1.20	$29,400	$29,400	$29,400
Stairs and railings				LF	$75	$75	$75	1.00	$0	$0	$0
Mixer Install	2	2	2	EA	$12,500	$12,500	$12,500	1.20	$30,000	$30,000	$30,000
Diffuser Grid Install	2,785	2,785	2,785	SF	$30	$30	$30	1.00	$83,550	$83,550	$83,550
Denite Recycle Pump	1	1	1	EA	$3,000	$3,000	$3,000	1.20	$3,600	$3,600	$3,600
Valves											
Telescoping valves				EA	$7,500	$7,500	$7,500	1.00	$0	$0	$0
Bypass valves or gates	6	6	6	EA	$3,500	$3,500	$3,500	1.00	$21,000	$21,000	$21,000
Primary Eff valves	2	2	2	EA	$3,500	$3,500	$3,500	1.00	$7,000	$7,000	$7,000
RAS valves	2	2	2	EA	$2,000	$2,000	$2,000	1.00	$4,000	$4,000	$4,000
Aeration Automated Valves	4	4	4	EA	$3,500	$3,500	$3,500	1.00	$14,000	$14,000	$14,000
Piping											
Primary to Selectors	40	40	40	LF	$250	$250	$250	1.00	$10,000	$10,000	$10,000
Bypass	225	225	225	LF	$250	$250	$250	1.00	$56,250	$56,250	$56,250
RAS	40	40	40	LF	$150	$150	$150	1.00	$6,000	$6,000	$6,000
Between E and W (14")	18	18	18	LF	$200	$200	$200	1.00	$3,600	$3,600	$3,600
Denite Recycle	60	60	60	LF	$50	$50	$50	1.00	$3,000	$3,000	$3,000
Aeration	50	50	50	LF	$250	$250	$250	1.00	$12,500	$12,500	$12,500
									$345,250	**$345,250**	**$345,250**
4 Splitter Structure											
Demolition											
Piping and Flume	20	20	20	LF	$15	$15	$15	1.00	$300	$300	$300
Concrete Coring Thru Wall	4	4	4	EA	$1,250	$1,250	$1,250	1.00	$5,000	$5,000	$5,000
Concrete											
Straight walls	21	21	21	CY	$675	$675	$675	1.00	$14,350	$14,350	$14,350
Concrete patching/repairs	1	1	1	LS	$2,000	$2,000	$2,000	1.00	$2,000	$2,000	$2,000
Weir Gate installation	3	3	3	EA	$3,500	$3,500	$3,500	1.20	$12,600	$12,600	$12,600

City of Viroqua
WWTP Facilities Planning
Capital Costs for PC/SP Calculations

	PHASE 1										
	Qty				Unit Cost			Install	Total Cost		
	Alt 3	PC	SP	Units	Alt 3	PC	SP	Factor	Alt 3	PC	SP
Bypass Gate (18")					$4,500	$4,500	$4,500	1.20	$0	$0	$0
Telescoping Valves					$7,500	$7,500	$7,500	1.20	$0	$0	$0
Grating and railings	350	350	350	SF	$20	$20	$20	1.00	$7,000	$7,000	$7,000
Piping											
Between Trains (18")				LF	$250	$250	$250	1.00	$0	$0	$0
To Clarifiers (12")	58	58	58	LF	$175	$175	$175	1.00	$10,150	$10,150	$10,150
									$51,400	**$51,400**	**$51,400**
5 Final Clarifiers											
Demolition											
Mechanism Removal	2	2	2	EA	$15,500	$15,500	$15,500	1.00	$31,000	$31,000	$31,000
Concrete Coring Thru Wall	4	4	4	EA	$1,500	$1,500	$1,500	1.00	$6,000	$6,000	$6,000
Concrete											
Clarifier Mechanism	2	2	2	EA	$95,000	$95,000	$95,000	1.20	$228,000	$228,000	$228,000
Walkways and railings	280	280	280	LF	$75	$75	$75	1.00	$21,000	$21,000	$21,000
Painting	2	2	2	EA	$30,000	$30,000	$30,000	1.00	$60,000	$60,000	$60,000
Piping											
To Post Aeration	36	36	36	LF	$175	$175	$175	1.00	$6,300	$6,300	$6,300
									$352,300	**$352,300**	**$352,300**
6 UV Structure											
Demolition											
Concrete				CY	$1,250	$1,250	$1,250	1.00	$0	$0	$0
Equipment				EA	$500	$500	$500	1.00	$0	$0	$0
Electrical				LS	$2,500	$2,500	$2,500	1.00	$0	$0	$0
Excavation				CY	$30	$30	$30	1.00	$0	$0	$0
Concrete											
Structural fill				CY	$25	$25	$25	1.00	$0	$0	$0
Slab on soil					$450	$450	$450	1.00	$0	$0	$0
Straight walls				CY	$675	$675	$675	1.00	$0	$0	$0
Misc concrete				CY	$500	$500	$500	1.00	$0	$0	$0
Steel Superstructure				LS	$50,000	$50,000	$50,000				
UV Equipment install				EA	$175,000	$175,000	$175,000	1.20	$0	$0	$0
Grating				LF	$50	$50	$50	1.00	$0	$0	$0
Bypass piping				LF	$125	$125	$125	1.00	$0	$0	$0
Bypass valves or gates				EA	$3,750	$3,750	$3,750	1.20	$0	$0	$0
									$0	**$0**	**$0**
7 Blower Building											
Demolition											
Blower removal	2	2	2	EA	$1,250	$1,250	$1,250	1.00	$2,500	$2,500	$2,500
Aeration piping				LF	$15	$15	$15	1.00	$0	$0	$0
Blower installation	2	2	2	EA	$42,000	$42,000	$42,000	1.20	$100,800	$100,800	$100,800
Aeration piping	1	1	1	LS	$5,000	$5,000	$5,000	1.00	$5,000	$5,000	$5,000
									$108,300	**$108,300**	**$108,300**
8 Phosphorus Removal											
Site Work				LS	$65,000	$65,000	$65,000	1.00	$0	$0	$0
Building and Equipment				EA	$1,238,500	$1,238,500	$1,238,500	1.00	$0	$0	$0
Chemical additions				LS	$224,000	$224,000	$224,000	1.00	$0	$0	$0
Piping				LS	$100,000	$100,000	$100,000	1.00	$0	$0	$0
									$0	**$0**	**$0**
9 Digester Complex											
Demolition											
Boiler/Heat Xchgr				LS	$2,500	$2,500	$2,500	1.00	$0	$0	$0
Gas train				LS	$4,000	$4,000	$4,000	1.00	$0	$0	$0
Digester mixing system				EA	$1,500	$1,500	$1,500	1.00	$0	$0	$0
Equipment Install											
Boiler/Heat Xchgr				EA	$175,000	$175,000	$175,000	1.20	$0	$0	$0
Gas train				EA	$45,000	$45,000	$45,000	1.20	$0	$0	$0
Digester mixing system				EA	$90,000	$90,000	$90,000	1.20	$0	$0	$0
Sludge Pumps				EA	$15,000	$15,000	$15,000	1.20	$0	$0	$0
Cover Rehabilitation				EA	$75,000	$75,000	$75,000	1.00	$0	$0	$0
Tuckpointing/Exterior Repairs				LS	$7,500	$7,500	$7,500	1.00	$0	$0	$0
Process Piping											
Sludge Feed				LF	$100	$100	$100	1.00	$0	$0	$0
Valves				EA	$950	$950	$950	1.00	$0	$0	$0
Plumbing											
New Water Connections				EA	$500	$500	$500	1.00	$0	$0	$0
Drains/Vents				EA	$550	$550	$550	1.00	$0	$0	$0
Painting				SF	$5	$5	$5	1.00	$0	$0	$0
									$0	**$0**	**$0**
10 Sludge Storage											
Exterior Repairs	1	1	1	LS	$5,000	$5,000	$5,000	1.00	$5,000	$5,000	$5,000
									$5,000	**$5,000**	**$5,000**

Capital Costs for PC/SP Calculations

	PHASE 1										
	Qty				Unit Cost			Install	Total Cost		
	Alt 3	PC	SP	Units	Alt 3	PC	SP	Factor	Alt 3	PC	SP
11 Waste Receiving Station											
Excavation	2,400	2,400	0	CY	$30	$30	$30	1.00	$72,000	$72,000	$0
Concrete											
Structural fill	25	25	0	CY	$25	$25	$25	1.00	$625	$625	$0
Straight walls	110	110	0	CY	$675	$675	$675	1.00	$74,250	$74,250	$0
Slab on grade	40	40	0		$450	$450	$450	1.00	$18,000	$18,000	$0
Shored slab	30	30	0	CY	$1,100	$1,100	$1,100	1.00	$33,000	$33,000	$0
Misc concrete	10	10	0	CY	$500	$500	$500	1.00	$5,000	$5,000	$0
Equipment Install											
Submersible pumps	2	2	0	EA	$7,500	$7,500	$7,500	1.00	$15,000	$15,000	$0
Diffusers	8	8	0	EA	$250	$250	$250	1.00	$2,000	$2,000	$0
Blower	1	1	0	EA	$3,750	$3,750	$3,750	1.20	$4,500	$4,500	$0
Stairs and railings	0	0	0	EA	$75	$75	$75	1.00	$0	$0	$0
Access hatches	5	5	0	EA	$1,250	$1,250	$1,250	1.20	$7,500	$7,500	$0
Mechanical gates	2	2	0	EA	$3,750	$3,750	$3,750	1.20	$9,000	$9,000	$0
Piping and valves	1	1	0	LS	$6,500	$6,500	$6,500	1.00	$6,500	$6,500	$0
									$247,375	**$247,375**	**$0**
12 Equalization Storage Basin											
Demolition											
Liner removal	3,725	3,725	3,725	SY	$10	$10	$10	1.00	$37,250	$37,250	$37,250
Lining											
Clay liner	3,725	3,725	3,725	SY	$15	$15	$15	1.00	$55,875	$55,875	$55,875
Compacted Gravel	3,725	3,725	3,725	SY	$5	$5	$5	1.00	$18,625	$18,625	$18,625
Asphalt	450	450	450	TON	$70	$70	$70	1.00	$31,500	$31,500	$31,500
									$143,250	**$143,250**	**$143,250**
13 Lab/Process Building											
Demolition	1	1	1	LS	$10,000	$10,000	$10,000	1.00	$10,000	$10,000	$10,000
Convert Chlorine Rm to Office	1	1	1	LS	$20,000	$20,000	$20,000	1.00	$20,000	$20,000	$20,000
Lab upgrade	1	1	1	LS	$20,000	$20,000	$20,000	1.00	$20,000	$20,000	$20,000
HVAC	1	1	1	LS	$20,000	$20,000	$20,000	1.00	$20,000	$20,000	$20,000
Windows and Doors	1	1	1	LS	$8,500	$8,500	$8,500	1.00	$8,500	$8,500	$8,500
Sludge Pump	1	1	1	LS	$17,500	$17,500	$17,500	1.20	$21,000	$21,000	$21,000
MCC Lineup Upgrade	1	1	1	LS	$80,000	$80,000	$80,000	1.20	$96,000	$96,000	$96,000
									$195,500	**$195,500**	**$195,500**
14 Sludge Thickening											
Construction											
Excavation	625	625	625	CY	$30	$30	$30	1.00	$18,750	$18,750	$18,750
Structural Fill	90	90	90	CY	$25	$25	$25	1.00	$2,250	$2,250	$2,250
Footings	15	15	15	CY	$400	$400	$400	1.00	$6,000	$6,000	$6,000
Slab on soil	20	20	20	CY	$550	$550	$550	1.00	$11,000	$11,000	$11,000
Foundation walls	25	25	25	CY	$650	$650	$650	1.00	$16,250	$16,250	$16,250
Stoops	5	5	5	CY	$750	$750	$750	1.00	$3,750	$3,750	$3,750
Block wall - split face	1,300	1,300	1,300	SF	$35	$35	$35	1.00	$45,500	$45,500	$45,500
Concrete planking	750	750	750	SF	$18	$18	$18	1.00	$13,125	$13,125	$13,125
Roofing	750	750	750	SF	$22	$22	$22	1.00	$16,500	$16,500	$16,500
Architectural	750	750	750	SF	$20	$20	$20	1.00	$15,000	$15,000	$15,000
Stairs	12	12	12	LF	$150	$150	$150	1.25	$2,250	$2,250	$2,250
Railings	32	32	32	LF	$50	$50	$50	1.25	$2,000	$2,000	$2,000
Equipment											
Polymer System	1	1	1	EA	$14,000	$14,000	$14,000	1.30	$18,200	$18,200	$18,200
Polymer spare parts	1	1	1	LS	$5,000	$5,000	$5,000	1.00	$5,000	$5,000	$5,000
DAF Thickener	1	1	1	EA	$225,000	$225,000	$175,000	1.15	$258,750	$258,750	$201,250
TWAS Pumps	2	2	2	EA	$17,500	$17,500	$17,500	1.25	$43,750	$43,750	$43,750
Beam and hoist	1	1	1	EA	$12,500	$12,500	$12,500	1.25	$15,625	$15,625	$15,625
Process Piping											
Sludge Feed	100	100	100	LF	$100	$100	$100	1.00	$10,000	$10,000	$10,000
Process Drain	100	100	100	LF	$100	$100	$100	1.00	$10,000	$10,000	$10,000
TWAS	125	125	125	LF	$100	$100	$100	1.00	$12,500	$12,500	$12,500
Polymer Feed	30	30	30	LF	$25	$25	$25	1.00	$750	$750	$750
Valves	6	6	6	EA	$900	$900	$900	1.00	$5,400	$5,400	$5,400
Plumbing											
New Water Connections	6	6	6	EA	$500	$500	$500	1.00	$3,000	$3,000	$3,000
Drains/Vents	6	6	6	EA	$550	$550	$550	1.00	$3,300	$3,300	$3,300
Painting	2,500	2,500	2,500	SF	$5	$5	$5	1.00	$12,500	$12,500	$12,500
									$551,150	**$551,150**	**$493,650**

City of Viroqua
WWTP Facilities Planning
Capital Costs for PC/SP Calculations

	PHASE 1											
	Qty				Unit Cost			Install	Total Cost		
	Alt 3	PC	SP	Units	Alt 3	PC	SP	Factor	Alt 3	PC	SP
Construction Cost									**$2,233,200**	**$2,233,200**	**$1,915,800**
Electrical					25%	25%	25%		**$558,300**	**$558,300**	**$479,000**
Construction Cost w/Elec									**$2,791,500**	**$2,791,500**	**$2,394,800**
Additional Contractor Costs											
Contractor Administration				LS	2.5%	2.5%	2.5%		$69,788	$69,788	$59,870
Mobilization				LS	2%	2%	2%		$55,830	$55,830	$47,896
Bonds, Permits, Insurance				LS	1%	1%	1%		$27,915	$27,915	$23,948
Project Documentation				LS	0.3%	0.3%	0.3%		$8,375	$8,375	$7,184
Testing				LS	0.3%	0.3%	0.3%		$8,375	$8,375	$7,184
Temporary Facilities	3	3	3	months	$3,000	$3,000	$3,000		$9,000	$9,000	$9,000
Equipment and Safety				LS	2.5%	2.5%	2.5%		$69,788	$69,788	$59,870
					8.60%	8.60%	8.60%				
Total Construction Cost									**$3,040,600**	**$3,040,600**	**$2,609,800**
Additional Design & Management Costs											
Contingencies					10%	10%	10%		$304,100	$304,100	$261,000
Engineering, Admin, Legal					15%	15%	15%		$456,100	$456,100	$391,500
Total Project Cost									**$3,800,800**	**$3,800,800**	**$3,262,300**

Appendix N

Funding and User Charge Calculations

CITY OF VIROQUA SEWER UTILITY
WASTEWATER BUDGET AND REVENUE PROJECTIONS

5/13/2015

ASSUMPTIONS

	Principal	Ann Payment		
EXISTING DEBTS				
CWF 2002	$ 1,709,957	$ 115,800	5/1/2022	Payment varies by year
West Broadway	$ 121,145	$ 16,600	2020	Payment varies by year
Revenue Bonds 2007D and 2010D varies-see below				

					Ann. % Incr.
WWTP ANNUAL O&M COSTS (includes taxes)	$ 497,500	Existing plant	$514,000	New plant	3%
WWTP ANNUAL REPLACEMENT FUND COSTS	$ 41,425	Existing plant	$94,000	New plant	
ANNUAL COLLECTION SYSTEM IMPROVEMENTS	$ 25,000				3%
INTEREST INCOME RATE ASSUMED	1%				
OTHER INCOME ANNUAL INCREASE	0%				

FACILITIES UPGRADES	Capital Costs	Grant %	Net Cost	Interest Rate	Payback Yrs	Rate Factor	Yearly Paymt	Year
Wastewater Treatment Facility Upgrade - Phase 1	$4,000,000	0%	$4,000,000	2.879%	19	0.0691	$276,273	2017
Effluent Force Main	$2,138,000	0%	$2,138,000	2.879%	19	0.0691	$147,668	2016
Phase 1A	$2,000,000	0%	$2,000,000	2.879%	19	0.0691	$138,136	2020
Phase 2	$500,000	0%	$500,000	2.879%	19	0.0691	$34,534	2020
Phase 3		0%	$0	3.000%	19	0.0698	$0	2022
Rock Ave Parkway/NE Ave.-completed	$1,140,000	0%	$1,140,000	3.250%	40	0.0450	$51,332	2016
S.Rock Ave.and Center Street	$958,810	0%	$958,810	3.000%	19	0.0698	$66,938	2019
	$1,000,000	0%	$1,000,000	3.000%	19	0.0698	$69,814	
CASH AND EQUIVALENTS AVAILABLE-12-31-2014	$ 1,134,249							

Assumptions Notes:
Assumes CWF for all projects, 20 year loans
Phase 1A starts in 2016
Phase 2, $500,000 was used for the UV replacement and cost for the future phosphorus is not included, hopefully not needed
No cost included for Phase 3
Bonds for future projects means bond for future sewer collection system projects in 2019, 2023 and 2026, can fund about a $1,000,000 project
Includes all existing debt
Vac Truck, Highway 14 lift station are funded from cash reserves
Operation costs and collection system replacement costs are increased annually by 3%

BUDGET ITEM	2014	2015	2016	2017	2018	2019	2020	2021	2022
EXPENSES									
Existing Loans	$ 132,400	$ 132,400	$ 132,400	$ 132,400	$ 132,400	$ 132,400	$ 132,400	$ 115,800	$ 115,800
Revenue Bonds-2007D	$ 103,582	$ 106,357	$ 104,020	$ 106,547	$ 55,042	$ 54,612	$ 112,822	$ 114,560	$ 116,072
Revenue Bonds-2010D	$ 102,307	$ 101,257	$ 100,207	$ 99,157	$ 152,017	$ 153,602	$ 96,032	$ 94,492	$ 92,952
Annual Operation and Maintenance Costs	$ 497,500	$ 512,425	$ 527,798	$ 514,000	$ 529,420	$ 545,303	$ 561,662	$ 578,512	$ 595,867
Estimated Outside Services Costs - Facilities Upgrade	$ 15,000	$ 250,000	$ 100,000	$ -	$ -	$ -	$ -	$ -	$ -
WWTP Replacement Fund Deposit	$ 41,425	$ 41,425	$ 41,425	$ 94,000	$ 94,000	$ 94,000	$ 94,000	$ 94,000	$ 94,000
Annual Collection System Improvements			$ 25,000	$ 25,750	$ 26,523	$ 27,318	$ 28,138	$ 28,982	$ 29,851
New WWTF Upgrade CWF Loan Debt				$ 92,128	$ 276,273	$ 276,273	$ 276,273	$ 276,273	$ 276,273
New Force Main Debt			$ 49,242	$ 147,668	$ 147,668	$ 147,668	$ 147,668	$ 147,668	$ 147,668
Phase 2 Debt-Min.				$ 46,064	$ 138,136	$ 138,136	$ 138,136	$ 138,136	$ 138,136
Phase 2 Debt-Max.								$ 11,516	$ 34,534
Phase 3 Debt								$ -	$ -
Highway 14 Lift station-reserves			$ 580,000						
VAC Truck-Reserves		$ 150,000							
Rock Ave Parkway/NE Ave.-completed-includes 10% debt coverage			$ 56,465	$ 56,465	$ 56,465	$ 56,465	$ 56,465	$ 56,465	$ 56,465
S.Rock Ave.and Center Street and future projects						$ 75,000	$ 75,000	$ 75,000	$ 75,000
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL ANNUAL EXPENSES	**$ 892,214**	**$ 1,293,864**	**$ 1,716,557**	**$ 1,314,179**	**$ 1,607,944**	**$ 1,700,777**	**$ 1,718,596**	**$ 1,731,404**	**$ 1,772,619**
REVENUES									
User Charge Revenues	$ 994,043	$ 1,021,060	$ 1,373,687	$ 1,373,687	$ 1,373,687	$ 1,600,799	$ 1,600,799	$ 1,827,910	$ 1,827,910
CWF Reimbursement				$ 365,000					
Cash from Replacement Fund									
Use of Cash on Hand	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Hauled Waste/Other Revenues	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Interest Income		$ 11,342	$ 8,728	$ 5,386	$ 9,685	$ 7,440	$ 6,514	$ 5,401	$ 6,421
TOTAL ACTUAL ANNUAL REVENUE	**$ 994,043**	**$ 1,032,402**	**$ 1,382,415**	**$ 1,744,073**	**$ 1,383,372**	**$ 1,608,238**	**$ 1,607,313**	**$ 1,833,312**	**$ 1,834,331**
EXCESS REVENUE FOR THIS FISCAL YEAR	$ 101,829	$ (261,462)	$ (334,142)	$ 429,894	$ (224,571)	$ (92,539)	$ (111,283)	$ 101,908	$ 61,712
CARRYOVER FROM PREVIOUS YEAR		$ 1,134,249	$ 872,787	$ 538,645	$ 968,540	$ 743,968	$ 651,429	$ 540,147	$ 642,055
TOTAL AVAILABLE CARRYOVER	**$ 1,134,249**	**$ 872,787**	**$ 538,645**	**$ 968,540**	**$ 743,968**	**$ 651,429**	**$ 540,147**	**$ 642,055**	**$ 703,767**
REVENUE DETAILS									
REUs Added Per Year	0								
Average Annual Usage per REU (cf)	4210								
Monthly Usage per REU (gallons)	2,624								
Estimated Number of REUs	3606	3606	3606	3606	3606	3606	3606	3606	3606
Estimated Annual Water Usage (cf)	113,556	113,556	113,556	113,556	113,556	113,556	113,556	113,556	113,556
Estimated Annual Water Usage (gallons)	9,462,985	9,462,985	9,462,985	9,462,985	9,462,985	9,462,985	9,462,985	9,462,985	9,462,985
ESTIMATED MONTHLY USER CHARGES									
Fixed Charges on Debt									
Actual Monthly Fixed Charge per REU Implemented	$ 11.00	$ 11.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00
Actual Annual Fixed Charge Revenue Generated	$ 475,992	$ 475,992	$ 692,352	$ 692,352	$ 692,352	$ 692,352	$ 692,352	$ 692,352	$ 692,352
Variable Charges - O, M & R Costs (Cost per 1000 gallons)									
Actual Variable Charge per 1000 Gallons Implemented	$ 4.80	$ 4.80	$ 6.00	$ 6.00	$ 6.00	$ 8.00	$ 8.00	$ 10.00	$ 10.00
Actual Annual Variable Charge Revenue Generated	$ 545,068	$ 545,068	$ 681,335	$ 681,335	$ 681,335	$ 908,447	$ 908,447	$ 1,135,558	$ 1,135,558
TOTAL ACTUAL MONTHLY USER CHARGE PER REU	**$ 23.60**	**$ 23.60**	**$ 31.75**	**$ 31.75**	**$ 31.75**	**$ 36.99**	**$ 36.99**	**$ 42.24**	**$ 42.24**
REVENUE GENERATED BY RATES	**$ 1,021,060**	**$ 1,021,060**	**$ 1,373,687**	**$ 1,373,687**	**$ 1,373,687**	**$ 1,600,799**	**$ 1,600,799**	**$ 1,827,910**	**$ 1,827,910**
Replacement Fund	$ 451,000	$ 492,425	$ 533,850	$ 627,850	$ 721,850	$ 815,850	$ 909,850	$ 1,003,850	$ 1,097,850
Restricted Bond funds-2014	$ 383,000								
Collection System Replacement Fund			$ 25,000	$ 50,750	$ 77,273	$ 104,591	$ 132,728	$ 161,710	$ 191,562
Collection System Project Cost									

BUDGET ITEM	2023	2024	2025	2026	2027	2028	2029	2030
EXPENSES								
Existing Loans								
Revenue Bonds-2007D	$ 166,167	$ 164,842	$ 163,251	$ 166,276	$ 168,836			
Revenue Bonds-2010D	$ 154,882	$ 155,115	$ 159,887	$ 154,310	$ 153,492	$ 322,842	$ 302,596	
Annual Operation and Maintenance Costs	$ 613,743	$ 632,155	$ 651,120	$ 670,653	$ 690,773	$ 711,496	$ 732,841	$ 754,826
Estimated Outside Services Costs - Facilities Upgrade	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
WWTP Replacement Fund Deposit	$ 94,000	$ 94,000	$ 94,000	$ 94,000	$ 94,000	$ 94,000	$ 94,000	$ 94,000
Annual Collection System Improvements	$ 30,747	$ 31,669	$ 32,619	$ 33,598	$ 34,606	$ 35,644	$ 36,713	$ 37,815
New WWTF Upgrade CWF Loan Debt	$ 276,273	$ 276,273	$ 276,273	$ 276,273	$ 276,273	$ 276,273	$ 276,273	$ 276,273
New Force Main Debt	$ 147,668	$ 147,668	$ 147,668	$ 147,668	$ 147,668	$ 147,668	$ 147,668	$ 147,668
Phase 2 Debt-Min.	$ 138,136	$ 138,136	$ 138,136	$ 138,136	$ 138,136	$ 138,136	$ 138,136	$ 138,136
Phase 2 Debt-Max.	$ 34,534	$ 34,534	$ 34,534	$ 34,534	$ 34,534	$ 34,534	$ 34,534	$ 34,534
Phase 3 Debt	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Highway 14 Lift station-reserves								
VAC Truck-Reserves								
Rock Ave Parkway/NE Ave.-completed-includes 10% debt coverage	$ 56,465	$ 56,465	$ 56,465	$ 56,465	$ 51,332	$ 51,332	$ 51,332	$ 51,332
S.Rock Ave.and Center Street and future projects	$ 150,000	$ 150,000	$ 150,000	$ 225,000	$ 225,000	$ 225,000	$ 225,000	$ 225,000
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL ANNUAL EXPENSES	**$ 1,862,615**	**$ 1,880,858**	**$ 1,903,954**	**$ 1,996,914**	**$ 2,014,650**	**$ 2,036,925**	**$ 2,039,094**	**$ 1,759,584**
REVENUES								
User Charge Revenues	$ 1,827,910	$ 1,827,910	$ 1,941,466	$ 1,941,466	$ 2,055,022	$ 2,055,022	$ 2,055,022	$ 2,055,022
CWF Reimbursement								
Cash from Replacement Fund								
Use of Cash on Hand	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Hauled Waste/Other Revenues	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Interest Income	$ 7,038	$ 6,761	$ 6,299	$ 6,737	$ 6,250	$ 6,716	$ 6,964	$ 7,193
TOTAL ACTUAL ANNUAL REVENUE	**$ 1,834,948**	**$ 1,834,671**	**$ 1,947,765**	**$ 1,948,203**	**$ 2,061,272**	**$ 2,061,738**	**$ 2,061,986**	**$ 2,062,215**
EXCESS REVENUE FOR THIS FISCAL YEAR	$ (27,667)	$ (46,187)	$ 43,812	$ (48,710)	$ 46,622	$ 24,813	$ 22,893	$ 302,631
CARRYOVER FROM PREVIOUS YEAR	$ 703,767	$ 676,100	$ 629,913	$ 673,725	$ 625,014	$ 671,636	$ 696,449	$ 719,342
TOTAL AVAILABLE CARRYOVER	**$ 676,100**	**$ 629,913**	**$ 673,725**	**$ 625,014**	**$ 671,636**	**$ 696,449**	**$ 719,342**	**$ 1,021,973**
REVENUE DETAILS								
REUs Added Per Year								
Average Annual Usage per REU (cf)								
Monthly Usage per REU (gallons)								
Estimated Number of REUs	3606	3606	3606	3606	3606	3606	3606	3606
Estimated Annual Water Usage (cf)	113,556	113,556	113,556	113,556	113,556	113,556	113,556	113,556
Estimated Annual Water Usage (gallons)	9,462,985	9,462,985	9,462,985	9,462,985	9,462,985	9,462,985	9,462,985	9,462,985
ESTIMATED MONTHLY USER CHARGES								
Fixed Charges on Debt								
Actual Monthly Fixed Charge per REU Implemented	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00
Actual Annual Fixed Charge Revenue Generated	$ 692,352	$ 692,352	$ 692,352	$ 692,352	$ 692,352	$ 692,352	$ 692,352	$ 692,352
Variable Charges - O, M & R Costs (Cost per 1000 gallons)								
Actual Variable Charge per 1000 Gallons Implemented	$ 10.00	$ 10.00	$ 11.00	$ 11.00	$ 12.00	$ 12.00	$ 12.00	$ 12.00
Actual Annual Variable Charge Revenue Generated	$ 1,135,558	$ 1,135,558	$ 1,249,114	$ 1,249,114	$ 1,362,670	$ 1,362,670	$ 1,362,670	$ 1,362,670
TOTAL ACTUAL MONTHLY USER CHARGE PER REU	**$ 42.24**	**$ 42.24**	**$ 44.87**	**$ 44.87**	**$ 47.49**	**$ 47.49**	**$ 47.49**	**$ 47.49**
REVENUE GENERATED BY RATES	**$ 1,827,910**	**$ 1,827,910**	**$ 1,941,466**	**$ 1,941,466**	**$ 2,055,022**	**$ 2,055,022**	**$ 2,055,022**	**$ 2,055,022**
Replacement Fund	$ 1,191,850	$ 1,285,850	$ 1,379,850	$ 1,473,850	$ 1,567,850	$ 1,661,850	$ 1,755,850	$ 1,849,850
Restricted Bond funds-2014								
Collection System Replacement Fund	$ 222,308	$ 253,978	$ 286,597	$ 320,195	$ 354,801	$ 390,445	$ 427,158	$ 464,973
Collection System Project Cost								

Appendix O

Public Input

Public Hearing Information and Comments to be Added after Hearing