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Comprehensive Wastewater Plan

Namakan Basin Sanitary Sewer Initiative

Prepared for Namakan Basin Joint Powers Board

1.0 Introduction

1.1 Background

Voyageur's National Park (the Park) is the nation's only water-based national park, with more than 84,000 acres of water and 134,000 acres of land. The interconnected waterways of the Park provide an unparalleled opportunity to explore the north woods lake country. Unfortunately, those waters are being negatively affected by human impact such as wastewater from existing developments throughout the region. This water quality degradation threatens the long-term health of the ecosystem and the economic health of the tourism industry upon which the local economy is based.

1.2 Namakan Basin Joint Powers Board

The Namakan Basin Joint Powers Board was set up to carry out a preliminary planning project to provide a feasible strategy for improving and sustaining the water quality within the project area. The planning project is to help the project partners develop a comprehensive wastewater plan for the housing, recreational, and resort developments in the Park's Namakan Basin area. The purpose of the Comprehensive Wastewater Plan is to provide an environmentally sensitive and reasonable solution to the problem of non-compliant and failing septic systems within the study area.

1.3 Purpose and Scope

In May, 2009 the Namakan Basin Joint Powers Board retained SEH to develop a Comprehensive Wastewater Plan for the project area. The purpose and scope of the comprehensive wastewater plan is to provide three separate focus areas; first, develop a needs assessment of the existing wastewater generating properties, secondly, review alternative wastewater collection and treatment alternatives (centralized and decentralized), and third, recommend alternatives and strategies for collection and treatment.

1.4 Related Wastewater Initiatives

Throughout the past several years, there have been various wastewater initiatives within the planning area. The wastewater initiatives have varied in complexity from Preliminary Engineering reports to formation of sanitary districts. Within the project area the following wastewater initiatives have taken place:

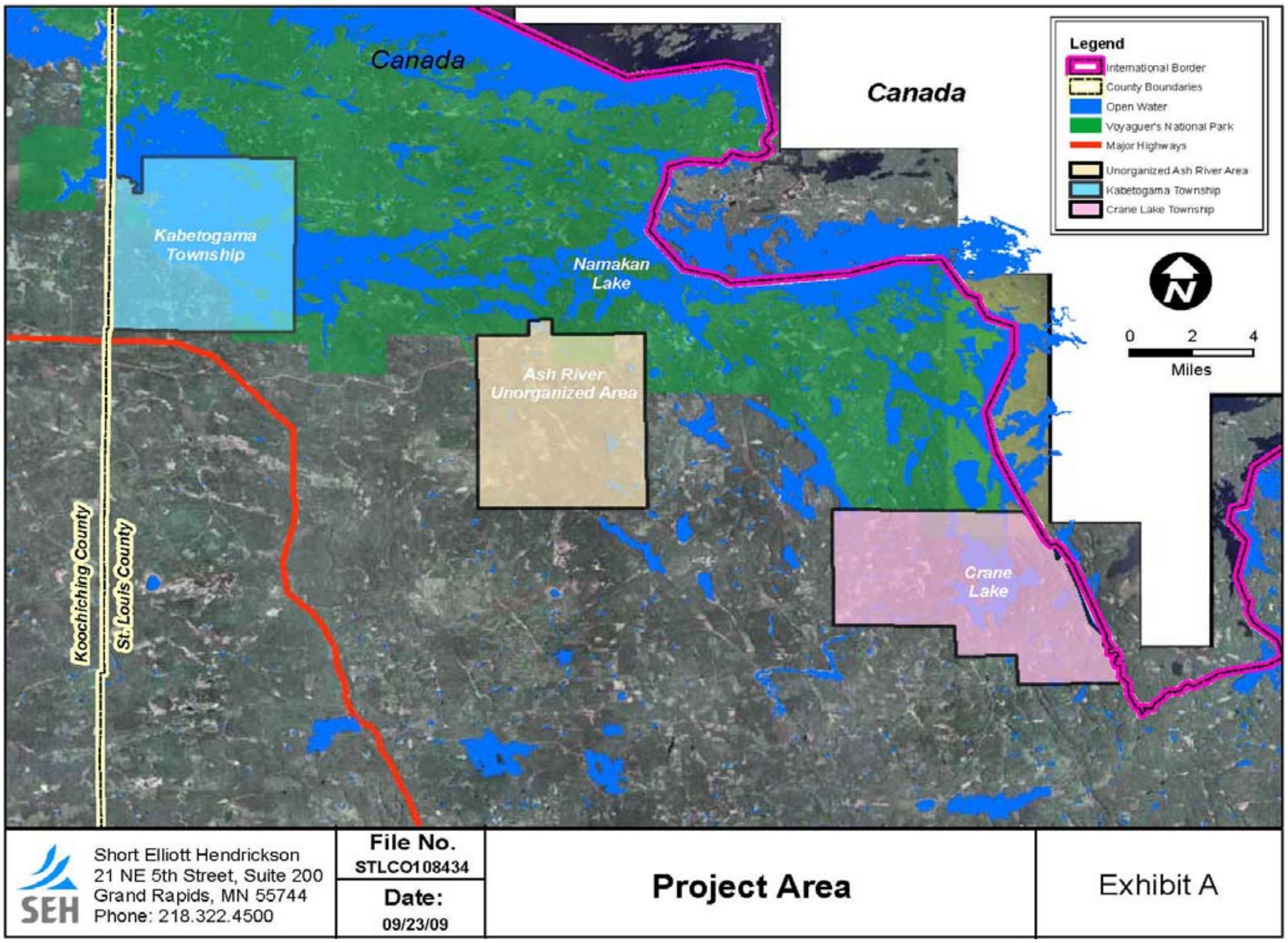
- Crane Lake Water and Sanitary District (CLWSD) - The CLWSD has a small diameter force main and grinder lift station sewer collection system and treatment facility. The system was installed in 2004 and currently serves about 110 properties. CLWSD is in the process of extending the collection system to the Eastern Service Area within the district. RLK report dated April 2007 (see Appendix J).

- Puck's Point Subordinate Service District- In October of 2007, North American Wetland Engineering, LLC completed a Preliminary Engineering Report (see Appendix K) for the Puck's Point Subordinate Service District. In May of 2010, SEH was hired to complete a revised facility plan to be submitted to the funding agencies. (see Appendix I)

- The Kabetogama Township Comprehensive Plan (see Appendix A) identified future improvements for the area. The Township would like to have Woodenfrog Campground designated a State Park by the DNR. Community sewer service to this area would assist the DNR with redeveloping the campground into a state park. It was assumed a future state park would have a similar number of campsites with a sewer connection at each.

1.5 Planning Area

The project area was divided up into three areas based on geography: Kabetogama Township, Ash River Unorganized Area and the Crane Lake Water and Sanitary District (CLWSD) as shown below and also as Figure 1 in the Appendix.

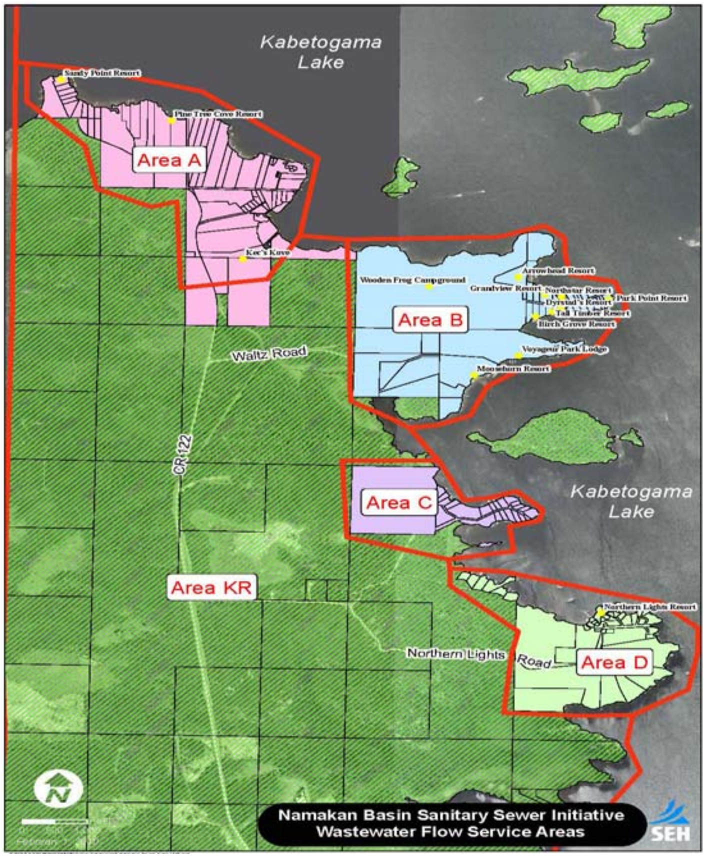


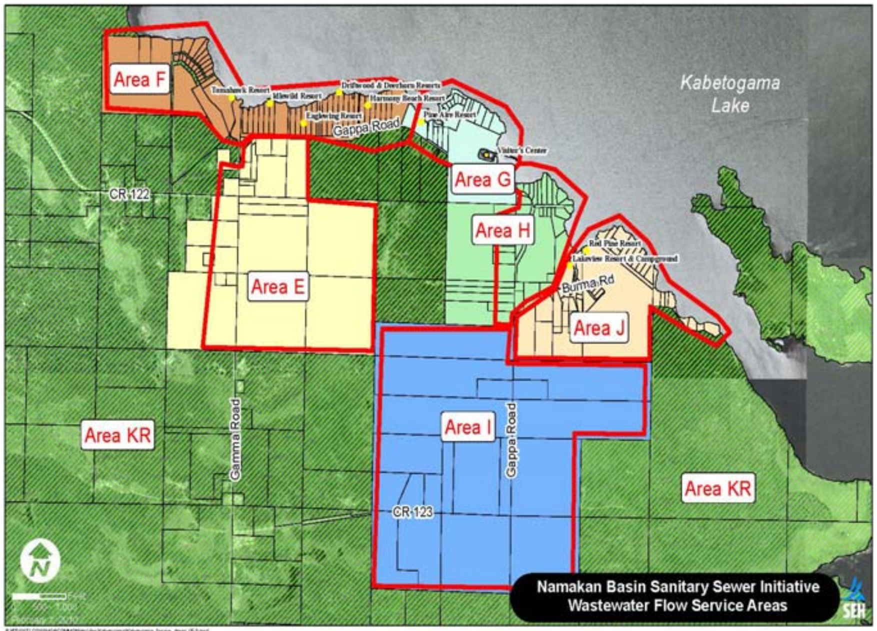
Each of the planning areas is further delineated by service areas for potential wastewater collection and treatment alternatives. These service areas are based on location and density of structures, potential wastewater collection areas, and recommendations of previous reports and findings. The service area boundaries will be modified as potential projects are developed and studied further. Service areas may be combined as they may be better served by creating one treatment site to take advantage of economies of scale and operational efficiencies. The final service area boundaries will depend on many factors including:

- Topography
- Condition of existing on-site systems
- Property owner requests
- Funding availability
- Type of proposed treatment or collection system

1.5.1 Kabetogama Township

The Kabetogama Planning Area is encompassed by the Township limits and was divided into ten service areas. The densely populated areas along the shoreline are in separate service areas than the remainder of the Township. The service areas within Kabetogama Township are shown below and also as Figure 4 in the Appendix.





The sewer generating parcels within the service areas consist of a mix of resorts, seasonal and year round lake homes along the southwest shore line of Kabetogama Lake. There are approximately 337 wastewater producing parcels in Kabetogama Township. The resorts within the service areas of Kabetogama Township are as follows:

<u>Service Area A</u>

- Sandy Point Resort
- Pine Tree Cove Resort
- Calm Bay Resort – converted to a CIC
- Kec's Kove

<u>Service Area B – Puck's Point Subordinate Service District</u>

- Arrowhead Resort
- Grandview Resort
- North Star Resort
- Birch Grove Resort
- Voyageur Park Lodge
- Moosehorn Resort
- Tall Timber Resort
- Dyrstad's Resort
- Park Point Resort
- Woodenfrog State Campground

<u>Service Area D</u>

- Northern Lights Resort

Service Area F

- Eagle Wing Resort
- Driftwood and Deer Horn Resorts
- Tomahawk Resort
- Idlewild Resort
- Harmony Beach Resort

Service Area G

- Pine Aire Resort
- Kabetogama Lake Visitor Center

Service Area H

- Pokorny's Campground

Service Area J

- Red Pine Resort
- Lakeview Resort and Campground

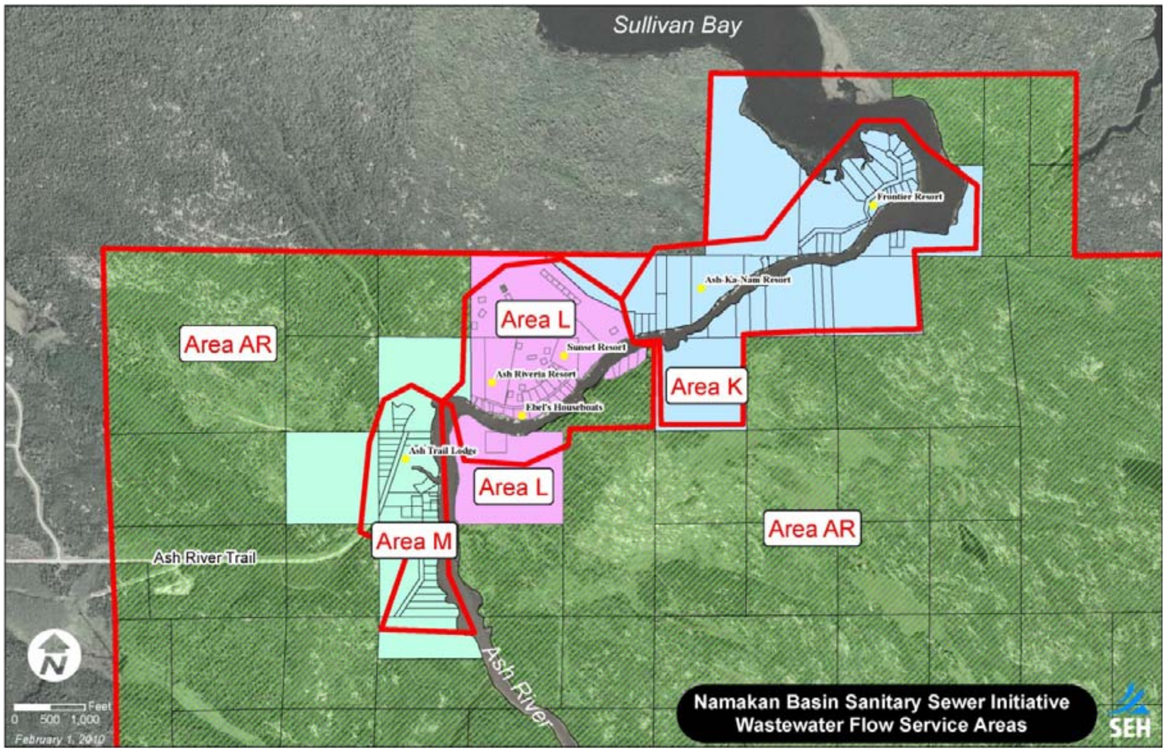
The Arrowhead Regional Development Commission (ARDC) identified a vision for the area in the Kabetogama Township Comprehensive Plan dated July 2008 (see Appendix C). This vision includes supporting and encouraging sustainable growth and use of the forests and Kabetogama Lake. Wastewater treatment and expanding services at the Woodenfrog State Campground were two of the issues identified in this report.

The Kabetogama Township Comprehensive Plan recommendations for Woodenfrog Campground included adding more campsites along the lakeshore, providing nighttime boat tie-ups, and improved infrastructure of the campground. The improved infrastructure could include shelters, bath houses with toilets, and shower facilities. Installing sewer, water, and electric to each campsite has been considered. These infrastructure improvements would be comparable to the services available at other State Park Campgrounds.

Wastewater treatment and water quality were issues were also identified in the Kabetogama Township Comprehensive Plan. The report identified and prioritized areas to help guide the Township in its pursuit of wastewater service development. The service areas in this report roughly follows the areas setup in the Comprehensive Plan.

1.5.2 Ash River Unorganized Area

The Ash River Planning area includes two unorganized townships of the unincorporated area of Ash River and is divided into three service areas (L, K, and M), with the remainder as service area AR below and also as shown in Figure 2 in the Appendix.



The sewer generating parcels within the service areas consist of a mix of resorts and seasonal and year round lake homes. There are approximately 146 wastewater producing parcels within the Ash River Planning Area. The resorts within the Ash River service areas are as follows:

<u>Service Area M</u>

- Ash Trail Lodge

<u>Service Area L</u>

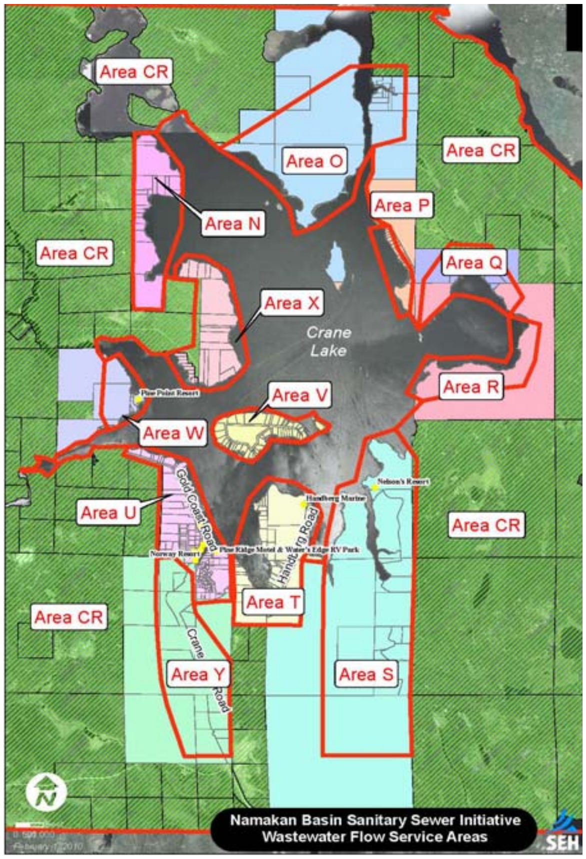
- Ebel's Houseboats
- Ash Riveria
- Sunset Resort

<u>Service Area K</u>

- Ash-Ka-Nam Resort
- Frontier Resort

1.5.3 Crane Lake Water and Sanitary District (CLWSD)

CLWSD planning area is divided into 13 service areas below and also shown as Figure 3 in the Appendix.



Wastewater generating parcels within the service areas consist of a mix of resorts and seasonal and year round lake homes. Most of the resorts are located near the south end of Crane Lake. There are approximately 272 wastewater producing parcels in CLWSD. The resorts and commercial properties within the CLWSD service areas are as follows:

<u>Area S:</u>

- Nelson's Resort

<u>Area T:</u>

- Handberg Marine
- Wildwood Escape

<u>Area U – Served by CLWSD Wastewater Treatment Facility:</u>

- Scott's Peaceful Valley
- Norway Resort
- Voyagaire Houseboats
- Scott's Resort and Seaplane Base
- Water's Edge RV Park

<u>Area Y – To be served by new extension of collection system in 2010</u>

- Anderson Outfitters
- Pine Ridge Motel

1.6 Abbreviations

CLWSD - Crane Lake Water and Sanitary District

FTYR – Full Time Year Round

PTYR – Part Time Year Round

FTSO – Full Time Summer Only

PTSO – Part Time Summer Only

STEP – Septic Tank Effluent Pumping System

LPGP – Lower Pressure Grinder Pump System

2.0 Existing Conditions

2.1 Introduction

Eighty Four percent (84%) of the sewage generating parcels within the project area are served by onsite wastewater systems along with wastewater generating parcels with no wastewater facility.

The age of the existing on-site systems range from new to 40+ years old. Most properties utilize some type of soil dispersal (drain field) where site conditions allow. Where bedrock is near the surface, a grey water drain field is utilized with an outhouse or incinerator toilet. Some properties installed holding tanks due to low usage and the inability to install an on-site system because of setbacks, soil conditions, bedrock, or groundwater proximity.

Using the guidance Minnesota Rules Chapter 7080 and the Minnesota Pollution Control Agency (MPCA) Unsewered Area Needs Documentation (UAND), the existing conditions section summarizes the findings of the Needs Assessment of the Subsurface Sewage Treatment Systems (SSTS) within the planning areas of Kabetogama Township, Ash River Unorganized Area, and Crane Lake Water and Sanitary District (CLWSD). The Needs Assessment assists in the development of the preliminary alternative analysis for Decentralized and Centralized options as described in future sections of this report.

The Needs Assessment is a desktop level review of the ISTS systems which included gathering information two ways; first collecting SSTS information from St. Louis County and MPCA in a GIS-based format, and secondly through individual questionnaires sent directly to the homeowner and businesses owners (resorts) within the project area.

Due to the rural nature of the project area, information from the County and MPCA was limited, therefore, the questionnaire information received from the property owners aided in the Needs Assessment. The questionnaire forms were sent out in October 2009 to property owners and businesses, and included the following information:

- Property use (full time year round, part time year round, full time summer only, part time summer only)
- Number of bedrooms and bathrooms
- Future plans for the property
- Type and age of septic system
- Maintenance performed on the septic system

- If the system has frozen
- Well depth and age
- Quality of well water (test results)

Data from questionnaires is used to supplement the County record information; therefore, the Joint Powers Board made a concerted effort to maximize the responses of the questionnaires. As of May of 2010, 65 percent of the respondents completed and returned the forms. Residents were informed the surveys were going to be used to develop recommendations for improvements and not for any enforcement actions based on their responses.

2.2 Needs Assessment

The Needs Assessment is intended to document the conformance or non-conformance of the SSTS systems for the project area based on a desktop level review. A physical site investigation was not performed at the SSTS locations. The MPCA wq-wwtp2-10 evaluates SSTS systems with the four categories:

System conditions per Minn. R. chs. 7080 and 7082:

1. Imminent threat to public health or safety (Minn. R. 7080.1500, subp. 4A).
2. Failure to protect groundwater — 2.a. Cesspools, seepage pits and/or systems lacking three (3) feet of vertical separation from seasonal high ground water or bedrock (Minn. R. 7080.1500, subp. 4B) — 2.b. Type V systems defined in Minn. R. 7080.2400 that fail consistently (Minn. R. 7082.0600, subp. 2).
3. Properties that cannot conform to setback requirements from water-supply wells or piping, buildings, property lines, or high water level of public waters.
4. SSTS system is in conformance.

To determine the condition of the existing SSTS, the following methods are determined by MPCA. An on-site compliance inspection was not performed to determine the existing SSTS conditions; therefore methods 2, 4, and 5 of the following summary were used to obtain existing SSTS conditions.

Methods of determining project need include:

1. A visual site inspection to document obvious threats to public health and safety, such as residential connections to a drain tile, overflow pipes, cesspools, or other unacceptable discharge locations.
2. A review of existing soil survey data to reasonably conclude if appropriate wastewater treatment technologies are being used on site. For example, seasonal high groundwater conditions may dictate the need for “mound” systems. If there are no mounds, the systems would be considered failing.
3. A site investigation including enough soil borings to create a soils map of the area. Complete an evaluation of the soil conditions to determine compatibility with existing wastewater treatment systems. If the soils map indicates a need for an above-ground system and none current exists, treatment systems are considered failing.
4. A review of local government records of the systems. If none exist, the system is unlikely to be in compliance. Existing records should be verified for accuracy.
5. A review of plat maps and other records to determine if any code setbacks, such as distance between SSTS and potable water wells or surface water, cannot be met

based on lot size. Systems on lots with inadequate size for setbacks should be considered noncompliant.

6. Compliance inspection as per Minn. R. 7082.0700, subp. 2.

Based on the desktop level review of the soil information, completed questionnaire forms, and County records, the following Compliance Criteria is created for the project.

Table 1
Compliance Criteria

	Non-compliant	Probably Non-compliant	May Be Non-compliant	May Be Compliant	No Building	CLWSD	Unsustainable	Building, but no System	Buildable Lot w/Septic	Misc. Land
Age of System	Older than 1980	Between 1980 and 1990	Between 1990 and 2000	Newer than 2000						
Type of System				Mound		Holding Tank, Outhouse, Privy	Holding Tank, Outhouse, Privy			
Lot Size	Less than 0.25 Acres	Between 0.25 and 0.50 Acres	Between 0.50 and 0.75 Acres	More than 0.75 Acres						
Shallow Well	Less than 50 feet deep			More than 50 feet deep						
Maintenance	Never			Less than 3 years ago						
Permit	No			Yes						
	1	2	3	4	5	6	7	8	9	0

A spreadsheet was created based on County records and the information from the questionnaires. The definitions of the compliance criteria in the columns shown above are as follows:

1. Non-Compliant – System older than 1980, lot size less than .25 acres, well depth less than 50 feet, septic tank never pumped.
2. Probably Non-Compliant – System age between 1980 and 1990, lot size between .25 and .50 acres.
3. Maybe non-compliant - System age between 1990 and 2000, lot size between .50 and .75 acres.
4. Maybe compliant – System age newer than 2000, mound, lot size larger than .75 acres, well depth more than 50 feet, septic tank pumped within last 3 years.
5. No building - County records indicate a parcel with zero market value of the structures.
6. CLWSD – Properties already served by the CLWSD.
7. Unsustainable – Sewage generating properties with holding tanks or outhouse privy.
8. Building with no system – A parcel with an market value of the structures but no existing SSTS.
9. Buildable lot with septic - A parcel with zero market value of the structures and an existing SSTS.
10. Miscellaneous Land – Property owned by a government body with no sewage generation.

According to Minnesota Rules Chapter 7080.1500, systems installed after March 1996 or in a designated shoreland area must have a minimum of 3 feet vertical separation between the system and groundwater or bedrock. If the system is outside of a designated shoreland area and installed before April 1996, this separation is reduced to 2 feet. This requirement means that most systems installed before March 1996 are not compliant because of the prevalence of bedrock and the high local groundwater elevation.

Based on the Compliance Criteria listed above, the following is a summary of findings for the three planning areas.

Table 2
Compliance Summary

* Noncompliant	1	265	16.61%
* Probably Noncompliant	2	30	1.88%
* May Be Noncompliant	3	51	3.20%
* May Be Compliant	4	101	6.33%
No Building	5	596	37.37%
* CLWSD	6	121	7.59%
* Unsustainable	7	113	7.08%
* Building w/o Septic	8	22	1.38%
* Buildable Lot w/Septic	9	52	3.26%
Misc. Land (Forest, State, Federal)	0	244	15.30%
	Total	**1,595**	**100.00%**

* Wastewater Generating Parcels

The total number of wastewater generating parcels within the three planning areas (sum of 1, 2, 3, 4, 6, 7, 8, and 9) equals 755.

The total number of assumed nonconforming SSTS systems (sum of 1, 2, 3, 7, and 8) equals 481.

This equates to a 481/755 = 64% non-conformance of the SSTS systems within the project area.

2.3 Kabetogama Township

Kabetogama Township is the largest wastewater producer of the three project areas. It also contains the most resorts which are typically the largest wastewater producers. Kabetogama Township has a variety of possible onsite wastewater treatment systems. The systems that are compliant of the residential properties have mound systems, however there are older noncompliant at grade systems and holding tanks.

In summary, the total number of wastewater generating parcels within Kabetogama Township (sum of 1, 2, 3, 4, 6, 7, 8, and 9) equals 337. The total number of assumed nonconforming SSTS systems (sum of 1, 2, 3, 7, and 8) equals 261. This equates to a 77% non-conformance of the SSTS systems within the project area.

The following table is a summary of findings:

Kabetogama Township

		A	B	C	D	E	F	G	H	I	J	KR	Total
Noncompliant	1	20	22	10	5	9	24	2	12	5	14	19	142
Probably Noncompliant	2	5	2	2	1	0	0	0	1	0	0	5	16
May Be Noncompliant	3	4	2	0	4	1	6	1	2	1	3	3	27
May Be Compliant	4	13	4	0	2	0	5	6	2	0	4	11	47
No Building	5	10	0	0	4	13	15	4	12	11	14	102	185
CLWSD	6	0	0	0	0	0	0	0	0	0	0	0	0
Unsustainable	7	5	4	13	0	3	11	1	13	1	11	2	64
Building w/o Septic	8	2	0	1	1	0	1	0	4	1	1	1	12
Buildable Lot w/Septic	9	7	0	0	15	0	0	7	0	0	0	0	29
Misc. Land	0	3	0	3	0	1	0	0	1	0	2	41	51
Total		69	34	29	32	27	62	21	47	19	49	184	573

The resorts typically have multiple mound systems to handle the wastewater flows. Northern Lights Lodge Condominium Community constructed a wetland wastewater pretreatment system. There are multiple areas in Kabetogama Township where onsite systems are not feasible or there isn't enough room on the property for the owner to expand their system to enable expansion of their resort.

Woodenfrog State Campground's 61 campsites are currently served by vault toilets and common water service at several points. There is a paved parking lot and boat access to Kabetogama Lake; all of which is managed and maintained by the Department of Natural Resources.

2.4 Ash River Unorganized Area

Nearly all of the properties in the Ash River area experience an inadequate area or suitable soils for onsite treatment systems. Some of the wastewater generating parcels have existing mound systems and holding tanks.

The following table is a summary of findings:

Ash River Unorganized Area

		K	L	M	AR	Total
Noncompliant	1	18	10	16	7	51
Probably Noncompliant	2	2	1	4	1	8
May Be Noncompliant	3	5	1	5	1	12
May Be Compliant	4	6	5	4	1	16
No Building	5	4	13	8	246	271
CLWSD	6	0	0	0	0	0
Unsustainable	7	11	8	4	8	31
Building w/o Septic	8	2	0	1	2	5
Buildable Lot w/Septic	9	0	23	0	0	23
Misc. Land	0	2	1	2	65	70
Total		50	62	44	331	487

In summary, the total number of wastewater generating parcels within Ash River Unorganized Area (sum of 1, 2, 3, 4, 6, 7, 8, and 9) equals 146. The total number of assumed nonconforming SSTS systems (sum of 1, 2, 3, 7, and 8) equals 107. This equates to a 73% non-conformance of the SSTS systems within the project area.

2.5 Crane Lake Water and Sanitary District

Currently, there are two MPCA permitted wastewater treatment facilities in the project area. One is Nelson's Resort on the southeast shore of Crane Lake and the other is the CLWSD treatment plant south of Crane Lake along County Road 24. Nelson's Resort treats wastewater generated from onsite. Currently, the CLWSD treatment facility treats wastewater from Area U and a few properties in Areas T and Y.

Most compliant residential properties have mound systems, but there are many older noncompliant at grade systems and holding tanks as well. The properties outside of the collection area for the CLWSD plant and near the shoreline are small lots and do not have room for a new onsite system.

The following table is a summary of findings:

Crane Lake Water and Sanitary District

		N	O	P	Q	S	T	U	V	W	X	Y	CR	Total
Noncompliant	1	2	7	6	6	6	11	3	14	2	10	3	2	72
Probably Noncompliant	2	2	0	0	0	1	2	0	1	0	0	0	0	6
May Be Noncompliant	3	1	0	2	0	0	4	0	2	0	2	1	0	12
May Be Compliant	4	2	5	0	0	2	7	0	13	0	6	1	2	38
No Building	5	6	4	0	2	4	16	40	15	1	6	12	34	140
CLWSD	6	0	0	1	0	0	4	113	0	0	0	3	0	121
Unsustainable	7	4	0	3	0	1	1	0	3	1	3	0	2	18
Building w/o Septic	8	1	0	1	0	0	0	0	1	0	0	0	2	5
Buildable Lot w/Septic	9	0	0	0	0	0	0	0	0	0	0	0	0	0
Misc. Land	0	2	3	3	2	5	1	1	1	2	0	3	100	123
Total		20	19	16	10	19	46	157	50	6	27	23	142	535

In summary, the total number of wastewater generating parcels within CLWSD (sum of 1, 2, 3, 4, 6, 7, 8, and 9) equals 272. The total number of assumed nonconforming SSTS systems (sum of 1, 2, 3, 7, and 8) equals 113. This equates to a 41% non-conformance of the SSTS systems within the project area.

3.0 Projected Conditions

St. Louis County provided property information to assist with projecting the potential wastewater flow from the planning area, which included septic permit information for some of the wastewater generating parcels. In addition, the questionnaires completed by residents and business owners in the project area helped supplement the County information.

The design flow calculation for each property was based on Minnesota Administrative Rule 7080.1860 as shown in Appendix F. The assumptions in Rule 7080.1860 takes into account the number of bedrooms, the total area of the building divided by the number of bedrooms, and different types of water using appliances.

The number of bedrooms were based on the information provided on the returned survey forms. If the County indicated there was a building and survey forms did not include the number of bedrooms, was assumed to be two per property. It was assumed the buildings on the properties were between 800- and 500-square feet per bedroom. If the County's data indicated there was no building and the property was owned by a public entity or was tax forfeited, it was assumed the property will not produce any wastewater flow.

It is assumed the wastewater stream will consist mostly of residential wastewater. The restaurants will be required to maintain a grease separator that will prevent grease from contaminating the rest of the wastewater stream.

The design flow was modified based on the usage information from the completed surveys. The following table shows the factors used to modify the assumed flows for each property. If no survey was returned, a correction factor was assumed to be the same as part time summer only.

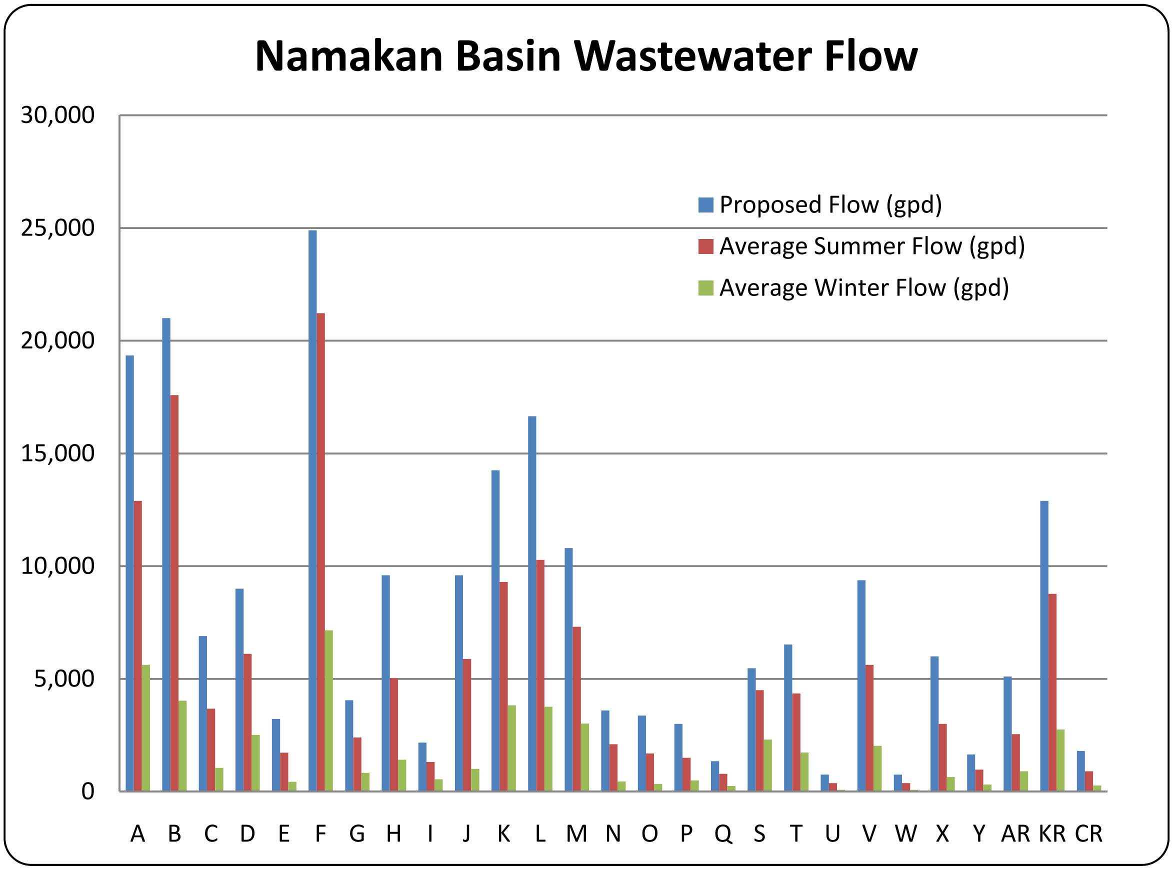
Table 3
Correction Factors

	Summer	Winter
FTYR	100%	60%
PTSO	50%	10%
PTYR	50%	30%
FTSO	100%	10%
NONE	50%	10%

3.1 Wastewater Flow Projections

Each project area was delineated into service areas. The summer and winter flows were modified based on the previously described correction factors. The following graph shows the large variation between the proposed flow, the average summer flow, and the average winter flow.

During final design, these variations will need to be taken into consideration. A flow equalization basin can be constructed at the treatment site or the septic tanks at the connection can serve this function. By installing dual force main, it is possible to utilize one force main during the winter months when flow is low and use both pipes during the summer when extra capacity is needed. The other alternative to deal with the seasonal variation in flow is to winterize the force mains and pumps to the properties not used full time during the winter. If the property is used occasionally during the winter, the septic tank that is proposed to be installed with the pump at the connection can be used as a holding tank and pumped out as needed.



4.0 Wastewater Collection Alternatives

4.1 General

A collection system is required in the areas where centralized treatment is proposed. A decentralized system (on-site treatment) may not be feasible due to factors including proximity to bedrock or groundwater and poor soil conditions (low infiltration rate). Also setback from waters of the state, property lines and wells or structures are constraints for decentralized systems. Wastewater collection systems can be categorized into two types: gravity and pressure.

4.2 Gravity Collection System

A gravity collection system would consist of minimum 8-inch diameter PVC pipes with concrete manholes conveying sewage by gravity flow from the residence to a regional lift station. This type of system is used predominantly in numerous community throughout the area. This system is typically the cheapest to operate and maintain due to minimal electrical or mechanical systems needed to operate pressure systems.

A lift station would be installed at the lowest point in the service area or where the bedrock or groundwater elevation limits the pipe installation. A smaller local lift station would be installed were the bed rock or groundwater limits the pipe depth and would pump to the remainder of the collection system which drains to the main lift station. The main lift station would then pump the sewage to the treatment site.

This system is typically installed deeper than other collection systems because of the need for the collection pipes to be lower than the dwellings and structures. Because of the depth, there is increased cost with installation with trench restoration, dewatering, and rock removal. The installation of this type of system will limit the access to residences and for resorts during construction.

Advantages:

- Low operation and maintenance costs
- Proven technology (in use in many communities)
- Future expansion capabilities

Disadvantages

- Increased restoration costs because of deep trench
- May still require pumps at residence because of topography
- Expensive to construct through bedrock and in high groundwater
- Limited by topography and soil conditions

4.3 Pressure Sewer Collection System

There are two types of pressure sewer collection systems. One is the Septic Tank Effluent Pumping System (STEP) which utilizes a septic tank and pump at each connection. The other is the Low Pressure Grinder Pump (LPGP) system which utilizes a sewage grinder pump at each connection. Both systems require a small diameter force main typically 1.5- to 4-inches diameter PVC or HDPE.

The force main is laid along the topography of the land which reduces the installation and restoration costs versus a gravity sewer collection system. Since it is a pressure system, there is also minimal infiltration into the system which helps minimize the quantity of effluent that requires treatment.

4.3.1 Septic Tank Effluent Pumping System (STEP)

The Septic Tank Effluent Pumping System (STEP) utilizes a septic tank and pump at each connection. The septic tank provides preliminary treatment of the sewage on-site and pumps the partially treated effluent through a small diameter force main to a treatment site for final treatment. If a STEP is utilized, the operating authority will need to determine responsibility for maintenance of the tank (property owner or district).

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Advantages

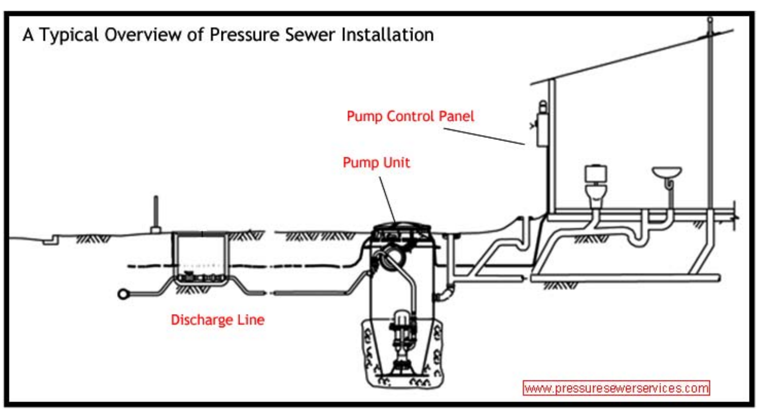
- Follows contour of land results in shallower trench and less restoration
- Small diameter pipes
- Septic tanks settle out solids and grease that may cause problems in collection system
- Individual septic tanks lessen peak flows to treatment site
- May be able to utilize existing septic tanks
- Minimal infiltration
- The septic tank from the STEP system could serve as a holding tank during low usage (during the winter months)

Disadvantages

- Requires periodic pumping of individual septic tanks
- Requires pumps (and electricity) at each tank
- Higher operation and maintenance costs than gravity systems
- Requires easements around the tanks as they are typically placed near the structure (house, cabin, resort, etc.)
- Need to determine if existing tanks can be utilized which may be difficult

4.3.2 Low Pressure Grinder Pump System (LPGP)

A low pressure grinder pump system is similar to a STEP system except that instead of septic tanks at each connection there is a grinder pump. This type of system is similar to the existing collection system in place for the CLWSD. Wastewater will flow to the grinder station via gravity from the dwelling, the grinder station will pump untreated wastewater into the small diameter force mains to the treatment site. A lift station is typically needed when the head pressure in the small diameter force mains exceeds the head capability of the grinder stations. Operation and maintenance of the grinder station is typically the responsibility of the sewer district.



Advantages

- Follows the contour of the land and results in shallower trench and less restoration
- Small diameter pipes
- Septic tanks not required at each connection
- Solids are handled at the treatment site

- Minimal infiltration

Disadvantages

- Higher operation and maintenance costs than gravity systems
- Requires easements at the grinder stations
- Flow equalization basin is typically needed before the treatment site

4.4 Summary of Wastewater Collection Alternatives

The wastewater collection layouts are included as Figures 8, 9, and10.

The wastewater collection system options will need to be more closely evaluated during final design for each of the service areas, as usage and additional property information is available.

Maintenance costs for the collection systems will be dependent upon the system that is ultimately installed. The operation and maintenance costs were based on the following assumptions. Each pump would require an annual service checkup and a monthly hour meter check. The force main or gravity sewer installed would require flushing once every three years. If a force main or pump will be winterized, it would occur at the time the pump is annually serviced.

5.0 Wastewater Treatment Alternatives

Treatment of wastewater is essential before introduction into a water body, either surface or subsurface. Several treatment and dispersal alternatives are available and applicability is dependent on site conditions. Treatment alternatives include soil treatment, stabilization ponds, and mechanical treatment systems. Soil treatment systems include treatment and dispersal in one step. Stabilization ponds and mechanical treatment systems require a dispersal system and could include subsurface dispersal, spray irrigation, or surface discharge.

5.1 Soil Based

Soil treatment relies on the microorganisms in the soil to consume organic material and nutrients. Soil treatment requires a three foot depth of acceptable soil for adequate treatment. The top three feet of soil provides an aerated environment for aerobic microorganisms. Saturated soil, bedrock, excessively drained, and heavy soils that do not permit infiltration are not adequate for treatment. When three feet of soil depth is not present, additional soil can be placed to provide the three feet necessary. A septic tank is required ahead of the treatment system to remove solids that would clog the soil. Soil treatment systems are good alternatives for individual residences. However, to treat flows for several residences, a large area would be required and may not be feasible if space is a constraint. The soil suitability exhibits are included in Figures 5, 6, and 7.

5.1.1 Mound

The soil based treatment is considered a mound system when there is less than three feet of soil for treatment and suitable soil is imported to build (mound) up and provide adequate soils for treatment.

5.1.2 Drain field

The soil based treatment is considered a drain field when there is adequate soils in place onsite to provide the necessary treatment.

5.2 Stabilization Ponds

A second alternative is stabilization ponds. Wastewater is stored in lined earthen basins where aerobic microorganisms consume organic materials and nutrients. Wastewater is typically stored for up to 180 days and discharged twice per year. Detention time can be reduced by adding aeration. Similar to soil treatment systems, subsurface conditions must be suitable for stabilization pond installation. A separation distance (varies upon liner construction) is required between bedrock and groundwater to prevent groundwater contamination compared to mechanical treatment systems. Stabilization ponds are popular treatment systems for small communities because of low operation costs. Stabilization ponds consume large areas of land but can be reduced in size by adding aeration. The drawback to aeration is increased maintenance and operation costs.

5.3 Mechanical Treatment

The final alternative is a mechanical treatment system of which there are several types. Mechanical treatment systems include media filters (sand and gravel), aerobic treatment units, and constructed wetlands.

5.3.1 Media Filters (Sand and Gravel)

Media filters are fixed film reactors with sand or gravel as the most typical media. Wastewater is distributed over the media and aerobic microorganisms consume organic matter and nutrients. A septic tank is included before the media filter either at the treatment site or at the residence, to reduce solids entering the filter. The filters can be single pass, which closely resemble a soil treatment system, or recirculating.

The CLWSD WWTF is a recirculating sand filter. A recirculating filter requires an under drain and pump station to redistribute the wastewater over the media. The benefit to recirculating the wastewater is a reduction to the sand filter size and better treatment. A recirculating filter has the potential to reduce nitrogen. After the wastewater has permeated through the filter, anaerobic conditions are present stimulating anaerobic bacteria that reduce nitrate. Nitrogen removal would typically not be adequate to meet the MPCA's nitrogen limit which would then require an additional treatment step.

5.3.2 Aerobic Treatment

Aerobic treatment units utilize aerobic microorganisms to degrade organic matter and nutrients. Air is introduced into the system through forced aeration or surface agitation increasing the respiration of microorganisms. Because of the increased respiration, aerobic treatment units are biologically more efficient than the other treatment systems. Increased biological efficiency reduces the size of the treatment system compared to soil treatment systems and media filters. Nitrogen removal can be accomplished in aerobic treatment units. However, the nitrogen removal is not adequate to meet the MPCA nitrogen limit and a supplemental nitrification system would still be required.

Aerobic treatment units are typically fixed film or suspended growth. In fixed film systems, aerated wastewater passes through media where microorganisms are attached. The microorganisms consume the organic matter and nutrients. When an excess of microorganisms accumulates, the microorganisms slough off the media and can be removed from the tank.

In suspended growth systems, the microorganisms are kept suspended with the aeration system. The microorganisms move throughout the tank and consume organic matter and nutrients. Following the aerobic treatment unit, a clarifier is required to settle out the solids where they are either wasted or recirculated back into the aerobic treatment unit. In small systems, solids are removed periodically and transported to a wastewater treatment facility for treatment. In larger treatment systems, the solids are treated on site in a digester and is disposed of through land application.

Onsite aerobic treatment units are scaled down versions of aerobic treatment systems used at centralized treatment facilities. Fixed film systems are either trickling filters or rotating biological contactors. Suspended growth systems are conventional activated sludge facilities or oxidation ditches.

5.3.3 Constructed Wetlands

Constructed wetlands can utilize aerobic and anaerobic microorganisms to consume organic matter and nutrients as wells as plants to uptake nutrients. Several types of constructed wetlands exist, but only subsurface flow systems are recommended in Minnesota.

Constructed wetlands utilize a lined pond, gravel, and wetland plants. Wastewater flows through the system where both microorganisms and plants consume the organic matter and nutrients. The water level in the constructed wetland is restricted to the depth of the gravel eliminating a free water surface that can freeze. Anaerobic conditions are also present in the system at the root level and consume nitrate reducing the total nitrogen in the system. The nitrogen removal is not adequate to meet the MPCA total nitrogen limit requiring additional treatment.

Constructed wetland may use blowers to supplement oxygen in the system. The increased oxygen increases the biological activity in the system reducing system size. Nitrogen treatment is also required following an aerated constructed wetland.

5.4 Summary of Treatment Alternatives

These are the six most likely treatment alternatives that can be utilized for the project area and the wastewater treatment recommendation exhibits are included as Figures 11, 12, and 13. Each of the treatment options has its advantages and disadvantages which need to be further evaluated when a proposed project is studied.

6.0 Effluent Discharge Alternatives

The effluent discharge alternatives can be used in combination with various treatment alternatives, as long as the discharge limits can be met.

6.1 Spray Irrigation

Spray irrigation relies on plants to uptake wastewater and nutrients within the wastewater stream. Spray irrigation utilizes a piping network with emitters to distribute wastewater above the ground surface and plants uptake the effluent through the soil. In addition to plant uptake, wastewater evaporates reducing volume.

Spray irrigation is popular for agricultural purposes, but may also be used in woodland areas. An example of a woodland irrigation system is located in Kettle Falls. Spray irrigation can only be used seasonally in Minnesota. The size of a spray irrigation system is dependent upon vegetative cover and climate. An alternative dispersal method is required during the non-growing season. In areas where the residences are seasonal, spray irrigation is a good option.

A pre-treatment system would be required when using spray irrigation, including disinfection. Unlike subsurface dispersal systems, nitrogen removal treatment would not be required for systems greater than 10,000 gallons per day (gpd). The cost of this system is reduced because nitrogen treatment is not required.

This alternative is feasible for areas where:

- Subsurface discharge isn't feasible
- Adequate area readily available
- Holding tanks to be utilized during winter and routinely pumped
- High fluctuation in summer and winter time flow.

6.2 Subsurface Discharge

Subsurface discharge systems rely on adequate soil to allow treated or untreated wastewater to permeate through the soil. A separation distance is required between the dispersal pipe and groundwater or bedrock. In systems that do not use pre-treatment, three feet separation is required. Dispersal systems that accept untreated wastewater, must also be sized to provide treatment. In systems that use pretreatment, the separation distance may be as little as 12-inches, depending on the level of treatment.

Separation distances will impact the type of subsurface discharge system. When the separation distance plus an additional 1-foot of cover is provided to prevent freezing, a below grade dispersal system can be used. Below grade dispersal systems include trenches and infiltration beds. A trench system has individual dispersal pipes in each trench, whereas infiltration beds have multiple dispersal pipes in each trench or bed. Effluent can be discharged to the trenches or bed either by gravity or pressurized.

Subsurface drip irrigation is also available as a dispersal system. In subsurface drip irrigation, treated wastewater is dosed into the soil. Distribution is through the means of small diameter pipe and emitters below the ground surface.

Neither adequate separation nor cover may be available requiring either an at-grade or above grade system. Systems where adequate separation is available but cover over the dispersal pipe is less than 1-foot, an at grade system is used. When the required separation distance is not available, an above grade system can be used where sand is imported to provide the separation. Both at-grade and mound systems require pressure distribution for dispersal and are configured as infiltration beds.

The MPCA total nitrogen limit must be considered when planning and designing a subsurface dispersal system of 10,000 gpd or greater. A system can be sized to treat for total nitrogen in addition to sizing for dispersal. When adequate area is not available for nitrogen treatment in the soil, pre-treatment is required.

6.3 Surface Discharge

A surface discharge is common for centralized systems, such as the Crane Lake Water and Sanitary District Wastewater Treatment Facility (CLWSD WWTF), and includes discharges to both rivers and lakes. Systems within the project area would be discharging into an outstanding resource value waterway, therefore stringent limits are anticipated.

6.4 Holding Tanks

Installing and/or maintaining holding tanks is the least preferred alternative. This alternative will be recommended only when:

- No location is available for onsite system
- Too expensive to connect to centralized system
- Dual purpose use of the holding tank.

May require development of site(s) to dispose of sewer pumped from tanks or hauler will be required to haul to wastewater treatment plans like the CLWSD WWTF.

6.5 Summary of Effluent Discharge Alternatives

These are the four most likely chosen discharge alternatives that can be utilized for the project area. Each has its advantages and disadvantages, which will need to be evaluated when a proposed project is advanced.

7.0 Recommended Plan

7.1 Introduction

The recommended plan for a centralized versus decentralized wastewater system is based on the information gathered from the Needs Assessment, geographic density of the dwellings, calculated flow determination of the service areas, and the soil suitability determination, which are previously described within this report.

The recommended plan for centralized and decentralized wastewater systems for the service areas are as follows:

<u>Centralized</u>

- Kabetogama (A, B, C, F, G, H, and J)
- Ash River (K, L, and M)
- CLSWD (N, O, P, Q, T, V, W, X, and Y)

Note, there may be some properties within these areas that will remain decentralized due to their geographical distance from the densely populated areas.

<u>Decentralized</u>

- Kabetogama (D, E, I and KR)
- Ash River (AR)
- CLWSD (R, S, and CR)

7.2 Centralized Systems

A centralized wastewater system includes collecting the wastewater from multiple dwellings to the treatment site, effectively treating the wastewater with the various flows and loadings, and finally discharging the effluent within the MPCA permitted requirements.

The following table is a collection, treatment, and distribution system matrix summarizing the suitability of the various systems.

Collection - Treatment - Discharge Matrix

Collection Alternatives	Treatment Suitability					
	Soil Based			Mechanical Treatment		
	Mound	**Drain Field**	**Stabilization Pond**	**Media Filter**	**Aerobic**	**Constructed Wetland**
Gravity System	Poor	Good	Good	Good	Good	Good
Low Pressure Grinder Pump System	Poor	Poor	Good	Good	Good	Good
Septic Tank Effluent Pumping System	Good	Good	Good	Good	Good	Good
Individual SSTS	Good	Good	Poor	Good	Good	Poor

Treatment Options	Effluent Discharge Suitability		
	Spray Irrigation	**Subsurface**	**Surface**
Mound	Poor	Good	Poor
Drain field	Poor	Good	Poor
Stabilization pond	Good	Poor	Good
Media Filter	Good	Good	Good
Aerobic	Good	Good	Good
Constructed Wetland	Good	Good	Good

7.2.1 Collection System

As previously mentioned in the collection system alternatives section, both the septic tank effluent pumping station (STEP) and the Low Pressure Grinder Pump Station (LPGPS) are systems better suited for the geographical topography and bedrock within the project area.

The STEP system is the recommended collection system for service areas A, B, C, F, G, H, J, K, L, M, N, O, P, Q, W, and X. The STEP collection system allows more flexibility with the use of the property and operational efficiencies. During winter months when a majority of the properties have limited wastewater generation, the pumps can be shut off and the tank can be used as a holding tank and periodically pumped based on use. Shutting down the collection system during this period of limited use will help eliminate the typical issues encountered with systems with seasonal variations. Some concerns generally associated with seasonal variations include: freezing force mains, increased maintenance of pumps, increased detention time of the wastewater which can cause toxicity issues of the wastewater treatment plant. The septic tank will require annual pumping at a minimum, but offers flow equalization and solids settling. As the specific service areas progress toward installation of a centralized system, current and future uses, along with the operating entity's capabilities, will need to be analyzed to determine if a STEP system or LPGP system is the best choice.

The low pressure grinder pump station (LPGP) is the recommended collection system for service areas T, V, and Y, which are within the CLWSD. This system will utilize the existing CLWSD trunk force main and lift station system that was installed in 2004. Due to the limited area and unsuitable soil conditions on the island, service area V is also recommended to be connected to the existing collection system.

Operation and maintenance costs were based on the following assumptions:

- O&M costs for STEP System were based on one annual pump service check ($300), once per month hour meter check (10 minutes per pump per month @ $75/hour) and pumping the tank every year ($250) for a total of $700 per year.

- O&M costs for LPGP systems were based on one annual pump service check ($300), biweekly hour meter check (10 minutes per pump every two weeks @ $75/hour) for a total of $625 per year.

- The maintenance costs for the force mains for the STEP and LPGP system was assumed to include flushing every three years at $240/800 LF of force main ($0.10/LF/year).

7.2.2 Treatment System

The recommended plan of treatment for the service areas designated for a centralized system will ultimately be determined when a more in depth engineering study is completed for the specific areas. As an example, Pucks Point is currently completing a Wastewater Facility Plan to determine the selected wastewater treatment alternative for the service area. While the scope of this report does not include a specific recommended treatment option, desktop investigative work has been completed to determine treatment effectiveness based on soil suitability (see Figures 5, 6, and 7).

Three classifications for suitability were used in the evaluation and include mostly unlimited, moderately limited, and severely limited. A Natural Resource Conservation Service (NRCS) soil survey is currently being completed for the project areas. Preliminary data from the survey was obtained from the NRCS and evaluated to determine suitability for both treatment and dispersal systems. The key factors in determining suitability include:

- Depth to bedrock;
- Depth to groundwater;
- Depth to redoximorphic features (indicator of seasonal saturation);
- Soil permeability; and
- Slope

Soil descriptions in the soil survey provide a typical profile of the soils within the soil group. A typical profile includes a soil type for each soil horizon that can be used to determine permeability, depth to redoximorphic features, depth to bedrock, and depth to groundwater. The soil description also provides a slope for the area and the percentage of the area covered by each soil type because most soil groups include at least two soil classifications.

The importance of each of key factor and allowable depth to limit condition is dependent upon the treatment or dispersal system. A summary of importance and allowable depths is provided in Table 4. Areas that are classified as mostly unlimited have 80 percent to 100 percent of the area covered with soils that are suitable for the treatment or dispersal system. Areas that are classified as moderately limited have 20 percent to 80 percent of the area covered with soils that are suitable for the treatment or dispersal systems. Areas with less than 20 percent of the area covered with soils suitable for the treatment or dispersal systems are classified as severely limited. An area that has either bedrock or groundwater within twelve inches of the surface or slopes in excess of 25 percent throughout the entire soil group area was assigned a suitability classification of severely limited for all treatment and dispersal systems.

Table 4
Summary of Suitable System Conditions

System	Soil Permeability Importance	Depth to Bedrock (inches)	Depth to Groundwater (inches)	Depth to Redox Features (inches)	Slope (%)
Stabilization Pond	Low	36-inches	36-inches	Surface	5
Trench System	High	48-inches	48-inches	48-inches	25
At-Grade System	High	36-inches	36-inches	36-inches	25
Mound System	High	12-inches	12-inches	12-inches	25
Spray Irrigation	Medium	12-inches	12-inches	12-inches	15

Bedrock and groundwater are important considerations in locating a stabilization pond. Adequate separation is required to prevent contamination of drinking water or downstream waters such as Kabetogama Lake, Ash River, and Crane Lake. Unlike other systems, the importance of soil permeability and separation to redoximorphic features is less because the intent of the system is to treat the wastewater above and disperse at a different location. A PVC liner or clay material can be brought in to mitigate soil problems. However, if seasonal saturation is at or near the pond bottom, a curtain drain would be required to lower the groundwater. Groundwater can cause a liner to float causing failure. Slope may also be an issue. Slope should be minimized to limit the import of fill material.

Trench systems, at-grade systems, and mound systems can be either soil treatment systems or soil dispersal systems depending mostly on system size. Suitability of the systems for treatment would be applicable to individual onsite systems or small cluster systems. Suitability of the systems for dispersal would be applicable to systems where pre-treatment is used such as an aerobic treatment unit, constructed wetland, or media filter. Medium and large sized cluster system will typically use a pre-treatment system before a dispersal system. Individual system owners may also choose to use the systems for dispersal and include a pre-treatment system for two reasons. First, including a pre-treatment system may reduce the dispersal system area if an inadequate area is available. Second, a pre-treatment system may allow the system owner to use a below grade dispersal system in place of a mound system through the Chapter 7080 “Alternative System” rules.

The suitability of soils for spray irrigation is similar to a mound system. However, the importance of permeability is less because in addition to infiltration, water is consumed by plants and also evaporation. A reduced slope compared to a mound system is also required to prevent runoff from the dispersal site. Slope for a mound system should be reduced however to limit the import of sand.

Suitability of soils for a treatment or dispersal was not the only factor in providing recommendations. Parcel size and proximity to wells was also considered. Adequate area must be provided to locate at least two treatment and dispersal systems in the event a system fails. The intent is to avoid providing a short term solution to a wastewater problem. Setback from wells must also be provided to protect drinking water. Well setback requirements further reduce potential areas for treatment and dispersal systems.

Treatment system costs are dependent on the level of treatment required. Individual on-site treatment systems and cluster type systems less than 5,000 gallons per day (gpd) do not require treatment for nitrogen. Treatment systems in excess of 5,000 gpd, but less than 10,000 gpd may be required to meet a 10 mg/L total nitrogen limit at property boundaries. The 10 mg/L limit would be required if there is a potential to impact the water quality of an aquifer. Treatment systems in excess of 10,000 gpd must comply with a 10 mg/L total nitrogen limit at property boundaries. In addition to the total nitrogen limit, systems in excess of 10 mg/L must comply with effluent limits set by the MPCA, including limits for BOD, TSS, and fecal coliform. The increase in treatment requirements increases the cost of the treatment systems.

Treatment systems in excess of 10,000 gpd, and potentially some in excess of 5,000 gpd, can comply with the nitrogen limit two ways. Treating the wastewater for nitrogen prior to dispersal can guarantee compliance with the effluence limit. The second alternative is monitoring the groundwater and relying on natural attenuation to meet the nitrogen limit. The alternative selected for complying with the nitrogen standard is dependent upon the size of the system, location, and proximity to property boundaries with respect to groundwater flow, and type of contributor. Nitrogen treatment will add in excess of 25 percent to the treatment system cost and is avoided whenever possible.

Cost estimates for typical systems that are recommended were obtained from system suppliers, operators, and local officials.

Four different unit costs were applied in the cost estimated and coincide with size and regulations as follows:

- A unit cost of $20,000 was applied for individual on-site systems and is the cost of recently installed systems in the areas.
- Unit costs of $25 per gallon were applied for small subsurface treatment systems (0 - 4,999 gpd),
- Unit costs of $30 per gallon were applied for medium subsurface treatment systems (5,000 gpd – 9,999 gpd).
- Unit costs of $35 per gallon were applied for large subsurface treatment systems (≥10,000 gpd).

In addition, typical items included in the O&M costs include electricity, septic tank pumping, and certified operator. A per residence cost of $250 per year was applied to all individual systems. O&M costs for centralized systems vary depending on the treatment system. Small systems that do not require nitrogen treatment are assigned an O&M cost of $1.67 per gallon. The assigned O&M cost assumes a non-aerated system that reduces electrical costs. Larger systems are assigned an O&M cost of $2 per gallon. Large systems will typically use an aerated treatment system and also require a MPCA certified operator increasing the cost compared to a smaller system.

A current connection fee of $15,171 is required for all new connections to the CLWSD. The connection fee is included in the cost estimate. Residences served by CLWSD also receive a sewer bill to pay for O&M. The current fee structure includes a $56 per month fixed connection fee and a $12.52 per 1,000 gallon usage fee.

7.2.3 Discharge

The discharge options suitability is summarized in the Collection – Treatment – Discharge Matrix table shown in section 7.2.

Subsurface discharge could be utilized for soil based treatment, constructed wetland, media filter or aerobic treatment system. Surface discharge could be utilized for a stabilization pond, media filter, aerobic treatment system or a constructed wetland. The discharge method chosen will depend on site conditions, treatment method, and discharge limit.

Spray irrigation in place of or in conjunction with subsurface dispersal was also considered. Treatment for wastewater constituents prior is necessary to spray irrigation. Nitrogen treatment is not required even for in excess of 10,000 gpd. Because nitrogen treatment can be avoided for systems in excess of 10,000 gpd, treatment system costs may be reduced. A detailed cost estimate would be required to determine the cost effectiveness of a woodland irrigation system.

7.3 Decentralized Systems

The recommended alternative for Service Areas D, E, I, R, S, AR, CR, and KR will include proper management of the existing onsite systems. These areas have low building density and typically have adequate land for an onsite system. The onsite system will include a septic and a mound system due to the need for regulatory separation distance between the drain field and the groundwater or bedrock.

There wastewater generating properties within other service areas that will utilize onsite systems as well. These individual systems are typically low use, further from a collection system, and are located on lots with suitable soil and adequate area on the property for future replacement.

7.4 Costs of Recommended Plan

Based on the information gathered and the recommended plan, the estimated capital and operating and maintenance costs are summarized below in Table 4 for the planning area. Individual service area collection system estimated costs are included in Appendix A.

The estimate includes construction costs plus a 15% contingency, 35% soft costs for engineering, administration, fiscal, and legal costs. The costs do not include an estimate for permanent easements or right-of way acquisition.

Table 5
Centralized Collection, Treatment, and Discharge

	Collection		Treatment		Total	
Area	**Capital Cost**	**O & M Cost**	**Capital Cost**	**O & M Cost**	**Capital Cost**	**O & M Cost**
A	$889,900.00	$21,400.00	$742,200.00	$26,800.00	$1,632,100.00	$48,200.00
B	$1,444,500.00	$20,200.00	$672,000.00	$38,400.00	$2,116,500.00	$58,600.00
C	$862,500.00	$18,600.00	$210,500.00	$11,400.00	$1,073,000.00	$30,000.00
D			$166,900.00	$16,400.00	$166,900.00	$16,400.00
E			$265,000.00	$3,800.00	$265,000.00	$3,800.00
F	$1,672,900.00	$33,600.00	$852,200.00	$49,500.00	$2,525,100.00	$83,100.00
G	$689,900.00	$15,000.00	$101,300.00	$6,800.00	$791,200.00	$21,800.00
H	$972,700.00	$24,100.00	$336,000.00	$19,200.00	$1,308,700.00	$43,300.00
I			$240,000.00	$3,000.00	$240,000.00	$3,000.00
J	$1,141,700.00	$23,700.00	$336,000.00	$19,200.00	$1,477,700.00	$42,900.00
K	$1,128,300.00	$25,700.00	$522,000.00	$21,900.00	$1,650,300.00	$47,600.00
L	$1,101,400.00	$18,900.00	$277,900.00	$33,000.00	$1,379,300.00	$51,900.00
M	$1,083,700.00	$24,300.00	$314,000.00	$19,900.00	$1,397,700.00	$44,200.00
N	$602,600.00	$8,900.00	$122,500.00	$6,100.00	$725,100.00	$15,000.00
O	$539,900.00	$10,100.00	$160,000.00	$4,800.00	$699,900.00	$14,900.00
P	$468,300.00	$9,400.00	$64,500.00	$5,400.00	$532,800.00	$14,800.00
Q	$205,000.00	$3,000.00	$80,000.00	$2,100.00	$285,000.00	$5,100.00
S			$200,000.00	$2,500.00	$200,000.00	$2,500.00
T	$1,165,200.00	$16,400.00	$443,500.00	$39,900.00	$1,608,700.00	$56,300.00
V	$1,367,200.00	$22,400.00	$525,500.00	$62,800.00	$1,892,700.00	$85,200.00
W	$122,800.00	$2,200.00	$40,000.00	$1,100.00	$162,800.00	$3,300.00
X	$375,000.00	$7,200.00	$313,200.00	$7,900.00	$688,200.00	$15,100.00
Y	$428,800.00	$3,700.00	$121,400.00	$13,000.00	$550,200.00	$16,700.00
AR			$500,000.00	$6,300.00	$500,000.00	$6,300.00
CR			$160,000.00	$2,000.00	$160,000.00	$2,000.00
KR			$940,000.00	$11,800.00	$940,000.00	$11,800.00
TOTAL	**$16,262,300.00**	**$308,800.00**	**$8,706,600.00**	**$435,000.00**	**$24,968,900.00**	**$743,800.00**

Note, there are no wastewater generating properties with Service Area R .