



**North/Northeast Big Kandiyohi
Lake Community**

Community Assessment Report

May 2024

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North/Northeast Big Kandiyo Lake Community Assessment Report

May 2024

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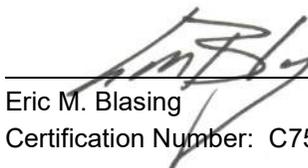
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1.0 PROFESSIONAL CERTIFICATION

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a certified MPCA Designer under the laws of the state of Minnesota.

Signature/Date:		<u>May 29, 2024</u>
Name:	Eric M. Blasing	Date
Registration:	Certification Number: C7582	



2.0 INTRODUCTION

The North/Northeast Big Kandiyohi Lake community (Project) is located along the north and northeast shoreline of Big Kandiyohi Lake in Fahlun Township, Kandiyohi County, Minnesota (Figure 1). The community is unsewered, and residential wastewater needs are met by individual subsurface sewage treatment systems (ISTS)¹. Residents are served water by a combination of individual and shared water supply wells. Stantec Consulting Services Inc. (Stantec) was retained to assess the probable compliance status of existing ISTS, and to evaluate alternatives for viable long-term wastewater treatment infrastructure.

This Community Assessment Report (CAR) was made possible through a Small Community Wastewater Program Technical Assistance Grant from the Minnesota Public Facilities Authority (PFA). These grants are available to small unsewered communities and used to analyze possible solutions to wastewater problems associated with noncompliant ISTS. Small Community Wastewater Program Technical Assistance grants are designed to help communities develop the technical, managerial, and financial capacity necessary to build, operate, and maintain new subsurface sewage treatment systems (SSTS). This report would not have been possible without the generous assistance of Kandiyohi County, the Big Kandiyohi Lake Association, the Minnesota Pollution Control Agency (MPCA), and the PFA.

The Project area contains 148 properties, as shown on Figure 1, including 146 residential and two commercial. The study area was selected based on adjacency to lakeshore, lot density, lot size, lot constraints, and expected ISTS status as these are the primary factors in considering a community wastewater solution. Individual property details and findings can be found within the parcel data spreadsheet in Appendix A.

2.1 PREVIOUS INVESTIGATIONS

An Unsewered Area Needs Documentation² assessment was completed by Kandiyohi County and Stantec as part of the CAR funding application. Information gathered in the Unsewered Area Needs Documentation was reviewed and incorporated into the findings of this report.

2.2 REPORT PURPOSE

This report serves as a planning document for possible long-term wastewater infrastructure solutions for the Project. The CAR is intended to present probable existing ISTS status and determine if the

¹ ISTS (a.k.a. septic system) are defined in Minnesota Rule Chapter 7080 as a type of SSTS that treats and disperses wastewater via the soil. "ISTS" refers generally to a home septic system.

² Unsewered Area Needs Documentation is a form created by the MPCA for unsewered communities when applying for funding. The form provides a preliminary status of existing ISTS conditions within the community.



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community is best served in the future by ISTS, a shared community system, or connection to a regional municipal wastewater treatment facility (WWTF).

2.3 WORK PERFORMED

An assessment of existing ISTS conditions was executed to determine a project baseline for analysis. Included in this assessment was a review of Kandiyohi County ISTS permit records, consultation with County staff, and field investigations to determine likely ISTS compliance status within the community. The analysis also evaluated potential future wastewater treatment options to serve the Project. Useful background information regarding some ISTS specifics (i.e., drainfield trench vs. mound) produced by the University of Minnesota Onsite Sewage Treatment Program (OSTP)³ is found in Appendix B.

A typical CAR investigation includes the development of potential community wastewater collection and treatment options. These options are based on areas of highest need due to low ISTS compliance, likely replacement ISTS type, and/or significant lot constraints. Based on the likely ISTS compliance, future replacement ISTS, and proximity to Lake Lillian, the Project includes a community wastewater collection and treatment alternative and connection to a regional municipal WWTF alternative. See Section 4 for further discussion.

³ The University of Minnesota OSTP provides technical training and continuing education for individuals who design, inspect, install, and maintain ISTS in Minnesota. Additional homeowner information regarding ISTS can be found at their website: <http://septic.umn.edu/>



3.0 EXISTING CONDITIONS

This section summarizes existing ISTS conditions within the Project area. All properties evaluated are served by an ISTS. Identified ISTS included pressure beds, trenches, at-grades, mounds, cesspool/drywells (CP/DW), outhouses, and holding tanks. A determination of likely ISTS compliance status was made for each property. In addition, a determination was made as to what the likely future ISTS would be to serve the property, based on soil conditions and existing site constraints.

3.1 METHODS

Fieldwork was completed in the summer of 2023 and included site visits to each participating property to locate water supply wells, wastewater tanks, and soil dispersal systems. Soil borings were conducted as needed, and ISTS were evaluated to determine their likely compliance status. An assessment was also made regarding the most likely option for each property's replacement ISTS.

Of the 148 properties, 31 agreed to participate in an onsite property assessment. Stantec was able to access all participating properties to complete a site inspection with the intent of documenting likely ISTS compliance and evaluating future ISTS options. Stantec used existing permit records, soil survey data, and completed soil borings on participating properties to evaluate soils throughout the Project area.

Likely ISTS compliance status for the 117 properties that did not allow a site visit was determined by permit review, visual assessment from the public right-of-way or adjacent property, soil conditions observed on neighboring properties, and professional judgement.

Prior to commencement of fieldwork, Kandiyo Lake County provided available ISTS permit files, design, and inspection records for the properties, and Geographic Information System (GIS) shape files of property boundaries. In addition, homeowner surveys were collected for participating properties to gain further knowledge of existing ISTS, parcel occupancy status, bedroom count, water supply, and dwelling water-use appliances. Information gleaned from records and homeowner surveys was incorporated into the parcel data spreadsheet (Appendix A) and used in the assessment.

3.2 FINDINGS

This section summarizes existing conditions of ISTS in the Project area. A determination of likely ISTS compliance status was made along with future wastewater treatment options to serve the properties.

3.2.1 Drinking Water Source

Property drinking water sources include individual and shared water supply wells (Figure 2). There is no community public water supply system. Note, not all water supply wells were located, as gathering locations on non-participating properties was not possible. Therefore, Figure 2 does not illustrate an inclusive exhibit of water supply wells for the Project area. Also included on Figure 2 is the 100-year flood zone areas.

Drinking water supply wells are typically described as either deep (greater than 50 feet of watertight casing) or shallow (less than 50 feet of watertight casing). Depth and location of wells must be considered when determining ISTS setback requirements. New ISTS drainfield components must meet a 50-foot setback from a standard deep well and a 100-foot setback from a shallow well. For shared community



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collection system pressure sewer forcemain, a 50-foot setback applies. The Minnesota Department of Health governs water supply well setbacks and potential variances.

3.2.2 Parcel Type

Table 3-1 summarizes parcel types in the Project area. Data is from homeowner surveys, zoning and tax records, and fieldwork observations. Of the 148 Project properties, 110 (74%) are seasonal and 38 (26%) are occupied year-round.

For the purpose of estimating wastewater flow volumes, Minnesota Rules Chapter 7080 classifies homes as Type I, II, III, or IV dwellings based on structure size and number of water-use appliances. Essentially, the smaller the structure and the fewer water-use appliances, the lower the flow volumes to expect. A Type I classification would assign the highest flows and Type IV, the lowest. As this information was unknown within the Project, the assumed dwelling classification was Type I.

Table 3-1: Parcel Type

Parcel Type	Number	Percentage
Residential	146	99%
Commercial	2	1%
Total	148	100%

3.2.3 ISTS Type

Table 3-2 summarizes ISTS types in the Project area.

Table 3-2: ISTS Type

ISTS Type	Number	Percentage
Trenches	12	8%
Pressure Bed	1	1%
At-Grade	1	1%
Mound	41	28%
CP/DW	30	20%
Outhouse	2	1%
Holding Tank	59	40%
No System	2	1%
Total	148	100%

3.2.4 ISTS Compliance Status

While evaluating each parcel, the likely ISTS compliance status was determined based on Minnesota Rules Chapter 7080 and Kandiyohi County SSTS ordinance. Noncompliant ISTS fall into one of two categories including Failure to Protect Groundwater (FTPG) or Imminent Threat to Public Health or Safety (ITPHS):



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- FTPG criteria include:
 - Less than 36-inches of vertical separation between the bottom of the soil dispersal system and a limiting condition such as seasonally high groundwater, hardpan, or bedrock.
 - Non-watertight tanks (includes cesspools, dry wells, and outhouse/privy systems).
 - Not meeting reporting requirements of an operating permit. Operating permits within Kandiyo Lake County are issued for ISTS with secondary pretreatment, non-standard systems, and systems designed to treat over 5,000 gallons per day.

- ITPHS criteria include:
 - Sewage backing up into the dwelling.
 - Untreated sewage discharging to the ground surface or surface waters.
 - Treated effluent surfacing on the ground surface from the soil dispersal system.
 - An ISTS in an unsafe condition (dangerous/missing tank riser covers, exposed wiring, unsound tank, etc.).
 - Any other condition deemed by an inspector to be a threat to human health or safety.

Table 3-3 summarizes likely compliance status within the Project. Likely compliance status is based on Kandiyo Lake County permit information, soils data, information provided by property owners, and onsite field assessments. The most common reason for noncompliant status was the use of outdated cesspool systems at 30 properties. Cesspools are not allowed under current state code. The second most common reason was subsurface trench or bed systems lacking adequate separation from groundwater or an other limiting condition. Most properties within the study area are at or near the lake level and subsurface systems are generally not viable.

Table 3-3: Likely ISTS Compliance Status

Status	Number	Percentage
Compliant	105	71%
Noncompliant ITPHS	0	0%
Noncompliant FTPG	41	28%
No System	2	1%
Total	148	100%

See Figure 3 and the parcel data spreadsheet in Appendix A for parcel-specific likely compliance status.

3.2.5 ISTS Age

Age is a factor in determining the overall health of a community's ISTS infrastructure. The typical ISTS lifespan is approximately 25 to 40 years under normal use and with proper maintenance. Over time, ISTS components can degrade, the distribution rock or sand/soil surface interface can plug, and soil beneath the soil dispersal system can eventually lose capacity to treat pollutants.

Waste strength, flow volume, and system maintenance are fundamental factors in how long an ISTS functions, but eventually all ISTS need to be replaced. Table 3-4 summarizes ISTS age ranges within the Project area. System ages were based on Kandiyo Lake County records and homeowner surveys. Thirty-five properties lacked County records or homeowner survey information, thus ISTS ages are unknown. ISTS



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lacking County records were likely either installed without a permit or installed prior to County recordkeeping. Figure 4 provides a visual representation of current ISTS ages within the Project area.

Table 3-4: ISTS Age (as of 2023)

System Age	Number	Percentage
< 10	35	24%
10 – 19	37	25%
20 – 29	32	21%
30 – 39	6	4%
40+	1	1%
Unknown	35	24%
No System	2	1%
Total	148	100%

3.2.6 Summary

Of the 148 ISTS within the Project, 105 (71%) are compliant and thus are not in need of immediate replacement. Of the 41 noncompliant ISTS, 30 are likely a cesspool-type system. These systems are outdated, do not protect groundwater, and are no longer allowed to be installed in Minnesota. Cesspools are basically a buried vessel with no bottom or with walls that allow wastewater to seep directly into the soil and/or groundwater.



4.0 ALTERNATIVES

When considering alternatives for long term wastewater infrastructure, three components are evaluated:

- Collection: the means wastewater generated from individual dwellings is conveyed to the wastewater treatment system.
- Treatment: settlement of solids, removal of pathogens, and reduction of nutrients in primary, secondary, and tertiary processes.
- Effluent dispersal: final distribution of treated effluent to surface waters, the ground surface, or subsurface soils.

When a series of homes are connected to a decentralized wastewater treatment system, it is commonly referred to as a community cluster system. Cluster system ownership, operation, and management occur through a municipality, the formation of a special purpose district, or through private ownership. For this report, the assumption was made that any community cluster system would fall under the ownership of Kandiyo Lake County as a subordinate service district (District). This would qualify the project for public funding opportunities. A system developed privately is not eligible for public financing and can present legal challenges as it relates to land ownership, system maintenance, and fee collection.

The City of Lake Lillian (Lake Lillian) sanitary infrastructure is nearby and the option to connect to their municipal WWTF is potentially viable. Therefore, feasible wastewater alternatives for the Project include the installation of ISTS to serve each dwelling, private ISTS excluding holding tanks (84 holding tank properties served by a community cluster SSTS), a shared community cluster SSTS, and connecting to Lake Lillian sanitary services. These alternatives are evaluated within the following section.

4.1 ALTERNATIVES ANALYSIS

The following alternatives have been evaluated for long-term wastewater treatment infrastructure to serve properties within the Project:

- Alternative 1:
 - 1a: Private ISTS, including Holding Tank systems.
 - 1b: Private ISTS excluding Holding Tanks (84 holding tank properties served by a community cluster SSTS).
- Alternative 2: Community Cluster Large Subsurface Sewage Treatment System (LSTS).
- Alternative 3: Regionalization to the Lake Lillian WWTF.

Table 4-1 includes the estimated design wastewater flow for the alternatives and the associated permit that would apply.



Table 4-1: Alternative Wastewater Design Flow and Permit Type

Alternative	No. of Properties	Design Wastewater Flow (gpd)*	Permit Type**
Alternative 1a: Private ISTS	148	Varies per property	Kandiyohi County ISTS
Alternative 1b: Private ISTS Excluding Holding Tanks (84 holding tank properties served by community cluster SSTS)	64 84	ISTS varies per property 17,400	Kandiyohi County ISTS State SDS
Alternative 2: Community Cluster LSTS	148	28,200	State SDS
Alternative 3: Regionalization to Lake Lillian	148	29,700	State NPDES

*Permit flow is not the actual flow observed, but rather is a prescribed design flow. The design flow considers an allowed reduction in per-dwelling flow estimates for community cluster systems with over 10 dwellings and includes infiltration and inflow for the collection system.

**Permit type required for ISTS assumes that the individual property owners are the ISTS owners/managers. The SDS permit required for the shared community cluster systems assumes Kandiyohi County is the owner.

Per Minnesota Rule 7081.0120, a daily wastewater flow was estimated for Alternative 1b and Alternative 2 using a formula specified in the rule. The formula calculates a design flow based on each dwelling’s classification and the total number of dwellings included. Typically, the actual daily wastewater flow observed is less than the estimated design flow as a safety factor is incorporated. One commercial establishment has a mound serving a dwelling and therefore design flow followed Minnesota Rule, Part 7080.1860. The other commercial establishment was calculated using Minnesota Rule, Part 7081.0130. Also included is the collection system infiltration and inflow (I/I), as specified in Minnesota Rule 7081.0120. As an SSTS is not included in Alternative 3, the wastewater design flow was estimated using flow estimates within 10-States Standards for Wastewater Facilities, 2014 Edition. See Appendix C for wastewater design flow calculation details.

The design wastewater flow dictates permitting authority, the level of pretreatment required, and other permitting requirements as summarized by the following classifications:

- A system designed with a wastewater flow less than 5,000 gpd is considered an ISTS and would be permitted by Kandiyohi County. These systems have the least restrictive design and permitting requirements.
- A system with a design wastewater flow greater than 10,000 gpd is permitted through the MPCA State Disposal System (SDS) program. These systems require enhanced pretreatment with nitrogen limits at the end-of-pipe (prior to soil dispersal) and/or within groundwater monitoring wells. These systems are considered LSTS.
- A system where surface discharge to a receiving water is employed like Lake Lillian, permitting is completed through the MPCA National Pollutant Discharge Elimination System (NPDES) permit.

4.1.1 Alternative 1: Private ISTS

The private ISTS alternative would require individual property owners to be responsible for the installation, management, operation, and maintenance of their ISTS. Therefore, operation and maintenance of ISTS would continue as is currently practiced. System upgrades, operation, and



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maintenance costs would be paid by the property owner with no public funding. Future decisions would be made by the property owner and a county issued ISTS permit would be required for each property. A publicly owned community cluster SSTS serving the 84 holding tank properties could qualify for public funding and would be managed like any public utility. A certified Service Provider/Operator would be required for operation and maintenance activities, and users would pay a monthly service fee to the District.

The typical life expectancy for a properly installed and maintained ISTS is 25 to 40 years. Life expectancy varies significantly depending on wastewater strength, water use patterns, construction, operation, and maintenance.

Advantages of private ISTS ownership can include lower permitting requirements and lower overall costs for installation, operation, and maintenance unless the ISTS is a holding tank. Disadvantages include management by individuals rather than the community, loss of yard space, potential for inadequate maintenance, and potential impacts to property values compared to a property connected to a public wastewater system.

4.1.1.1 Future ISTS Upgrades

As stated in Section 3.2.4, 28% of ISTS within the Project are likely noncompliant. This accounts for some type of potential imminent ISTS upgrade at 41 properties. However, all properties need an ISTS upgrade at some point in the future based on their limited life expectancy. The ISTS type needed at upgrade is significant as it directly influences the initial capital, operation, and maintenance costs. Minnesota Rules, part 7080.2200 – 7080.2400 define ISTS type including the following:

- Type I: Standard systems including subsurface or above-grade soil dispersal systems on undisturbed soils. Type I systems meet all technical sizing, design, and construction requirements, have suitable soils, and can meet all setbacks.
- Type II: Holding tanks, privies, and systems in floodplains.
- Type III: Non-standard systems that deviate from Type I code requirements, are constructed on soil which is difficult, disturbed, or contains seasonally high groundwater. Type III systems can include intentionally undersized soil dispersal systems due to inadequate area. These systems must use flow restriction that limits the daily effluent discharged to the soil dispersal system.
- Type IV: Commonly referred to as “performance” systems, Type IV systems include secondary pretreatment by means of an aerobic treatment unit or media filter prior to soil dispersal. These pretreatment technologies introduce air either mechanically or passively, which encourages aerobic bacterial growth and reduces loadings such as biochemical oxygen demand (BOD) and total suspended solids (TSS). Adding secondary pretreatment allows treated effluent to be loaded to the soil at a higher rate which will reduce the overall size of the soil dispersal system. Type IV systems can also include tertiary treatment technologies which reduce pathogenic bacteria (fecal coliform used as the indicator). This allows treated effluent to be dispersed with reduced vertical separation from the bottom of the soil dispersal system distribution media to the limiting condition. Type IV systems are more expensive to design, construct, operate, and maintain.



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Appendix A and Figure 5 summarize each property's most likely future ISTS based on the lot size, soil conditions, SSTS design requirements, and current land use. For a property that does not have suitable space for a soil dispersal system due to site improvements, setbacks, and/or the food zone, the future ISTS would likely be a holding tank. Whether a Type III or Type IV system is used to address various site constraints is up to the homeowner, the ISTS designer, and the permitting authority. There are advantages and disadvantages to each. For this report, properties with challenging soils or limited room for a soil dispersal system are classified as needing either a Type III or Type IV system. Table 4-2 and Table 4-3 summarize likely future ISTS for noncompliant properties and all Project properties, respectively.

Table 4-2: Future ISTS for Noncompliant Properties

ISTS Type	Number	Percentage
Type I	5	12%
Type II	24	59%
Type III or Type IV	12	29%
Total	41	100%

Table 4-3: Future ISTS for All Properties

ISTS Type	Number	Percentage
Type I	18	12%
Type II	84	57%
Type III or Type IV	46	31%
Total	148	100%

Of the 148 evaluated properties, only 18 properties (12%) have adequate area for a standard Type I ISTS, while 130 (88%) do not. Those 130 properties would likely be served by a Type II holding tank or a Type III or Type IV ISTS. Of the 41 likely noncompliant properties, five (12%) have adequate area for a Type I ISTS while 36 (88%) do not.

To address the 84 likely future holding tanks, Private ISTS Alternative 1b has been developed that would remove the 84 holding tank ISTS. Wastewater generated from these 84 properties (Figure 5) would be treated by a community cluster SSTS consisting of a collection and treatment system. The estimated design flow from the 84 holding tank properties is 17,400 gpd, classifying the system as an LSTS. The closest potential treatment site would be just south of the service area as described in Section 4.1.2.2. The selected collection system would be the same as described 4.1.2.1. The treatment system would include primary, secondary, and tertiary treatment prior to being dispersed to a mound soil dispersal system, like that described in 4.1.2.2. Based on the estimated design flow, soil loading rates, and LSTS sizing requirements, a minimum 2,175 lineal feet of mound would be required. For this alternative, the remaining 64 properties would be served by Type I, Type III, or Type IV ISTS, as summarized in Table 4-3.



4.1.1.2 Private ISTS Summary

The following points summarize the private ISTS alternative:

- Advantages:
 - Alternative 1a:
 - Construction, operation, and maintenance costs are based on need and strictly dependent upon the individual property. The community does not share overall costs.
 - Less overall capital costs when compared to a community system.
 - Local groundwater recharge
 - Alternative 1b:
 - Low-interest rate loans and grant programs available for design and construction costs for the community cluster LSTS.
 - Allows for more usable land area on properties served by community cluster LSTS excluding holding tanks.
 - Routine operation and maintenance activities completed by a certified Service Provider/Operator for the community cluster LSTS without holding tanks.
 - Local groundwater recharge
- Disadvantages:
 - Alternative 1a:
 - Less freedom on yard usage.
 - Individuals may choose to forgo proper operation and maintenance practices leading to poor ISTS performance, failure, or an imminent threat to public health.
 - Potential lower property values when compared to a community cluster LSTS.
 - Grant funding is not available to reduce capital costs for the ISTS only option.
 - Alternative 1b:
 - Land acquisition in close proximity can be difficult for the community cluster LSTS. Currently, there is no agreement or discussion with landowners.
 - High estimated construction cost for the community cluster LSTS serving the holding tank properties, making grant programs a requirement for affordability.

4.1.2 Alternative 2: Community Cluster LSTS

The community cluster system alternative would include collection, treatment, and an above-grade mound soil dispersal system. Due to the estimated design wastewater flow, the cluster system would be considered a LSTS and permitted by the MPCA. The following section evaluates a community cluster LSTS to serve the Project.

4.1.2.1 Collection System

Four common collection systems are available to convey wastewater which include the following:



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- Conventional gravity
 - A conventional gravity collection system includes a building sewer on each property that conveys raw sewage to a large diameter (\geq 8-inch diameter) sewer main. Manholes are required every 400 feet or major directional change along the sewer route and lift stations may be needed depending upon topography.
- Septic tank effluent gravity (STEG)
 - STEG systems include a septic tank on each property from which settled wastewater or effluent flows into common small diameter gravity piping.
- Septic tank effluent pump (STEP)
 - STEP systems include a septic tank on each property from which effluent is pumped into a common small diameter pressure forcemain.
- Grinder pump low pressure sewer
 - Grinder pump collection systems include a pump basin on each property. A grinder pump macerates raw sewage and discharges into common small diameter pressure forcemain. See Appendix D for a grinder station detail.

Based on topography, lot size, reduced land disturbance, and construction costs, the grinder pump low pressure sewer collection system would be the most feasible and cost-effective to serve the Project area.

A grinder pump low pressure sewer system utilizes grinder pumps at each home. Grinder pumps work collectively to convey sewage to the treatment site. A small footprint is required at each connection, as the grinder pump is housed in a cylindrical 24-inch diameter vault. These systems require electrical power, air release valves, cleanouts, and large tanks at a centralized treatment location for primary solids settling to occur.

Utilizing a pressurized grinder system significantly reduces potential inflow and infiltration (I/I) into the collection system. Flexible high-density polyethylene (HDPE) piping is installed using directional drilling equipment instead of open cut excavation, which leads to less clearing, grubbing, and overall site disturbance. Sewage flows full and under pressure in the forcemain. Therefore, piping does not have to maintain a constant grade and can follow topography. Because the piping remains full, it must maintain proper bury depth and incorporate insulation where needed for frost protection.

Operation and maintenance tasks include performing routine system inspections and responding to emergency situations. Such circumstances include broken or obstructed pressure mains, power outages, or pump failures. Also, the centralized settling tank(s) would accumulate solids over time and require monitoring and periodic pumping.

The design of a pressure collection system incorporates calculations of inline pressures and flow velocity that will be encountered compared to the number of pumps running simultaneously. The flow velocity must be maintained at or above two feet per second to ensure proper solids scouring within the piping.

An advantage of using grinder stations is that they do not require a septic tank on the property. Therefore, they require less area for construction and site disturbance is minimized. Grinder stations are typically installed using smaller construction equipment which is important on small lots with space constraints due



to structures, trees, or other physical impediments. A well-maintained grinder pump could last 15 to 25 years depending on proper care, use, and regular inspections.

4.1.2.2 Wastewater Treatment System

The wastewater treatment system would provide primary, secondary, and tertiary treatment prior to being dispersed to the soil. The system would include pretreatment components designed to treat wastewater constituents and in particular, total nitrogen to less than 10 mg/L end-of-pipe, as would be required by the MPCA SDS permit.

A treatment site has not been selected as land was not available to be evaluated during fieldwork. However, a potential treatment location along Big Kandi Drive is shown on Figure 6. The site appears to have suitable topography and soils and is within a reasonable distance from the project area. This location is shown for conceptual purposes to illustrate the scale of land purchase needs for a cluster system. The owner has not been contacted and it is unknown if the land would be available. If a community cluster LSTS is selected, this area would need to be further evaluated to ensure the site and soil can accommodate the system.

According to the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey, soils within this area primarily include the Amiret, Swanlake, Normania, Canisteo, and Harps loams featuring moderately structured clay loam and loam extending to massive loam with depth. USDA NRCS soil series descriptions can be found in Appendix E. These soils are very deep, moderately-well to poorly-drained, and formed on glacial till plains and moraines. Periodically saturated soils are predominant with seasonally high groundwater occurring approximately 18 – 24 inches below the ground surface. Based on the desktop analysis, these soils could accommodate an above-grade soil dispersal system that would maintain a minimum vertical separation to seasonally high groundwater of 36-inches.

The grinder pump low presser sewer collection system would convey raw sewage to the treatment site which would include buried precast concrete tanks, aerobic treatment units (ATU), a denitrification unit, dose tank, pumps, controls, a mound soil dispersal system, and other associated appurtenances. A small control building would be located adjacent to the treatment tanks that would house the control panel, electrical distribution panel, carbon source chemical feed equipment, blowers, and be equipped with a generator for backup power. A gravel drive would provide access and the entire site would include perimeter fencing.

Per LSTS requirements, the mound soil dispersal system would be designed to accommodate 150% of the design flow and an additional 50% reserve area would be set aside for potential future mound replacement use. The proposed mound soil loading rate, rock bed loading rate, and contour loading rate are 0.6 gpd/ft², 1.2 gpd/ft², and 12 gpd/ft, respectively. These values may vary based on a full site assessment and soil investigation.

Based on these loading rates, 3,525 lineal feet of mound would be required. It is envisioned 16 mound cells would be constructed. The actual number of cells and dimensions would vary depending upon actual site characteristics. Figure 6 shows the treatment site location but does not represent a final design or imply landowner consent to sell the property. The estimated treatment site area shown is 20 acres.



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Each mound cell would receive treated effluent on a timed basis from a dedicated pump within the dose tank. The pumps would alternate throughout the day and the total number of doses to the mound system would depend upon the actual wastewater flow volume. Effluent would be distributed evenly within the rock bed via pressure laterals that would infiltrate vertically through the bed and into the clean mound sand. Once through the sand, treated effluent would infiltrate into the native soil.

An automated control panel would govern system operations and be equipped with remote telemetry. This feature would allow real-time remote access to detailed operations data, the ability for the operator to change setpoint values, and alarm condition notification.

The community cluster LSTS requires routine operation and maintenance responsibilities. Typical tasks include monitoring and logging wastewater flows, inspecting pumps and blowers, inspecting grinder stations, field flushing pressure distribution laterals, rotating mound cells, checking treatment tanks for solids accumulation, sampling, reporting, and monitoring treatment processes. Accumulated tank solids would be pumped periodically, as required by the MPCA, and hauled to an approved facility for disposal.

Construction, operation, and maintenance costs for the cluster LSTS would be assessed equally across the service area. See Section 5 for a cost analysis.

4.1.2.3 Community Cluster LSTS Summary

The following points summarize the community cluster LSTS alternative:

- Advantages:
 - Low-interest rate loans and grant programs available for design and construction costs.
 - Potential property value increase compared to private ISTS.
 - Allows for more usable land area on properties.
 - Routine operation and maintenance activities completed by a certified Service Provider/Operator.
 - Local groundwater recharge.
- Disadvantages:
 - Land acquisition in close proximity can be difficult. Currently, there is no agreement or discussion with landowners.
 - Highest estimated construction cost making grant programs a requirement for affordability.
 - High operation, maintenance, and replacement costs.
 - Potential local opposition.

4.1.3 Alternative 3: Regionalization to Lake Lillian

Regionalization refers to the conveyance of one entity's wastewater to an existing WWTF.

Regionalization may be advantageous for both parties as there would be an economy of scale to treat the wastewater. If the existing treatment facility has capacity, the cost to treat a gallon of wastewater



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decreases as additional users are included. Collection and conveyance construction costs to transport the raw wastewater is the primary component with no treatment system construction costs.

Prior to analyzing the regionalization alternative, Lake Lillian was contacted to explore if regionalization is feasible. The superintendent of Public Works brought the concept to the City Council who decided to ask their Engineer if the existing WWTF has sufficient capacity to accommodate the added flow. Stantec repeatedly reached out to the superintendent to inquire what was determined by the Engineer. However, after many attempts, no response was provided to Stantec. It is recommended the alternative be analyzed and if regionalization is selected, additional effort would be needed to determine if connecting the Project is viable. The WWTF must be analyzed if it has sufficient capacity to accommodate the added flow. The Lake Lillian WWTF consists of a two-celled stabilization pond system located southeasterly of the city. Final treated effluent is discharged to the South Fork Crow River.

Regionalization would serve all 148 properties within the Project and provide opportunity for connecting properties along the forcemain route. Raw wastewater would be conveyed from the Project dwellings via grinder pump stations to a main duplex lift station located along Big Kandi Drive. From the lift station, raw sewage would be pumped within HDPE forcemain installed within roadway right-of-way to a Lake Lillian manhole, and ultimately to the Lake Lillian WWTF. The manhole is located at the intersection of County Road 8 SE and Oakdale Avenue (Figure 7). This location was selected based on aerial photography and was not discussed with Lake Lillian; the actual connection point would need to be approved.

All operation, maintenance, and repairs on the collection system would be completed by a certified Service Provider/Operator contracted by the District.

4.1.3.1 Regionalization to Lake Lillian Summary

The following points summarize the regionalization to Lake Lillian alternative:

- Advantages:
 - Low-interest rate loans and grant programs available for design and construction costs.
 - Allows for more usable land area on properties.
 - Reliable wastewater treatment.
 - No land acquisition required.
 - No new state discharge permit required.
 - Allows for future growth on nearby vacant property, if amenable to Lake Lillian.
 - Limited operation and maintenance activities.
 - Low construction disturbance and restoration.
- Disadvantages:
 - Additional effort is needed to ascertain if regionalization is viable.
 - Long conveyance distance and low flows can lead to corrosion and odor concerns.
 - Complexities with setting up a user agreement between the District and Lake Lillian.



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- The District would not be managing its own wastewater treatment facility, only collection and conveyance to Lake Lillian, and therefore would be dependent upon and subject to conditions required by Lake Lillian.



5.0 OPINION OF PROBABLE COST ANALYSIS

Several alternatives have been evaluated to improve existing wastewater infrastructure within the Project including private ISTS replacement, private ISTS excluding holding tanks (84 holding tank properties served by a community cluster LSTS), community cluster LSTS, and regionalization to Lake Lillian. The following section includes an opinion of probable cost analysis of these alternatives including capital, operation, maintenance, and replacement (OM&R) costs. A 20-year present worth and financing analysis have also been completed.

5.1 OPINION OF PROBABLE COST ESTIMATE

Table 5-1 provides estimated construction costs to replace ISTS within the Project. The replacement ISTS would include Type 1 mounds, Type 2 holding tanks, and Type 3 or 4 systems.

Table 5-1: Private ISTS Opinion of Probable Cost Estimate

New ISTS Type	Number	Estimated Cost per ISTS	Estimated Construction Cost
Type I	18	\$30,000	\$540,000
Type II	84	\$7,500	\$630,000
Type III or Type IV	46	\$35,000	\$1,610,000
Construction Cost Subtotal			\$2,780,000
Contingency			\$278,000
Total Estimated Construction Cost			\$3,058,000
Estimated Construction Cost per Connection			\$20,700

Table 5-2 provides estimated construction costs to replace all future likely holding tanks with a community cluster LSTS. The remaining 64 properties within the Project would be served by replacement ISTS including Type I mounds and Type III or IV systems. Note, the estimated community cluster LSTS construction costs do not include reductions from potential grant funding programs.

The community cluster system includes a grinder pump low pressure sewer collection system and a LSTS consisting of primary, secondary, and tertiary treatment prior to being dispersed to a mound soil dispersal system. See Appendix F for a detailed cost estimate.



Table 5-2: Private ISTS Opinion of Probable Cost Estimate Excluding Holding Tanks

New ISTS Type	Number	Estimated Cost per ISTS	Estimated Construction Cost
Type I Mound	18	\$30,000	\$540,000
Type III or Type IV	46	\$35,000	\$1,610,000
Cluster LSTS	84	N/A	\$7,303,000
Construction Cost Subtotal			\$9,453,000
Contingency			\$945,300
Engineering Services (Cluster LSTS)			\$1,315,000
Legal & Administrative (Cluster LSTS)			\$74,000
Total Estimated Construction Cost			\$11,787,300
Estimated Construction Cost per Connection			\$79,700

Table 5-3 summarizes estimated construction costs for a community cluster LSTS to serve the Project area. Note, these estimated construction costs do not include reductions from potential grant funding programs. The community cluster system includes a grinder pump low pressure sewer collection system and LSTS consisting of primary, secondary, and tertiary treatment prior to being dispersed to a mound soil dispersal system. See Appendix F for a detailed cost estimate.

Table 5-3: Community Cluster LSTS Opinion of Probable Construction Cost Estimate

Collection System	Treatment System	Contingency	Engineering Services	Legal & Admin.	Total Estimated Construction Cost	Estimated Construction Cost per Connection
\$6,155,000	\$4,822,000	\$1,098,000	\$1,976,000	\$110,000	\$14,161,000	\$95,700

Table 5-4 summarizes estimated construction costs for regionalization to the Lake Lillian WWTF. Note, these estimated construction costs do not include reductions from potential grant funding programs. This alternative would include a grinder pump low pressure sewer with a lift station conveying wastewater to a Lake Lillian manhole located at the intersection of County Road 8 SE and Oakdale Avenue. See Appendix F for a detailed cost estimate.

Table 5-4: Regionalization to Lake Lillian Probable Construction Cost Estimate

Collection System	Treatment System	Contingency	Engineering Services	Legal & Admin.	Total Estimated Construction Cost	Estimated Construction Cost per Connection
\$7,468,000	N/A	\$747,000	\$1,345,000	\$75,000	\$9,635,000	\$65,100



5.2 OPERATION, MAINTENANCE, AND REPLACEMENT COSTS

When comparing wastewater treatment alternatives, OM&R costs must be included in the evaluation. Annual OM&R for ISTS vary greatly depending on type. Holding tanks have the highest OM&R costs due to pumping, which can be thousands per year depending upon water usage. Type I and Type III or IV ISTS would have much less OM&R costs than holding tanks and have been estimated at approximately \$400 and \$1,000 per year, respectively. Replacement costs are for short-lived assets such as pumps, blowers, and controls. Each replacement cost is calculated based on the component cost spread over its estimated life.

For purposes of this study, it was assumed that dwellings served by holding tanks would generate one-third of their respective design wastewater flow, and seasonal properties would occupy the dwelling for 60 days during the summer months. Also, for Alternative 1b, Alternative 2, and Alternative 3, it was assumed that three-quarters and one-quarter of the established design wastewater flow would be generated from the properties during the summer and winter months, respectively. The winter wastewater flow estimate was chosen because only 38 properties are year-round, based on property tax parcel data records.

Table 5-5 provides estimated annual OM&R costs for each alternative with total costs shared by all 148 connections. Annual OM&R costs for Alternative 1a was the highest due to holding tank pumping costs. Annual OM&R costs for Alternative 1b and Alternative 2 included costs associated with electricity to operate pumps and blowers, equipment replacement fund, Service Provider/Operator fees, laboratory costs, and chemical costs for the community cluster LSTS. Annual OM&R for Alternative 3 was the lowest.

Table 5-5: Estimated Annual Operation, Maintenance, & Replacement Costs

	Alternative 1a: Private ISTS	Alternative 1b: Private ISTS Excluding Holding Tanks	Alternative 2: Community Cluster LSTS	Alternative 3: Regionalization to Lake Lillian
Total Annual OM&R Costs	\$296,680	\$168,600*	\$137,400	\$124,300
Estimated Annual OM&R Costs per Connection	\$2,005	\$1,140	\$930	\$840
Estimated Monthly OM&R Costs per Connection	\$168	\$95	\$78	\$70

*Includes \$63,400/year for the 64 ISTS on private properties and \$105,200/year for the 84-dwelling community cluster LSTS.

5.3 PRESENT WORTH ANALYSIS

A present worth analysis allows the direct comparison of alternatives by converting future costs into present-day dollar amounts. Future expenditures on capital replacement, operations, and maintenance are converted by using financial calculation formulas, an assumed 20-year timeframe, and a discount rate. The discount rate is generally described as the difference between the available rate of return on an investment and the average inflation rate. A discount rate of 0.5% was utilized in the analysis. After converting future expenditures into a present worth value, these costs were added to estimated capital construction costs and used in alternative comparison.



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Annual costs for each alternative include OM&R and debt service on loans taken out for construction. Capital construction costs not covered by grant funding would be paid for by a low-interest loan available through the PFA. Each connection would be responsible for their equal share of the debt service, which would be included on annual property tax statements. If desired, the property owner could pay their share as a lump sum to avoid interest charges.

Table 5-6 summarizes the present worth and financing analysis. For Alternative 1b (community cluster LSTS), Alternative 2, and Alternative 3, it was assumed the project would obtain an 80% grant from the PFA. The alternatives could pursue funding through the Small Community Wastewater Treatment Program, Point Source Implementation Grant Program, and/or the Water Infrastructure Fund. The remaining costs would be covered by a 20-year, 1.9% loan (current rate per PFA). Grant eligibility is based on affordability, total project construction costs, project priority list (PPL) ranking, funding reserves, median household income, and other factors. Note, it is not certain the project would receive a grant but based on experience, there is opportunity. To equally compare the alternatives, it was assumed private ISTS would be covered by loans of the same length and interest rate by the property owners.

Table 5-6: Present Worth and Financing Analysis

	Alternative 1a: Private ISTS	Alternative 1b: Private ISTS Excluding Holding Tanks	Alternative 2: Community Cluster LSTS	Alternative 3: Regionalization to Lake Lillian
Present Worth Analysis				
Total Estimated Probable Construction Cost	\$3,058,000	\$11,788,000	\$14,161,000	\$9,635,000
Grant Funding Reduction to Capital Construction Cost	\$0	\$7,538,400	\$11,328,800	\$7,708,000
Final Total Estimated Probable Construction Cost	\$3,058,000	\$4,249,600	\$2,832,200	\$1,927,000
Final Total Estimated Probable Construction Cost per Connection	\$20,660	\$28,710	\$19,140	\$13,020
Annual OM&R Present Worth	\$5,634,000	\$3,202,000	\$2,609,000	\$2,361,000
Total Estimated Present Worth	\$8,692,000	\$7,451,600	\$5,441,200	\$4,288,000
Financing Analysis				
Estimated Loan Amount	\$3,058,000	\$4,249,600	\$2,832,200	\$1,927,000
Annual Loan Payment (20-year, 1.9% Interest)	\$185,300	\$257,400	\$171,600	\$116,800
Annual OM&R Costs	\$296,680	\$168,600	\$137,400	\$124,300
Total Estimated Annual Costs (OM&R and Loan Payment)	\$481,980	\$426,000	\$309,000	\$241,100
Estimated Annual Costs per Connection	\$3,260	\$2,880	\$2,090	\$1,630
Estimated Monthly Costs per Connection	\$272	\$240	\$174	\$136



6.0 SUMMARY AND RECOMMENDATIONS

The CAR investigation estimated the likely compliance status for existing ISTS in the Project and provides a direct comparison of alternatives for long-term wastewater treatment infrastructure. The following is a summary of findings:

- The majority of existing ISTS (51%) are greater than 20 years old or of unknown age.
- One hundred five of 148 properties (71%) likely have a compliant ISTS.
- Likely future ISTS to serve the properties include 18 Type I (12%), 84 Type II (57%) and 46 Type III or Type IV (31%).
- The alternatives evaluated for long-term wastewater treatment infrastructure include Alternative 1a: Private ISTS, Alternative 1b: Private ISTS Excluding Holding Tanks, Alternative 2: Community Cluster LSTS, Alternative 3: Regionalization to Lake Lillian.
- Estimated opinion of probable construction costs for the alternatives are:
 - Alternative 1a: \$3,058,000 (\$20,700 per connection)
 - Alternative 1b (before grant funding reduction): \$11,788,000 (\$79,700 per connection)
 - Alternative 1b (after grant funding reduction): \$4,249,600 (\$28,700 per connection)
 - Alternative 2 (before grant funding reduction): \$14,161,000 (\$95,700 per connection)
 - Alternative 2 (after grant funding reduction): \$2,832,200 (\$19,150 per connection)
 - Alternative 3 (before grant funding reduction): \$9,635,000 (\$65,100 per connection)
 - Alternative 3 (after grant funding reduction): \$1,927,000 (\$13,050 per connection)
- Estimated present worth values for the alternatives are:
 - Alternative 1a: \$8,692,000
 - Alternative 1b: \$7,451,600
 - Alternative 2: \$5,441,200
 - Alternative 3: \$4,288,000
- Estimated annual costs per connection including potential grant funding, low-interest loan principal forgiveness, and OM&R costs for the alternatives are:
 - Alternative 1a: \$3,260 (\$272 per month)
 - Alternative 1b: \$2,880 (\$240 per month)
 - Alternative 2: \$2,090 (\$174 per month)
 - Alternative 3: \$1,630 (\$136 per month)

6.1 RECOMMENDATIONS

This CAR provides information that will assist in making informed decisions on the next steps to take as alternatives are reviewed. It is our recommendation that the following be considered:

- If project stakeholders value the lowest capital cost (without grant funding reduction), existing dwellings would continue using private ISTS and ISTS should be upgraded.
- If project stakeholders desire a community solution, then regionalization to Lake Lillian should be pursued.
- If project stakeholders do not desire regionalization but want a community solution, then the community cluster LSTS should be pursued. Further considerations for this alternative include:
 - Explore construction financing grant opportunities. Work with PFA and Stantec for assistance.



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- Explore the creation of a subordinate service district which would allow Kandiyohi County a means to effectively provide and finance wastewater services for the Project.
- Investigate the opportunity of acquiring land (Parcel ID: 16-035-0030) for the LSTS at the location shown on Figure 6.

6.2 NEXT STEPS

Kandiyohi County will continue to enforce MN Rules Chapter 7080 SSTS regulations and the county ordinance. Noncompliant ISTS will require upgrades and homeowners will be responsible for ensuring their ISTS remain in compliance.

The following actions should be taken by Project stakeholders based on selecting a community solution:

- Determine the desire of property owners within the Project area to pursue a community solution.
- If regionalization is desirable, continue discussion with Lake Lillian to determine feasibility and potential next steps.
 - Explore construction financing grant opportunities. Work with the PFA and Stantec for assistance.
- If a community cluster LSTS is desirable, explore construction financing grant opportunities, creation of a subordinate service district, and land acquisition as described in Section 6.1.



FIGURES

Figure 1: Project Area

Figure 2: Water Supply Well Locations

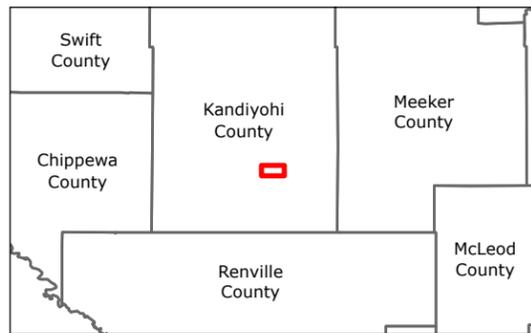
Figure 3: Likely ISTS Compliance Status

Figure 4: ISTS Age (as of 2023)

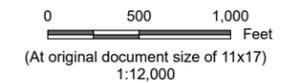
Figure 5: Likely Future ISTS for All Properties

Figure 6: Community Cluster LSTS Concept

Figure 7: Regionalization to Lake Lillian Concept



Legend
 Study Area Parcels



Project Location
 Fahln Twp., Kandiyohi Co., MN Prepared by ARH on 2024-05-16

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 Community Assessment Report

Figure No.

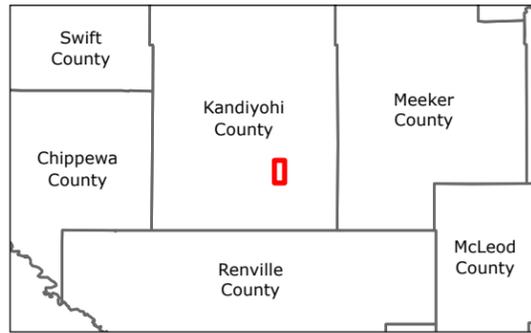
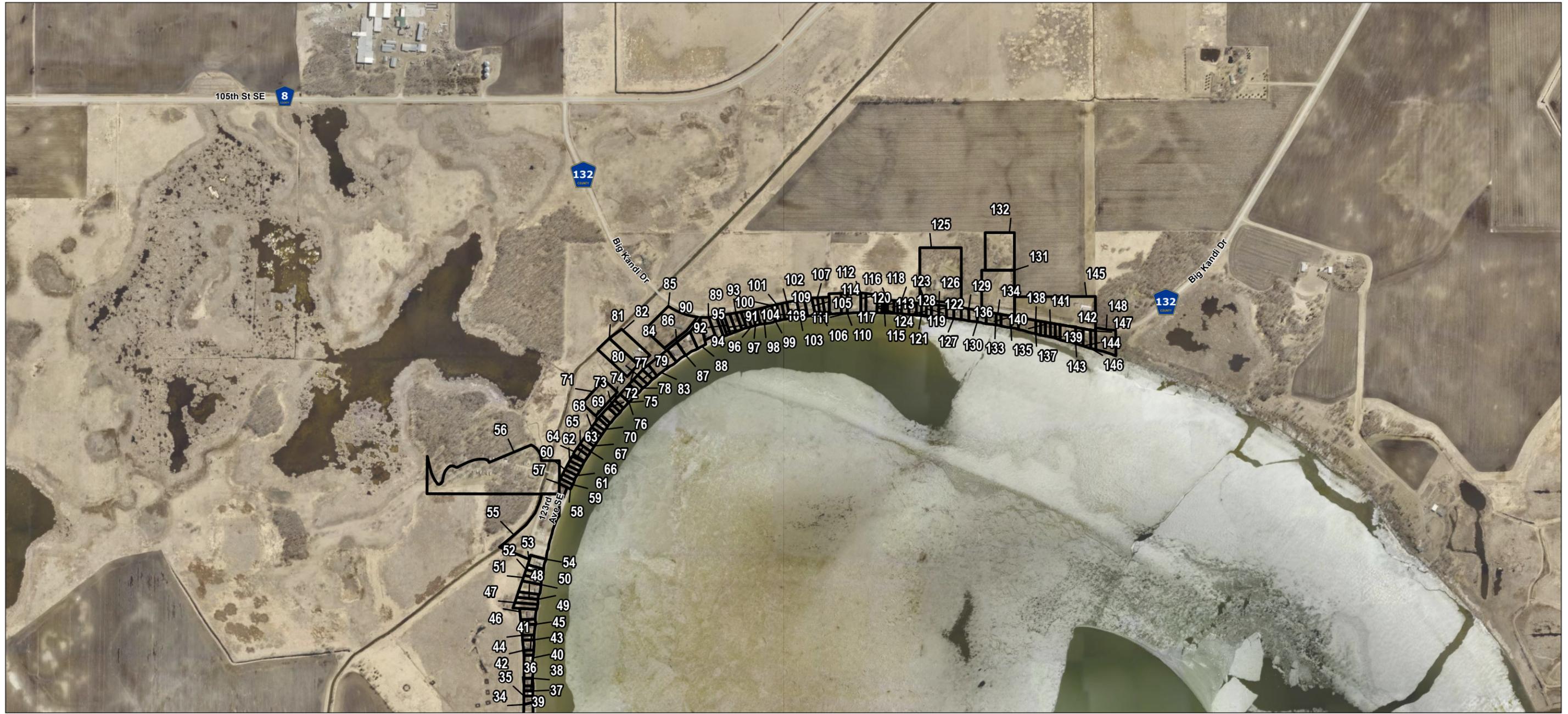
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Title

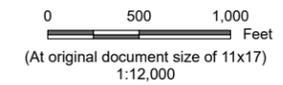
Project Area

Notes
 1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
 2. Data Sources: Kandiyohi Co., Stantec
 3. Background: 2022 Kandiyohi Co. Aerial

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Legend
 Study Area Parcels



Project Location
 Fahlan Twp., Kandiyohi Co., MN *Prepared by ARH on 2024-05-16*

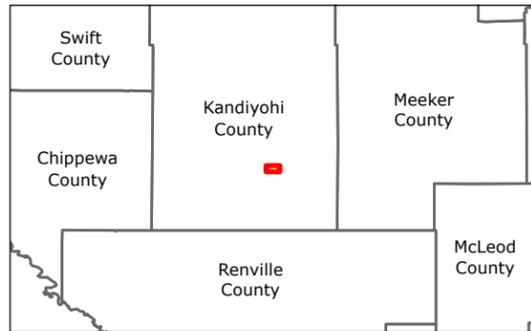
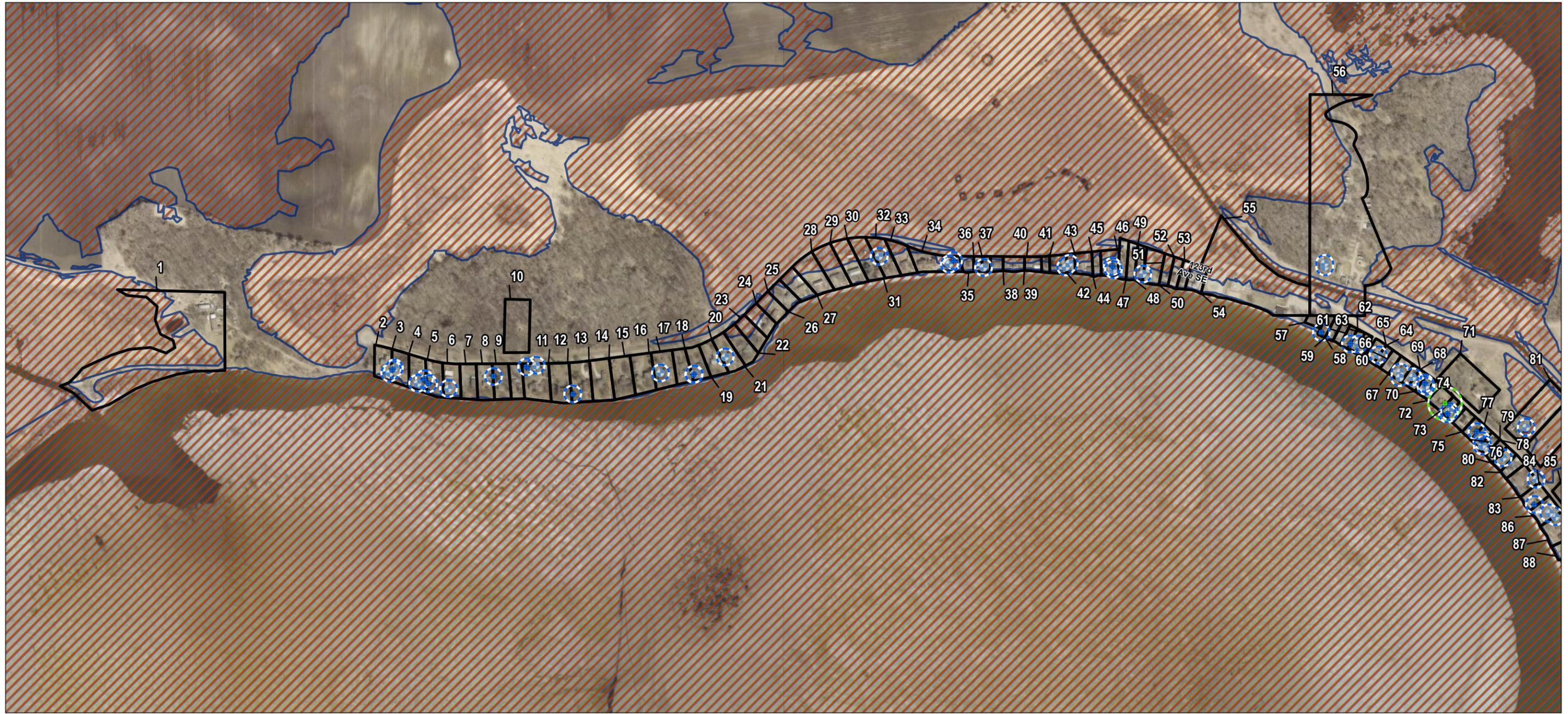
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Figure No.
1

Title
Project Area

Notes
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 2. Data Sources: Kandiyohi Co., Stantec
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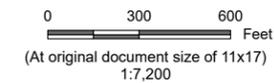
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Legend

-  Study Area Parcels
-  FEMA 1% Annual Floodplain
-  Deep Well*
-  Shallow Well*
-  County Well Index - Verified Well Location
-  Deep Well 50 ft Setback Buffer
-  Shallow Well 100 ft Setback Buffer

*Water supply wells only located on parcels that granted permission to access the property



Project Location
Fahlun Twp., Kandiyohi Co., MN

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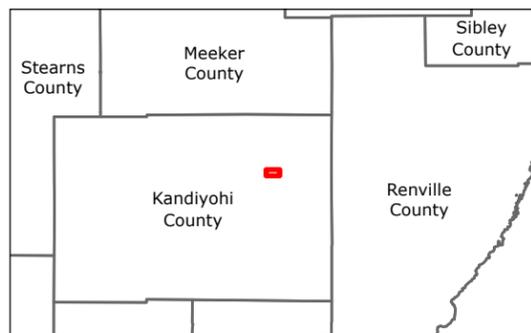
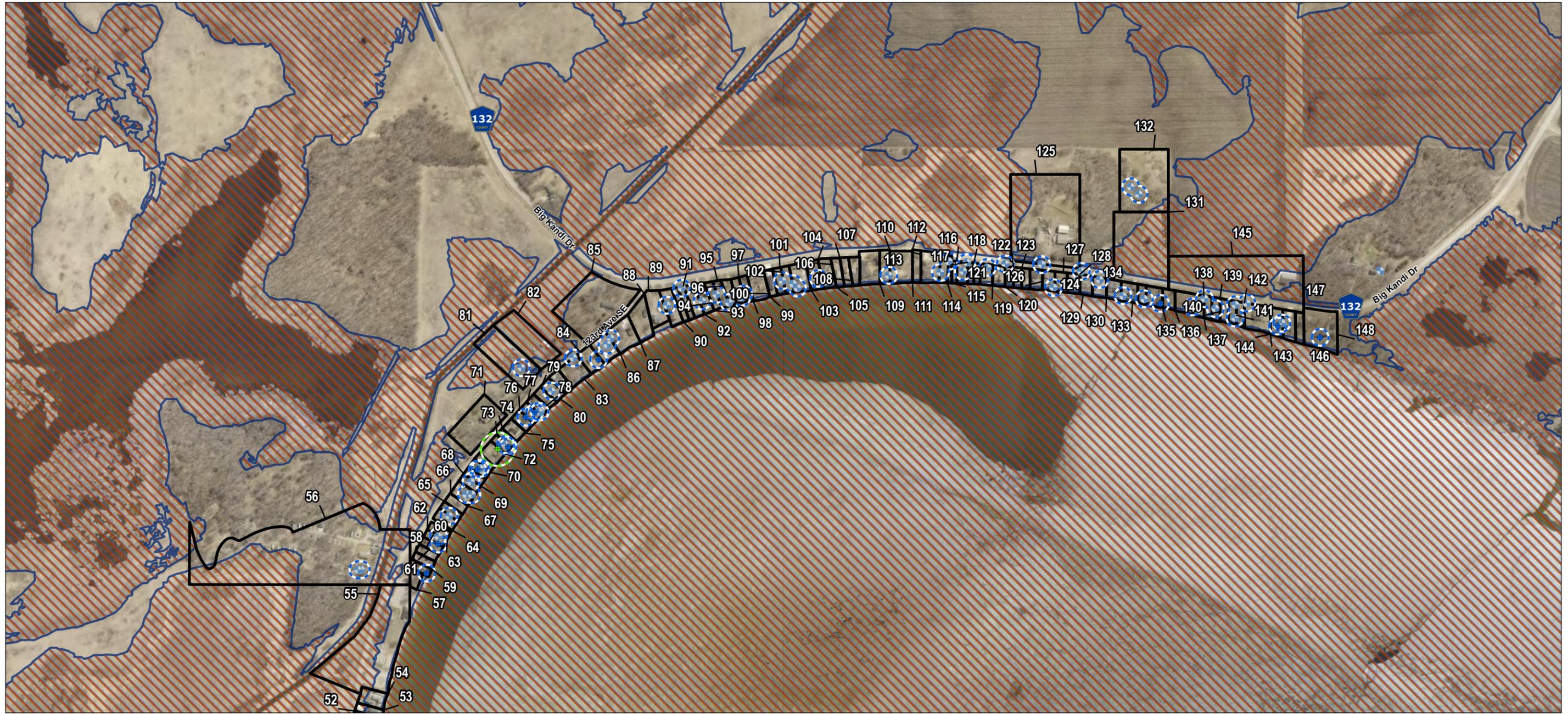
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Figure No.

2a

Title

**Water Supply Well Locations with FEMA
1% Annual Floodplain**



- Legend**
- Study Area Parcels
 - FEMA 1% Annual Floodplain
 - County Well Index - Verified Well Location
 - Deep Well 50 ft Setback Buffer
 - Deep Well*
 - Shallow Well 100 ft Setback Buffer
 - Shallow Well*

*Water supply wells only located on parcels that granted permission to access the property



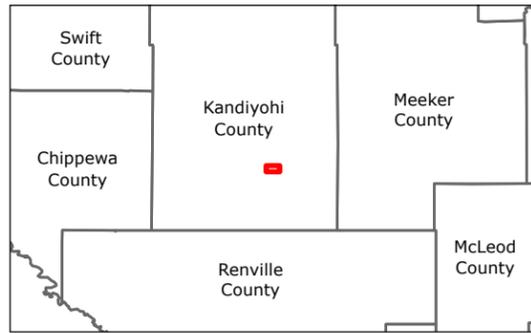
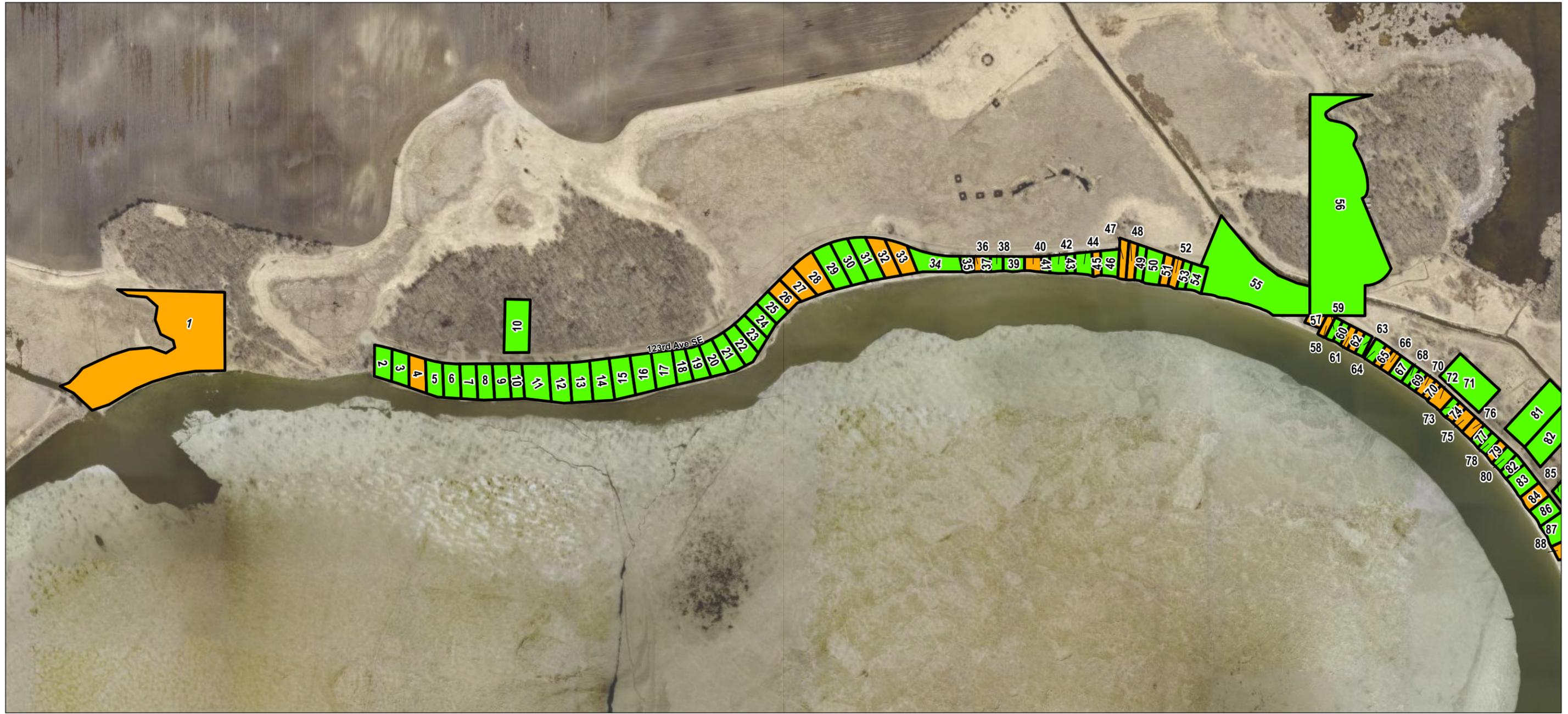
Project Location: Fahlun Twp., Kandiyohi Co., MN
Prepared by ARH on 2024-05-16

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Community Assessment Report
227705807

Figure No. **2b**

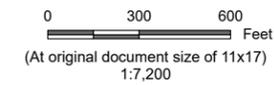
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Legend

- Study Area Parcels
- Likely ISTS Compliance Status**
- No System
- Compliant
- Failure to Protect Groundwater (FTPG)
- Imminent Threat to Public Health or Safety (ITPHS)



Project Location Fahlun Twp., Kandiyohi Co., MN *Prepared by* ARH on 2024-05-16

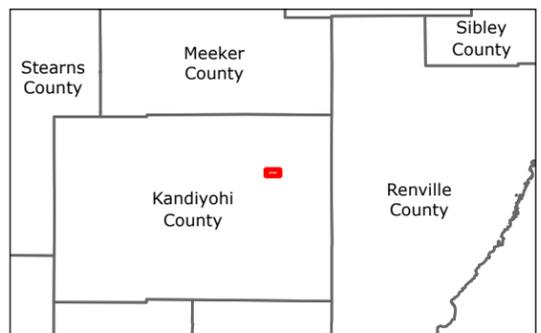
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 North/Northeast Big Kandiyohi Lake Community
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Figure No. **3a**

Title **Likely ISTS Compliance Status**

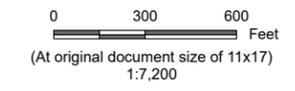
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 2. Data Sources: Kandiyohi Co., Stantec
 3. Background: 2022 Kandiyohi Co. Aerial

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Legend

- Study Area Parcels
- Likely ISTS Compliance Status**
- No System
- Compliant
- Failure to Protect Groundwater (FTPG)
- Imminent Threat to Public Health or Safety (ITPHS)



Project Location Fahln Twp., Kandiyohi Co., MN *Prepared by* ARH on 2024-05-16

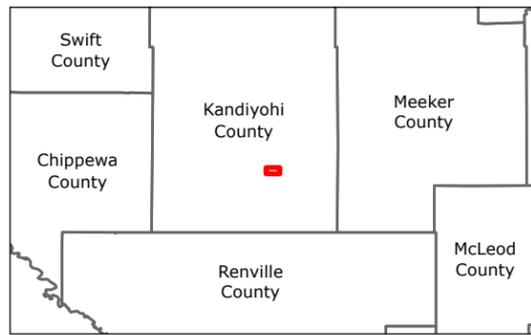
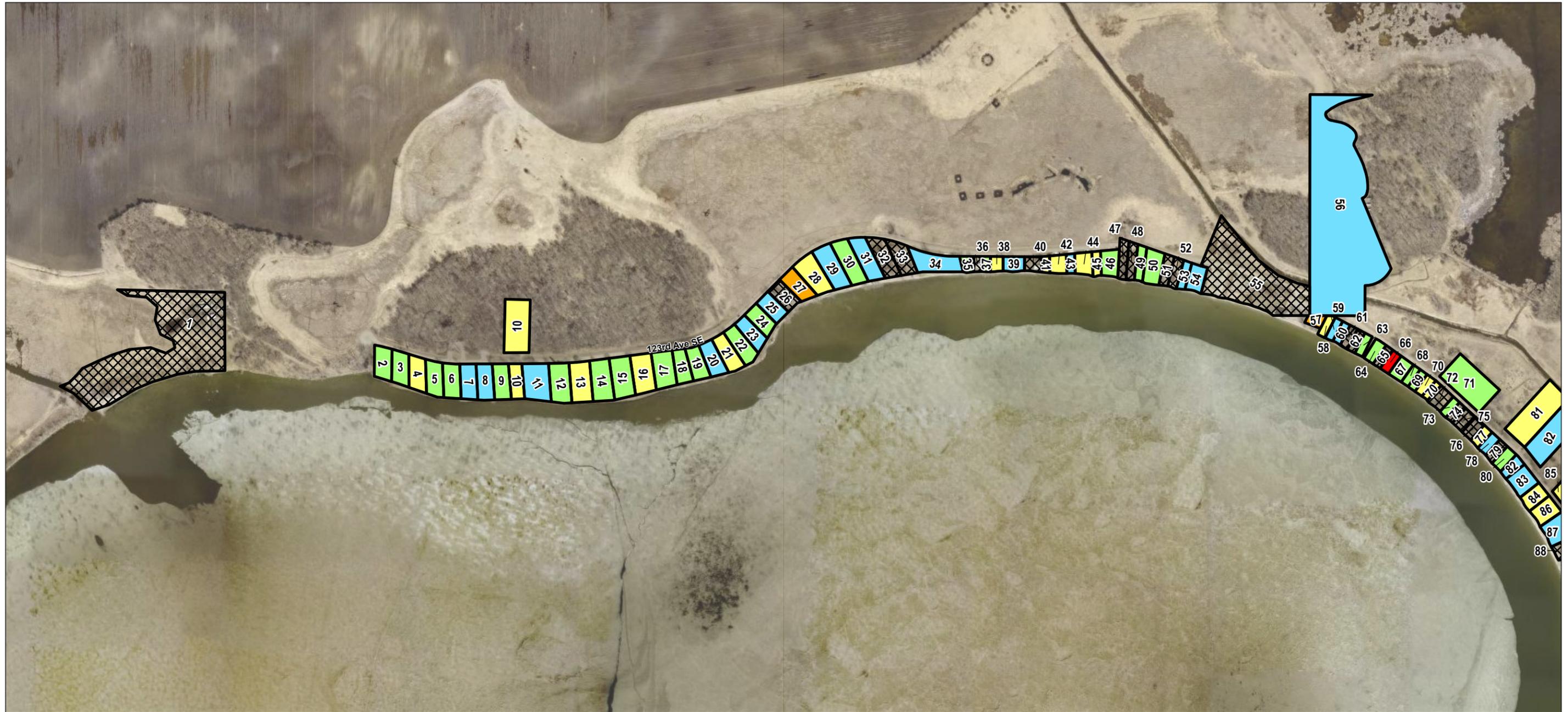
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Figure No. **3b**

Title
Likely ISTS Compliance Status

Notes
 1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
 2. Data Sources: Kandiyohi Co., Stantec
 3. Background: 2022 Kandiyohi Co. Aerial

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Legend
 Study Area
 Parcels

- SSTS Age**
- Unknown
 - <10 Years
 - 10-19 Years
 - 20-29 Years
 - 30-39 Years
 - 40+ Years
 - No System

0 300 600 Feet
 (At original document size of 11x17)
 1:7,200



Project Location Fahln Twp., Kandiyohi Co., MN *Prepared by* ARH on 2024-05-16

Client/Project Kandiyohi County, MN 227705807
 North/Northeast Big Kandiyohi Lake Community
 Community Assessment Report

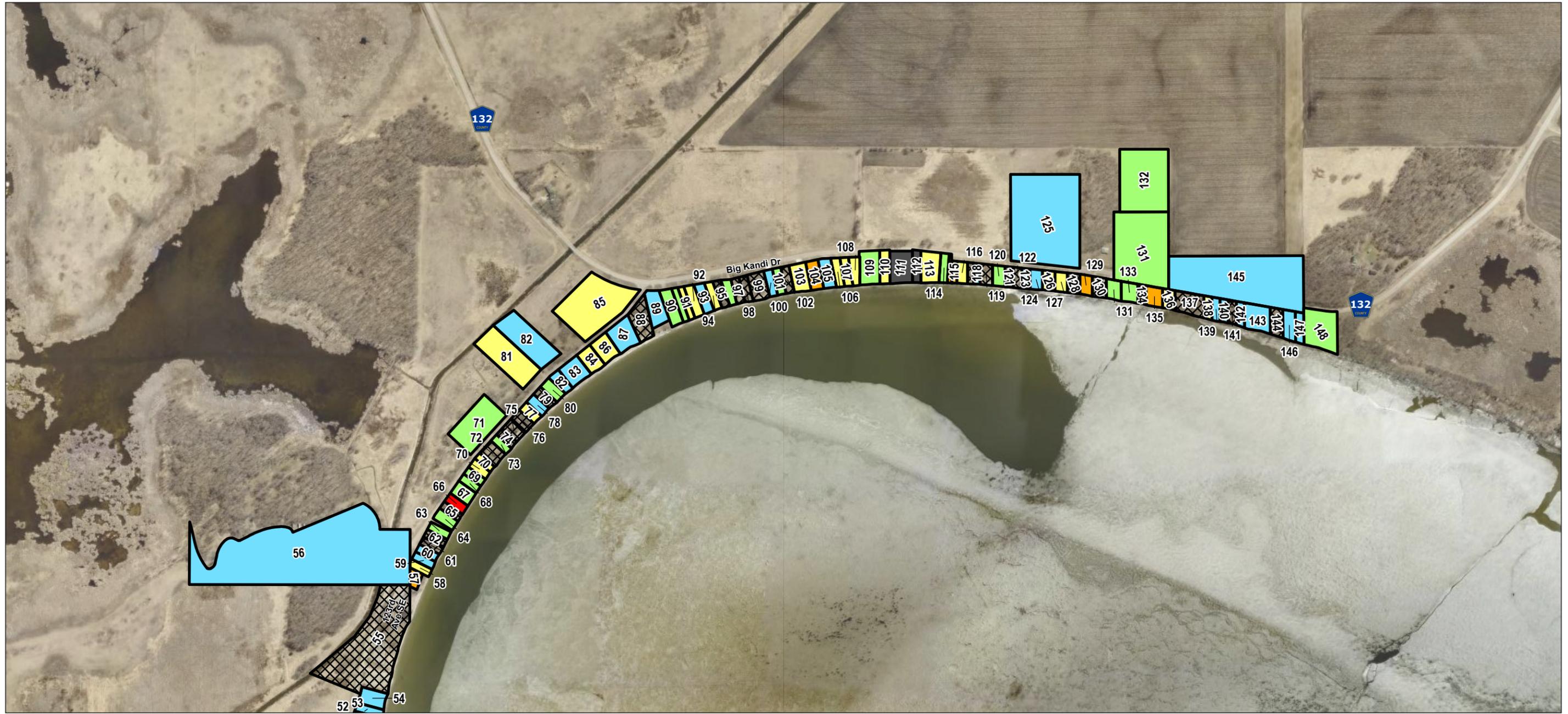
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4a

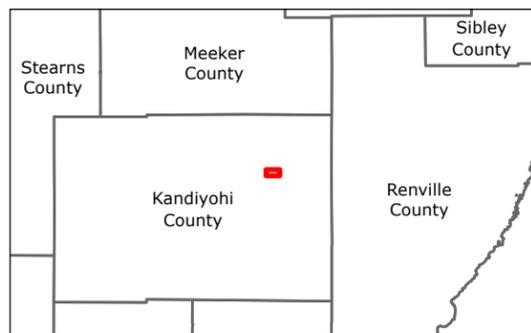
Title

ISTS Age (as of 2023)

Notes
 1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
 2. Data Sources: Kandiyohi Co., Stantec
 3. Background: 2022 Kandiyohi Co. Aerial

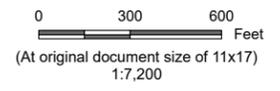


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Legend
 Study Area
 Parcels

- SSTS Age**
- Unknown
 - <10 Years
 - 10-19 Years
 - 20-29 Years
 - 30-39 Years
 - 40+ Years
 - No System



Project Location Prepared by ARH on 2024-05-16
 Fahlun Twp., Kandiyohi Co., MN

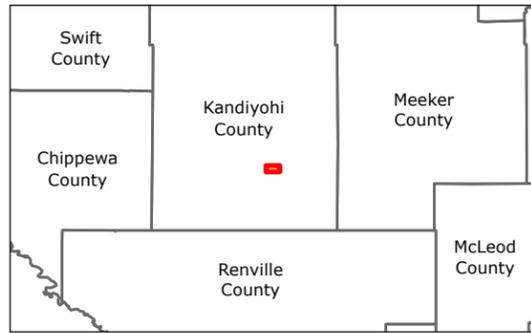
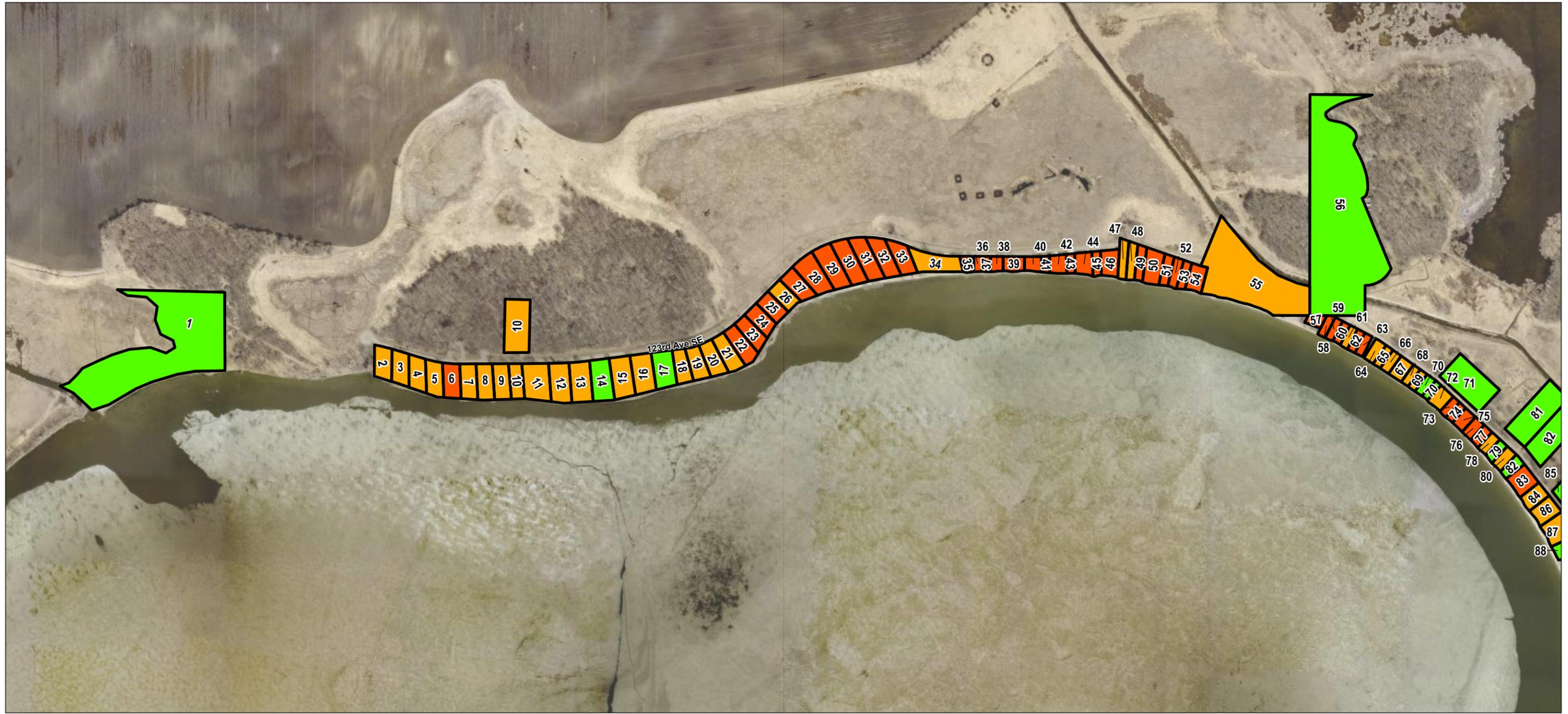
Client/Project 227705807
 Kandiyohi County, MN
 North/Northeast Big Kandiyohi Lake Community
 Community Assessment Report

Figure No.

4b

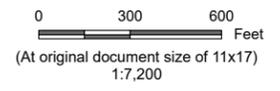
Title

ISTS Age (as of 2023)



Legend

- Study Area Parcels
- Likely Future ISTS**
- Type I
- Type II
- Type III/IV



Project Location Fahln Twp., Kandiyohi Co., MN *Prepared by* ARH on 2024-05-16

Client/Project Kandiyohi County, MN 227705807

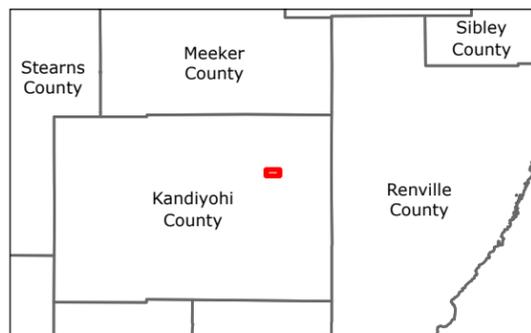
North/Northeast Big Kandiyohi Lake Community
Community Assessment Report

Figure No. **5a**

Title
Likely Future ISTS for All Properties

Notes
 1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
 2. Data Sources: Kandiyohi Co., Stantec
 3. Background: 2022 Kandiyohi Co. Aerial

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Legend

- Study Area Parcels
- Likely Future ISTS**
- Type I
- Type II
- Type III/IV



Project Location Fahln Twp., Kandiyohi Co., MN *Prepared by* ARH on 2024-05-16

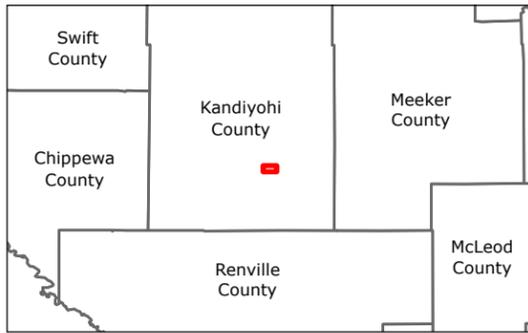
Client/Project Kandiyohi County, MN 227705807
 North/Northeast Big Kandiyohi Lake Community
 Community Assessment Report

Figure No. **5b**

Title
Likely Future ISTS for All Properties

Notes
 1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
 2. Data Sources: Kandiyohi Co., Stantec
 3. Background: 2022 Kandiyohi Co. Aerial

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- Legend**
- Study Area Parcels
 - Wastewater Treatment Site
 - Collection System Pressure Sewer Forcemain

0 300 600 Feet
 (At original document size of 11x17)
 1:7,200



Project Location Fahln Twp., Kandiyohi Co., MN *Prepared by* ARH on 2024-04-08

Client/Project Kandiyohi County, MN 227705807
 North/Northeast Big Kandiyohi Lake Community
 Community Assessment Report

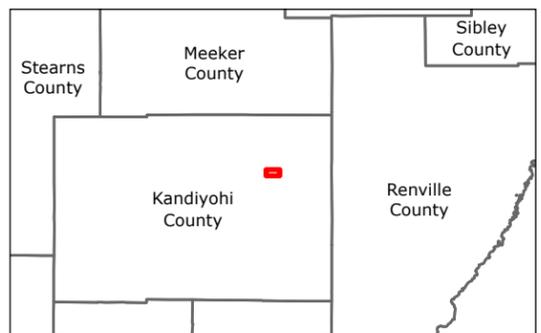
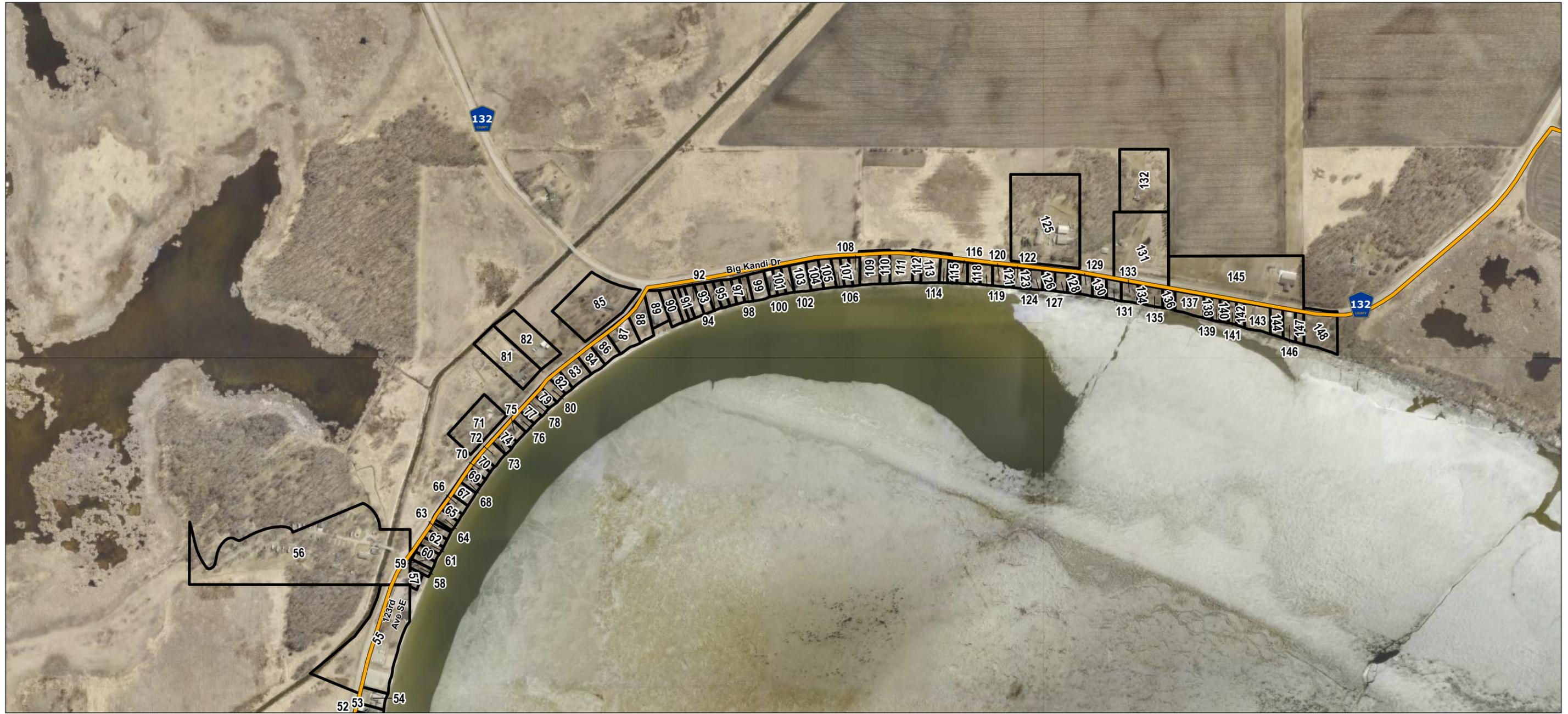
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6a

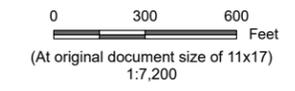
Title

Community Cluster LSTS Concept

- Notes**
1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
 2. Data Sources: Kandiyohi Co., Stantec
 3. Background: 2022 Kandiyohi Co. Aerial



- Legend**
- Study Area Parcels
 - Wastewater Treatment Site
 - Collection System Pressure Sewer Forcemain



Project Location Fahln Twp., Kandiyohi Co., MN *Prepared by ARH on 2024-04-08*

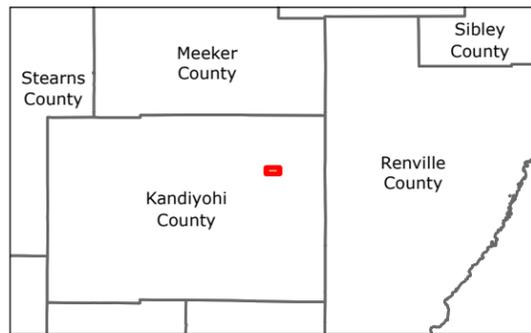
Client/Project Kandiyohi County, MN 227705807
 North/Northeast Big Kandiyohi Lake Community
 Community Assessment Report

Figure No. **6b**

Title **Community Cluster LSTS Concept**

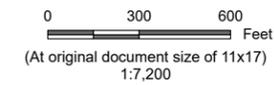
Notes
 1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
 2. Data Sources: Kandiyohi Co., Stantec
 3. Background: 2022 Kandiyohi Co. Aerial

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Legend

- Study Area Parcels
- Wastewater Treatment Site
- Collection System Pressure Sewer Forcemain



Project Location Fahlnun Twp., Kandiyohi Co., MN *Prepared by* ARH on 2024-04-08

Client/Project Kandiyohi County, MN 227705807
 North/Northeast Big Kandiyohi Lake Community
 Community Assessment Report

Figure No.

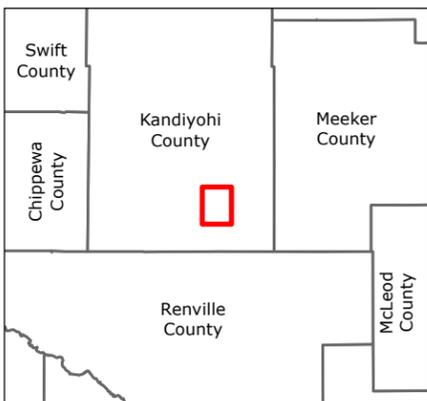
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Title

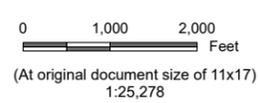
Community Cluster LSTS Concept

- Notes**
1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
 2. Data Sources: Kandiyohi Co., Stantec
 3. Background: 2022 Kandiyohi Co. Aerial

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- Legend**
- Study Area Parcels
 - Collection System Pressure Sewer Forcemain
 - LS Lift Station



Project Location
Fahln Twp., Kandiyohi Co., MN

Prepared by ARH on 2024-04-08

Client/Project
Kandiyohi County, MN
North/Northeast Big Kandiyohi Lake Community
Community Assessment Report

227705807

Figure No.

7

Title

Regionalization to Lake Lillian Concept

- Notes**
1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
 2. Data Sources: USGS
 3. Background: USGS 7.5 Minute Quadrangle

APPENDIX A

Parcel Data Spreadsheet

North/Northeast Big Kandiyohi Lake Community Assessment Report
Parcel Data Spreadsheet

CAR MAP ID#	Parcel ID	Address	Property Type: Commercial, Residential, or Other (No Dwelling or Vacant)	ISTS Information							Compliance Information					Likely Future ISTS			Estimated New ISTS Replacement Cost	Estimated Annual Operation, Maintenance, & Replacement Costs
				County Permit on File	Property Use	Year Installed	ISTS Age as of 2023	System Type	Number of Bedrooms	Estimated Design Flow	Likely Compliance status									
											Compliant (X if Yes)	Certificate of Compliance Date	Noncompliant							
													ITPHS (X if Yes)	Failure to Protect Groundwater (X if Yes)	VS = lack of vertical separation SD = surface discharge CP/DW = cesspool/drywell SA = safety threat (type of threat)	Type 1 (Standard Type & Size)	Type 2 (Holding Tank)	Type 3 or 4 (Poor Soils, Undersized, or Rip & Replace)		
1	16-028-0020	7811 123rd Ave SE	Residential	No	Yr-Rd	Unk	Unk	CP/DW	2	300				X	CP/DW	X			\$30,000	\$400
2	16-170-0010	8015 123rd Ave SE	Residential	7/15/2005	Yr-Rd	2005	18	Mound	3	450	X							X	\$35,000	\$1,000
3	16-170-0020	8025 123rd Ave SE	Residential	6/18/2012	Seasonal	2012	11	Holding Tank	2	300	X							X	\$35,000	\$1,000
4	16-170-0030	8039 123rd Ave SE	Residential	6/26/1996	Yr-Rd	1996	27	Trenches	3	450			X	VS				X	\$35,000	\$1,000
5	16-170-0040	8055 123rd Ave SE	Residential	10/12/2010	Seasonal	2010	13	Mound	3	450	X							X	\$35,000	\$1,000
6	16-170-0050	8079 123rd Ave SE	Residential	2/15/2012	Yr-Rd	2012	11	Holding Tank	2	300	X						X		\$7,500	\$7,230
7	16-170-0060	8091 123rd Ave SE	Residential	11/13/2017	Seasonal	2017	6	Mound	3	450	X							X	\$35,000	\$1,000
8	16-170-0070	8109 123rd Ave SE	Residential	8/5/2014	Seasonal	2014	9	Mound	2	300	X							X	\$35,000	\$1,000
9	16-170-0080	8121 123rd Ave SE	Residential	9/20/2013	Seasonal	2013	10	Mound	2	300	X							X	\$35,000	\$1,000
10	16-150-0110	8137 123rd Ave SE	Residential	6/25/1999	Seasonal	1999	24	Mound	3	450	X	2016						X	\$35,000	\$1,000
11	16-150-0090	8169 123rd Ave SE	Residential	9/1/2022	Yr-Rd	2022	1	Mound	3	450	X							X	\$35,000	\$1,000
12	16-150-0080	8181 123rd Ave SE	Residential	12/8/2004	Yr-Rd	2004	19	Mound	3	450	X	2014						X	\$35,000	\$1,000
13	16-150-0070	8201 123rd Ave SE	Residential	6/10/1999	Seasonal	1999	24	Mound	3	450	X	2006						X	\$35,000	\$1,000
14	16-150-0060	8219 123rd Ave SE	Residential	9/30/2010	Seasonal	2010	13	Mound	4	600	X					X			\$30,000	\$400

North/Northeast Big Kandiyohi Lake Community Assessment Report
Parcel Data Spreadsheet

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				County Permit on File	Property Use	Year Installed	ISTS Age as of 2023	System Type	Number of Bedrooms	Estimated Design Flow	Likely Compliance status									
											Compliant (X if Yes)	Certificate of Compliance Date	Noncompliant							
													ITPHS (X if Yes)	Failure to Protect Groundwater (X if Yes)	VS = lack of vertical separation SD = surface discharge CP/DW = cesspool/drywell SA = safety threat (type of threat)	Type 1 (Standard Type & Size)	Type 2 (Holding Tank)	Type 3 or 4 (Poor Soils, Undersized, or Rip & Replace)		
15	16-150-0050	8233 123rd Ave SE	Residential	8/10/2005	Seasonal	2005	18	Mound	3	450	X	2016						X	\$35,000	\$1,000
16	16-150-0040	8255 123rd Ave SE	Residential	10/2/2002	Seasonal	2002	21	Mound	3	450	X	2021						X	\$35,000	\$1,000
17	16-150-0020	8291 123rd Ave SE	Residential	9/1/2005	Yr-Rd	2005	18	Mound	3	450	X	2022				X			\$30,000	\$400
18	16-160-0010	8303 123rd Ave SE	Residential	8/15/2012	Seasonal	2012	11	Mound	3	450	X	2019						X	\$35,000	\$1,000
19	16-160-0020	8315 123rd Ave SE	Residential	7/27/2006	Seasonal	2006	17	Mound	3	450	X							X	\$35,000	\$1,000
20	16-160-0030	8329 123rd Ave SE	Residential	8/23/2018	Yr-Rd	2018	5	Mound	4	600	X							X	\$35,000	\$1,000
21	16-160-0040	8341 123rd Ave SE	Residential	5/27/1999	Yr-Rd	1999	24	Mound	4	600	X							X	\$35,000	\$1,000
22	16-160-0050	8359 123rd Ave SE	Residential	5/16/2007	Yr-Rd	2007	16	Mound	3	450	X						X		\$7,500	\$10,850
23	16-160-0060	8373 123rd Ave SE	Residential	9/30/2014	Yr-Rd	2014	9	Mound	3	450	X						X		\$7,500	\$10,850
24	16-160-0070	8391 123rd Ave SE	Residential	12/6/2012	Yr-Rd	2012	11	Mound	4	600	X						X		\$7,500	\$14,460
25	16-160-0080	8407 123rd Ave SE	Residential	8/21/2020	Seasonal	2020	3	Holding Tank	2	300	X						X		\$7,500	\$1,190
26	16-160-0090	8423 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	2*	300				X	CP/DW			X	\$35,000	\$1,000
27	16-160-0100	8437 123rd Ave SE	Residential	No	Seasonal	1984	39	Trenches	2	300		2021		X	VS		X		\$7,500	\$1,190
28	16-160-0110	8451 123rd Ave SE	Residential	7/15/2002	Seasonal	2002	21	Trenches	2	300				X	VS		X		\$7,500	\$1,190

North/Northeast Big Kandiyohi Lake Community Assessment Report
Parcel Data Spreadsheet

CAR MAP ID#	Parcel ID	Address	Property Type: Commercial, Residential, or Other (No Dwelling or Vacant)	ISTS Information							Compliance Information					Likely Future ISTS			Estimated New ISTS Replacement Cost	Estimated Annual Operation, Maintenance, & Replacement Costs	
				County Permit on File	Property Use	Year Installed	ISTS Age as of 2023	System Type	Number of Bedrooms	Estimated Design Flow	Likely Compliance status										
											Compliant (X if Yes)	Certificate of Compliance Date	Noncompliant								
													ITPHS (X if Yes)	Failure to Protect Groundwater (X if Yes)	VS = lack of vertical separation SD = surface discharge CP/DW = cesspool/drywell SA = safety threat (type of threat)	Type 1 (Standard Type & Size)	Type 2 (Holding Tank)	Type 3 or 4 (Poor Soils, Undersized, or Rip & Replace)			
29	16-160-0120	8467 123rd Ave SE	Residential	8/25/2022	Seasonal	2022	1	Holding Tank	3	450	X						X			\$7,500	\$1,790
30	16-160-0130	8489 123rd Ave SE	Residential	11/22/2010	Seasonal	2010	13	Mound	3	450	X						X			\$7,500	\$1,790
31	16-160-0140	8501 123rd Ave SE	Residential	6/1/2020	Seasonal	2020	3	Mound	3	450	X						X			\$7,500	\$1,790
32	16-160-0150	8511 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	2*	300				X	CP/DW		X			\$7,500	\$1,190
33	16-160-0160	8527 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	2*	300				X	CP/DW		X			\$7,500	\$1,190
34	16-160-0170	8541 123rd Ave SE	Residential	6/26/2019	Seasonal	2019	4	Mound	3	450	X							X		\$35,000	\$1,000
35	16-250-0250	8559 123rd Ave SE	Residential	6/2/2005	Seasonal	2005	18	Holding Tank	2	300	X						X			\$7,500	\$1,190
36	16-250-0240	8571 123rd Ave SE	Residential	No	Yr-Rd	Unk	Unk	CP/DW	3	450				X	CP/DW		X			\$7,500	\$10,850
37	16-250-0230	8589 123rd Ave SE	Residential	7/22/2009	Seasonal	2009	14	Holding Tank	3	450	X						X			\$7,500	\$1,790
38	16-250-0220	8601 123rd Ave SE	Residential	9/23/1996	Seasonal	1996	27	Holding Tank	2	300	X						X			\$7,500	\$1,190
39	16-250-0210	8615 123rd Ave SE	Residential	8/25/2022	Seasonal	2022	1	Holding Tank	3	450	X						X			\$7,500	\$1,790
40	16-250-0190	8647 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	2*	300				X	CP/DW		X			\$7,500	\$1,190
41	16-250-0180	8665 123rd Ave SE	Residential	5/1/2003	Seasonal	2003	20	Holding Tank	2	300	X	2018					X			\$7,500	\$1,190
42	16-250-0170	8679 123rd Ave SE	Residential	5/13/1994	Yr-Rd	1994	29	Holding Tank	4	600	X						X			\$7,500	\$14,460

North/Northeast Big Kandiyohi Lake Community Assessment Report
Parcel Data Spreadsheet

CAR MAP ID#	Parcel ID	Address	Property Type: Commercial, Residential, or Other (No Dwelling or Vacant)	ISTS Information							Compliance Information					Likely Future ISTS			Estimated New ISTS Replacement Cost	Estimated Annual Operation, Maintenance, & Replacement Costs	
				County Permit on File	Property Use	Year Installed	ISTS Age as of 2023	System Type	Number of Bedrooms	Estimated Design Flow	Likely Compliance status										
											Compliant (X if Yes)	Certificate of Compliance Date	Noncompliant								
													ITPHS (X if Yes)	Failure to Protect Groundwater (X if Yes)	VS = lack of vertical separation SD = surface discharge CP/DW = cesspool/drywell SA = safety threat (type of threat)	Type 1 (Standard Type & Size)	Type 2 (Holding Tank)	Type 3 or 4 (Poor Soils, Undersized, or Rip & Replace)			
43	16-250-0150	8709 123rd Ave SE	Residential	8/21/2020	Yr-Rd	2020	3	Holding Tank	2	300	X						X			\$7,500	\$7,230
44	16-250-0130	8721 123rd Ave SE	Residential	5/8/2003	Seasonal	2003	20	Holding Tank	3	450	X						X			\$7,500	\$1,790
45	16-250-0120	8737 123rd Ave SE	Residential	6/27/1997	Seasonal	1997	26	Mound	2	300		2022	X	VS			X			\$7,500	\$1,190
46	16-250-0100	8755 123rd Ave SE	Residential	7/9/2010	Seasonal	2010	13	Holding Tank	2	300	X						X			\$7,500	\$1,190
47	16-250-0090	8779 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	1	300			X	CP/DW				X		\$35,000	\$1,000
48	16-250-0080	8807 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	1*	300			X	CP/DW				X		\$35,000	\$1,000
49	16-250-0070	8835 123rd Ave SE	Residential	11/26/2008	Yr-Rd	2008	15	Holding Tank	3	450	X						X			\$7,500	\$10,850
50	16-250-0060	8865 123rd Ave SE	Residential	7/8/2004	Seasonal	2004	19	Holding Tank	3	450	X						X			\$7,500	\$1,790
51	16-250-0050	8893 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	Outhouse	2	300			X	VS			X			\$7,500	\$1,190
52	16-250-0040	8921 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	2	300			X	CP/DW			X			\$7,500	\$1,190
53	16-250-0030	8949 123rd Ave SE	Residential	11/10/2020	Seasonal	2020	3	Holding Tank	3	450	X						X			\$7,500	\$1,790
54	16-250-0020	8979 123rd Ave SE	Residential	11/3/2020	Yr-Rd	2020	3	Mound	2	300	X						X			\$7,500	\$7,230
55	16-023-0140	9011 123rd Ave SE	Commercial	No	Seasonal	Unk	Unk	Holding Tank	N/A	300	X							X		\$35,000	\$1,000
56	16-023-0070	9144 123rd Ave SE	Commercial	6/3/2004	Seasonal	2021	2	Mound	4	600	X	2021					X			\$30,000	\$400

North/Northeast Big Kandiyohi Lake Community Assessment Report
Parcel Data Spreadsheet

CAR MAP ID#	Parcel ID	Address	Property Type: Commercial, Residential, or Other (No Dwelling or Vacant)	ISTS Information							Compliance Information					Likely Future ISTS			Estimated New ISTS Replacement Cost	Estimated Annual Operation, Maintenance, & Replacement Costs
				County Permit on File	Property Use	Year Installed	ISTS Age as of 2023	System Type	Number of Bedrooms	Estimated Design Flow	Likely Compliance status									
											Compliant (X if Yes)	Certificate of Compliance Date	Noncompliant							
													ITPHS (X if Yes)	Failure to Protect Groundwater (X if Yes)	VS = lack of vertical separation SD = surface discharge CP/DW = cesspool/drywell SA = safety threat (type of threat)	Type 1 (Standard Type & Size)	Type 2 (Holding Tank)	Type 3 or 4 (Poor Soils, Undersized, or Rip & Replace)		
57	16-300-0020	9125 123rd Ave SE	Residential	7/19/1990	Seasonal	1990	33	Outhouse	1	300				X	VS		X		\$7,500	\$1,190
58	16-300-0030	9137 123rd Ave SE	Residential	6/15/1998	Seasonal	1998	25	Trenches	2	300				X	VS		X		\$7,500	\$1,190
59	16-300-0040	9151 123rd Ave SE	Residential	8/13/2015	Seasonal	2015	8	Holding Tank	3	450	X						X		\$7,500	\$1,790
60	16-300-0050	9181 123rd Ave SE	Residential	8/13/2015	Seasonal	2015	8	Holding Tank	2	300	X						X		\$7,500	\$1,190
61	16-300-0060	9209 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	2*	300				X	CP/DW			X	\$35,000	\$1,000
62	16-300-0070	9239 123rd Ave SE	Residential	No	Yr-Rd	Unk	Unk	CP/DW	2*	300				X	CP/DW		X		\$7,500	\$7,230
63	16-300-0080	9267 123rd Ave SE	Residential	12/7/2011	Seasonal	2011	12	Holding Tank	2	300	X						X		\$7,500	\$1,190
64	16-300-0090	9295 123rd Ave SE	Residential	7/23/2008	Yr-Rd	2008	15	Mound	2	300	X	2020						X	\$35,000	\$1,000
65	16-300-0100	9325 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	2*	300				X	CP/DW			X	\$35,000	\$1,000
66	16-300-0110	9353 123rd Ave SE	Residential	No	Seasonal	1983	40	Trenches	2*	300				X	VS			X	\$35,000	\$1,000
67	16-300-0120	9383 123rd Ave SE	Residential	7/27/2005	Yr-Rd	2005	18	Mound	2	300	X							X	\$35,000	\$1,000
68	16-300-0140	9439 123rd Ave SE	Residential	6/30/2010	Seasonal	2010	13	Holding Tank	2	300	X							X	\$35,000	\$1,000
69	16-300-0150	9469 123rd Ave SE	Residential	6/30/2010	Seasonal	2010	13	Holding Tank	2	300	X							X	\$35,000	\$1,000
70	16-300-0160 & 16-500-0010	9497 123rd Ave SE	Residential	7/1/1997	Seasonal	1997	26	Trenches	1	300				X	VS		X		\$30,000	\$400

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											Compliant (X if Yes)	Certificate of Compliance Date	Noncompliant							
													ITPHS (X if Yes)	Failure to Protect Groundwater (X if Yes)	VS = lack of vertical separation SD = surface discharge CP/DW = cesspool/drywell SA = safety threat (type of threat)	Type 1 (Standard Type & Size)	Type 2 (Holding Tank)	Type 3 or 4 (Poor Soils, Undersized, or Rip & Replace)		
71	16-400-0200	9628 123rd Ave SE	Residential	11/8/2004	Yr-Rd	2004	19	Mound	3	450	X					X			\$30,000	\$400
72	16-500-0020	9555 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	1	300				X	CP/DW			X	\$35,000	\$1,000
73	16-500-0030	9583 123rd Ave SE	Residential	11/15/2013	Seasonal	2013	10	Holding Tank	2	300	X						X		\$7,500	\$1,190
74	16-500-0040	9613 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	2*	300				X	CP/DW		X		\$7,500	\$1,190
75	16-500-0050	9641 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	4	600				X	CP/DW		X		\$7,500	\$2,380
76	16-500-0060	9669 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	2*	300				X	CP/DW		X		\$7,500	\$1,190
77	16-500-0070	9677 123rd Ave SE	Residential	5/29/2002	Yr-Rd	2002	21	Holding Tank	2	300	X						X		\$7,500	\$7,230
78	16-500-0080	9699 123rd Ave SE	Residential	4/19/2019	Yr-Rd	2019	4	Pressure Bed	3	450	X							X	\$35,000	\$1,000
79	16-026-0070	9727 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	1*	300				X	CP/DW		X		\$30,000	\$400
80	16-026-0060	9755 123rd Ave SE	Residential	8/1/2013	Seasonal	2013	10	Holding Tank	1	300	X							X	\$35,000	\$1,000
81	16-325-0020	9716 123rd Ave SE	Residential	8/8/2003	Yr-Rd	2003	20	Mound	2	300	X	2016					X		\$30,000	\$400
82	16-300-0170 & 16-325-0030	9783 123rd Ave SE	Residential	8/11/2017	Seasonal	2017	6	Mound	2	300	X						X		\$30,000	\$400
83	16-300-0182	9813 123rd Ave SE	Residential	7/18/2019	Yr-Rd	2019	4	Holding Tank	3	450	X						X		\$7,500	\$10,850
84	16-300-0180	9841 123rd Ave SE	Residential	5/13/1999	Seasonal	1999	24	Trenches	2	300				X	VS			X	\$35,000	\$1,000

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85	16-026-0093	9872 123rd Ave SE	Residential	6/22/1999	Yr-Rd	1999	24	Trenches	3	450	X	2021				X			\$30,000	\$400
86	16-026-0090	9855 123rd Ave SE	Residential	9/23/1996	Yr-Rd	1996	27	Trenches	3	450	X						X		\$35,000	\$1,000
87	16-026-0092	9867 123rd Ave SE	Residential	5/9/2017	Seasonal	2017	6	Trenches	4	600	X						X		\$35,000	\$1,000
88	16-300-0190	9881 123rd Ave SE	Residential	No	Seasonal	Unk	Unk	CP/DW	1	300			X	CP/DW	X				\$30,000	\$400
89	16-300-0195	12388 Big Kandi Drive	Residential	11/18/2019	Yr-Rd	2020	3	Holding Tank	3	450	X						X		\$35,000	\$1,000
90	16-300-0200 & 16-300-0210	12420 Big Kandi Drive	Residential	4/27/2012	Yr-Rd	2012	11	Mound	4	600	X						X		\$35,000	\$1,000
91	16-300-0220	12448 Big Kandi Drive	Residential	3/27/2000	Yr-Rd	2000	23	Holding Tank	1	300	X						X		\$7,500	\$7,230
92	16-300-0240	12462 Big Kandi Drive	Residential	12/9/1999	Seasonal	1999	24	Holding Tank	2	300	X						X		\$7,500	\$1,190
93	16-300-0230	12476 Big Kandi Drive	Residential	7/20/2021	Yr-Rd	2021	2	At-Grade	2	300	X						X		\$35,000	\$1,000
94	16-300-0260	12490 Big Kandi Drive	Residential	5/29/2003	Seasonal	2003	20	Holding Tank	2	300	X						X		\$7,500	\$1,190
95	16-300-0250	12502 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	CP/DW	2*	300			X	CP/DW		X			\$7,500	\$1,190
96	16-300-0270	12516 Big Kandi Drive	Residential	11/16/2012	Seasonal	2012	11	Holding Tank	2	300	X						X		\$7,500	\$1,190
97	16-300-0280 & 16-300-0290	12530 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	CP/DW	1*	300			X	CP/DW		X			\$7,500	\$1,190
98	16-300-0300	12558 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	CP/DW	1	300			X	CP/DW		X			\$7,500	\$1,190

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													ITPHS (X if Yes)	Failure to Protect Groundwater (X if Yes)	VS = lack of vertical separation SD = surface discharge CP/DW = cesspool/drywell SA = safety threat (type of threat)	Type 1 (Standard Type & Size)	Type 2 (Holding Tank)	Type 3 or 4 (Poor Soils, Undersized, or Rip & Replace)		
99	16-300-0310	12572 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	CP/DW	2	300				X	CP/DW			X	\$35,000	\$1,000
100	16-300-0315	12586 Big Kandi Drive	Residential	12/18/2020	Seasonal	2020	3	Holding Tank	4	600	X						X		\$7,500	\$2,380
101	16-300-0320	12600 Big Kandi Drive	Residential	11/28/2011	Yr-Rd	2011	12	Holding Tank	3	450	X						X		\$7,500	\$10,850
102	16-300-0331	12616 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	CP/DW	1*	300				X	CP/DW			X	\$35,000	\$1,000
103	16-300-0330	12632 Big Kandi Drive	Residential	11/15/2002	Seasonal	2002	21	Trenches	4	600	X	2014					X		\$7,500	\$2,380
104	16-300-0340	12664 Big Kandi Drive	Residential	No	Seasonal	1984	39	Trenches	3	450		2015		X	VS			X	\$35,000	\$1,000
105	16-300-0360	12680 Big Kandi Drive	Residential	8/22/2018	Seasonal	2018	5	Holding Tank	3	450	X	2018					X		\$7,500	\$1,790
106	16-300-0370	12696 Big Kandi Drive	Residential	5/16/2000	Seasonal	2000	23	Holding Tank	3	450	X						X		\$7,500	\$1,790
107	16-300-0380	12720 Big Kandi Drive	Residential	8/23/2002	Seasonal	2002	21	Holding Tank	2	300	X	2015					X		\$7,500	\$1,190
108	16-300-0390	12744 Big Kandi Drive	Residential	5/23/2000	Seasonal	2000	23	Holding Tank	1	300	X						X		\$7,500	\$1,190
109	16-026-0150	12768 Big Kandi Drive	Residential	11/19/2010	Seasonal	2010	13	Mound	3	450	X						X		\$7,500	\$1,790
110	16-026-0140	12790 Big Kandi Drive	Residential	5/11/1998	Seasonal	1998	25	Holding Tank	2	300	X							X	\$35,000	\$1,000
111	16-026-0110	12810 Big Kandi Drive	Residential	No	Seasonal	N/A	N/A	No System	3*	450							X		\$30,000	\$400
112	16-026-0120	12826 Big Kandi Drive	Residential	No	Seasonal	N/A	N/A	No System	2*	300							X		\$7,500	\$1,190

North/Northeast Big Kandiyohi Lake Community Assessment Report
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													ITPHS (X if Yes)	Failure to Protect Groundwater (X if Yes)	VS = lack of vertical separation SD = surface discharge CP/DW = cesspool/drywell SA = safety threat (type of threat)	Type 1 (Standard Type & Size)	Type 2 (Holding Tank)	Type 3 or 4 (Poor Soils, Undersized, or Rip & Replace)		
113	16-026-0130	12852 Big Kandi Drive	Residential	6/22/1994	Seasonal	1994	29	Holding Tank	2	300	X	2009						X	\$35,000	\$1,000
114	16-026-0170	12872 Big Kandi Drive	Residential	9/8/2006	Seasonal	2006	17	Holding Tank	1	300	X	2015					X		\$7,500	\$1,190
115	16-026-0180 & 16-350-0125	12886 Big Kandi Drive 12902 Big Kandi Drive	Residential	No	Yr-Rd	1988	35	Holding Tank	1	300	X	2003					X		\$7,500	\$7,230
116	16-350-0122	12910 Big Kandi Drive	Residential	6/27/1996	Seasonal	1996	27	Holding Tank	2	300	X						X		\$7,500	\$1,190
117	16-350-0100	12924 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	CP/DW	1*	300				X	CP/DW		X		\$7,500	\$1,190
118	16-350-0110	12938 Big Kandi Drive	Residential	5/21/2015	Seasonal	2015	8	Holding Tank	1	300	X						X		\$7,500	\$1,190
119	16-350-0090	12950 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	CP/DW	1*	300				X	CP/DW		X		\$7,500	\$1,190
120	16-350-0080	12972 Big Kandi Drive	Residential	4/14/2006	Seasonal	2006	17	Holding Tank	2	300	X	2020					X		\$7,500	\$1,190
121	16-350-0070	12990 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	CP/DW	2*	300				X	CP/DW		X		\$7,500	\$1,190
122	16-350-0060	13002 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	CP/DW	2*	300				X	CP/DW		X		\$7,500	\$1,190
123	16-350-0050	13022 Big Kandi Drive	Residential	7/14/2022	Seasonal	2022	1	Holding Tank	1	300	X						X		\$7,500	\$1,190
124	16-350-0040	13040 Big Kandi Drive	Residential	5/10/2021	Seasonal	2021	2	Holding Tank	2	300	X						X		\$7,500	\$1,190
125	16-026-0162	13073 Big Kandi Drive	Residential	7/9/2020	Yr-Rd	2020	3	Mound	3	450	X						X		\$30,000	\$400
126	16-350-0030	13062 Big Kandi Drive	Residential	5/14/2001	Seasonal	2001	22	Holding Tank	1	300	X	2013					X		\$7,500	\$1,190

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													ITPHS (X if Yes)	Failure to Protect Groundwater (X if Yes)	VS = lack of vertical separation SD = surface discharge CP/DW = cesspool/drywell SA = safety threat (type of threat)	Type 1 (Standard Type & Size)	Type 2 (Holding Tank)	Type 3 or 4 (Poor Soils, Undersized, or Rip & Replace)		
127	16-350-0020	13080 Big Kandi Drive	Residential	6/18/1998	Seasonal	1998	25	Holding Tank	2	300	X	2011					X		\$7,500	\$1,190
128	16-350-0010	13098 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	Holding Tank	3	450	X	2006					X		\$7,500	\$1,790
129	16-550-0010	13110 Big Kandi Drive	Residential	9/16/1993	Seasonal	1993	30	Holding Tank	2	300	X						X		\$7,500	\$1,190
130	16-550-0020	13134 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	CP/DW	1*	300				X	CP/DW		X		\$7,500	\$1,190
131	16-550-0030 & 16-026-022	13156 Big Kandi Drive	Residential	6/24/2008	Yr-Rd	2008	15	Mound	3	450	X	2022					X		\$30,000	\$400
132	16-026-0021	13161 Big Kandi Drive	Residential	6/24/2008	Yr-Rd	2008	15	Mound	3	450	X	2018					X		\$30,000	\$400
133	16-550-0040	13178 Big Kandi Drive	Residential	6/21/2006	Seasonal	2006	17	Holding Tank	3	450	X	2016					X		\$7,500	\$1,790
134	16-550-0060	13212 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	Holding Tank	4	600	X	2007					X		\$7,500	\$2,380
135	16-550-0080	13244 Big Kandi Drive	Residential	No	Seasonal	1988	35	Mound	2	300	X	2017					X		\$35,000	\$1,000
136	16-550-0090	13260 Big Kandi Drive	Residential	8/8/2001	Seasonal	2001	22	Holding Tank	3	450	X						X		\$7,500	\$1,790
137	16-550-0110	13298 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	CP/DW	3	450				X	CP/DW		X		\$30,000	\$400
138	16-550-0120	13318 Big Kandi Drive	Residential	9/24/2003	Seasonal	2003	20	Holding Tank	2	300	X	2023					X		\$7,500	\$1,190
139	16-550-0130	13332 Big Kandi Drive	Residential	5/2/2016	Seasonal	2016	7	Holding Tank	4	600	X						X		\$7,500	\$2,380
140	16-550-0140	13354 Big Kandi Drive	Residential	6/3/2016	Seasonal	2016	7	Holding Tank	4	600	X						X		\$7,500	\$2,380

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141	16-550-0150	13370 Big Kandi Drive	Residential	No	Seasonal	Unk	Unk	Holding Tank	1*	300	X	2016					X			\$7,500	\$1,190
142	16-550-0160	13386 Big Kandi Drive	Residential	8/9/2016	Seasonal	2016	7	Holding Tank	2	300	X						X			\$7,500	\$1,190
143	16-551-0010	13398 Big Kandi Drive	Residential	10/12/2015	Yr-Rd	2015	8	Mound	3	450	X							X		\$35,000	\$1,000
144	16-551-0020	13440 Big Kandi Drive	Residential	5/10/2018	Seasonal	Unk	Unk	CP/DW	3	450			X	CP/DW			X			\$7,500	\$1,790
145	16-026-0023	13419 Big Kandi Drive	Residential	No	Seasonal	2018	5	Mound	2	300	X						X			\$30,000	\$400
146	16-026-0050	13468 Big Kandi Drive	Residential	11/25/2014	Yr-Rd	2014	9	Mound	2	300	X							X		\$35,000	\$1,000
147	16-026-0030	13494 Big Kandi Drive	Residential	5/24/2021	Seasonal	2021	2	Holding Tank	2	300	X						X			\$7,500	\$1,190
148	16-035-0060	13558 Big Kandi Drive	Residential	7/21/2004	Seasonal	2004	19	Mound	3	450	X	2018					X			\$30,000	\$400

* No permit or Kandiyo Lake County Assessor data.
Bedroom count was based off dwelling size and comparing to neighboring structures.

APPENDIX B

ISTS Information

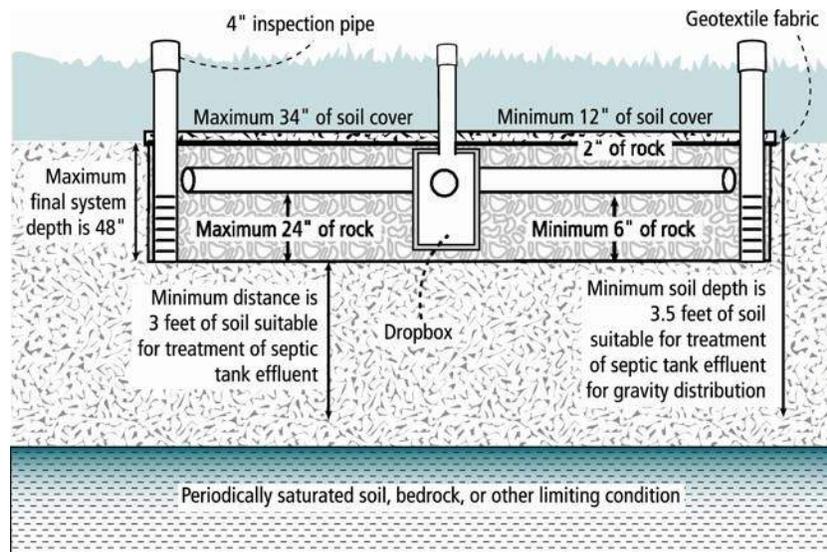
Below-Grade Systems

Below-grade systems are constructed in original soil with distribution of effluent occurring below the soil surface. With below grade systems the soil treatment area is designed and installed such that the infiltrative surface is below the original ground elevation and a final cover of topsoil stabilizes the completed installation, supports vegetative growth, and sheds runoff. It is the underlying soil that treats the many harmful components in the effluent before it reaches surface or ground waters. The two types of below-grade soil treatment systems commonly used are trenches and seepage beds.

Trenches have better oxygen transfer than beds and are recommended whenever the site conditions allow although seepage beds are often more attractive due to reduced land area requirements. In addition, the cost and time of construction, trenches are preferred because they have greater infiltrative surface for the same bottom area, and less damage typically occurs to the infiltrative surface during construction (Otis et al, 1977).

The figure below shows minimum depths and separation requirements for trenches or seepage beds. For systems without pretreatment, at least three feet of soil suitable for treatment should be located below the bottom of the distribution media. The minimum depth of distribution media is six inches, followed by a minimum soil cover of twelve inches, so that the total distance from the periodically saturated or other limiting condition to the final grade is approximately 4.5 feet. Note that this total could be made up of 3.5 feet of original soil and one foot of soil (7080.2150, Subp. 3) over the distribution media of the system.

Figure 1 - Trench and Bed Depth



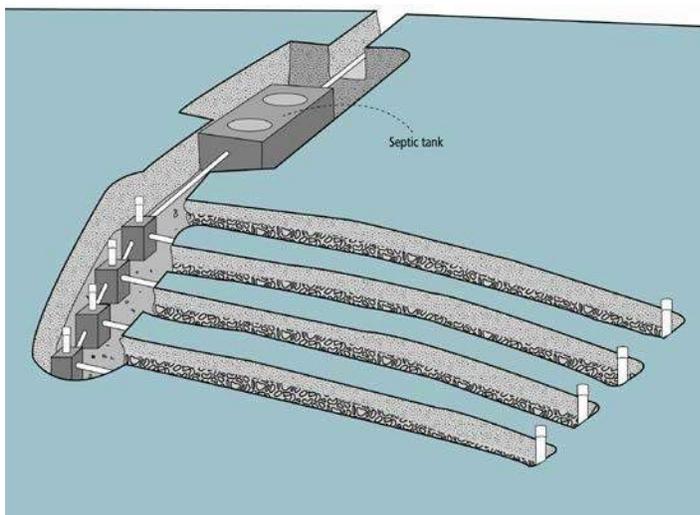
From MN Rules 7080.2260 Subp. 3. If the distribution media in a trench or a bed is in contact with soil texture group 2 through 4 (medium sand, fine sand, coarse and medium loamy sand) pressure distribution must be used.

Below-Grade Systems: Specifications

Trenches

The trench is the most common of the soil treatment systems. **According to MN Rules Chapter 7080.1100, Subp. 89 a trench is defined as a soil treatment and dispersal system, the absorption width of which is 36 inches or less.** Trenches are narrower than they are wide, no wider than three feet, and are laid out along the contours of the soil. A typical trench is constructed by making a level excavation 18 to 36 inches wide. The method of distributing the septic tank effluent can be either pressure or gravity. There are a number of different configurations by which the trenches can be connected with each other and with the septic tank: parallel, serial, and continual. A typical trench is constructed by making a level excavation 18 to 36 inches wide. A typical layout for a trench system is shown in Figure 2.

Figure 2 - Typical Trench Layout



The soil around and beneath the trench must be neither too coarse nor too fine. A coarse soil may not adequately filter pathogens, and a fine soil may be too tight to allow water to pass through. Soils with percolation rates between 0.1 and 60 mpi or soils with a listed loading rate on Table IX in Chapter 7080.2150 are suitable for treating sewage using a Type I below-grade design. **Trench media must never be placed in contact with soils having a percolation rate faster than 0.1 mpi or soil type 1 or slower than 60 mpi. For soils with percolation rates faster than 0.1 mpi and between 61 and 120 mpi, Type I below-grade systems may not be used (7080.2150, Subp. 3).**

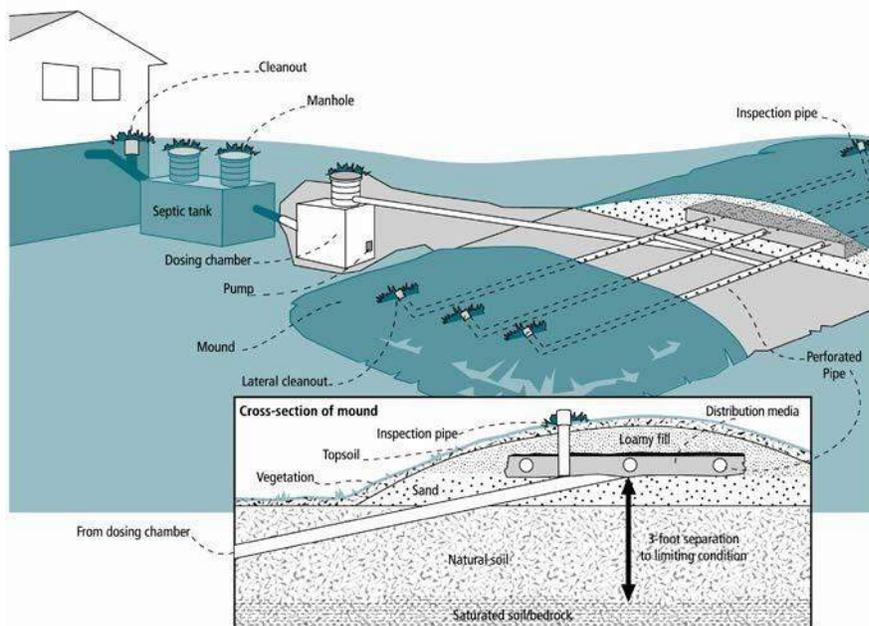
The trench soil treatment system consists of distribution media, covered with a minimum of 12 inches of soil and a close-growing and vigorous vegetation. Many trench systems utilize a pipe and gravel distribution system where effluent passes through the pipe and is stored within the media until it can be absorbed into the soil. Partial treatment is achieved as effluent passes through the biomat. The biomat also distributes effluent across the soil surfaces and maintains aerobic conditions outside the trench.

Mound Systems

Mound systems are defined in Chapter 7080.1100, Subp. 50, as “a soil treatment and dispersal system designed and installed such that all of the infiltrative surface is installed above grade, using clean sand between the bottom of the infiltrative surface and the original ground elevation, utilizing pressure distribution and capped with suitable soil material to stabilize the surface and encourage vegetative growth.”

A sewage treatment mound is nothing more than a seepage bed elevated by clean sand fill to provide adequate separation between where sewage effluent is applied and a limiting soil layer as shown in the figure below. Mounds were developed in the early 1970s to overcome soil and site conditions, which limit the use of trenches and beds (Converse et al., 1977). Limiting conditions include high water tables, shallow soil depth to bedrock, slowly permeable soil, or soil too coarse for treatment.

Figure 1 - Mound System and Components



A mound system is a two-stage process involving both effluent treatment and dispersal. Treatment is accomplished predominately by physical and biochemical processes within the clean sand material and native soil. The physical characteristics of the influent wastewater, influent loading rate temperature, and the nature of the receiving fill material and in situ soil affect these processes.

Physical entrapment, increased retention time, and conversion of pollutants in the effluent are important treatment objectives accomplished under unsaturated conditions. Pathogens contained in the effluent are eventually deactivated through filtering, retention, and adsorption by the fill material. In addition, many pollutants are converted to other chemical forms by oxidation processes.

The mound system addresses high water table conditions by elevating the infiltration bed to achieve the needed vertical separation. By using uniform distribution and adequate vertical separation in the selected sand media, vertical unsaturated flow is maintained, thus ensuring the maximum treatment permitted by this technology. On sites with slowly permeable soils, the mound system helps assure a known level of effluent treatment before effluent is discharged to the native soil. These soils are subject to severe damage from smearing and compaction, especially during the construction of conventional systems, which drastically reduces the permeability of the soil by destroying water-moving

pores and channels. As a result these sites present a high potential for site and soil interface damage in addition to the need for large soil treatment systems to provide adequate infiltration area. For these sites, mound systems provide the following advantages:

- The mound effluent enters the more permeable natural topsoil over a larger area where it can move laterally until absorbed by the less permeable subsoil.
- The bio-mat that develops at the bottom of the media/sand infiltration area will not clog the filter media as readily as it would the less permeable natural soil.
- The infiltration area within the filter media is much smaller than it would be if placed in the more slowly permeable subsoil, yet the total mound area is probably larger than it would be for a conventional soil treatment system, if one could be used.

Mound systems are used primarily in shallow soils overlying a restrictive layer or elevated groundwater table. The shallower the soil, the more attention must be paid to transporting the treated effluent away from the point of application. Fifteen mound systems in Wisconsin were found to have a total nitrogen reduction of at least 55% from the pretreatment effluent to mound toe effluent (Blasing and Converse, 2004). Sufficient numbers of mounds have been installed in Minnesota and elsewhere to prove that the mound treatment system is a Type I technology. There are more than 50,000 single-family mounds successfully treating sewage in Minnesota.

Dispersal is primarily affected by the depth of the unsaturated receiving soils, their hydraulic conductivity, land slope, and the area available for dispersal. The mound consists of sand material, an absorption bed, and cover material. Effluent is dispersed into the absorption bed, where it flows through the fill material and undergoes biological, chemical, and physical treatment. It then passes into the underlying soil for further treatment and dispersal to the environment. Clean sand (defined by state rule) is required for mounds to effectively treat and disperse effluent.

Cover material consists of material that provides erosion protection, a barrier to excess precipitation infiltration, and allows gas exchange. The native soil serves, in combination with the fill, as treatment media, and it also disperses the treated effluent.

APPENDIX C

Wastewater Flow Calculation

North/Northeast Big Kandiyo Lake Community
Alternative 1b: Community Cluster LSTS for the 84 Holding Tank Properties
Design Wastewater Flow
(MN Rules 7080.1850, 7081.0120, 7081.0140)

CAR Map ID#	Address	Parcel ID#	# Bedroom	Dwelling Classification*	Flow (gpd)	Reduction Factor	Wastewater Flow (gpd)
5	8055 123rd Ave SE	16-170-0040	3	I	450	0.45	203
22	8359 123rd Ave SE	16-160-0050	3	I	450	1.00	450
23	8373 123rd Ave SE	16-160-0060	3	I	450	1.00	450
24	8391 123rd Ave SE	16-160-0070	4	I	600	1.00	600
25	8407 123rd Ave SE	16-160-0080	2	I	300	0.45	135
27	8437 123rd Ave SE	16-160-0100	2	I	300	0.45	135
28	8451 123rd Ave SE	16-160-0110	2	I	300	0.45	135
29	8467 123rd Ave SE	16-160-0120	3	I	450	0.45	203
30	8489 123rd Ave SE	16-160-0130	3	I	450	0.45	203
31	8501 123rd Ave SE	16-160-0140	3	I	450	0.45	203
32	8511 123rd Ave SE	16-160-0150	2	I	300	0.45	135
33	8527 123rd Ave SE	16-160-0160	2	I	300	0.45	135
35	8559 123rd Ave SE	16-250-0250	2	I	300	0.45	135
36	8571 123rd Ave SE	16-250-0240	3	I	450	0.45	203
37	8589 123rd Ave SE	16-250-0230	3	I	450	0.45	203
38	8601 123rd Ave SE	16-250-0220	2	I	300	0.45	135
39	8615 123rd Ave SE	16-250-0210	3	I	450	0.45	203
40	8647 123rd Ave SE	16-250-0190	2	I	300	0.45	135
41	8665 123rd Ave SE	16-250-0180	2	I	300	0.45	135
42	8679 123rd Ave SE	16-250-0170	4	I	600	1.00	600
43	8709 123rd Ave SE	16-250-0150	2	I	300	0.45	135
44	8721 123rd Ave SE	16-250-0130	3	I	450	0.45	203
45	8737 123rd Ave SE	16-250-0120	2	I	300	0.45	135
46	8755 123rd Ave SE	16-250-0100	2	I	300	0.45	135
49	8835 123rd Ave SE	16-250-0070	3	I	450	0.45	203
50	8865 123rd Ave SE	16-250-0060	3	I	450	0.45	203
51	8893 123rd Ave SE	16-250-0050	2	I	300	0.45	135
52	8921 123rd Ave SE	16-250-0040	2	I	300	0.45	135
53	8949 123rd Ave SE	16-250-0030	3	I	450	0.45	203
54	8979 123rd Ave SE	16-250-0020	2	I	300	0.45	135
57	9125 123rd Ave SE	16-300-0020	1	I	150	0.45	68
58	9137 123rd Ave SE	16-300-0030	2	I	300	0.45	135
59	9151 123rd Ave SE	16-300-0040	3	I	450	0.45	203
60	9181 123rd Ave SE	16-300-0050	2	I	300	0.45	135
62	9239 123rd Ave SE	16-300-0070	2	I	300	0.45	135
63	9267 123rd Ave SE	16-300-0080	2	I	300	0.45	135
73	9583 123rd Ave SE	16-500-0030	2	I	300	0.45	135
74	9613 123rd Ave SE	16-500-0040	2	I	300	0.45	135
75	9641 123rd Ave SE	16-500-0050	4	I	600	1.00	600
76	9669 123rd Ave SE	16-500-0060	2	I	300	0.45	135
77	9677 123rd Ave SE	16-500-0070	2	I	300	0.45	135
83	9813 123rd Ave SE	16-300-0182	3	I	450	0.45	203
91	12448 Big Kandi Drive	16-300-0220	1	I	150	0.45	68
92	12462 Big Kandi Drive	16-300-0240	2	I	300	0.45	135
94	12490 Big Kandi Drive	16-300-0260	2	I	300	0.45	135
95	12502 Big Kandi Drive	16-300-0250	2	I	300	0.45	135
96	12516 Big Kandi Drive	16-300-0270	2	I	300	0.45	135

CAR Map ID#	Address	Parcel ID#	# Bedroom	Dwelling Classification*	Flow (gpd)	Reduction Factor	Wastewater Flow (gpd)
97	12530 Big Kandi Drive	16-0280 & 16-300	1	I	150	0.45	68
98	12558 Big Kandi Drive	16-300-0300	1	I	150	0.45	68
100	12586 Big Kandi Drive	16-300-0315	4	I	600	1.00	600
101	12600 Big Kandi Drive	16-300-0320	3	I	450	0.45	203
103	12632 Big Kandi Drive	16-300-0330	4	I	600	1.00	600
105	12680 Big Kandi Drive	16-300-0360	3	I	450	0.45	203
106	12696 Big Kandi Drive	16-300-0370	3	I	450	0.45	203
107	12720 Big Kandi Drive	16-300-0380	2	I	300	0.45	135
108	12744 Big Kandi Drive	16-300-0390	1	I	150	0.45	68
109	12768 Big Kandi Drive	16-026-0150	3	I	450	0.45	203
112	12826 Big Kandi Drive	16-026-0120	2	I	300	0.45	135
114	12872 Big Kandi Drive	16-026-0170	1	I	150	0.45	68
115	12886 Big Kandi Drive	16-0180 & 16-300	1	I	150	0.45	68
116	12910 Big Kandi Drive	16-350-0122	2	I	300	0.45	135
117	12924 Big Kandi Drive	16-350-0100	1	I	150	0.45	68
118	12938 Big Kandi Drive	16-350-0110	1	I	150	0.45	68
119	12950 Big Kandi Drive	16-350-0090	1	I	150	0.45	68
120	12972 Big Kandi Drive	16-350-0080	2	I	300	0.45	135
121	12990 Big Kandi Drive	16-350-0070	2	I	300	0.45	135
122	13002 Big Kandi Drive	16-350-0060	2	I	300	0.45	135
123	13022 Big Kandi Drive	16-350-0050	1	I	150	0.45	68
124	13040 Big Kandi Drive	16-350-0040	2	I	300	0.45	135
126	13062 Big Kandi Drive	16-350-0030	1	I	150	0.45	68
127	13080 Big Kandi Drive	16-350-0020	2	I	300	0.45	135
128	13098 Big Kandi Drive	16-350-0010	3	I	450	0.45	203
129	13110 Big Kandi Drive	16-550-0010	2	I	300	0.45	135
130	13134 Big Kandi Drive	16-550-0020	1	I	150	0.45	68
133	13178 Big Kandi Drive	16-550-0040	3	I	450	0.45	203
134	13212 Big Kandi Drive	16-550-0060	4	I	600	1.00	600
136	13260 Big Kandi Drive	16-550-0090	3	I	450	0.45	203
138	13318 Big Kandi Drive	16-550-0120	2	I	300	0.45	135
139	13332 Big Kandi Drive	16-550-0130	4	I	600	1.00	600
140	13354 Big Kandi Drive	16-550-0140	4	I	600	1.00	600
141	13370 Big Kandi Drive	16-550-0150	1	I	150	0.45	68
142	13386 Big Kandi Drive	16-550-0160	2	I	300	0.45	135
144	13440 Big Kandi Drive	16-551-0020	3	I	450	0.45	203
147	13494 Big Kandi Drive	16-026-0030	2	I	300	0.45	135

*MN Rule 7080 Classification designation assumed to be Classification I

Total Average Dry Weather (ADW) Flow, gpd: 16,200

Collection system forcemain length (mile) 2.8
Pipe diameter, inch 2

Infiltration/Inflow (200 gpd/in. dia./mi), gpd: 1,200

Total Average Wet Weather (AWW) Flow, gpd: 17,400

North/Northeast Big Kandiyohi Lake Community
Alternative 2: Community Cluster LSTS
Design Wastewater Flow
(MN Rules 7080.1850, 7081.0120, 7081.0140)

CAR Map ID#	Address	Parcel ID#	# Bedroom	Dwelling Classification*	Flow (gpd)	Reduction Factor	Wastewater Flow (gpd)
1	7811 123rd Ave SE	16-028-0020	2	I	300	0.45	135
2	8015 123rd Ave SE	16-170-0010	3	I	450	0.45	203
3	8025 123rd Ave SE	16-170-0020	2	I	300	0.45	135
4	8039 123rd Ave SE	16-170-0030	3	I	450	0.45	203
5	8055 123rd Ave SE	16-170-0040	3	I	450	0.45	203
6	8079 123rd Ave SE	16-170-0050	2	I	300	0.45	135
7	8091 123rd Ave SE	16-170-0060	3	I	450	0.45	203
8	8109 123rd Ave SE	16-170-0070	2	I	300	0.45	135
9	8121 123rd Ave SE	16-170-0080	2	I	300	0.45	135
10	8137 123rd Ave SE	16-150-0110	3	I	450	0.45	203
11	8169 123rd Ave SE	16-150-0090	3	I	450	0.45	203
12	8181 123rd Ave SE	16-150-0080	3	I	450	0.45	203
13	8201 123rd Ave SE	16-150-0070	3	I	450	0.45	203
14	8219 123rd Ave SE	16-150-0060	4	I	600	1.00	600
15	8233 123rd Ave SE	16-150-0050	3	I	450	0.45	203
16	8255 123rd Ave SE	16-150-0040	3	I	450	0.45	203
17	8291 123rd Ave SE	16-150-0020	3	I	450	0.45	203
18	8303 123rd Ave SE	16-160-0010	3	I	450	0.45	203
19	8315 123rd Ave SE	16-160-0020	3	I	450	0.45	203
20	8329 123rd Ave SE	16-160-0030	4	I	600	1.00	600
21	8341 123rd Ave SE	16-160-0040	4	I	600	1.00	600
22	8359 123rd Ave SE	16-160-0050	3	I	450	0.45	203
23	8373 123rd Ave SE	16-160-0060	3	I	450	0.45	203
24	8391 123rd Ave SE	16-160-0070	4	I	600	1.00	600
25	8407 123rd Ave SE	16-160-0080	2	I	300	0.45	135
26	8423 123rd Ave SE	16-160-0090	2	I	300	0.45	135
27	8437 123rd Ave SE	16-160-0100	2	I	300	0.45	135
28	8451 123rd Ave SE	16-160-0110	2	I	300	0.45	135
29	8467 123rd Ave SE	16-160-0120	3	I	450	0.45	203
30	8489 123rd Ave SE	16-160-0130	3	I	450	0.45	203
31	8501 123rd Ave SE	16-160-0140	3	I	450	0.45	203
32	8511 123rd Ave SE	16-160-0150	2	I	300	0.45	135
33	8527 123rd Ave SE	16-160-0160	2	I	300	0.45	135
34	8541 123rd Ave SE	16-160-0170	3	I	450	0.45	203
35	8559 123rd Ave SE	16-250-0250	2	I	300	0.45	135
36	8571 123rd Ave SE	16-250-0240	3	I	450	0.45	203
37	8589 123rd Ave SE	16-250-0230	3	I	450	0.45	203
38	8601 123rd Ave SE	16-250-0220	2	I	300	0.45	135
39	8615 123rd Ave SE	16-250-0210	3	I	450	0.45	203
40	8647 123rd Ave SE	16-250-0190	2	I	300	0.45	135
41	8665 123rd Ave SE	16-250-0180	2	I	300	0.45	135
42	8679 123rd Ave SE	16-250-0170	4	I	600	1.00	600
43	8709 123rd Ave SE	16-250-0150	2	I	300	0.45	135
44	8721 123rd Ave SE	16-250-0130	3	I	450	0.45	203
45	8737 123rd Ave SE	16-250-0120	2	I	300	0.45	135
46	8755 123rd Ave SE	16-250-0100	2	I	300	0.45	135

CAR Map ID#	Address	Parcel ID#	# Bedroom	Dwelling Classification*	Flow (gpd)	Reduction Factor	Wastewater Flow (gpd)
47	8779 123rd Ave SE	16-250-0090	1	I	150	0.45	68
48	8807 123rd Ave SE	16-250-0080	1	I	150	0.45	68
49	8835 123rd Ave SE	16-250-0070	3	I	450	0.45	203
50	8865 123rd Ave SE	16-250-0060	3	I	450	0.45	203
51	8893 123rd Ave SE	16-250-0050	2	I	300	0.45	135
52	8921 123rd Ave SE	16-250-0040	2	I	300	0.45	135
53	8949 123rd Ave SE	16-250-0030	3	I	450	0.45	203
54	8979 123rd Ave SE	16-250-0020	2	I	300	0.45	135
55	9011 123rd Ave SE	16-023-0140	N/A	I	300	0.45	135
56	9144 123rd Ave SE	16-023-0070	4	I	600	1.00	600
57	9125 123rd Ave SE	16-300-0020	1	I	150	0.45	68
58	9137 123rd Ave SE	16-300-0030	2	I	300	0.45	135
59	9151 123rd Ave SE	16-300-0040	3	I	450	0.45	203
60	9181 123rd Ave SE	16-300-0050	2	I	300	0.45	135
61	9209 123rd Ave SE	16-300-0060	2	I	300	0.45	135
62	9239 123rd Ave SE	16-300-0070	2	I	300	0.45	135
63	9267 123rd Ave SE	16-300-0080	2	I	300	0.45	135
64	9295 123rd Ave SE	16-300-0090	2	I	300	0.45	135
65	9325 123rd Ave SE	16-300-0100	2	I	300	0.45	135
66	9353 123rd Ave SE	16-300-0110	2	I	300	0.45	135
67	9383 123rd Ave SE	16-300-0120	2	I	300	0.45	135
68	9439 123rd Ave SE	16-300-0140	2	I	300	0.45	135
69	9469 123rd Ave SE	16-300-0150	2	I	300	0.45	135
70	9497 123rd Ave SE	0160 & 16-50	1	I	150	0.45	68
71	9628 123rd Ave SE	16-400-0200	3	I	450	0.45	203
72	9555 123rd Ave SE	16-500-0020	1	I	150	0.45	68
73	9583 123rd Ave SE	16-500-0030	2	I	300	0.45	135
74	9613 123rd Ave SE	16-500-0040	2	I	300	0.45	135
75	9641 123rd Ave SE	16-500-0050	4	I	600	1.00	600
76	9669 123rd Ave SE	16-500-0060	2	I	300	0.45	135
77	9677 123rd Ave SE	16-500-0070	2	I	300	0.45	135
78	9699 123rd Ave SE	16-500-0080	3	I	450	0.45	203
79	9727 123rd Ave SE	16-026-0070	1	I	150	0.45	68
80	9755 123rd Ave SE	16-026-0060	1	I	150	0.45	68
81	9716 123rd Ave SE	16-325-0020	2	I	300	0.45	135
82	9783 123rd Ave SE	0170 & 16-3	2	I	300	0.45	135
83	9813 123rd Ave SE	16-300-0182	3	I	450	0.45	203
84	9841 123rd Ave SE	16-300-0180	2	I	300	0.45	135
85	9872 123rd Ave SE	16-026-0093	3	I	450	0.45	203
86	9855 123rd Ave SE	16-026-0090	3	I	450	0.45	203
87	9867 123rd Ave SE	16-026-0092	4	I	600	1.00	600
88	9881 123rd Ave SE	16-300-0190	1	I	150	0.45	68
89	12388 Big Kandi Drive	16-300-0195	3	I	450	0.45	203
90	12420 Big Kandi Drive	0-0200 & 16-30	4	I	600	1.00	600
91	12448 Big Kandi Drive	16-300-0220	1	I	150	0.45	68
92	12462 Big Kandi Drive	16-300-0240	2	I	300	0.45	135

CAR Map ID#	Address	Parcel ID#	# Bedroom	Dwelling Classification*	Flow (gpd)	Reduction Factor	Wastewater Flow (gpd)
93	12476 Big Kandi Drive	16-300-0230	2	I	300	0.45	135
94	12490 Big Kandi Drive	16-300-0260	2	I	300	0.45	135
95	12502 Big Kandi Drive	16-300-0250	2	I	300	0.45	135
96	12516 Big Kandi Drive	16-300-0270	2	I	300	0.45	135
97	12530 Big Kandi Drive	16-300-0280 & 16-300-0290	1	I	150	0.45	68
98	12558 Big Kandi Drive	16-300-0300	1	I	150	0.45	68
99	12572 Big Kandi Drive	16-300-0310	2	I	300	0.45	135
100	12586 Big Kandi Drive	16-300-0315	4	I	600	1.00	600
101	12600 Big Kandi Drive	16-300-0320	3	I	450	0.45	203
102	12616 Big Kandi Drive	16-300-0331	1	I	150	0.45	68
103	12632 Big Kandi Drive	16-300-0330	4	I	600	0.45	270
104	12664 Big Kandi Drive	16-300-0340	3	I	450	0.45	203
105	12680 Big Kandi Drive	16-300-0360	3	I	450	0.45	203
106	12696 Big Kandi Drive	16-300-0370	3	I	450	0.45	203
107	12720 Big Kandi Drive	16-300-0380	2	I	300	0.45	135
108	12744 Big Kandi Drive	16-300-0390	1	I	150	0.45	68
109	12768 Big Kandi Drive	16-026-0150	3	I	450	0.45	203
110	12790 Big Kandi Drive	16-026-0140	2	I	300	0.45	135
111	12810 Big Kandi Drive	16-026-0110	3	I	450	0.45	203
112	12826 Big Kandi Drive	16-026-0120	2	I	300	0.45	135
113	12852 Big Kandi Drive	16-026-0130	2	I	300	0.45	135
114	12872 Big Kandi Drive	16-026-0170	1	I	150	0.45	68
115	12886 Big Kandi Drive	16-026-0180 & 16-350-0190	1	I	150	0.45	68
116	12910 Big Kandi Drive	16-350-0122	2	I	300	0.45	135
117	12924 Big Kandi Drive	16-350-0100	1	I	150	0.45	68
118	12938 Big Kandi Drive	16-350-0110	1	I	150	0.45	68
119	12950 Big Kandi Drive	16-350-0090	1	I	150	0.45	68
120	12972 Big Kandi Drive	16-350-0080	2	I	300	0.45	135
121	12990 Big Kandi Drive	16-350-0070	2	I	300	0.45	135
122	13002 Big Kandi Drive	16-350-0060	2	I	300	0.45	135
123	13022 Big Kandi Drive	16-350-0050	1	I	150	0.45	68
124	13040 Big Kandi Drive	16-350-0040	2	I	300	0.45	135
125	13073 Big Kandi Drive	16-026-0162	3	I	450	0.45	203
126	13062 Big Kandi Drive	16-350-0030	1	I	150	0.45	68
127	13080 Big Kandi Drive	16-350-0020	2	I	300	0.45	135
128	13098 Big Kandi Drive	16-350-0010	3	I	450	0.45	203
129	13110 Big Kandi Drive	16-550-0010	2	I	300	0.45	135
130	13134 Big Kandi Drive	16-550-0020	1	I	150	0.45	68
131	13156 Big Kandi Drive	16-026-0030 & 16-026-0040	3	I	450	0.45	203
132	13161 Big Kandi Drive	16-026-0021	3	I	450	0.45	203
133	13178 Big Kandi Drive	16-550-0040	3	I	450	0.45	203
134	13212 Big Kandi Drive	16-550-0060	4	I	600	0.45	270
135	13244 Big Kandi Drive	16-550-0080	2	I	300	0.45	135
136	13260 Big Kandi Drive	16-550-0090	3	I	450	0.45	203
137	13298 Big Kandi Drive	16-550-0110	3	I	450	0.45	203
138	13318 Big Kandi Drive	16-550-0120	2	I	300	0.45	135

CAR Map ID#	Address	Parcel ID#	# Bedroom	Dwelling Classification*	Flow (gpd)	Reduction Factor	Wastewater Flow (gpd)
139	13332 Big Kandi Drive	16-550-0130	4	I	600	0.45	270
140	13354 Big Kandi Drive	16-550-0140	4	I	600	0.45	270
141	13370 Big Kandi Drive	16-550-0150	1	I	150	0.45	68
142	13386 Big Kandi Drive	16-550-0160	2	I	300	0.45	135
143	13398 Big Kandi Drive	16-551-0010	3	I	450	0.45	203
144	13440 Big Kandi Drive	16-551-0020	3	I	450	0.45	203
145	13419 Big Kandi Drive	16-026-0023	2	I	300	0.45	135
146	13468 Big Kandi Drive	16-026-0050	2	I	300	0.45	135
147	13494 Big Kandi Drive	16-026-0030	2	I	300	0.45	135
148	13558 Big Kandi Drive	16-035-0060	3	I	450	0.45	203

*MN Rule 7080 Classification designation assumed to be Classification I

Total Average Dry Weather (ADW) Flow, gpd: 27,000

Collection system forcemain length (mile) 2.8
Pipe diameter, inch 2

Infiltration/Inflow (200 gpd/in. dia./mi), gpd: 1,200

Total Average Wet Weather (AWW) Flow, gpd: 28,200

North/Northeast Big Kandiyohi Lake Community
Alternative 3: Regionalization to Lake Lillian
Design Wastewater Flow

# Households in Project Area	147	
Population	294	1.9 persons per household (use 2 persons) (US Census for East Lake Lillian Township, MN)

WASTEWATER FLOW

Residential Flow (gpd)	29,400	100 gpcd (10-States Standards 11.243)
Commercial Flow (gpd)	300	MN Rules 7081.0130
Total Average Wet Weather Flow (gpd)	29,700	

APPENDIX D

Grinder Station Detail





HYDROMATIC[®]
SEWAGE GRINDER PUMPS
AND PACKAGES

Submersible Grinder Pumps

2 HP Submersible Grinders

Hydromatic® 2 HP grinder pumps offer a proven method of reducing residential waste into a fine slurry for ideal transfer to a variety of sewage treatment operations.



Centrifugal Grinders

Our centrifugal grinders use an exclusive dual-cutter design that prevents clogging, binding and roping in a wide range of operating conditions. These cutters cut waste twice to reduce it to an even finer slurry. The first cut is performed by the radial cutter; the second by the axial cutter that recuts the waste in a perpendicular direction to the radial cutters. Centrifugal grinders offer a number of semi-open vortex impeller diameters to generate dependable performance over a wide range of flow and head conditions.

Semi-Positive Displacement Grinders

Semi-positive displacement grinders feature a progressing cavity design with a Buna-N stator for extended durability in the high head conditions required by low pressure sewer systems.

Non-Submersible Grinders

Non-submersible grinder pumps offer the same reliable service that comes with a submersible grinder pump. Our exclusive dual cutters reduce waste into a fine slurry for ideal transfer to a variety of sewage treatment applications. Available with either cast iron or navy M bronze pump ends, these pumps provide the service you need when your application doesn't require a submersible pump.

2 HP Grinder Packages

Hydromatic 2 HP grinder packages provide the superior quality of Hydromatic grinder pumps combined with the highest quality fittings and controls. A control panel specifically designed to optimize pump performance, packaged all together in a durable UV-resistant basin, make for quick and easy installation.

TL-Pro System

Liftout rail system for centrifugal grinders provides ease of installation and removal of the pump. The TL-Pro system uses a cast iron discharge elbow with integrated ball check valve, and is available with spark-proof rails for hazardous locations.



Available with:

- HPGR200
- HPG(X)200
- HGRS200



TL-Pro liftout valve with integral ball check valve.

TG-Pro System

Flexible piping system with slip-fit discharge connection provides ease of installation and removal for all 2 HP grinders. Pumps include a stainless steel stand.



Available with:

- HPD200
- HPG200
- HPGR200
- HGRS200



Heavy-duty 1 1/4" flexible pipe and easy slip-fit connection allows for quick installations and servicing.

TH-Pro System

Factory assembled discharge piping with single union ball valve disconnect eliminates installation errors and reduces installation time dramatically.



Available with:

- HPD200 and HPGR200



Ball valve with union disconnect allows easy removal of the pump and piping.

Innovative solid state control panel with hand-contact sensor to control the alarm functions and integrated alarm light and buzzer. The control panel includes on-board pumping system diagnostics with pump run time counter and pump cycle counter.

Submersible Grinder Pumps

TL-Pro and TG-Pro

Using an exclusive control circuit board built to maximize the performance of Hydromatic 2 HP grinder pumps, the Novus 1000 Plus Series control panel is an integral part of the 2 HP grinder package. Standard features include lockable latches, sub-door, raised back panel, flashing red alarm light, electronic horn and "Touch-to-Silence" pad in a NEMA 4X enclosure.

Standard Features and Benefits

- 24" fiberglass basin
- UV-resistant basin and lid
- Brass shut-off valve
- Built-in anti-siphon protection
- NEMA 6 JBox
- Weighted float switches
- Slip-fit connection ball check valve
- Pressure-relief valve (HPD200 models only)



NOVUS
1000 PLUS SERIES

3, 5 & 7.5 HP Submersible Grinders

When your waste removal needs exceed the capabilities of the residentially designed 2 HP submersible grinders, Hydromatic offers a complete line of 3, 5 & 7.5 HP submersible grinder pumps with a variety of high flow and high head conditions. These grinders use the exclusive dual cutter grinder system and have dual seals for added motor protection and are available for Class I and Class II hazardous locations.

Hydromatic 3, 5 & 7.5 HP grinder packages combine the quality of Hydromatic grinder pumps with our exclusive Novus Series of control panels. Available with a variety of material and NEMA-rating enclosures, Novus Series control panels use state-of-the-art digital controllers to optimize operation of your simplex, duplex or triplex grinder system.

PR Rail System

Non-corrosive lift-out rail system designed for horizontal discharge pumps (HPGFH/HPGHH) feature a reliable connection/disconnection system, including a diaphragm gasket, for sealing to the discharge elbow. The system will accept 3" flow.



Submersible Grinder Guide

		Single Seal			Dual Seal			Hazardous Location		
		HGRS200	HPGR200	HPD200	HPG200	HPGH / HPGHH	HPGF / HPGFH	HPG(X)200	HPGH(X) / HPGHH(X)	HPGF(X) / HPGFH(X)
Cord Entry: Sealed for maximum protection from wicking and water seepage into the motor housing.	Compression Fitting	X	X	X	X	X	X	X	X	X
	Epoxy Barrier				X	X	X	X	X	X
	O-Rings				X	X	X	X	X	X
	Connection Box								X	X
Bearings: Heavy-duty ball bearings, upper (radial) and lower (thrust), are continuously lubricated by oil to ensure long service life.		X	X	X	X	X	X	X	X	X
Motor: Oil-filled motor provides superior cooling and permanent lubrication of bearings, low maintenance and extended service life. Electrical design combines the advantages of high torque output with optimum running efficiency engineered specifically for grinder operation.	Single Phase: Start capacitors for maximum starting torque. Motor windings contain automatic thermal overload protection.	2 HP 230V 60 Hz 3450 RPM	2 HP 230V 60 Hz/50 Hz 3450/2900 RPM	2 HP 230V 60 Hz/50 Hz 1750/1460 RPM	2 HP 200/230V 60 Hz/50 Hz 3450/2900 RPM	3 & 5 HP 200/230V 60 Hz/50 Hz 3450/2900 RPM	3 & 5 HP 200/230V 60 Hz/50 Hz 1750/1460 RPM	2 HP 200/230V 60 Hz/50 Hz 3450/2900 RPM	3 & 5 HP 200/230V 60 Hz/50 Hz 3450/2900 RPM	3 & 5 HP 200/230V 60 Hz/50 Hz 1750/1460 RPM
	Three Phase				2 HP 200/230/460/575V 60 Hz/50 Hz 3450/2900 RPM	3, 5, 7½ HP 200/230/460/575V 60 Hz/50 Hz 3450/2900 RPM	3, 5, 7½ HP 200/230/460/575V 60 Hz/50 Hz 1750/1460 RPM	2 HP 200/230/460/575V 60 Hz/50 Hz 3450/2900 RPM	3, 5, 7½ HP 200/230/460/575V 60 Hz/50 Hz 3450/2900 RPM	3, 5, 7½ HP 200/230/460/575V 60 Hz/50 Hz 1750/1460 RPM
Stator Bolts: Stator is secured to the motor housing by means of stator bolts which ensures ease of maintenance if the need ever arises.		X	X	X	X	X	X	X	X	X
Shaft: Stainless steel shaft to eliminate corrosion and fatigue for longer pump life. Minimized shaft overhang decreases deflection and increases bearing and seal life.		X	X	X	X	X	X	X	X	X
Seals: Mechanical seal constructed with a ceramic stationary face and a carbon rotating face. Field-proven for long service life.	Single Seal	X	X	X	X	X	X	X	X	X
	Dual Seal: Maximum moisture protection for the motor.				X	X	X	X	X	X
Moisture Probes: Electrical sensors to detect the presence of moisture in the seal chamber before it damages the motor.	Single Probe				X	X	X			
	Two Probes: Redundant protection from moisture intrusion							X	X	X
Cutters: Reduce solids to the smallest particle size, thereby greatly reducing clogging, roping or binding.	High efficiency cutter	X		X						
	Exclusive dual cutter design		X		X	X	X	X	X	X
Discharge	1½" NPT vertical discharge	X	X	X	X			X		
	2" NPT vertical discharge					X	X		X	X
	3" 125 lb. horizontal flange					X	X		X	X
Impeller: Multi-vane, semi-open impeller precludes material buildup around shaft and seal.	Valox® with insert	X	X		X	X	X			
	Cast bronze				X			X	X	X
Progressing Cavity: Semi-positive displacement feed system designed specifically for LPS applications. 300 Series stainless steel single lobe rotor and Buna-N double helix stator for extended life.				X						



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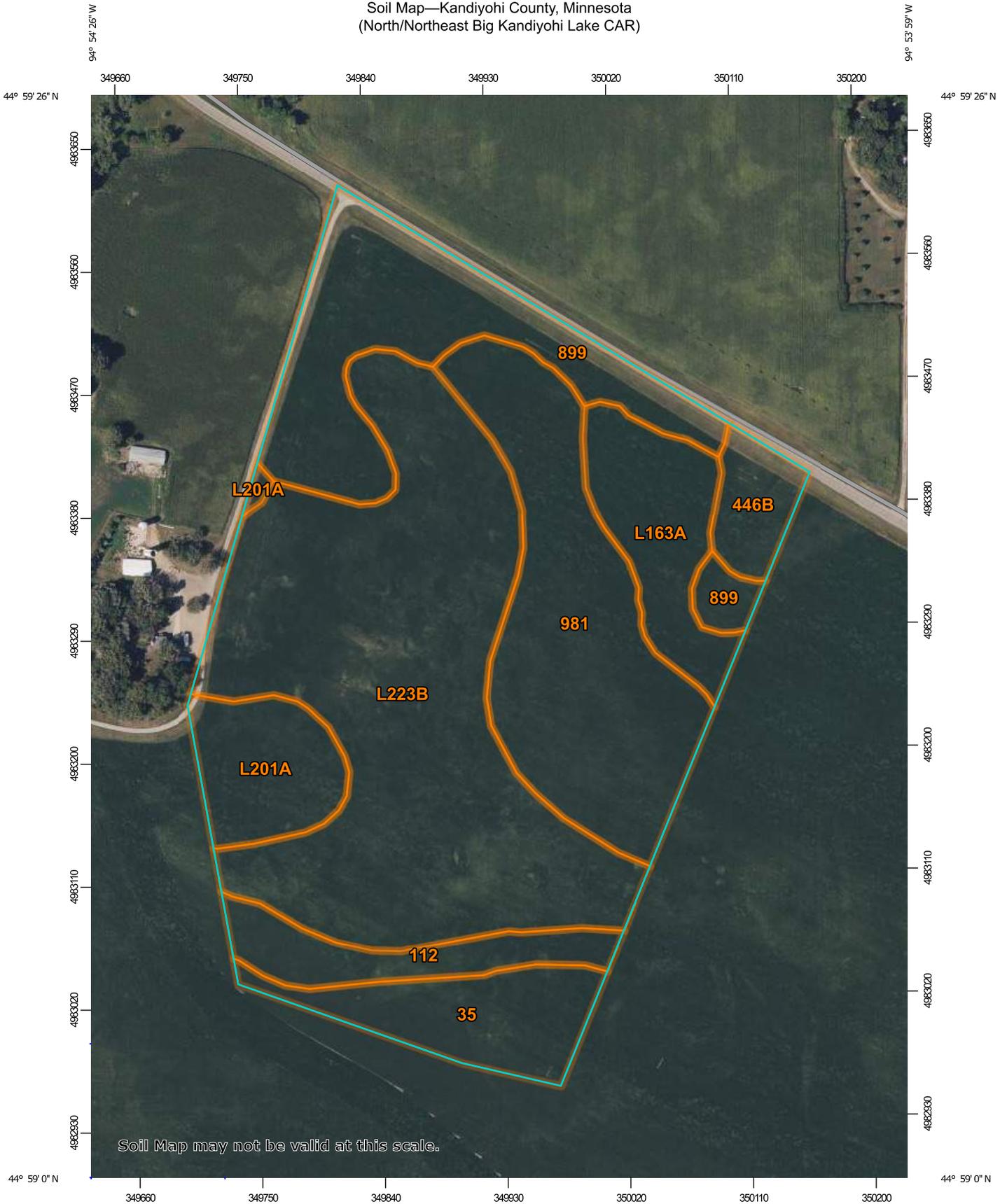
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APPENDIX E

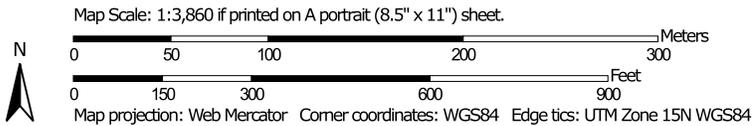
Soil Information



Soil Map—Kandiyohi County, Minnesota
(North/Northeast Big Kandiyohi Lake CAR)



Soil Map may not be valid at this scale.



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 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

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: Kandiyohi County, Minnesota

Survey Area Data: Version 22, Sep 10, 2023

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

Date(s) aerial images were photographed: Aug 9, 2021—Sep 15, 2021

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

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
35	Blue Earth mucky silt loam, 0 to 1 percent slopes	3.0	6.5%
112	Harps clay loam, 0 to 2 percent slopes	2.2	4.8%
446B	Normania loam, 2 to 5 percent slopes	1.3	2.8%
899	Harps-Okoboji complex, 0 to 2 percent slopes	7.0	14.9%
981	Canisteo-Harps loams	8.7	18.8%
L163A	Okoboji silty clay loam, 0 to 1 percent slopes	3.2	7.0%
L201A	Normania loam, 1 to 3 percent slopes	2.6	5.6%
L223B	Amiret-Swanlake loams, 2 to 6 percent slopes	18.5	39.6%
Totals for Area of Interest		46.6	100.0%

Established Series
Rev. RCG-AGG-TWN
05/2016

AMIRET SERIES

The Amiret series consists of very deep, well drained soils that formed in loamy, calcareous, friable till. These soils are on convex knolls and side slopes on ground moraines and till plains. Slope ranges from 2 to 6 percent. Mean annual precipitation is about 800 millimeters. Mean annual air temperature is about 8 degrees C.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Calcic Hapludolls

TYPICAL PEDON: Amiret loam, on a convex slope of 3 percent, on the summit of a knoll, on a till plain, in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 18 centimeters; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak medium granular; friable; common fine roots; about 4 percent gravel; neutral; abrupt smooth boundary.

A--18 to 30 centimeters; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; common fine roots; about 4 percent gravel; neutral; clear smooth boundary.

Bw--30 to 51 centimeters; brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; common fine roots; about 2 percent gravel; neutral; clear smooth boundary.

Bk1--51 to 76 centimeters; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure; friable; few fine roots; carbonates segregated in common light gray (10YR 7/2) rounded soft masses; about 2 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2--76 to 127 centimeters; olive brown (2.5Y 4/4) loam; weak coarse subangular blocky structure parting to weak medium platy; friable; calcium carbonates segregated in common light gray (10YR 7/2) rounded fine soft masses; few fine distinct dark yellowish brown (10YR 4/6) iron concentrations and few fine distinct gray (2.5Y 6/1) iron depletions; few strong brown (7.5YR 5/6) iron concentrations on ped exteriors; about 6 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

Bck1--127 to 170 centimeters; light olive brown (2.5Y 5/4) loam; weak medium platy structure; friable; calcium carbonates segregated in few light gray (10YR 7/2) rounded fine soft masses; few fine prominent dark yellowish brown (10YR 4/6) iron concentrations and few fine distinct gray (2.5Y 6/1) iron depletions; few strong brown (7.5YR 5/6) iron concentrations on ped exteriors; few fine black (10YR 2/1) manganese accumulations in ped exteriors; about 6 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

Bck2--170 to 203 centimeters; light olive brown (2.5Y 5/4) loam; massive; friable; calcium carbonates segregated in few light gray (10YR 7/2) rounded fine soft masses; few fine prominent dark yellowish brown (10YR 4/6) iron concentrations; few strong brown (7.5YR 5/6) iron concentrations on ped exteriors; common fine black (10YR 2/1) manganese accumulations in ped exteriors; about 6 percent gravel; strongly effervescent; slightly alkaline.

TYPE LOCATION: Major Land Resource Area (MLRA) 103-Central Iowa and Minnesota Till Prairies,

Renville County, Minnesota subset; about 4 miles east and 8 miles south of the town of Sacred Heart; located about 175 feet north and 2,000 feet east of the southwest corner of section 13, T. 114 N., R. 37 W.; USGS Mount Iverson Lake topographic quadrangle; lat. 44 degrees 40 minutes 23 seconds N. and long. 95 degrees 15 minutes 04 seconds W., NAD 83.

RANGE IN CHARACTERISTICS:

Mollic epipedon thickness--17 to 49 centimeters

Depth to carbonates--35 to 100 centimeters

Clay content in the particle-size control section (weighted average)--18 to 32 percent

Sand content in particle-size control section (weighted average)--25 to 45 percent

Rock fragment content--2 to 8 percent, mixed lithology, shale fragments 2 to 10 millimeters in size, are common

Ap or A horizon:

Hue--10YR

Value--2 or 3

Chroma--1 to 3

Texture--clay loam or loam

Clay content--18 to 32 percent

Sand content--25 to 45 percent

Reaction--pH 6.1 to 7.3

Moist bulk density--1.35 to 1.45 g/cc

Thickness--15 to 49 centimeters

Some pedons have a AB or BA horizon less than 15 centimeters thick

Bw horizon:

Hue--10YR or 2.5Y

Value--3 to 5

Chroma--3 or 4

Texture--clay loam or loam

Clay content--18 to 32 percent

Sand content--25 to 45 percent

Reaction--pH 6.1 to 7.3

Moist bulk density--1.30 to 1.45 g/cc

Thickness--10 to 60 centimeters

Bk horizon:

Hue--10YR or 2.5Y

Value--4 to 6

Chroma--3 or 4

Texture--clay loam or loam

Clay content--18 to 32 percent

Sand content--25 to 45 percent

Reaction--pH 7.4 to 8.4

Calcium carbonate equivalent--15 to 25 percent; 5 percent or more higher than the underlying horizon(s)

Moist bulk density--1.35 to 1.55 g/cc

Thickness--30 to 150 centimeters

BCK, Ck, BC or C horizon:

Hue--10YR or 2.5Y

Value--4 to 6

Chroma--2 to 4

Texture--clay loam or loam

Clay content--18 to 32 percent

Sand content--25 to 45 percent
Reaction--pH 7.4 to 8.4
Calcium carbonate equivalent--10 to 20 percent
Moist bulk density--1.35 to 1.55 g/cc

COMPETING SERIES: These are the [Annton](#) and [Ves](#) series.

[Annton](#)--have a clay content of 24 to 35 percent and a moist bulk density range of 1.45 to 1.65 g/cc in the lower third of the series control section

[Ves](#)--do not have a frequently saturated zone within a depth of 1.8 meters during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation

GEOGRAPHIC SETTING:

Parent material--loamy, calcareous, friable till
Landform--convex knolls and side slopes on ground moraines and till plains
Slope--2 to 6 percent
Elevation--210 to 560 meters above sea level
Mean annual air temperature--6 to 11 degrees C
Mean annual precipitation--610 to 930 millimeters
Frost-free period--140 to 180 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Canisteo](#), [Glencoe](#), [Normania](#), [Seaforth](#), [Swanlake](#), [Ves](#), and [Webster](#) soils.

[Canisteo](#)--are on lower landscape positions and are frequently saturated from the surface to a depth of 0.3 meter during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation

[Glencoe](#)--are on lower landscape positions in depressions and have a mollic epipedon 60 to more than 200 centimeters thick

[Normania](#)--are on slightly lower landscape positions and have a frequently saturated zone between depths of 0.5 and 1.2 meters during the wettest periods of the year when precipitation is within one standard deviation of the 30 year mean of annual precipitation

[Seaforth](#)--are on slightly lower landscape positions and have carbonates in all parts of the series control section

[Swanlake](#)--are on higher landscape positions on convex side slopes and have carbonates in all parts of the series control section

[Ves](#)--are on higher landscape positions on convex side slopes and do not have a frequently saturated zone within the series control section during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation

[Webster](#)--are on lower landscape positions and are frequently saturated from the surface to a depth of 0.3 meter during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:

Drainage class--well drained--a frequently saturated zone between 1.0 to 1.8 meters during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation

Saturated hydraulic conductivity 1.00 to 10.00 micrometers per second

USE AND VEGETATION:

Most areas are cultivated. The principal crops are corn, small grains and soybeans. The native vegetation is big bluestem, little bluestem, switchgrass, and other grasses of the tall grass prairie.

DISTRIBUTION AND EXTENT:

Physiographic Division--Interior Plains
Physiographic Province--Central Lowland
Physiographic Section--Western lake section
MLRA--Central Iowa and Minnesota Till Prairies (103)

LRR--M; south-central and southwestern Minnesota
Extent--moderate

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota
MLRA SSO 10-ALB (Albert Lea, Minnesota).

SERIES ESTABLISHED: Renville County, Minnesota, 1995.

REMARKS:

Particle-size control section--the zone from a depth of 25 to 100 centimeters; series control section--the zone from the surface to a depth of 150 centimeters.

Diagnostic horizons and features recognized in this pedon are:

mollic epipedon-- the zone from the surface to a depth of 30 centimeters (Ap and A horizon);
cambic horizon--the zone from a depth of 30 to 51 centimeters (Bw horizon); calcic horizon--the zone from a depth of 51 to 127 centimeters (Bk1 and Bk2 horizons);
udic moisture regime.

This soil was formerly included in the Ves series. However, it was separated due to soil saturation in the lower part of the pedon in normal years.

Cation-exchange activity class is inferred from lab data from similar soils in the surrounding area.

Taxonomy version--Keys to Soil Taxonomy, tenth edition, 2006.

ADDITIONAL DATA:

Laboratory data--refer to Minnesota Agricultural Experiment Station CFC numbers 4605, 4606, and 1314 for results of similar pedons.

National Cooperative Soil Survey
U.S.A.

Established Series
Rev. TCJ-RCG-AGG
09/2006

SWANLAKE SERIES

The Swanlake series consists of very deep, well drained soils that formed in loamy calcareous till on ground moraines and till plains. Slope ranges from 2 to 6 percent. Mean annual air temperature is about 9 degrees C (48 degrees F). Mean annual precipitation is about 711 mm (28 inches).

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Typic Calcudolls

TYPICAL PEDON: Swanlake loam, on a south-facing, convex slope of 6 percent, in a cultivated field, at an elevation of about 459 m (1,505 feet). (Colors are for moist soil unless otherwise noted.)

Ap--0 to 23 cm (0 to 9 inches); very dark grayish brown (10YR 3/2) loam; grayish brown (2.5Y 5/2) dry; weak fine subangular blocky structure; very friable; about 4 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary. [18 to 28 cm (7 to 11 inches thick)]

Bk1--23 to 71 cm (9 to 28 inches); light olive brown (2.5Y 5/4) loam; weak fine subangular blocky structure; very friable; many very dark gray (10YR 3/1) worm casts; common light brownish gray (2.5Y 6/2) lime masses; about 6 percent gravel; violently effervescent; slightly alkaline; clear irregular boundary.

Bk2--71 to 94 cm (28 to 37 inches); light olive brown (2.5Y 5/4) loam; moderate medium subangular blocky structure parting to weak fine subangular blocky; very friable; about 5 percent gravel; common light brownish gray (2.5Y 6/2) lime masses; violently effervescent; slightly alkaline; clear wavy boundary.

Bk3--94 to 109 cm (37 to 43 inches); light olive brown (2.5Y 5/4) loam; moderate medium subangular blocky structure; very friable; about 8 percent gravel; few fine prominent olive (5Y 5/6) Fe concentrations and common coarse prominent olive gray (5Y 5/2) Fe depletions; many soft light brownish gray (2.5Y 6/2) lime masses; violently effervescent; slightly alkaline; clear wavy boundary. [15 to 127 cm (Thickness of the Bk horizon is 6 to 50 inches.)]

C--109 to 152 cm (43 to 60 inches); light olive brown (2.5Y 5/4) loam; massive; friable; about 5 percent gravel; common medium distinct yellowish brown (10YR 5/4) and few coarse prominent yellowish red (5YR 5/8) Fe concentrations; few light brownish gray (2.5Y 6/2) lime masses; violently effervescent; moderately alkaline.

TYPE LOCATION: Cottonwood County, Minnesota; about 1 mile east and 4.5 miles south of Jeffers; located about 762 m (2,500 feet) north and 61 m (200 feet) east of the southwest corner of section 16, T. 106 N., R. 36 W.; USGS Harder Lake topographic quadrangle; lat. 43 degrees 59 minutes 06 seconds N. and long. 95 degrees 10 minutes 47 seconds W., NAD 83.

RANGE IN CHARACTERISTICS: The mollic epipedon is 18 to 36 cm (7 to 14 inches) thick. Carbonates are typically at the surface or are at the surface if the upper 18 cm (7 inches) is mixed. Rock fragments of mixed lithology range from 2 to 10 percent by volume throughout.

The A horizon has hue of 10YR, value of 2 or 3, chroma of 1 or 2. It is loam or silt loam. It has 1 to 10 percent calcium carbonate equivalent. It is slightly alkaline or moderately alkaline.

The Bk horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 to 6. Calcium carbonate equivalent ranges from 15 to 30 percent. It is loam or clay loam. Reaction is slightly alkaline or moderately alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 and chroma of 3 to 6. It is loam or clay loam. The calcium carbonate equivalent ranges from 10 to 20 percent. Reaction is slightly alkaline or moderately alkaline. It is friable or firm based on the geomorphic surface it occurs on.

COMPETING SERIES: This is the [Belview](#) series. Belview soils do not have saturation in the lower third of the series control section.

GEOGRAPHIC SETTING: Swanlake soils are on convex slopes with gradients of 2 to 6 percent on ground moraines and till plains. They formed in calcareous, loamy till of Late Wisconsinan Age. Mean annual air temperature ranges from 6 to 10 degrees C (43 to 50 degrees F). Mean annual precipitation ranges from 585 to 890 mm (23 to 35 inches). Frost-free period ranges from 155 to 200 days. Elevation ranges from 213 to 479 m (700 to 1,570 feet) above sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Annton](#) (P) [Amiret](#), [Clarion](#), [Crippin](#), [Delft](#), [Nicollet](#), [Omsrud](#), [Pell Creek](#) (P), [Storden](#), [Walnut Grove](#) (P), [Webster](#) and [Ves](#) series, which are members of a drainage sequence with Swanlake soils. The well drained Annton, Amiret, Clarion, Omsrud and Ves soils are on less convex sideslopes and low rises and knolls. The somewhat poorly drained Crippin, Nicollet, and Walnut Grove soils are on lower lying, less sloping areas. The poorly drained Delft, Pell Creek (P), and Webster soils are on adjacent flats or drainageways. The well drained Storden soils are on the sharply convex knolls and ridges.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Well drained. Surface runoff is low to medium. Saturated hydraulic conductivity is 4.23 to 14.11 micrometers per second (.6 to 2. inches per hour) in the friable till and 1.41 to 4.23 micrometers per second (.6 to 2.0 inches per hour) in the firm till. The apparent seasonal high saturation is as high as 107 centimeters (3.5 feet) at some time from April through June in normal years.

USE AND VEGETATION: Most areas are used to grow row crops. Corn and soybeans are the principal crops. Native vegetation is tall grass prairie.

DISTRIBUTION AND EXTENT: MLRA-103. Southwestern and south central Minnesota. The series is extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota.

SERIES ESTABLISHED: Cottonwood County, Minnesota, 1978.

REMARKS: Diagnostic horizons and features recognized in this pedon are: mollic epipedon - zone from surface to a depth of 23 cm (9 inches) (Ap horizon); calcic horizon - the zone from 23 to 94 cm (9 to 37 inches) (Bk1 and Bk2 horizons); udic moisture regime. These soils formerly were included with mapping units of Clarion and Storden soils. The series concept now has soil saturation in the lower third of the series control section on slopes up to 6 percent. A new series called Belview has been established to replace Swanlake soils that do not have saturation in the lower third of the series control section and are on higher slopes.

Currently, a firm clay loam till C horizon is associated with the Gary moraine in Minnesota. A friable loam till C horizon is associated with the Bemis and Altamont moraines in Minnesota. A glacial till study and distribution of similar soils by geomorphic areas in Minnesota is needed to more accurately characterize this series by landform.

ADDITIONAL DATA: Soil Interpretation record numbers MN0142-moderate permeability; MN0317-moderately slow permeability. Central File Code Nos. 2103 for some data on the typical pedon and to 2104 and 2105 for data on two additional pedons. Soil Interpretation Record number MN0300.

Established Series
Rev. HLH-KMB-JJB
04/2013

NORMANIA SERIES

The Normania series consists of very deep, moderately well drained soils that formed in loamy calcareous till. These soils are on slightly concave to slightly convex slopes on upper parts of drainageways and swales on ground moraines and till plains. Slope ranges from 0 to 3 percent. Mean annual precipitation is about 610 to 930 millimeters, and mean annual air temperature is about 8 degrees C.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Aquic Hapludolls

TYPICAL PEDON: Normania loam on a slightly concave foot slope of 2 percent, on a till plain in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap-- 0 to 15 centimeters; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; about 2 percent gravel; neutral (pH 7.0); abrupt smooth boundary.

A-- 15 to 33 centimeters; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; about 2 percent gravel; neutral (pH 7.0); clear irregular boundary.

AB-- 33 to 43 centimeters; very dark gray (10YR 3/1) loam, very dark grayish brown (2.5Y 3/2) crushed; dark grayish brown (10YR 4/2) dry; weak very fine and fine subangular blocky structure; friable; many dark grayish brown (2.5Y 4/2) worm casts; about 2 percent gravel; neutral (pH 7.0); clear irregular boundary.

Bw-- 43 to 66 centimeters; dark grayish brown (2.5Y 4/2) loam; weak coarse prismatic structure parting to weak medium subangular blocky; friable; about 3 percent gravel; neutral (pH 7.0); clear irregular boundary.

Bk-- 66 to 91 centimeters; olive brown (2.5Y 4/4) loam; weak medium subangular blocky structure; friable; common medium distinct grayish brown (2.5Y 5/2) iron depletions; about 5 percent gravel; few soft masses of calcium carbonate; strongly effervescent; moderately alkaline (pH 8.2); gradual smooth boundary.

Bkg-- 91 to 127 centimeters; grayish brown (2.5Y 5/2) loam; massive; friable; common medium distinct light olive brown (2.5Y 5/4) iron concentrations; about 5 percent gravel; common soft masses of calcium carbonate; strongly effervescent; moderately alkaline (pH 8.2); gradual smooth boundary.

Cg-- 127 to 200 centimeters; gray (5Y 5/1) loam; massive; friable; common medium prominent light olive brown (2.5Y 5/6) iron concentrations; about 5 percent gravel; few iron oxide stains; slightly effervescent; moderately alkaline (pH 8.2).

TYPE LOCATION: Major Land Resource Area (MLRA) 103 - Central Iowa and Minnesota Till Prairies, Lyon County, Minnesota subset; about 1 mile east of Ghent; located about 180 feet north and 125 feet east of the southwest corner of section 11, T. 112 N., R. 42 W; USGS Minnesota quadrangle, lat. 44 degrees 30 minutes 59 seconds N and long. 95 degrees 52 minutes 37 seconds W., NAD 83.

RANGE IN CHARACTERISTICS:

Depth to carbonates--50 to 90 centimeters

Thickness of mollic epipedon is--25 to 50 centimeters

Rock fragment content--1 to 8 percent by volume throughout, mixed lithology and size(shale fragments 2 to 10 mm in size are a common component)

Clay content of the particle size control section ranges--18 to 33 percent and the sand content ranges from 30 to 50 percent throughout

Ap and A horizon:

Hue--10YR

Value--2 or 3

Chroma--1 or 2

Texture--loam or clay loam

Reaction--pH 6.1 to 7.3

Thickness--30 to 45 centimeters

AB horizon: (when present)

Hue--10YR

Value--2 or 3

Chroma--1 to 3

Texture--loam or clay loam

Thickness--0 to 25 centimeters

Bw horizon:

Hue--2.5Y or 10YR

Value-- 3 or 4

Chroma--2 to 4

Texture-- loam or clay loam

Reaction--pH 6.1 to 7.3

Thickness--15 to 45 centimeters

Bk and Bkg horizon:

Hue--2.5Y

Value--4 or 5

Chroma--2 to 4

Texture-- loam or clay loam

Reaction--pH 7.4 to 8.4

Calcium carbonate equivalent--15 to 25 percent

Thickness--15 to 100 centimeters

Cg or C horizon:

Hue--2.5Y or 5Y

Value--4 to 6

Chroma--1 through 4

Texture--loam or clay loam

Reaction--pH 7.4 to 8.4

Calcium carbonate equivalent--10 to 20 percent

Moist bulk density--1.40 to 1.50 g/cc

COMPETING SERIES: These are the [Arkton](#), [Crippin](#), [Fostoria](#), [Kensett](#), [Merton](#), [Nicollet](#), [Ottosen](#), [Readlyn](#), [Snider](#), [Stone](#), Walnut Grove, and [Wilmington](#) series.

[Arkton](#)--have a bulk density of 1.6 g/cc or greater in the lower third of the series control section

[Crippin](#)--have carbonates within a depth of 25 centimeters

[Fostoria](#)--do not have rock fragments in the upper two thirds of the series control section

[Kensett](#)--have a lithic contact within a depth of 100 centimeters

[Merton](#) --do not have coarse fragments in the upper third of the series control section
[Nicollet](#)--do not have a calcic horizon in the series control section
[Ottosen](#)--have less than 25 percent sand in the upper third of the series control section
[Readlyn](#)--do not have carbonates within a depth of 100 centimeters and have a moist bulk density of 1.75 to 1.90 g/cc in the lower third of the series control section
[Snider](#)--do not have coarse fragments in the series control section
[Stone](#)--have a lithic contact within a depth of 150 centimeters
Walnut Grove--have a moist bulk density of 1.45 to 1.65 g/cc in the lower third of the series control section
[Wilmonton](#)--have a moist bulk density of 1.6 to 1.8 g/cc in the lower third of the series control section, and have less than 25 percent sand in the upper third of the series control section

GEOGRAPHIC SETTING:

Parent material--loamy calcareous till
Landform--slightly concave to slightly convex slopes on upper parts of drainageways and swales on ground moraines and till plains
Geologic formation--Des Moines Lobe of the late Wisconsin glaciation
Slope--0 to 3 percent
Elevation--210 to 560 meters above sea level
Mean annual air temperature--6 to 11 degrees C
Mean annual precipitation--610 to 930 millimeters
Frost-free period--150 to 200 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Amiret](#), [Canisteo](#), [Seaforth](#), [Ves](#), and [Webster](#) soils.

[Amiret](#)--are on slightly higher landscape position and have a saturated zone greater than 100 centimeters during the wettest periods of the year

[Canisteo](#)--are on lower landscape positions and are frequently saturated from the surface to a depth of 30 centimeters during the wettest periods of the year

[Seaforth](#)--have carbonates in all parts of the series control section

[Ves](#)--are on higher landscape positions on convex side slopes and do not have a frequently saturated zone within a depth of 180 centimeters during the wettest periods of the year

[Webster](#)--are on lower landscape positions and are frequently saturated from the surface to a depth of 0.3 meter during the wettest periods of the year

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:

Drainage class--moderately well--a zone of saturation is found between depths of 50 to 120 centimeters in the wettest months of normal years.

Saturated hydraulic conductivity--4.2 to 14.1 micrometers per second (moderately high)

USE AND VEGETATION: Most areas are cultivated. The principal crops are corn, soybeans, and small grains. Native vegetation is tall grass prairie.

DISTRIBUTION AND EXTENT:

Physiographic Division--Interior Plains

Physiographic Province--Central Lowland

Physiographic Section--Western Lake section

MLRA--Central Iowa and Minnesota Till Prairies (103)

LRR M; south-central and southwestern Minnesota

Extent--large

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Lyon County, Minnesota, 1976.

REMARKS:

Particle-size control section--the zone from a depth of 25 to 100 cm;
Series control section--the zone from the surface to a depth of 150 cm.

Diagnostic horizons and features recognized in this pedon are:

mollic epipedon--the zone from the surface to a depth of 43 centimeters (Ap, A and AB horizons);

cambic horizon--the zone from 43 to 66 centimeters (Bw horizon);

calcic horizon--the zone from 66 to 127 centimeters (Bk1 and Bk2 horizons);

udic moisture regime;

aquic subgroup--iron depletions in calcic horizon (Bk)

Drainage and saturation was revised to align with historical series concept following an analysis of Taxonomic Unit Description pedons throughout MLRA 103.

MLRA SSO Responsible: 10-ALB (Albert Lea, Minnesota)

Taxonomy version--Keys to Soil Taxonomy, eleventh edition, 2010.

ADDITIONAL DATA:

Pedon 1976MN083500 is the type location.

Laboratory data--Pedons S1976MN173-000 (2301), S1978MN015-024 (2720), S1978MN015-025 (2721), and S1980MN064-000 (3275) have accompanying University of Minnesota lab data in KSSL.

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Established Series
Rev. AGG-TCJ
06/2015

CANISTEO SERIES

The Canisteo series consists of very deep, poorly and very poorly drained soils that formed in calcareous, loamy till or in a thin mantle of loamy or silty sediments and the underlying calcareous, loamy till. These soils are on rims of depressions, depressions and flats on moraines or till plains. Slope ranges from 0 to 2 percent. Mean air annual temperature is about 9 degrees C. Mean annual precipitation is about 785 millimeters.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, mesic Typic Endoaquolls

TYPICAL PEDON: Canisteo clay loam, on a nearly level to slightly convex slope, on a ground moraine, in a cultivated field. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 25 centimeters inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak medium subangular blocky structure; friable; about 2 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

A--25 to 46 centimeters; very dark gray (N 3/0) clay loam, dark gray (N 4/0) dry; moderate very fine subangular blocky structure; friable; about 2 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg1--46 to 61 centimeters; olive gray (5Y 5/2) loam; weak medium subangular blocky structure; friable; few light gray (2.5Y 7/2) calcium carbonates on faces of peds; few fine prominent olive (5Y 5/6) iron concentrations; about 3 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

Bkg2--61 to 99 centimeters; light olive gray (5Y 6/2) loam; weak medium subangular blocky structure; friable; few light gray (2.5Y 7/2) calcium carbonates on faces of peds; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; about 3 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg1--99 to 165 centimeters; gray (5Y 6/1) loam; massive; friable; common medium prominent light olive brown (2.5Y 5/4) iron concentrations; about 5 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg2--165 to 203 centimeters; gray (5Y 6/1) loam; massive; friable; few dark yellowish brown (10YR 4/6) iron concretions in pores; many medium prominent dark yellowish brown (10YR 4/6) iron concentrations; about 5 percent gravel; slightly effervescent; slightly alkaline.

TYPE LOCATION: Major Land Resource Area (MLRA) 103-Central Iowa and Minnesota Till Prairies, Waseca County, Minnesota subset; about 4.5 miles south and 3 miles west of Waseca; located about 1,800 feet south and 200 feet west of the northeast corner of section 22, T. 108 N., R. 22 W.; USGS Morrystown quadrangle; lat. 44 degrees 8 minutes 52 seconds N. and long. 93 degrees 26 minutes 50 seconds W., NAD 83.

RANGE IN CHARACTERISTICS:

mollic epipedon thickness--25 to 60 centimeters

depth to carbonates--0 to 50 centimeters

Clay content in particle-size control section (weighted average)--20 to 35 percent

Sand content in particle-size control section (weighted average)--25 to 55 percent

Ap and A horizon:

Hue--10YR or is neutral

Value--2 or 3

Chroma--0 or 1

Texture--clay loam, loam, silty clay loam, or silt loam

Clay content--18 to 35 percent

Sand content--18 to 45 percent

Rock fragment content--0 to 8 percent

Calcium carbonate equivalent--5 to 15 percent

Reaction--pH 7.4 to 8.4

Thickness--18 to 60 centimeters

Bg horizon (when present):

Hue--10YR, 2.5Y, or 5Y

Value--4 or 5

Chroma--1 or 2

Texture--clay loam, loam, silty clay loam, silt loam, or sandy loam

Clay content--18 to 35 percent

Sand content--18 to 55 percent

Rock fragment content--0 to 8 percent

Calcium carbonate equivalent--10 to 15 percent

Reaction--pH 7.4 to 8.4

Thickness--0 to 60 centimeters

Bkg horizon:

Hue--10YR, 2.5Y, or 5Y

Value--4 or 5

Chroma--1 or 2

Texture--clay loam, loam, silty clay loam, silt loam, or sandy loam

Clay content--18 to 35 percent

Sand content--18 to 55 percent

Rock fragment content--0 to 8 percent

Calcium carbonate equivalent--15 to 25 percent

Reaction--pH 7.4 to 8.4

Thickness--0 to 60 centimeters

BC or Cg (when present):

Hue--10YR, 2.5Y, or 5Y

Value--4 to 5

Chroma--1 to 4

Texture--clay loam, loam, fine sandy loam, or sandy loam

Clay content--12 to 30 percent

Sand content--18 to 55 percent, poorly sorted

Rock fragment content--2 to 8 percent

Calcium carbonate equivalent--15 to 25 percent

Reaction--pH 7.4 to 8.4

Some pedons have a 2BCg horizon with texture of clay loam and a moist bulk density of 1.60 to 1.80 g/cc (firm till)

COMPETING SERIES: These are the [Hetz](#), [Hooppole](#), [Jeffers](#), [Kish](#), and [Tilfer](#) series.

[Hetz](#)--have a calcium carbonate equivalent range of 0 to 5 percent throughout the series control section
[Hoopole](#)--have a sand content of 75 to 95 percent in the lower third of the series control section
[Jeffers](#)--have an average content of gypsum that ranges from 2 to 5 percent in the particle size control section
[Kish](#)--have a sand content that is well sorted in the lower third of the series control section
[Tilfer](#)--have a lithic contact with limestone bedrock within a depth of 100 centimeters

GEOGRAPHIC SETTING:

Parent material--calcareous, loamy till or a thin mantle of loamy or silty sediments and the underlying calcareous, loamy till
Landform--rims of depressions, depressions and flats on moraines or till plains
Slope--0 to 2 percent
Elevation--200 to 575 meters above sea level
Mean annual air temperature--6 to 12 degrees C
Mean annual precipitation--585 to 990 millimeters
Frost free period--155 to 210 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Clarion](#), [Glencoe](#), [Harps](#), [Nicollet](#), and [Okoboji](#) soils.

[Clarion](#)--are on higher landscape positions on convex slopes and have a frequently saturated zone between depths of 1.2 to 1.8 meters during the wettest periods of years when precipitation is within one standard deviation of 30 year mean annual precipitation

[Glencoe](#) and [Okoboji](#)--are on lower landscape positions in depressions and have a mollic epipedon greater than 60 centimeters thick

[Harps](#)--are on rims of depressions and are violently effervescent in the upper third of the series control section

[Nicollet](#)--are on higher landscape positions on flat and rises and do not have carbonates in the upper third of the series control section

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:

Drainage class--poorly drained and very poorly drained--in an undrained condition, a frequently saturated zone occurs at the surface to a depth of 0.3 meters during the wettest periods of years when precipitation is within one standard deviation of 30 year mean annual precipitation

Saturated hydraulic conductivity--1.00 to 10.00 micrometers per second and 0.10 to 1.00 micrometers per second in the firm till, when present

USE AND VEGETATION:

Most areas are artificially drained and cultivated. The principal crops are corn, soybeans, small grains, and legume hay. Reed canarygrass commonly dominates partially drained pasture. Native vegetation is predominantly wet-site tall prairie species such as prairie cordgrass, switchgrass, big bluestem, woolly sedge, giant goldenrod and Canada goldenrod. The native vegetation on very poorly drained ponded phases is herbaceous marsh species tolerant of excessive wetness such as, cattails, bulrushes, giant burreed, giant reed grass and hydrophytic sedges.

DISTRIBUTION AND EXTENT:

Physiographic Division--Interior Plains

Physiographic Province--Central Lowland

Physiographic sections--Western lake section and Till Plains

MLRAs--Central Iowa and Minnesota Till Prairies (103), Till Plains (102B), and Illinois and Iowa Deep Loess and Drift, East-Central Part (108B)

LRR M; north-central Iowa, south-central Minnesota, southeastern South Dakota, and west-central Illinois

Extent--large

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota.

SERIES ESTABLISHED: Dodge County, Minnesota, 1959.

REMARKS:

Particle-size control section--the zone from a depth of 25 to 100 centimeters;
series control section--the zone from the surface of the soil to a depth of 150 centimeters.

Diagnostic horizons and features recognized in this pedon are:

mollic epipedon--the zone from the surface of the soil to a depth of 46 centimeters (Ap and A horizons);

cambic horizon--the zone from a depth of 46 to 99 centimeters (Bkg1 and Bkg2 horizons);

calcareous family--carbonates in all parts between depths of 25 and 50 centimeters;

aquic moisture regime.

Cation-exchange activity class is inferred from lab data from similar soils in the surrounding area.

The concepts of moderately fine and moderately coarse substratum phases were established by the MLRA-103 steering committee based on an analysis of particle-size data from Iowa and Minnesota. The Des Moines Lobe till generally gets sandier and has less clay as one progresses south along the path of the Des Moines advance. 1/20/2011-TYPE LOCATION error was corrected. 2/2014 - USE AND VEGETATION updated.

Taxonomy versionKeys to Soil Taxonomy, tenth edition, 2006.

National Cooperative Soil Survey
U.S.A.

Established Series
Rev. CSF-RJW-TWN
05/2014

HARPS SERIES

The Harps series consists of very deep, poorly drained soils formed in till or alluvium derived from till. Harps soils are on narrow rims or shorelines of depressions on till plains and moraines. Slope ranges from 0 to 3 percent. Mean annual air temperature is about 8 degrees C. Mean annual precipitation is about 675 millimeters.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Typic Calciaquolls

TYPICAL PEDON: Harps clay loam, on a nearly level rim of a depression, in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 20 centimeters; black (10YR 2/1) clay loam, dark gray (5Y 4/1) dry; moderate fine granular structure; friable; about 5 percent rock fragments; violently effervescent; moderately alkaline; abrupt smooth boundary.

Ak1--20 to 31 centimeters; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; about 5 percent rock fragments; violently effervescent; moderately alkaline; clear smooth boundary.

Ak2--31 to 41 centimeters; very dark gray (N 3/0) with about 20 percent dark gray (5Y 4/1) clay loam, gray (10YR 5/1) dry; weak fine and very fine subangular blocky structure; friable; common medium prominent light gray (10YR 7/2) masses of calcium carbonate; about 3 percent rock fragments; violently effervescent; moderately alkaline; clear wavy boundary. (Combined thickness of the A horizon is 30 to 60 centimeters.)

Bkg1--41 to 66 centimeters; mixed light olive gray (5Y 6/2) and gray (5Y 5/1) loam, weak fine subangular blocky structure; very friable; few very dark gray (10YR 3/1) krotovinas; many fine and medium distinct light gray (10YR 7/2) masses of calcium carbonate; common fine prominent dark yellowish brown (10YR 4/4) redoximorphic concentrations; about 3 percent rock fragments; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg2--66 to 86 centimeters; mixed olive gray (5Y 5/2) and gray (5Y 5/1) loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; about a 3 centimeter very dark gray (10YR 3/1) krotovina; many fine and medium prominent light gray (10YR 7/1) masses of calcium carbonate; many fine prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; about 3 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bkg3--86 to 107 centimeters; mixed olive gray (5Y 5/2) and gray (5Y 5/1) loam; weak medium prismatic structure parting to very weak medium subangular blocky; friable; few dark gray (5Y 4/1) and very dark gray (N 3/0) coats on faces of peds; about a 3 centimeter very dark gray (N 3/0) krotovina; common medium prominent light gray (10YR 7/1) masses of calcium carbonate; many fine prominent dark yellowish brown (10YR 4/4) redoximorphic concentrations; about 5 percent rock fragments; strongly effervescent; moderately alkaline; diffuse smooth boundary.

Bkg4--107 to 160 centimeters; gray (5Y 5/1) loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; common prominent strong brown (7.5YR 5/6) iron coats on faces of peds; few

medium prominent light gray (10YR 7/1) masses of calcium carbonate; many fine prominent dark yellowish brown (10YR 4/4) redoximorphic concentrations; about 5 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary. (Combined thickness of the Bkg horizon is 60 to 130 centimeters.)

BCg--160 to 200 centimeters; dark gray (5Y 4/1) loam; weak coarse prismatic structure; firm; common prominent strong brown (7.5YR 5/6) iron coats on faces of peds; common medium prominent red (2.5YR 4/6) masses of iron; few fine prominent light gray (10YR 7/2) masses of calcium carbonate; about 7 percent rock fragments; strongly effervescent; moderately alkaline.

TYPE LOCATION: Major Land Resource Area (MLRA) 103-Central Iowa and Minnesota Till Prairies, Webster County, Iowa subset; about 8 miles east of Fort Dodge; located about 225 feet west and 2,180 feet north of the southeast corner of section 23, T. 89 N., R. 27 W.; USGS Eagle Grove SW topographic quadrangle; lat. 42 degrees 30 minutes 26 seconds N. and long. 93 degrees 59 minutes 32 seconds W., NAD 83.

RANGE IN CHARACTERISTICS:

Thickness of mollic epipedon--30 to 60 centimeters

Depth to carbonates--carbonates are present throughout the profile

Clay content in the particle-size control section (weighted average)--20 to 30 percent

Sand content in the particle-size control section (weighted average)--30 to 55 percent

Gypsum content--0 to 5 percent

Ap or Ak horizon:

Hue--10YR or is neutral

Value--2 or 3

Chroma--0 or 1

Texture--loam or clay loam

Clay content--25 to 35 percent

Sand content--30 to 45 percent

Rock fragment content--1 to 5 percent

Calcium carbonate equivalent--15 to 45 percent (centers on about 30 percent)

Reaction--moderately alkaline or strongly alkaline

AB horizon (if present):

Hue--10YR to 5Y, or is neutral

Value--3 or 4

Chroma--0 or 1

Texture--loam or clay loam

Clay content--20 to 35 percent

Sand content--30 to 50

Rock fragment content--1 to 5 percent

Calcium carbonate equivalent--15 to 40 percent (centers on about 30 percent)

Reaction--moderately alkaline or strongly alkaline

Bkg horizon:

Hue--10YR to 5Y

Value--5 or 6

Chroma--1 or 2

Texture--loam, clay loam, or sandy clay loam

Clay content--18 to 32 percent

Sand content--30 to 60 percent

Rock fragment content--1 to 5 percent

Calcium carbonate equivalent--10 to 40 percent

Reaction--moderately alkaline or strongly alkaline

BCg or Cg (if present) horizon:

Hue--2.5Y or 5Y

Value--4 to 6

Chroma--1 or 2

Texture--loam, fine sandy loam, sandy loam, or clay loam

Clay content--12 to 30 percent

Sand content--35 to 65 percent

Rock fragment content--2 to 10 percent

Calcium carbonate equivalent--10 to 30 percent

Reaction--moderately alkaline or strongly alkaline

COMPETING SERIES: These are the [Baldock](#), [Lawet](#), and [Revere](#) series.

[Baldock](#)--are in areas that have a mean annual precipitation range of 150 to 300 millimeters

[Lawet](#)--do not have rock fragments in the series control section

[Revere](#)--have a gypsic horizon

GEOGRAPHIC SETTING:

Parent material--till of Wisconsin age or alluvium derived from till

Landform--narrow rims or shorelines of depressions on till plains and moraines

Slope--0 to 3 percent

Elevation--300 to 600 meters above sea level

Mean annual air temperature--6 to 10 degrees C

Mean annual precipitation--455 to 890 millimeters

Frost free period--140 to 200 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Canisteo](#), [Klossner](#), [Okoboji](#), [Wacousta](#), and [Webster](#) soils.

[Canisteo](#)--are at slightly lower landscape positions on flats and swales and are not violently effervescent in the upper third of the series control section

[Klossner](#)--are at lower landscape positions in depressions and have organic materials in the upper third of the series control section

[Okoboji](#)--are at lower landscape positions in depressions and have mollic epipedons greater than 60 centimeters thick

[Wacousta](#)--are at lower landscape positions in depressions and have a sand content that averages less than 15 percent sand in the particle-size control section

[Webster](#)--are at slightly lower landscape positions on flats and swales and do not have calcic horizons

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:

Drainage class--poorly drained--in an undrained condition, a frequently saturated zone occurs at the surface to a depth of 0.3 meters during the wettest periods of years when precipitation is within one standard deviation of the 30 year mean of annual precipitation

Saturated hydraulic conductivity--1.00 to 10.00 micrometers per second

USE AND VEGETATION:

Most areas are artificially drained and cultivated. The principal crops are corn, soybeans, small grains, and legume hay. Reed canarygrass commonly dominates partially drained pasture. Native vegetation is predominantly wet-site tall prairie species such as prairie cordgrass, switchgrass, big bluestem, woolly sedge, giant goldenrod and Canada goldenrod.

DISTRIBUTION AND EXTENT:

Physiographic Division--Interior Plains

Physiographic Province--Central Lowland

Physiographic section--Western lake section

MLRAs--Central Iowa and Minnesota Till Prairies (103) and Southern Black Glaciated Plains (55C)
LRRs F and M; north-central Iowa, south-central Minnesota, and southeastern South Dakota
Extent--large

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Webster County, Iowa, 1968.

REMARKS:

Particle-size control section--the zone from a depth of 25 to 100 centimeters;
series control section--the zone from the surface to a depth of 160 centimeters.

Diagnostic horizons and features recognized in this pedon include:

mollic epipedon--the zone from the surface to a depth of 41 centimeters (Ap, Ak1 and Ak2 horizons);
calcic horizon--the zone from a depth of 20 to 160 centimeters (Ak1, Ak2, Bkg1, Bkg2, Bkg3, and Bkg4 horizons);
aquic moisture regime.

Cation-exchange activity class is inferred from lab data from similar soils in the surrounding area.

A moderately coarse substratum phase is recognized in the southern part of MLRA 103 and a moderately fine substratum phase is recognized in the northern part of MLRA 103. This difference is based on statistical analysis of lab data throughout the MLRA.

Taxonomy version--Keys to Soil Taxonomy, tenth edition, 2006.

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APPENDIX F

Cost Analysis



Probable Construction Cost Estimate
Alternative 1b: Community Cluster LSTS for 84 Holding Tank Properties
North/Northeast Big Kandiyo Lake Community

Item No.	Item	Quantity	Unit	Unit Cost	Total Cost
<u>Collection System</u>					
1	Mobilization and Demobilization	1	LS	\$ 212,500	\$ 212,500
2	Septic Tank Abandonment	84	EA	\$ 1,500	\$ 126,000
3	Grinder Station and Controls	84	EA	\$ 17,500	\$ 1,470,000
4	Grinder Electrical Installation	84	EA	\$ 1,250	\$ 105,000
5	Building Sanitary Sewer Cleanout	84	EA	\$ 500	\$ 42,000
6	Connect to Existing Sanitary Sewer Service	84	EA	\$ 750	\$ 63,000
7	4" Gravity Building Sanitary Sewer	3,360	LF	\$ 50	\$ 168,000
8	Pressure Sewer	14,500	LF	\$ 30	\$ 435,000
9	Pressure Sewer Lateral	8,400	LF	\$ 35	\$ 294,000
10	Air/Vacuum Release Valve and Manhole	4	EA	\$ 12,000	\$ 48,000
11	Isolation Valve	7	EA	\$ 4,000	\$ 28,000
12	Pressure Sewer Cleanout	15	EA	\$ 4,500	\$ 67,500
13	2" Curb Stops	84	EA	\$ 2,500	\$ 210,000
14	Washed Stone	1,000	CY	\$ 50	\$ 50,000
15	Select Granular	1,000	CY	\$ 50	\$ 50,000
16	Insulation (4")	1,500	SY	\$ 50	\$ 75,000
17	Property Site Restoration	84	EA	\$ 2,500	\$ 210,000
18	Asphaltic Roadway Patch	600	SY	\$ 100	\$ 60,000
19	Class V Gravel Roadway Patch	600	SY	\$ 20	\$ 12,000
20	Silt Fence	2,000	LF	\$ 5	\$ 10,000
21	Sediment Control Log	800	LF	\$ 10	\$ 8,000
22	Traffic Control	1	LS	\$ 10,000	\$ 10,000

Collection Subtotal: \$ 3,754,000

<u>Treatment System</u>					
23	Mobilization and Demobilization	1	LS	\$ 196,000	\$ 196,000
24	Septic Tank #1	40,000	GAL	\$ 5.00	\$ 200,000
25	Septic Tank #2	40,000	GAL	\$ 5.00	\$ 200,000
26	Equalization Tank	20,000	GAL	\$ 5.00	\$ 100,000
27	ATU Tank	50,000	GAL	\$ 5.00	\$ 250,000
28	Denitrification Dose Tank	6,000	GAL	\$ 5.00	\$ 30,000
29	Denitrification Treatment Tank	12,500	GAL	\$ 5.00	\$ 62,500
30	Polishing ATU Tank	12,500	GAL	\$ 5.00	\$ 62,500
31	Dose Tank	20,000	GAL	\$ 5.00	\$ 100,000
32	Aluminum Access Hatch	19	EA	\$ 2,500	\$ 47,500
33	Tank Riser Pipe	120	LF	\$ 250	\$ 30,000
34	Tank Riser/tank Adapter	40	EA	\$ 100	\$ 4,000
35	Riser Fiberglass Lid	40	EA	\$ 300	\$ 12,000
36	Effluent Screen	2	EA	\$ 2,500	\$ 5,000
37	Submersible Effluent Pump	22	EA	\$ 3,000	\$ 66,000
38	Pump Guide Rails & Discharge Piping	22	EA	\$ 3,000	\$ 66,000
39	Control Panel	1	LS	\$ 100,000	\$ 100,000
40	Float Switch Sensors	12	EA	\$ 500	\$ 6,000
41	Aerobic Treatment Unit	2	EA	\$ 75,000	\$ 150,000
42	Nitrification Treatment Unit	2	EA	\$ 75,000	\$ 150,000
43	Denitrification Treatment Unit	1	EA	\$ 60,000	\$ 60,000
44	Polishing Aerobic Treatment Unit	1	EA	\$ 75,000	\$ 75,000
45	Preaeration Equipment	1	EA	\$ 20,000	\$ 20,000
46	Sludge Receiving Manhole	1	LS	\$ 17,500	\$ 17,500
47	Chemical Feed Equipment	1	LS	\$ 15,000	\$ 15,000

Item No.	Item	Quantity	Unit	Unit Cost	Total Cost
48	Magnetic Flow Meter Manhole	1	LS	\$ 60,000	\$ 60,000
49	Control Building	1	LS	\$ 100,000	\$ 100,000
50	Control Building Furnishings	1	LS	\$ 12,500	\$ 12,500
51	Mound Soil Dispersal System	2,200	LF	\$ 325	\$ 715,000
52	Yard Piping	2,500	LF	\$ 30	\$ 75,000
53	Tank Insulation	1	LS	\$ 35,000	\$ 35,000
54	Gravel Access Road	90	CY	\$ 100	\$ 9,000
55	Culvert	1	LS	\$ 2,500	\$ 2,500
56	Perimeter Fence	2,000	LF	\$ 20	\$ 40,000
57	Site Restoration	6	ACRE	\$ 15,000	\$ 90,000
58	Silt Fence	1,500	LF	\$ 5	\$ 7,500
59	Rock Construction Entrance	1	LS	\$ 2,500	\$ 2,500
60	Electrical Service	1	LS	\$ 35,000	\$ 35,000
61	Backup Generator	1	LS	\$ 100,000	\$ 100,000
62	Electrical Component Installation Costs	1	LS	\$ 150,000	\$ 150,000
63	Land	12	ACRE	\$ 7,500	\$ 90,000

Treatment Subtotal: \$ 3,549,000

Collection & Treatment Subtotal: \$ 7,303,000

Contingency: \$ 731,000

Engineering Services: \$ 1,315,000

Legal & Administrative: \$ 74,000

Total Probable Construction Cost Estimate: \$ 9,423,000

Cost per Connection: \$ 112,200

Annual Operation, Maintenance, & Replacement Cost Estimate
Alternative 1b: Community Cluster LSTS for 84 Holding Tank Properties
 North/Northeast Big Kandiyohi Lake Community

Collection System	Estimated Cost	Notes
Service Provider	\$3,750	30 hrs./year @125/hr for residential grinder inspections
Miscellaneous Repairs/Service	\$2,500	
Electricity		
Grinder Pumps & Controls	\$0	To be paid for by private property owner
Equipment Replacement	\$25,900	

Collection Subtotal: \$32,200

Treatment System	Estimated Cost	Notes
Service Provider	\$30,000	\$2,500/month for third party Service Provider
Property Insurance	\$1,200	\$100/month
Administration	\$900	1 hr./month @ \$75/hr.
MPCA Permit	\$250	New permit \$1,250 every 5 years
Miscellaneous Repairs/Service	\$2,500	
Septage Hauling/Disposal	\$2,000	\$0.20/gallon, 20,000 gallons every 2 years
Mowing/Snow Removal	\$750	
Laboratory	\$5,000	
Chemical	\$6,300	
Telemetry	\$600	\$50/month
Electricity		
Pumps, Blowers, & Controls	\$15,900	
Equipment Replacement	\$7,600	

Treatment Subtotal: \$73,000

Total Annual OM&R Costs: \$105,200

Cost per Connection per Year: \$1,260 84 Connections
Cost per Connection per Month: \$105

Probable Construction Cost Estimate
Alternative 2: Community Cluster LSTS
North/Northeast Big Kandiyohi Lake Community

Item No.	Item	Quantity	Unit	Unit Cost	Total Cost
<u>Collection System</u>					
1	Mobilization and Demobilization	1	LS	\$ 348,400	\$ 348,400
2	Septic Tank Abandonment	148	EA	\$ 1,500	\$ 222,000
3	Grinder Station and Controls	148	EA	\$ 17,500	\$ 2,590,000
4	Grinder Electrical Installation	148	EA	\$ 1,250	\$ 185,000
5	Building Sanitary Sewer Cleanout	148	EA	\$ 500	\$ 74,000
6	Connect to Existing Sanitary Sewer Service	148	EA	\$ 750	\$ 111,000
7	4" Gravity Building Sanitary Sewer	5,920	LF	\$ 50	\$ 296,000
8	Pressure Sewer	15,000	LF	\$ 30	\$ 450,000
9	Pressure Sewer Lateral	14,800	LF	\$ 35	\$ 518,000
10	Air/Vacuum Release Valve and Manhole	4	EA	\$ 12,000	\$ 48,000
11	Isolation Valve	7	EA	\$ 4,000	\$ 28,000
12	Pressure Sewer Cleanout	15	EA	\$ 4,500	\$ 67,500
13	2" Curb Stops	148	EA	\$ 2,500	\$ 370,000
14	Washed Stone	1,700	CY	\$ 50	\$ 85,000
15	Select Granular	1,700	CY	\$ 50	\$ 85,000
16	Insulation (4")	2,650	SY	\$ 50	\$ 132,500
17	Property Site Restoration	148	EA	\$ 2,500	\$ 370,000
18	Asphaltic Roadway Patch	1,200	SY	\$ 100	\$ 120,000
19	Class V Gravel Roadway Patch	1,200	SY	\$ 20	\$ 24,000
20	Silt Fence	2,500	LF	\$ 5	\$ 12,500
21	Sediment Control Log	800	LF	\$ 10	\$ 8,000
22	Traffic Control	1	LS	\$ 10,000	\$ 10,000

Collection Subtotal: \$ 6,155,000

<u>Treatment System</u>					
23	Mobilization and Demobilization	1	LS	\$ 265,000	\$ 265,000
24	Septic Tank #1	40,000	GAL	\$ 5.00	\$ 200,000
25	Septic Tank #2	40,000	GAL	\$ 5.00	\$ 200,000
26	Septic Tank #3	40,000	GAL	\$ 5.00	\$ 200,000
27	Equalization Tank	25,000	GAL	\$ 5.00	\$ 125,000
28	ATU Tank	75,000	GAL	\$ 5.00	\$ 375,000
29	Denitrification Dose Tank	6,000	GAL	\$ 5.00	\$ 30,000
30	Denitrification Treatment Tank	12,500	GAL	\$ 5.00	\$ 62,500
31	Polishing ATU Tank	12,500	GAL	\$ 5.00	\$ 62,500
32	Dose Tank	20,000	GAL	\$ 5.00	\$ 100,000
33	Aluminum Access Hatch	25	EA	\$ 2,500	\$ 62,500
34	Tank Riser Pipe	150	LF	\$ 250	\$ 37,500
35	Tank Riser/tank Adapter	52	EA	\$ 100	\$ 5,200
36	Riser Fiberglass Lid	52	EA	\$ 300	\$ 15,600
37	Effluent Screen	3	EA	\$ 2,500	\$ 7,500
38	Submersible Effluent Pump	28	EA	\$ 3,000	\$ 84,000
39	Pump Guide Rails & Discharge Piping	28	EA	\$ 3,000	\$ 84,000
40	Control Panel	1	LS	\$ 100,000	\$ 100,000
41	Float Switch Sensors	12	EA	\$ 500	\$ 6,000
42	Aerobic Treatment Unit	3	EA	\$ 75,000	\$ 225,000
43	Nitrification Treatment Unit	3	EA	\$ 75,000	\$ 225,000
44	Denitrification Treatment Unit	1	EA	\$ 60,000	\$ 60,000
45	Polishing Aerobic Treatment Unit	1	EA	\$ 75,000	\$ 75,000
46	Preaeration Equipment	1	EA	\$ 20,000	\$ 20,000
47	Sludge Receiving Manhole	1	LS	\$ 17,500	\$ 17,500
48	Chemical Feed Equipment	1	LS	\$ 15,000	\$ 15,000

Item No.	Item	Quantity	Unit	Unit Cost	Total Cost
49	Magnetic Flow Meter Manhole	1	LS	\$ 60,000	\$ 60,000
50	Control Building	1	LS	\$ 100,000	\$ 100,000
51	Control Building Furnishings	1	LS	\$ 12,500	\$ 12,500
52	Mound Soil Dispersal System	3,530	LF	\$ 325	\$ 1,147,250
53	Yard Piping	3,500	LF	\$ 30	\$ 105,000
54	Tank Insulation	1	LS	\$ 40,000	\$ 40,000
55	Gravel Access Road	90	CY	\$ 100	\$ 9,000
56	Culvert	1	LS	\$ 2,500	\$ 2,500
57	Perimeter Fence	2,000	LF	\$ 20	\$ 40,000
58	Site Restoration	10	ACRE	\$ 15,000	\$ 150,000
59	Silt Fence	1,500	LF	\$ 5	\$ 7,500
60	Rock Construction Entrance	1	LS	\$ 2,500	\$ 2,500
61	Electrical Service	1	LS	\$ 35,000	\$ 35,000
62	Backup Generator	1	LS	\$ 100,000	\$ 100,000
63	Electrical Component Installation Costs	1	LS	\$ 200,000	\$ 200,000
64	Land	20	ACRE	\$ 7,500	\$ 150,000

Treatment Subtotal: \$ 4,822,000

Collection & Treatment Subtotal: \$ 10,977,000

Contingency: \$ 1,098,000

Engineering Services: \$ 1,976,000

Legal & Administrative: \$ 110,000

Total Probable Construction Cost Estimate: \$ 14,161,000

Cost per Connection: \$ 95,700

Annual Operation, Maintenance, & Replacement Cost Estimate
Alternative 2: Community Cluster LSTS
North/Northeast Big Kandiyohi Lake Community

Collection System	Estimated Cost	Notes
Service Provider	\$5,000	40 hrs./year @125/hr for residential grinder inspections
Miscellaneous Repairs/Service	\$2,500	
Electricity		
Grinder Pumps & Controls	\$0	To be paid for by private property owner
Equipment Replacement	\$45,700	

Collection Subtotal: \$53,200

Treatment System	Estimated Cost	Notes
Service Provider	\$30,000	\$2,500/month for third party Service Provider
Property Insurance	\$1,200	\$100/month
Administration	\$900	1 hr./month @ \$75/hr.
MPCA Permit	\$250	New permit \$1,250 every 5 years
Miscellaneous Repairs/Service	\$2,500	
Septage Hauling/Disposal	\$2,000	\$0.20/gallon, 20,000 gallons every 2 years
Mowing/Snow Removal	\$750	
Laboratory	\$5,000	
Chemical	\$10,200	
Telemetry	\$600	\$50/month
Electricity		
Pumps, Blowers, & Controls	\$21,700	
Equipment Replacement	\$9,100	

Treatment Subtotal: \$84,200

Total Annual OM&R Costs: \$137,400

Cost per Connection per Year: \$930 148 Connections
Cost per Connection per Month: \$78

Probable Construction Cost Estimate
Alternative 3: Regionalization to Lake Lillian
North/Northeast Big Kandiyohi Lake Community

<u>Item No.</u>	<u>Item</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
<u>Collection System - Service Area</u>					
1	Mobilization and Demobilization	1	LS	\$ 418,300	\$ 418,300
2	Septic Tank Abandonment	148	EA	\$ 1,500	\$ 222,000
3	Grinder Station and Controls	148	EA	\$ 17,500	\$ 2,590,000
4	Grinder Electrical Installation	148	EA	\$ 1,250	\$ 185,000
5	Building Sanitary Sewer Cleanout	148	EA	\$ 500	\$ 74,000
6	Connect to Existing Sanitary Sewer Service	148	EA	\$ 750	\$ 111,000
7	4" Gravity Building Sanitary Sewer	5,920	LF	\$ 50	\$ 296,000
8	Pressure Sewer	15,000	LF	\$ 30	\$ 450,000
9	Pressure Sewer Lateral	14,800	LF	\$ 35	\$ 518,000
10	Air/Vacuum Release Valve and Manhole	4	EA	\$ 12,000	\$ 48,000
11	Isolation Valve	7	EA	\$ 4,000	\$ 28,000
12	Pressure Sewer Cleanout	15	EA	\$ 4,500	\$ 67,500
13	2" Curb Stops	148	EA	\$ 2,500	\$ 370,000
14	Washed Stone	1,700	CY	\$ 50	\$ 85,000
15	Select Granular	1,700	CY	\$ 50	\$ 85,000
16	Insulation (4")	2,650	SY	\$ 50	\$ 132,500
17	Property Site Restoration	148	EA	\$ 2,500	\$ 370,000
18	Asphaltic Roadway Patch	1,200	SY	\$ 100	\$ 120,000
19	Class V Gravel Roadway Patch	1,200	SY	\$ 20	\$ 24,000
20	Silt Fence	2,500	LF	\$ 5	\$ 12,500
21	Sediment Control Log	800	LF	\$ 10	\$ 8,000
22	Traffic Control	1	LS	\$ 5,000	\$ 5,000
<u>Collection System - Conveyance to Lake Lillian</u>					
23	Lift Station and Valve Vault	1	LS	\$ 200,000	\$ 200,000
24	Lift Station Electrical/Control	1	EA	\$ 50,000	\$ 50,000
25	Magnetic Flow Meter	1	EA	\$ 15,000	\$ 15,000
26	Backup Generator	1	EA	\$ 80,000	\$ 80,000
27	4" Pressure Sewer	20,000	LF	\$ 30	\$ 600,000
28	Connect to Existing City of Lake Lillian Manhole	1	LS	\$ 7,500	\$ 7,500
29	Air/Vacuum Release Valve and Manhole	3	EA	\$ 12,000	\$ 36,000
30	Isolation Valve	8	EA	\$ 4,500	\$ 36,000
31	Pressure Sewer Cleanout	20	EA	\$ 4,500	\$ 90,000
32	Washed Stone	160	CY	\$ 50	\$ 8,000
33	Select Granular	160	CY	\$ 50	\$ 8,000
34	Site Restoration	1,000	SY	\$ 7.50	\$ 7,500
35	Asphaltic Roadway Patch	50	SY	\$ 100	\$ 5,000
36	Silt Fence	2,500	LF	\$ 5	\$ 12,500
37	Sediment Control Log	600	LF	\$ 10	\$ 6,000
38	Erosion Control Blanket	1,500	SY	\$ 5	\$ 7,500
39	Traffic Control	1	LS	\$ 5,000	\$ 5,000
40	Lake Lillian Sewer Service Connection Fee	148	LS	\$ 500	\$ 74,000

Subtotal: \$ 7,468,000

Contingency: \$ 747,000

Engineering Services: \$ 1,345,000

Legal & Administrative: \$ 75,000

Total Probable Construction Cost Estimate: \$ 9,635,000

Cost per Connection: \$ 65,200

Annual Operation, Maintenance, & Replacement Cost Estimate
Alternative 3: Regionalization to Lake Lillian
North/Northeast Big Kandiyohi Lake Community

Collection System	Estimated Cost	Notes
Operator	\$18,000	\$1,500/month for third party Operator
Property Insurance	\$900	\$75/month (lift station)
Administration	\$900	1 hr./month @ \$75/hr.
Mowing/Snow Removal	\$500	Lift station
Telemetry	\$600	\$50/month (lift station control panel)
Miscellaneous Repairs/Service	\$2,500	
Electricity		
Grinder Pumps & Controls	\$0	To be paid for by private property owner
Lift Station	\$3,700	
Equipment Replacement	\$49,500	
Lake Lillian Sewer Service Fee	\$47,700	\$4.83 per 1,000 gallons, \$13.50/month base rate per connection
Total Annual OM&R Costs: \$124,300		
Cost per Connection per Year:	\$840	148 Connections
Cost per Connection per Month:	\$70	

