Bonnie Beach Community

Community Assessment Report

May 2022

Prepared for:

Kandiyohi County
400 Benson Ave SW
Willmar, MN 56201

Prepared by:

Stantec Consulting Services Inc.
2080 Wooddale Drive, Suite 100
Woodbury, MN 55125

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Prepared by: ______________________________
(signature)

Name: **Eric Blasing**

Reviewed by: ______________________________
(signature)

Name: **Peter Miller**

Approved by: ______________________________
(signature)

Name: **Eric Blasing**

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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 Advanced Designer under the laws of the state of Minnesota.

Signature/Date:	______________________	May 4, 2022
Name:	Peter G. Miller	Date
Registration:	Certification Number: C2341	

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:	______________________	May 4, 2022
Name:	Eric M. Blasing	Date
Registration:	Certification Number: C7582	

2.0 INTRODUCTION

The community of Bonne Beach is located on a peninsula of Big Kandiyohi Lake in Lake Lillian, Fahlun Township, Kandiyohi County, Minnesota (Figure 1). The community is seasonal, 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 soil-based subsurface sewage treatment system (SSTS) 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 SSTS. This report would not have been possible without the generous assistance of Kandiyohi County, the Minnesota Pollution Control Agency (MPCA), and the Big Kandiyohi Lake Association.

The Bonnie Beach area contains 46 properties; 31 of which have been included in the Bonnie Beach CAR study area (Bonnie Beach), as shown on Figure 1. Twenty-four properties were originally included however, seven additional properties were added either by property owner request or field observations revealing a structure on the property. The remaining 15 properties are vacant, located on the island, and/or do not contain an ISTS. The study area was selected based on 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 Documentation[2] assessment was completed prior to grant funding being received for the preparation of the CAR. Information gathered in the Unsewered Area Needs Documentation was reviewed and incorporated into the findings of this report.

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[1] ISTS (a.k.a. septic system) is 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 communty.

2.2 REPORT PURPOSE

This report serves as a planning document for possible long-term wastewater infrastructure solutions for Bonnie Beach. The CAR is intended to present existing ISTS status and determine if the community is best served in the future by ISTS or a shared community system.

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 desktop Kandiyohi County permit file review and field investigations of likely ISTS compliance. The analysis also evaluated potential future SSTS wastewater treatment options. 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 poor ISTS compliance, future ISTS type, and/or significant lot constraints. Based on the likely ISTS compliance, existing dwelling locations, and future replacement ISTS, Bonnie Beach does include a community wastewater collection and treatment alternative. See Section 4 for further discussion.

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[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 Bonnie Beach. All but eight properties evaluated are served by an ISTS including trenches, mound, cesspool/drywell (CP/DW), outhouse, or holding tank. A determination of likely ISTS compliance status was made at each property. In addition, a determination was made as to what the likely future ISTS would be to serve the property.

Properties included in the assessment were developed by the Big Kandiyohi Lake Association and Kandiyohi County, in collaboration with Stantec. Individual parcel information and ISTS records were provided by Kandiyohi County.

3.1 METHODS

Fieldwork was completed in fall 2021 and included site visits to each participating property to locate wells, wastewater tanks, and drainfields. Soil borings were conducted as needed, and ISTS were evaluated to determine their likely compliance. An assessment was also made regarding the most likely option for each property's replacement ISTS.

Of the 46 Bonnie Beach properties, 14 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 properties to evaluate soils throughout Bonnie Beach.

Seventeen properties did not participate in an onsite assessment. Likely compliance status for these properties was determined by permit and records review, visual assessment from the public right-of-way or lakeshore, soil conditions observed on neighboring properties, and professional judgement.

Prior to commencement of fieldwork, Kandiyohi County provided available ISTS permitting, design, and inspection records for individual properties. In addition, Geographic Information System (GIS) shape files of property boundaries were supplied. 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 Bonnie Beach. Properties evaluated either contained an ISTS or did not have a system. A determination of likely ISTS compliance status was made along with future wastewater treatment to serve the properties.

3.2.1 Drinking Water Source

Bonnie Beach property drinking water sources include individual and shared water supply wells (Figure 2). There is no community public water supply system. 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 sensitive well. For shared community collection system forcemain, a 50-foot setback applies. Water supply well setbacks and potential variances are governed by the Minnesota Department of Health.

3.2.2 Parcel Type

Table 3-1 summarizes parcel types in Bonnie Beach. Data is from homeowner surveys, parcel zoning records, and fieldwork observations. An important factor to consider is the dwelling classification as this dictates expected wastewater volumes generated and the design flow. Minnesota Rules Chapter 7080 classifies dwellings based on structure size and number of water-use appliances (i.e., garbage disposal, self-cleaning humidifier in furnace, large bathtub, wash machine, dishwasher, and water conditioning unit) included in the dwelling from Type I to Type IV. Essentially, the smaller the structure and the less water-use appliances, the lower the flow volumes to expect. A Type I classification would assign the highest flows and Type IV, the lowest. Within Bonnie Beach, the likely dwelling classifications include Type I, Type II, and Type III. See Appendix A for specific parcel dwelling classifications and associated wastewater design flows.

Table 3-1: Parcel Type

Parcel Type	Number	Percentage
Residential	20	65%
Commercial	0	0%
Other*	11	35%
Total	**31**	**100%**

*Other = parcel without a dwelling or is vacant

3.2.3 ISTS Type

Table 3-2 summarizes ISTS type in Bonnie Beach which includes trenches, mound, CP/DW, outhouse, holding tank, or no system.

Table 3-2: ISTS Type

ISTS Type	Number	Percentage
Trenches	2	6%
Mound	1	3%
CP/DW	9	29%
Outhouse	3	10%
Holding Tank	8	26%
No System	8	26%
Total	**31**	**100%**

3.2.4 ISTS Compliance Status

While visiting each parcel, the likely ISTS compliance status was made based on Minnesota Rules Chapter 7080 and Kandiyohi County SSTS ordinance. An existing ISTS can either be compliant or noncompliant including the following:

- Failure to protect groundwater (FTPG). The criteria that determine a FTPG include:
    - Less than 36-inches of vertical separation between the bottom of the drainfield distribution media and limiting condition being periodically saturated soil (seasonally high groundwater), hardpan, or bedrock.
    - Non-watertight tanks (includes CP/DW and outhouse systems).
    - Not meeting reporting requirements of an operating permit. Operating permits within Kandiyohi County are issued for ISTS with pretreatment, non-standard systems, and larger midsized subsurface sewage treatment systems (MSTS).
- Imminent threat to public health or safety (ITPHS). The criteria that determine a ITPHS include:
    - Surfacing effluent from the soil dispersal system.
    - Sewage backing up into the dwelling.
    - Sewage discharged to the ground surface or surface waters.
    - An ISTS in an unsafe condition (dangerous/missing tank riser covers, exposed wiring, unsound tank, etc.)
    - Any other condition deemed to be a threat to human health or safety.

Table 3-3 summarizes likely compliance status within Bonnie Beach of the 23 properties that have an ISTS. Likely compliance status is based on Kandiyohi County permit information, soils data, information provided by property owners, and onsite field observations.

Table 3-3: Likely ISTS Compliance Status

Status	Number	Percentage
Compliant	9	39%
Noncompliant ITPHS	0	0%
Noncompliant FTPG	14	61%
Total	**23**	**100%**

The parcel data spreadsheet (Appendix A) contains property specific likely ISTS compliance status and Figure 3 provides a visual depiction of each ISTS within Bonnie Beach.

3.2.5 ISTS Age

Age is also 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 drainfield/soil surface interface can plug, and soil beneath the drainfield 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 Bonnie Beach. System ages were based on Kandiyohi County records and homeowner surveys. Figure 4 provides a visual representation of current ISTS ages within Bonnie Beach.

Table 3-4: ISTS Age

System Age* (years)	Number	Percentage
< 10	5	22%
10 – 19	4	17%
20 – 29	0	0%
30 – 39	2	9%
40+	2	9%
Unknown	10	43%
Total	**23**	**100%**

*As of 2022

3.2.6 Summary

Of the 23 ISTS within Bonnie Beach, nine (39%) are compliant and thus are not in need of replacement. However, of the nine compliant ISTS, eight are holding tank systems. Of the 14 noncompliant ISTS, nine are likely a CP/DW. 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 need to be evaluated including:

- 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 Kandiyohi County as a subordinate service district. This would qualify the project for public funding opportunities. A system developed privately can present legal challenges as it relates to land ownership/easements and fee collection. Also, privately owned systems are not eligible for public funding.

For Bonnie Beach, there is not the option to connect to a regional municipal facility. Feasible alternatives include the installation of ISTS to serve each dwelling or a shared community cluster system to serve multiple properties. These alternatives are evaluated within the following section.

4.1 ALTERNATIVES ANALYSIS

The following two alternatives have been evaluated for long-term wastewater treatment infrastructure in Bonnie Beach:

- Alternative 1: private ISTS to serve all dwellings along 126th Avenue SE
- Alternative 2: a community cluster system to serve all dwellings along 126th Avenue SE

An alternative to serve all properties, including those on the island, was not developed as these properties are unimproved and servicing them by a shared system would be difficult. These properties could be served by ISTS if developed, and Figure 5 shows likely ISTS types for them.

The two alternatives developed are for the existing 20 dwellings along 126th Avenue SE. Most of these properties do not have sufficient room for a Type 1 ISTS and would be served by a future holding tank (Figure 6).

Public grant and low-interest loan funding programs are available for community cluster systems and eligibility is based on need. Bonnie Beach's need for upgrading ISTS is moderately high as 61% are FTPG. Therefore, a community cluster system could be funded.

Table 4-1 includes the estimated daily wastewater design flow for both alternatives and the associated permit that would apply. Appendix C includes calculation details for Alternative 2.

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

Alternative	No. of Properties	Wastewater Design Flow (gpd)*	Permit Type**
Alternative 1: Private ISTS	20	Varies per property	Kandiyohi County ISTS
Alternative 2: Community Cluster System	20	5,400	Kandiyohi County MSTS

*Permit flow is not the actual flow observed, but rather is a prescribed design flow dictated by state code. 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 MSTS permit required for the shared community cluster system assumes Kandiyohi County is the owner.

Per Minnesota Rules, Part 7081.0120, a daily wastewater flow was estimated for Alternative 2 using a formula specified in the rule. The formula calculates a design flow based on each dwelling's classification (Type I – Type IV) 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.

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

- 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.
- A system with a design wastewater flow of 5,000 – 10,000 gpd would be considered a MSTS and be permitted by Kandiyohi County. MSTS include more design and permitting requirements than ISTS including a groundwater investigation, nitrogen mitigation, absorption area sizing, and an operation and maintenance plan.
- A system designed with a wastewater flow less than 5,000 gpd are considered ISTS and would be permitted by Kandiyohi County. These systems have the least design and permitting requirements.

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 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.

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 improper or lack of 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, 61% of ISTS within Bonnie Beach are likely noncompliant. This accounts for some type of potential imminent ISTS upgrade at 14 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 1: standard systems including subsurface or above-grade soil dispersal systems on undisturbed soils. Type 1 systems meet all technical sizing, design, and construction requirements, have suitable soils, and can meet all setbacks.
- Type 2: holding tanks, privies, and systems in floodplains.
- Type 3: non-standard systems that deviate from Type 1 code requirements, are constructed on soil which is difficult, disturbed, or contains seasonally high groundwater. Type 3 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 4: commonly referred to as “performance” systems, Type 4 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 4 systems 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 drainfield distribution media to the limiting condition. Type 4 systems are more expensive to design, construct, and maintain.

Appendix A, Figure 5, and Figure 6 summarize each property’s most likely future ISTS based on the lot size, soil conditions, and current land use. For a dwelling that does not have suitable space for a drainfield, the future ISTS would likely need to be a holding tank. Whether a Type 3 or Type 4 system is used to address various site constraints is up to the homeowner and their ISTS designer. There are advantages and disadvantages to each. For this report, properties with challenging soils or limited room for a drainfield are classified as needing either a Type 3 or Type 4 system. Tables 4-2, 4-3, and 4-4 summarize likely future ISTS to serve the 14 noncompliant systems, the 20 dwellings along 126th Avenue SE, and for all properties, respectively.

Table 4-2: Future Replacement of Noncompliant ISTS

ISTS Type	Number	Percentage
Type 1	4	29%
Type 2	7	50%
Type 3 or Type 4	3	21%
Total	**14**	**100%**

Table 4-3: Future ISTS for 126th Avenue SE Dwellings

ISTS Type	Number	Percentage
Type 1	2	10%
Type 2	15	75%
Type 3 or Type 4	3	15%
Total	**20**	**100%**

Table 4-4: Future ISTS for All Properties

ISTS Type	Number	Percentage
Type 1	8	25%
Type 2	20	65%
Type 3 or Type 4	3	10%
Total	**31**	**100%**

Most properties (75%) do not have adequate area for a standard Type 1 ISTS. Of the 31 properties evaluated, 20 are so confined that they would likely be served by a future holding tank. Of the 14 properties that have a noncompliant ISTS, 71% do not have adequate area for standard Type 1 ISTS. Finally, of the 20 dwellings along 126th Avenue SE, only two (10%) could be served by a Type 1 ISTS and 15 (75%) would be a future holding tank.

4.1.1.2 Private ISTS Summary

The following points summarize the private ISTS alternative:

- Advantages:
  - 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 owned and managed cluster system.
- Disadvantages:
  - 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 comparted to a community wastewater system.
  - Grant funding is not available to reduce capital costs.

4.1.2 Alternative 2: Community Cluster System

The community cluster system alternative would include collection, treatment, and an above-grade soil dispersal system. Due to the estimated design wastewater flow, the cluster system would be considered a MSTS and be permitted by Kandiyohi County. The following section evaluates a community cluster system to serve the 20 dwellings along 126th Avenue SE.

4.1.2.1 Collection System

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

- Conventional gravity
  - Conventional gravity sewer includes a building sewer on each property that conveys raw sewage to a large diameter (≥ 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 elevation.
- 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 that discharges into common small diameter pressure forcemain (see Appendix D for a grinder station detail).

Based on topography, lot size, and construction costs, the grinder pump low pressure sewer collection system would be the most feasible and cost-effective collection system for Alternative 2.

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 power, air release valves, cleanouts, and primary solids settling to occur at a centralized treatment location. Utilizing a pressurized grinder system significantly reduces potential inflow and infiltration of clear water into the system. Flexible high-density polyethylene (HDPE) piping is directionally drilled 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 monitoring flows, performing routine system inspections for atypical conditions, and responding to emergency situations. Such circumstances include broken or obstructed pressure mains, power outage, or pump failure. 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 sewage 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.

4.1.2.2 Wastewater Treatment System

The wastewater treatment system would be designed to accommodate wastewater generated from 20 properties along 126th Avenue SE. These are properties that have existing dwellings, and many are or would be served by holding tanks.

A treatment site has not been selected as land was not available to be evaluated during fieldwork. However, open farm fields are plentiful adjacent to Bonnie Beach and an area northwest was selected that is higher in elevation and appears feasible (Figure 7). If a community cluster system 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 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 and poorly drained, and formed from glacial till plains and moraines. Periodically saturated soils are predominant with seasonally high groundwater occurring approximately 18 – 24 inches below 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 collection system would convey raw sewage to the treatment site which would include treatment tanks and a mound soil dispersal system. Septic tank capacity would be designed to accommodate the design flow per MN Rule 7080.1930. Downstream of the septic tanks would be a dose tank that would time dose a multi-cell mound system. Per rule, the mound system would be designed to accommodate 150% of the design flow as there would be no secondary pretreatment. An additional 50% reserve area would be set aside for potential future replacement use.

The proposed mound soil loading rate, rock bed loading rate, and contour loading rate are 0.45 gpd/ft^2, 1.2 gpd/ft^2, and 12 gpd/ft, respectively. These loading rates are based on septic tank effluent dispersed on clay loam soil. These values may vary based on a full site assessment and soil investigation. Based on these loading rates, 675 lineal feet of mound would be required. It is envisioned six mound cells would be constructed each with dimensions of 40 ft. x 120 ft. The actual number of cells and dimensions would vary depending upon actual site characteristics. Figure 7 shows a conceptual layout but does not represent a final design or imply landowner consent to sell the property.

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 actual wastewater flow generated from the dwellings. 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. The supply piping from the dose tank to the mound cells would be installed with positive slope to allow drainback into the dose tank.

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 cluster system requires routine operation and maintenance responsibilities. Typical tasks include monitoring and logging wastewater flows, inspecting pumps and controls, field flushing pressure distribution laterals, rotating mound cells, and checking treatment tanks for solids accumulation. Tank solids would be pumped periodically, as required by the MPCA, and hauled to an approved facility for proper disposal.

Construction, operation, and maintenance costs for the cluster system would be assessed equally across the 20-dwelling service area. See Section 5 for a cost analysis.

4.1.2.3 Community Cluster System Summary

The following points summarize the community cluster system alternative:

- Advantages:
  - Low-interest rate loans and grant programs available for design and construction costs.
  - Potential property value increase compared to private ISTS.
  - Eliminates the holding tank pumping burden on property owners.
  - Allows for more usable land area on properties.
  - Routine operation and maintenance activities completed by a service provider.
- Disadvantages:
  - Land acquisition in close proximity can be difficult. Currently, there is no agreement or discussion with landowners.
  - Higher capital costs than private ISTS.
  - Potential local opposition.

5.0 OPINION OF PROBABLE COST ANALYSIS

Two alternatives have been evaluated to improve existing wastewater infrastructure at Bonnie Beach including private ISTS replacement and a community cluster system, both to serve the 20 dwellings along 126th Avenue SE. The following section includes an opinion of probable cost analysis of these alternatives including capital, operation, maintenance, and replacement (O,M&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 along 126th Avenue SE. The two Type 1 soil dispersal systems would be above-grade mounds, Type 2 holding tanks would be 2,000-gallons in capacity, and Type 3 or 4 systems would include an ISTS with pretreatment.

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

New ISTS Type	Number	Estimated Cost per ISTS	Estimated Construction Cost
Type 1 Mound	2	$25,000	$50,000
Type 2 Holding Tank	15	$7,500	$112,500
Type 3 or Type 4	3	$30,000	$90,000
		Construction Cost Subtotal	$252,500
		Contingency	$25,250
		Total Estimated Construction Cost	$277,750
		Estimated Construction Cost per Connection	$13,900

Table 5-2 summarizes estimated construction costs for a community cluster system to serve the 20 dwellings along 126th Avenue SE. 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 mound soil dispersal system. See Appendix F for a detailed cost estimate.

Table 5-2: Community Cluster System Opinion of Probable Construction Cost Estimate

Collection System	Treatment System	Contingency	Engineering Services	Legal & Admin.	Total Estimated Construction Cost	Estimated Construction Cost per Connection
$709,000	$471,000	$118,000	$213,000	$36,000	$1,547,000	$77,400

5.2 OPERATION, MAINTENANCE, AND REPLACEMENT COSTS

When comparing wastewater treatment alternatives, O,M&R costs must be included in the evaluation. Table 5-3 provides estimated annual O,M&R costs for each alternative with total costs shared by all 20 connections. Associated costs were estimated based on seasonal, 5-month dwelling usage. Of the five months, it was assumed the dwellings were occupied during weekends for a total of 60-days. These assumptions are particularly important when calculating holding tank pumping costs.

Annual O,M&R for ISTS vary greatly depending on type. Holding tanks have the highest O,M&R costs due to pumping, which can be thousands per year depending upon water usage. Type 1 and Type 3 or 4 ISTS would have much less O,M&R costs than holding tanks and have been estimated at approximately $400 and $775 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.

Table 5-3: Estimated Annual Operation, Maintenance, & Replacement Costs

	Alternative 1: Private ISTS	Alternative 2: Community Cluster System
Total Annual O,M&R Costs	$32,100	$11,600
Estimated Annual O,M,&R Costs per Connection	$1,605	$580
Estimated Monthly O,M&R Costs per Connection	$134	$49

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 timeframe (20-years), 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.

Annual costs for each alternative include O,M&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 to the County by the PFA. Each connection would be responsible for their equal share of the debt service and O,M,&R costs which would be assessed on annual property taxes. If desired, the property owner could pay their share as a lump sum to avoid interest charges.

Table 5-4 summarizes the present worth and financing analysis. For Alternative 2, it was assumed the project would obtain an 80% grant from the PFA under the Small Community Wastewater Treatment Program. The remaining 20% would be covered by a 20-year term, 1% loan through the same program. Similar projects have been able to acquire additional grant however, to be conservative, an 80% grant was used in analysis. 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 replacement costs would be covered by loans of the same length and interest rate by the property owners.

Table 5-4: Present Worth and Financing Analysis

	Alternative 1: Private ISTS	Alternative 2: Community Cluster System
Total Estimated Probable Construction Cost	$277,750	$1,547,000
Grant Funding Reduction to Capital Construction Cost (80% Grant Award for Alternative 2)	$0	$1,237,600
Final Total Estimated Probable Construction Cost	$277,750	$309,400
Annual O,M&R Present Worth	$609,000	$221,000
Total Estimated Present Worth	$886,750	$530,400
Estimated Loan Amount (80% Grant Award for Alternative 2)	$277,750	$309,400
Annual Loan Payment (20-year, 1% Interest)	$15,400	$17,200
Annual O,M&R Costs	$32,100	$11,600
Total Estimated Annual Costs (O,M&R and loan payment)	$47,500	$28,800
Estimated Annual Costs per Connection	$2,380	$1,440
Estimated Monthly Costs per Connection	$198	$120

6.0 SUMMARY AND RECOMMENDATIONS

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

- All properties are seasonal.
- The majority (61%) of existing ISTS are greater than 20 years old of unknown age.
- Nine (9) of 23 properties (39%) with an ISTS are compliant.
- Twenty (20) of the 31 properties (65%) within the CAR project would be limited to a future holding tank.
- Fifteen (15) of the 20 properties (75%) along 126th Avenue SE would be limited to a future holding tank.
- Two alternatives were evaluated for long-term wastewater treatment infrastructure to serve the 20 existing Bonnie Beach dwellings along 126th Avenue SE including: private ISTS (Alternative 1) and a community cluster system (Alternative 2).
- Both wastewater treatment alternatives include systems that would be permitted by Kandiyohi County.
- Estimated opinion of probable costs for the alternatives are:
    - Alternative 1: $277,750 ($13,900 per connection)
    - Alternative 2 (before grant funding reduction): $1,547,000 ($77,400 per connection)
    - Alternative 2 (after grant funding reduction): $309,400 ($15,500 per connection)
- Estimated present worth values for the alternatives are:
    - Alternative 1: $886,750
    - Alternative 2: $530,400
- Estimated annual costs per connection including potential grant funding, low-interest loan principal forgiveness, and O,M,&R costs for the alternatives are:
    - Alternative 1: $2,380 ($198 per month)
    - Alternative 2: $1,440 ($120 per month)

6.1 RECOMMENDATIONS

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

- If project stakeholders value the lowest capital cost, existing dwellings would continue using private ISTS and noncompliant ISTS should be upgraded. Owners need to recognize the O,M,&R costs associated with the upgrade to mostly holding tanks.
- If project stakeholders desire a community solution, then the community cluster system should be pursued. The cluster system should be sized to accommodate the existing 20 dwellings along 126th Avenue SE. If other lots that are vacant or without a dwelling desire to be included, associated estimated costs per connection would decrease.

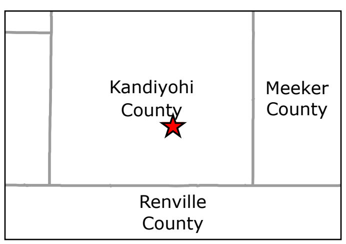
6.2 NEXT STEPS

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

The following actions should be taken by Bonnie Beach stakeholders based on selecting the community cluster system alternative:

- Determine the desire of property owners along 126th Avenue SE to pursue the community cluster system wastewater solution.
- Explore construction financing grant opportunities and in particular, the Small Community Wastewater Treatment Program. Work with the PFA and Stantec for assistance.
- Explore the creation of a subordinate service district which would allow Kandiyohi County a means to effectively provide and finance wastewater services for Bonnie Beach residents.
- Investigate the opportunity of land acquisition for a community cluster system as shown on Figure 7.

FIGURES



Study Area Parcels
County Parcels

N
0 500 1,000 Feet
(At original document size of 8.5x11)
1:12,000

Notes
1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
2. Data Sources: Kandiyohi Co., Stantec
3. Background: 2020 Kandiyohi Co. Aerial

Stantec

Project Location
T118N, R34W, S28 & 33
T. of Fahlun, Kandiyohi Co., MN

Prepared by KJM on 2022-03-23

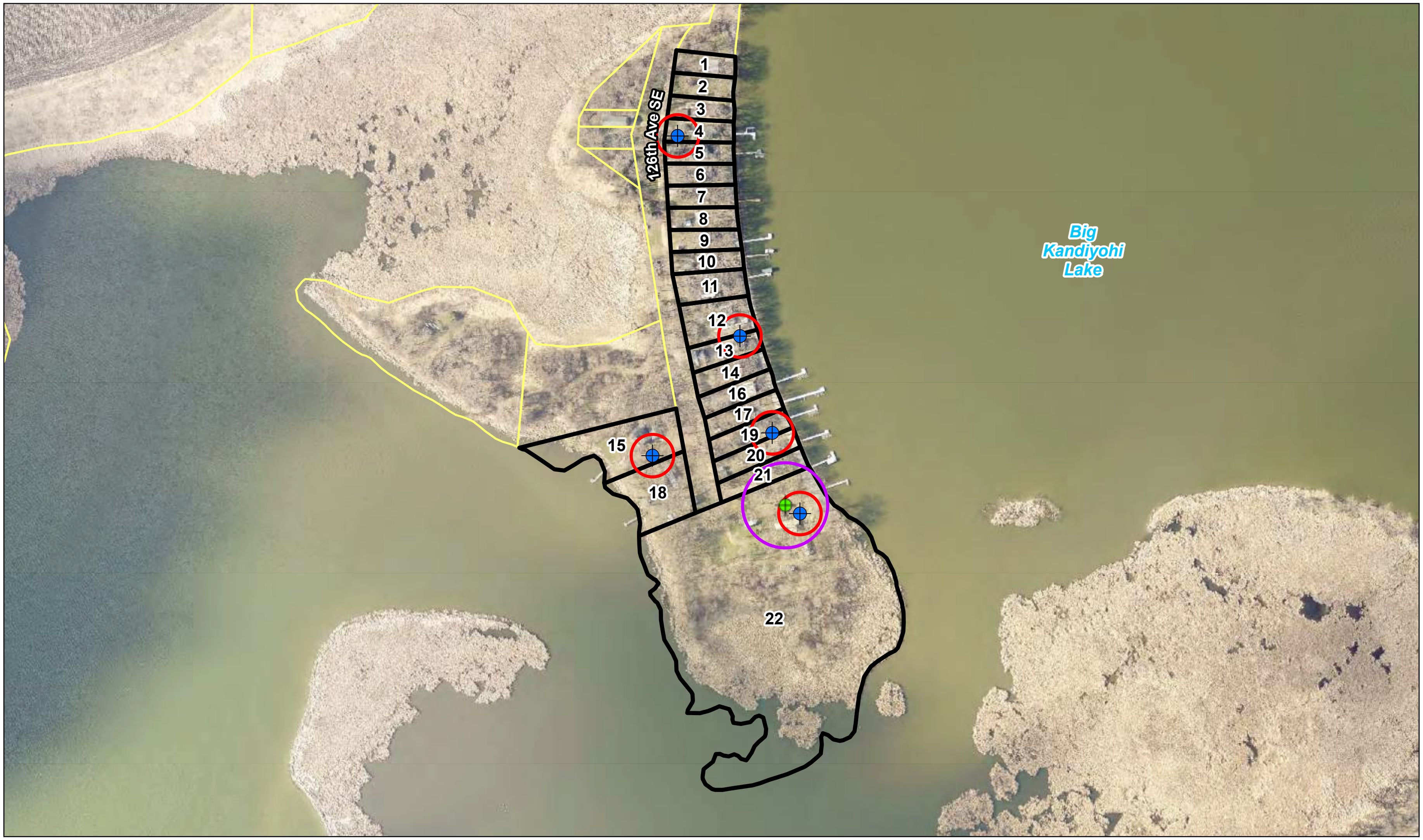
Client/Project
Kandiyohi County, MN
Bonnie Beach CAR
CAR Report

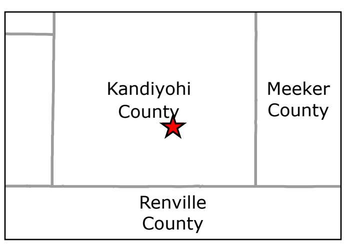
227702442

Figure No.
1

Title
Project Area

V:\2277\active\227702442\gis\Pro\Bonnie Beach CAR Pro\Bonnie Beach CAR Pro.aprx Revised: 2022-03-23 By: kjmueller





- Deep Well
- Shallow Well
- Deep Well 50 ft Setback Buffer
- Shallow Well 100 ft Setback Buffer
- Study Area Parcels
- County Parcels

N

0 175 350 Feet
(At original document size of 8.5x11)
1:4,200

Notes
1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
2. Data Sources: Kandiyohi Co., Stantec
3. Background: 2020 Kandiyohi Co. Aerial

Stantec

Project Location
T118N, R34W, S28 & 33
T. of Fahlun, Kandiyohi Co., MN

Prepared by KJM on 2022-03-28

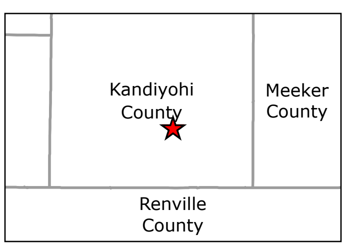
Client/Project
Kandiyohi County, MN
Bonnie Beach CAR
CAR Report

227702442

Figure No.
2

Title
Water Supply Well Locations

V:\2277\active\227702442\gis\Pro\Bonnie Beach CAR Pro\Bonnie Beach CAR Pro.aprx Revised: 2022-03-28 By: kjmueller



- Study Area Parcels
- County Parcels

Likely Compliance Status

- Compliant
- Failure to Protect Groundwater (FTPG)
- No System

N

0 250 500 Feet
(At original document size of 8.5x11)
1:5,997

Notes

1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
2. Data Sources: Kandiyohi Co., Stantec
3. Background: 2020 Kandiyohi Co. Aerial

Stantec

Project Location
T118N, R34W, S28 & 33
T. of Fahlun, Kandiyohi Co., MN

Prepared by KJM on 2022-03-28

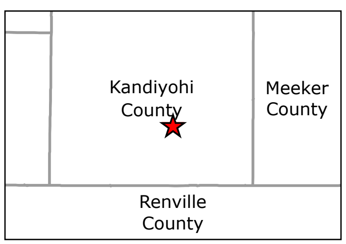
Client/Project
Kandiyohi County, MN
Bonnie Beach CAR
CAR Report

227702442

Figure No.
3

Title
Likely ISTS Compliance Status

V:\2277\active\227702442\gis\Pro\Bonnie Beach CAR Pro\Bonnie Beach CAR Pro.aprx Revised: 2022-03-28 By: kjmueller



Study Area Parcels
County Parcels
ISTS Age
Unknown
<10 Years
10-19 Years
30-39 Years
40+ Years
No System

N

0 250 500 Feet
(At original document size of 8.5x11)
1:5,997

Notes
1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
2. Data Sources: Kandiyohi Co., Stantec
3. Background: 2020 Kandiyohi Co. Aerial

Stantec

Project Location
T118N, R34W, S28 & 33
T. of Fahlun, Kandiyohi Co., MN

Prepared by KJM on 2022-03-28

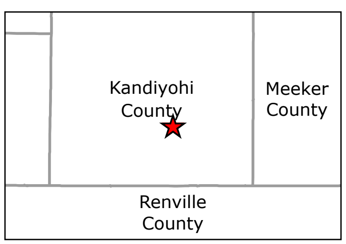
Client/Project
Kandiyohi County, MN
Bonnie Beach CAR
CAR Report

227702442

Figure No.
4

Title
ISTS Age (as of 2022)

V:\2277\active\227702442\gis\Pro\Bonnie Beach CAR Pro\Bonnie Beach CAR Pro.aprx Revised: 2022-03-28 By: kjmueller



- Study Area Parcels
- County Parcels

Likely Future ISTS

- Type 1
- Type 2
- Type 3 or 4

N

0 250 500 Feet

(At original document size of 8.5x11)
1:5,997

Notes
1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
2. Data Sources: Kandiyohi Co., Stantec
3. Background: 2020 Kandiyohi Co. Aerial

Stantec

Project Location
T118N, R34W, S28 & 33
T. of Fahlun, Kandiyohi Co., MN

Prepared by KJM on 2022-03-28

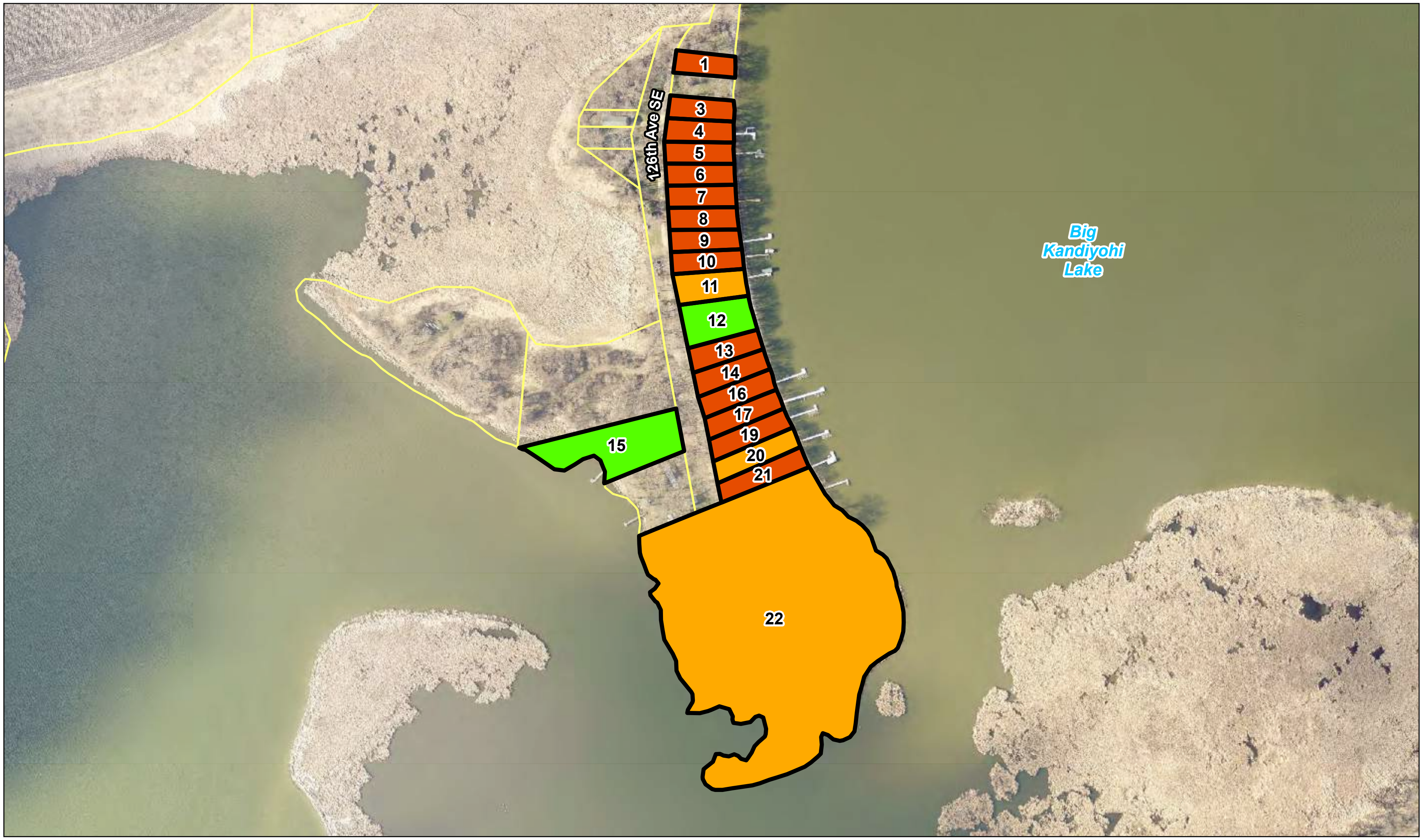
Client/Project
Kandiyohi County, MN
Bonnie Beach CAR
CAR Report

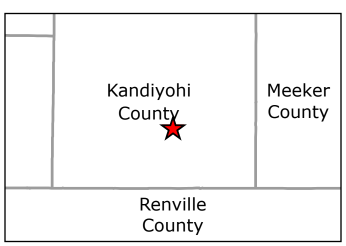
227702442

Figure No.
5

Title
Likely Future ISTS for All Properties

V:\2277\active\227702442\gis\Pro\Bonnie Beach CAR Pro\Bonnie Beach CAR Pro.aprx Revised: 2022-03-28 By: kjmueller





Study Area Parcels
County Parcels
Likely Future ISTS
Type 1
Type 2
Type 3 or 4

N

0 175 350 Feet
(At original document size of 8.5x11)
1:4,200

Notes
1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
2. Data Sources: Kandiyohi Co., Stantec
3. Background: 2020 Kandiyohi Co. Aerial

Stantec

Project Location
T118N, R34W, S28 & 33
T. of Fahlun, Kandiyohi Co., MN

Prepared by KJM on 2022-04-15

Client/Project
Kandiyohi County, MN
Bonnie Beach CAR
CAR Report

227702442

Figure No.
6

Title
Likely Future ISTS for 126th Ave SE Dwellings

V:\2277\active\227702442\gis\Pro\Bonnie Beach CAR Pro\Bonnie Beach CAR Pro.aprx Revised: 2022-04-15 By: kjmueller

Kandiyohi County
Meeker County
Renville County

Collection System Forcemain
Wastewater Treatment Site
Study Area Parcels
County Parcels

N
0 300 600 Feet
(At original document size of 8.5x11)
1:7,200

Notes
1. Coordinate System: NAD 1983 HARN Adj MN Kandiyohi Feet
2. Data Sources: Kandiyohi Co., Stantec
3. Background: 2020 Kandiyohi Co. Aerial

Stantec

Project Location
T118N, R34W, S28 & 33
T. of Fahlun, Kandiyohi Co., MN

Prepared by KJM on 2022-03-28

Client/Project
227702442
Kandiyohi County, MN
Bonnie Beach CAR
CAR Report

Figure No.
7

Title
Community Cluster System Concept

V:\2277\active\227702442\gis\Pro\Bonnie Beach CAR Pro\Bonnie Beach CAR Pro.aprx Revised: 2022-03-28 By: kjmueller

APPENDIX A

Parcel Data Spreadsheet

Bonnie Beach Community
Parcel Data Spreadsheet

				ISTS Information							Compliance Information									
											Likely Compliance status					Likely Future ISTS				
													Noncompliant							
CAR MAP ID#	Parcel ID	Address	Property Type: Commercial, Residential, or Other (No Dwelling or Vacant)	County Permit on File	Year Installed	ISTS Age as of 2022	System Type	Number of Bedrooms (est.)	Likely MPCA Dwelling Classification	Estimated Design Flow	Compliant (X if Yes)	Certificate of Compliance Date	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)	Estimated New ISTS Replacement Cost (126th Ave SE Dwellings only)	Estimated Annual Operation, Maintenance, & Replacement Costs
1	16-200-0010	6400 126th Ave SE	Residential	Yes	2008	14	Mound	3	III	218	X	2008					X		$7,500	$1,310
2	16-200-0020	6414 126th Ave SE	Other				N/A									X				
3	16-200-0030	6428 126th Ave SE	Residential	No	Unk	Unk	CP/DW	Unk	I	300				X	CP/DW		X		$7,500	$1,800
4	16-200-0040	6442 126th Ave SE	Residential	Yes	2015	7	Holding Tank	5	I	750	X	2015					X		$7,500	$4,500
5	16-200-0050	6456 126th Ave SE	Residential	Yes	2014	8	Holding Tank	3	I	450	X	2014					X		$7,500	$2,700
6	16-200-0060	6470 126th Ave SE	Residential	Yes	2021	1	Holding Tank	3	I	450	X	2021					X		$7,500	$2,700
7	16-200-0070	6484 126th Ave SE	Residential	No	Unk	Unk	CP/DW	Unk	II	300				X	CP/DW		X		$7,500	$1,800
8	16-200-0075	6498 126th Ave SE	Residential	No	Unk	Unk	CP/DW	Unk	II	300				X	CP/DW		X		$7,500	$1,800
9	16-200-0080	6512 126th Ave SE	Residential	Yes	2006	16	Holding Tank	2	III	180	X	2006					X		$7,500	$1,080
10	16-200-0090	6526 126th Ave SE	Residential	No	Unk	Unk	CP/DW	Unk	II	300				X	CP/DW		X		$7,500	$1,800
11	16-200-0100	6540 126th Ave SE	Residential	No	Unk	Unk	CP/DW	Unk	II	300				X	CP/DW			X	$30,000	$770
12	16-200-0110	6568 126th Ave SE	Residential	No	Unk	Unk	CP/DW	2	I	300				X	CP/DW	X			$25,000	$390
13	16-200-0120	6582 126th Ave SE	Residential	Yes	2015	7	Holding Tank	2	II	225	X	2015					X		$7,500	$1,350

Bonnie Beach Community
Parcel Data Spreadsheet

				ISTS Information							Compliance Information					Likely Future ISTS				
											Likely Compliance status									
													Noncompliant							
CAR MAP ID#	Parcel ID	Address	Property Type: Commercial, Residential, or Other (No Dwelling or Vacant)	County Permit on File	Year Installed	ISTS Age as of 2022	System Type	Number of Bedrooms (est.)	Likely MPCA Dwelling Classification	Estimated Design Flow	Compliant (X if Yes)	Certificate of Compliance Date	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)	Estimated New ISTS Replacement Cost (126th Ave SE Dwellings only)	Estimated Annual Operation, Maintenance, & Replacement Costs
14	16-200-0130	6596 126th Ave SE	Residential	No	Unk	Unk	CP/DW	Unk	II	300				X	CP/DW		X		$7,500	$1,800
15	16-200-0192	6645 126th Ave SE	Residential	Yes	1991	31	Trench	3	I	450				X	VS	X			$25,000	$390
16	16-200-0140	6610 126th Ave SE	Residential	Yes	2021	1	Holding Tank	2	II	225	X	2021					X		$7,500	$1,350
17	16-200-0150	6624 126th Ave SE	Residential	Yes	2004	18	Holding Tank	1	II	225	X	2020					X		$7,500	$1,350
18	16-200-0193	6649 126th Ave SE	Other				N/A										X			
19	16-200-0160	6638 126th Ave SE	Residential	No	1962	60	CP/DW	3	II	300				X	CP/DW		X		$7,500	$1,800
20	16-200-0170	6652 126th Ave SE	Residential	No	1965	57	CP/DW	2	III	180				X	CP/DW			X	$30,000	$770
21	16-200-0180	6666 126th Ave SE	Residential	Yes	2012	10	Holding Tank	3	II	300	X	2012					X		$7,500	$1,800
22	16-200-0190	6678 126th Ave SE	Residential	Yes	1992	30	Trench	2	III	180				X	VS			X	$30,000	$770
25	16-033-0200	6142 Big Kandi Lake Rd	Other				N/A									X				
26	16-033-0041	6208 Big Kandi Lake Rd	Other	No	Unk	Unk	Outhouse							X	VS		X			
32	16-033-0160	6604 Big Kandi Lake Rd	Other	No	Unk	Unk	Outhouse							X	VS	X				
34	16-033-0140	6736 Big Kandi Lake Rd	Other				N/A										X			

Bonnie Beach Community
Parcel Data Spreadsheet

				ISTS Information							Compliance Information – Likely Compliance status		Noncompliant			Likely Future ISTS				
CAR MAP ID#	Parcel ID	Address	Property Type: Commercial, Residential, or Other (No Dwelling or Vacant)	County Permit on File	Year Installed	ISTS Age as of 2022	System Type	Number of Bedrooms (est.)	Likely MPCA Dwelling Classification	Estimated Design Flow	Compliant (X if Yes)	Certificate of Compliance Date	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)	Estimated New ISTS Replacement Cost (126th Ave SE Dwellings only)	Estimated Annual Operation, Maintenance, & Replacement Costs
35	16-033-0130	6802 Big Kandi Lake Rd	Other	No	Unk	Unk	Outhouse							X	VS	X				
36	16-033-0120	6868 Big Kandi Lake Rd	Other				N/A									X				
39	16-033-0042	7066 Big Kandi Lake Rd	Other				N/A									X				
41	16-033-0090	7198 Big Kandi Lake Rd	Other				N/A										X			
45	16-033-0042	7066 Big Kandi Lake Rd	Other				N/A										X			

APPENDIX B

ISTS Information

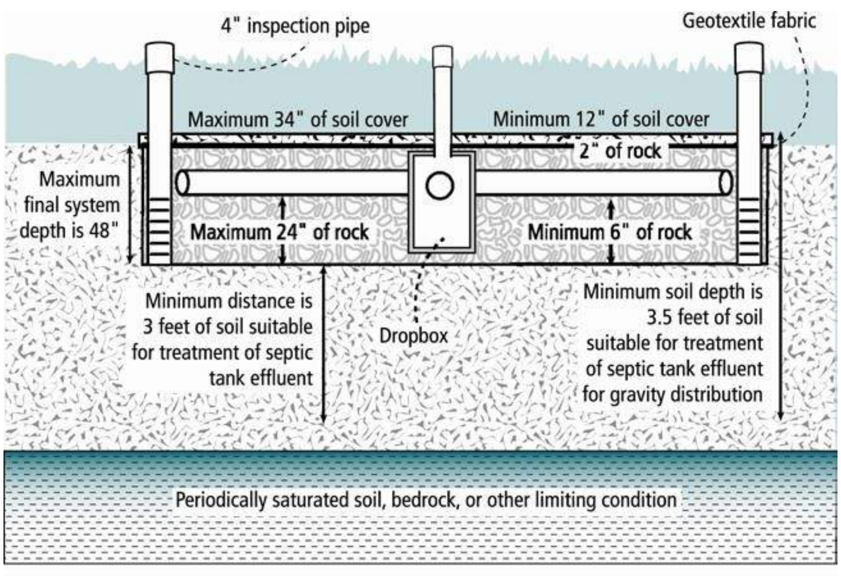
Below-Grade Systems

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 then 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



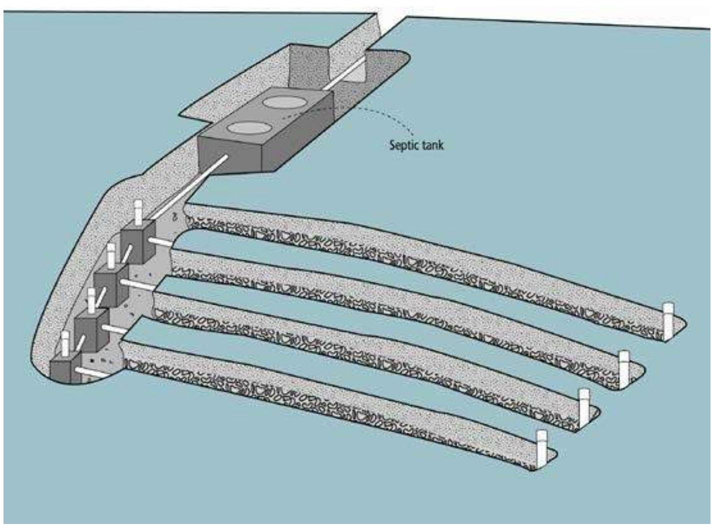
From MN Rules 7080.2260 Subp. 3. If the distribution media in a trench or a bed is in contact with soil texture group 2 through 4 (medium sand, fine sand, coarse and medium loamy sand) pressure distribution must be used.

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).**

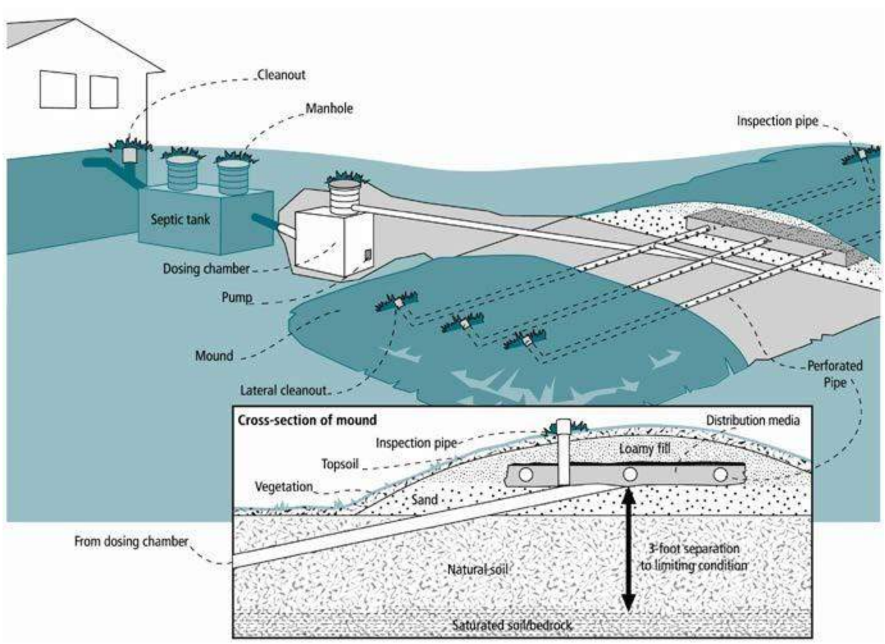
The trench soil treatment system consists of distribution media, covered with a minimum of 12 inches of soil and a close-growing and vigorous vegetation. Many trench systems utilize a pipe and gravel distribution system where effluent passes through the pipe and is stored within the media until it can 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

Bonnie Beach Community - Alternative 2: Community Cluster System
Design Wastewater Flow
(MN Rules 7080.1850, 7081.0120, 7081.0140)

CAR Map ID#	Address	Parcel ID#	# Bedroom*	Likely Dwelling Classification****	Flow (gpd)	Reduction Factor	Wastewater Flow (gpd)
1	6400 126th Ave SE	16-200-0010	3	III	218	0.45	98
2**	6414 126th Ave SE	16-200-0020	0		0		0
3	6428 126th Ave SE	16-200-0030	3	I	300	1	300
4	6442 126th Ave SE	16-200-0040	5	I	750	1	750
5	6456 126th Ave SE	16-200-0050	3	I	450	1	450
6	6470 126th Ave SE	16-200-0060	3	I	450	1	450
7	6484 126th Ave SE	16-200-0070	3	II	300	1	300
8	6498 126th Ave SE	16-200-0075	3	II	300	1	300
9	6512 126th Ave SE	16-200-0080	2	III	180	0.45	81
10	6526 126th Ave SE	16-200-0090	3	II	300	1	300
11	6540 126th Ave SE	16-200-0100	3	II	300	1	300
12	6568 126th Ave SE	16-200-0110	2	I	300	1	300
13	6582 126th Ave SE	16-200-0120	2	II	225	0.45	101
14	6596 126th Ave SE	16-200-0130	3	II	300	0.45	135
15	6645 126th Ave SE	16-200-0192	3	I	450	1.0	450
16	6610 126th Ave SE	16-200-0140	2	II	225	0.45	101
17	6624 126th Ave SE	16-200-0150	1	II	225	0.45	101
18***	6649 126th Ave SE	16-200-0193	0		0		0
19	6638 126th Ave SE	16-200-0160	3	II	300	0.45	135
20	6652 126th Ave SE	16-200-0170	2	III	180	0.45	81
21	6666 126th Ave SE	16-200-0180	3	II	300	0.45	135
22	6678 126th Ave SE	16-200-0190	2	III	180	0.45	81

*3-bedrooms assumed if unknown

**No dwelling on parcel and owned by same owner as parcel 16-200-0030

***No dwelling on parcel and owned by same owner as parcel 16-200-0150

****MN Rule 7080 Classification designation based on permit data, homeowner surveys, and onsite observations.

Count "1" Flow Reduction Factor:	10
Count "0.45" Flow Reduction Factor:	10
Total Average Dry Weather (ADW) Flow, gpd:	5,000
2-inch collection system forcemain length (mile)	0.93
Pipe diameter, inch	2
Infiltration/Inflow (200 gpd/in. dia./mi), gpd:	400
Total Average Wet Weather Flow (AWW), gpd:	**5,400**

APPENDIX D

Grinder Station Detail

PENTAIR

HYDROMATIC®

SEWAGE GRINDER PUMPS AND PACKAGES

WWW.HYDROMATIC.COM

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 1¼" 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)

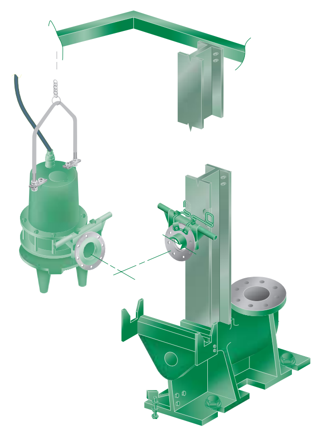
3, 5 & 7.5 HP Submersible Grinders

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	1¼" 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						

PENTAIR

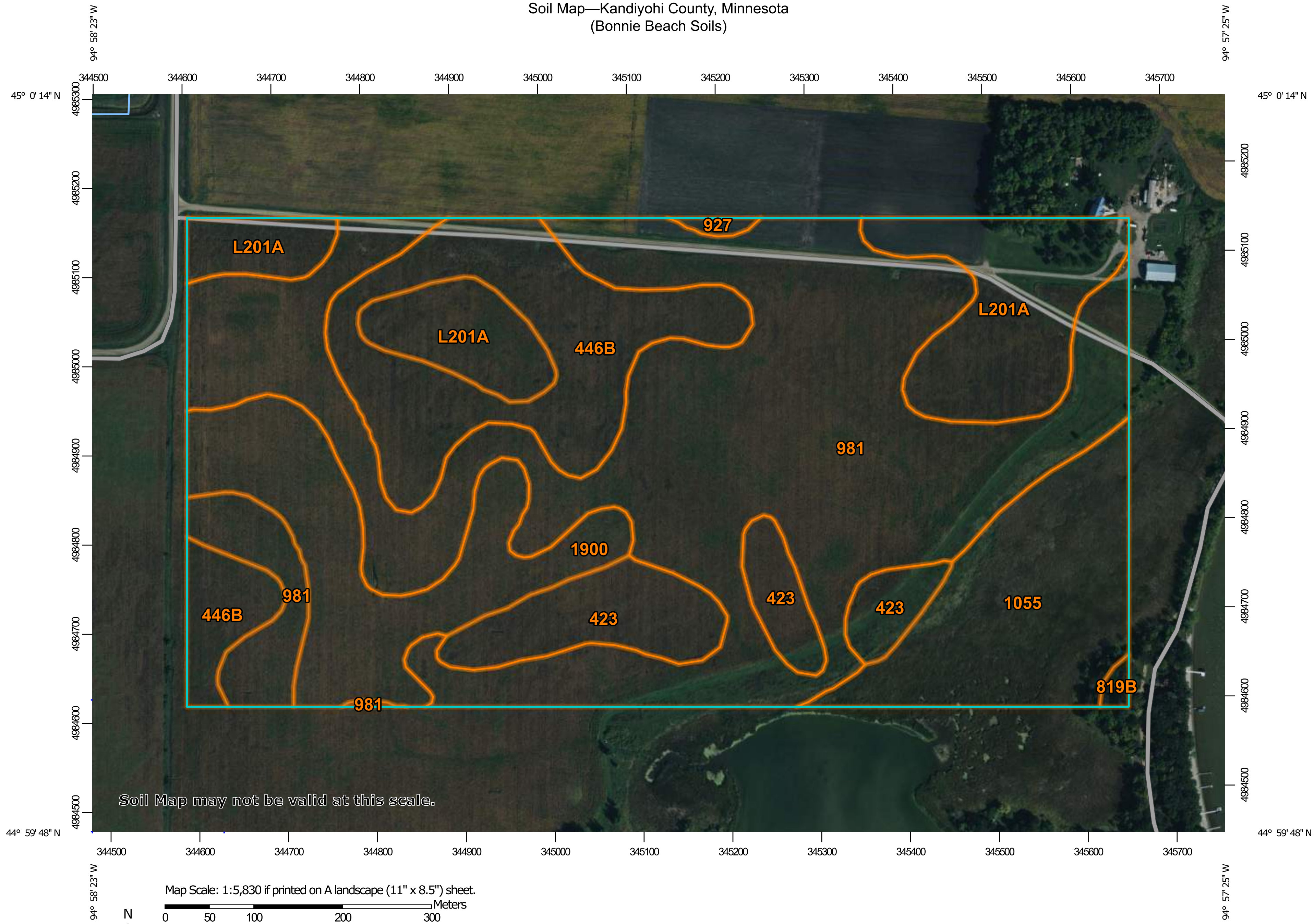
740 EAST 9TH STREET,
ASHLAND, OHIO 44805
WWW.HYDROMATIC.COM

269 TRILLIUM DRIVE, KITCHENER,
ONTARIO, CANADA N2G 4W5
WWW.HYDROMATIC.COM

APPENDIX E

Soil Information

Soil Map—Kandiyohi County, Minnesota
(Bonnie Beach Soils)



Map Scale: 1:5,830 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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 20, Sep 10, 2021

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

Date(s) aerial images were photographed: Apr 1, 2021—Oct 1, 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
423	Seaforth loam, 1 to 3 percent slopes	10.3	7.1%
446B	Normania loam, 2 to 5 percent slopes	19.5	13.5%
819B	Regal-Hawick complex, 0 to 4 percent slopes	0.3	0.2%
927	Harps-Glencoe-Seaforth complex, 0 to 3 percent slopes	0.4	0.2%
981	Canisteo-Harps loams	66.0	45.8%
1055	Aquolls and Histosols, ponded	14.6	10.1%
1900	Okoboji-Canisteo depressional complex, 0 to 1 percent slopes	15.4	10.7%
L201A	Normania loam, 1 to 3 percent slopes	17.8	12.3%
Totals for Area of Interest		**144.2**	**100.0%**

LOCATION NORMANIA MN

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 Wilmonton 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.

LOCATION CANISTEO MN+IA IL SD

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 Morristown 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
Hooppole--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 thast 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, wooly 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.

LOCATION HARPS IA+MN SD

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 corps 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, wooly 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 Bgk4 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.

APPENDIX F

Cost Analysis

Probable Construction Cost Estimate
Alternative 2: Community Cluster System
Bonnie Beach Community

Item No.	Item	Quantity	Unit	Unit Cost	Total Cost
	Collection - Grinder Pump Low Pressure Sewer				
1	Mobilization and Demobilization	1	LS	$40,200	$40,200
2	Septic Tank Abandonment	20	EA	$1,000	$20,000
3	Grinder Station Package and Controls	20	EA	$10,000	$200,000
4	Grinder Electrical Installation	20	EA	$1,250	$25,000
5	Building Sanitary Sewer Cleanout	20	EA	$250	$5,000
6	Connect to Existing Sanitary Sewer Service	20	EA	$500	$10,000
7	4" Gravity Building Sanitary Sewer	800	LF	$50	$40,000
8	Pressure Sewer	4,900	LF	$30	$147,000
9	2" Pressure Sewer Lateral	2,000	LF	$30	$60,000
10	Air/Vacuum Release Valve and Manhole	1	EA	$10,000	$10,000
11	Isolation Valve	1	EA	$4,500	$4,500
12	Pressure Sewer Cleanout	5	EA	$2,500	$12,500
13	2" Curb stops	20	EA	$1,500	$30,000
14	Washed Stone	250	CY	$50	$12,500
15	Select Granular	250	CY	$50	$12,500
16	Insulation (4")	360	SY	$30	$10,800
17	Property Site Restoration	20	EA	$1,500	$30,000
18	Class V Gravel Roadway Patch	750	SY	$50	$37,500
19	Traffic Control	1	LS	$1,500	$1,500
				Collection Subtotal:	**$709,000**
	Treatment - Mound Soil Dispersal System				
20	Mobilization and Demobilization	1	LS	$27,000	$27,000
21	Septic Tank	22,000	GAL	$2.00	$44,000
22	Dose Tank	5,000	GAL	$2.00	$10,000
23	Treatment Tank Installation	27,000	GAL	$2.00	$54,000
24	Aluminum Access Hatch	4	EA	$2,000	$8,000
25	Tank Riser Pipe	30	LF	$75	$2,250
26	Tank Riser/tank Adapter	6	EA	$75	$450
27	Riser Fiberglass Lid	6	EA	$200	$1,200
28	Effluent Screen	1	EA	$1,500	$1,500
29	Submersible Effluent Pump	6	EA	$2,500	$15,000
30	Pump Guide Rails & Discharge Piping	6	EA	$2,500	$15,000
31	Main Treatment System Control Panel	1	LS	$25,000	$25,000
32	Float Switch Sensors	4	EA	$500	$2,000
33	Mound Bed System	675	LF	$175	$118,125
34	Yard Piping	1,200	LF	$20	$24,000
35	Insulation (4")	220	SY	$25	$5,500
36	Gravel Access Road	100	LF	$75	$7,500
37	Perimeter Fence	1,500	LF	$15	$22,500
38	Site Restoration	2.0	ACRE	$15,000	$30,000
39	Erosion Control	1	LS	$2,500	$2,500
40	Electrical Component Installation Costs	1	LS	$25,000	$25,000
41	Land Acquisition	3	Acre	$10,000	$30,000

Treatment Subtotal:	**$471,000**
Collection & Treatment Subtotal:	**$1,180,000**
Contingency:	**$118,000**
Engineering Services:	**$213,000**
Legal & Administrative:	**$36,000**
Total Probable Construction Cost Estimate:	**$1,547,000**
Cost per Connection:	**$77,400**

Annual Operation, Maintenance, & Replacement Cost Estimate
Alternative 2: Community Cluster System
Bonnie Beach Community

Collection System	Estimated Cost	Notes
Service Provider	$1,750	
Miscellaneous Repairs/Service	$1,000	
Electricity		
Grinder Pumps & Controls	$0	To be paid for by private property owner
Equipment Replacement	$2,700	
Collection Subtotal:	**$5,500**	

Treatment System	Estimated Cost	Notes
Service Provider	$1,750	
Property Insurance	$900	$75/month
Miscellaneous Repairs/Service	$500	
Septage Hauling/Disposal	$800	4,000 gallons a year at $0.20/gallon
Data Service	$480	$40/month
Electricity		
Pumps & Controls	$440	
Equipment Replacement	$1,200	
Treatment Subtotal:	**$6,100**	

Total Annual O,M&R Costs:	**$11,600**	
Cost per Connection per Year:	**$580**	20 Connections
Cost per Connection per Month:	**$49**	