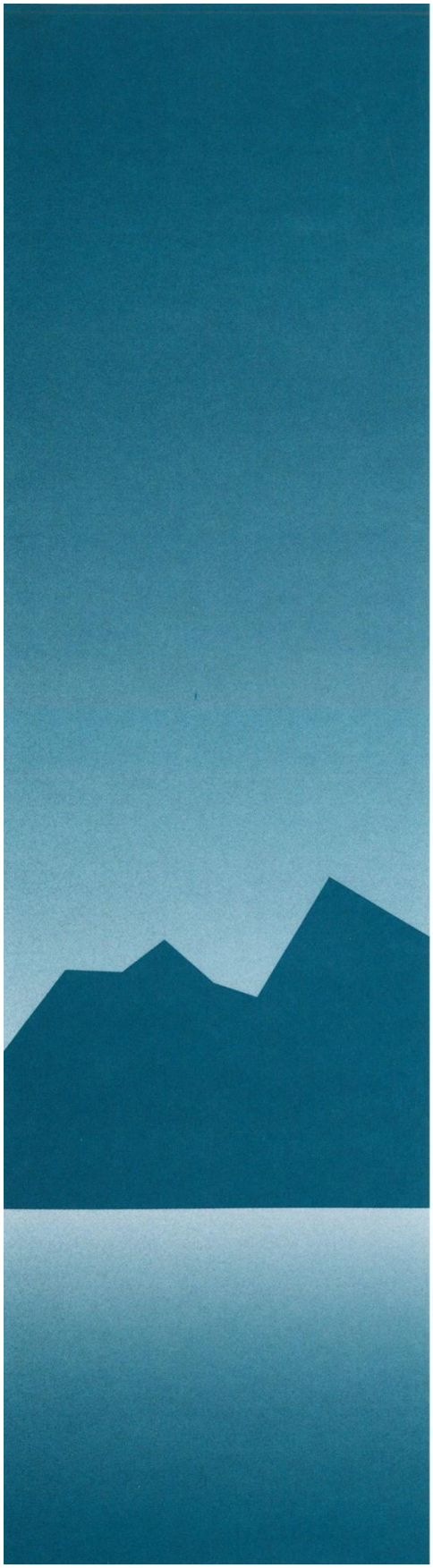

DESIGN REPORT

Manure Storage
And
Site Development
Project

Golden Sands Dairy, LLC
Wood County, Wisconsin

June 5, 2012
Revised July 16, 2012

PREPARED FOR:

Jim Wysocki
Golden Sands Dairy LLC
P.O. Box 330
Bancroft, WI 54921

PREPARED BY:

Resource Engineering Associates, Inc.
3510 Parmenter Street
Middleton, Wisconsin, 53562-1535

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Operations & Maintenance Plan

1.0 INTRODUCTION

1.1. KEY INFORMATION

I. Site Owner:
Jim Wysocki
Owner
PO Box 330
Bancroft, WI 54921

II. Site Location:
Wood County, Wisconsin
Town of Saratoga (T 21N, R 6E)
SW1/4 of SE1/4, and SE1/4 of SW1/4 Section 20, and eastern 200 foot strip of SW1/4 of SW1/4
See Maps in Appendix A

III. Site Contact:
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WISCONSIN PROFESSIONAL ENGINEER
ROBERT J. POFAHL
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7-17-12

I, Robert J Pofahl, hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A-E, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct.

1.2. SCOPE OF SERVICES

Mr. Jim Wysocki of Golden Sands , LLC requested Resource Engineering Associates, Inc. (REA) to prepare a Design Layout and Design Report for a manure storage system and feed storage runoff control systems to meet Wisconsin Department of Natural Resources (WDNR) NR 243 (WPDES permit) requirements for manure storage and handling. The Scope of Services for the project included tasks as follows:

- Prepare an existing conditions map of the proposed facility area identifying topography, and readily apparent site features;
- Prepare soil logs and collect soil samples from borings in the proposed manure basin, solids/sand stacking area, future digester area, and feed storage pad area to identify soil classification, soil moisture / saturation, percent fines (P200);
- Prepare engineering drawings and design specifications for the manure and runoff handling system facilities including the manure storages and feed storage runoff control system;
- Prepare a site grading plan and erosion control plan;
- Prepare documentation to submit for a WDNR WPDES permit for manure storage and feed storage runoff handling.

This design report includes a management assessment, site assessment, summary of design factors, and an operation and maintenance plan. NRCS Conservation Practices referenced includes NRCS 313, 629, and 634, See Appendix C.

1.3. BACKGROUND

The proposed facility is a new operation that will integrate dairy into the current irrigated potato and vegetable production cropland. This proposal is environmentally–sized to allow for advanced manure handling and nutrient recycling systems. The facility is modeled after the Central Sands Dairy in Juneau County.

Dairy crop production will enhance the sustainable farming methods of the current potato production systems. The practices will reduce wind erosion by utilizing limited tillage practices on the field corn silage crops and having multiple years in alfalfa production in each rotation.

Reduced nutrient leaching will be attained by harvesting forages and using the recycled organic nutrients from the cow manure in the following crop years, greatly reducing the amount of commercial fertilizer applied each year. The combination of forage crops and the application of recycled nutrients will increase the soil's organic matter. Runoff, while not a significant issue on these sandy soils, will be virtually non-existent due to the amount of surface residue and soil conditioning during forage production years.

Pesticide use will be decreased due to longer rotations between potato crops and improved soil health, which allows integrated pest management systems to lower the insect and disease pressures. In addition, forage crops generally utilize less pesticides than vegetable canning crops.

Upon installation of the digester in Phase II, irrigated agricultural land in this area will be transitioned to a more sustainable form of cropping and electrical generators in Phase II will produce electricity to power 1,400 homes as a "green power" source

1.4. PROPOSED DEVELOPMENT

In general the new facility will include the following:

Two free-stall barns—98' x 1,553' each
Dry cow barn—113' x 420'
Special needs barn—98' x 428'
Milking parlor and holding area—92' x 370'
575' x 390' concrete pad for silage
260' x 100' concrete pad and commodity building
90' x 176' manure processing building (phase II)
200' x 200' calf hutch area
30,000,000 gallon concrete liquid manure storage basin (290' x 315' bottom)
Two concrete manure solids storage pads - sand 82' x 176' and manure solids 172' x 200'
Digester (Phase II)
Five concrete tanks for soaker water collection
Concrete tank for solids pad runoff collection
500' x 445' hay storage area (not concrete)
Scale station
Two wells

1.5. MANAGEMENT ASSESSMENT

The purpose of the Management Assessment as identified in NRCS Practice Standard 313 is to determine options for manure and waste water handling and disposal. The assessment is performed to explore options and to determine the purpose of storage components, available resources, manure disposal schemes, and waste characterization. Issues included are as follows:

Waste Characterization: The proposed dairy will have 3,400 milk cows, 600 dry cows, 300 heifers and 1000 calves. Bedding for cows is planned to be sand. The manure from the animals, except the calves, will enter a sand separator prior to entering a digester (once Phase II is implemented). The bedded calf manure will be land spread when the pens are cleaned or stored on the manure solids pad. Digested manure solids will be separated with mechanical separators and the liquid portion of the manure will be stored in the proposed basin. Separated manure solids will be stacked on site prior to land application. The processed liquid manure in the basin (once phase II is implemented) will be irrigated to cropland to be developed adjacent to the dairy. Until Phase II is implemented,l manure will be land applied and incorporated. Manure application will be based on crop nutrient needs. The nutrient management plan is being completed by Frese Crop Consulting.

Wastewater includes parlor/milkhouse wash water (7.65 g/c/d), silage leachate water (0.25 g/c/d) and sand separation water (0.5 g/c/d) for a total of 8.4 g/c/d (Note: cows are based on milking cows) . Wastewater as outlined above is calculated as 28,560 g/d for the 3400 cows (8.4 gpd x 3400 cows = 28,560 gpd).

The parlor water will be recycled to flush the parlor holding area, then will be pumped to the processing building before entering the digester. Soakers will be used during months when the liquid can be irrigated to cropland, about 33,000 gallons per day (Average over 180 days).

Manure and waste water calculations and manure basin sizing is presented in the spreadsheet presented in Appendix B.

Table 1. Summary of volume of waste to be stored.

Animals	Number	Manure (ft^3/cow)	Bedding (ft^3/cow)	Storage Days	Vol./Day (gal.)	Total Vol. (gal.)	Total Vol. (ft^3)
1400 lb Milk Cows	3,400	2.5	0.0	180	64,089	11,535,955	1,542,240
1400 lb Dry Cows	600	1.9	0.0	180	8,527	1,534,896	205,200
Heifers	300	1.1	0.0	180	2,468	444,312	59,400
wastewater plus sand rinse water	--	--	--	180	27,710	4,987,800	666,818
Subtotal					**102,794**	**18,502,963**	**2,473,658**
solids & sand pad runoff				180		371,352	49,646
leachate from feed storage				180		149,600	20,000
feed storage runoff gallons				180		1,788,393	239,090
workpads outside barns				180		176,430	23,587
Total Manure & Runoff to Storage						**20,812,308**	
soaker water to storage					33,000	5,940,000	
sand	4300		0.45	90			174,150
manure solids				90			298,809

See Appendix B for manure generation rates.
Waste water generation rate calculations are as presented in the report. See checklist for page reference.

Land Base: The farm has approximately 6,112 acres of cropland owned, rented or in a land spreading agreement available to apply nutrients.

Planned Storage Period: The planned storage period is 180 days for liquid manure. Calculations indicate 192 days will be provided.

Waste Handling & Transfer: Waste from the planned barns will be vacuumed by tankers and hauled to the processing building. Five concrete transfer tanks are designed to hold soaker water that

is collected before it is pumped to the sand separator. Wastewater from the parlor will be pumped to the sand separator. Separated sand will be piled on a pad for reuse or land application.

Once Phase II is implemented, manure from the sand separator will go through an anaerobic digester. The digested manure will be separated using mechanical separators. The solid portion will be temporarily stored on a contained concrete pad and the liquid portion will be pumped to a storage basin. Manure will be field applied in accordance with a nutrient management plan prepared by others.

Facility Waste Removal Methods: Liquid manure accumulated in the storage basin will be irrigated as a liquid. The owner will evaluate alternative custom pumps for emptying. Separated solids manure will be land applied per the nutrient management plan.

Storage Liner: The liner for the storage basins will consist of a concrete liner in accordance with NRCS 313 - Table 5 Concrete Liner Criteria for Impoundments. "Water Tight" Concrete with waterstops.

Access and Safety: Manure will generally be removed by pumping over the walls or embankments of manure storages. Access to the main manure storage basin will be from a concrete ramp, but access is expected to be infrequent due to use of the sand separator, digester and solids separator. The basin is to be fenced to limit access by cattle and for safety for workers and visitors. Other storages will have safety railings installed as per owner's direction.

Labor & Equipment Needs: The farm will employ laborers and purchase vacuum tank scrapers to collect manure and agitation and pumping equipment to empty storage basins.

Odor, Aesthetics & Animal Health: The site is located over ¼ mile from the nearest property owner or house. State Highway 13 forms the east boundary of the Dairy, a 200 foot setback from the east end of the barns is included in the design.

As cows to stock the barn are initially brought in, the manure will be stored in the manure basin. Once the facilities are at 90% capacity, the facility plans to operate a sand removal and digester system to process the manure. The solids will be removed and land spread during the growing season. The separated liquid will be applied by irrigation.

Expansion Considerations: Expansion is not being considered at this time.

1.6. SITE ASSESSMENT

The purpose of the site assessment is to determine physical characteristics that may influence placement, construction, maintenance, and environmental integrity of the proposed storages.

Location: The building locations, land elevations (topography), public road access, soil test boring locations, nearby property lines, are identified on Sheet C-100 of the plan set. Adjacent properties in the section will be under common ownership by partners.

Water Table Information: Well Constructor Reports were obtained from the Wisconsin Geological and Natural History Survey (WG&NHS) for Wood County. The closest well reports are from Section 20 & 29 T21N R6E which are north and south of the proposed dairy. The well logs list the depth from surface to normal water level ranging from 12-33 feet (12 feet seems to be in a perched water table condition, as the depth dropped substantially during pumping).

Water table data is consistent with a Water Table Elevation Map for Irrigable Lands Inventory (1981) also by the WG&NHS. The map shows the water table in the site area at elevations between 980 and 990, with a gradient to the west, southwest. The general surface elevation from the site survey is 1004 msl; this suggests groundwater is 14 – 24 feet below the surface. The well construction reports and WG&NHS map is presented in Appendix A.
Soil borings collected on site identified water table depths ranging from 21.5 feet to 23.5 feet as presented in Appendix A.

Test Boring Logs and Soil Test Results: Soil test boring locations are as identified on the Site Layout Map. Logs of the test borings are presented in Appendix A. The data is summarized as follows:

- Soil observations on site generally indicated the following:
  - 0-0.5 feet, topsoil- Sand, dark brown, composed of roots, grass & tree residue;
  - 0.5 -24 feet, poorly graded sand, some small gravel intermixed periodically.

- Bedrock was not encountered in the test borings.

- Watertable was encountered at an elevation ranging from 21.5 to 23.5 feet below grade.

Sinkholes and other karst features: Sinkholes or karst features are not believed to be on the site. The area is not known to have karst features.

Borrow Areas: Borrow for buildings and basins will come from the construction of stormwater basins and roads on site.

Potential Discharge Impacts: Over filling such that over topping would occur would spill into proposed adjacent farm fields and depressions constructed on site.

Floodplain Considerations

Flood plain areas are not believed to be in or adjacent to the construction area. This is supported by the Wisconsin DNR Water Viewer Map.

2.0 FEED STORAGE LEACHATE AND RUNOFF CONTROL

A silage feed storage pad is planned to be built east of the proposed liquid manure storage basin. The facility plans to store silage in three to five piles on the pad. Silage may produce leachate with nitrogen, phosphorus, BOD, and ammonia. Silage will be covered with plastic, which will divert precipitation reducing the amount of potential leachate. A leachate and runoff collection system is designed to collect runoff from the feed pad for up to the 25 year storm and transfer the runoff to storage. Silage pad runoff and leachate volumes are included in the waste storage design spread sheet.

We believe the system design factors meet the objective of no discharge of pollutants, but management and experience will dictate specific operational needs.

2.1 LEACHATE COLLECTION SYSTEM

The leachate collection system includes a sloping silage pad to the southwest corner, collection trenches on the south and west side of the pad, a collection tank with sump, pump with manual and automatic controls. Leachate and runoff will flow to the collection trenches and flow to the collection tank where runoff will be pumped to storage.

2.1.1 SITE CONDITIONS

Soil Borings

Borings 15, 16, 17, 21, 22 & 23 were logged to a depth of 12 to 15 feet in the area of the feed storage pad. Soil characteristics were similar to the rest of the site, as discussed in the site characteristics. Because of the sandy nature of the soils, the feed storage pad is planned to be of a "water tight" concrete design. See Appendix A for boring logs.

2.1.2 LEACHATE VOLUME

The silage is intended to be stored at low moisture content, typically in the range of 30-35 percent solids. The leachate volume was calculated for the largest harvest anticipated (corn silage) as per owner. The calculation is as follows:

Calculation:

- Weight of stored feed = 32,000 to 40,000 tons per year
- Leachate volume = 40,000 tons * 0.5 ft^3/ton * 7.48 gal/ ft^3 = 149,600 gallons
-

Leachate volume is included in the waste storage design spread sheet.as wastewater.

2.1.3 HYDROLOGY

The feed storage pad area and collection trenches are approximately 240,000 ft^2 in size. Runoff from the feed storage pad is included as runoff in the manure storage calculation.

2.1.4 COLLECTION STRUCTURES

2.1.4.1 COLLECTION TRENCHES

The concrete collection trenches are designed to be "watertight" and to collect the first flush of 0.1inches plus convey the 25yr 24hr storm to manure storage.

2.1.4.2 COLLECTION TANK

The collection tank is designed to be a poured in place watertight tank with sump. The tank and pump system will collect the first flush from the feed storage pad using a small pump, and additional runoff (up to the 25 year design storm) using a larger pump. The pump system is proposed because gravity discharge to a vegetative treatment area would be difficult without significant fill.

During a runoff event, the tank should be pumped within 24 hours to remove potentially odorous liquids and solids. The pumps and pump controls should be

observed for potential maintenance needs, such that the system is functional for the next storm event.

During freezing conditions the pump will need to be weather protected..

2.2 GRADING AROUND THE FEED STORAGE

Grading around the feed storage is designed for working access and to divert runoff away from the feed storage.

3.0 SOAKER WATER COLLECTION

During the summer months the dairy plans to utilize soakers to keep the cows cool. Soaker water that does not evaporate or is not absorbed by solids in the alleys will flow toward the ends of the barns where liquids will drain into a reception trench located in an outside work pad. The work pad and trench will collect excess soaker water as well as manure that may be tracked out of the barn. The trench will flow to a concrete basin where it will be pumped to the digester. There will be five of these basins; one at each end of the freestall barns and one at the end of the special needs barn (no soakers are planned for the dry cow barn).

These basins will be "watertight" concrete. The basin inside dimension will be 10' by 12' by 8' with a 2.5' deep sump. The Maximum Operating Level (MOL) will be 1.4' from the top to address precipitation, the 25yr24hr storm event, and 1' of freeboard. Waste is planned to be pumped from the tanks to a collection line that runs from the tanks to the processing building. Each tank will have a check valve between the tank and the collection line to protect against backflow.

The dairy plans to operate the soakers when the temperature is above 70 degrees. If the soakers are on May through September the historical average for those months have 125 days where the temperature is above 70 degrees. If the soakers run half the time these days they will generate 47,412 gal/day.

Soaker water calculation

Freestall Barn
Soaker line length for freestall barns =1515ft
Soaker spacing=8 ft
Cycle= 2 min. on - 6 min. off
Nozzle flow rate = 0.6gal/min
4 rows of misters (for two barns)

1515'/8ft x 4rows= 756 misters
2min. on /8min. off x12hr/day=3hrs/day (running)
0.6g/min*60min/hr*3hrs/day*756misters=81,648gal/day

Special Needs Barn (no soakers in dry cow barn)
Soaker line length for special needs barn =490ft
Soaker spacing=8 ft
Cycle= 2 min on- 6 min off
Nozzle flow rate = 0.6gal/min

490'/8ft x 2 (alleys) = 122 misters (in barn)
2min. on/8min x 12hr/day=3hrs/day (running)
0.6g/min x 60min/hr*3hrs/day x 122misters=13,176 gal/day

The WI NRCS wastewater spreadsheet indicates that half (50%) of the water used for misters goes to storage. The balance would evaporate (therefore water to be stored is calculated by multiplying by 0.5).

81,648gal/day
+ 13176gal/day
94824gal/day (total applied) 94,824gpd x 0.5(collected ratio) = 47,412 gal/day

The misters are estimated (by past experience) to operate about 125 days per season.
47,412 gal/day*125 days = 5,926,500 gallons per season.

Since 180 days of storage is intended, storage is planned over 180 days.
5,926,500 gallons / 180 days = 32,925 gallons per day (round to 33,000 gpd)

Soaker water is included in the manure storage calculation spread sheet as part of the waste water number.

4.0 SEPARATED SAND AND MANURE SOLIDS PAD

4.1 SEPARATED SAND & WORK PADS

Once the digester is constructed, before manure is pumped to the digester, the sand is planned to be removed by McClanahan separators, Hydrocylones, and gravity settling. The reclaimed sand will be stored on a 176' by 82' watertight concrete pad until it is able to be reused or field applied (14,432 square feet. The dairy estimates sand use will be about 50 lbs/cow/day (110lb/ft^3) or 0.45 ft^3/cow/day.

Table 3. Summary of volume of sand to be stored.

Animals	Number	Bedding (ft^3/cow)	Storage Days	Vol./Day (ft^3)	Total Vol. (ft^3)
1400 lb Milk Cows	3,400	0.45	90	1,530	137,700
1400 lb Dry Cows	600	0.45	90	270	24,300
1000 lb Heifers	300	0.45	90	135	12,150
Total				**1,935**	**174,150**

Stacking with 1:1 sideslopes and a compaction factor of 1.2 the volume on the sand pad will equate to a 28 foot high pile. Runoff from the pad will flow into an adjacent basin to be pumped to the processing building to assist in sand separation.

If the separated sand pad becomes full and sand cannot be reused or field applied sand will be stacked on the silage pad (runoff is collected from the pad).

Rainfall from the working pads outside the barns will also be collected. Five pads totaling about 23,200 ft^2, the rainfall runoff from these pads for 180 days of storage is about 176,430 gallons. The work pads are included in the runoff area.

4.2 SEPARATED SOLIDS PAD

Digested manure will enter a solid separator to separate the solids from the liquid portion to more economically handle the land application of the manure. The solids will be stacked on a 200' by 172' watertight concrete pad (34,400 square feet) . Stacking with 1:1 sideslopes and a pile height of 30 feet the pad storage volume would be 298,800 ft^3. Digested manure solids are estimate to be generated at a rate of 132,865 lbs/day (66.5 tons/day). If the manure solids density is 45 lbs/ft^3 the volume produced is about 2,953ft^3/day. The storage pad will allow for about 90 days storage. Separated solids will be land applied in accordance with the farms nutrient management plan, or if necessary will be stacked on the feed pad (runoff controls are provided on the feed pad).

Runoff from the pad will flow into an adjacent transfer tank basin to be pumped to the digester or storage (See below)

4.3 SOLIDS & SAND STORAGE RUNOFF BASIN

Rainfall from the solids pads will be collected. The pads total area is about 48,832 ft^2, the rainfall runoff from these pads for 180 days of storage based on the Waste Facility Design spreadsheet is about 371,500 gallons (See Appendix B). Some rain that falls on this pad will be absorbed by the separated solids and not runoff, but if minimal solids are stored the 371,000 gallons would need to be stored. Runoff calculations are included in the manure storage spreadsheet based on the square foot area.

The solids & sand pad basin will be a "watertight" concrete basin with a 6:1 concrete ramp for access (occasional access is anticipated to remove solids). The basin inside dimension will be 98' by 36' by 8'. The Maximum Operating Level (MOL) will be 1.7 feet from the top to address precipitation, the 25yr 24hr storm event, and 1' of freeboard. This provides about 18,400ft^3 of storage for the 25yr 24hr storm assuming no water is absorbed by solids. The 100yr/24hr storm will fill the basin and back up into the solids pad.

Runoff collected in the solids water runoff basin will to be pumped to the processing building. Accumulated solids can be removed with equipment via the ramp.

5.0 LIQUID MANURE STORAGE

The proposed liquid manure storage basin is located in the southeast corner of the site. The basin location, dimensions and elevations are shown on Sheet C303 of the plan set. The storage basin top elevation will be 1015. Natural ground in the area of the storage basin is at an elevation ranging from approximately 1000 to 1004. The bottom of the basin will be about 15 to 19 feet below the natural ground at an elevation of 985.

5.1 SITE CONDITIONS

The soil characteristics are consistent across the site as discussed in Section 1.6. Twelve soil borings (SB 1-12)were logged in the liquid manure storage basin footprint. Saturation was observed in the soil cores at depths ranging from 22 to 23.5 feet below grade.

The data indicates separation to ground water is greater than 2 feet(as required in NRCS 313). Ground water separation is proposed to be confirmed during basin excavation (See Plans).

5.2 CAPACITY

The basin capacity is planned to be 30 million gallons plus a one foot freeboard and emergency capacity for a 25 year 24 hour storm (about 2 feet total).

5.3 DESIGN

The liquid manure storage basin was designed by REA in accordance with WI NRCS Conservation Practice Standard: *Waste Storage Facility (313)*. The basin is planned to have sloped-side walls and a concrete liner with waterstops. The basin floor dimensions are 290' x 315'. The inner side wall slopes are 2.5:1 to accommodate concrete placement and the outer slopes were set at 3:1 to accommodate mowing. The berm top width is 20' to accommodate vehicle traffic.

The maximum operating level (MOL) is elevation =1013.2 feet giving a one foot freeboard and storage for a 25 yr, 24 hr rainfall event above the maximum operation level. The design fill height of the berm on the basin side is approximately 15 feet. The top of berm elevation is increased 5 percent or 0.7 feet for settlement in accordance with NRCS 313.

Manure will enter the basin from the processing building through a pipe above the top of the basin. The pipe will be covered with a minimum of 2 feet of soil and will be surfaced with a concrete pad. The piping should be insulated to protect pipe from freezing in the winter.

6.0 TIME SCHEDULE

The objective is to begin construction in April 2013 and complete construction to start populating the barns by November 2013. The silage pad construction will need to be completed first to allow for the storage of feed for the cows that will arrive in the fall.

Phase II will begin once arrangements have been made for financing, regulatory approvals, and construction plans have been prepared and approved. The digester is expected to be operable before the facility is 90 % of design capacity.

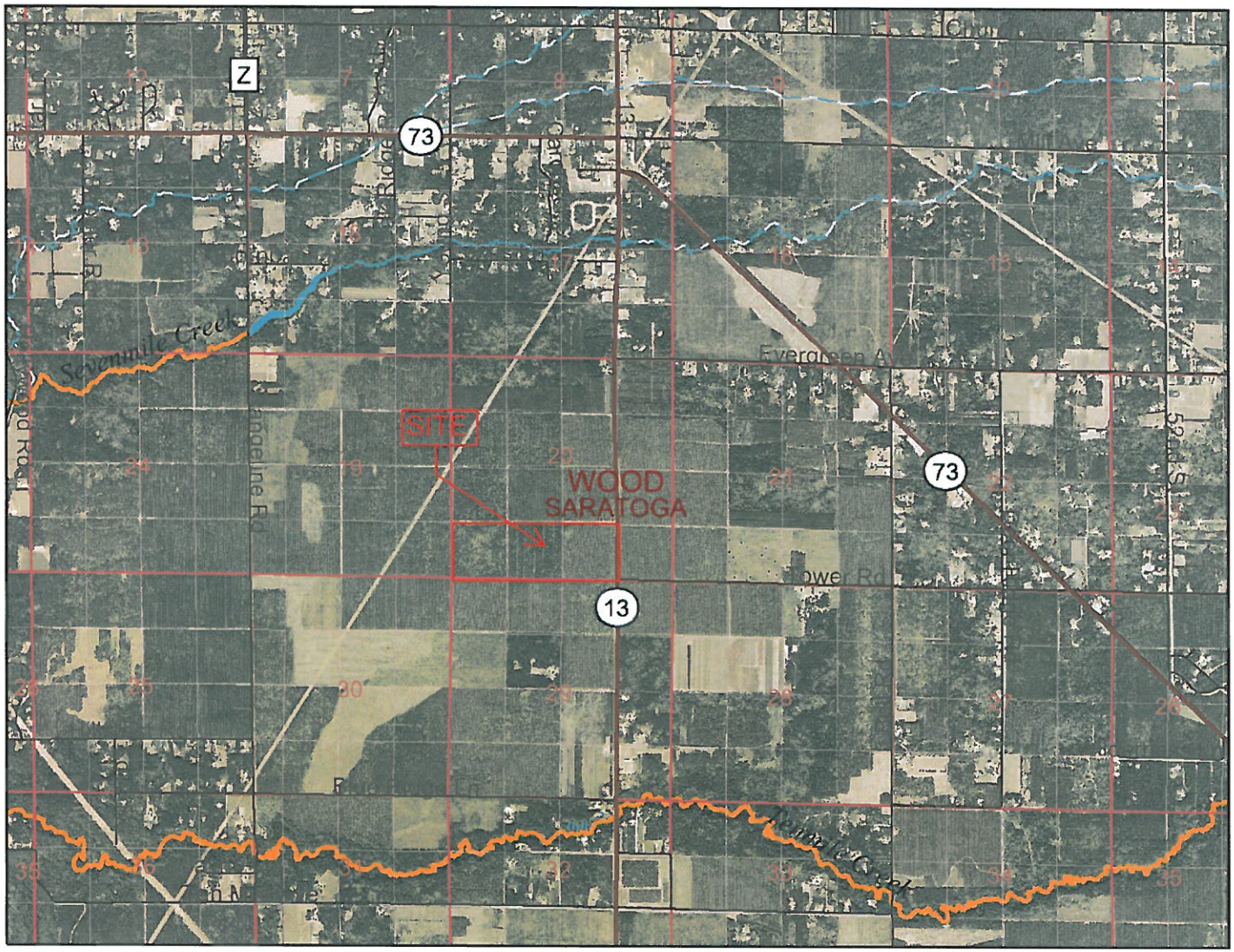
Appendix D includes a pre-construction meeting form, Construction Observation (Inspection) Plan, Qualifications of Construction Observer, Routine Inspection Checklist, and Operations and Management Plan. These forms and Plans should be used during and after construction. The Plans and Checklists should be updated on an annual basis.

Appendix - A Site Data

Site Map
Quad Map
Wetlands Map
Soil Borings Map and Boring Logs
Soils Map and Soils Data
Watertable Elevation Map
Well logs

Site Map

Map Created on May 01, 2012



0 4500 9000 13500 ft.

Legend

Major Highways

- Interstate
- State Highway
- U.S. Highways
- County Roads
- Local Roads
- 24K County Boundaries
- PLSS Sections
- PLSS Q-Q Sections
- Civil Towns
- Civil Town
- PRF Other River Public Rights Features
- PRF Sensitive Rivers
- PRF Other Public Rights Features
- PRF Sensitive Areas of Lakes
- ASNRI Wild Rice Streams
- ASNRI Outstanding and Exceptional Streams
- ERW
- ORW
- ORW
- ASNRI Wild and Scenic Rivers
- ASNRI Trout Streams
- Class I Trout
- Class II Trout
- Class III Trout
- ASNRI Wild Rice Areas
- ASNRI Outstanding and Exceptional Lakes

N

Scale: 1:48,000

This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

Quad Map

Quad Map

0 2250 4500 6750 ft.

Legend

Major Highways

- Interstate
- State Highway
- U.S. Highways
- County Roads
- Local Roads
- 24K County Boundaries

Civil Towns

- Civil Town
- PRF Other River Public Rights Features
- PRF Sensitive Rivers
- PRF Other Public Rights Features
- PRF Sensitive Areas of Lakes
- ASNRI Wild Rice Streams
- ASNRI Outstanding and Exceptional Streams
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- ORW
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- Class II Trout
- Class III Trout
- ASNRI Wild Rice Areas
- ASNRI Outstanding and Exceptional Lakes
- ERW

N

Scale: 1:24,000

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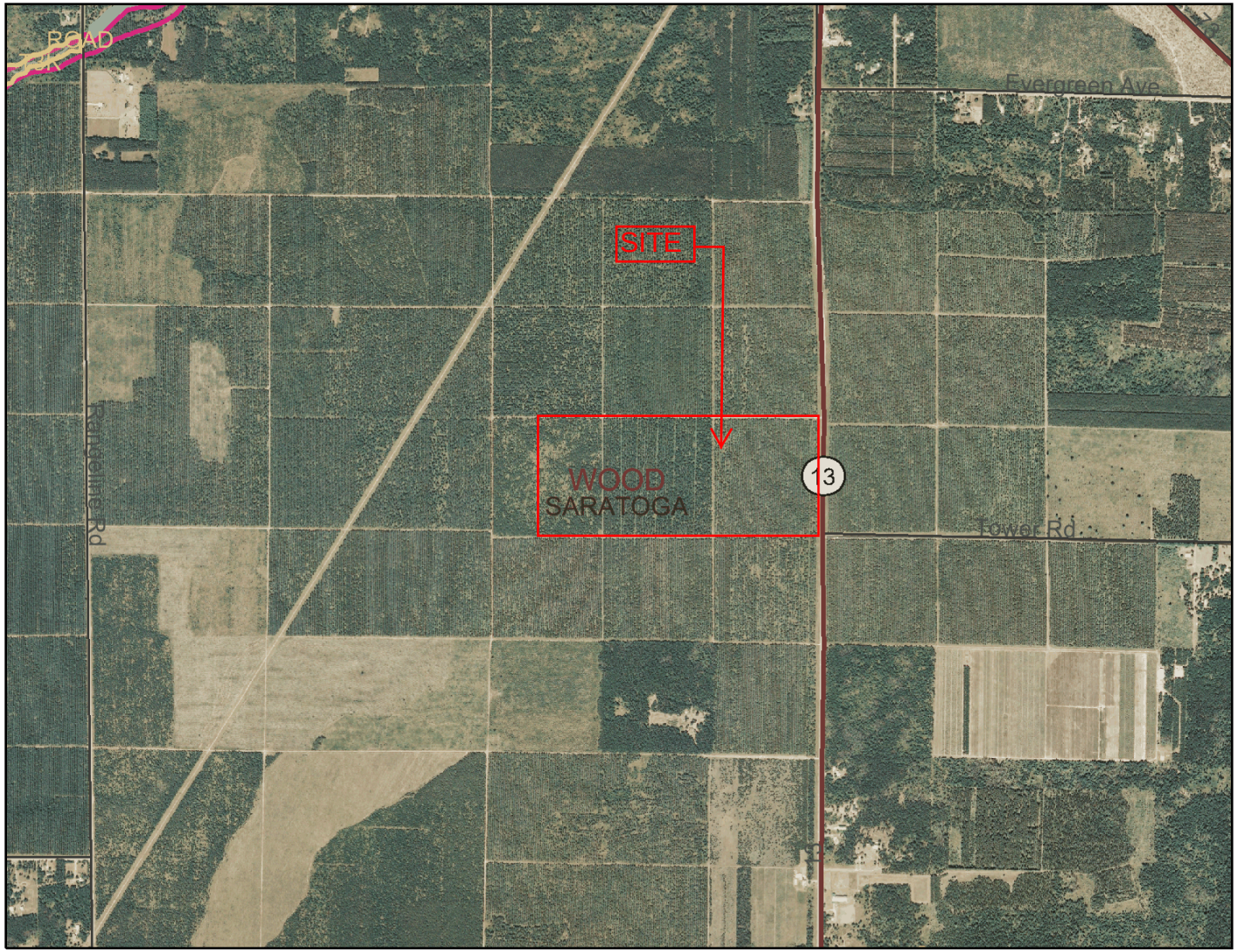
Wetlands Map

Wetlands Map



Legend

Major Highways

- Interstate
- State Highway
- U.S. Highways

County Roads

Local Roads

24K County Boundaries

Civil Towns

- Civil Town

USDA Wetspots

DNR Wetland Points

- Excavated Pond
- Dammed Pond
- Wetland Too Small to Delineate
- Filled Excavated Pond
- Filled Dammed Pond
- Filled Wetland Too Small to Delineate
- Filled or Drained Wetland

DNR Wetland Areas

- Upland
- Wetland
- Filled or Drained Wetland

Wetland Indicator Soils

24K Open Water

24K Rivers and Shorelines

- Intermittent
- Fluctuating
- Perennial

Cities and Villages

- Village
- City

N

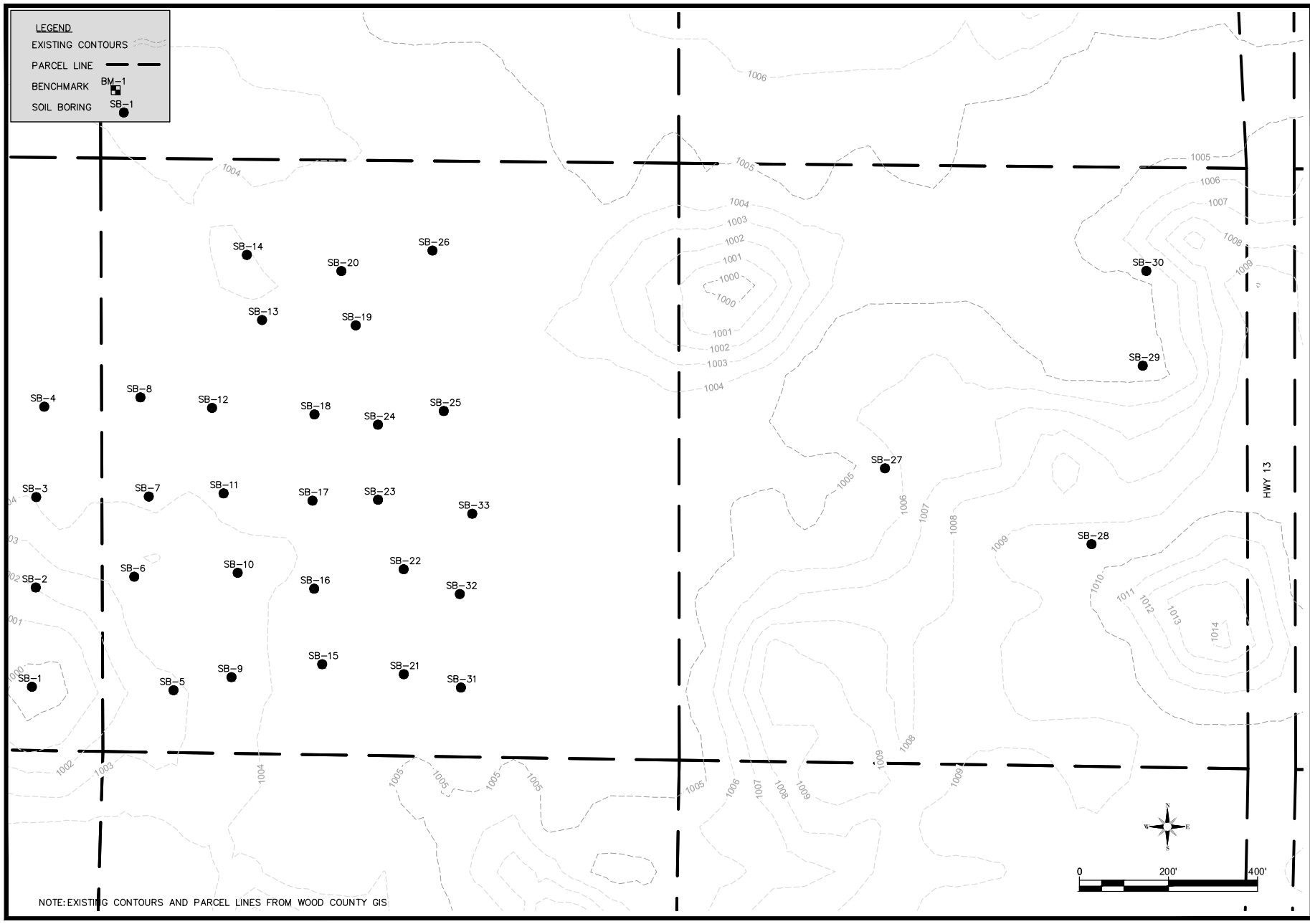
Scale: 1:24,000

0 2250 4500 6750 ft.

Map created on May 15, 2012

Wisconsin Wetland Inventory (WWI) maps show graphic representations of the type, size and location of wetlands in Wisconsin. These maps have been prepared from the analysis of high altitude imagery in conjunction with soil surveys, topographic maps, previous wetland inventories and field work. State statutes define a wetland as "an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions." The principal focus of the WWI is to produce wetland maps that are graphic representations of the type, size and location of wetlands in Wisconsin. Within this context, the objective of the WWI is to produce reconnaissance level information on the location, type, size of these habitats such that they are accurate at the nominal scale of the 1:24,000 (1 inch = 2000 feet) base map. The DNR recognizes the limitations of using remotely sensed information as the primary data source. They are to be used as a guide for planning purposes. There is no attempt, in either the design or products of this inventory, to define the limits of jurisdiction of any Federal, State, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, State, or local agencies concerning specified agency regulatory programs and jurisdictions that may affect such activities. The most accurate method of determining the legal extent of a wetland for federal or state regulations is a field delineation of the wetland boundary by a professional trained in wetland delineation techniques.

Soil Borings Map and Boring Logs



NOTE: EXISTING CONTOURS AND PARCEL LINES FROM WOOD COUNTY GIS

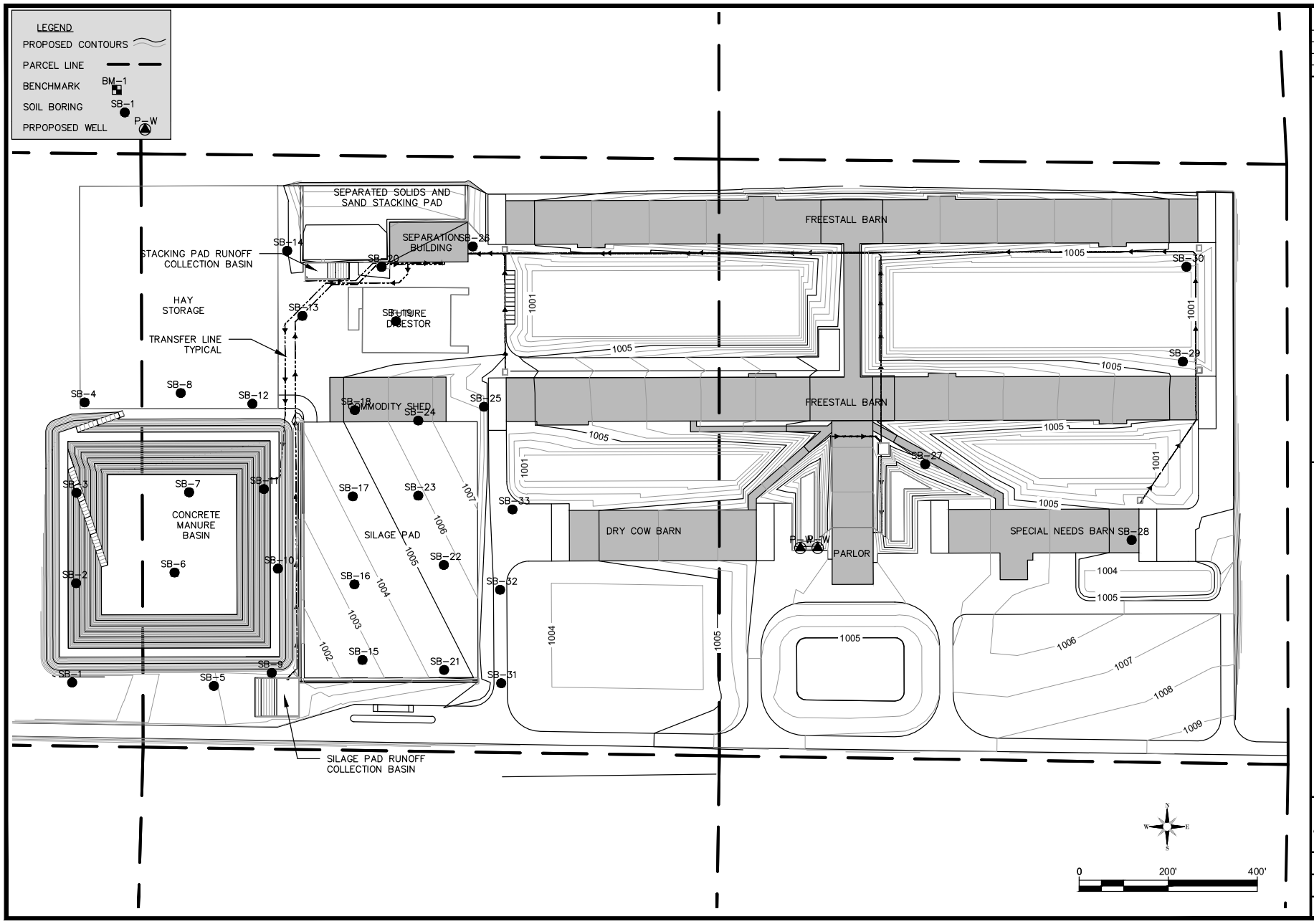
REVISIONS:
DATE
DATE
DATE
DATE

RESOURCE ENGINEERING ASSOCIATES, INC.
Resource Engineering Associates, Inc.
3510 Parmenter St., Suite 100
Middleton, Wisconsin 53562-2507
Phone: 608-831-5522
Fax: 608-831-6564
Web: www.reaeng.com

EXISTING CONDITIONS FACILITY SITE PLAN
GOLDEN SANDS DAIRY
8550 CENTRAL SANDS RD.
BANCROFT, WI 54921

DATE: 5/12/12
DRAWN: DRW
CHECKED: RJP
APPROVED: RJP
DRAWING NAME: 1232site.dwg
PROJECT NUMBER: 120032.1

C100



REVISIONS:
DATE
DATE
DATE
DATE

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Middleton, Wisconsin 53562-2507
Phone: 608-831-5522
Fax: 608-831-6564
Web: www.reaeng.com

PROPOSED LAYOUT FACILITY SITE PLAN GOLDEN SANDS DAIRY 8550 CENTRAL SANDS RD. BANCROFT, WI 54921

DATE: 5/12/12
DRAWN: DRW
CHECKED: RJP
APPROVED: RJP
DRAWING NAME: 1232site.dwg
PROJECT NUMBER: 120032.1

C101

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki
DATE 5-9-12 PROJ #
MAP UNIT
SURFACE COND. Grass/Trees
DRAWING #

LOCATION
TEST [redacted] #1
DTW 23.5'
SURFACE ELEV. 1001.7917
[redacted] DESCRIPTION (N Rd) - basin Area (SW corner)
REA T[redacted] Rp.
EQUIP. Geoprobe.
DEPTH to BEDROCK

~9:00 AM

Recovery

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES (Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color)	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA (Site Map, Geology Units, Water Table, Field Tests, Comments) Note: Cased Sample Tube.	DEPTH (ft)
0	12"	Topsoil					0
1	SP	Poorly graded sand... moist				7.5YR 4/4 Very Dark Brown	1
38" 2		few fines <10% - medium grain				few fine Roots to ~ 4ft.	2
3		Very Dark Brown			X		3
4		4' - Brown				10YR 5/4 Brown.	4
26" 5							5
6							6
7							7
8							8
9		9' Coarser texture - few gravel					9
29" 10							10
11							11
12							12
13							13
29" 14		14' Very little fines - mostly coarse sand!					14
15							15
16							16
17		Pocket of small gravel coarse grained sand. - still moist					17
28 18							18
19							19
20							20
29" 21						After ~10 min waterlevel IN casing @ 23.8'	21
22							22
23	4"	finer grain sand -					23
24		free water apparent at 24' IN profile appears started at 23½'.				7.5YR 4/4 Brown	24
39" 25					X	EOB at 28'	25

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REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki
DATE 5-9-12 PROJ #
MAP UNIT
SURFACE COND. Trees/grass.
DRAWING #

LOCATION
TEST [redacted] #2
DTW 23.5'
SURFACE ELEV. 1003.0786
[redacted] DESCRIPTION N #1 - 200'

REA T[redacted] RO.
EQUIP. Geoprobe
DEPTH to BEDROCK

10:00 Am.

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	8"	Top soil - Dark Brown. Sand. - few grass & roots.					0
1	SP	Poorly graded Sand moist - few fines Strong Brown medium grained				7.5YR4/6. - Strong brown	1
2		moist					2
3						10YR 4/4 Dark yellow brown	3
4							4
5							5
6							6
7							7
8							8
9							9
10		medium to coarse grained still moist					10
11							11
12							12
13							13
14							14
15							15
16		medium grained Sand					16
17							17
18							18
19							19
20							20
21							21
22							22
23		23.5' Apparent Saturation					23
24		EOB 24'					24
25							25

24" 28" 29 28 26"

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REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysochi
DATE 5/9/12 PROJ #
LOCATION
TEST [redacted] #3 REA T[redacted] Rp.
MAP UNIT
DTW 23.5 ft EQUIP. Geoprobe.
SURFACE COND. Grass/Trees.
SURFACE ELEV. 1002.96 DEPTH to BEDROCK
DRAWING #
[redacted] DESCRIPTION 200' N #2.

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	6"	Top Soil Dark Brown - moist Sand Some root; grass organic material.					0
1	SP	Brown - moist - few fines 7.5YR 4/4					1
2	SP	7.5YR5/4 Brown					2
3							3
4							4
5							5
6		6' - Streak 7.5YR 4/6 strong brown moist					6
7		7.5YR 5/4 Brown.					7
8							8
9							9
10		lense with more moisture - at 10' - 11'.			X		10
11							11
12							12
13							13
14							14
15							15
16							16
17							17
18							18
19							19
20							20
21							21
22							22
23		23.5' apparent saturation					23
24		EOB 24'					24
25							25

29"
28
30
26"
30
26"

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REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki
DATE _____ PROJ # _____
MAP UNIT _____
SURFACE COND. Grass/Trees
DRAWING # _____

LOCATION _____
TEST [redacted] #4
DTW _____
SURFACE ELEV. 1002.30
[redacted] DESCRIPTION N #3-200'

REA T[redacted] Rg.
EQUIP. Geoprobe
DEPTH to BEDROCK _____
(Appears to be in a Low Area)

11:20 Am

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	4"	Topsoil - 4" Dark Brown moist grass; Roots					0
1	SP	med. to fine Sand - Some Silt moist. 7.5YR 4/4 Brown.					1
2		↓					2
3		7.5YR 5/4 Brown					3
4		↓			X		4
5							5
6							6
7		At ~7' medium sand - less Silt					7
8	SP	↓					8
9							9
10							10
11							11
12							12
13							13
14		Lense medium Sand					14
15							15
16							16
17							17
18							18
19							19
20							20
21							21
22		▽ 22.5' Apparent Saturation					22
23							23
24		EOB - 24'					24
25							25

24"
29"
30"
23"
28"
24"

Page ___ of ___

REA SOIL PROFILE/TEST PIT LOG

PROJECT
DATE 5/9/12 PROJ #
MAP UNIT
SURFACE COND. Trees/grass.
DRAWING #

LOCATION
TEST [redacted] #5
DTW 23.8 FT.
SURFACE ELEV. 1003.08
[redacted] DESCRIPTION 200' E. #1

REA T[redacted] Rp
EQUIP. Geoprobe
DEPTH to BEDROCK

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	6"	Topsoil dark brown - moist grass; Roots. - Sand -					0
1	P	Sand - medium grained - Poorly graded moist				7.5YR 4/6 Strong brown.	1
2							2
3							3
4		7.5YR 5/4 brown medium to fine Sand.					4
5							5
6							6
7							7
8		3" Lense Coarse sand.					8
9							9
10		MORE moisture - medium to Coarse Sand.					10
11							11
12							12
13							13
14							14
15							15
16							16
17							17
18							18
19							19
20							20
21							21
22							22
23		▽ Saturation at ~ 23.8'					23
24		EOB 24'					24
25							25

Page ___ of ___

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wyzocki
DATE 5-9-12 PROJ #
MAP UNIT
SURFACE COND Grass/Trees.
DRAWING #
END 1:15 pm

LOCATION
TEST [redacted] #6
DTW 23.3 ft
SURFACE ELEV. 1003.20
[redacted] DESCRIPTION 200' N #5

REA T[redacted] Rp.
EQUIP. Geoprobe.
DEPTH to BEDROCK

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	6"	Topsoil - dark brown - moist few fines - many fine Roots.					0
1	SP	Sand medium - Some fines - poorly graded - few gravel (1/4" ϕ) moist				7.5YR 3/4 Dark Brown	1
4	SP	7.5YR 6/4 light brown.					4
4		Less fines					4
8		7.5YR 5/4 brown - moist - (more moist than above). more fines.			X		8
12		more coarse sand - less fines					12
18		medium sand					18
22		7.5YR 5/6 Strong brown.					22
23		Saturation ~ 23.3'					23
24		EOB - 24'					24
25							25

24"
27"
25
27
27
28

Page ___ of ___

REA SOIL PROFILE/TEST PIT LOG

LOCATION W 1/4
TEST [redacted] #7
DTW 23.5 ft.
SURFACE ELEV. 1003.38
[redacted] DESCRIPTION 200' N #6.

REA T[redacted] Rp.
EQUIP. Geoprobe
DEPTH to BEDROCK

PROJECT Wysocki
DATE 5-9-12 PROJ #
MAP UNIT
SURFACE COND. Grass/Trees.
DRAWING #

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0		6" Topsoil dark brown - Sand. Roots. moist					0
1	Sp	Poorly graded medium Sand - moist				7.5YR 4/4 Brown 3'	1
2						7.5YR 5/4 Brown	2
3							3
4							4
5							5
6							6
7							7
8							8
9							9
10		MORE moisture @ 10' & down.					10
11							11
12							12
13							13
14		medium to coarse Sand 14'+					14
15							15
16							16
17							17
18		18 Strong Brown.				7.5YR 5/6 Strong Brown	18
19		19 Brown					19
20		medium to coarse Sand					20
21							21
22							22
23		▽ Saturated at 23.5'					23
24		EOB 24'					24
25							25

25" 28" 28" 30 24 16

Page __ of __

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki

LOCATION W/d

DATE 5-9-12 PROJ #

TEST [redacted] #8

REA T[redacted] Rp.

MAP UNIT

DTW 22.0'

EQUIP. Geoprobe

SURFACE COND.

SURFACE ELEV. 1002.35

DEPTH to BEDROCK

DRAWING #

[redacted] DESCRIPTION 200' N #7

2:00 Start

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	7"	Topsoil - Dark Brown - Roots, grass. Sand.					0
1	SP	Sand few fines - brown. Moist, medium grain.				7.5 YR 4/4	1
2							2
3	3'	7.5 YR 5/4. Brown					3
4							4
5							5
6							6
7							7
8		Coarser grained. 7.5 YR 4/4 Brown.					8
9							9
10		more moisture. at 10' +					10
11							11
12							12
13							13
14		medium grained					14
15							15
16							16
17							17
18							18
19							19
20							20
21							21
22		▽ Apparent Saturation ~22'					22
23							23
24		EOB - 24'					24
25							25

27 27 26" 27 27" 23"

Page ___ of ___

REA SOIL PROFILE/TEST PIT LOG

LOCATION
TEST [redacted] # 9
DTW 23.5 ft.
SURFACE ELEV. 1002.61
[redacted] DESCRIPTION 200' S #110

REA T[redacted] Rp.
EQUIP. Geoprobe
DEPTH to BEDROCK

PROJECT
DATE 5-9-12 PROJ #
MAP UNIT
SURFACE COND. Grass/Trees.
DRAWING #
Start 435 END 500

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES (Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color)	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA (Site Map, Geology Units, Water Table, Field Tests, Comments)
0	4"	Topsoil Sand - moist Dark Brown.				
		Sand few fines - medium grain				
1		7.5YR 3/4 Dark Brown. moist				Sampled 1-3'
2						
3						
4		7.5YR 5/8 - (Strong Brown)				
5		7.5YR 4/3 (Brown)				
6						
7						
8		medium to coarse grained. 7.5YR 5/3 (Brown)				
9						
10						
11		MORE moist at 11'+				
12		medium grain				
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23		▽ Saturated at ~ 23.5'				
24		EOB at 24'				
25						

20"
29"
29
28
32"

Page __ of __

REA SOIL PROFILE/TEST PIT LOG

LOCATION
TEST [redacted] #10
DTW 23 ft
SURFACE ELEV. 1003.51
[redacted] DESCRIPTION 200' S #11

REA T[redacted] RP
EQUIP. Geoprobe
DEPTH to BEDROCK

PROJECT Wysocki
DATE 5-9-12 PROJ #
MAP UNIT
SURFACE COND. Trees/grass.
DRAWING #

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES (Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color)	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA (Site Map, Geology Units, Water Table, Field Tests, Comments)
0	5"	Topsoil - Dark Brown - moist Roots; grass.				
1	SP	Sand - medium to fine - moist. 7.5YR 3/3 Dark Brown				
2	SP	Sand medium to fine grained. fines 7.5YR 5/6 Strong Brown.				
3						
4						
5		more fines				
6						
7					X	
8		4" lense - 5YR 4/6 (Yellish brown) Few small Lenses above main profile. 7.5YR 4/3 (brown) medium to Coarse Sand				
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23		saturated at ~ 23'				
24		EOB @ 24'				
25						

23"
27"
28"
23"
24
21

Page __ of __

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki
DATE 5-9-12 PROJ #
MAP UNIT
SURFACE COND. Trees/Grass
DRAWING #

LOCATION
TEST [redacted] #11
DTW 23 ft
SURFACE ELEV. 1003.62
[redacted] DESCRIPTION 200' S #12

REA T[redacted] Rp
EQUIP. Geoprobe
DEPTH to BEDROCK

Finish 400

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0		Topsoil - Dark Brown -					0
1		Sand - medium grain - few fines - moist 7.5YR4/4 Brown					1
2							2
3		10YR 5/4 brown.					3
4							4
5							5
6							6
7		wetter at 7'					7
8		medium grained moist					8
9							9
10							10
11		11' - becomes fine sand - few fines					11
12		12' medium to coarse sand					12
13							13
14							14
15							15
16		medium sand					16
17							17
18							18
19		4" Lense 5YR 5/8 Yellowish Red					19
20		Brown below 18'-4"					20
21		Light brown 7.5YR 6/4					21
22							22
23		▽ Saturated at ~23'					23
24		EOB 24'					24
25							25

25"
30"
27"
28"
25"
30"

Page ___ of ___

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki
DATE 5-9-12 PROJ #
MAP UNIT
SURFACE COND. Grass / Trees.
DRAWING #
Start 2:49 pm

LOCATION
TEST [redacted] #12
DTW 23'
SURFACE ELEV. 1003.21
[redacted] DESCRIPTION 200' E #8

REA T[redacted] Rp.
EQUIP. Geoprobe
DEPTH to BEDROCK

Done 3:10

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	6"	Topsoil - Dark Brown - Roots; grass moist					0
1	SP	Sand - medium grain - moist 7.5YR 3/4 Dark Brown.					1
2	SP						2
3		9.4YR 6/4 Light brown.					3
4		7.5YR 5/4 Brown					4
5							5
6							6
7							7
8		medium to coarse grained					8
9							9
10		more moisture					10
11							11
12							12
13							13
14							14
15							15
16							16
17							17
18							18
19							19
20							20
21							21
22		7.5YR 6/4 Light brown					22
23		▽ Apparent Saturation at 23' 7.5YR 5/3 Brown.					23
24		EOB 24'					24
25							25

7.8"
28"
32
22
32
61

Page __ of __

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysochi

LOCATION

DATE 5-10-12 PROJ #

TEST [redacted] #13 REA T[redacted] Rp. MAP UNIT

DTW 22.5' EQUIP. Geoprobe. SURFACE COND. Trees/grass.

SURFACE ELEV. 1004.44 DEPTH to BEDROCK DRAWING #

[redacted] DESCRIPTION 200' S #14 Start 7:00 AM END ~7:30

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	5"	Topsoil Dark Brown - moist - Roots, glass					0
1	12"	Sand - fine grained - moist 7.5YR 3/4 Dark Brown.					1
		7.5YR4/4 Brown					
2							2
3							3
4		medium grained					4
5							5
6							6
7							7
8							8
9							9
10							10
11	4	4" Lense fine sand					11
12		medium to coarse sand					12
13							13
14							14
15							15
16							16
17							17
18							18
19							19
20							20
21							21
22		▽ Saturated at ~22½'					22
23							23
24		EOB - 24'					24
25							25

25" 1 30 31 23 7 28 27"

Page __ of __

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki

LOCATION

DATE 5-10-12 PROJ #

TEST [redacted] #14 REA [redacted] Ro MAP UNIT

DTW excavation EQUIP. Logger GeoProbe SURFACE COND. Trees/grass

SURFACE ELEV. 1004.82 DEPTH to BEDROCK DRAWING #

[redacted] DESCRIPTION 150' N #13 END 8:55 am.

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES (Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color)	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA (Site Map, Geology Units, Water Table, Field Tests, Comments)	DEPTH (ft)
0	6"	Topsoil - Sand - dark Brown moist. grass; Roots					0
1	Sp.	Sand - medium to fine grained little Silt - moist 7.5YR 3/4 Dark Brown					1
2	2½	medium grained sand					2
3		moist 7.5YR 5/4 brown					3
4							4
5		medium to fine grained					5
6							6
7							7
8							8
9		Coarse Sand - few medium					9
10							10
11							11
12							12
13							13
14		EOB at 15'					14

44

4

30'

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki

LOCATION

DATE 5-9-12 PROJ #

TEST [redacted] #15 REA [redacted] Bp MAP UNIT

DTW excavation none. EQUIP. Logger Geoprobe SURFACE COND.

SURFACE ELEV. 1004.69 DEPTH to BEDROCK DRAWING #

[redacted] DESCRIPTION 200' South Rd END 5:45

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES (Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color)	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA (Site Map, Geology Units, Water Table, Field Tests, Comments)	DEPTH (ft)
0	4"	Topsoil Dark Brown - moist.					0
		Sand - few fines - medium grade - moist					
1	SP	7.5YR 4/4 Brown Poorly graded Sand moist medium grain.				7.5YR 3/4 Dark Brown.	1
2							2
3						7.5YR 5/3 Brown.	3
4							4
5							5
6		medium grained moist					6
7							7
8							8
9							9
10							10
11							11
12		EOB 12'					12
13							13
14							14

30"

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysoski

LOCATION

DATE 5-9-12 PROJ #

TEST [redacted] # 16

REA [redacted]

MAP UNIT

DTW excavation none

EQUIP. Logger

SURFACE COND. Grass/Trees

SURFACE ELEV. 1008.55

DEPTH to BEDROCK

DRAWING #

[redacted] DESCRIPTION ~200' N #15

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	6"	Topsoil Dark Brown - moist Sand. few fines					0
1	Sp	Poorly graded sand - med. to fine grain - Little silt 7.5YR 3/4 Dark Brown. Moist					1
2							2
3		7.5YR 5/3 Brown					3
4							4
5							5
6							6
7							7
8							8
9		Becomes medium grained still moist					9
10							10
11							11
12		EOB 12'					12
13							13
14							14

50"

42"

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki

LOCATION

DATE 5-9-12 PROJ #

TEST [redacted] # 17 REA [redacted] Rp MAP UNIT

DTW excavation None. EQUIP. Logger Geoprobe SURFACE COND. grass/Trees

SURFACE ELEV. 1009.62 DEPTH to BEDROCK DRAWING #

[redacted] DESCRIPTION 200' N #16

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES (Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color)	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA (Site Map, Geology Units, Water Table, Field Tests, Comments)	DEPTH (ft)
0	6"	Topsoil Dark Brown. moist					0
1	Sp	Sand - moist 7.5YR 3/4 (Dark Brown) fine to medium grain					1
2	Sp	Brown 7.5YR 5/3					2
3							3
4							4
5		medium grain. still moist					5
6							6
7							7
8							8
9							9
10							10
11							11
12		EOB 12'					12
13							13
14							14

48"

32"

REA SOIL PROFILE/TEST [redacted] LOG PROJECT Wysocki

LOCATION _____ DATE 5/9/12 PROJ # _____

TEST [redacted] # 18 REA T[redacted] RP MAP UNIT _____

DTW _____ EQUIP. Geoprobe SURFACE COND. Grass/Trees.

SURFACE ELEV. 1005.07 DEPTH to BEDROCK _____ DRAWING # _____

[redacted]L DESCRIPTION 200' N #17 start 6:25

46"

36"

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	6"	Topsoil Dark Brown - Moist grass, Roots.					0
		sand moist fine to med. grain. 7.5YR 3/3 dark brown					
1							1
2							2
3		medium to fine grained moist 7.5YR 5/4 Brown					3
4							4
5							5
6		medium to coarse grained					6
7							7
8							8
9		medium grain.					9
10							10
11							11
12		EOB 12'					12
13							13
14							14
15							15

Page __ of __

REA SOIL PROFILE/TEST [redacted] LOG

PROJECT Wysocki

LOCATION

TEST [redacted] #19

REA T[redacted] Rp

DATE 5/10/12 PROJ #

DTW 22.5'

EQUIP. Geoprobe

MAP UNIT

SURFACE ELEV. 1004.35

DEPTH to BEDROCK

SURFACE COND. Grass / Trees.

[redacted] DESCRIPTION 200' E #13

DRAWING #

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	4"	Topsoil - Dark Brown - moist					0
		Sand - 7.5YR 4/4 Brown - moist - medium					
1	SP	To fine grained					1
2		Sand - fine to medium grain					2
		moist 7.5YR 5/4 Brown.					
3							3
4							4
5							5
6		fine to [illegible]					6
7							7
8							8
9	6"	Coarse grain					9
10		fine to medium grain					10
11							11
12	6"	Coarse grain					12
13		medium grain					13
14							14
15							15
16							16
17							17
18							18
19		Coarse grained					19
20		medium grained					20
21							21
22		Saturation at ~22.5'					22
23							23
24		EOB 24'					24
25							25

Page __ of __

REA SOIL PROFILE/TEST [redacted] LOG

PROJECT Wysocki

LOCATION

DATE 5/10/12 PROJ #

TEST [redacted] # 20 REA [redacted] Rp. MAP UNIT

DTW 1003.52 EQUIP. Geoprobe SURFACE COND. Grass Trees

SURFACE ELEV. DEPTH to BEDROCK DRAWING #

LEGAL DESCRIPTION 150' N #19

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	4"	Topsoil - Dark Brown - moist Sand					0
	SP	Sand - moist - 7.5 YR 3/4 (Dark Brown)					
1	18"	Sand					1
		Sand - moist - 7.5 YR 5/4 (Brown) medium grained					
2							2
3							3
4		10 YR 6/4 Light brown					4
5		fine grained					5
6							6
7		medium grained					7
8							8
9							9
10							10
11							11
12							12
13							13
14		EOB at 15'					14
15							15

42"

32"

43"

Page__ of __

EA SOIL PROFILE/TEST [redacted] LOG PROJECT Wysocki

LOCATION _____ DATE 5/10/12 PROJ # 120032.1

TEST [redacted] # 21 REA [redacted] Rp. MAP UNIT _____

DTW excavation EQUIP. Logger Geoprobe. SURFACE COND. Trees/grass.

SURFACE ELEV. 1005.14 DEPTH to BEDROCK _____ DRAWING # _____

[redacted] DESCRIPTION 200' S # 22. start 11:25a

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	6"	Topsoil - moist - Dark Brown Sand.					0
1	SP	10 YR 3/4 Dark Brown Sand - medium to fine grained little fines - moist.					1
2							2
		7.5 YR 4/4 (Dark Brown)					
3							3
		7.5 YR 5/3 Brown					
4	4½	medium sand.					4
5							5
6							6
7							7
8							8
9							9
10							10
11							11
12							12
13							13
14		EOB 15'					14

36"

30"

34"

REA SOIL PROFILE/TEST ~~PIT~~ LOG

PROJECT Wysocki

LOCATION

DATE 5-10-12 PROJ # 1200321

TEST [redacted] # #22 REA [redacted] Rp. MAP UNIT

DTW excavation EQUIP. Geoprobe SURFACE COND. Trees

SURFACE ELEV. 1006.12 DEPTH to BEDROCK DRAWING #

[redacted] DESCRIPTION 200' S. #23

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES (Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color)	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA (Site Map, Geology Units, Water Table, Field Tests, Comments)	DEPTH (ft)
0		Topsoil - moist - Dark Brown					0
6"	SP	Sand - moist - medium grained					
1		to fine grained 7.5YR 3/4 Dark Brown				Tree Roots Appeared at 2'	1
18"		Sand - moist medium to fine grained					
2		7.5YR 4/4 Brown					2
3							3
4							4
5							5
6		medium to coarse Sand					6
7							7
8		7.5YR 6/3 Light brown					8
9							9
10							10
11		medium Sand					11
12							12
13							13
13½		becomes more moist					
14		EOBG 15'					14

42"

42

33"

REA SOIL PROFILE/TEST [redacted] LOG

PROJECT Wysocki

LOCATION

DATE 5/10/12 PROJ # 120032.1

TEST [redacted] # #23 REA [redacted] Rp. MAP UNIT

DTW excavation EQUIP. Logger Geoprobe SURFACE COND. Trees/grass.

SURFACE ELEV. 1004.39 DEPTH to BEDROCK DRAWING #

[redacted] DESCRIPTION 200' S #24 Stack 10 45a

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES (Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color)	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA (Site Map, Geology Units, Water Table, Field Tests, Comments)	DEPTH (ft)
0	6"	Topsoil sand - moist dark brown.					0
	SP	Sand - moist - medium to fine grained					
1		7.5YR 3/3 Dark Brown					1
	2'						
2		7.5YR 4/4 Brown.					2
3		7.5YR 5/4 Brown.					3
4							4
5		7.5YR 5/8 Strong brown					5
6		7.5YR 6/3 Light brown					6
7							7
8							8
9		Coarse Sand					9
10							10
11							11
12							12
13							13
14		EOB 15'					14

39

37

42

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki
LOCATION
DATE 5-10-12 PROJ #120032.1
TEST [redacted] #24
REA T[redacted] RP.
MAP UNIT
DTW 21.5'
EQUIP. Geoprobe
SURFACE COND. Trees/grass
SURFACE ELEV. 1003.94
DEPTH to BEDROCK
DRAWING #
[redacted] DESCRIPTION 100' W #25

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	6"	Topsoil - moist - dark brown - sand Roots: grass.					0
1	SP	Sand - moist 7.5YR 3/3 Dark Brown				many Tree Roots.	1
	18"	medium to fine grained					
2	SP	7.5YR 5/6 (Strong brown)					2
3							3
4							4
5							5
6		Some silt					6
7		coarse to medium sand.					7
8		7.5YR 6/4 Light brown. Coarse to medium sand.					8
9							9
10							10
11		7.5YR 5/4 brown					11
12		7.5YR 6/3 Light brown. medium sand - Little fine sand.					12
13							13
14							14
15							15
16							16
17							17
18							18
19							19
20							20
21							21
22		Saturation @ 21½'					22
23							23
24							24
25		EOB @ 24'					25

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REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki

LOCATION

DATE 5-10-12 PROJ # 120032.1

TEST [redacted] #25 excavation

REA [redacted] Rp.

MAP UNIT

DTW

EQUIP. Geoprobe Logger

SURFACE COND. Grass/Trees

SURFACE ELEV. 1003.05

DEPTH to BEDROCK

DRAWING #

[redacted] DESCRIPTION 200' N # 23 100' E # 24

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0 6"		Topsoil - Sand - moist - Dark Brown					0
1	SP	Sand - moist - medium to fine grained - little fines - 7.5 YR 3/3 Dark Brown.				many Tree Roots to 5'	1
2							2
3		7.5 YR 5/6 strong brown.					3
4		medium grained					4
5							5
6							6
7							7
8		medium to coarse grained					8
9							9
10							10
11							11
12							12
13							13
14		EOB 15'					14

4

4½

7½

32"

9

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki

LOCATION

DATE 5-10-12 PROJ # 120032.1

TEST [redacted] # 26 excavation

REA [redacted] Rp.

MAP UNIT

DTW

EQUIP. Logger Geoprobe

SURFACE COND. Trees/grass

SURFACE ELEV. 1003.92

DEPTH to BEDROCK

DRAWING #

[redacted] DESCRIPTION 150' South - North Road

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	6"	Topsoil - Sand - Dark Brown - moist					0
		7.5YR3/4 Dark Brown - Sand moist - medium to fine Grain					1
2							2
		Coarse grained 7.5YR 5/6 Strong Brown.					3
4							4
5							5
6		medium grained 7.5YR 6/4 Light brown					6
7							7
8							8
9							9
10							10
11	1/2	4" grayish brown lense					11
12		medium to coarse grained					12
13							13
14							14
		EOB 15'					15

42"

40"

41"

REA SOIL PROFILE/TEST [redacted] LOG

PROJECT Wy Soche

LOCATION

TEST [redacted] # 27

REA T[redacted] RP

DATE 5/10/12 PROJ # 120032.1

DTW

EQUIP. Geoprobe.

MAP UNIT

SURFACE ELEV. 1005.41

DEPTH to BEDROCK

SURFACE COND. Grass / Trees.

[redacted] DESCRIPTION Parlor Tank

DRAWING #

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0	6"	Topsoil - Sand Dark Brown moist grass, roots.					0
1	18	Sand - few fines - medium grain. moist 7.5YR3/4 (Dark Brown)				many Roots.	1
2	SP	medium to fine sand 10YR6/3 Light Brown still moist					2
3							3
4							4
5							5
6		7.5YR4/6 Strong brown.					6
7							7
8		7.5YR6/3 medium to coarse sand					8
9							9
10							10
11							11
12							12
13							13
14							14
15							15
16							16
17							17
18							18
19							19
20							20
21							21
22		Saturated at 22'					22
23		Coarse Sand					23
24							24
25							25

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki

LOCATION

DATE 5/10/12 PROJ # 120032.1

TEST [redacted] # #28 REA [redacted] Rp MAP UNIT

DTW excavation EQUIP. Logger SURFACE COND. Grass/Trees

SURFACE ELEV. 1008.95 DEPTH to BEDROCK DRAWING #

[redacted] DESCRIPTION 100' West - 300' S #29. start 2:00

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES (Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color)	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA (Site Map, Geology Units, Water Table, Field Tests, Comments)	DEPTH (ft)
0	8"	Topsoil sand, dark Brown - moist Roots: grass.					0
1		Sand - moist medium to fine grained 7.5YR3/4 Dark Brown					1
2		7.5YR4/4 (Brown)					2
3		7.5YR5/4 (Brown) Still moist.					3
4							4
5							5
6							6
7							7
8							8
9							9
10							10
11							11
12							12
13							13
14		Not 1/4" Root at 15'				EOB at 15'	14

43"

38"

30"

REA SOIL PROFILE/TEST PIT LOG

PROJECT Wysocki

LOCATION

DATE 5/10/12 PROJ # 120032.1

TEST [redacted] # 29 excavation

REA [redacted] Rp.

MAP UNIT

DTW

EQUIP. Logger Geoprobe

SURFACE COND. Trees / grass.

SURFACE ELEV. 1005.43

DEPTH to BEDROCK

DRAWING #

[redacted] DESCRIPTION 300' S. #30.

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0							0
4"		Topsoil - Dark Brown - Sand moist - Roots, grass.					
	SP	Sand - medium grained 7.5 YR 4/6 (Strong brown) moist.					
1						many Roots to 2'	1
2							2
3		7.5 YR 5/6 Strong brown					3
4							4
5							5
6							6
7		7.5 YR 6/4 light brown still medium grained					7
8							8
9		7.5 YR 5/3 brown					9
10							10
11							11
12							12
13		Coarse grained Sand					13
14						EOB @ 15'	14

38"

39"

34"

REA SOIL PROFILE/TEST [redacted] LOG

PROJECT Wyzoski

LOCATION

DATE 5-10-12 PROJ # 1200321

TEST [redacted] # 30 REA [redacted] MAP UNIT

DTW excavation EQUIP. Geoprobe. Logger SURFACE COND. Trees/Grass.

SURFACE ELEV. 1006.50 DEPTH to BEDROCK DRAWING #

[redacted] DESCRIPTION 200' N Rd - 200' E Hy 13 R/W. Start 1:15 pm

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES (Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color)	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA (Site Map, Geology Units, Water Table, Field Tests, Comments)	DEPTH (ft)
0		Topsoil - moist - Sand dark Brown. Roots & grass.					0
1	12" SP 18	sand, medium to fine grained dark Brown - moist					1
2		7.5YR 4/6 (strong brown)					2
3	SP						3
4							4
5		fine grained 7.5 YR 6/4 (Light brown)					5
6							6
7							7
8		Coarse grained 4" Brown lense from 3'-8'-4"				few brown lenses IN profile to 12'	8
9							9
10							10
11							11
12							12
13							13
14		fine grained Sand little silt				EOB @ 15'	14

4'

36

24"

REA SOIL PROFILE/TEST PIT LOG

PROJECT Golden Sands

LOCATION Bunker Silo Area (East End) South - DATE 7/16/12 PROJ #

TEST [redacted] #31 REA [redacted] MAP UNIT 105°F - few high clouds

DTW Excavation EQUIP. Hand Auger Logger SURFACE COND. grass

SURFACE ELEV. 1004.9 DEPTH to BEDROCK DRAWING #

[redacted] DESCRIPTION Open Area 480 W ℄ 210' North Benchmark

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES (Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color)	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA (Site Map, Geology Units, Water Table, Field Tests, Comments)	DEPTH (ft)
0	SP	Sand - few Roots 10YR5/3 Brown - Very Dry - single grain - fine to medium Texture.					0
1							1
2							2
3"		7.5YR 5/6 Strong brown moist to dry medium Texture					
3							3
4							4
5		7.5YR5/4 Brown.					5
6							6
7							7
8							8
9							9
10							10
11		EOB 11'					11
12							12
13							13
14							14

REA SOIL PROFILE/TEST PIT LOG

PROJECT Golden Sands

LOCATION Bunker Silo Area

DATE 7/16/12 PROJ #

TEST [redacted] # 32

REA [redacted] Rp

MAP UNIT

DTW excavation

EQUIP. Logger Handauger

SURFACE COND. Grass; undergrowth

SURFACE ELEV. 1004.7

DEPTH to BEDROCK

DRAWING #

[redacted] DESCRIPTION 210' N # 31

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0		Sand - fine grained 10YR 4/6 yellowish brown Dry					0
1	SP						1
2	2½'	Becomes moist-medium texture 7.5YR 5/6 Strong brown					2
3							3
4							4
5		Becomes moist					5
6							6
7		Becomes moist					7
8							8
9							9
10							10
11		EOB- 11'					11
12							12
13							13
14							14

REA SOIL PROFILE/TEST PIT LOG PROJECT Golden Sands

LOCATION Bunker N.E Corner DATE 7/16/17 PROJ #

TEST [redacted] # 33 REA [redacted] RP. MAP UNIT

DTW excavation EQUIP. Logger Hand auger SURFACE COND.

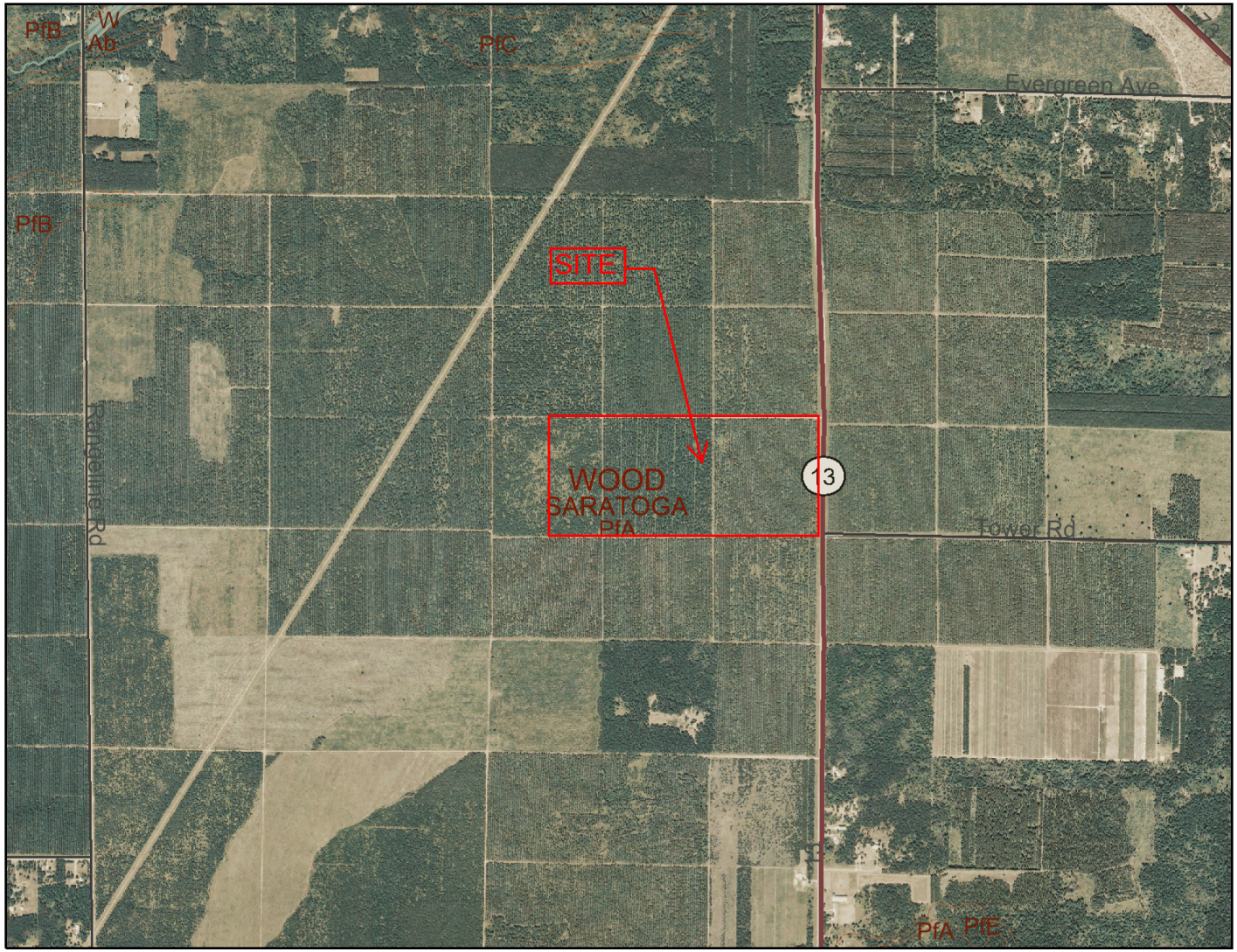
SURFACE ELEV. 1004.5 DEPTH to BEDROCK DRAWING #

[redacted] DESCRIPTION 180' N #32 450' W Section Line bench mark.

DEPTH (ft)	USCS Class	DESCRIPTION OF USCS PROPERTIES Depth, USCS Name, Stiffness, Plasticity, Qualifiers, Moisture & Color	COLOR Matrix	COLOR Mottling	SAMPLE Depth	LOCATION & GENERAL DATA Site Map, Geology Units, Water Table, Field Tests, Comments	DEPTH (ft)
0							0
	SP	Sand. Poorly graded - fine 7.5YR 4/3 Brown					
1							1
2							2
3		becomes moist medium grain 10YR 4/4 dark Yellowish brown.					3
4							4
5		10YR 5/6 Strong browns.				grains Are Various colors color is dominant color.	5
6							6
7							7
	7½	10YR 5/4 yellowish brown					
8							8
9							9
10							10
11		EOB @ 11'					11
12							12
13							13
14							14

Soils Map and Soils Data

Soils Map



0 2250 4500 6750 ft.

Map created on May 15, 2012

Legend

Major Highways

- Interstate
- State Highway
- U.S. Highways

County Roads

Local Roads

24K County Boundaries

Civil Towns

- Civil Town

NRCS Wisconsin Soils

- Open Water
- Soil Mapping Unit

24K Open Water

24K Rivers and Shorelines

- Intermittent
- Fluctuating
- Perennial

Cities and Villages

- Village
- City

N

Scale: 1:24,000

Wisconsin Wetland Inventory (WWI) maps show graphic representations of the type, size and location of wetlands in Wisconsin. These maps have been prepared from the analysis of high altitude imagery in conjunction with soil surveys, topographic maps, previous wetland inventories and field work. State statutes define a wetland as "an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions." The principal focus of the WWI is to produce wetland maps that are graphic representations of the type, size and location of wetlands in Wisconsin. Within this context, the objective of the WWI is to produce reconnaissance level information on the location, type, size of these habitats such that they are accurate at the nominal scale of the 1:24,000 (1 inch = 2000 feet) base map. The DNR recognizes the limitations of using remotely sensed information as the primary data source. They are to be used as a guide for planning purposes. There is no attempt, in either the design or products of this inventory, to define the limits of jurisdiction of any Federal, State, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, State, or local agencies concerning specified agency regulatory programs and jurisdictions that may affect such activities. The most accurate method of determining the legal extent of a wetland for federal or state regulations is a field delineation of the wetland boundary by a professional trained in wetland delineation techniques.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

WISCONSIN RESEARCH DIVISION OF THE COLLEGE OF AGRICULTURE AND LIFE SCIENCES, UNIVERSITY OF WISCONSIN

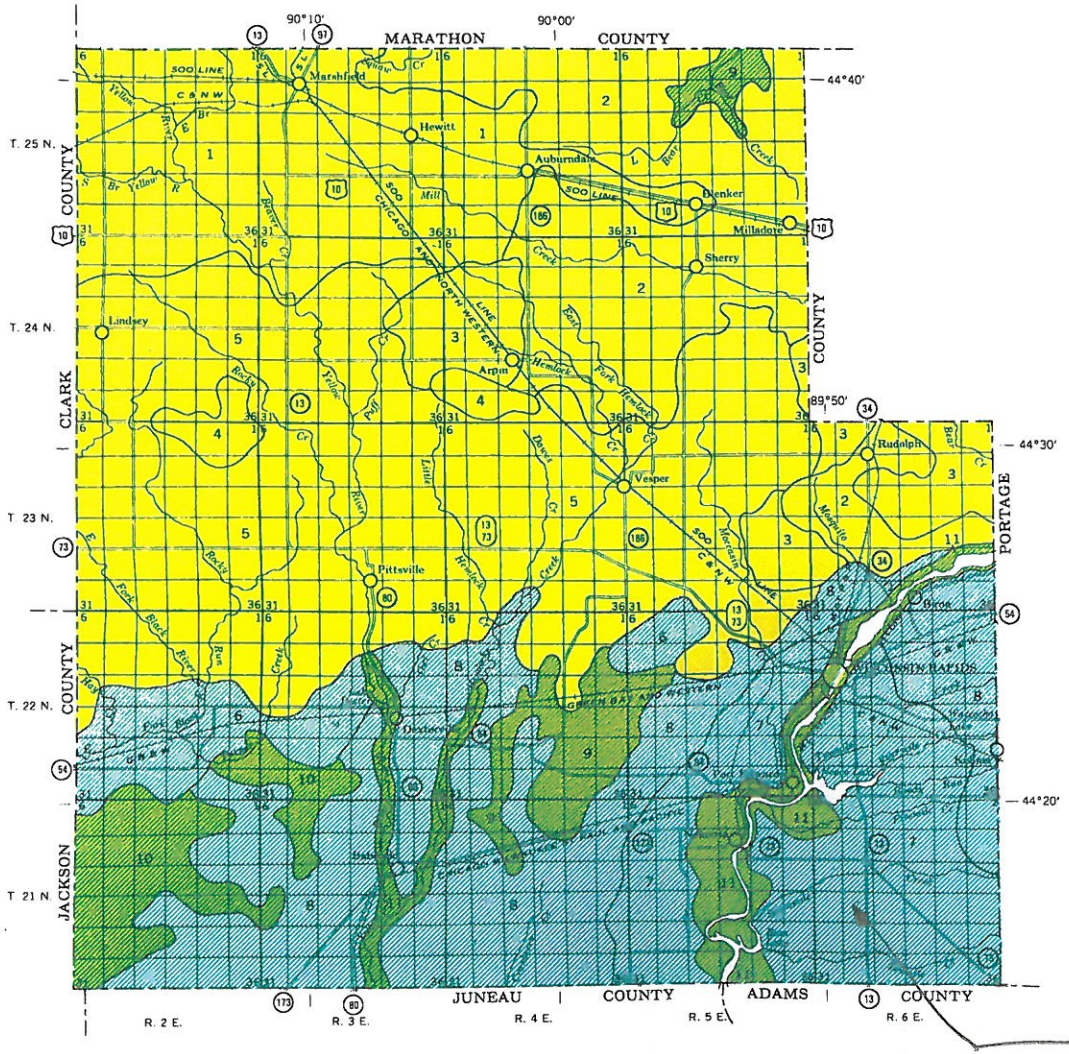
GENERAL SOIL MAP

WOOD COUNTY, WISCONSIN

Scale 1:253,440

1 0 1 2 3 4 Miles

N



SOIL ASSOCIATIONS *

LOAMY SOILS

1 — Withee-Marshfield-Santiago association: Nearly level to moderately steep, poorly drained to well drained soils that have a heavy silt loam to silty clay loam subsoil; formed in a thin layer of loess and in loamy glacial till; on uplands

2 — Milladore-Eaupleine-Sherry association: Nearly level to sloping, poorly drained to well drained soils that have a loam to silty clay loam subsoil; formed in a thin layer of loess and in loamy residuum from gneissic rocks; on uplands

3 — Dolph-Altdorf association: Nearly level, poorly drained and somewhat poorly drained soils that have a clay subsoil; formed in a thin layer of loess and in clayey residuum from schistose rocks; on uplands

4 — Fenwood-Rietbrock association: Gently sloping to moderately steep, somewhat poorly drained and well drained soils that have a loam to light silty clay loam subsoil; formed in a thin layer of loess and in loamy residuum from granitic and greenstone rocks; on uplands

5 — Vesper-Kert association: Nearly level, poorly drained and somewhat poorly drained soils that have a loam to clay subsoil; formed in a thin layer of loess and in residuum from stratified sandstone and shale; on uplands

SANDY SOILS

6 — Elm Lake-Merrillan association: Nearly level, poorly drained and somewhat poorly drained soils that have a sandy to silty clay loam subsoil; formed in sandy sediments and in residuum from stratified sandstone and shale; on uplands

7 — Plainfield-Friendship association: Nearly level to steep, moderately well drained and excessively drained soils that have a sandy subsoil; formed in deep sandy outwash; on outwash plains

8 — Newson-Meehan association: Nearly level, poorly drained and somewhat poorly drained soils that have a sandy subsoil; formed in deep sandy outwash; on outwash plains and glacial lake deposits

ORGANIC AND ALLUVIAL SOILS

9 — Markey-Rifle association: Nearly level, very poorly drained organic soils that have an organic subsoil over sand, and deep organic soils; formed in partly decomposed plant remains; in basins and depressions

10 — Dawson-Greenwood association: Nearly level, very poorly drained, very acid organic soils that have an organic subsoil over sand, and deep, very acid organic soils; formed in partly decomposed plant remains; in basins and depressions

11 — Alluvial land, wet, association: Nearly level, poorly drained, sandy and loamy soils that have a sandy and loamy subsoil; formed in recent alluvium; on the flood plains of streams

*Texture applies to the surface layer unless otherwise indicated.

Compiled 1976

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

Map Unit Legend

Wood County, Wisconsin (WI141)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
PfA	Plainfield sand, 0 to 2 percent slopes	111.5	100.0%
Totals for Area of Interest		**111.5**	**100.0%**

Map Unit Description

Wood County, Wisconsin

PfA Plainfield sand, 0 to 2 percent slopes

Setting

Elevation: 700 to 1200 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 145 to 170 days

Composition

Plainfield and similar soils: 100 percent

Description of Plainfield

Setting

Landform: Outwash plains
Parent material: Sandy outwash

Properties and Qualities

Slope: 0 to 2 percent
Surface area covered with stones and boulders: 0.0 percent
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High or very high (5.95 to 19.98 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 0 percent
Gypsum maximum: 0 percent
Available water capacity: Low (about 3.2 inches)

Interpretive Groups

Land capability classification (irrigated): 3e
Land capability (non irrigated): 4s

Typical Profile

0 to 3 inches: sand
3 to 20 inches: sand
20 to 60 inches: sand

Map Unit Description (Brief, Generated)

Wood County, Wisconsin

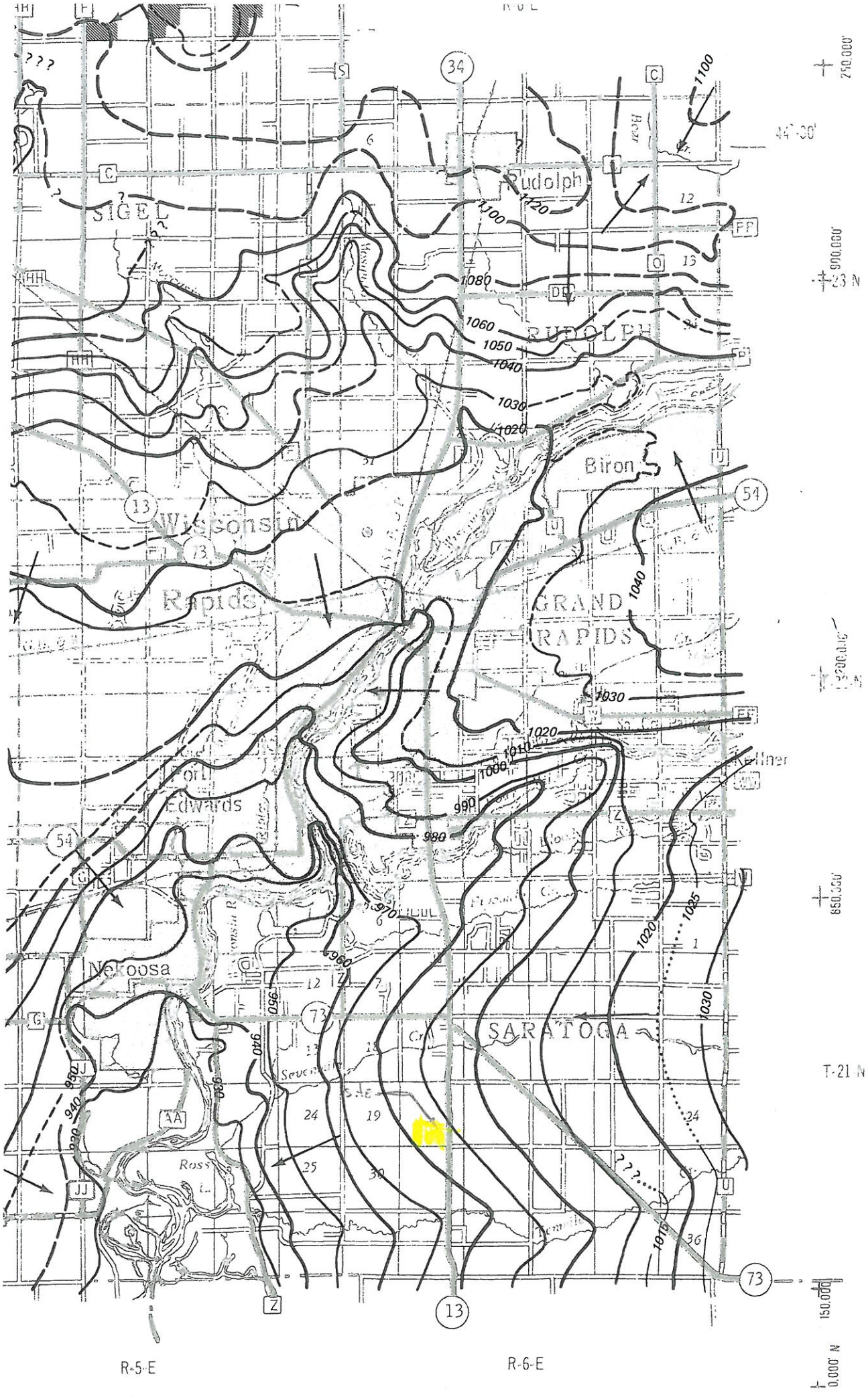
[Minor map unit components are excluded from this report]

Map unit: PfA - Plainfield sand, 0 to 2 percent slopes

Component: Plainfield (100%)

The Plainfield component makes up 100 percent of the map unit. Slopes are 0 to 2 percent. This component is on outwash plains. The parent material consists of sandy outwash. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is excessively drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. Nonirrigated land capability classification is 4s. Irrigated land capability classification is 3e. This soil does not meet hydric criteria.

Watertable Elevation Map


Rudolph
SIGEL
RUDOLPH
Biron
Wisconsin
Rapids
GRAND
RAPIDS
Port
Edwards
Nekoosa
SARATOGA
Ross
Seven
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1080
1060
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1040
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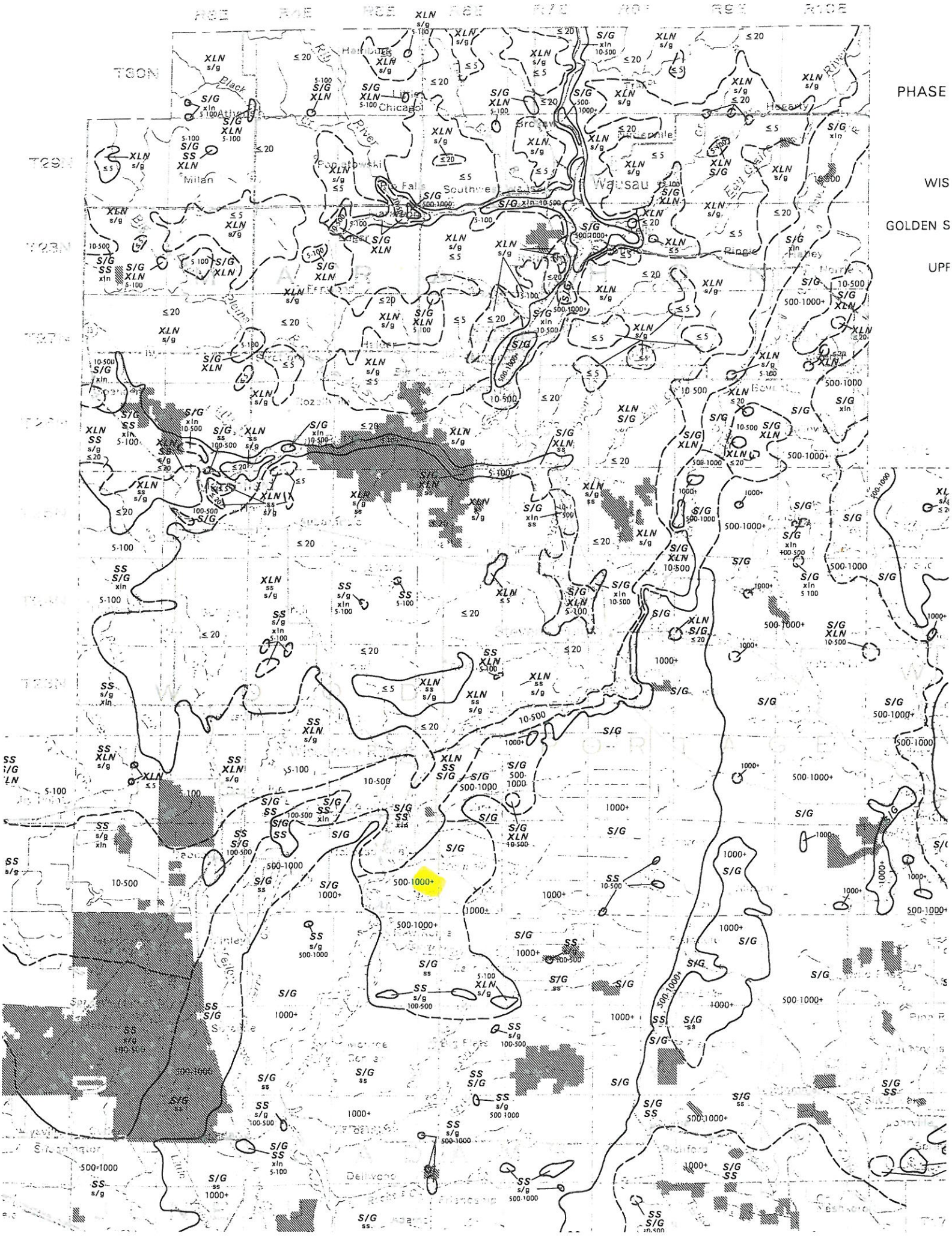
R-6-E
PORTAGE CO.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R9E
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Chicago
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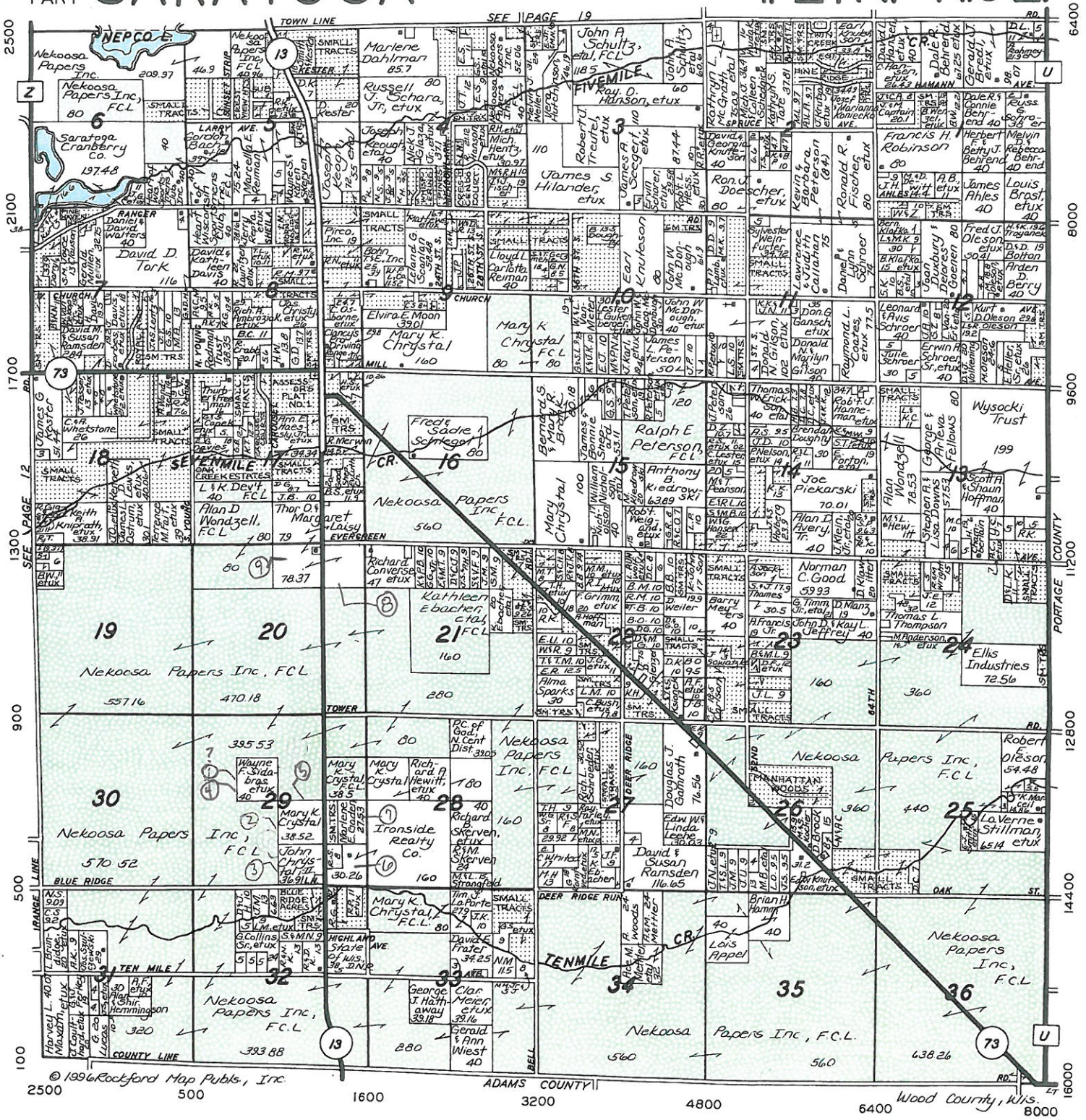
Milan
Southwe
Ringle
Hoeft
Dellwood
Black
River
Plenty
Eau Claire
XLN
S/G
SS
s/g
xln
≤20
≤5
5-100
10-500
100-500
500-1000
500-1000+
1000+

Well logs

EAST PART

SARATOGA T. 21N.–R.6E.



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(1)

WISCONSIN UNIQUE WELL NUMBER
Source: WELL CONSTRUCTION **AC539**

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3300-77A
(Rev 02/02)bw

Depth 50.5 FT

Property Owner: RON THURBER	Telephone Number: - -
Mailing Address: 13811 HWY 135	
City: WISCONSIN RAPIDS	State: WI / Zip Code: 54494
County of Well Location: 72 WOOD	Co Well Permit No: W / Well Completion Date: May 27, 1988
Well Constructor: RICHARD J ROTH	License #: 2617 / Facility ID (Public):
Address: W2867 HWY 73 SOUTH	Public Well Plan Approval#:
City: NEKOOSA	State: WI / Zip Code: 54457 / Date Of Approval:
Hicap Permanent Well #	Common Well # / Specific Capacity: gpm/ft

1. Well Location

T=Town C=City V=Village
T of SARATOGA

Fire# 13811

Street Address or Road Name and Number: HWY 13 S

Subdivision Name | Lot# | Block #

SE ?

Gov't Lot or SW 1/4 of NW 1/4 of Section 29 T 21 N;R 6 E

Latitude Deg. Min.
Longitude Deg Min.

2. Well Type 1 (See item 12 below)
1=New 2=Replacement 3=Reconstruction
of previous unique well # _____ constructed in 88

Lat/Long Method

Reason for replaced or reconstructed Well?
NEW HOME

2 1=Drilled 2=Driven Point 3=Jetted 4=Other

3. Well Serves P # of homes and or (eg: barn, restaurant, church, school, industry, etc.)
M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole

High Capacity:
Well? N
Property? N

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? Y
Well located in floodplain? N
Distance in feet from well to nearest: (including proposed)

1. Landfill
26 2. Building Overhang
47 3. 1=Septic 2= Holding Tank
57 4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
33 13. Building Drain 2
1=Cast Iron or Plastic 2=Other
14. Building Sewer 1=Gravity 2=Pressure
1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure
1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
	surface	

Upper Enlarged Drillhole
-- 1. Rotary - Mud Circulation ----------
-- 2. Rotary - Air ----------
-- 3. Rotary - Air and Foam ----------
-- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
-- 6. Cable-tool Bit _ n. dia ----------
-- 7. Temp. Outer Casing _ in. dia. _____ depth ft.
Removed ?
Other

Lower Open Bedrock

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
2.0	GALV. WELL PIPE	surface	47

Dia.(in.)	Screen type, material & slot size	From	To
	POINT	47	51

7. Grout or Other Sealing Material

Method / Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
	surface		

9. Static Water Level
31.5 feet B ground surface
A=Above B=Below

10. Pump Test
Pumping level ft. below surface
Pumping at GP Hrs

11. Well Is: 14 in. A Grade
A=Above B=Below
Developed?
Disinfected? Y
Capped?

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?
If no, explain

13. Initials of Well Constructor or Supervisory Driller KMR Date Signed 6/8/88

Initials of Drill Rig Operator (Mandatory unless same as above) Date Signed

Additonal Comments?
Owner Sent Label? Y
Variance Issued?
More Geology?

Batch

WISCONSIN UNIQUE WELL NUMBER
Source: WELL CONSTRUCTION

EM435

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3300-77A
(Rev 02/02)bw

Depth 44 FT

Property Owner: BERNIE KLOSKOWSKI
Telephone Number: 715-323-6006
Mailing Address: 13911 HWY 13 S
City: WISCONSIN RAPIDS
State: WI
Zip Code: 54494
County of Well Location: 72 WOOD
Co Well Permit No: W
Well Completion Date: August 28, 1991

1. Well Location
T=Town C=City V=Village
T of SARATOGA
Fire#
Street Address or Road Name and Number: 13911 HWY 13 S
Subdivision Name
Lot#
Block #

Well Constructor: BERTRAM JUNEMANN WD INC
License #: 84
Facility ID (Public)
Address: 7285 CTY TRK S
Public Well Plan Approval#
City: RUDOLPH
State: WI
Zip Code: 54475
Date Of Approval
Hicap Permanent Well #
Common Well #
Specific Capacity: gpm/ft

Gov't Lot or NE 1/4 of SE 1/4 of Section 29 T 21 N;R 6 E
Latitude Deg. Min.
Longitude Deg Min.

2. Well Type 2 (See item 12 below)
1=New 2=Replacement 3=Reconstruction
Lat/Long Method
of previous unique well # _____ constructed in 0
Reason for replaced or reconstructed Well?
POINT PLUGGED

3. Well Serves P # of homes and or (eg: barn, restaurant, church, school, industry, etc.)
M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole
High Capacity: Well? N Property? N

1 1=Drilled 2=Driven Point 3=Jetted 4=Other

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? Y
Well located in floodplain? N
Distance in feet from well to nearest: (including proposed)

1. Landfill
15 2. Building Overhang
60 3. 1=Septic 2= Holding Tank
75 4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain 1=Cast Iron or Plastic 2=Other
14. Building Sewer 1=Gravity 2=Pressure 1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure 1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25 25. Other NR 812 Waste Source
SMALL GARDEN COMPOSI

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
6.0	surface	44

Upper Enlarged Drillhole
-- 1. Rotary - Mud Circulation
-- 2. Rotary - Air
-- 3. Rotary - Air and Foam
-- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
-- 6. Cable-tool Bit _ n. dia
-- 7. Temp. Outer Casing _ in. dia. _____ depth ft. Removed ?
Other
Lower Open Bedrock

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6.0	P.E. A-53 18.97 FOREIGN CONDUVEN	surface	41

Dia.(in.)	Screen type, material & slot size	From	To
5.6	OD JOHNSON SS	41	44

7. Grout or Other Sealing Material

Method / Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
	surface		

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
_Y_	SAND AND GRAVEL	0	44

9. Static Water Level
28.0 feet B ground surface
A=Above B=Below

10. Pump Test
Pumping level 30.0 ft. below surface
Pumping at 10.0 GP 1.0 Hrs

11. Well Is: 12 in. A Grade
A=Above B=Below
Developed? Y
Disinfected? Y
Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property? N
If no, explain OWNER

13. Initials of Well Constructor or Supervisory Driller JJ Date Signed 10/12/91

Initials of Drill Rig Operator (Mandatory unless same as above) Date Signed

Additonal Comments?
Owner Sent Label? Y
Variance Issued?
More Geology?

Batch 146

WISCONSIN UNIQUE WELL NUMBER **IH329**

Source: WELL CONSTRUCTION

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3300-77A (Rev 02/02)bw

3

Depth 42 FT

Property Owner: GREENEWAY, KARL	Telephone Number: - -
Mailing Address: 1131 BLUE RIDGE	
City: NEKOOSA	State: WI / Zip Code: 54457
County of Well Location: 72 WOOD	Co Well Permit No: W / Well Completion Date: April 3, 1995
Well Constructor: BERTRAM JUNEMANN WELL DRILLING I	License #: 84 / Facility ID (Public)
Address: 7285 CTY TRK S	Public Well Plan Approval#
City: RUDOLPH	State: WI / Zip Code: 54475 / Date Of Approval
Hicap Permanent Well # / Common Well #	Specific Capacity: gpm/ft

1. Well Location

T=Town C=City V=Village
T of SARATOGA

Fire#

Street Address or Road Name and Number: 1131 BLUE RIDGE LN

Subdivision Name / Lot# / Block #

Gov't Lot or SW 1/4 of SE 1/4 of Section 29 T 21 N;R 6 E

Latitude Deg. Min.
Longitude Deg Min.

2. Well Type 1 (See item 12 below)

1=New 2=Replacement 3=Reconstruction

Lat/Long Method

of previous unique well # _____ constructed in 0

Reason for replaced or reconstructed Well?
NEW CONST

1 1=Drilled 2=Driven Point 3=Jetted 4=Other

3. Well Serves # of homes and or
P (eg: barn, restaurant, church, school, industry, etc.)

M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole

High Capacity:
Well? N
Property? N

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? Y

Well located in floodplain? N

Distance in feet from well to nearest: (including proposed)

1. Landfill
6 2. Building Overhang
3. 1=Septic 2= Holding Tank
4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain 1=Cast Iron or Plastic 2=Other
14. Building Sewer 1=Gravity 2=Pressure 1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure 1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
6.0	surface	42

Upper Enlarged Drillhole
-- 1. Rotary - Mud Circulation ----------
-- 2. Rotary - Air ----------
-- 3. Rotary - Air and Foam ----------
-- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
-- 6. Cable-tool Bit _ n. dia ----------
-- 7. Temp. Outer Casing _ in. dia. _____ depth ft. Removed ?
Other

Lower Open Bedrock

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
__Y_	SAND @ GRAVEL	0	42

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6.0	PE A53 280 SAWHILL	surface	39

Dia.(in.)	Screen type, material & slot size	From	To
5.6	JOHNSON SS	39	42

7. Grout or Other Sealing Material

Method / Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
NONE REQUIRED	surface	0.0	

9. Static Water Level
20.0 feet B ground surface
A=Above B=Below

10. Pump Test
Pumping level 23.0 ft. below surface
Pumping at 20.0 GP M 1.0 Hrs

11. Well Is: 12 in. A Grade
A=Above B=Below
Developed? Y
Disinfected? Y
Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?
If no, explain NONE

13. Initials of Well Constructor or Supervisory Driller JJ Date Signed 4/18/95

Initials of Drill Rig Operator (Mandatory unless same as above) Date Signed

Additonal Comments?
Owner Sent Label? Y
Variance Issued?
More Geology?

Batch 333

WISCONSIN UNIQUE WELL NUMBER **KP652**

Source: WELL CONSTRUCTION

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3300-77A (Rev 02/02)bw (4)

Depth 39 FT

Property Owner	SIDABRAS, WAYNE (Kulka)?
Telephone Number	- -
Mailing Address	13550 HWY 13 S
City	WISCONSIN RAPIDS
State	WI
Zip Code	54494
County of Well Location	72 WOOD
Co Well Permit No	W
Well Completion Date	August 17, 1995
Well Constructor	BERTRAM JUNEMANN WELL DRILLING I
License #	84
Facility ID (Public)	
Address	7285 CTY TRK S
Public Well Plan Approval#	
City	RUDOLPH
State	WI
Zip Code	54475
Date Of Approval	
Hicap Permanent Well #	
Common Well #	
Specific Capacity	gpm/ft

1. Well Location

T=Town C=City V=Village
T of SARATOGA

Fire#

Street Address or Road Name and Number
13550 HWY 13 S

Subdivision Name | Lot# | Block #

Gov't Lot **or** SE 1/4 of NW 1/4 of Section 29 T 21 N;R 6 E

Latitude Deg. Min.
Longitude Deg Min.

2. Well Type 1 (See item 12 below)

1=New 2=Replacement 3=Reconstruction

of previous unique well # _____ constructed in 0

Lat/Long Method

Reason for replaced or reconstructed Well?
MORE WATER

1 1=Drilled 2=Driven Point 3=Jetted 4=Other

3. Well Serves # of homes and or
P (eg: barn, restaurant, church, school, industry, etc.)

M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole

High Capacity:
Well? N
Property? N

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? Y

Well located in floodplain? N

Distance in feet from well to nearest: (including proposed)

1. Landfill
4 2. Building Overhang
40 3. 1=Septic 2= Holding Tank
60 4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain 1=Cast Iron or Plastic 2=Other
14. Building Sewer 1=Gravity 2=Pressure 1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure 1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
6.0	surface	39

Upper Enlarged Drillhole
-- 1. Rotary - Mud Circulation ----------
-- 2. Rotary - Air ----------
-- 3. Rotary - Air and Foam ----------
-- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
-- 6. Cable-tool Bit _ n. dia ----------
-- 7. Temp. Outer Casing _ in. dia. _____ depth ft.
Removed ?
Other

Lower Open Bedrock

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6.0	PE A53 280 SAWHILL	surface	36

Dia.(in.)	Screen type, material & slot size	From	To
5.6	JOHNSON SS	36	39

7. Grout or Other Sealing Material

Method	Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
	NONE REQUIRED	surface	0.0	

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
__Y_	SAND @ GRAVEL	0	39

9. Static Water Level
21.0 feet B ground surface
A=Above B=Below

10. Pump Test
Pumping level 24.0 ft. below surface
Pumping at 30.0 GP M 1.0 Hrs

11. Well Is: 12 in. A Grade
A=Above B=Below
Developed? Y
Disinfected? Y
Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property? N
If no, explain OWNER

13. Initials of Well Constructor or Supervisory Driller JJ Date Signed 8/17/95

Initials of Drill Rig Operator (Mandatory unless same as above) Date Signed

Additonal Comments?
Owner Sent Label? Y
Variance Issued?
More Geology?

Batch 369

WISCONSIN UNIQUE WELL NUMBER
Source: WELL CONSTRUCTION **OI532**

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3300-77A
(Rev 02/02)bw

Depth 42 FT

Property Owner: PIERCE, WM	Telephone Number: - -
Mailing Address: 13951 ST HWY 13 S	
City: WISCONSIN RAPIDS	State: WI / Zip Code: 54494
County of Well Location: 72 WOOD	Co Well Permit No: W / Well Completion Date: November 1, 2000
Well Constructor: BERTRAM JUNEMANN WELL DRILLING	License #: 84 / Facility ID (Public)
Address: 7285 CTY TRK S	Public Well Plan Approval#
City: RUDOLPH	State: WI / Zip Code: 54475 / Date Of Approval
Hicap Permanent Well #	Common Well # / Specific Capacity: gpm/ft

1. Well Location
T=Town C=City V=Village
T of SARATOGA
Fire#
Street Address or Road Name and Number: 13951 HWY 13
Subdivision Name | Lot# | Block #
Gov't Lot or NE 1/4 of SE 1/4 of Section 29 T 21 N;R 6 E
Latitude Deg. Min.
Longitude Deg Min.
Lat/Long Method

2. Well Type 2 (See item 12 below)
1=New 2=Replacement 3=Reconstruction
of previous unique well # _____ constructed in _____
Reason for replaced or reconstructed Well?
VOLUME & PRESSURE
1 1=Drilled 2=Driven Point 3=Jetted 4=Other

3. Well Serves # of homes and or **HOME**
P (eg: barn, restaurant, church, school, industry, etc.)
M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole
High Capacity: Well? N Property? N

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? Y
Well located in floodplain? N
Distance in feet from well to nearest: (including proposed)

1. Landfill
8 2. Building Overhang
50 3. 1=Septic 2= Holding Tank
60 4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain 1=Cast Iron or Plastic 2=Other
14. Building Sewer 1=Gravity 2=Pressure 1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure 1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
6.0	surface	42

Upper Enlarged Drillhole
-- 1. Rotary - Mud Circulation ----------
-- 2. Rotary - Air ----------
-- 3. Rotary - Air and Foam ----------
-- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
-- 6. Cable-tool Bit _ n. dia ----------
-- 7. Temp. Outer Casing _ in. dia. _____ depth ft. Removed ?
Other
Lower Open Bedrock

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6.0	P.E. A-53 .280 IPSCO	surface	39

Dia.(in.)	Screen type, material & slot size	From	To
6.0	TELE. JOHNSON S.S. 1I SLOT	39	42

7. Grout or Other Sealing Material
Method MOUNDED

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
BENTONITE	surface		1 S

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
_Y_	SAND & GRAVEL	0	42

9. Static Water Level
29.0 feet B ground surface
A=Above B=Below

10. Pump Test
Pumping level 32.0 ft. below surface
Pumping at 15.0 GP M 1.0 Hrs

11. Well Is: 12 in. A Grade
A=Above B=Below
Developed? Y
Disinfected? Y
Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property? Y
If no, explain

13. Initials of Well Constructor or Supervisory Driller: JJ Date Signed 11/15/00
Initials of Drill Rig Operator (Mandatory unless same as above): JJJ Date Signed

Additonal Comments?
Owner Sent Label? Y
Variance Issued?
More Geology?

Batch 707

Replacement (6)

WISCONSIN UNIQUE WELL NUMBER
Source: WELL CONSTRUCTION **SI208**

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3300-77A
(Rev 02/02)bw

Depth 46 FT

Property Owner: IRONSIDE, LARRY	Telephone Number: - -
Mailing Address: 2228 BIRON DR E	
City: WISCONSIN RAPIDS	State: WI / Zip Code: 54494
County of Well Location: 72 WOOD	Co Well Permit No: W / Well Completion Date: July 19, 2004
Well Constructor: BERTRAM JUNEMANN WELL DRILLING	License #: 84 / Facility ID (Public)
Address: 7285 CTY TRK S	Public Well Plan Approval#
City: RUDOLPH / State: WI / Zip Code: 54475	Date Of Approval
Hicap Permanent Well # / Common Well #	Specific Capacity: gpm/ft

1. Well Location
T=Town C=City V=Village
T of SARATOGA
Fire#
Street Address or Road Name and Number: 14241 HWY 13
Subdivision Name / Lot# / Block #
Gov't Lot or SE 1/4 of SE 1/4 of Section 29 T 21 N;R 6 E
Latitude Deg. Min.
Longitude Deg Min.

2. Well Type 2 (See item 12 below) Lat/Long Method
1=New 2=Replacement 3=Reconstruction
of previous unique well # _____ constructed in _____
Reason for replaced or reconstructed Well?
POINT IN BASEMENT
1 1=Drilled 2=Driven Point 3=Jetted 4=Other

3. Well Serves P # of homes and or (eg: barn, restaurant, church, school, industry, etc.)
M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole
High Capacity: Well? N Property? N

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? Y
Well located in floodplain? N
Distance in feet from well to nearest: (including proposed)

1. Landfill
25 2. Building Overhang
45 3. 1=Septic 2= Holding Tank
60 4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 1 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain 1=Cast Iron or Plastic 2=Other
14. Building Sewer 1=Gravity 2=Pressure 1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
35 17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure 1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
6.0	surface	46

Upper Enlarged Drillhole
-- 1. Rotary - Mud Circulation
-- 2. Rotary - Air
-- 3. Rotary - Air and Foam
-- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
-- 6. Cable-tool Bit _ n. dia
-- 7. Temp. Outer Casing _ in. dia. _____ depth ft. Removed ?
Other
Lower Open Bedrock

8. Geology

Geology Codes	Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
_S_	SAND	0	21
_C_	CLAY	21	24
_Y_	SAND & GRAVEL	24	46

6. Casing Liner Screen Material, Weight, Specification Manufacturer & Method of Assembly

Dia. (in.)		From (ft.)	To (ft.)
6.0	PE A53 .280 PARAGON	surface	43

Dia.(in.)	Screen type, material & slot size	From	To
6.0	TELE ALLOY 12 SLOT	43	46

9. Static Water Level
25.0 feet B ground surface
A=Above B=Below

10. Pump Test
Pumping level 29.0 ft. below surface
Pumping at 25.0 GP M 1.0 Hrs

11. Well Is: 16 in. A Grade
A=Above B=Below
Developed? Y
Disinfected? Y
Capped? Y

7. Grout or Other Sealing Material
Method MOUNDED

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
BENTONITE	surface		1 S

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property? N
If no, explain OWNER

13. Initials of Well Constructor or Supervisory Driller JJ Date Signed 7/22/04
Initials of Drill Rig Operator (Mandatory unless same as above) JUJ Date Signed 7/22/04

Additonal Comments?
Owner Sent Label? Y
Variance Issued?
More Geology?

Batch 937

WISCONSIN UNIQUE WELL NUMBER **TG032**

Source: WELL CONSTRUCTION

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3300-77A
(Rev 02/02)bw

Depth 53 FT

Property Owner: ALFT, JOHN	Telephone Number: 715-572-2685
Mailing Address: 13811 STATE HWY 13 S	
City: WISCONSIN RAPIDS	State: WI / Zip Code: 54494
County of Well Location: 72 WOOD	Co Well Permit No: W / Well Completion Date: December 21, 2005
Well Constructor: HAUPT WELL & PUMP CO INC	License #: 529 / Facility ID (Public)
Address: DAVID HAUPT	Public Well Plan Approval#
City: AUBURNDALE	State: WI / Zip Code: 54412 / Date Of Approval
Hicap Permanent Well #	Common Well # / Specific Capacity: 5 gpm/ft

1. Well Location

T=Town C=City V=Village: T of SARATOGA

Fire#: 13811

Street Address or Road Name and Number: 13811 STATE HWY 13 S

Subdivision Name: CSM 4062 | Lot# | Block #

Gov't Lot **or** NE 1/4 of SE 1/4 of Section 29 T 21 N;R 6 E

Latitude Deg. 44 Min. 16.15

Longitude Deg 89 Min. 48.55

2. Well Type 1 (See item 12 below)

1=New 2=Replacement 3=Reconstruction

of previous unique well # _____ constructed in _____

Reason for replaced or reconstructed Well?

Lat/Long Method: GPS008

1 1=Drilled 2=Driven Point 3=Jetted 4=Other

3. Well Serves P # of homes and or (eg: barn, restaurant, church, school, industry, etc.)

M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole

High Capacity: Well? N Property? N

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? Y

Well located in floodplain? N

Distance in feet from well to nearest: (including proposed)

1. Landfill
8 2. Building Overhang
35 3. 1=Septic 2= Holding Tank
65 4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 1 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain 1=Cast Iron or Plastic 2=Other
14. Building Sewer 1=Gravity 2=Pressure 1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure 1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
6.0	surface	53

Upper Enlarged Drillhole
-- 1. Rotary - Mud Circulation
-- 2. Rotary - Air
-- 3. Rotary - Air and Foam
-- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
-- 6. Cable-tool Bit _ n. dia
-- 7. Temp. Outer Casing _ in. dia. _____ depth ft. Removed ?
Other

Lower Open Bedrock

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6.0	NEW STEEL 18.97 A53 WHEATLAND PE WELD	surface	50

Dia.(in.)	Screen type, material & slot size	From	To
5.5	.012 SS JOHNSON	50	53

7. Grout or Other Sealing Material

Method MOUNDED

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
#8 GRANULAR BENSEAL	surface		2.5 S

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
_NS_	FINE SAND	0	19
_NYM	SILTY FINE SAND/GRAVEL	19	49
__GS	GRAVEL PEA/SAND MIX	49	53

9. Static Water Level

33.0 feet B ground surface A=Above B=Below

10. Pump Test

Pumping level 38.0 ft. below surface

Pumping at 25.0 GP M 1.5 Hrs

11. Well Is: 16 in. A Grade A=Above B=Below

Developed? Y

Disinfected? Y

Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?

If no, explain

13. Initials of Well Constructor or Supervisory Driller: DH Date Signed 12/22/05

Initials of Drill Rig Operator (Mandatory unless same as above): AH Date Signed 12/21/05

Additonal Comments? Variance Issued?

Owner Sent Label? Y More Geology?

21834087

Batch 1015

WISCONSIN UNIQUE WELL NUMBER
Source: WELL CONSTRUCTION

HO099

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3300-77A
(Rev 02/02)bw

Depth 30 FT

Property Owner: KNUTH, RANDY
Telephone Number: 715 -325 -2966
Mailing Address: 11711 BELL RD
City: WIS RAPIDS | State: WI | Zip Code: 54494
County of Well Location: 72 WOOD | Co Well Permit No: W | Well Completion Date: December 23, 1993

Well Constructor: BRIAN HEEG | License #: 355 | Facility ID (Public):
Address: 5069 E CTY F | Public Well Plan Approval#:
City: AUBURNDALE | State: WI | Zip Code: 54412 | Date Of Approval:
Hicap Permanent Well # | Common Well # | Specific Capacity: gpm/ft

1. Well Location
T=Town C=City V=Village
T of SARATOGA
Fire#
Street Address or Road Name and Number
Subdivision Name | Lot# | Block #
Gov't Lot or NE 1/4 of NE 1/4 of Section 20 T 21 N;R 6 E
Latitude Deg. Min.
Longitude Deg Min.

2. Well Type 1 (See item 12 below) Lat/Long Method
1=New 2=Replacement 3=Reconstruction
of previous unique well # _____ constructed in 0
Reason for replaced or reconstructed Well?
HOUSE
2 1=Drilled 2=Driven Point 3=Jetted 4=Other

3. Well Serves P # of homes and or (eg: barn, restaurant, church, school, industry, etc.)
M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole
High Capacity: Well? N Property? N

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? Y
Well located in floodplain? N
Distance in feet from well to nearest: (including proposed)

1. Landfill
7 2. Building Overhang
80 3. 1=Septic 2= Holding Tank
4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain 1=Cast Iron or Plastic 2=Other
14. Building Sewer 1=Gravity 2=Pressure 1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure 1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
2.0	surface	30

Upper Enlarged Drillhole
-- 1. Rotary - Mud Circulation
-- 2. Rotary - Air
-- 3. Rotary - Air and Foam
-- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
-- 6. Cable-tool Bit _ n. dia
-- 7. Temp. Outer Casing _ in. dia. _____ depth ft. Removed ?
X Other DRIVEN
Lower Open Bedrock

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
2.0	STEEL ASTM A53 SAWHILL USA T@C	surface	27

Dia.(in.)	Screen type, material & slot size	From	To
2.0	7 SLOT STAINLESS POINT	27	30

7. Grout or Other Sealing Material

Method / Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
	surface		

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
_S_	SAND	0	30

9. Static Water Level
12.0 feet B ground surface
A=Above B=Below

10. Pump Test
Pumping level 30.0 ft. below surface
Pumping at 8.0 GP M 2.0 Hrs

11. Well Is: 18 in. A Grade
A=Above B=Below
Developed? Y
Disinfected? Y
Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?
If no, explain

13. Initials of Well Constructor or Supervisory Driller: BH Date Signed 1/4/94
Initials of Drill Rig Operator (Mandatory unless same as above): BH Date Signed 1/4/94

Additonal Comments?
Owner Sent Label? Y
Variance Issued?
More Geology?

Batch 270

(9)

WISCONSIN UNIQUE WELL NUMBER
Source: WELL CONSTRUCTION **UD547**

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3300-77A
(Rev 02/02)bw

Depth 46 FT

Property Owner: ST PETER, PATRICK	Telephone Number: - -
Mailing Address: 11220 HWY 13 S	
City: WISCONSIN RAPIDS	State: WI / Zip Code: 54457
County of Well Location: 29 JUNEAU	Co Well Permit No: W / Well Completion Date: August 16, 2007
Well Constructor: BRIAN M PATTEN	License #: 6619 / Facility ID (Public)
Address: PATTENS SEPTIC & WELL SERVICE LLC	Public Well Plan Approval#
City: ARKDALE	State: WI / Zip Code: 54613 / Date Of Approval
Hicap Permanent Well #	Common Well # / Specific Capacity gpm/ft

1. Well Location
T=Town C=City V=Village
T of SARATOGA
Fire# 11220
Street Address or Road Name and Number: 11220 HWY 13 S
Subdivision Name | Lot# | Block #
Gov't Lot or NW 1/4 of NE 1/4 of Section 20 T 21 N;R 6 E
Latitude Deg. Min.
Longitude Deg Min.

2. Well Type 3 (See item 12 below) Lat/Long Method
1=New 2=Replacement 3=Reconstruction
of previous unique well # _____ constructed in _____
Reason for replaced or reconstructed Well?
NO WATER
3 1=Drilled 2=Driven Point 3=Jetted 4=Other

3. Well Serves # of homes and or
P (eg: barn, restaurant, church, school, industry, etc.)
M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole
High Capacity: Well? N Property? N

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties?
Well located in floodplain? N
Distance in feet from well to nearest: (including proposed)

1. Landfill
2. Building Overhang
3. 1=Septic 2= Holding Tank
4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain 1=Cast Iron or Plastic 2=Other
14. Building Sewer 1=Gravity 2=Pressure 1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure 1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
2.0	surface	42
1.3	42	46

Upper Enlarged Drillhole
-- 1. Rotary - Mud Circulation ----------
-- 2. Rotary - Air ----------
-- 3. Rotary - Air and Foam ----------
X -- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
-- 6. Cable-tool Bit _ n. dia ----------
-- 7. Temp. Outer Casing _ in. dia. _____ depth ft. Removed ?
Other
Lower Open Bedrock

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
2.0	WHEATLAND GALVANIZED R & D THREADED ASTM #589F 3.75 # PER FT	surface	42

Dia.(in.)	Screen type, material & slot size	From	To
1.3	JOHNSON STAINLESS 7 SLOT	42	46

7. Grout or Other Sealing Material

Method / Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
	surface		

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
__S_	SAND	0	46

9. Static Water Level
19.0 feet B ground surface
A=Above B=Below

10. Pump Test
Pumping level 25.0 ft. below surface
Pumping at 15.0 GP M 1.0 Hrs

11. Well Is: 14 in. A Grade
A=Above B=Below
Developed? Y
Disinfected? Y
Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?
If no, explain

13. Initials of Well Constructor or Supervisory Driller BP Date Signed 9/28/07
Initials of Drill Rig Operator (Mandatory unless same as above) Date Signed

Additonal Comments? Variance Issued?
Owner Sent Label? Y More Geology?

26877049

Batch 1098

Appendix B – Waste Storage Calculations

180 day requirement

WASTE STORAGE FACILITY DESIGN - 313 STANDARD

CLIENT: Wysocki	COUNTY: Wood	DATE:	6/5/12
DSN BY:	CHK BY:	DATE:	
COMMENTS:			

ANIMAL TYPE> 1 (1=DAIRY, 2=BEEF, 3=VEAL, 4=SWINE(finishing), 5=SWINE(farrowing), 6=POULTRY, 0=OTHER)

For Dairy: Rolling Herd Average 28,000 lbs/cow/yr Is it a stanchion barn? n (Y or N)

MANURE AND WASTEWATER

LIVESTOCK KIND	NUMBER	AVG. WT. PER HEAD	DAILY OUTPUT, CU FT MANURE	BEDDING	TOTAL	DAYS OF STORAGE	VOLUME REQUIRED	ANIMAL UNITS
Cows	3400	1,400	2.52		8568.0	180	1,542,240	4,760
Dry	600	1,200	1.90		1140.0	180	205,200	720
Heifers	300	700	1.10		330.0	180	59,400	210
Calves		350						

WASTEWATER: 61560 GAL/DAY 8229.9 CU FT/DAY 5,690 TOT. A.U.

TOTAL DAILY VOLUME: 18267.9 CU FT / DAY

	24,595,963	GALLONS
Total Manure and Wastewater	3,288,230	CU FT
Expected % solids in waste (Includes runoff and precip.)	5.9	%

RUNOFF VOLUME

MONTHLY RUNOFF

RCN 95 $\frac{12.2 \text{ IN.}}{12}$ X 307,202 Ft2 Drainage Area= 312,322 CU FT (Do not include storage area)

25-Year, 24-HOUR RUNOFF

RCN 95 $\frac{4.02 \text{ IN.}}{12}$ X 307,202 Ft2 Drainage Area= 103,005 CU FT (Do not include storage area)

	27,702,606	GALLONS
Total for Manure, Milking Center, Runoff Volume, and 25 Yr Runoff	3,703,557	CU FT

PRECIPITATION

Does the facility collect precipitation? (No roof or lid) 1 (1 for yes, 2 for no)

Beginning Month for Precip. Collection 11 (1=Jan, 2=Feb, etc.)

Precipitation minus evaporation

Average Precipitation on Storage Surface	9.7 INCH	0.8 FT
Average Evaporation from Storage Surface	- 4.8 INCH	0.4 FT
Net Precipitation on Storage Surface	4.9 INCH	0.4 FT
25-Yr, 24-Hr Precip on Storage Surface	4.6 INCH	0.4 FT

REMAINING WASTE (If no sump, use these minimums: ponds -2', tanks-1') 0.0 FT

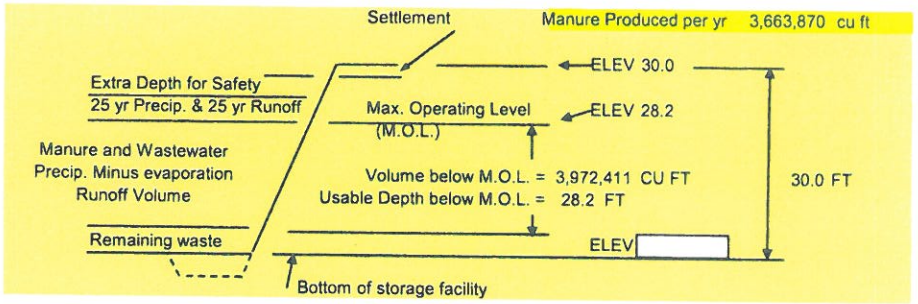
EXTRA DEPTH FOR SAFETY (1-ft. Minimum) 1.0 FT

SETTLEMENT (5% of Embankment Height) FT

M.O.L. DEPTH (Depth to hold Manure, Wastewater, Runoff, and Precip.) 28.23 FT

Total Depth of the Storage Facility 30.0 FT

STORAGE FACILITY ELEVATIONS Design Storage Volume 4,153,845 cu ft



STORAGE DIMENSIONS AND SIZING

SIDE SLOPES OF STORAGE (Use "0" for walls)	2.5	:1
CHOOSE A BOTTOM WIDTH		FT
BOTTOM LENGTH REQUIRED	1772	FT
ROUND STORAGE BOTTOM DIAMETER	339	FT

SECTION FOR FIGURING VOLUME OF A CHOSEN OR EXISTING STORAGE FACILITY

RECTANGULAR

BOTTOM SIDE 1:	315	FT		
BOTTOM SIDE 2:	290	FT		
M.O.L. VOLUME PROVIDED:	3,972,411	CU FT	29,713,631	GALLONS
DAYS STORAGE PROVIDED:	192	DAYS		
TOTAL VOLUME FROM BOTTOM TO SETTLED TOP:	4,326,750	CU FT	32,364,090	GALLONS

192 days storage

1/ Includes feed pad, sand/manure solids pad & Bldg work pads Surface Areas.

2/ 28,560 gal/d: 7.65 g/d parlor/milkhouse water, 0.25 g/d AV. silage leachate water over 180 days, 0.5 g/d for sand seperation ⇒ 8.4 g/d. Plus Average of 33,000 gpd soaker water (See page 7-Leachate, page 3-waste characterization,

Annual Manure Generation

WASTE STORAGE FACILITY DESIGN - 313 STANDARD

CLIENT: Wysocki | COUNTY: Wood | DATE: 6/5/12
DSN BY: RP | CHK BY: RP | DATE:
COMMENTS:

ANIMAL TYPE> 1 (1=DAIRY, 2=BEEF, 3=VEAL, 4=SWINE(finishing), 5=SWINE(farrowing), 6=POULTRY, 0=OTHER)

For Dairy: Rolling Herd Average 28,000 lbs/cow/yr | Is it a stanchion barn? n (Y or N)

MANURE AND WASTEWATER

LIVESTOCK KIND	NUMBER	AVG. WT. PER HEAD	DAILY OUTPUT, CU FT MANURE	BEDDING	TOTAL	DAYS OF STORAGE	VOLUME REQUIRED	ANIMAL UNITS
Cows	3400	1,400	1/ 2.52		8568.0	365	3,127,320	4,760
Dry	600	1,200	1.90		1140.0	365	416,100	720
Heifers	300	700	1.10		330.0	365	120,450	210
Calves		350						

WASTEWATER: 3/ 44834 GAL/DAY 5993.9 CU FT/DAY 5,690 TOT. A.U.

TOTAL DAILY VOLUME: 16031.9 CU FT / DAY

43,770,158 GALLONS

Total Manure and Wastewater 5,851,625 CU FT

Expected % solids in waste (Includes runoff and precip.) 6.9 %

RUNOFF VOLUME 2/ 4,174,468

MONTHLY RUNOFF

RCN 95 — 21.8 / 12 IN. X 307,202 Ft2 Drainage Area= 558,084 CU FT (Do not include storage area)

25-Year, 24-HOUR RUNOFF (770,477)

RCN 95 — 4.02 / 12 IN. X 307,202 Ft2 Drainage Area= 103,005 CU FT (Do not include storage area)

48,715,097 GALLONS

Total for Manure, Milking Center, Runoff Volume, and 25 Yr Runoff 6,512,714 CU FT

PRECIPITATION Does the facility collect precipitation? (No roof or lid) 1 (1 for yes, 2 for no)

Beginning Month for Precip. Collection 11 (1=Jan, 2=Feb, etc.)

Precipitation minus evaporation

Average Precipitation on Storage Surface	31.1 INCH	2.6 FT
Average Evaporation from Storage Surface	- 27.4 INCH	2.3 FT
Net Precipitation on Storage Surface	3.7 INCH	0.3 FT
25-Yr, 24-Hr Precip on Storage Surface	4.6 INCH	0.4 FT

REMAINING WASTE (If no sump, use these minimums: ponds -2', tanks-1') 0.0 FT

EXTRA DEPTH FOR SAFETY (1-ft. Minimum) 1.0 FT

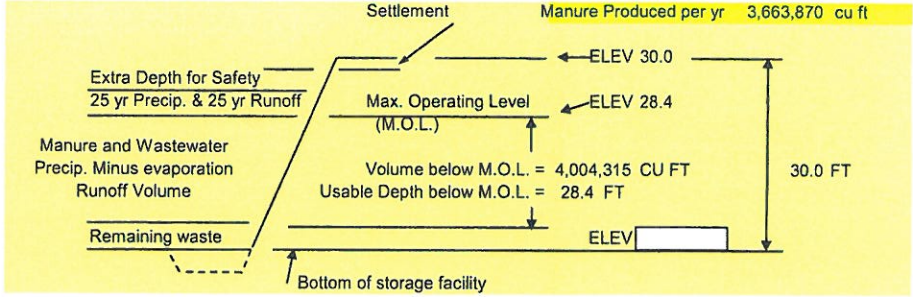
SETTLEMENT (5% of Embankment Height) FT

M.O.L. DEPTH (Depth to hold Manure, Wastewater, Runoff, and Precip.) 28.40 FT

Total Depth of the Storage Facility 30.0 FT

STORAGE FACILITY ELEVATIONS Design Storage Volume 4,185,750 cu ft

Waste 54/2060 5 a 360 Days T



STORAGE DIMENSIONS AND SIZING

SIDE SLOPES OF STORAGE (Use "0" for walls) 2.5 :1

CHOOSE A BOTTOM WIDTH FT

BOTTOM LENGTH REQUIRED 3161 FT

ROUND STORAGE BOTTOM DIAMETER 471 FT

SECTION FOR FIGURING VOLUME OF A CHOSEN OR EXISTING STORAGE FACILITY

RECTANGULAR	BOTTOM SIDE 1:	315 FT		
	BOTTOM SIDE 2:	290 FT		
	M.O.L. VOLUME PROVIDED:	4,004,315 CU FT	29,952,278	GALLONS
	DAYS STORAGE PROVIDED:	223 DAYS		
	TOTAL VOLUME FROM BOTTOM TO SETTLED TOP:	4,326,750 CU FT	32,364,090	GALLONS
ROUND	CHOOSE BOTTOM:	FT DIAM		
	M.O.L. VOLUME PROVIDED:	149,821 CU FT	1,120,664	GALLONS
	DAYS STORAGE PROVIDED:	8 DAYS		
	TOTAL VOLUME FROM BOTTOM TO SETTLED TOP:	176,715 CU FT	1,321,828	GALLONS

1/ Adjusted for manure solids removal.

2/ Includes Runoff from feed Storage - Sand Storage - Solids Storage & barn · work Pads

3/ Includes parlor water, silage leachate & Soaker water.

manure & wastewater & Runoff.

43,770,158
4,174,468

47,944,626 gallons - 1 year

Appendix C - NRCS standards

NRCS 313, Waste Storage
NRCS 634, Manure Transfer
NRCS 629, Waste Treatment

NRCS 313, Waste Storage

WASTE STORAGE FACILITY
(No.)
Code 313

Natural Resources Conservation Service
Conservation Practice Standard

I. Definition

A waste storage *impoundment*[1] made by constructing an embankment and/or excavating a pit or dugout, or by fabricating a *structure*.

II. Purpose

To temporarily store wastes such as manure, *manure processing derivatives*, *leachate*, *wastewater*, and *contaminated runoff* in a manner which safeguards the environment.

III. Conditions Where Practice Applies

This standard applies to:

- construction of a storage facility in areas where the soils, geography, and topography are suitable and where the construction, operation, and maintenance will protect the soil and water resources,
- areas that are part of a planned agriculture waste management system intended to reduce contaminated runoff and meet the facility management goals, regulatory requirements, or *nutrient management plans* by providing storage of waste,
- waste storage facilities utilizing embankments with a maximum *effective height* of 25 feet and where damage resulting from failure would be limited,
- temporary unconfined stacks of manure and derivatives outside the *animal production area*, and
- storage of milking center wastewater generated at the animal production area.

This standard does not apply to:

- facilities in which greater than 10% of the design storage volume or greater than 25,000 gallons is occupied by any combination of domestic waste, industrial wastewater generated offsite, or sludge. These types of facilities are defined and regulated under various codes administered by the Wisconsin Department of Natural Resources (WDNR).
- closure of waste storage facilities. For information related to closures refer to the criteria contained in Wisconsin NRCS Field Office Technical Guide (FOTG) Section IV, Standard 360, Closure of Waste Impoundments.

IV. Federal, Tribal, State and Local Laws

Waste storage facilities shall comply with all federal, tribal, state, and local laws, rules or regulations. The operator is responsible for securing required permits. This standard does not contain the text of the federal, tribal, state, or local laws governing waste storage facilities.

V. Criteria

The following criteria establishes **minimum** allowable limits for design parameters, acceptable installation processes, or performance requirements.

A. General Criteria

The following general criteria apply to this practice.

1. Management Assessment

A management assessment shall be conducted, documented, and incorporated into the design. The assessment shall be performed with the owner/operator to explore options and to determine the purpose of storage components, available resources, manure disposal schemes, and waste characteristics.

When the intent of the owner/operator is to process and/or treat the various waste streams within the animal production area, the designer shall provide a narrative describing the system. The description will include the intent and purpose of the treatment or processing strategies relative to landspreading or waste distribution strategies, stabilization of organic by-products, reducing pollutant loads, nutrient concentration, waste consistencies, odor control, energy production, and volume reduction.

[1]Words in the standard that are shown in italics are described in VIII. Definitions. The words are italicized the first time they are used in the text.

The management assessment shall address the following:

a. Waste Characterization.

(1) Sources, volumes and consistency of manure, contaminated runoff, manure processing derivatives, leachate, wastewater, and other inputs to the waste storage facility.

(2) Animal types.

(3) Bedding types and quantity.

b. Land base available for utilization of waste.

c. Planned storage period.

d. Waste handling and transfer methods.

e. Facility waste removal methods.

f. Storage liner possibilities and preferences.

g. Access needs and limitations.

h. Safety needs.

i. Labor and equipment needs.

j. Odor production concerns and control strategies – identify sources of odors and potential public contact.

k. Aesthetics and animal health.

l. Provisions for facility expansion.

2. Site Assessment

A site assessment shall be conducted, documented, and incorporated into the design. The assessment shall be performed to determine physical site characteristics that will influence the placement, construction, maintenance, and environmental integrity of a proposed waste storage facility, unconfined manure stacks, and transfer components. The assessment shall include input from the owner/operator. The site assessment shall include:

a. Locations and elevations of buildings, roads, lanes, soil test pits, property lines, setbacks, easements, wells, floodplains, surface waters, surface drains, drain tile, utilities, overhead lines, cultural resources, and wetlands.

b. Test pit or soil boring logs, soil test results, and a soil survey photo, if available. Test pit soil or boring criteria include:

(1) The number and distribution needed to characterize the subsurface (soils, saturation, and *bedrock*). Test pits or borings shall be added if there is inconsistency within or between test pits or borings.

(2) Based on the facility *footprint* there shall be a minimum of one test pit or boring per 15,000 square feet of footprint, with a minimum of two per facility. Test pits and borings used to meet this criteria shall be located in the footprint or no more than 100 feet from the footprint.

(3) For manure transfer systems, the number of test pits or soil borings shall be in accordance with NRCS FOTG Section IV, Standard 634, Manure Transfer.

(4) Soil layers shall be described with respect to texture using the Unified Soil Classification System (USCS).

(5) A minimum depth to ensure separation distances in Tables 1-6 and 9 of this standard and Table 1 in NRCS FOTG Section IV, Standard 634, Manure Transfer.

(6) The elevation of bedrock and bedrock type, if encountered, such as sandstone, limestone, dolomite, or granite.

(7) Saturation indicators, if encountered, such as seepage from sand and gravel lenses, lens thickness, estimated volume of flow, and elevation. Ground water maps and well construction logs shall be included when available and applicable.

c. Locations, dimensions and elevations of *sinkholes* and other *karst* features within 1,000 feet of the facility.

d. Locations, dimensions and elevations, soil volumes, soil samples, testing results, and reclamation plans of any borrow areas. Characterize borrow areas according to Section V.A.2.b.(1).

e. Identification of potential impacts from failure of the embankments, liners, or structures.

3. Floodplain

Waste storage facilities located in *flood prone areas* shall be protected from inundation, structural damage, and instability. These facilities shall be designed to accommodate any additional loading resulting from static water levels or saturated soils. The lowest point at which floodwater could enter the waste storage facility shall be 2 feet above the maximum elevation of flow resulting from a 100-year, 24-hour rainfall event.

4. Location

Waste storage facilities shall be located so the potential impacts from breach of embankment, accidental release, and liner failure are minimized. Consideration VI.N. contains information related to reducing the impacts.

5. Design Storage Volume

Design storage volumes shall be calculated with the procedures and default values found in the Wisconsin supplement to Chapter 10 of the NRCS Agricultural Waste Management Field Handbook (AWMFH) or estimates and measurements documented in the plan. The design storage duration and volume shall be consistent with the nutrient management plan and emptying schedule. Design volume shall include the sum of the following during the storage period:

a. Manure, bedding and other wastes.

b. The volume of wastewater from all sources that is anticipated to enter the storage facility. The wastewater volume shall be based on default values or estimates and measurements documented in the plan.

c. Normal precipitation less evaporation on the surface of the facility.

d. Runoff volumes from the drainage area for design storage duration.

e. 25-year, 24-hour precipitation on the surface of the facility.

f. 25-year, 24-hour runoff volume from the drainage area.

6. Maximum Operating Level

The maximum operating level for waste storage facilities shall be the storage level that provides for the design storage volume listed in Section V.A.5 less the volume of precipitation and runoff from the 25-year, 24-hour storm event. See Figure 1.

A permanent marker or indicator that does not compromise the integrity of the liner shall be installed at the maximum operating level. The stored waste shall be managed such that it remains below the maximum operating level during normal operating conditions.

A contingency plan shall be implemented when the maximum operating level is reached. See Section V.A.14.c for specific contents of the contingency plan.

7. Extra Depth for Safety

A minimum of one foot of depth shall be added to the design storage volume to reduce the risk of overtopping. This depth is not intended to add storage capacity. See Figure 1.

8. Remaining Waste and Sumps

An additional depth shall be added to the facility to accommodate the waste that cannot be routinely removed during emptying. A minimum of two feet shall be added to storage depth for facilities with side slopes and one foot for vertical walled facilities. The additional storage depth can be reduced if a sump is installed or other provisions to empty the facility have been made.

9. Embankment Requirements

a. The foundation area shall be stripped to remove vegetation and unsuitable materials.

b. A core trench shall be required whenever the settled embankment fill height at the centerline is ≥ 10 feet. Minimum dimensions of the core trench shall be 8-foot bottom width, 2-foot depth, and 1:1 or flatter side slopes.

c. After settlement, the top of the embankment shall be ≥ 1 foot above the surrounding grade. Any diversion along the embankment shall have capacity for 25-year, 24-hour flow plus 0.5 feet of freeboard.

d. Additional fill for settlement shall be a minimum of 5% of the fill height measured at the centerline.

e. The minimum top width shall be according to the table below.

Settled Embankment Fill Height (feet)	Top Width (feet)
0 - 10	≥ 8
10.1 - 15	≥ 10
15.1 - 20	≥ 15
20.1 - 25	≥ 20

f. The sum of interior and exterior side slopes shall be ≥ 5:1 with no slope steeper than 2:1. Tables 1, 3, 4, and 5 contain specific embankment requirements.

g. Compaction shall be according to NRCS FOTG Section IV, Wisconsin Construction Specification 204, Earthfill for Waste Storage Facilities.

10. Separation from Saturation or Bedrock

The separation is determined to be the closest distance from any point on the inside surface (bottom and sides) of the storage facility to the feature from which separation is required.

a. The following criteria apply to saturation:

(1) *Regional High Water Table* - The regional high water table shall not be lowered to achieve the required separation.

(2) *Confined Lenses and Perched Water* may be drained. All *drainage systems* shall have a free outlet. The effect of temporary tailwater on the structure or liner and the effects of outletting to perennial and intermittent waterways shall be evaluated. At a minimum, drain tile and/or drain fill material shall be located outside the facility footprint.

b. The following criteria apply to bedrock. Excavation of bedrock is permitted to achieve the required separation distance as specified in the tables. Consolidated bedrock shall not be removed by blasting. The entire width of the surface of any excavated, consolidated rock material shall have a positive grade away from the storage facility with no ponding on the excavated surface. If bedrock is excavated, the material placed between the liner and the bedrock shall have a minimum of 20% fines.

11. Safety Design

Safety design shall identify and minimize the hazards to animals and people. In particular, Waste Storage Facility designs may create *confined spaces*, which may pose significant hazards to people. At a minimum, safety design shall include the following.

a. Warning signs, fences, ladders, ropes, bars, rails, and other devices shall be provided, as appropriate, to ensure the safety of humans and livestock. Fences a minimum of 4 feet tall that do not allow passage of animals or people shall be installed to restrict access.

b. Ventilation for covered waste-holding structures to prevent the inhalation of poisonous gases, asphyxiation, or explosion.

c. Safety stops, gates, or both installed at push-off ramps and load-out areas of impoundments and structures to prevent accidental entry of machinery.

d. Equipment access ramps and embankment slopes shall be compatible with the equipment intended to be used.

e. Confined spaces where human entry may occur shall be designed and operated in compliance with the provisions contained in ASABE EP470, Manure Storage Safety.

12. Seeding and Mulching

Disturbed areas and embankments shall be seeded and mulched in accordance with NRCS FOTG Section IV, Standard 342, Critical Area Planting.

13. Plans and Specifications

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. A construction plan and inspection plan are required.

a. The plans, specifications, and documentation for the installation of

waste storage impoundments and structures shall include:

- Management assessment,
- Site assessment,
- Safety design features,
- Operation and maintenance plan,
- Construction plan,
- Construction inspection plan, and
- Construction site erosion control plan (see NR 216).

b. Documentation for siting unconfined stacks of manure and derivatives in cropland outside the waste production area shall include:

- Management assessment,
- Site assessment, and
- Location maps, soils maps, and USGS quadrangle maps.

14. Operation and Maintenance

An operation and maintenance plan shall be developed that is consistent with the purposes of this practice, intended life of the components, safety requirements, and the criteria for the design. At a minimum, the plan shall include:

a. Operational requirements for emptying the storage facility. This shall require that waste be removed and utilized at locations, times, rates, and volumes detailed in a plan in accordance with NRCS FOTG Section IV, Standard 590, Nutrient Management.

b. Requirements for location and methods of waste removal in order to maintain liner integrity.

c. A contingency plan which shall be implemented when the maximum operating level is reached. The contingency plan shall include how to handle unexpected volumes of wastewater and/or runoff that could cause the system to overflow before scheduled emptying can occur. The contingency plan shall provide for the safe disposition of waste.

d. An emergency response plan to deal with spills or overflows at the animal production area.

e. Requirements for inspecting and maintaining the facility as well as monitoring the waste level relative to the permanent maximum operating level marker or indicator.

f. Safety issues and procedures/requirements connected with waste storage facilities.

B. Specific Criteria for Waste Storage Impoundments and Structures

Waste Storage impoundments and structures shall be designed to contain all wastes until emptied and utilized in accordance with the Operation and Maintenance Plan. This includes impoundments (Section 1, and Tables 1 through 5) and structures (Section 2, Table 6). The storage facilities may be used alone or in combination to contain the various waste streams. There shall be no gravity outlets from the waste storage facility.

The following specific criteria apply to this practice:

1. Impoundment Design Criteria

Table 1 contains the criteria for constructing waste impoundments into existing soils with no additional liner. Tables 2 through 5 contain the criteria for impoundments with liners. The portions of the waste storage facilities that do not meet Table 1 criteria shall be lined. A combination of liners is acceptable. The liners shall be joined so as to preserve the performance and integrity of all liner types. Concrete walls used in impoundments shall maintain the integrity of any liner. Any penetration and overfall/outfalls of the liner shall be constructed to maintain the performance and integrity of the liner used. Liners shall be designed to withstand all anticipated internal and external loads, hydrostatic uplift pressure, and agitation scouring. Soil criteria in Tables 1 through 5 refers to mineral soils. Construction shall not occur on or with organic soils.

Table 1 - *In-Place Earth* Criteria for Impoundments 20 Feet Deep or Less[Note 1]

1. Size - Design Storage Volume - Manure Produced at Farm per year	≤ 300,000 cu. ft. ≤ 300,000 cu. ft.	> 300,000 cu. ft.[Note 2] > 300,000 cu. ft.	> 300,000 cu. ft.[Note 2] > 300,000 cu. ft.
2. Waste Characteristics - % Solids in Stored Waste	≥ 4	≥ 2[Note 3]	≥ 2[Note 3]
3. Soils - *% Fines* - Thickness, (measured perpendicular to storage surface) - *Plasticity Index (PI)*[Note 4]	≥ 50% ≥ 5 ft. —	≥ 50% ≥ 3 ft. (impoundment < 16 ft. deep)[Note 1] ≥ 4 ft. (impoundment ≥ 16 ft. deep) ≥ 7	≥ 40% ≥ 3 ft. (impoundment < 16 ft. deep)[Note 1] ≥ 4 ft. (impoundment ≥ 16 ft. deep) ≥ 12
4. Separation Distances - Well Distance[Note 5] - Sinkholes - Saturation (V.A.10) - Bedrock	≥ 250 ft. ≥ 800 ft. ≥ 5 ft. ≥ 5 ft.	≥ 250 ft. ≥ 400 ft. ≥ 3 ft. (impoundment < 16 ft. deep) ≥ 4 ft. (impoundment ≥ 16 ft. deep) ≥ 5 ft.	≥ 250 ft. ≥ 400 ft. ≥ 3 ft. (impoundment < 16 ft. deep) ≥ 4 ft. (impoundment ≥ 16 ft. deep) ≥ 5 ft.
5. Embankment	Shall be constructed with material meeting criteria in Table 1 from the inside surface to the embankment centerline. If this material has a PI less than 7, then the sum of the embankment slopes shall be 6 or greater and the constructed embankment height shall be less than 10 feet.		
6. Other - Scour Protection • Agitation and Pumping Locations • Scraping and Other Mechanical Means of Removing Solids and Sand - Bottom Modification	Not required if actual soil thickness is 3 feet greater than the minimum required in the table. 20 ft. x 20 ft. x 4 in. thick concrete pad or sump in bottom and 20 ft. wide ramp or a 16 ft. wide ramp with 12 in. high curbs to top of facility. Protect with hard surfacing designed for the expected conditions and loads, a minimum of 4 in. thick. If the bottom of the impoundment is less than three feet below the native soil surface, the bottom soil shall be reworked to a minimum depth of 6 in. and compacted in accordance with WI Spec 204[Note 6].		

Note 1 The depth is measured from the bottom of the impoundment to the maximum operating level.

Note 2 These two columns show the minimum criteria for larger storage facilities and farms, but can also be used for smaller facilities and farms.

Note 3 In Place Impoundments are not allowed if the waste has less than 2% solids.

Note 4 PI shall be determined by ASTM D-4318, Atterberg Limits.

Note 5 Community water system wells may require larger separation distances (see NR 812).

Note 6 NRCS FOTG Section IV, Wisconsin Construction Specification 204, Earthfill for Waste Storage Facilities.

Table 2 - Clay Liner Criteria for Impoundments

1. Size - Design Storage Volume - Manure Produced at Farm Per Year	≤ 300,000 cu ft. ≤ 300,000 cu ft.	> 300,000 cu ft.[Note 1] > 300,000 cu ft.	> 300,000 cu ft.[Note 1] > 300,000 cu ft.
2. Waste Characteristics - % Solids in Stored Waste	—	≥ 2	< 2
3. Clay Liner Material Requirements - Thickness, Bottom - Thickness, Sides - % Fines - Plasticity Index (PI)[Note 2] - *Permeability*, cm/sec.[Note 3]	≥ 3 ft. ≥ 5 ft. ≥ 50% ≥ 12 —	≥ 3 ft. ≥ 5 ft. ≥ 50% ≥ 12 ≤ $1x10^{-6}$	As specified in Table 2A ≥ 5 ft. ≥ 50% ≥ 12 ≤ $1x10^{-7}$
4. Clay Liner Compaction Specification	WI Spec 204[Note 4]	WI Spec 300[Note 5]	WI Spec 300[Note 5]
5. Separation Distances - Wells[Note 6] - Sinkholes - Saturation (V.A.10) - Bedrock	≥ 250 ft. ≥ 400 ft. ≥ 4 ft. ≥ 3 ft.	≥ 250 ft. ≥ 400 ft. ≥ 4 ft. ≥ 3 ft.	≥ 250 ft. ≥ 400 ft. As specified in Table 2A Same as liner thickness
6. Other - Liner Protection Required	• If facility bottom is to be mechanically cleaned • At all agitation and pumping locations[Note 7]		

Note 1 These two columns show the minimum criteria for larger storage facilities and farms, but can also be used for smaller facilities and farms.

Note 2 PI shall be determined by ASTM D-4318, Atterberg Limits.

Note 3 Permeability shall be determined by ASTM D-5084 using a Shelby tube sample.

Note 4 NRCS FOTG Section IV, Wisconsin Construction Specification 204, Earthfill for Waste Storage Facilities.

Note 5 NRCS FOTG Section IV, Wisconsin Construction Specification 300, Clay Liner.

Note 6 Community water system wells may require larger separation distances (see NR 812).

Note 7 Minimum concrete agitation pad or sump to be 20 ft. x 20 ft. with a 20 ft. wide concrete ramp or 16 ft. wide concrete ramp with 12 in. high curbs in accordance with Table 5 criteria.

Table 2A – Clay Liner Thickness (Bottom) and Separation to Saturation[Note 1]

Impoundment Depth[Note 2] (feet)	Liner Thickness (feet)	Separation to Saturation (feet)
0 – 13	≥ 3.0	≥ 4.0
13.1 – 14	≥ 3.2	≥ 4.2
14.1 – 16	≥ 3.6	≥ 4.6
16.1 – 18	≥ 4.1	≥ 5.1
18.1 – 20	≥ 4.5	≥ 5.5

Note 1 Thickness is calculated based on a maximum permeability of $1x10^{-7}$ cm/sec and a specific discharge limit of 500 gallons/acre/day using Darcy's Law.

Note 2 Depth is the distance from the bottom of the impoundment up to the maximum operating level (M.O.L.).

Table 3 - *Geomembrane* Liner Criteria for Impoundments

1. Liner Material	60 mil High Density Polyethlene (HDPE) or 60 mil Linear Low Density Polyethylene (LLDPE). The geomembrane shall be installed with *intimate contact* to the soil below[Note 1]	
2. Soils (Directly Below Liner)[Note 2] - % Fines - Plasticity Index (PI) - Thickness - Compaction of Placed Material	≥ 20% ≥ 7 ≥ 1.5 ft. WI Spec 202	≥ 20% — ≥ 3 ft. WI Spec 202
3. Separation Distances - Well Distance[Note 3] - Sinkholes - Saturation (V.A.10) - Bedrock	≥ 250 ft. ≥ 400 ft. ≥ 3 ft. (1.5 ft. sep. for sump) ≥ 3 ft. (1.5 ft. sep. for sump)	≥ 250 ft. ≥ 400 ft. ≥ 4 ft. (3 ft. sep. for sump) ≥ 3 ft.
4. Waste Characteristics	No limitations	
5. Embankment Requirements - Inside Slope	2.5:1 or flatter.	
6. Other - Liner Protection Required - Gas release system - Liner Installation	• At all agitation and pumping locations[Note 4 and 5] • If facility bottom is to be mechanically cleaned[Note 5] Required for all facilities. The system shall be designed in such a manner to prevent waste and runoff from entry into the gas release system.[Note 1] • Continuous Inspection Required • All geomembrane placement, seaming, seam testing, and repair and concrete placement for liner protection shall be completed under the continuous observation of a qualified third-party quality assurance inspector under the direction of a Professional Engineer. This inspector shall not be an employee of the contractor, owner, or geomembrane supplier.	

Note 1 Intimate contact does not exclude the use of gravel trenches for gas venting or monitoring systems.

Note 2 The liner is in intimate contact with the soil, and the two work together to reduce seepage losses.

Note 3 Community water system wells may require larger separation distances (see NR 812).

Note 4 Minimum dimension of 20 ft. x 20 ft. concrete pad or sump in bottom and 20 ft. wide ramp with 12 in. curb to top of facility with provisions for liner integrity.

Note 5 Poured-in-place concrete slabs shall meet requirements of Table 5, Note 2 if the geomembrane will be joined to the liquid-tight concrete. All connections between the geomembrane and concrete shall be liquid tight and structurally sound. If the liner protection is placed on top of the geomembrane, it shall be structurally sound, but liquid-tightness is not required. Liner protection poured on top of the geomembrane shall be separated from the geomembrane by a sacrificial layer of the same weight geomembrane and a cushioning layer of 12 oz/sy non-woven geotextile. The sacrificial layer shall not be welded to the geomembrane liner. Liner protection installation over the geomembrane shall be completed by methods that will maintain the integrity and performance of the liner. Liner protection placed on slopes shall be designed with provisions to insure stability.

Table 4 - *Geosynthetic Clay Liner (GCL)* Criteria for Impoundments

1a. Soils (Directly Below Liner)[Note 1] - % Fines - Plasticity Index (PI) - Thickness (from bottom and sides) - Compaction of placed material	≥ 20% ≥ 7 ≥ 1.5 ft. WI Spec 203	≥ 20% — ≥ 3 ft. WI Spec 203
1b. Liner Cover Material Thickness - Bottom - Side Slopes - Compaction of Placed Materials	≥ 1 ft. ≥ 2 ft. WI Spec 203	≥ 1 ft. ≥ 2 ft. WI Spec 203
2. Separation Distances - Well Distance[Note 2] - Sinkholes - Saturation (V.A.10) - Bedrock	≥ 250 ft. ≥ 400 ft. ≥ 4 ft. ≥ 3 ft.	≥ 250 ft. ≥ 400 ft. ≥ 5 ft. ≥ 4 ft.
3. Waste Characteristics	No limitations	
4. Embankment Requirements - Inside Slope[Note 3]	3:1 or flatter	
5. Other - Required Liner Protection - Scraping and Other Mechanical Means of Removing Solids and Sand - GCL Material[Note 5]	• If facility bottom is to be mechanically cleaned • At all agitation and pumping locations[Note 4] Protect with hard surfacing designed for the expected conditions and loads, a minimum of 4 in. thick. Non-woven needle punched.	

Note 1 The liner is in intimate contact with the soil, and the two work together to reduce seepage losses.

Note 2 Community water system wells may require larger separation distances (see NR 812).

Note 3 The GCL and soil cover shall be stable at the designed side slope.

Note 4 Minimum dimension of 20 ft. x 20 ft. x 4 in. thick concrete pad or sump in bottom and 20 ft. wide ramp or a 16 ft. wide ramp with 12 in. high curb to top of facility. GCL continues under the concrete pad or sump.

Note 5 The liner shall be installed according to manufacturer's specifications and NRCS FOTG Section IV, Wisconsin Construction Specification 203, Geosynthetic Clay Liner.

Table 5 - Concrete Liner Criteria for Impoundments[Note 1]

	Concrete[Note 2]	Concrete - Soil Composite[Note 3]	
1. Soils (Directly Below Liner)[Note 3] - % Fines - Plasticity Index (PI) - Thickness (bottom and sides) - Compaction of Placed Material	— — — —	≥ 20% ≥ 7 ≥ 1.5 ft. WI Spec 204	≥ 20% — ≥ 3 ft. WI Spec 204
2. Separation Distances - Sinkholes - Well Distance[Note 4] - Saturation (V.A.10) - Bedrock	≥ 400 ft. ≥ 100 ft. ≥ 2 ft. (1 ft. sep. for sump) ≥ 2 ft. (1 ft. sep. for sump)	≥ 400 ft. ≥ 100 ft. ≥ 3 ft. ≥ 3 ft.	≥ 400 ft. ≥ 100 ft. ≥ 4 ft. ≥ 3 ft.
3. Waste Characteristics	No limitations		
4. Embankment Requirements - Side Slopes	In accordance with WI Spec 4		

Note 1 Slabs for uses other than liners such as protection, scraping, and access shall be a minimum of 4 inches thick with steel as required for anticipated loads and usage.

Note 2 The concrete liner thickness shall be a minimum of 5 in., contain distributed reinforcing steel, and all *contraction* or *expansion joints* shall have imbedded non-metallic waterstops in accordance with NRCS FOTG Section IV, Wisconsin Construction Specification 4, Concrete. The required size and spacing of reinforcing steel and spacing of liquid tight expansion or contraction joints shall be based on subgrade drag theory as discussed in industry guidelines such as American Concrete Institute, ACI 360, "Design of Slabs-on-Grade," or the WI Supplement to Chapter 10 of the NRCS AWMFH. Steel shall be continuous through all *construction joints*.

Note 3 The concrete is in intimate contact with the soil, and the two work together to reduce seepage losses. The concrete liner thickness shall be a minimum of 5 inches and continuous reinforcement of #3 steel bars spaced at 18 inches on center each way. No contraction or expansion joints are required. The concrete shall be placed in intimate contact with the foundation soils. If construction joints are required, steel shall be continuous through all construction joints and no waterstop is required. If the soil material below the floor meets Table 1 criteria, intimate contact is not required.

Note 4 Community water system wells may require larger separation distances (see NR 812).

2. Structure Design Criteria

The structure design shall include all items that will influence the performance of the structure, including loading assumptions, material properties, construction quality, waterstops, pipe penetrations, anchor plates, or other attachments to walls such as fence posts. Design assumptions and construction requirements shall be indicated on the construction plans. Waste storage structure separation criteria shall be as shown in Table 6. Any penetration of the structure shall be constructed to maintain the performance and integrity of the structure.

Table 6 - Waste Storage Structure Separation Distances

Well Distance[Note 1]	≥ 100 ft.
Sinkholes	
Storage floor above ground	≥ 200 ft.
Storage floor below ground	≥ 400 ft.
Saturation (V.A.10) (1 ft. sep. for sump)	≥ 2 ft.
Bedrock (1 ft. sep. for sump)	≥ 2 ft.

Note 1 Community water system wells may require larger separation distances (see NR 812).

Tanks may be designed with or without covers. Covers, beams, or braces that are integral to structural performance shall be designed accordingly and indicated on the construction drawings. The openings in covered tanks shall be designed to accommodate equipment for loading, agitating, and emptying. These openings shall be equipped with grills or secure covers for safety, and for odor and vector control.

a. Fabricated Structures - Fabricated structures shall be designed according to the following criteria:

(1) Steel. "Manual of Steel Construction," American Institute of Steel Construction.

(2) Timber. "National Design Specifications for Wood Construction," American Forest and Paper Association.

(3) Concrete. "Building Code Requirements for Reinforced Concrete, ACI 318," American Concrete Institute. Concrete shall have a minimum compressive strength of 3500 psi.

b. Foundations - The foundations of fabricated waste storage structures shall be proportioned to safely support all superimposed loads without excessive movement or settlement.

Where a non-uniform foundation cannot be avoided or applied loads may create highly variable foundation loads, settlement shall be calculated from site specific soil test data. Index tests of site soil may allow correlation with similar soils for which test data is available. If no test data is available, presumptive bearing strength values for assessing actual bearing pressures may be obtained from Table 7 or another nationally recognized building code. In using presumptive bearing values, adequate detailing and articulation shall be provided to avoid distressing movements in the structure.

Table 7 - Presumptive Allowable Bearing Stress Values[Note 1]

Foundation Description	Allowable Stress
- Crystalline Bedrock	12,000 psf
- Sedimentary Rock	6,000 psf
- Sandy Gravel or Gravel	5,000 psf
- Sand, Silt Sand, Clayey Sand, Silty Gravel, Clayey Gravel	3,000 psf
- Clay, Sandy Clay, Silty Clay, Clayey Silt	2,000 psf

Note 1 Basic Building Code, 12th Edition, 1993, Building Officials and Code Administrators, Inc. (BOCA)

c. Structural Loading - Waste storage structures shall be designed to withstand all anticipated loads including internal and external loads, hydrostatic uplift pressure, concentrated surface and impact loads, water pressure due to seasonal high water table, frost or ice pressure, and load combinations in compliance with this standard and applicable local building codes.

The lateral earth pressures should be calculated from soil strength values determined from the results of appropriate soil tests. Lateral earth pressures can be calculated using the procedures in NRCS Technical Release - 74, Lateral Earth

Pressures. If soil strength tests are not available, the presumptive lateral earth pressure values indicated in Table 8 shall be used.

Lateral earth pressures based upon equivalent fluid assumptions shall be assigned according to the following conditions:

(1) Rigid frame or restrained wall. Use the values shown in Table 8 under the column "Frame Tanks," which gives pressures comparable to the at-rest condition.

(2) Flexible or yielding wall. Use the values shown in Table 8 under the column "Free Standing Wall," which gives pressures comparable to the active condition. Walls in this category are designed on the basis of gravity for stability or are designed as a cantilever having a base wall thickness to height of backfill ratio not more than 0.085.

Internal lateral pressure used for design shall be 65 psf.

If heavy equipment will be operated near the wall, an additional surcharge equivalent to two feet of soil shall be applied in the wall analysis.

Tank covers shall be designed to withstand both dead and live loads. The live load values for covers contained in ASAE EP378.3, Floor and Suspended Loads on Agricultural Structure Due to Use, and in ASAE EP393.3, Manure Storages, shall be the minimum used. The actual axle load for tank wagons having more than a 2,000 gallon capacity shall be used.

If the facility is to have a roof, snow and wind loads shall be as specified in ASCE SEI/ASCE 7-02, Minimum Design Loads for Buildings and Other Structures. If the facility is to serve as part of a foundation or support for a building, the total load shall be considered in the structural design.

Table 8 - Lateral Earth Pressure Values[Note 1]

Soil		Equivalent Fluid Pressure (lbs./sq. ft./per ft. of depth)			
		Above Regional High Water Table		Below Regional High Water Table[Note 3]	
Description	Unified Classification[Note 2]	Free Standing Wall	Frame Tanks	Free Standing Wall	Frame Tanks
- Clean gravel, sand or sand-gravel mixtures (maximum 5% fines)[Note 4]	GP, GW, SP, SW	30	50	80	90
- Gravel, sand, silt and clay mixtures (< 50% fines) - Coarse sands with silt and/or clay (<50% fines)	All gravel/sand dual symbol classifications and GM, GC, SC, SM, SC-SM	35	60	80	100
- Low-plasticity silts and clays with some sand and/or gravel (≥ 50% fines - Fine sands with silt and/or clay (< 50% fines)	CL, ML, CL-ML, SC, SM, SC-SM	45	75	90	105
- Low to medium plasticity silts and clays with little sand and/or gravel (≥ 50% fines)	CL, ML, CL-ML	65	85	95	110
- High plasticity silts and clays (liquid limit more than 50)[Note 5]	CH, MH	–	–	–	–

Note 1 For lightly compacted soils (85% to 95% maximum standard density). Includes compaction by use of typical farm equipment.

Note 2 All definitions and procedures in accordance with ASTM D-2488 and D-653.

Note 3 Includes hydrostatic pressure.

Note 4 Generally, only washed materials are in this category.

Note 5 Not recommended. Requires special design if used, see the companion documents in Chapter 10 AWMFH.

d. Floors - Concrete floors shall be designed according to one of the following options.

(1) The concrete floor thickness shall be a minimum of 5 inches for uniform foundations, contain distributed reinforcing steel, and all contraction or expansion joints shall have imbedded non-metallic waterstops in accordance with NRCS FOTG Section IV, Wisconsin Construction Specification 4 - Concrete. The required area of reinforcing steel and spacing of liquid tight contraction or expansion joints shall be based on subgrade drag theory as discussed in industry guidelines such as American Concrete Institute, ACI 360, "Design of Slabs-on-Grade," or the WI Supplement to Chapter 10 of the NRCS AWMFH. The steel shall be continuous through all construction joints.

(2) If the soil material below the floor slab has 20% minimum fines and is at least 3 feet thick or has a minimum of 20% fines, is at least 1.5 feet thick, and has a PI of > 7, the reinforcing may be #3 bars spaced at 18 inches on center each way. No contraction or expansion joints are required. The concrete shall be placed in intimate contact with the foundation soil. The reinforcing steel shall be continuous through all construction joints. If the soil material below the floor meets Table 1 criteria, intimate contact is not required. Drain tile and/or drain fill material shall be kept outside of the soil component of the composite liner. Refer to the companion documents contained in Chapter 10 of the AWMFH for further guidance.

e. Wall Joints - Waterstop joints for cast-in-place walls shall be located at the floor waterstop joint locations and shall be continuous with the floor waterstop. Waterstops shall be imbedded non-metallic in accordance with NRCS FOTG Section IV, Wisconsin Construction Specification 4, Concrete.

Joints for pre-cast walls shall demonstrate evidence of equivalent performance to waterstop joints as determined by the NRCS State Conservation Engineer.

C. Specific Criteria For Temporary, Unconfined Stacks of Manure and Derivatives Outside the Animal Production Area

This includes solid type manure and derivatives that are deposited for subsequent loading and spreading. Waste material having less than 16% solids shall not be stacked in the field. Storage of these materials shall be in facilities meeting the criteria in section V.B.1 and 2. Criteria for unconfined waste stacks are shown in Table 9.

Table 9 – Temporary, Unconfined Stacks of Manure and Derivatives Outside the Animal Production Area

1. Waste Consistencies[Note 1]	> 32% Solids	16% to 32% Solids [2]
2. Size & Stacking Period - Stacking Period - Maximum Volume/Stack - Frequency of Stacking Site Use - Conservation BMPs above and below site[Note 3]	 8 months ≤ 40,000 cu ft 1 year out of 2 Yes	 8 months ≤ 15,000 cu ft 1 year out of 3 Yes
3. *Hydrologic Soil Groups*	B or C	B or C
4. Subsurface Separation Distance - Saturation (V.A.10) - Bedrock	 ≥ 3 ft. ≥ 3 ft.	 ≥ 3 ft. ≥ 5 ft.
5. Surface Separation Distance - Wells[Note 4] - Lakes - Sinkholes, or other Karst Features - Quarries - Streams - Wetlands and Surface Inlets - Other Concentrated Flow - Land Slope Down Gradient of Stack - Floodplain	 ≥ 250 ft. ≥ 1,000 ft. ≥ 1,000 ft. ≥ 1,000 ft. ≥ 300 ft. ≥ 300 ft. ≥ 100 ft. ≤ 6% ≥ 100 ft.	 ≥ 250 ft. ≥ 1,000 ft. ≥ 1,000 ft. ≥ 1,000 ft. ≥ 500 ft. ≥ 500 ft. ≥ 300 ft. ≤ 3% ≥ 300 ft.

Note 1 Refer to AWMFH, Figure 9-1 for consistency values and Chapter 4 for % solids, for specific livestock types.

Note 2 16% to 32% solids represents waste at near saturation conditions where additions of free water from runoff, rain, or snowmelt can result in liquid flow conditions.

Note 3 Stacking sites shall employ conservation BMPs to divert overland flow, and provide buffering to downstream channels and lakes.

Note 4 Community water system wells may require larger separation distances (see NR 812).

VI. Considerations

Additional recommendations relating to design which may enhance the use of, or avoid problems with, this practice, but are not required to ensure its basic conservation function are as follows:

A. Consider using the companion documents located in Chapter 10 of the NRCS, Agriculture Waste Management Field Handbook (AWMFH).

B. Consider using the Waste Storage Design spreadsheet located in Chapter 10 of the NRCS AWMFH for design storage volume, liner thicknesses, and other calculations described in this standard.

C. Implementing erosion control methods on the top half of the inside slopes of earthen impoundments may reduce erosion.

D. Adding an auxiliary spillway, additional embankment height, or both may be needed to help protect the embankment, particularly for systems that store runoff. Factors such as downstream hazards and receiving waters should be evaluated in this consideration.

E. Non-polluted runoff should be excluded except where its storage is advantageous.

F. Separating solids from waste entering waste storage facilities may minimize the frequency of accumulated solid removal and benefit the pumping and application of the stored waste, however this may increase odors.

G. Consider outletting drainage systems to locations that will not directly enter surface water.

H. Adding or including steel reinforcement in slabs that will be scraped may prevent vertical displacement at crack locations.

I. Consider placing a permanent marker at the level one-foot below the top of the storage facility and a marker to designate the empty level. This consideration is particularly important for operations considering future herd expansion to WPDES permit size.

J. Monitoring and leakage collection systems should be considered for larger waste storage facilities, especially where the site assessment indicates the area is sensitive for groundwater impacts. This is particularly important for operations considering future expansion to WPDES permit size. Components of a designed system may include secondary containment (soil or synthetic), leachate collection, leachate recirculation, monitoring sumps, and/or monitoring wells. See NR 141 for regulations concerning monitoring wells.

K. Composting should be done in accordance with guidance from books such as "On-Farm Composting Handbook," NRAES-54, or equivalent.

L. Avoid locating facilities in areas where negative impacts to water resources may occur, particularly near streams or in floodplains.

M. Consider incorporating the following practices into the waste management system to reduce emissions of greenhouse gases, ammonia, volatile organic compounds, and odor:

- National Handbook of Conservation Practices (NHCP), Standards 366, Anaerobic Digestion-Controlled Temperature; 367, Waste Storage Cover; and 317, Composting Facility,
- Siting of livestock housing or feedlots, manure storage, and land application,
- Biofilters,
- Feed ration additives and adjustments,
- Manure additives, disinfectants, or aeration,
- Incorporation of manure when land-applied,
- Moisture and dust control within livestock housing areas, and
- Dead animal disposal plans.

For additional information on odor abatement see: ASAE EP379.2 Feb. 2003 Control of Manure Odors.

N. The following should be considered either singly or in combination to minimize the potential of or the consequences of sudden breach of embankments:

- An auxiliary spillway,
- Additional depth for safety,
- Storage for wet-year rather than normal-year precipitation,
- Reinforced embankment, such as additional top width, flattened and/or armored downstream side slopes, and
- Secondary containment.

O. When designing impoundment embankments, consider using flatter slopes on the outside embankment slope. This would provide better operation access and easier maintenance of the impoundment (i.e., pumping equipment access, mowing, and removal of woody vegetation.)

VII. References

USDA, NRCS, Agricultural Waste Management Field Handbook, Part 651, 1992.

USDA, NRCS Wisconsin Field Office Technical Guide (FOTG), Section IV, Practice Standards and Specifications.

Wisconsin Administrative Code, Department of Natural Resources, Chapters NR 141 and NR 812.

American Society of Testing Materials (ASTM) D-4318, D-5084, D-2488, and D-653.

American Concrete Institute (ACI) 318, 360, and 3630.

Manual of Steel Construction, American Institute of Steel Construction.

National Design Specifications for Wood Construction, American Forest and Paper Association.

Building Officials and Code Administrators, Inc. (BOCA), Basic Building Code, 12th Edition, 1993.

USDA, NRCS, Technical Release 74, Lateral Earth Pressures.

American Society of Agricultural and Biological Engineers (ASABE), Standards EP378.3, EP393.2, EP379.2, and EP470.

American Society of Civil Engineers (ASCE), Minimum Design Loads for Buildings and Other Structures, SEI/ASCE 7-02.

Northeast Regional Agricultural Engineering Service, NRAES-54, On-Farm Composting Handbook, June 1992.

USDA, NRCS, National Handbook of Conservation Practices.

VIII. Definitions

% Fines (Table 1) – Percentage of given sample of soil which passes through a #200 sieve.

Animal Production Area (III) – Means any part of the livestock operation that is used for the feeding and housing of livestock. This includes the entire animal confinement and feeding area, and any adjacent manure storage areas, raw materials storage areas, and waste containment areas. This does not include pasture and cropland.

Bedrock (V.A.2.b.(1)) – Consolidated rock material and weathered in-place material with > 50%, by volume, larger than 2 mm in size.

Confined Lenses and Perched Water (V.A.10.a.(2)) – Confined lenses are water bearing deposits of stratified lacustrine material or material laid down by glaciers between deposits of less permeable till. Perched water is saturation found above and separated from the regional high water table.

Confined Space (V.A.11) – Confined Space is a space that 1) contains or has the potential to contain a hazardous atmosphere; 2) is large enough and so configured that a person can bodily enter; 3) has limited or restricted means for entry or exit; and 4) is not designed for continuous human occupancy.

Construction Joint (Table 5, Note 2) – These joints are used where a fresh pour of concrete abuts an existing recent pour. Construction joints where the steel is continuous through the joint are considered to be monolithic and liquid tight, if constructed properly.

Contaminated Runoff (II) – Runoff that has come through or across a barnyard or animal lot or feed storage area. It generally includes the runoff and any manure, sediment, feed, or other material carried in the runoff. It contains lower concentrations of contaminants than leachate from feed or manure.

Contraction Joints (Table 5, Note 2) – Contraction joints, often called control joints, are used to control the location of cracks caused by concrete shrinkage during setting and thermal changes.

Drainage System (V.A.10.a.(2)) – Water conveyance measures of specified capacity, location, and material that insure the removal of water to a free outlet.

Effective Height (III) – Height from the settled top of the embankment to the lowest point of the existing ground surface, measured at the centerline.

Expansion Joints – (Table 5, Note 2) – These joints are used to prevent crushing of abutting concrete or other structural units due to compressive forces developed during expansion caused by high temperature.

Footprint (V.A.2.b.(2)) – This is the area defined by the outside edge of the top surface of the waste when the facility is completely full. This is the top edge of the

waste in a pond or the inside wall surface of a vertical walled structure.

Flood Prone Areas (V.A.3) – These include areas delineated as floodplains on Federal Emergency Management Agency (FEMA) maps, or local floodplain maps as well as areas along perennial streams (blue lines) shown on the United States Geologic Survey quadrangle sheets that may be subject to out of bank flows.

Geosynthetic Clay Liner, GCL (Table 4) – A manufactured hydraulic barrier consisting of clay bonded to a layer or layers of geosynthetic materials.

Geomembrane (Table 3) – Very low permeability synthetic membrane liner or barrier used with any geotechnical engineering related material so as to control fluid migration in a man-made project, structure or system. (ASTM D 4439)

Hydrologic Soil Groups (Table 9) – Hydrologic Groups (HSG) are assigned for all soils mapped by USDA soil scientists. The hydrologic soil group, designated A, B, C, or D, indicates, in general, the amount of runoff to be expected from the soil after prolonged wetting. Soils in Group A yield very little runoff because they are rapidly permeable. Soils in Hydrologic Group D take water very slowly and yield large amounts of runoff. See Section II of the NRCS Wisconsin Field Office Technical Guide for HSG designations.

Impoundment (I) – A waste storage facility constructed of earthen embankments and/or excavations for the purpose of storing waste. An impoundment may be lined or unlined.

In-Place Earth (Table 1) – The entire surface of the bottom of the impoundment is excavated a minimum depth of one foot into the native soil.

Intimate Contact (Table 3) – Direct contact between liner materials (concrete, GCL, and geomembrane) and soil.

Karst (V.A.2.c.) – Refers to areas of land underlain by carbonate bedrock (limestone or dolomite). Typical land features in karst areas include sinkholes, disappearing streams, closed depressions, blind valleys, caves, and springs. See the companion document in Chapter 10 of the AWMFH for additional discussion of karst features.

Leachate (II) – Concentrated liquid waste which has percolated through or drained by gravity from a pile of manure, manure processing derivative, or animal feed. It contains much higher concentrations of contaminants than Contaminated Runoff.

Manure Processing Derivatives (II) – The by-products and waste components that are produced as a result of treatment and processing practices. These include, but are not limited to, the following waste components: separated sand, separated manure solids, precipitated manure sludges, supernatants, digested liquids, composted biosolids, process waters.

Nutrient Management Plans (III) – A planning document that outlines the requirements for managing the amount, form, placement, and timing of applications of plant nutrients to cropland.

Permeability (Table 2) – The coefficient of permeability (K) is a measure of the ability of soil to transmit liquids. It is used to compute the flow rate of liquid through a soil liner for specific conditions of soil thickness and fluid head.

Plasticity Index, PI (Table 1) – A soil property indicating moldability. Measured by ASTM D-4318.

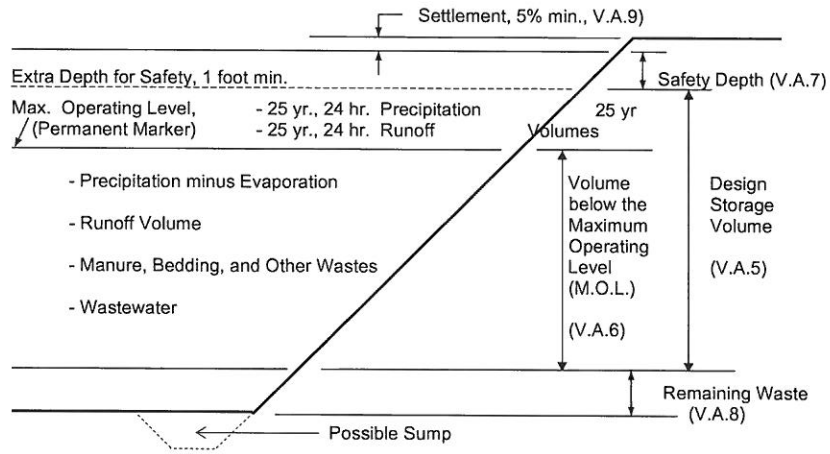
Regional High Water Table (V.A.10.a(1)) – The seasonal high free water surface of a large body of groundwater covering a region. All soil below the regional water table is saturated. Soil mottling (redoximorphic features) is not necessarily an indicator of the regional high water table, but is an indication of soil saturation.

Sinkholes (V.A.2.c) – Closed, usually circular depressions which form in karst areas. Sinkholes are formed by the downward migration of unconsolidated deposits into solutionally enlarged openings in the top of bedrock.

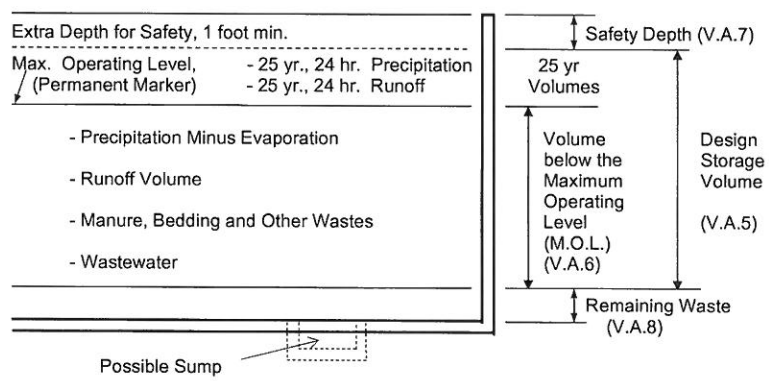
Structure (I) – A waste storage facility consisting of constructed surfaces, tanks, or walls for the purpose of storing waste above or below the ground surface. Structures may be constructed of concrete, steel, wood or other construction materials.

Wastewater (II) – Milking center waste, flush water, leachate from feed holding areas, and similar waste materials generated at the animal production area.

Figure 1 Design Storage Volume



IMPOUNDMENT



STRUCTURE

NRCS 634, Manure Transfer

MANURE TRANSFER

(No.)
Code 634

Natural Resources Conservation Service
Conservation Practice Standard

I. Definition

A manure conveyance system using structures, conduits, or equipment.

II. Purposes

To transfer animal manure (bedding material, spilled feed, process and wash water, *wastewater*[1], *contaminated runoff*, *leachate* and other fluids and residues associated with animal production may be included) in a manner which safeguards the environment. It includes transfer through a hopper, reception structure or tank, a pump, *channel*, or conduit to:

- A manure storage/treatment facility,
- A wastewater treatment strip,
- A loading area,
- Cropland or satellite storage facilities using permanent conduits or pipelines.

III. Conditions Where Practice Applies

The manure transfer component is part of a planned agricultural waste management or comprehensive nutrient management system.

This standard applies where manure and other waste is generated by livestock production or processing, and a conveyance system is necessary to transfer material from the source to a storage facility, treatment facility, loading area, cropland, or satellite storage facilities using permanent conduits or pipelines.

This standard does not apply to conveyance systems using equipment or mechanisms such as barn cleaners, alley scrapers, or belts for moving manure in the housing facility to the manure transfer system (reception structure, pump, channel, or conduit).

This standard does not apply to transfer by vehicles or temporary surface pipelines from the storage facility, treatment facility, or loading area to the field or another storage facility.

IV. Federal, Tribal, State and Local Laws

Users of this standard should be aware of potentially applicable federal, tribal, state and local laws, rules or regulations or permit requirements governing manure transfer. This standard does not contain the text of the federal, tribal, state or local laws.

V. Criteria

The following **minimum** criteria shall apply to all transfer designs.

A. General Criteria

1. Management Assessment

A management assessment shall be conducted, documented, and incorporated into the design. The assessment shall be performed with the owner/operator to explore options and to determine the purpose of transfer components, available resources, manure handling practices, and waste characterizations. Pertinent items in the Management Assessment criteria in V. A. 1. of Wisconsin NRCS Field Office Technical Guide (FOTG) Section IV, Standard 313, Waste Storage Facility, shall be followed.

2. Site Assessment

A site assessment shall be conducted, documented, and incorporated into the design. The assessment shall be performed to determine physical site characteristics that will influence the placement, construction, maintenance, and environmental integrity of a proposed manure transfer system. Pertinent items in the Site Assessment criteria in V. A. 2. of NRCS FOTG Section IV, Standard 313, Waste Storage Facility, shall be followed.

The minimum number of test pits for reception structures or tanks shall be one per tank length of 40 feet or less and one more for each additional 80 feet of tank. Test pits used to meet this criteria shall be located no more than 100 feet from the *footprint*.

Conservation Practice Standards are reviewed periodically and updated if needed. To obtain the current version of this standard, download it from the electronic Field Office Technical Guide, or contact the NRCS State Office or the Wisconsin Land and Water Conservation Association office at (608) 441-2677.

NRCS, WI
6/09

[1] Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used in the text.

3. Structures

All structures shall be designed to withstand the anticipated static and dynamic loading.

4. Safety

The system design shall identify and minimize the hazards to animals and people during construction and operation. Manure transfer designs may create *confined spaces*, which can pose significant hazards to people. At a minimum, a design shall include the following.

a. Open structures shall be provided with covers or barriers such as gates, fences, etc., to restrict access of animals or people. Include warning signs as necessary.

b. Barriers shall be placed on push-off ramps to prevent tractors or other equipment from slipping into reception structures or tanks.

c. Ventilation and warning signs shall be provided for manure transfer systems as necessary to warn of the danger of entry and to reduce the risk of explosion, poisoning, or asphyxiation.

d. Pipelines from enclosed buildings shall be provided with a water-sealed trap and vent or similar devices where necessary to control gas entry into buildings.

e. A minimum of one in-line manual valve in the transfer pipe where the *maximum operating level* of the storage facility is higher than the top of the transfer structure.

f. Confined spaces where human entry may occur shall be designed and operated in compliance with the provisions contained in ASABE EP470, Manure Storage Safety.

5. Operation and Maintenance

An operation and maintenance plan shall be developed that is consistent with the purpose of this practice, intended life of the components, safety requirements, criteria for design, and the Operation and Maintenance plan in NRCS FOTG Section IV, Standard 313, Waste Storage Facility.

B. Specific Criteria

1. Reception Structures or Tanks, Pumps, and Channels

Reception structures or tanks, pumps, and channels shall meet the following criteria.

a. They shall be liquid tight.

b. They shall meet the separation distance criteria in Table 1 of this standard.

c. Lateral seepage from *confined lenses and perched water* shall be controlled as needed for the structural integrity of reception structures or tanks and channels.

d. Excavation of *bedrock* is permitted.

e. Cast in place concrete reception structures or tanks and channels shall be designed according to the structural and soil criteria in NRCS FOTG Section IV, Standard 313, Waste Storage Facility.

f. Prefabricated tanks used to transfer wastes that are predominately manure shall be designed according to the structural and soil criteria in NRCS FOTG Section IV, Standard 313, Waste Storage Facility.

g. Prefabricated tanks used to transfer process and wash water, wastewater, contaminated runoff, and leachate shall meet the following requirements:

(1) The tank shall be currently listed on the Wisconsin Department of Commerce Plumbing Product Approvals or Alternate Product Approvals List.

(2) The tank shall comply with all stipulations listed in the Wisconsin Department of Commerce approval that relate to liquid tightness and/or structural strength.

(3) The tank shall be located a minimum of 15 feet from established or planned roadways.

h. Pumps shall be sized to transfer manure at the required system head and flow rate. The type of pump shall be based on the consistency of the manure and the type of bedding used. Requirements for pump installations shall be based on manufacturer's recommendations.

i. Channels going through in-place soils or through liners, such as clay, concrete, polyethylene, or geosynthetic clay, shall be installed so that the performance and integrity of the in-place soil or the liner is maintained.

Table 1 - Separation Distances for Reception Structures or Tanks, Pumps, and Channels[Note 1]

Transfer Components	Floor Surface or Bottom of Pump Relative to Bedrock	Floor Surface or Bottom of Pump Relative to *Regional Water Table* (RWT)	Well Separation Distance[Note 2]
Piston Pumps			
Pumps encased in concrete	≥ 6 inches (bottom of pump)	Bottom of pump maximum depth into RWT shall be 2 feet	≥ 50 feet
Pumps housed in tank	≥ 1 foot (floor of tank)	Floor may be at the level of the RWT	≥ 50 feet
Reception Structures or Tanks			
Small Pits where the footprint is ≤ 100 square feet	≥ 1 foot	Floor may be at the level of the RWT	≥ 50 feet
Large Reception Structures or Tanks	≥ 2 feet	≥ 2 feet (≥1 foot for sumps)	≥ 100 feet
Channels			
(≥ 2 foot depth)	≥ 2 feet	≥ 2 feet (≥1 foot for sumps)	≥ 100 feet

Note 1 The separation is determined to be the closest distance from any point on the inside surface (bottom and sides) of the pumps, reception structures, channels and tanks to the feature from which separation is required.

Note 2 Well separation distances are in accordance with NR 812, Well Construction and Pump Installation.

2. Transfer Pipe

Transfer pipes to waste storage/treatment facility shall meet the following criteria:

a. Joints shall be liquid tight. Pipes shall be bedded according to NRCS Wisconsin Construction Specification 15, Plastic Pipe Conduits, and backfilled according to NRCS Wisconsin Construction Specification 204, Earthfill for Waste Storage Facilities.

b. Pipes shall meet the criteria in Table 2. Pipes of equivalent strength, durability, and liquid tightness are acceptable. All joints and couplings shall be liquid tight in accordance with the manufacturer's specifications. Standard manufactured pieces shall be used for angles needed to make direction changes. Thrust blocks for pipes 4 inches or greater in diameter shall be at least 0.5 cubic yards of concrete or designed in accordance with standard engineering practice and installed at all angles for pumped systems. The pipe selection shall be compatible with the pump characteristics.

c. Pipes going through in-place soils or through liners such as clay, concrete, polyethylene, or geosynthetic clay shall be installed so that the performance and integrity of the in-place soil or the liner is maintained.

d. Pipes shall be at least 6 inches above bedrock. Excavation of bedrock is acceptable. There is no separation required from the *regional water table*.

e. Pipes shall be protected from frost with a minimum of 4 feet of soil cover or an equivalent amount of soil and insulation. This criteria does not apply to pipes that are empty following transfer.

3. Pipelines

Pipelines to cropland or satellite storage facilities shall meet the following criteria.

a. Design of pipelines shall be in accordance with sound engineering principles considering the load on the pipe, exposure, required capacity etc.

b. Pipelines used for transferring waste to an irrigation system, either spray or injection, or to another waste storage facility shall meet the requirements of National Handbook of Conservation Practices (NHCP), Standard 430DD, Irrigation Water Conveyance, High Pressure, Underground, Plastic Pipeline. Other pipe materials and design procedures may be used if designed and sealed by a Professional Engineer registered in Wisconsin.

c. All pipelines shall be designed based on the type of material and total solids content and shall convey the required flow without plugging. Flow velocities shall be sufficient to minimize settling of solids in the pipeline.

d. Pipelines shall be installed with appropriate connection devices to prevent contamination of private or public water supply distribution systems and ground water.

4. Gravity Transfer

This applies to systems using pipes or channels to carry manure between reception structures or tanks and storage facilities, treatment facilities, or loading areas. Gravity transfer pipes and structures shall meet the following criteria.

a. There shall be no gravity outlets from the waste storage facility.

b. *Reception structures or tanks with a gravity pipe outlet* shall follow all previous reception structure criteria (V.B.1.a-i) plus the following additional criteria.

(1) Reception structures built with pre-manufactured manholes shall conform to the criteria in ASTM C-478.

(2) The top elevation and volume of the reception structure or tank shall meet the following criteria.

- Slower Flowing Manure. For manure which tends to be slower flowing due to bedding, feed, or dryness (typically stanchion barns), the maximum operating level of the waste storage facility (see criteria in V.A.5 of NRCS FOTG Section IV, Standard 313, Waste Storage Facility) shall be a minimum of four feet below the bottom of the barn cleaner, scrape alley, etc. The volume of the reception structure or tank between the maximum operating level and the barn cleaner or scrape alley must be at least one-half of the daily manure production.

- Faster Flowing Manure. For manure which tends to be faster flowing due to lack of bedding or additional liquids (typically free stall barns, veal or hog facilities), the maximum operating level of the waste storage facility shall be a minimum of two feet below the scrape alley, barn cleaner, channel, etc., plus an additional height equal to 1% of the transfer pipe length. There is no minimum volume for the reception structure or tank with this type of manure.

c. Gravity transfer pipes shall follow all previous transfer pipe criteria (V.B.2.a-e) plus the following additional criteria.

(1) The pipe length shall be a maximum of 150 feet for slower flowing manure and a maximum of 400 feet for faster flowing manure.

(2) The pipe diameter shall be a minimum of 24 inches for slower flowing manure.

(3) For pipes carrying slower flowing manure or for reception structures using knife valves, a vent pipe (4-inch diameter minimum) shall be installed within 4 feet of the reception structure.

Table 2 - Transfer Pipes

Material	Materials Components and ASTM Specifications	Well Separation Distance[Note 1]
Pipes Carrying Pumped Manure		
Piston Pumps		
PVC	D-3034 (SDR 35) (4"-15"), F-679 (18"-27")	≥ 50 feet
	D-2241 (SDR 26) or D-1785 (Sch. 40)	≥ 25 feet
Pressure Pumps		
	Other than Chopper Pumps	
PVC	D-2241 (SDR 26) or D-1785 (Schedule 40) or AWWA C-900 (DR 25)	>25 feet
PE	F 714 (DR 17)	>25 feet
	Chopper Pumps	
PVC	D-2241 (SDR 21) or D-1785 (Sch. 80) or AWWA C-900 (DR 18)	≥ 25 feet
PE	F 714 (DR 11)	≥25 feet
Pipes Carrying Gravity Flow Manure		
PVC	F-679, F-794, D-3034 (SDR 35), D-2241(SDR 32.5), or D-1785 (Sch. 40 or 80)	≥ 25 feet
PE	ASTM F-667 (smooth inside wall) or AASHTO M252 (4"-10") or AASHTO M294 (12"- 48") Joints for all pipes according to ASTM D-3212 (10.8 psi)	≥ 25 feet

Note 1 Based on NR 812 - Well Construction and Pump Installation.

VI. Considerations

Additional recommendations relating to design which may enhance the use of, or avoid problems with, this practice but are not required to ensure its basic conservation function are as follows:

A. Use appropriate check valves, anti-siphon protection, and open air breaks.

B. Operation and maintenance of gravity pipes carrying faster flowing manure may be enhanced by using venting and clean-out access pipes.

C. Flow through the transfer pipe of a gravity system may be enhanced by using knife valves at the outlet of the reception structure.

D. Flow characteristics may be enhanced by adding dilute waste water to gravity flow systems that do not contain sand bedding.

E. Addition of very liquid wastewater to manure containing sand bedding enhances sand settling. Add water when sand settling is desired.

F. A wet sump may be useful for gravity reception structures.

G. Gravity pipes should be as straight as possible. Risers, such as pre-manufactured manholes, can be used to change direction.

H. Consider restraining the last section of concrete pipes used for gravity transfer.

I. Evaluate the need for frost protection to reduce plugging in transfer gutters and channels.

VII. Plans and Specifications

Plans and specifications for installing manure transfer systems shall be in accordance with this standard and shall describe the requirements for

applying the practice to achieve its intended purpose. An inspection plan is required. The plans and specifications must be compatible with and can often be combined with the plans and specifications for the waste storage facility.

VIII. References

USDA, NRCS, Agricultural Waste Management Field Handbook, Part 651, 1992.

Wisconsin Administrative Code, Department of Natural Resources, Chapter NR 812.

USDA, NRCS, National Handbook of Conservation Practices.

USDA, NRCS Wisconsin Field Office Technical Guide (FOTG), Section IV, Practice Standards and Specifications.

American Society of Agricultural and Biological Engineers (ASABE), Standard EP470, Manure Storage Safety.

IX. Definitions

Bedrock (V.B.1.d) – Consolidated rock material and weathered in-place material with > 50%, by volume, larger than 2 mm in size.

Channel (II) – Structures used to convey manure to reception structures, tanks, or waste storage facilities. They generally are made from concrete and range up to 12 feet wide and from 2 feet to 12 feet deep.

Confined Lenses and Perched Water (V.B.1.c) – Water bearing deposits of stratified lacustrine material or material laid down by glaciers between deposits of less permeable till. Perched water is saturation found above and separated from the regional high water table.

Confined Space (V.A.11) – Confined Space is a space that 1) contains or has the potential to contain a hazardous atmosphere; 2) is large enough and so configured that a person can bodily enter; 3) has limited or restricted means for entry or exit; and 4) is not designed for continuous human occupancy.*Contaminated Runoff (II)* – Runoff that has come through or across a barnyard or animal lot or feed storage area. It generally includes the runoff and any manure, sediment, feed, or other material carried in the runoff. It contains lower concentrations of contaminants than leachate from feed or manure.

Footprint (V.A.2) – This is the area defined by the outside edge of the top surface of the waste when the facility is completely full. This is the top edge of the outside edge of the waste in a reception structure or tank.

Leachate (II) – Concentrated liquid waste which has percolated through or drained by gravity from a pile of manure, manure processing derivative, or animal feed. It contains much higher concentrations of contaminants than contaminated runoff.

Maximum Operating Level (V.A.4.e) – The maximum operating level for waste storage facilities shall be the storage level that provides for the design storage volume as shown in section V.A.5. of FOTG Standard 313 less the volume of precipitation and runoff from the 25-year, 24-hour storm event. See Figure 1 in NRCS FOTG Section IV, Standard 313, Waste Storage Facility. The maximum operating level does not include the Extra Depth for Safety; see FOTG Standard 313 section V.A.7.

Reception structures or tanks with a gravity pipe outlet (V.B.4.b.) – Any manure containment structure having a gravity pipe outlet to the waste storage facility.

Regional Water Table (V.B.2.d) – The seasonal high, free water surface of a large body of groundwater covering a region. All soil below the regional water table is saturated. Soil mottling (redoximorphic features) is not necessarily an indicator of the regional high water table, but is an indication of soil saturation.

Wastewater (II) – Milking center waste, flush water, leachate from feed holding areas, and similar waste materials.

NRCS 629, Waste Treatment

WASTE TREATMENT

(No.)
Code 629

Natural Resources Conservation Service
Conservation Practice Standard

I. Definition

The mechanical, chemical, or biological treatment of agricultural waste.

II. Purpose

To use mechanical, chemical, or biological treatment facilities and/processes as part of an agricultural waste management system to:

- improve ground and surface water quality by reducing the nutrient content, organic strength, and/or pathogen levels of agricultural waste;
- improve air quality by reducing odors and gaseous emissions;
- produce value added byproducts;
- facilitate desirable waste handling, storage, or land application alternatives; and
- manage *leachate*[1] and *contaminated runoff* emanating from livestock *feed storage areas*.

III. Conditions Where Practice Applies

This practice applies where the form and characteristics of agricultural waste make it difficult to manage so as to prevent it from becoming a nuisance or hazard or where changing the form or composition provides additional utilization alternatives, and where conventional waste management alternatives are deemed ineffective.

- This practice applies to the treatment of *milking center wastewater* from *milking centers* producing up to 500 gallons of wastewater per day.
- This practice applies to leachate and contaminated runoff generated by livestock feed and *waste feed* storage areas.
- Liquids and solids need to be separated for further processing or for effective transport and subsequent utilization.
- Raw agricultural waste contains excess nutrients for land application based on crop utilization requirements or nutrient ratios need to be modified to be more consistent with crop utilization requirements.
- There is a need to reduce the potential for leaching or runoff of nutrients.
- Odors and/or gaseous emissions from livestock production facilities and waste storage/treatment system components must be reduced.
- Value-added byproducts can be produced to offset treatment costs.
- Reduction of pathogens is required.

IV. Federal, Tribal, State, and Local Laws

Users of this standard should be aware of potentially applicable federal, tribal, state and local laws, rules, regulations or permit requirements governing waste treatment. This standard does not contain the text of federal, tribal, state, or local laws.

Concentrated animal feeding operations will need to comply with the requirements of Wisconsin Administrative Code NR 243, Animal Feeding Operations.

V. Criteria

The following criteria establish minimum allowable limits for design parameters, acceptable installation processes, or performance requirements.

A. Specific Criteria for All Waste Treatment Facilities That Are Not Related to Milking Center or Feed Storage

1. Management Assessment

   A management assessment shall be conducted, documented, and incorporated into the design. The assessment shall be performed with the owner/operator to explore waste treatment options, available resources, and waste characteristics.

   The designer shall provide a narrative describing the agricultural waste management system, the waste treatment components objectives, and the anticipated outcomes of implementation. The narrative shall also include the strategy for utilization, storage, or land spreading of the wastes following treatment.

[1]Words in the standard that are shown in italics are described in VII. Definitions. The words are italicized the first time they are used in the text.

2. Design

   The waste treatment system provider shall complete and supply to the landowner/operator a detailed design of the facility/process clearly outlining the objectives and anticipated outcomes of implementation.

   The design documentation shall include a process diagram containing, at a minimum, the following information:

   - volumetric flow rates including influent, effluent, and recycle streams;
   - waste load projections including volume, mass, and characteristics of the waste important to the waste treatment facility or process;
   - unit process volumes and hydraulic retention times where appropriate;
   - air emissions projections from the system;
   - nutrient fate projections within the system; and
   - process monitoring and control system requirements as described below in the "Monitoring" section of the criteria.

   Independent, verifiable data demonstrating results of the use of the facility or process in other similar situations and locations shall be provided.

   Where use of a waste treatment facility or process to improve one resource concern negatively impacts another, impacts and mitigation measures, if required by state or local agencies, are to be documented. The mitigation measures shall become a required component of this practice.

3. Components

   Waste treatment facilities and processes may consist of multiple components. Where criteria for individual components are described in existing Natural Resources Conservation Service (NRCS) practice standards, those practice standards and their specific criteria shall be used for planning, designing, and installation of that component.

   Where components of a facility or process are not described in a current NRCS practice standard, the system provider shall furnish a one-year warranty on all construction or applied processes. In addition, the manufacturer shall provide a warranty that describes the service life of each component and what the warranty covers.

   The waste treatment facility or process shall have a minimum practice life of ten years. Where components have less than a ten-year service life, their planned replacement during the life of the practice shall be clearly identified in the Operation and Maintenance Plan.

4. Expected System Performance

   The expected system performance shall be clearly documented prior to system installation. At a minimum, the expected system volumetric flow rate, expected macro-nutrient reductions or change in form, expected pathogen reductions, gaseous ammonia and hydrogen sulfide emissions reductions (or increases) shall be documented.

5. Operating Costs

   Where components of a facility or process are not described in a current NRCS practice standard, the system provider shall furnish an annual estimate of operating costs for the system. Operating costs not based on actual systems data shall be clearly identified as estimates.

6. Monitoring

   Equipment needed to properly monitor and control the waste treatment facility or process shall be installed as part of the system. Process control parameters to be monitored shall include those parameters identified in the design documentation. Parameters considered critical to proper system operation shall be identified in the Operation and Maintenance Plan. Run status of critical equipment and unit processes shall be monitored.

7. Byproducts

   Implementation of a waste treatment process or operation of a waste treatment facility shall not result in discharge of byproducts harmful to the environment.

   All byproducts shall be handled and stored in accordance with the criteria contained in Wisconsin NRCS Field Office Technical Guide (FOTG) Section IV, Standards 634, Manure Transfer, and 313, Waste Storage Facility.

   Byproducts land applied to supply plant nutrients shall meet the criteria in NRCS FOTG, Section IV, Standard 590, Nutrient Management.

Any unmarketable or unused byproducts shall be handled and disposed of in accordance with all applicable federal, state, and local laws and regulations. A plan for dealing with such byproducts shall be prepared and approved by NRCS prior to utilization of the process or installation of the waste treatment facility, and shall include a listing of any permits or permissions required for the execution of the plan.

Byproducts shall be recycled to the extent possible without causing a hazard to the environment.

8. Safety

Design of the process or facility shall include safety features to minimize hazards. Guards and shields shall be provided for moving parts of the equipment used in the treatment process. Waste treatment facilities shall be fenced and warning signs shall be posted where needed to prevent children and others from entering a hazardous area.

All treatment processes shall be carried out in accordance with all safety regulations. Protective clothing shall be utilized when handling potentially harmful chemicals that may be used in the process.

If the facility includes a *confined space*, the confined space shall be configured in such a way that monitoring for hazardous gases, ventilation, observation of workers in the confined space, and extraction of workers from the confined space are all possible and practicable. Provisions of the American Society of Agricultural and Biological Engineers (ASABE) Standard EP 470, Manure Storage Safety, shall be followed.

9. Plans and Specifications

Plans shall include engineering drawings and supporting documentation as well as other plans required to manage the system (e.g., a nutrient management plan for proper land application of byproducts).

Plans and specifications for waste treatment facilities shall be prepared in accordance with the criteria of this standard and good engineering practice.

As a minimum, the plans and specifications shall provide the following:

- layout and installation details of livestock facilities, waste collection points, waste transfer components, waste treatment and storage facilities;
- location of all inflow and discharge pipelines, pipeline materials, diameter and slope;
- details of support systems for all components of the treatment facility; and
- fencing and signage as appropriate for safety purposes.

10. Operation and Maintenance

An operation and maintenance (O&M) plan shall be developed and reviewed with the owner/operator prior to construction of a waste treatment facility or implementation of a waste treatment process. The O&M plan shall be consistent with the proper operation of all system components and shall contain requirements including but not limited to the following.

- Recommended loading rates of the waste treatment facility or process for hydraulic and critical pollutant parameters.
- Proper operating procedures for the waste treatment facility or process, including the amount and timing of any chemicals added.
- Operation and maintenance manuals for pumps, blowers, instrumentation and control devices, and other equipment used as components of the waste treatment facility or process.
- Description of the planned startup procedures, normal operation, safety issues, and normal maintenance items. This includes procedures for the planned replacement of components with less than a ten-year service life.
- Alternative operation procedures in the event of equipment failure.
- Troubleshooting guide.
- Monitoring and reporting plan designed to demonstrate system performance on an ongoing basis.

B. Specific Criteria for Milking Center Wastewater Treatment

This practice standard criteria does not apply to the treatment of barn and holding area manure, waste milk, and sewage from restrooms and laundry facilities.

This practice standard criteria does not apply to those operations of a size to be regulated by a Wisconsin Pollutant Discharge Elimination System (WPDES) permit in accordance with NR 243 Animal Feeding Operations or NR 214

Land Treatment of Industrial Liquid Wastes, By-Product Solids and Sludges.

1. Criteria Applicable to All Treatment Methods.

a. Management Assessment

A management assessment shall be conducted, documented, and incorporated into the design. The assessment shall be performed with the owner and operator to determine planned management and explore design options. The management assessment shall address the following.

- Waste Characterization – Consistency, volume, content, sources, and degree of *source control*.
- Equipment, labor, and management capabilities.
- Expected changes to current or future management and equipment, including expansion needs.

b. Site Assessment

A site assessment shall be conducted, documented, and incorporated into the design. The assessment shall be performed to determine physical site characteristics that will influence the placement, construction, maintenance, and environmental integrity of a proposed milking center wastewater treatment system. The assessment shall include input from the owner and operator. The site assessment shall include the following.

- Locations of buildings, roads, lanes, soil test pits, property lines, setbacks, easements, wells, surface water features, surface drains, drain tile, utilities, cultural resources, *karst features* and wetlands. An assessment of the area used for final disposal of the milking center wastewater shall be conducted.
- Identification of potentially impacted resources.
- Soil test pits to document depth to *bedrock*, soil texture, thickness of soil layers, and depth to saturation. An adequate number of test pits shall be completed to adequately characterize the proposed system site, unless otherwise specified in the specific criteria.
- Identify existing waste storage capacity.
- Existing pretreatment, including source control.

c. Design Criteria

1) Exclude surface water runoff from entering the milking center wastewater treatment system.

2) Pipelines shall be designed to avoid freezing.

3) Design Flow Rate – Design flow shall be determined by measuring or estimating using the procedures in the companion documents located in the Wisconsin supplement to Chapter 10 of the NRCS Agriculture Waste Management Field Handbook (AWMFH).

4) The treatment system shall be located a minimum of 25 feet from drainage tile.

d. Operation and Maintenance

An operation and maintenance plan shall be developed that is consistent with the purposes of the practice, its intended life, safety requirements, and the design criteria.

Prior to construction, the owner/operator shall sign the operation and maintenance plan to indicate an understanding of the requirements, and a commitment to operate and maintain the practice as specified.

The operation and maintenance plan shall include the following.

- A management plan. The treatment system shall be operated in conformance with a management plan. The management plan shall specify information on pretreatment processes including source control, load and rest schedules, scheduled maintenance, vegetative cover management and removal, scheduling of soil nutrient testing, operational strategies for periods of adverse weather, monitoring procedures, and any other pertinent information. The management plan shall be updated to account for changes in an operation.
- A contingency plan to address unexpected volumes of waste milk, wastewater, and runoff.
- An emergency response plan to address the containment, clean-up, and reporting of spills.
- Provisions to ensure that waste milk is never dumped into any treatment system requiring a pretreatment tank.
- Maintenance and repair of fencing.
- Annual pumping of pretreatment tanks. Contents of the tank shall be land applied according to a *spreading plan*, stored in a waste storage facility meeting the criteria of NRCS FOTG, Section IV, Standard 313, Waste Storage Facility, or removed by a licensed hauler.

e. Prefabricated Underground Pretreatment Tanks (Pretreatment Tank)

Pretreatment can be accomplished using a prefabricated concrete, steel, or plastic sewage ("septic") tank. Requirements for using pretreatment tanks include the following.

- Those currently listed on the Wisconsin Department of Commerce Plumbing Product Approvals or Alternate Product Approvals List.
- Compliance with all stipulations listed in the Department of Commerce approval that relate to liquid tightness and/or structural strength.
- Appropriate baffling to function as grease traps.
- A minimum of 15 feet separation from established or planned roadways.
- Adequate ballast to prevent flotation.
- A separation distance of at least 25 feet from any *channelized flow* path, surface water feature, well, and karst feature, greater than 10 feet from any water supply line, greater than 5 feet from any building, and greater than 2 feet from any property line.

f. Milkhouse Plumbing

1) A sanitary trap is required to prevent gasses from flowing into the milking center from the treatment system.

2) Materials must be provided to ensure all riser joints, access openings, and pipe connections are installed watertight.

3) For all treatment methods, except frequent haul, a flow diverter valve shall be installed at the discharge end of the wash water transfer line to divert waste milk from the treatment system.

g. Safety

Install a fence around the milking center treatment system where needed to exclude people, equipment and/or animals. Open storage containers or access openings shall be fenced, covered, or secured to prevent entry by people or animals. Warning signs shall be posted to alert people of the dangers of entering the storage container or pretreatment tank. Provisions of the ASABE Standard EP 470, Manure Storage Safety, shall be followed.

2. Specific Criteria for Frequent Haul

a. This system uses a storage container to receive and hold wastewater discharged from the milking center. The wastewater is removed from the storage container and land applied in accordance with a spreading plan. The application rate shall be limited to prevent runoff.

1) Design

a) The storage container capacity shall be a minimum of three days and no more than ten days of discharge from the milking center.

b) The storage container shall be water tight and designed to withstand all loads to which it will be exposed including but not limited to the spreader being filled. The container shall be equipped with a high water alarm to facilitate management.

Provide a vent to the atmosphere for covered storage containers.

Each storage container having a cover shall be provided with a minimum access opening of 23 inches that allows for storage container maintenance. The opening shall terminate above grade.

The options for storage containers include:

- Tanks meeting structural criteria contained in NRCS FOTG, Section IV, Standard 634, Manure Transfer,
- Department of Commerce list as per section V.B.1.e; (baffling is not required),
- Above-ground storage containers installed and used in accordance with manufacturers' recommendations. In addition, above ground tanks shall be insulated or located within a heated structure.

c) All pumps installed in the tank shall be a two-inch minimum diameter discharge industrial grade trash or sewerage pump. When a submersible pump is installed, the pump intake shall be a minimum of 8 inches above the floor.

d) Install guard posts and other safety devices as necessary.

2) Specific Operation and Maintenance

a) Hauling equipment shall be capable of transporting the liquid and solid waste without spillage.

b) At a minimum remove, accumulated solids from the bottom eight inches of the tank at least annually.

3. Specific Criteria for Ridge and Furrow

The ridge and furrow system includes a pretreatment tank from which the wastewater is delivered to a furrow infiltration area.

a. Siting Parameters

1) Soils – The in situ soils shall at least have 50% of the particles passing a No. 200 sieve (P200 $\geq$ 50%), and a thickness of 3 feet below the furrow bottom. There shall be a 3-foot minimum separation distance from the furrow bottom to bedrock and saturation.

2) The furrows shall be located a minimum of 50 feet from any private well and a minimum of 50 feet from channelized flow, surface water feature, or karst feature.

b. Design

1) Pretreatment – Pretreatment tanks shall be provided and shall be sized to provide a minimum three-day hydraulic retention time prior to discharge to the ridge and furrow system. The outlet from the pretreatment tank shall be gravity flow to a dosing tank or chamber which shall be separate from the pretreatment tank. A pump or siphon for pressure distribution of wastewater shall be located in the dosing tank or chamber.

2) *Load/Rest Cycle* – There shall be three days between dosing to any given furrow to allow sufficient resting for soil conditions to become unsaturated and aerobic prior to being loaded again.

3) System Size – The loading rate shall not exceed ½ gallon per square foot of the furrow bottom per day. This is equivalent to 1½ gallons per square foot of furrow bottom for a three-day cycle.

   Furrow side slopes may not be steeper than 1:2 (1 horizontal: 2 vertical). The furrows shall be 1 foot deep and 1 foot wide at the bottom. Furrows shall be level and may be cut on the contour. Individual furrows shall not exceed 200 feet in length.

   Ridgetops shall be a minimum of 6 feet wide to allow removal of vegetation by equipment.

4) Wastewater Distribution – The system shall be constructed in a manner which provides equal liquid distribution within the furrow. The header shall be designed to allow complete drainage after each wastewater loading.

   When multiple furrows are employed, the wastewater distribution system shall be constructed so individual furrows within the system can be taken out of service for resting without interrupting the discharge to the remaining furrows.

c. Planting Medium

1) Compaction at the furrow bottom during construction shall be minimized.

2) Seedbed preparation, vegetation establishment and maintenance of vegetation on the ridges shall be in accordance with criteria specified in the NRCS FOTG, Section IV, Standard 342, Critical Area Planting. Vegetation suited to wet conditions shall be used.

d. Specific Operation and Maintenance

1) Ensure the load/rest cycle is maintained.

2) At a minimum, twice per year mow the vegetation and remove the cut material from the site of ridge and furrow system.

3) Inspect the furrow bottoms annually and skim off accumulated solids. If infiltration decreases, rework the bottom of the furrow when dry.

4. Specific Criteria for Constructed Wetland

A constructed wetland shall be designed as a surface flow system consisting of adequate pretreatment and seepage control, a suitable plant growth medium, rooted vegetation, and the structural components needed to contain and control the flow.

Constructed wetlands shall discharge to one of the following:

- a treatment method included in this standard;
- a minimum of 200 feet of non-channelized overland flow;
- a waste storage facility designed in accordance with NRCS FOTG, Section IV, Standard 313, Waste Storage Facility, or
- be recycled through the constructed wetland.

a. Siting Parameters

1) Soils – The constructed wetland shall be located on in situ soils having at least 50% passing the No. 200 sieve (P200 ≥ 50%), a Plasticity Index (PI) of 7 or more, and a thickness of 2 feet below the bottom of the wetland. There shall be 2 feet of separation to saturation and bedrock or the constructed wetland shall be lined in accordance with Section V.B.4.b.(3). The separation distance includes liner thickness.

2) The constructed wetland shall be located 50 feet from any existing wetland, surface water feature, karst feature, or well.

b. Design

1) Pretreatment – Pretreatment tanks shall be provided and shall be sized to provide a minimum of three-day hydraulic retention time prior to discharging to a constructed wetland.

2) Water Budget – A water budget that considers wastewater volumes, precipitation, evapotransporation, return of discharge water to the head of the wetland, and water reuse in the waste management system shall be used to determine the required hydraulic retention time in the wetland and storage requirements of the wetland pretreatment and post treatment facilities when included. The hydraulic retention time in the wetland shall be greater than or equal to eight days.

Note: Hydraulic retention time is the time liquid remains in the wetland calculated as: Surface Area x Flow Depth x Porosity of the Flow Path ÷ Flow Rate.

3) Liner Criteria – Measures for controlling seepage shall be designed according to one of the following procedures.

   - NRCS FOTG, Section IV, Standard 521A Pond Sealing or Lining, Flexible Membrane.
   - NRCS FOTG, Section IV, Standard 521C Pond Sealing or Lining, Bentonite Sealant.
   - Clay liners shall be 1 foot thick, with soils having at least 50% passing the No. 200 sieve (P200 ≥ 50%) and PI ≥ 12. Compaction of the liner shall be in accordance with Wisconsin NRCS Construction Specification 204,

Earthfill for Waste Storage Facilities.

4) Exterior Perimeter Embankment – The slopes shall be no steeper than 3:1. The exterior embankment shall have a minimum top width of 10 feet. The height of the constructed wetland perimeter embankment shall be the sum of the following:

- design flow depth,
- ice accumulation depth of 6 inches,
- wetland *accretion depth* of 10 inches,
- 25-year, 24-hour precipitation, and
- 12 inches of extra depth for safety.

5) Interior Embankment – Side slopes shall be no steeper than 2:1. Interior embankments shall have a minimum top width of 8 feet. The height of interior embankments shall be the minimum of the sum of the following:

- design flow depth,
- ice accumulation depth of 6 inches, and
- wetland accretion depth of 10 inches.

6) Inlet – An inlet structure that distributes the flow across the upper end of the wetland shall be provided.

7) Surface Area – The surface area of the wetland shall be designed to accommodate an organic loading rate of less than or equal to 80 lbs BOD5/acre/day. The influent concentration of BOD shall be measured or a default concentration of 3000 mg/L shall be used. The maximum *hydraulic loading rate* shall be 0.2 feet/day.

8) Configuration – If multiple cells are required, individual cells within the constructed wetland shall have a length-to-width ratio in the range of 10:1 to 15:1. The bottom of the wetland cells shall be level.

9) Design Flow Depth – The design flow depth shall be a minimum of 0.33 feet and a maximum of 1.5 feet.

10) Primary Outlet – An outlet shall be provided that allows maintenance of proper water level in the wetland and controls the flow from the wetland.

11) Auxiliary Overflow Device – An ungated overflow device shall operate when the 25-year, 24-hour precipitation is exceeded. The overflow device shall operate without infringing on the wetland perimeter embankment's extra depth of safety.

12) Primary Planting Medium – A minimum of 1 foot of topsoil with a minimum organic content of 5% is required.

13) Vegetation – A minimum density of 80% coverage shall be fully established within two years. The companion documents located in the Wisconsin supplement to Chapter 10 of the NRCS AWMFH contains a list of recommended vegetation.

14) Vegetation Establishment – Refer to the companion documents located in the Wisconsin supplement to Chapter 10 of the NRCS AWMFH.

c. Specific Operation and Maintenance

1) Operational requirements shall include:

- control of influent volume to maintain the level of water appropriate for the vegetation and water budget, and
- surveillance of inlet and outlet for plugging and evenness of flow distribution.

2) Maintenance requirements shall include:

- repair of embankments,
- control of undesirable vegetation including the removal and prevention of woody vegetation on the embankment,
- mowing of embankments periodically to allow visual inspection,
- corrective actions when vegetation density falls below 80%, determine the cause and take corrective actions,

- repair of pipelines and flow control and distribution structures, and
- control of burrowing animals.

5. Specific Criteria for Subsurface Absorption System – The subsurface absorption system includes a pretreatment tank followed by a subsurface absorption field using either a soil cover or an organic matter cover.

a. Siting Criteria

1) Soil Evaluation – Soil evaluations for subsurface absorption systems shall be conducted and reported by a Certified Soil Tester (CST) licensed through the Department of Commerce.

The CST shall evaluate soils over a minimum area, calculated as follows:

Area (ft^2) = (3 x wastewater production (gal/day)) ÷ 0.2 gal/ft^2/day

A minimum of three test pits shall be completed. The CST shall provide a maximum soil application rate for all soil horizons, from the soil surface to either saturation, bedrock, or to a maximum depth of 8 feet. Soil application rates shall be based on soil texture and structure, shall be provided in units of gallons per square foot per day, and shall be currently published values from Department of Commerce (Comm 83 Private Onsite Wastewater Treatment Systems, 83.44-2 Table 2).

2) Separation Distance – The subsurface absorption system shall be located a minimum of 100 feet from any private water well and a minimum of 50 feet from channelized flow, a surface water feature, or karst feature.

b. Design Criteria

1) Pretreatment – Pretreatment tanks shall be provided and shall be sized to provide a minimum six-day hydraulic retention time prior to discharging to the subsurface absorption system.

2) Infiltrative Surface Design – The infiltrative surface shall be located at least 3 feet above saturation or bedrock. There shall be at least 2 feet of soil beneath the infiltrative surface that has a design soil application rate of greater than zero. The bottom of the infiltrative surface shall be level. Scarification of the infiltrative surface of the soil shall be done to reduce smear and shear.

The minimum size of the subsurface absorption system shall be 1.5 times the wastewater production rate, divided by the soil application rate at the infiltrative surface.

3) Distribution System – Gravity piping upstream of a soil absorption system shall be a minimum 4-inch diameter schedule 40 PVC pipe or equal, installed at a minimum grade of 1% or 1/8 inch per foot. It shall be buried to a depth sufficient to prevent damage from frost or traffic.

Pressure piping to a soil absorption system shall be a minimum two-inch diameter schedule 40 PVC or equal, with a pump sized to produce a velocity in the pipe between two and five feet per second.

Distribution laterals shall be perforated with 1-inch diameter holes, spaced at a maximum of 3 feet, and installed such that the perforations are facing downward at the four and eight o'clock positions.

At least two 4-inch diameter perforated observation pipes shall be installed in each system at the upstream and downstream ends. The observation pipes shall be perforated within the clear washed stone zone and extend from the infiltrative surface to a minimum 1 foot above final grade and shall be capped.

Laterals shall be installed in either level trenches or in level beds.

a) Trenches shall be at least 6 feet wide and the distribution pipe shall be centered within the trench.

b) Beds shall be at least 6 feet wider and longer than the lateral distribution network, and the distribution network shall be centered in the bed. Distribution,

laterals within a bed shall be spaced a maximum of 6 feet apart.

Laterals within a soil absorption system shall be 4-inch minimum diameter schedule 40 PVC; installed level or sloped in the direction of flow at a maximum of 2 inches per 100 feet. An air vent shall be connected to the upstream end of the subsurface absorption system piping.

4) Soil Covered Absorption System Bedding and Cover

a) Six inches of 1½- to 2½-inch washed stone shall be placed beneath the lateral piping for the entire width of the bed or trench. Pipes shall be stabilized by placing stone across the entire width of bed or trench to the top of the pipe.

b) A single layer of non-woven geotextile fabric shall be placed over the soil absorption system stone. Fabric shall meet the requirements of Wisconsin Construction Specification 13, Geotextiles, Class II fabric.

c) Backfill over the fabric shall consist of an 18-inch minimum thickness of topsoil, measured from the top of the lateral pipe.

d) The final finished grade of the subsurface absorption system shall be at least 1 foot above surrounding grade.

e) Immediately after completion of final grading, the surface topsoil material shall be stabilized by mulching and seeding.

5) Organic Matter Cover Absorption System Bedding and Cover

a) Six inches of 1½- to 2½-inch clear washed stone shall be placed beneath the lateral piping to a width of no less than 24 inches. Pipes shall be stabilized by encasing them in windrows of stone to a height 6 inches above the top of the pipe.

b) Backfill over the stone shall consist of either bark or woodchips a minimum thickness of 2 feet measured from the top of the stone above the lateral pipe.

c) The infiltrative surface shall be located a minimum of 30 inches below the ground surface or the top of a confining berm.

c. Specific Operation and Maintenance

1) Prevent traffic on the system.
2) Pump the pretreatment tank.
3) Maintain the thickness of the organic material cover.

6. Specific Criteria for Buffer Process

The buffer process includes a pretreatment tank from which wastewater is delivered to a sod area by an above-ground perforated distribution pipe located on the contour.

a. Siting Parameters

1) Soils – The buffer area shall be situated or constructed in soils having at least 20% passing the No. 200 sieve (P200 ≥ 20%) with a minimum thickness of 2 feet below the buffer surface. The minimum separation to saturation and bedrock shall be 2 feet.

2) The down gradient end of the buffer area shall be a minimum of 50 feet from any private water well, channelized flow, surface water feature, or karst feature.

3) The slope of the buffer area shall be between 2% and 15%.

b. Design Criteria

1) Pretreatment – Pretreatment tanks shall be provided and shall be sized to provide a minimum three-day hydraulic retention time prior to discharge to the buffer area. The outlet from the pretreatment tank shall be gravity flow to a dosing tank or chamber which shall be separate from the pretreatment tank. A pump or siphon for pressure distribution of wastewater shall be located in the dosing tank or chamber.

2) Minimum filter area shall be based on the greater of either:

- A minimum flow through time of 20 minutes at a maximum flow depth of 0.5 inch using a Manning's n=0.30. The minimum flow depth shall be 0.1 inch.
- A minimum area to accommodate the design loading rate, up to a maximum of 0.9 inch per week.

3) Allowable soil dosing rate

a) The allowable soil dosing rate is shown in Table 1.

Table 1
Allowable Soil Dosing Rates
(gal/sq ft of buffer area)

Soil Drainage Class	Soil >40"	Depth 24"-40"[1]
Well Drained	0.300	0.250
Moderately Well Drained	0.250	0.200
Somewhat Poorly Drained	0.125	0.075

[1] Not acceptable at soil depth less than 24 inches.

b) Wastewater shall be dosed to the upper end of the buffer at a frequency of no more than once every three days.

c) Wastewater shall be distributed to the buffer through a level perforated plastic pipe suspended between one and 1.5 feet above the ground. Perforations shall be between a ½ inch and 1 inch in diameter, placed in the bottom of the pipe, and spaced at 2-foot to 6-foot intervals.

d) The actual flow depth and hydraulic loading rate produced by the selected pump and designed distribution system shall be calculated and shown to be in accordance with criteria in this standard.

c. Specific Operation and Maintenance

1) Maintain the wastewater spreader to the initial design function.

2) Inspect and repair the buffer area after storm events and fill in gullies, remove flow-disrupting sediment accumulation, re-seed disturbed areas, and take other measures to prevent concentrated flow.

3) Harvest buffer area vegetation as appropriate to encourage dense growth, maintain upright growth, and remove nutrients and other contaminants that are contained in the plant tissue. Controlled grazing can be an acceptable method of harvest.

4) Conduct controlled grazing, harvesting, and other maintenance activities only when the buffer area is dry and moisture content in the surface soil layer will not allow compaction or rutting.

7. Milking Center Wastewater Treatment Considerations

Additional recommendations relating to design which may enhance the use of or avoid problems with this practice, but are not required to ensure its basic conservation function are as follows:

a. Consider using the companion documents located in Chapter 10 of the Agricultural Waste Management field Handbook (AWMFH).

b. Dairy animals should not be in contact with the milking center wastewater to avoid disease transfer. Exclude dairy animals from the application site while liquid is present.

c. Utilize water, organic matter, and chemical conservation methods in the milking center.

d. Measures should be taken to control vectors (mosquitoes, flies, etc.) if they pose a problem.

e. Consideration should be given to storage of wastewater during winter months.

f. Install measures to exclude or minimize attractiveness of constructed wetland dikes to muskrats.

g. Settling basins may be installed prior to pretreatment tanks as a method to remove solids, such as lime, that may be difficult to remove from a tank.

8. Plans and Specifications

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. Plans shall include construction sequence, vegetation establishment, and management and maintenance requirements.

C. Specific Criteria for Feed Storage Leachate and Runoff Control

Criteria contained in this standard may not be adequate to comply with the requirements for concentrated animal feeding operations (CAFO) designs. Designers shall consult with the Wisconsin Department of Natural Resources (DNR) on feed storage, feed storage leachate collection, and contaminated runoff control for a CAFO.

This practice standard criteria does not apply to:

- industrial inputs or waste stored at an industrial facility (i.e., cannery, distillery, brewery);
- commercial feed mills;
- feeds considered dry (typically 40% moisture or less) within storage areas protected from precipitation;
- feed bunk equipment; and
- self-feeding structures (non-mobile).

1. Criteria Applicable to All Treatment Methods

a. Management Assessment

A management assessment shall be conducted, documented, and incorporated into the design. The assessment shall be performed with the owner/operator to explore options and to determine the feed storage needs, pollution control components, available resources, and leachate and contaminated runoff disposal schemes and their impact on water resources. The designer shall provide a narrative describing the system.

b. Site Assessment

A site assessment shall be conducted, documented, and incorporated into the design. The assessment shall be performed to determine physical site characteristics that influence the placement, construction, maintenance, and environmental integrity of a proposed livestock feed storage leachate and contaminated runoff control system. The assessment shall include input from the owner/operator.

Include in the site assessment:

1) Test pits or soil borings if borrow sites are needed or if the following components are used: *permanent feed storage areas*; *feed storage runoff treatment areas*; and leachate and contaminated runoff transfer, collection, and storage systems. Written documentation shall include:

a) The number, depth, and distribution needed to characterize the subsurface (soil layers, saturation, and bedrock). Test pits or borings shall be added if there is inconsistency within or between test pits or borings.

b) Feed storage area –There shall be one test pit or boring per 15,000 square feet of area, with a minimum of two per area. For storage areas less than 5,000 square feet, one test pit or boring is adequate. Test pits and borings used to meet these criteria shall be located in the footprint or not more than 100 feet from the perimeter of the feed storage area.

c) Soil layers described with respect to texture using the Unified Soil Classification System (USCS) as per ASTM D2488-00 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

d) The elevation of bedrock and bedrock type such as sandstone, limestone, dolomite, or granite.

e) Saturation indicators such as redoximorphic features, seepage from sand and gravel lenses, lens thickness, estimated volume of flow, and elevation. Groundwater maps and well construction logs shall be included when available and applicable.

2) Locations, dimensions, and elevations of *sinkholes* and other karst features within 1,000 feet of the facility.

3) Locations, dimensions, elevations, soil volumes, soil samples, and reclamation plans of any borrow areas.

c. Outside Water Exclusion

The 25-year, 24-hour storm design criteria shall be used to exclude clean water runoff from entering the feed storage area, leachate/contaminated runoff storage and transfer, and all treatment areas.

d. Separation from Saturation or Bedrock

The separation is determined to be the closest distance from any point on the top surface of the liner material (bottom and sides slopes) of the feed storage area to the feature from which separation is required. Refer to Tables 2, 3, and 4 for separation distances.

1) The following criteria apply to saturation.

a) *Regional High Water Table* - The regional high water table shall not be lowered to achieve the required separation.

b) *Confined Lenses and Perched Water* may be drained in all areas except for feed storage runoff treatment areas. All drainage systems shall have a free outlet. The effect of temporary tailwater on the structure or liner and the effects of outletting to perennial and intermittent waterways shall be evaluated.

2) The following criteria apply to bedrock. Excavation of bedrock is permitted to achieve the required separation. Consolidated bedrock shall not be removed by blasting. The entire width of the surface of any excavated, consolidated rock material shall have a positive grade away from the storage facility with no ponding on the excavated surface. If bedrock is excavated, the material placed between the liner and the bedrock shall have a minimum of 20% fines.

e. Leachate and Contaminated Runoff from Permanent Areas

1) All leachate shall be collected and conveyed to a transfer and/or storage system.

2) Typically, the largest leachate volume is based on the harvest that will produce the largest silage weight. Estimate the leachate volume using ½ cu. ft. leachate per ton of stored feed over a 30-day period. Unless determined otherwise, assume 60 lbs. per cubic foot of stored feed (33.3 cu. ft./ton).

3) Frequent Haul of Leachate– Storage or transfer systems that require manual pump out shall be sized to contain a minimum of 20% of the total leachate volume as determined above.

4) Contaminated runoff shall be delivered (via gravity or pump) to a feed storage runoff treatment area or shall be collected and land applied according to a nutrient management plan.

5) Transfer – All transfer components (pipes, reception structures, tanks, and channels) shall meet the criteria contained in NRCS FOTG, Section IV, Standard 634, Manure Transfer. Materials shall be corrosion resistant.

All pumps shall be trash or sewage type and be able to withstand an acidic environment. Pumps must be installed and used in accordance with the manufacturer's recommendations.

6) Storage – Facilities for long-term storage of leachate and contaminated runoff shall be designed in accordance with NRCS FOTG, Section IV, Standard 313, Waste Storage Facility. Leachate and/or contaminated runoff is considered to be less than 2% solids. Materials shall be corrosion resistant.

f. Safety Design

Safety design shall identify and minimize the hazards to animals and people. At a minimum, safety design shall include the following, where applicable.

1) Warning signs and fences to notify of potential hazards.

2) Minimize the accumulation of gasses, provide ventilation for covered waste-holding structures to reduce the risk of inhalation of poisonous gasses, asphyxiation, or explosion.

Note: Adding leachate to manure can produce poisonous gasses.

If the facility includes a confined space, the confined space shall be configured in such a way that monitoring for hazardous gases, ventilation, observation of workers in the confined space, and extraction of workers from the confined space are all possible and practicable. Provisions of ASABE Standard EP 470 shall be followed.

g. Seeding and Mulching

Disturbed areas shall be seeded and mulched in accordance with NRCS FOTG, Section IV, Standard 342, Critical Area Planting.

h. Plans and Specifications

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. A construction plan and inspection plan are required.

1) A comprehensive package of plans, specifications, and documentation for the installation of all feed storage areas, leachate and contaminated runoff storage, and transfer components shall include:

- management assessment,
- site assessment,
- safety design features,
- operation and maintenance plan,
- construction plan,
- construction inspection plan, and
- construction site erosion control plan (see NR 216).

2) Documentation for siting of *non-permanent feed storage areas* and waste feed areas shall include:

- a management assessment,
- a site assessment, and
- location maps, soils maps, and USGS quadrangle maps.

i. Operation and Maintenance

An operation and maintenance plan shall be developed that is consistent with the purposes of this practice, intended life of the components, safety requirements, and the criteria for the design. At a minimum, the plan shall include:

- handling and disposal practices for waste feed;
- handling and disposal practices for snow storage associated with the feed storage area;
- the frequency for cleaning the floor of accumulated feed;
- the interval for removing accumulated solids from the system components;
- proper treatment and disposal practices for leachate and contaminated runoff; and
- the schedule of inspection of system components to insure proper operation.

2. Specific Criteria for Permanent Feed Storage Areas, excluding *Tower Silos*

a. Leachate Collection

Horizontal feed storage can lose leachate through the floor (subsurface discharge) and around the perimeter (surface discharge). The system shall include collection components that intercepts and directs leachate to storage. Unless a liquid-tight concrete or concrete-composite liner is used, the system shall also include a subsurface collection system to direct leachate to storage. A subsurface drainage system shall consist of a suitable subgrade, liner, *leachate drainage layer*, and surfacing material. When a leachate drainage layer is required, it shall be placed above the liner and below the surfacing material of the silage storage footprint and the apron. The profile and configuration of the collection system must allow gravitational flow to a low point (sump). Acceptable collection systems are included in Tables 2, 3, and 4.

Table 2
Earthen Collection System

	Soil Liner	Clay Liner
1. Liner		
• %Fines passing the #200 sieve	≥50%	≥40%
• Thickness	≥2 feet	≥1 feet
• Plasticity Index (PI)[Note1]	---	≥12
• Compaction Specification[Note 2]	WI Spec. 204	WI Spec. 204
2. Leachate Drainage Layer[Notes 3, 6]		
• %Fines passing the #200 sieve	≤5%	
• Compacted Thickness	≥6 inches	
• Sideslopes	3H:1V or flatter	
3. Surfacing Material Options		
• Concrete	≥5 inches total thickness non-reinforced with maximum *contraction joint* spacing of 16 feet in both length and width	
• Flexible Pavement	≥4 inches Wisconsin DOT E-0.3 Hot Mix Asphalt in ≥ 2 lifts over 13 inches *crushed stone* subbase[Note 8]	
• *Macadam*	a. 4 inches of crushed stone over 18 inches base course of angular rock[Note4], or b. 4 inches of crushed stone over 18 inches base course of round graded rock, over an additional 6 inches pit run sand-gravel[Note 4], or c. 4 inches of crushed stone over 8 inches base course of graded rock[Note4], over nonwoven geotextile[Note5]	
• Soil[Note 6]	Increase earthen liner thickness by ≥2 feet	
4. Separation Distances[Note7]		
• Well Distance	100 feet	
• Sinkholes	400 feet	
• Saturation	2 feet	
• Bedrock	2 feet	

Note[1] PI shall be determined by ASTM D-4318, Atterberg Limits.

Note[2] NRCS FOTG, Section IV, Wisconsin Construction Specification 204, Earthfill for Waste Storage Facilities.

Note[3] Other open cell material placed under the full footprint (i.e., geonet) may be used in lieu of granular soils. The leachate drainage layer must be resistant to pH as low as 3.5. Certain material, such as limestone, may not be acid resistant

Note[4] The base course layer can also be considered the leachate drainage layer.

Note[5] The geotextile shall be Class I, nonwoven and meet the requirements of Table 2 in Wisconsin Construction Specification 13, Geotextiles.

Note[6] When using the soil surfacing material option, the leachate drainage layer is not required.

Note[7] The separation distance is measured from the top of the earthen liner, and does not include surfacing material or the leachate drainage layer.

Note[8] The crushed stone subbase can also be considered the leachate drainage layer.

Table 3
Flexible Membrane Collection System

1. Liner Material	60 mil High Density Polyethylene (HDPE), 60 mil Very Flexible Polyethylene (VFPE), 60 mil Linear Low Density Polyethylene (LLDPE), or 45 mil Ethylene Propylene Diene Monomer (EPDM)[Note 1]
2. Leachate Drainage Layer[Note2]	Shall extend to the edge of the footprint of the feed storage area
• % Fines passing the #200 sieve	≤5%
• Particle Size and Shape	≤3/16 inch rounded
• Compacted Thickness	≥6 inches
3. Surfacing Material Options	
• Concrete	≥5 inches total thickness non-reinforced with maximum contraction joint spacing of 16 feet in both length and width
• Flexible Pavement	≥4 inches Wisconsin DOT E-0.3 Hot Mix Asphalt in ≥2 lifts over 9 inches crushed stone subbase[Note 6] for subgrade soils[Note 7] classified as SP, GP, SW, and GW. ≥4 inches Wisconsin DOT E-0.3 Hot Mix Asphalt in ≥ 2 lifts over 13 inches crushed stone subbase[Note 6] for all other subgrade soils[Note 7] except organic soils.
• Macadam	4 inches of crushed stone over 8 inches base course of graded rock[Note3], over nonwoven geotextile[Note4]
4. Separation Distances[Note5]	
• Well Distance	100 feet
• Sinkholes	400 feet
• Saturation	2 feet
• Bedrock	2 feet

Note[1] HDPE, VFPE, and LLDPE shall meet Wisconsin Construction Specification 202, Polyethylene Geomembrane Lining. All liners shall be installed according to manufacturer's recommendations.

Note[2] The leachate drainage material must be stable to resist sliding on the side slopes. In addition to the granular soils, other open cell material placed under the full footprint (i.e., geonet) may be used. The leachate drainage layer must be resistant to pH as low as 3.5. Certain materials, such as limestone, may not be acid resistant. Flexible membrane liners shall be protected from puncture by use of suitable materials in the leachate drainage layer preparation.

Note[3] If the base course layer contains aggregates larger than 4 inches, the drainage layer shall be twice the depth of the largest aggregate.

Note[4] The geotextile shall be a minimum 12-ounce per square yard nonwoven. Increasing the drainage layer to 12 inches can substitute for the geotextile.

Note[5] The separation distance is measured from the top of the liner, and does not include surfacing material or the leachate drainage layer.

Note[6] The leachate drainage layer is required under the crushed stone subbase to protect the liner.

Note[7] The subgrade consists of the first five feet of soil under the crushed stone subbase. If any of the subgrade consists of soil other than SP, GP, SW, or GW, then 13 inches of crushed stone subbase must be used.

Table 4
Concrete Collection System [Notes 1, 4, 5]

	Concrete[Note 2]	Concrete-Soil Composite[Note 3]	
1. Soils (Directly Below Liner			
• % Fines	---	≥20%	≥20%
• Plasticity Index	---	≥7	---
• Thickness	---	≥1.5 feet	≥3 feet
• Compaction of Placed Material	WI Spec. 204	WI Spec. 204	WI Spec. 204
2. Separation Distances[Note 6]			
• Well Distance	≥100 feet	≥100 feet	≥100 feet
• Sinkholes	≥400 feet	≥400 feet	≥400 feet
• Saturation	≥2 feet	≥3 feet	≥4 feet
• Bedrock	≥2 feet	≥3 feet	≥3 feet

Note[1] The liner material is also the surfacing material. The leachate drainage layer is the concrete surface.

Note[2] The concrete liner thickness shall be a minimum of 5 inches, contain distributed reinforcing steel and all contraction or *expansion joints* shall have imbedded non-metallic water stops in accordance with NRCS FOTG, Section IV, Wisconsin Construction Specification 4, Concrete. The concrete liner thickness and reinforcement design shall be based on the anticipated equipment loadings. The required spacing of liquid-tight expansion or contraction joints shall be based on the Subgrade Drag Theory as discussed in industry guidelines such as the American Concrete Institute, ACI 360, "Design of Slabs-on-Grade," or the Wisconsin Supplement to Chapter 10 of the NRCS Agricultural Waste Management Field Handbook (AWMFH). Steel shall be continuous through all *construction joints*.

Note[3] The concrete is in intimate contact with the soil, and the two work together to reduce seepage losses. The concrete liner thickness shall be a minimum of 5 inches and continuous reinforcement of #3 steel bars spaced at 18 inches on center each way. No contraction or expansion joints are required. The concrete shall be placed in intimate contact with the foundation soils. If construction joints are required, steel shall be continuous through all construction joints and no waterstop is required. If the soil material below the floor meets Table 2 criteria, then Table 2 design criteria shall be used.

Note[4] The subgrade shall be compacted and firm.

Note[5] Joints having water stops shall be protected from differential movement by the use of keyways or dowels. Dowels shall be spaced no farther than the rebar oriented in the same direction. Thicken concrete an additional four inches at the joint and taper concrete thickness a minimum of 5 feet from the joint in each direction.

Note[6] The separation distance is measured from the top of the concrete.

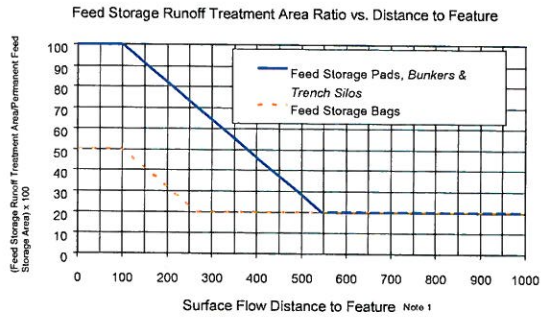


Figure 1. Sizing Feed Storage Runoff Treatment Areas for Contaminated Runoff

Note [1] The distance to the feature is considered as the surface flow length from the feed storage area to lakes, ponds, wetlands, *open channel* flow, grassed waterways, streams, sinkholes, and karst features.

b. Contaminated Runoff

All contaminated runoff shall be delivered (via gravity or pump) to a feed storage runoff treatment area or shall be collected and land applied according to a nutrient management plan. The conveyance to the feed storage runoff treatment area shall be designed for a delivery rate produced by the 25-year, 24-hour storm event. Size the treatment area according to Figure 1.

The feed storage runoff treatment area, determined by using Figure 1, may be reduced if the *first flush* of contaminated runoff volume is collected and land applied according to a nutrient management plan. Determine the area reduction amount as follows:

1) If the first 0.05 inches of contaminated runoff is collected, the area may be reduced up to 50%.

2) If the first 0.2 inches or more of contaminated runoff is collected, the area may be reduced by greater than 50% or eliminated.

c. Feed Storage Runoff Treatment Area Siting Parameters

The feed storage runoff treatment area shall consist of grassed, wooded, or cropped areas. The treatment area shall be situated or constructed over a 2-foot minimum depth of soil with at least 20% passing the No. 200 sieve (P200 ≥ 20%), and a minimum separation to saturation and bedrock of 2 feet. The treatment area shall be farther than 50 feet from any private water well.

The runoff distributed to the feed storage runoff treatment area must be spread across the full width of the upper end of the treatment area. The minimum length or width of the treatment area shall be 20 feet. The ratio of length:width or width:length shall not be greater than 10:1.

Only slopes from 0.5% to 8% may be considered as part of the treatment area. If a row crop is used as part of the treatment area, it must be planted on the contour. Overland flow shall be maintained.

Solids shall be kept off the treatment area. If a sediment basin is used in conjunction with a feed storage runoff treatment area to remove solids from contaminated runoff, it shall meet the siting parameters specified for the treatment area.

3. Specific Criteria, Tower Silos

A collection system shall be installed to collect leachate from the tower silo when there is a risk of environmental impact to surface or groundwater.

Floor drains shall be connected to the leachate collection or transfer system.

If rainwater is collected, include this volume in the design. Rainwater may be diverted.

All joints between the tower silo floor and foundation shall be sealed.

4. Specific Criteria – Non-Permanent Areas

a. Feeds with over 75% moisture are not allowed on non-permanent areas.

b. The storage site must be rotated annually, with a minimum of two consecutive years of non-use after a location is rotated out of use. The storage site must be moved a minimum of 50 feet from the previous location.

c. The area where feed was stored must be re-vegetated after the feed is moved.

d. The criteria in Table 5 shall be met.

Table 5
Non-Permanent Feed Storage Area Requirements

1. Hydrologic Soil Groups	B, C, D	A
2. Subsurface Separation Distance		
• Saturation	≥ 3 feet	≥ 5 feet
• Bedrock	≥ 3 feet	≥ 5 feet
3. Surface Separation Distance		
• Wells	≥250 feet	≥250 feet
• Lakes	≥1,000 feet	≥1,000 feet
• Sinkholes, or other Karst Features	≥1,000 feet	≥1,000 feet
• Quarries	≥1,000 feet	≥1,000 feet
• Streams	≥300 feet	≥300 feet
• Wetlands and Surface Inlets	≥300 feet	≥300 feet
• Open channel flow	≥100 feet	≥100 feet
• Land Slope	≤ 6%	≤ 6%
• Floodplain (100 yr)	≥100 feet	≥100 feet

5. Considerations for Feed Storage Leachate and Runoff Control

Additional recommendations relating to the design which may enhance the use of, or avoid problems with this practice, but are not required to ensure its basic conservation function, are as follows:

a. A collection system to accept leachate may be installed around the perimeter of the feed storage area.

b. Limit how much feed is exposed to precipitation while removing plastic and/or feed from storage. Cover waste feed with plastic or place under a roof to reduce leachate and contaminated runoff.

c. Avoid locating feed storage areas and treatment systems in the 100-year floodplain without a flood analysis.

d. When manual pump regulation is used, an alarm or indicator to mark the full level is suggested.

e. Acid resistance measures should be taken for concrete and fiberglass tanks.

f. A sediment basin should be considered to remove solids prior to entering a transfer system or feed storage runoff treatment area. Design the sediment basin according to NRCS FOTG, Section IV, Standard 350, Sediment Basin.

g. Line the top of the silage and the walls with plastic to exclude precipitation runoff from contacting the forage.

h. Use dry feed ingredients on the floor and under the silage, or blend dry feed with wet silage, to absorb potential leachate.

i. Where floor base material is in contact with leachate/seepage, use a non-calcareous base material.

j. Store plastic and weighting materials in a manner that avoids infestation by rodents and insects. Use cut tires or drill holes to reduce water accumulation. Mow weeds to discourage vermin colonization.

k. As generated, place waste plastic in a storage area where it will remain free of dirt and precipitation and be protected from transportation by the wind. Recycle or landfill the waste plastic on a regular basis.

l. When transferring leachate or contaminated runoff, consider installing a run time indicator on the pump.

m. Acid resistant reinforced concrete, with designed contraction joint spacing and a compacted subgrade, is recommended when surfacing a feed storage area with concrete.

n. Consider treating runoff from *work areas* where excessive spilled feed accumulates.

VI. References

USDA, NRCS Wisconsin Field Office Technical Guide (FOTG), Section IV, Practice Standards and Specifications.

USDA, NRCS National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook and Companion Documents.

USDA, NRCS, National Engineering Handbook, Part 637, Environmental Engineering, Chapter 3, Constructed Wetlands.

Murphy, T. J. and Bogovich, W. M. 2001. "Vegetated Filter Areas for Agricultural Wastewater Treatment", ASAE Meeting Paper No. 01-2296. St. Joseph, Mich.: ASAE.

USDA, NRCS, National Soil Survey Handbook, Title 430-VI.

Wisconsin Department of Commerce, Safety and Buildings Division, Wisconsin Plumbing Products Register.

ASTM D2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

Wisconsin Department of Natural Resources, Wisconsin Administrative Code NR 214, Land Treatment of Industrial Liquid Wastes, By-Product Solids and Sludges.

Wisconsin Department of Natural Resources, Wisconsin Administrative Code NR 216, Storm Water Discharge Permits.

Wisconsin Department of Natural Resources, Wisconsin Administrative Code NR 243, Animal Feeding Operations.

ASTM D-4318, Atterberg Limits.

American Concrete Institute, ACI 360, Design of Slabs-on-Grade.

American Society of Agricultural and Biological Engineers (ASABE) Standard EP 470, Manure Storage Safety.

VII. Definitions

Accretion Depth (V.B.4.b(4)) – The natural build up of soil or vegetative debris over time.

Bedrock (V.B.1.b.) – Consolidated rock material and weathered in-place material with >50%, by volume, larger than 2 mm in size.

Bunkers and Trench Silos (Figure 1) – Horizontal feed storage areas confined along at least one side. Trench silos are typically built with walls partially or fully below the ground surface.

Channelized Flow (V.B.1.e) – Water movement in a surface drainage feature including, but not necessarily limited to: swales, draws, grassed waterways, ditches, gullies, creeks, or rivers.

Confined Lenses and Perched Water Table (V.C.1.d.(1)(b)) – Confined lenses are water bearing deposits of stratified lacustrine material or material laid down by glaciers between deposits of less permeable till. Perched water is saturation found above and separated from the regional high water table.

Confined Space (V.A.8) – Confined Space is a space that 1) contains or has the potential to contain a hazardous atmosphere; 2) is large enough and so configured that a person can bodily enter; 3) has limited or restricted means for entry or exit; and 4) is not designed for continuous human occupancy.

Construction Joint (Table 4, Note 2) – These joints are used where a fresh pour of concrete abuts an existing recent pour. Construction joints where the steel is continuous through the joint are considered to be monolithic and liquid tight, if constructed properly.

Contaminated Runoff (II) – Runoff that has come through or across a feed storage area. It generally includes the runoff and any sediment, feed, or other material carried in the runoff. It contains lower concentrations of contaminants than leachate from feed or manure.

Contraction Joints (Table 2) – Contraction joints, often called control joints, are used to control the location of cracks caused by concrete shrinkage during setting and thermal changes.

Crushed Stone (Table 2) – 100% passing the ¾-inch sieve and 10% maximum passing the No. 200 sieve.

Expansion Joints (Table 4, Note 2) – These joints are used to prevent crushing of abutting concrete or other structural units due to compressive forces developed during expansion caused by high temperature.

Feed Storage Area (II) – An area used to store livestock feed. Livestock feed may include corn silage, haylage, and industrial by-products (i.e., distillers grain, brewers grain, candy, pizza crust, bakery waste, cotton seed, soy bean meal, animal fats, blood meal, fish meal, cannery waste, beet pulp, citrus pulp, soy hulls, corn midlings, whey, potatoes, grocery store vegetables). This is the area defined by the outside edge of the surface of where the feed is stored, including the apron.

Feed Storage Runoff Treatment Area (V.C.1.b.1.) – A vegetated area designed to treat contaminated runoff from feed storage areas by physical, chemical and biological means.

First Flush (V.C.2.b) – The initial contaminated runoff volume, which typically contains higher concentrations of contaminants than runoff produced during the remainder of the storm event.

Hydraulic Loading Rate (V.B.4.b.(7)) – Considered as the flow rate distributed over the surface area calculated as: HLR = Flow Rate / Surface Area

Karst Feature (V.B.1.b) – Areas of land underlain by carbonate bedrock (limestone or dolomite). Typical land features include sinkholes, disappearing streams, closed depressions, blind valleys, caves, and springs. See the companion document to Standard 313, in Chapter 10 of the AWMFH for additional discussion of karst features.

Leachate (II) – Concentrated liquid which has percolated through or drained from animal feed. It contains much higher concentrations of contaminants than Contaminated Runoff.

Leachate Drainage Layer (V.C.2.a.) – Material that allows leachate to flow to a collection point.

Load/Rest Cycle (V.B.3.b.(2)) – A schedule of operation in which a certain volume of waste is loaded on a portion of the treatment system and then that portion is rested to allow the soil to reaerate and the soil micro-organisms to break down the waste material.

Macadam (Table 2) – Layers of crushed stone or crushed stone and geotextile designed to distribute point loads over an area to avoid soil surface failure.

Milking Center (III) – Facility for harvesting cooling and storing milk from dairy cows, sheep, or goats. The facility can include animal holding area, milking parlor, milk house, milking equipment, and washing equipment. Excluded from the milking center is animal housing.

Milking Center Wastewater (III) – Consists of wash water used to clean the milk harvesting and milk cooling equipment. Other contaminated sources of wastewater (water softener) and wash water used to clean the floors and walls can be included in the combined flow of the milking center wastewater discharge. Wastewater from the floor of the holding area is excluded from treatment systems specified by this standard. Clean discharge water sources (plate cooler, roof water) and sanitary wastewater (toilets, sinks, clothes laundry) must be excluded from the treatment system.

Non-permanent feed storage area (V.C.1.h.(2)) – An area used to store livestock feed for no more than 12 months at one location followed by a minimum of two consecutive years of non-use.

Open Channel (Figure 1, Note 1) – Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on the United States Geological Survey (USGS) quadrangle sheets.

Permanent feed storage area (V.C.1.h.(1)) – An area used to store livestock feed for more than 12 months at one location.

Regional High Water Table (V.C.1.d.(1)(a)) – The seasonal high free water surface of a large body of groundwater covering a region. All soil below the regional water table is saturated. Soil mottling (redoximorphic features) is not necessarily an indicator of regional high water table, but is an indication of soil saturation.

Sinkholes (V.C.1.b.(2)) – Closed, usually circular depressions which form in karst areas. Sinkholes are formed by the downward migration of unconsolidated deposits into solutionally enlarged openings in the top of bedrock.

Source Control (V.B.1.a) – Management practices and/or equipment that reduce the volume and

strength of the generated milking center waste stream to facilitate its treatment. Further explanation of source control measures to reduce volume, strength and reduce contaminant levels are found in the companion documents in the WI supplement to Chapter 10 of the NRCS AWMFH.

Spreading Plan (V.B.1.d.) – A plan that prevents runoff, excessive accumulation of nutrients in the soil, and spreading of wastes in karst areas and areas of concentrated flow.

Tower Silo (V.C.2.) – Vertical high moisture feed storage structure confined on the sides and bottom.

Waste Feed (III) – Spilled, spoiled or unused feed not suitable for livestock consumption. Includes feed mixed with snow and other contaminants.

Work Area (V.C.5.n.) – An area where feed is loaded and mixed. Feed is not typically stored in this area.

APPENDIX D

PRE-CONSTRUCTION MEETING FORM
CONSTRUCTION INSPECTION PLAN
QUALIFICATIONS OF CONSTRUCTION OBSERVER
ROUTINE INSPECTION CHECKLIST
OPERATIONS & MAINTENANCE PLAN

PRE-CONSTRUCTION MEETING

A meeting shall be scheduled before construction to discuss construction schedules, plan details, construction specifications, and known site limitations. The meeting should include the following:

	Invited	Attended	Not Attended
❑ **Owner_____**	_____	_____	_____
❑ **County LCD_____**	_____	_____	_____
❑ **Engineer_____**	_____	_____	_____
❑ **_____**	_____	_____	_____
❑ **DNR _____**	_____	_____	_____
❑ **Excavator_____**	_____	_____	_____
❑ **Concrete Contractor_____**	_____	_____	_____
❑ **Building Contractor_____**	_____	_____	_____
❑ **Geotechnical consultant_____**	_____	_____	_____
❑ **Other_____**	_____	_____	_____
❑ **Other_____**	_____	_____	_____

Items of discussion should include:

- ❑ **Review plans & specifications**
- ❑ **Locate and observe benchmark**
- ❑ **Discuss construction observation and which party is responsible for specific structures**
- ❑ **Determine who and how construction staking will take place**
- ❑ **Discuss soil material testing for sub-base and backfill**
- ❑ **Discuss concrete thickness; rebar size, and spacing for reception tanks**
- ❑ **Discuss waterstop and control joints for and reception tanks.**
- ❑ **Discuss backfill material requirements for transfer pipes and reception tanks.**
- ❑ **Discuss sub-base material requirements for basin and reception tank.**
- ❑ **Discuss reinforcement and waterstop requirements for manure basin**
- ❑ **Discuss reinforcement and waterstop placement for feed pad**

Other items discussed:

CONSTRUCTION INSPECTION PLAN

The form identifies specific construction features which should be documented to support conformance to the plans and specifications.

The Contractor is responsible for means and methods to accomplish construction in accordance with the plans and specifications. Construction observation by the engineer is not intended to be an exhaustive check or a detail inspection of the Contractor's work but rather to allow the engineer to become generally familiar with the work in progress and to determine, in general, if the work is proceeding in accordance with the Contract Documents.

Items to be observed and documented include the following: (Initial and date individual items as performed**).**

CONCRETE LINED STORAGE BASIN:

- Subgrade conditions: **Document subgrade material and properties at select locations for conformance to the plans. Document that contractor observed footing for conformance with the plans. Document watertable separation.**
- Control Joints: **Document control joints spacing for conformance to plans at select locations, and document weld and waterstop placement at select locations.**
- Concrete Liner: **Document steel sizing/spacing, concrete thickness, and conformance to plans at select locations.**
- Safety Fence: **Document safety fence placement**
- Seeding/Mulching: **Document seeding and mulching for conformance to specifications as presented in the plan set.**

PIPE PENETRATIONS:

- Manure transfer pipe: **Document installation of pipe boots and seals at select locations for conformance to the plan and specifications.**

DRAINAGE:

- **Document post construction surface drainage and conformance to the plan.**

TRANSFER PIPES

- **Document manhole materials and placement for conformance to plans at select locations.**
- **Document pipe materials and elevation conformance to plans at select locations.**

- **Document watertight pipe joints for conformance with plans at select locations.**

RECEPTION TANKS

- Subgrade conditions: **Document subgrade material and properties at select locations for conformance to the plans. Document that contractor observed foundation for conformance with the plans.**
- Control Joints: **Document control joints spacing for conformance to plans at select locations, and document weld and waterstop placement at select locations.**
- Concrete Liner: **Document steel sizing/spacing, concrete thickness, and conformance to plans at select locations.**
- Safety Fence: **Document safety fence placement.**
- Seeding/Mulching: **Document seeding and mulching for conformance to specifications as presented in the plan set.**

FEED STORAGE RUNOFF CONTROL

- SETTLING BASIN/ TANK
  - Document concrete and tank placement conforms to plans.
  - Document tank specifications and pump installation conforms to plans.
- LEACHATE/GRAYWATER TRANSFER PIPE
  - **Document pipe materials and elevation conformance to plans at select locations.**
  - **Document watertight joints for conformance with plans.**

QUALIFICATIONS FOR CONSTRUCTION OBSERVER

Construction observation personnel shall be under the supervision of Robert Pofahl, PE.

Engineer personnel should obtain readily available construction material manufacturers tags, take photographs of materials listed, and collect data from contractors before, during, and after the project scoped activities are completed.

The purpose of providing documentation is to document that the systems were installed according to the approved plan design. The Contractor is responsible for means and methods to accomplish construction in accordance with the plans and specifications. Construction observation by the engineer is not intended to be an exhaustive check or a inspection of the Contractor's work but rather to allow the engineer to become generally familiar with the work in progress and to determine, in general, if the work is proceeding in accordance with the Contract Documents.

REA staff expected to be assigned for construction documentation activities at Golden Sands Dairy project are:

- **Robert Pofahl, PE**
- **Lee Elver**
- **Dan Wierzba**

REA construction personnel shall be under the supervision of Robert Pofahl, PE.

ROUTINE OBSERVATION CHECKLIST
(MANURE BASIN AND TRANSFER)

The manure storage basin, manure transfer system, manure transfer tanks and associated facilities should be observed at least annually for proper operation and durability to contain the manure and waste water. For documentation purposes, the checklist below will provide a summary of observations. If a yes response is given, identify the concern and propose and appropriate action.

Date_____

Observer_____

Structure _____

Yes	No	
☐	☐	**Is the manure basin concrete liner in poor condition (evidence of cracks or broken concrete)?**
☐	☐	**Are the basin exterior slopes eroding or is there other evidence of failure?**
☐	☐	**Are grades allowing clean surface water to flow into the manure basin?**
☐	☐	**Is evidence of overtopping the manure storage basin or leakage apparent?**
☐	☐	**Is stormwater flowing away from the manure storage basin causing erosion or transporting manure residues?**
☐	☐	**Is manure escaping or overtopping the manure transfer system?**
☐	☐	**Is manure accumulation in the transfer tank? If necessary, prepare a plan for removal.**

Comments:

ROUTINE INSPECTION CHECKLIST
(FEED STORAGE AREA)

The leachate collection and treatment system(s) should be observed at least monthly and every time it is manually cleaned for proper operation and durability to contain, convey, and treat the stormwater runoff and leachate from the feed storage area. For documentation purposes, the checklist below will provide a summary of observations. If a yes response is given, identify the concern and propose and appropriate action.

Date_____

Observer_____

Yes	No	
□	□	**Is the concrete in poor condition (evidence of cracks or broken concrete)?**
□	□	**Are grades allowing clean surface water to flow into the treatment systems?**
□	□	**Is there evidence of leachate flowing into clean water flowpaths?**
□	□	**Is stormwater flowing away from the leachate collection systems causing erosion or transporting waste feed residue?**
□	□	**Are solids plugging up or stopping flow to the pumps**
□	□	**Is the transfer tank filled with sediment?**
□	□	**Are the pumps and controls operating?**

Comments:

OPERATION AND MAINTENANCE PLAN
(MANURE BASIN AND TRANSFER TANKS & PIPES)

Manure accumulated in the storage basin structure shall be removed bi-annually at a minimum as the basins are estimated to have 180 days of storage. The accumulated manure stored in the basin is planned to be mixed and removed by pumping to injection equipment or to center pivot irrigation systems. Manure is planned to be field applied in accordance with a nutrient management plan. A nutrient management plan developed in accordance with NRCS 590 specifications is being prepared by others

Routine Inspections

Routine inspection of the manure storage basin and transfer system should be made at least bi-annually when the basin is emptied. The check list as presented in the basin inspection checklist should be used to document conditions of the manure storage basin and transfer system. Areas damaged by weather or equipment should be repaired as necessary.

Basin General: **The manure storage basin should be observed for overall performance in containing manure residue in the basin and protecting against overflow or operational losses. Safety practices should be observed and repaired as appropriate.**

Manure Transfer System: **The manure transfer system should be observed for overall performance in respect to manure transfer from the freestall barns to the proposed basin. Addition of dry or frozen manure or sand laden manure may cause plugging of transfer pipes so caution needs to be practiced.**

Pipes between the reception tanks, manure processing room and the storage basin should be checked and cleaned if necessary.

Methods to Monitor Manure Liquid Level

The manure level should be maintained at least 1.7 feet below the top of the manure storage basin (MOL), to maintain 1.0 foot of freeboard, plus the 25 year, 24 hour storm event (0.7 ft) to prevent manure from overflowing containment. The maximum fill level can be shown by mounting a maximum fill line on the basin wall. Depth measuring markers will be installed in the basin.

Yearly Checks

- **Maintain safety fences, warning signs, and gates.**
- **Maintain vegetative cover, riprap areas, and repair/reseed as necessary to maintain a stable embankment.**
- **Eliminate the growth of woody plants on embankment side slopes.**
- **Periodically remove sediment or soil that may deposit in the waterways to maintain design capacity.**

Displacement or other indications of differential movement of the structure should be reported to the Engineer for direction on action which may be needed. Bank erosion or rodent holes should be repaired as soon as possible.

OPERATIONS & MAINTENANCE
(FEED STORAGE AREA)

Leachate and Runoff Collection:
The proposed operations plan for the system is as follows:

- The objective is to remove runoff and leachate up to the 25 yr/24 hr Storm.
- The pumps should be observed after each storm event to determine if maintenance is needed, including cleaning the pump inlet.
- The feed handling area should be cleaned after use and the settling basin should be cleaned after each precipitation event.
- Check the inlet and clean or repair as as needed
- Concrete areas damaged by weather or equipment should be repaired by grouting or caulking as appropriate.
- During silage & haylage harvest, tank should be pumped prior to rain events if possible as tank could be filled with leachate.