NONMETALLIC MINE RECLAMATION PLAN
BREEZY POINT PROPERTIES
MAXVILLE AND NELSON TOWNSHIPS
BUFFALO COUNTY, WISCONSIN

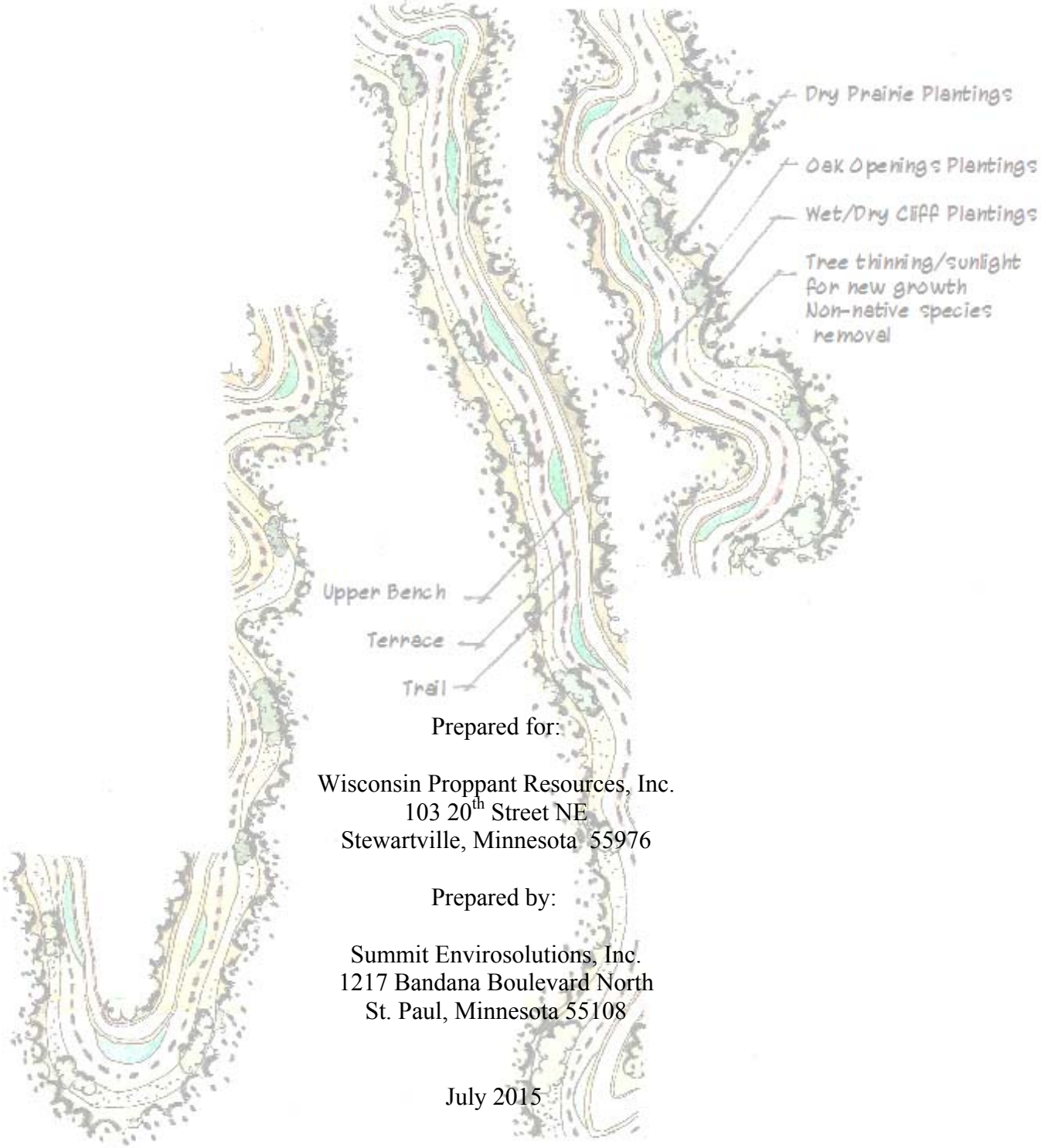

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Table of Contents

Tables

Figures

Appendices

NONMETALLIC MINE RECLAMATION PLAN
BREEZY POINT MINE
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Introduction

This Nonmetallic Mine Reclamation Plan is prepared for the proposed Wisconsin Proppant Resources, Inc. (WPR) project located in the Towns of Maxville and Nelson, Buffalo County, Wisconsin. This plan has been prepared by Summit Envirosolutions, Inc. (Summit) on behalf of WPR in general accordance with Wisconsin Statute Chapter 295, Wisconsin Administrative Code Chapter NR 135, and Buffalo County Non-Metallic Mining Reclamation Ordinance Chapter 757.

WPR is proposing a unique nonmetallic mining operation in Maxville and Nelson Townships, Buffalo County, Wisconsin on parcels to be leased from the property owners. It is projected that 330,000 to 550,000 tons of industrial sand will be transported off-site annually for three to six years during construction of a "bluff trail", a terrace built into the side of the existing bluff. The bluff trail will restore the terrace to pre-settlement vegetation consisting primarily of dry prairie species, oak openings, and wet- and dry-cliff plantings. The current and projected price of the

sand beneath the mined area makes this project possible. The bluff trail will have positive benefits for the landscape and wildlife in the area, including:

- Restoring the area to pre-settlement vegetation;
- Creating habitat for flora and fauna species;
- Reducing erosion;
- Improving storm water quality; and
- Increasing the recreational value of the property.

The site consists of approximately 30 acres where progressive mining and reclamation will take place. Construction of the bluff trail will be accomplished, to the extent practical, using earthmoving equipment which may include, but will not be limited to, excavators, dozers, backhoes, front-end loaders, conveyors, and trucks.

The excavated material will transported via overland conveyor or haul trucks to the wet processing plant, located in the south-central section of the property. Once the material has been washed and sorted, it will be moved by conveyor to the drying plant, where it will be dried and sized to end-product specifications. After processing, the proppant material will be loaded into trucks and transported to a trans-load facility for shipment via rail and barge.

Progressive phasing will be the basis of the excavation program. The mine development program will have four phases ranging from 5.7 to 9.5 acres, encompassing approximately 30 total acres. The phases will be utilized for excavation, stockpiles, access roads, conveyors, and equipment staging. Final reclamation to dry prairie, native prairie with oak openings, wet/dry cliff habitat, and agricultural land will occur when the land will no longer be disturbed during the mining process.

Erosion control and storm water Best Management Practices (BMPs) will be implemented prior to excavation. Once BMPs are in place, construction of the processing plants and excavation of the sandstone will begin simultaneously during Phase 1. Proposed mining will not take place within a 75-foot buffer from surrounding property boundaries. Mining activities will begin in the southern area of Phase 1. Excavation of the material within this phase will progress north and west in a counter-clockwise fashion. The sandstone will be excavated from approximate elevations between 1,050 and 1,120 feet above sea level (ASL).

The project has a relatively small footprint and short timeframe and is unlike other non-metallic mining projects proposed and approved for a Conditional Use Permit (CUP). The mining areas are contained within horseshoe-shaped valleys, creating limited visibility by neighbors and from County Highway K. The entire mining area is approximately 30 acres and the bluff trail could be completed in as little as four years, depending on market conditions for end-users of the excavated sand.

While intended to be a stand-alone document, this Reclamation Plan is also a companion document to the CUP Application document submitted to Buffalo County on July 18, 2014, which is incorporated by reference herein.

This Reclamation Plan is organized in three sections. Section 1 presents information about existing environmental conditions at the properties involved in the excavation activities. Section 2 presents the mining plan to remove the sandstone and construct the bluff trail. Section 3 presents information on post-mining land use and specifics regarding plantings and methods to ensure successful reclamation and reduce erosion. The following site information and reclamation plan are submitted on behalf of WPR to supply information regarding reclamation as required by the Buffalo County Nonmetallic Mining Ordinance Chapter 757.

1.0 Site Information

1.1 Site Location

The mine site is located in portions of Sections 28, 32, 33 and 34, Township 24 North, Range 13 West, and Sections 4 and 5, T23N R13W. It is between County Highway K, Lindstrom Valley Road, and County Highway V in Maxville and Nelson Townships, Buffalo County, Wisconsin (Figure 1). The project site properties are listed in Table 1.

Table 1. Project Site Properties

Property Tax Parcel ID	Owner Name	Owner Address	Approx. Area (Acres)	Legal Description
020-00554-0000	Breezy Point Acres, LLC	W2184 County Road K, Durand, WI 54736	39	SW ¼ of SE ¼, Sec. 28, T24N R13W
020-00553-0000	Breezy Point Acres, LLC	As above	40	NW ¼ of SE ¼, Sec. 28, T24N R13W
020-00551-0000	Breezy Point Acres, LLC	As above	40	SE ¼ of SW ¼, Sec. 28, T24N R13W
032-00095-0000	Breezy Point Farms, Inc.	W2184 County Road K, Durand, WI 54736	41.3	NE ¼ of NE ¼, Sec. 5, T23N R13W
032-00077-0000	Breezy Point Farms, Inc.	As above	42.3	NW ¼ of NW ¼, Sec. 4, T23N R13W
032-00078-0000	Breezy Point Farms, Inc.	As above	.2	FRL NW ¼ of NW ¼, Sec. 4, T23N R13W
032-00075-0000	Breezy Point Farms, Inc.	As above	42.7	FRL NW ¼ of NW ¼, Sec. 4, T23N R13W, except PT
020-00648-0000	Breezy Point Farms, Inc.	As above	40	SE ¼ of SE ¼, Sec. 32, T24N R13W
020-00660-0000	Breezy Point Farms, Inc.	As above	37	NW ¼ of SW ¼, Sec. 33, T24N R13W
020-00645-0000	Breezy Point Farms, Inc.	As above	40	NE ¼ of SE ¼, Sec. 32, T24N R13W

(Table 1 continued)

020-00662-0000	Breezy Point Forest, LLC	W2184 County Road K, Durand, WI 54736	40	SW ¼ of SW ¼, Sec. 33, T24N R13W
020-00663-0000	Breezy Point Forest, LLC	As above	35.5	SE ¼ of SW ¼, Sec. 33, T24N R13W
020-00657-0000	Breezy Point Forest, LLC	As above	20	E ½ of SW ¼ of NW ¼, Sec. 33, T24N R13W
020-00658-0000	Breezy Point Forest, LLC	As above	40	SE ¼ of NW ¼, Sec. 33, T24N R13W
020-00659-0000	Breezy Point Forest, LLC	As above	40	NE ¼ of SW ¼, Sec. 33, T24N R13W
020-00673-0000	Breezy Point Lands, LLC	W2184 County Road K, Durand, WI 54736	40	NW ¼ of NW ¼, Sec. 34, T24N R13W
020-00649-0000	Breezy Point Lands, LLC	As above	40	NE ¼ of NE 1//4, Sec. 33, T24N R13W
020-00557-0000	Breezy Point Lands, LLC	As above	40	SE ¼ of SE ¼, Sec. 28, T24N R13W
020-00650-0000	Breezy Point Properties, LLC	W2184 County Road K, Durand, WI 54736	40	NW ¼ of NE ¼, Sec. 33, T24N R13W
020-00655-0000	Breezy Point Properties, LLC	As above	20	E ½ of NW ¼ of NW ¼, Sec. 33, T24N R13W
020-00653-0000	Breezy Point Properties, LLC	As above	40	NE ¼ of NW ¼, Sec. 33, T24N R13W
020-00663-0020	Deric Lindstrom	W2168 Lindstrom Rd., Durand, WI 54736	1.7	Part of SE ¼ of SW, Sec. 33, T24N R13W

Of the approximately 760-acre property owned by Breezy Point, WPR will be the lessor and operator of approximately 100 acres, of which approximately 30 acres will be phased for logging, grading, excavating the sandstone, and reclamation to a bluff trail. Approximately 55 acres will be developed for a processing and storage area and access roads.

Adjacent properties within one-half mile of the proposed mine site boundary are depicted on Figure 2. A listing of the adjacent properties, owners, and property descriptions is included in Appendix I.

1.2 Topography and Drainage

Currently, the proposed mining areas are primarily hardwood forest and the proposed processing area is primarily agricultural fields. Figure 3 presents a topographic map showing the relatively steep-sided hills that create two horseshoe-shaped valleys on the property. Current general surface water drainage patterns are also depicted on Figure 3. The site is located completely within the Bear Creek Watershed. Figure 4 presents ten-foot topographic contours of the site based on the United States Geological Survey (USGS) National Elevation Dataset (NED). Due to the steep topography across the mining property, a figure depicting five-foot contours for the site would be illegible.

1.3 Geology

According to the *Bedrock Geology of Wisconsin, West-Central Sheet,* originally published by the Wisconsin Geological and Natural History Survey, the local bedrock geology is comprised of Cambrian-aged sandstone consisting primarily of coarse-grained quartz arenite sandstones of the Jordan Formation. This is capped by the sandstone, shale, and dolostone of the Prairie du Chien Group and underlain by the shaly sandstone, siltstone, and shale of the St. Lawrence Formation. A generalized bedrock geology map adapted from the *Bedrock Geology of Wisconsin, West-Central Sheet* is presented on Figure 5; however, test borings indicate that the map is not accurate to the scale of the site. Jordan Sandstone was present at test boring locations outside the area delineated on Figure 5.

The geology of the mine site was assessed by collecting outcrop samples and advancing four test borings at the locations shown on Figure 6. Test borings indicated consistent geologic layering of the sandstone resource across a small quarry site. Based on the results of this assessment, the estimated sandstone resource is anticipated to be located within the Jordan Formation and Coon Valley member of the Oneota Formation between an approximate elevation of 1,050 and 1,120 feet ASL. Test boring logs are included in Appendix II.

1.4 Wetlands

According to the Wisconsin Department of Natural Resources Surface Water Data Viewer, wetland indicator soils are located in the southwestern portion of the property (Figure 7). A dammed pond (approximately .15 acre) and a potential wetland "too small to delineate" are also indicated on the mining property, but outside proposed mining activity. Wetland indicator soils appear on an adjacent property to the east of the mine site. Appropriate erosion control and sedimentation BMPs, including down-slope topsoil berms and silt fencing, will be utilized to protect these areas during mine construction and operation activities. Additionally, the mine floor will be angled during excavation to create a bench that will prevent runoff from escaping from the mine area. See Section 2.4 for specific descriptions of BMPs. Wetland delineations will be performed prior to mining activities. Setbacks and BMPs will be used to avoid impacts to identified wetlands.

1.5 Structures

Five houses and buildings associated with a working dairy farm are located on the property; however, these structures are outside of the proposed mining and processing area limits. The existing buildings will remain onsite. New structures requiring building permits would include a small office building/scale house, a building for drying the sand, and silos to store the finished product.

There are 20 residences located within one-half mile of the proposed mining boundary. A listing of addresses, owners, and distances to the proposed mining boundary is included in Appendix I. One residence is surrounded by the property owned by Breezy Point and is located between 760 and 1,190 feet from the nearest proposed active mining area (Phase 4), across Lindstrom Valley Road.

An area water well inventory was completed using the WDNR Drinking Water System Well Construction Report database. According to this database, one water well is located within the proposed site and fifteen water wells are located on adjacent properties within one-half mile of the mine property boundary. These are presented on Figure 2 and are summarized in Table 2. The associated Well Construction Reports are included in Appendix III.

Additional water wells are predicted to exist on the project site and for the residences on Parcels 1, 9, 21, and 22 (Figure 2), but a search of the WDNR database did not discover associated Well Construction Reports.

Table 2. Water Well Locations and Owners

Unique Well No.	Figure 2 Label	Listed Owner	Owner Address
AJ170	7	Cyril Weisenbeck	Route 3, Box 127, Durand, WI 54736
AC887	23	Dan Weisenbeck	W2295 County Road K, Durand, WI 54736
AQ929	21	Cedric Brantner	W2226 County Road K, Durand, WI 54736
AQ980	23	Dan Weisenbeck	W2295 County Road K, Durand, WI 54736
AQ989	26	Wilfred Kralewski	W2215 Highway V, Durand WI 54736
BB764	23	Darrel & Thelma Weisenbeck	Route 3, Durand, WI 54736
DF150	12	David Stellpflug	Route 3, Box 93, Durand, WI 54736
GJ542	18	Breezy Point Farms, Inc.	W2184 County Road K, Durand, WI 54736
GQ410	2	Bernard Traun	W2148 Highway V, Durand, WI 54736
KC711	On mine property	Chris Lindstrom	W1982 County Road K, Durand, WI 54736
NC311	16	Charles Brion	W2142 County Road KK, Durand, WI 54736
QW445	28	Mike Kralewski	S679 State Road 25, Nelson, WI 54756
TI109	26	Ron Kralewski	W2246 County Road V, Durand, WI 54736
UM553	7	Dave & Cheryl Weisenbeck	S387 County Road AA, Durand, WI 54736
WV775	17	Nora Lindstrom	W2184 County Road K, Durand, WI 54736
YK509	11	Bill & Heather Weisenbeck	Highway K, Durand, WI 54736

A Dairyland Power Cooperative Q-17 161kV electrical transmission line passes northwest/southeast through the proposed mine site, adjacent to Phase 1 and above Phase 2. Dairyland Power Cooperative has granted conditional permission for excavation and mining

activities within the 80-foot-wide electrical transmission line right of way, between and adjacent to pole structures and anchoring devices. No machinery or equipment will be operated within twenty feet of any part of the electrical transmission line and conductor wires, nor within ten feet of any line pole structures and anchoring systems. Additionally, access to and from Dairyland Power Cooperative electrical transmission line facilities will not be impeded at any time, and no materials will be stockpiled within the right of way. See Appendix IV for the correspondence and conditions from Dairyland Power Cooperative.

1.6 Soils

According to National Resource Conservation Service (NRCS) maps, 49 soil types are present on the mine site, as shown on Figure 8. These units are described in the NRCS Report in Appendix V. The NRCS descriptions indicate that the majority of the site has A and B horizons comprised of fine sand, silt loam, sandy loam, and loamy sands with a total average thickness ranging from nine to sixty inches. During stripping and excavation in preparation for mining, the A and B horizons will be stockpiled and banked separately. A and B horizon soil volumes for each phase were estimated based on the NRCS soil descriptions. Table 3 summarizes the volumes of A and B horizons available for reclamation across the site. During reclamation, bermed soil from the processing area may be used to supplement the topsoil and subsoil volumes in Phases 2 through 4 to create an average A and B horizon depth of at least 12 inches. Observations during drilling activities support this average depth of the topsoil and subsoil.

Table 3. Estimated A and B Horizon Volumes

	Approx. Acres	A Horizon (cubic feet)	B Horizon (cubic feet)	Total A + B Horizon (ft^3)	A+B Horizon reclamation depth (inches)
Phase 1	5.7	29,709	189,943	219,652	10.6
Phase 2	6.3	33,849	187,944	221,793	9.7
Phase 3	9.5	55,162	334,156	389,318	11.3
Phase 4	9	50,319	245,906	296,225	9.1
Processing Area*	49.5	666,642	3,234,732	3,901,374	21.7
Total	80	835,681	4,192,681	5,028,362	**17.3**

* This is a conservative estimate based on a B horizon depth for the Processing Area of 18 inches. Because the Processing Area is located on silt loam soils to a depth of up to 68 inches, additional reclamation soil volume will be available in berms created by grading the east and west slopes of the Processing Area to a level, lower elevation prior to construction.

1.7 Groundwater and Surface Water

Based on observations made during subsurface assessment and the Generalized Water-Table Elevation Map of Buffalo County, Wisconsin Map (William G. Batton and Alexander Zaporozec, *Wisconsin Geological and Natural History Survey*, 2000), the regional groundwater elevation contours indicate that flow directions for groundwater located beneath the site are generally south toward Little Bear Creek. Groundwater at the lowest elevation of the proposed quarry operations appears to be present at an elevation between 800 to 900 feet ASL (Figure 9).

The bottom of the sandstone resource is anticipated to be at an elevation of 1,050 feet ASL; therefore, the mining activities will be a minimum of 150 feet above the groundwater. In the processing areas, the bottom of the storm water ponds will be designed to leave a minimum of 10 feet between the bottom of the ponds and the top of the groundwater. As shown on Figure 9, groundwater occurs at approximately 800 feet ASL in the processing area. The minimum ground elevation in the area of the storm water ponds is 850 feet ASL; therefore, a 10-foot minimum separation is feasible.

The project will create a terrace, which will force storm water to infiltrate the underlying substrate, rather than the current conditions where significant runoff continues to erode the existing steep slopes within the mining area and delivers sediment-laden waters to Little Bear Creek. The bluff trail will be positioned on a relatively flat terrace that ranges in width from 80 feet to 200 feet and be designed to slope slightly downward into the uphill side of the bluff. Based on the relatively flat slope and the high-permeability of underlying sandstone (i.e., the lower 50 feet of the Jordan Formation), surface water discharges are not likely in mined areas. While the water infiltrating into the terrace will likely discharge into Little Bear Creek as groundwater base flow, it will be filtered and cooler in temperature. Currently, water entering Little Bear Creek is surface water laden with sediment and warmed by air temperature. Moreover, the areas beneath the constructed terraces will be significantly less prone to erosion.

Prior to the commencement of mining activities, baseline surface water elevation and quality data will be collected from the unnamed tributary to Little Bear Creek, at the south end of the potential wetland depicted on Figure 7. Surface water samples will be tested for total suspended solids, dissolved oxygen, and temperature to evaluate the impacts of the mining operation on the local environment.

Per the landowner's statement, storm water has not been observed to flow down the valley past where the field road leaves the waterway. Areas adjacent to the tributaries of Little Bear Creek contribute runoff directly to the surface water.

Prior to the commencement of mining activities, baseline groundwater elevation and quality data will be collected from a set of three groundwater monitoring wells to be installed at the site. Two monitoring wells will be located hydraulically down-gradient from the storm water pond(s);

the third will be located northeast of the processing area. See Figure 10 for proposed monitoring well locations. Each monitoring well will be instrumented with a telemetric pressure transducer/data-logger to continuously monitor groundwater elevation. Groundwater elevation data will be automatically uploaded to a database and evaluated for trends and potentiometric surface changes.

Groundwater quality samples will be collected from monitoring wells pursuant to the Buffalo County Ordinance and will be tested for acrylamide, bacteria, nitrate, total suspended solids, turbidity, total dissolved solids, conductivity, arsenic, cadmium, calcium, chromium, cobalt, iron, lead, magnesium, manganese, pH, volatile organic compounds (VOCs), oil and grease, and other chemical constituents requested by the WDNR, Buffalo County, or the towns of Maxville and Nelson, and that are used in the mining or processing on site. Additionally, prior to commencement of mining and annually thereafter, water sampling and analysis for the same list of parameters will be offered to well owners within one-half mile of the processing site.

Mining activities will implement BMPs for water conservation methods, including recycling of process water, to reduce the withdrawal of groundwater.

1.8 Threatened and Endangered Species

The WDNR Natural Heritage Inventory (NHI) database was reviewed for the occurrence of threatened and endangered species in relation to the proposed development on the WPR property. The database was specific to the Township and Range location within Buffalo County when compared to the WPR proposed site. The information is summarized in Table 3 below and the key for the status and ranks is presented in Appendix VI.

Table 4. Threatened and Endangered Species List

Scientific Name	Common Name	State Status	Federal Status	State Rank	Global Rank	Group Name
Crystallaria asprella	Crystal Darter	END		S1	G3	Fish~
Plethobasus cyphyus	Bullhead	END	Listed End.	S1	G3	Mussel~
Sistrurus catenatus catenatus	Eastern Massasauga	END	C	S1	G3G4T3	Snake~
Cycleptus elongatus	Blue Sucker	THR		S2	G3G4	Fish~
Polyodon spathula	Paddlefish	THR		S2	G4	Fish~
Simpsonaias ambigua	Salamander Mussel	THR		S2	G3	Mussel~
Tritogonia verrucosa	Buckhorn	THR		S2	G4G5	Mussel~
Truncilla donaciformis	Fawnsfoot	THR		S1S2	G5	Mussel~
Alasmidonta marginata	Elktoe	SC/P		S3	G4	Mussel~
Haliaeetus leucocephalus	Bald Eagle	SC/P		S4B,S4N	G5	Bird~
Pituophis catenifer	Gophersnake	SC/P		S2S3	G5	Snake
Ammocrypta clara	Western Sand Darter	SC/N		S3	G3	Fish~

(Table 4 continued)

Anguilla rostrata	American Eel	SC/N		S2	G4	Fish~
Macrhybopsis storeriana	Silver Chub	SC/N		S3	G5	Fish~
Dry prairie	Dry Prairie	NA		S3	G3	Community
Oak opening	Oak Opening	NA		S1	G1	Community
Southern dry-mesic forest	Southern Dry-mesic Forest	NA		S3	G4	Community

Most of the endangered, threatened, and species of concern are aquatic animals and will not be impacted as a result of the project. The two snake species listed (Eastern Massasauga and Gophersnake) have typical habitats that are not represented in the proposed project area; however, the proposed reclamation will likely restore habitat used by the Gophersnake. Of the three communities listed for this township and range, the reclamation plan calls for restoration to Dry Prairie and Oak Opening plant communities. A formal Endangered Resources (ER) Review will be performed by a Certified ER Reviewer prior to commencement of mining activities.

1.9 Landscape

The site is located within the Western Coulee and Ridges Ecological Landscape. The Coulee and Ridges Landscape is the largest of Wisconsin's Ecological Landscapes. The vegetation is made up of a mix of forest, agriculture, grasslands, and wetlands.

The WDNR's description of the Western Coulee and Ridges Ecological Landscape notes that forests can be managed and conserved. Considerations by the DNR for planning and management include developing reliable and practical methods of regenerating and maintaining the Ecological Landscape's oak ecosystems, including oak woodlands and oak savannas.

The ecological landscape of the site is currently a mix of forest and agriculture. Typical wildlife in the area includes whitetail deer, turkeys, turtles, snakes, bats, warblers, sparrows, flycatchers, and meadowlarks.

1.10 Cultural or Historical Resources

The Wisconsin Historic Preservation Database (WHPD), which houses and allows users to access the most up-to-date information within the Wisconsin Historical Society's Archaeological Sites Inventory (ASI), Architecture and History Inventory (AHI), and the Archaeological Reports Inventory (ARI) was accessed on July 25, 2014, in order to research any previously identified archaeological and architecturally historic cultural resources within or adjacent to the property boundary. Based on the current ASI, AHI, and ARI information, two archaeological surveys have been previously conducted within the project area. No cultural resources have been identified within the project area. These surveys are described in greater detail below:

A Phase I archaeological investigation comprised of pedestrian reconnaissance (walkover) was conducted in the mid-1970s in advance of the construction of the Alma to Tremval and Alma to Crystal transmission lines (Survey No. 74-1013 in the WHPD), which included portions of the SE ¼ of Section 28 and the NE ¼ of Section 33, T24N, R13W, within the current proposed project area. No archaeological resources were identified in these areas. In 2011, a Phase I survey was undertaken for a proposed manure lagoon and sand reclamation land at Breezy Point Farms (Survey No. 11-0850 in the WHPD), which included a portion of the NW ¼ of Section 4, T23N, R13W, within the current proposed project area. Pedestrian reconnaissance was conducted within portions of the survey parcel that had been previously disturbed by heavy equipment, and shovel testing was completed in less-disturbed areas. No cultural materials were identified during the investigation, and no additional archaeological work was recommended.

2.0 Mine Plan

Proposed hours of the mining operation are 6:00 a.m. to 8:00 p.m. during Daylight Savings Time, 6:00 a.m. to 6:00 pm during Central Standard Time, Monday through Friday, 6:00 a.m. to Noon on Saturday. The processing plants are proposed to operate continuously.

2.1 Methods of Resource Removal

The basic steps to construct the bluff trail include:

- Installing silt fencing and other erosion control BMPs as needed down-slope of the trail area. Silt fencing in rocky terrain will be installed along the down-slope tree-line;
- Precision logging over the area where proppant material is present below the topsoil (approximately 80 to 200 feet wide);
- Removal of remaining vegetation and reclaiming stumps and brush as mulch material;
- Blading topsoil into a berm on the down-slope edge of the clear cut area;
- Stabilizing and seeding topsoil storage berm;
- Cutting a “wedge” into the bedrock to remove sandstone--benching and wall angle will depend on rock mechanics (assume vertical walls with benches at 35 feet);
- Sloping the terrace at a slight grade back toward the hill. The outermost edge of the excavation will be kept at the highest elevation;
- Installing a geotextile-wrapped drain pipe on the top of the first bench;
- Leaving a “trench” at the base of the wall cut to create elongate depressions (retention basins) for water storage;
- Sloping each 600-foot linear trench to a low middle point (i.e., 300 feet on each side);

- Spreading B horizon and topsoil back over terrace;
- Planting native vegetation – primarily prairie species with oak openings in a strategic pattern and leaving a narrow meandering trail for access; and
- Monitoring reclamation success and high-wall stability.

Excavation will begin once the storm water BMPs are installed, access roads are constructed, and will be coincident with the construction of processing areas. A combination of cut, crown fill, outslope, and inslope with ditch sections will need to be used for access road construction. Erosion control and sedimentation BMPs and products will meet or exceed Wisconsin Department of Transportation standards.

Mining will be accomplished to the extent practical using earthmoving equipment such as skid steers, excavators, dozers, backhoes, front-end loaders, conveyors and trucks. Machinery will utilize white noise back-up alarms and strobe lights where allowed by the United States Department of Labor Mine Safety and Health Administration (MSHA). In general, conventional excavation will be used to facilitate the extraction of the sandstone and blasting is not currently anticipated; however, blasting may be necessary if tightly cemented sandstone deposits are encountered. Blasting, if required, will be completed in compliance with Federal, State, and local laws and ordinances. Blasting will be limited to between the hours of 10:00 a.m. and 2:00 p.m. and notice will be given to residents within half a mile a minimum of 48 hours prior to blasting.

Figure 10 presents the conceptual mine plan. The operation plan calls for four separate phases ranging from 5.7 to 9.5 acres, together totaling approximately 30 acres. Mining activities will begin in Phase 1 and proceed sequentially to Phases 2, 3, and 4.

Topsoil and excavated material will be placed in separate berms on the downslope of the "wedge cut". These earthen berms will be constructed with an anticipated height of eight feet, a width of eight feet at the top and sixteen feet at the bottom. A and B horizon soil volume estimates in Table 3 indicate that adequate volumes will be available to create the berms for each mine phase, as depicted in Figure 10. To the extent possible, the A and B horizon soil berms will be isolated during the stripping operation and hydro-seeded with a protective starter vegetative cover. These berms will serve as both site screening and material storage for final reclamation.

Generally, the excavation of each phase will be completed to an approximate elevation of 1,050 feet ASL. Excavation operations will consist of: removing overburden material to an approximate elevation of 1,120 feet ASL; stockpiling material for future reclamation; and excavating the sandstone at a near vertical slope, with benches at varying heights depending on the rock mechanics. The mine manager will ultimately determine the appropriate heights, benches, and design features to minimize rock fall and maximize high-wall stabilization. If areas are encountered near property boundaries where, in the opinion of the mine manager, mining would result in unstable conditions, that area of the phase will be bypassed.

Overburden and material output from the processing plants that does not meet the product specification (out of specification) will be graded onto the terrace to achieve optimal slope and topographic relief for the oak openings. This includes under-sized and over-sized material from the sandstone that was transported by conveyor. The operator will decide the product specifications based on current market conditions (generally, U.S. Standard Sieve sizes 20 to 140).

The terrace will remain at the final mined elevation, and will be reclaimed to a level 3:1 floor, or terrace level. Figure 11 illustrates the proposed conceptual final contour topography of the site post mining. Figure 11 also shows the location of the transect (A to A') used to create a cross section that illustrates the original site surface, extent of mining, and proposed reclaimed surface concepts (terraces) presented on Figure 12. The proposed mine phases will extend 80 to 200 feet laterally into the bedrock, with an average width of approximately 120 feet. The overall dimensions of cross sections will vary with the existent topography.

Phase 2 will be mined according to this sequence, with the exception of providing required setback from the Dairyland Power Cooperative pole structures, anchoring devices, and transmission and conductor wires, and maintaining a continuous roadway to each pole site composed of compacted surfaces 12 to 16 feet wide (per Appendix IV).

Phase 1 A and B horizons will be stockpiled in berms on the down-hill side of the access road built along the lower contour. Sandstone material excavated from Phase 1 will be transported via conveyor or truck to the wet processing plant. Out of specification material from Phase 1 will be used to complete the reclaimed elevation of Phase 1. This succession will be repeated until sandstone has been excavated from all phases. This site operation will be completed within three to six years dependent on market conditions.

2.2 Processing Methods

The processing area, approximately 50 acres, will be located on the south-central portion of the mining area. A conceptual layout is depicted on Figure 10A. The processing area footprint will include space for the wet and dry processing equipment, settling ponds, storm water ponds, stockpiles, an office/scale building, access roads, and parking. Wet processing equipment may include conveyors, screeners, crushers, a hydrosizer, a water tank, a clarifier tank, and belt or plate presses. Dry processing may include dryers, screeners, air filters, blowers, a bag house, and scrubbers. The processing area and processing procedures are described below:

- The processing area will be prepared by grading top soil into separate A- and B-horizon berms, stabilized by seeding and mulching.
- Erosion and storm water BMPs will be installed, as illustrated in Figures 10 and 10A, including top soil berms and silt fencing.

- Storm water ponds and detention areas capable of managing a 25-year, 24-hour precipitation event, plus a catastrophic release from the water tank, will be constructed at the lower elevations of the processing area (Figure 10A);
- Up to three settling ponds will be constructed on the east side of the processing area. The lined ponds will be designed in series, with an approximate volume of 2 million gallons each, and a maximum depth of six feet. Geotechnical borings will be advanced to evaluate substrate materials in order to design the geotextile liner system appropriate for the settling pond areas. Water/fines will be conveyed through HPDE pipe to the first settling pond. A system of culverts and valves will connect the ponds and will be used to increase residence time or provide for more water storage, as necessary. Water will be pumped back from the settling ponds to the water storage tank once turbidity criteria are met in the settling pond system. An example of settling pond design is included in Appendix VIII. Liner installation will follow the "Pond Liner Design, Decision Flowchart", Appendix D (page 17) of the NRCS Wet Detention Pond Standard 2001.
- Processing equipment will be erected;
- The wet and dry processing facilities, sand stockpiles, and the water tank will be constructed on concrete slab. The remainder of the processing area will be surfaced with crushed aggregate (Prairie du Chien dolomite).
- A high-capacity well will be drilled and installed to fill the water tank;
- Raw sand will be transported to the processing area by conveyor and truck;
- Sand will be screened to remove sand over-size material, which is sent to a crusher and rescreened;
- Screened/crushed sand will be loaded into the hydrosizer via conveyor;
- Water from a storage tank will be pumped through the hydrosizer to sort the sand into various products;
- Sand at the desired size range will emerge from the hydrosizer and be piled via conveyor – the excess water will gravity-drain into the make-up water pond system and be pumped back into the water tank;
- Sand, silt, and clay that is finer than the desired sand size (fines) will flow out of the hydrosizer to the settling ponds;
- Due to the low percentage of silt and clay sized particles in the mined material, processing will generate less fines than most other processing facilities in Wisconsin. It is the intent of the operators not to use flocculants. However, food-grade flocculants may be used, in which case a fines management plan will be developed and furnished to the County.
- The intent of the settling pond/clarifier system will be to recirculate water for re-use to minimize the amount of groundwater pumping. The system will be designed to exceed 95% reuse, not including water contained in the material prior to drying or evaporation.
- Sediment accumulated within the settling ponds will be removed by excavation approximately once per year. Fines removed from the settling ponds may be mixed with

the B horizon soils prior to the replacement of the B horizon onto the reclamation area. The fines will be tested for the presence of acrylamides prior to the mixing and first application of the B horizon and fines, and once every 50,000 cubic yards of fines applied.

- Alternatively, the sand, silt, and clay that is finer than the desired sand size (fines) may flow out of the hydrosizer to a clarification tank;
- Food-grade flocculants may be added to the clarifier tank to separate the water and the fines;
- The fines will be mechanically moved from the clarifier to the press, where remaining water will be squeezed from the fines and then gravity-drained into the make-up water pond;
- Dewatered fines from the filter press will be stockpiled for reuse as reclamation material as needed. The dewatered fines will be tested for the presence of acrylamides prior to the mixing and first application of the B horizon and fines, and once every 50,000 cubic yards of fines applied.
- The sand will then either be dried and loaded or loaded moist to trucks for offsite transport.

2.3 Volumes

The total estimated resource volume for raw sandstone is approximately 3.2 million tons. This volume was estimated using data obtained from exploration test-borings and the Spatial Analyst Extension in ESRI's ArcGIS software, modified to calculate volumes taking into account the topography. The estimated raw sand resource for each phase is presented in Table 4.

Table 5. Estimated Sandstone Resource Volumes

Phase	Approx. Acres	Cubic Yards of Sandstone	Tons of Sandstone
1	5.7	460,000	644,000
2	6.3	508,000	711,200
3	9.5	670,000	938,000
4	9	630,000	882,000
Total	**30.5**	**2,268,000**	**3,175,200**

2.4 Storm Water Management and Erosion Control

Storm water from areas of active mine operation will be internally drained onsite and retention structures will control off site discharges consistent with pre-mining conditions. The

permeability of the exposed sandstone during the excavation will be a significant factor in preventing sheet or underflow. Storm water discharge permits and runoff management will comply with NR 216 and NR 151, respectively. An application for coverage under the Wisconsin Pollutant Discharge Elimination System (WPDES) generalized permit No. WI-0046515-5 will be submitted to the WDNR and is included as Appendix VII.

Prior to construction or mining within a drainage area, the offsite receiving areas will be protected by the installation and construction of appropriate erosion control BMPs, in accordance with the guidelines provided in the WDNR Conservation Practice Standards (Appendix VIII or current edition).

Storm water basins within the processing area (Figure 10A) will be designed to retain a 25-year, 24-hour event and a catastrophic release of water from the water tank. In a worst case scenario, with the largest mine phase in the drainage basin open (Phase 2, 6.3 acres), the difference in exposed surface substrate between pre- and post-mining conditions (including the 50-acre processing area) would generate approximately 1,250,000 additional gallons of storm water runoff during a 25-year, 24-hour event (3.5 inches). The watershed would have previously had an estimated 6,732,000 gallons of runoff during such an event. Calculations have used the parameters based on "fair" soils, as described in the NRCS Technical Release 55 (TR-55). It is recommended that a site evaluation for storm water infiltration be undertaken (NRCS 1002, Appendix VIII), with construction of appropriate infiltration devices (i.e., storm water detention areas) to manage up to an additional 1,250,000 gallons of storm water on site. See Appendix IX for details on the storm water calculations and reference information.

Where necessary to protect offsite drainage areas, diversion channels will be installed to route storm water run-off to the constructed storm water basins. Temporary erosion control measures employed at the site may include: (pertinent WDNR Conservation Practice Standards are noted in parentheses and a copy can be found in Appendix VIII)

- Mine roads outside the active mine area will employ silt fence or lined channels as necessary (Silt Fence - 1056, Channel Erosion Mat - 1053).

- Erosion bales and sediment logs will be placed as ditch checks in swales and ditches (Ditch Checks - 1062, Sediment Bale Barrier - 1055).

- Silt fence will be installed at road perimeters, the edges of berms and stockpiles around the processing area, and outside the active mine area where it is not protected by previously installed erosion control measures (Silt Fence - 1056).

- Seed and mulch will be applied to berms, permanent stockpiles, diversions, channels, road slopes, pond slopes located outside the active mine area, and mine area that is no longer active (Seeding - 1059, Mulch - 1058).

- Temporary erosion control seeding is discussed in Sec 2.5.

- Final reclamation seeding is discussed in Section 3.2.
- Erosion mats will be placed in concentrated flow channels and on slopes greater than 4:1 (Channel Erosion Mat - 1053, Non-channel Erosion Mat - 1052).
- Rock rip-rap will be placed where necessary as ditch checks, channel liners, and at inlet/outlet structures (Ditch Checks - 1062).
- Stone tracking pads will be used at the site access point during initial construction. The site access road entrance will be paved to prevent offsite sediment deposition (Stone Tracking Pad - 1057).

Erosion control BMPs and the geotextile-wrapped tile line at the top of the mining area will be inspected weekly and within 24 hours after rainfall events of one-half inch or greater until the drainage area has been either temporarily or permanently reclaimed. Inspection will be documented on a Construction Site Inspection Form (Form 3400-187, Appendix VIII). In the event of slope failures, failed seeding, plugging, or persistent erosion problems, additional BMPs will be assessed and applied where practicable. BMPs may include repair, replacement, hydro-seeding, silt fence, erosion control mats, turf reinforcement mats, water diversions, rock-lined chutes, slope breaks, soil stabilizers, and inlet protection.

Sediment that has accumulated behind or in the bottom of an erosion control structure will be removed and mixed with out-of-specification material in the processing area prior to spreading for reclamation purposes.

Storm water on the proposed project site is regulated by the WDNR and Buffalo County. Mine operation shall be conducted in a manner that assures compliance with applicable water quality and storm water management requirements.

2.5 Temporary Erosion Control Vegetation Plan

Temporary stabilization seeding, followed by mulching, will be used to provide erosion control where disturbed areas require vegetation and are not at final reclamation grade or at prime season (Spring or Fall). Annual Rye Grass (*Lolium multiflorum)*, sown at a rate of approximately 20 pounds per acre, is quick to germinate, providing fast-growing vegetative cover even in areas where topsoil has not been placed yet. Seeding for each disturbed area will follow best available methods, as described in Section 630 of the Wisconsin Department of Transportation Standard Specification for Highway and Structure Construction and Chapter 6, Section 40 of the Construction and Materials Manual (Appendix X or current edition). After seeding, areas will be mulched using the best available methods and will follow procedures described in Section 627 of the WisDOT Standard Specifications (Appendix X).

Erosion control BMPs will be inspected by the operator weekly and within 24 hours after rainfall events of one-half inch or grater until the area has been permanently reclaimed. Inspection will

be documented on a Construction Site Inspection Form (Form 3400-187, Appendix VIII). In the event of slope failures, failed seeding, or persistent erosion problems, additional BMPs will be assessed and applied where practicable. BMPs may include: hydro-seeding, silt fence, erosion control mats, turf reinforcement mats, water diversions, rock-lined chutes, slope breaks, soil stabilizers, and inlet protection.

2.6 Site Safety and Monitoring

Measures that address public safety on and off site, such as warning signs and fencing, will be implemented according to MSHA, the Occupational Safety and Health Administration, and WisDOT standards. The property lines of active phases will be clearly identified and posted with warning signs at 50-foot intervals. The entrance will be secured by a locked gate of sufficient size to preclude vehicular access.

Dust control will be implemented consistent with NR 415.075. Air quality will be monitored at several locations considering prevailing up- and down-wind conditions.

An annual summary of environmental monitoring results will be submitted to Buffalo County by January 31st for the previous calendar year.

3.0 Post Mining Land Use

The result of mining will be a bluff trail winding through a terrace of Dry Prairie and Oak Opening beneath Dry Cliff and Moist Cliff communities. Figure 13 shows a plan view of the bluff trail concept for this site. The trail will provide bluff access to the landowner for recreational purposes and provide a corridor for wildlife. A meandering berm will be created along the outside portion to form soft edges and topographic relief for wildlife. The berm will also be vegetated to create Dry Prairie and Oak Openings plant communities. The access road will not be reclaimed and will be maintained for access to the bluff trail. The processing and staging/loading areas will be reclaimed into agricultural use.

3.1 Reclamation Measures

Reclamation will start immediately upon initiating mining activities and continue throughout the sand extraction process. Approximately four phases of mining will be conducted over a four- to six-year period as shown on Figure 10. The approximate area of each phase is presented in Table 6.

Table 6. Mining Phase Areas

Phase	Approximate Area (Acres)
Phase 1	5.7
Phase 2	6.3
Phase 3	9.5
Phase 4	9
Total Mining	**30.5**
Access Roads	5
Processing & Staging/Loading	49.5
Total Disturbed	**85**

The trail will be constructed in each phase by clearing a 140-foot wide area on the hillside over the Jordan sandstone. An initial bench 50 feet wide and sloped at 3% toward the hillside will be constructed at the base of the excavation. The thin veneer of organic matter and stony and rocky soil above the 1,050 ASL contour will be bermed at least eight feet from the downhill cut by maintaining 3:1 slopes and a maximum height of six feet (Figures 14A through 14D). BMPs will be employed throughout the mining process to minimize the potential for erosion beneath the contour cut. Measures, including seeding with Annual Rye Grass and mulching the berms, will be implemented to prevent erosion. Final shaping and seeding of the berms will occur at the conclusion of each phase of mining.

A 3% slope into the hillside will be constructed and, coupled with the high permeability sand, will prevent storm water from leaving the mining area. Thus, mine construction will reduce the existing erosional processes and stabilize the bluff over the long term. A six-foot deep ditch will be constructed at the base of the lower headwall to serve as a catchment for slough and to provide additional water storage. As each phase of mining progresses, the ditch will be alternately sloped at 3% along the contour on 300 foot centers (for a "wavelength" of 600 feet). Creating slightly different elevations within the ditch will prevent storm water from flowing parallel to the cut, out of a single mining phase.

Figures 14A through 14D depict examples of the varying potential width of the lower bench/trail. Figure 14C specifically illustrates a non-vertical high wall in the event of possible stability concerns.

Topsoil will be applied (if necessary) on the berm area on the outer slope. This area will then be seeded, mulched, and planted with native seed mixes (Dry Prairie and Oak Savanna mixes appropriate to the local area). Oak seedlings will be added in the areas seeded for Oak Savanna. The wooded area below the trail bench will be thinned to allow sufficient sunlight to penetrate to

the berm and trail area to support successful growth of the native seed mixes. Thinning will emphasize removal of buckthorn and non-native tree species. Areas adjacent to the hillside will be shaped and seeded with a specialized mix that includes species for Dry/Moist Cliff communities.

Mining refuse will be reused and recycled whenever possible. Other solid wastes will be disposed of in accordance with applicable rules of the Wisconsin Department of Natural Resources adopted pursuant to Chapters 289 and 291 of the Wisconsin Statutes.

The site will be reclaimed in a manner so as to comply with federal, state, and local regulations governing public health, safety, and welfare. Reclamation will comply with any applicable federal, state, and local laws including those related to environmental protection, zoning, and land use control.

The processing area footprint will be active during the lifetime of the progressive mining program. Soil and overburden stockpiles will be seeded within 72 hours of completion of final grading. Out of specification material from the material conveyed to the site will be used to reclaim a natural rolling landscape to eventually promote natural drainage into Little Bear Creek.

Roads will be designed to create access to new phases, leaving prior excavated phases undisturbed, and allowing a succession of final reclamation to begin as soon as possible. Final reclamation plans of particular phases will be designed appropriately for elevation, slopes, surface water detention and drainage patterns, and the pre-existing conditions.

As restoration efforts begin, out of specification material and overburden will be used for fill material to establish necessary grades. The soil profile will be replaced, disked, and raked after final grading on each reclamation area. During replacement, the subsoil and topsoil will be tilled up to 24 inches to break up compaction, increase rooting depth, and create surface stability. The A and B horizon soils (stockpiled separately) will be placed with care to maintain the horizon sequence to the extent possible. Fines removed from the settling ponds may be mixed with the B horizon soils prior to the replacement of the B horizon onto the reclamation area. The dewatered fines will be tested for the presence of acrylamides prior to the mixing and first application of the B horizon and fines, and once every 50,000 cubic yards of fines produced.

Soil tests providing information such as pH, organic matter content, soil texture, and levels of nitrogen, potassium and phosphorous will be used to develop soil amendment protocols, such as compost and fertilizer. Areas that have been treated with temporary seeding may need to be disked or tilled prior to planting of final seed mix to encourage permanent vegetation growth. All amendments, seeding, and planting will be carried out using local NRCS standards and in accordance with the Wisconsin Agronomy Technical Note 5 (Appendix VIII or current edition).

The mine floor will be reclaimed with 3:1 slopes back into the hillside. The top of the reclaimed surface will be graded to a slightly rolling surface suitable for planting native vegetation. Slopes

will be no steeper than 3:1 slope, and will be seeded, mulched, and protected from erosion using NRCS and WisDOT BMPs (Appendices VIII and X, respectively). A combination of silt fencing, hay bales, and ditch checks will be placed around areas with newly-placed topsoil to help minimize loss of soil and to protect onsite surface water.

Erosion control BMPs will be inspected by the operator weekly and within 24 hours after rainfall events of one-half inch or greater until the area has been permanently reclaimed. Inspection will be documented on a Construction Site Inspection Form (Form 3400-187, Appendix VIII). In the event of slope failures, failed seeding, or persistent erosion problems, additional BMPs will be assessed and applied where practicable. BMPs may include: hydro-seeding, silt fence, erosion control mats, turf reinforcement mats, water diversions, rock-lined chutes, slope breaks, soil stabilizers, and inlet protection.

Soil and topsoil will be hauled from excavation areas or stockpiles via truck and will be worked using dozers, graders, and/or skid loaders to achieve rough grades and final grades. Water will be used to control dust and aid in compaction. Topsoil will be watered but not otherwise compacted.

3.2 Revegetation Plan

Figure 13 illustrates the reclamation and revegetation approach that will be implemented at the site. The objectives include:

- Restore plant communities and species that are native to the site and can be successfully established and sustained on the reclaimed area;
- Increase the diversity of native habitats; and,
- Blend with the existing plant communities adjacent to the mined area.

Native plant communities that exist in Buffalo County and are proposed for establishment on the site include Dry Prairie, Oak Openings, and Moist/Dry Cliff. Diverse Dry Prairie and Oak Savanna seed mixes, including a species mix appropriate to the local area and site conditions, will be sown on the berm areas. Prairie seed mix will be sown and mulched as the ground cover. Oak saplings (approximately 1” caliper) will be added and randomly planted and staked in the areas seeded with oak savanna seed mix.

Proposed seed mixes and plant lists are presented in Sections 3.2.1 through 3.2.4. Establishing permanent vegetation will follow the NCRS Critical Planting Code 342 and Wisconsin Agronomy Technical Note 5 (Appendix VIII or current edition). If broadcast seeding is necessary due to site conditions, rate of seeding will be doubled. See Section 3.4 for criteria to be used to analyze successful reclamation.

Reclaimed dry prairie acreage will be mowed (to a height of approximately six inches) twice in the each of the first two growing seasons after seeding, and once in the third growing season to

enhance seed establishment and minimized weeds. Maintenance through Year 5 after revegetation will consist of an annual invasive species survey/removal. Invasive species may include, but not be limited to: Garlic mustard (*Alliaria petiolate);* Musk thistle (*Carduus nutans);* Spotted knapweed (*Centaurea maculosa);* Canada thistle (*Cirsium arvense);* Bull thistle (*Cirsium vulgare);* Field bindweed (*Convolvulus arvensis);* Leafy spurge (*Euphorbia esula);* Sweetclover (*Melilotus species);* Wild parsnip (*Pastinaca sativa);* and Common buckthorn (*Rhamnus cathartica).* Prescribed burn of prairie acreage will follow a Prescribed Burn Plan (site-specific to the parcel size, topography, weather conditions, etc.) approved under NCRS BMPs.

Areas adjacent to the mined slopes will be selected for development of Moist/Dry Cliff communities. Topsoil will be added in these areas. A specialized native seed mix including moist/dry cliff forbs will be seeded in the areas. The mix will include species for both moist and dry cliff communities; seeds will self-select and adapt to the moisture conditions in the seeded areas.

3.2.1 Dry Prairie Reclamation

Areas with dry prairie as reclamation land use (approximately 18 acres) will be revegetated following the final grading by drill seeding, which will be completed into graded, disked and cultipacked areas within 72 hours of topsoil reapplication, prior to the next growing season. Canada Wild Rye and Sideoats Grama will be seeded along with the prairie seed mix as companion crops to stabilize the site against erosion, to decrease competition from weeds, and to provide shade and cover for prairie species seedlings in the first two years. The native plant species will become more prevalent in subsequent years.

The Dry Prairie seed mix will be drill-seeded at a rate of approximately 6.5 pounds per acre, or the amount necessary to maintain a minimum of 60 seeds per square foot (at least 50% of which must be grasses). A conceptual list of species for this seed mix appears in Table 7. If broadcast seeding is necessary due to site conditions, rate of seeding will be doubled. See Section 3.4 for criteria to be used to analyze successful reclamation. Reclaimed dry prairie acreage will be mowed (to a height of approximately six inches) twice in the each of the first two growing seasons after seeding, and once in the third growing season. Invasive species removal will be undertaken for the first five growing seasons.

Table 7. Conceptual List of Species for Reclaimed Dry Prairie

	Common Name	Scientific Name	Approx. PLS ounces per acre
Grasses	Canada Wild Rye	*Elymus Canadensis*	16.0
	Sideoats Grama	*Gouteloua curtipendula*	32.0
	Big Bluestem	*Andropogon gerardii*	8.0
	Sand dropseed	*Sporobolus cryptandrus*	4.0
	Prairie June Grass	*Koeleria macrantha*	4.0
Forbs	Purple Prairie Clover	*Dalea (Petalostemum) purpurea*	6.0
	Stiff Goldenrod	*Oligoneuron rigidum*	4.0
	Silky Aster	*Symphyotrichum sericeum*	3.0
	Butterflyweed	*Asclepias tuberosa*	3.0
	Partridge-pea	*Chamaecrista (Cassia) fasciculate*	3.0
	Hoary Vervain	*Verbena stricta*	3.0
	Flowering Spurge	*Euphorbia corollata*	3.0
	Western Sunflower	*Helianthus occidentaalis*	3.0
	Rough Blazingstar	*Liatris aspera*	3.0
	Spotted Mint	*Monarda punctate*	3.0
	Yellow Coneflower	*Ratibida pinnata*	3.0
	Spiderwort	*Tradescantia ohiensis*	3.0

PLS: Pure Live Seed

3.2.2 Oak Openings (Savanna) Reclamation

Areas with Oak Openings as reclamation land use (approximately 7 acres) will be revegetated following the final grading by drill seeding, which will be completed into graded, disked and cultipacked areas within 72 hours of topsoil reapplication, prior to the next growing season. Canada Wild Rye will be seeded, along with a basic dry prairie seed mix, as a companion crop to stabilize the site against erosion, to decrease competition from weeds, and to provide shade and cover for prairie species seedlings in the first two years. The native plant species will become more prevalent in subsequent years.

The Oak Openings (Savanna) seed mix will be drill-seeded at a rate of approximately 6.5 pounds per acre, or the amount necessary to maintain a minimum of 60 seeds per square foot (at least 50% of which must be grasses). A conceptual list of species for this seed mix appears in Table 8. If broadcast seeding is necessary due to site conditions, rate of seeding will be doubled. See Section 3.4 for criteria to be used to analyze successful reclamation. Reclaimed oak openings acreage will be mowed (to a height of approximately six inches) twice in the each of the first two growing seasons after seeding, and once in the third growing season. Invasive species removal will be done for the first five growing seasons.

Table 8. Conceptual List of Species for Reclaimed Oak Openings (Savanna)

	Common Name	Scientific Name	Approx. PLS ounces per acre
Grasses	Big Bluestem	*Andropogon gerardi*	20.0
	Canada Wild Rye	*Elymus Canadensis*	20.0
	Indiangrass	*Sorgastrum nutans*	20.0
	Little Bluestem	*Schizachyrium scoparium*	32.0
Forbs	Stiff Goldenrod	*Solidago rigida*	3.0
	Purple Prairie Clover	*Dalea purpurea*	4.0
	Yellow Cone Flower	*Ratibida pinnata*	3.0
	Wild Bergamot	*Monarda fistulosa*	2.0

PLS: Pure Live Seed

Saplings (approximately 1" caliper) will be planted and staked during the second growing season at a rate of 120 per acre. Sapling species may include: Burr Oak, *Quercus macrocarpa*; White Oak, *Quercus alba*; and Black Oak, *Quercus velutina*. See Section 3.4 for criteria to be used to analyze successful reclamation of the Oak Openings.

3.2.3 Wet/Dry Cliff Community Reclamation

Approximately five acres are proposed to be reclaimed to Wet/Dry Cliff Communities. A conceptual list of species for this seed mix appears in Table 9. These areas will be hand seeded due to the uneven nature of the cliff community environments; they will be seeded at a rate of approximately 10 pounds per acre. See Section 3.4 for criteria to be used to analyze successful reclamation.

Table 9. Conceptual List of Species for Wet/Dry Cliff Communities

	Common Name	Scientific Name	Approx. PLS ounces per acre
Grasses and Sedges	Virginia Wild Rye	*Elymus virginicus*	24
	Silky Wild Rye	*Elymus villosus*	16
	Beak Grass	*Diarrhena obovate*	16
	Bottlebrush Grass	*Elymus hystrix*	8
	Common Wood Sedge	*Carex blanda*	8
	Wood Gray Sedge	*Carex grisea*	8
	Hairy Wood Chess	*Bromus pubescens*	8
	Wood Reed Grass	*Cinna arundinacea*	8
Wildflowers/Forbs	Columbine	*Aquilegia Canadensis*	6
	Red Baneberry	*Actaea rubra*	6
	Wild Leek	*Allium tricoccum*	5
	Wild Ginger	*Asarum canadense*	5
	Jack-in-the-Pulpit	*Arisaema triphyllum*	5
	Tall Bellflower	*Campanula Americana*	5
	Blue Cohosh	*Caulophyllum thalictroides*	4
	Wild Geranium	*Geranium maculatum*	4
	Virginia bluebells	*Mertensia virginica*	4
	Solomon's Seal	*Ploygonum virginianum*	4
	Bloodroot	*Sanguinaria Canadensis*	4
	Early Meadow Rue	*Thalictrum dioicum*	3
	Jacob's Ladder	*Polemonium reptans*	3
	Sweet Cicely	*Osmorhiza claytonia*	3
	Pointed-leaved Tick Trefoil	*Desmodium glutinosum*	3

PLS: Pure Live Seed

3.2.4 Processing Area Reclamation

The processing area will be utilized by the landowner post-mining for equipment storage, recreation, and agriculture. Topsoil that is graded, bermed, and stabilized at the time of construction will be spread over the area to be re-vegetated. Excess topsoil will be used to reclaim areas of the access roads not utilized as field or bluff-trail access roads. The soil profile (subsoil and a minimum of 12 inches of topsoil), if disturbed during the construction and operation phases, will be replaced. During replacement, the subsoil and topsoil will be tilled up to 24 inches to break up compaction, increase rooting depth and create surface stability. Topsoil will be placed with the care to maintain the horizon sequence to the extent possible.

Soil tests providing information such as pH, organic matter content, soil texture, and levels of nitrogen, potassium and phosphorous will be used to develop soil amendment protocols, such as compost and fertilizer. All amendments, seeding, and planting will be carried out by the operator

or a subcontractor using local NRCS recommended technical guides (Appendix VIII or current edition).

In the final two years of the project, settled fines may not be removed from the settling ponds, in order to allow these areas to partially fill in. The settling ponds will be further reclaimed after project completion by redistributing stockpiled topsoil to a minimum depth of 12 inches and reclaiming the area for agricultural land use. The storm water pond(s) will remain for recreational use.

Drill seeding will be used to plant the stabilization and forage seed mix specified in Table 10 throughout the reclaimed processing and staging/loading area. It will be seeded at a rate of approximately 14 pounds per acre. Canada Wild Rye will act as nurse crop in the first year to stabilize the site against erosion, to decrease competition from weeds, and to provide shade and cover for perennial seedlings. The forage grasses will act in Years 2 through 4 to build the plant root structure and improve the soil profile. Landowners may leave the acreage reclaimed with this seed mix as pastured agricultural land, or may use this acreage as agricultural cropland as early as the third year after reclamation seeding. See Section 3.4 for criteria to be used to analyze successful reclamation.

Based on the suitability of the soil to assure viable seed germination and survivability, an organic mat of hay/straw will be applied after seeding. Typically, depending on the site conditions, up to 5 tons of mulch per acre could be used. The mulch cover will be applied so as to be loose enough to allow some sunlight to penetrate yet thick enough to provide shade and protection from desiccation and raindrop impact and erosion.

Table 10. Conceptual List of Stabilization and Forage Species

Common Name	Scientific Name	Pounds per Acre
Canada Wild Rye	*Elymus Canadensis*	2
Annual Rye Grass	*Lolium multiflorum*	2
Timothy	*Phleum pretense*	1
Tall Fescue	*Festuca aundinaceae*	1.5
Alsike Clover*	*Trifolium hybridum*	2
Red Clover*	*Trifolium praetense*	2
Alfalfa*	*Medicago sativa*	2.5
White Clover*	*Trifolium repens*	2
	Total	14

* Must be inoculated according to the seed provider's instruction prior to seeding

3.3 Soil and Vegetation Monitoring

Monitoring and management of revegetation establishment will be carried out by Summit for five years, in compliance with NRCS Critical Area Planting Code 342 (Appendix VIII or current

edition), the project's objectives, and to correct results in order to meet successful reclamation criteria. Specific sampling units on reshaped vegetated slopes and in open seeded areas will be identified and monitored yearly via seasonal field visits and using field forms and logged photo documentation.

Soil monitoring will include establishment of sample plots on the site at the rate of one plot per 10 acres. Each plot will be a circular area with a radius of approximately one meter. Monitors will measure moist bulk density and soil strength of reconstructed soil. Testing of macro nutrients, such as nitrogen, phosphorous, potassium, calcium, magnesium and sulfur, as well as trace elements including iron, manganese, copper and zinc will be performed.

If the inventory indicates soil compaction or a lack of nutrient concentrations that promote successful plant growth, incorporation of soil treatments and application of necessary organic amendments such as manure, compost, and mulch will be applied. Buffalo County will be notified prior to completion of monitoring events.

3.4 Criteria for Successful Reclamation

Annual inspections of reclaimed acreage will be conducted by Summit to measure density and diversity of vegetative growth. A transect survey of the reclaimed area will be completed, with a minimum of 10 random GIS points per acre. Each point will be set in a random direction, with degrees documented with weather, date, and time. In the random direction, measurement of 50 feet will be taken, with data collected from every half foot. The onsite inspections will be documented through reports and photo monitoring to evaluate the following protocols:

1. For Dry Prairie, Oak Openings, and Wet/Dry Cliff areas, total perennial vegetation cover of at least 70% (90% of 70% of points);
2. For Dry Prairie, Oak Openings, and Wet/Dry cliff areas, total relative cover of grasses to be between 20% and 90%;
3. For Dry Prairie, Oak Openings, and Wet/Dry Cliff areas, at least five species of perennial grasses will each comprise at least 5% of the cover;
4. For Dry Prairie, Oak Openings, and Wet/Dry Cliff areas, at least five species of forbs/wildflowers will each comprise at least 5% of the cover; and
5. For Oak Opening areas, oak saplings will be measured for growth and survival percentage.
6. For reclaimed agricultural (pasture or crop) areas, productivity will return to at least 75% of the pre-mining productivity by the third year post-reclamation.

An annual reclamation report and activities plan will be prepared and submitted by January 31st of each calendar year. The report will be developed to meet the requirements of NR135.36 and will include information to document:

- The extent of current mine development;
- The existing groundwater elevations, as recorded quarterly at the groundwater monitoring wells;

- The results of reclamation and storm water facility site inspections completed during the reporting period;
- The results of storm water discharge monitoring;
- The reclamation and storm water management activities planned during the next calendar year;
- A daily record of the type, volume, and use of material brought to the mine for reclamation; and
- Reevaluation of financial assurance based on the past year's operation.

3.5 Landscape Reclamation Costs

Landscape reclamation costs are estimated to be approximately $784,650 for the entire disturbed acreage on the project site. Because mining will be undertaken in phases, there will not be more than the acreage of one phase (maximum 9.5 acres) open at one time. For any given year, the estimated landscape reclamation costs would include: the cost of reclaiming the processing area ($147,500); the long-term maintenance cost ($30,000); and the cost of reclaiming the number of current mine acres open ($523,400/30 = average cost to reclaim a quarried acre = $17,447 x the number of acres open). For example, during Phase 2, the estimated cost of landscape restoration for the entire site would be $147,500 + $30,000 + $17,447 per acre x 9.5 acres ($165,746), or a total of $343,246. Descriptions of reclamation items and costs appear in Table 11.

Table 11. Estimated Landscape Reclamation Costs

Reclamation Item	Item Description	Item Unit Cost	Units	Number of Units	Reclamation Cost
Dry Prairie - approximately 18 acres	Topsoil preparation – final grading, discing	$7,000	acre	18	$126,000
	Weed-free mulch (approx. 5 tons/acre)	$1,250	acre	18	$22,500
	Prairie Seed Mix (with Canada Wild Rye and Sideoats Grama nurse crops) and drill seeding	$1,350	acre	18	$24,300
	Mowing (2x in Years 1 and 2; once in Year 3)	$500	acre	18	$9,000
	Invasive species removal (Years 1-5)	$1,000	acre	18	$18,000
	Prescribed burn plan and implementation	$50	acre	18	$900
Oak Openings - approximately 7 acres	Topsoil preparation – final grading, discing	$7,000	acre	7	$49,000
	Weed-free mulch (approx. 5 tons/acre)	$1,250	acre	7	$8,750
	Oak Savanna Seed Mix (with Canada Wild Rye as nurse crop) and drill seeding	$1,600	acre	7	$11,200
	Oak saplings (1” caliper), approx. 120/acre, planted and staked	$24,000	acre	7	$168,000
	Mowing (2x in Years 1 and 2: once in Year 3)	$1,000	acre	7	$7,000
	Invasive species removal (Years 1-5)	$1,000	acre	7	$7,000
Wet/Dry Cliff Communities - approximately 5 acres	Topsoil preparation – final grading, discing	$7,000	acre	5	$35,000
	Weed-free mulch (approx. 5 tons/acre)	$1,250	acre	5	$6,250
	Wet/Dry Cliff Communities Seed Mix	$5,100	acre	5	$25,500
	Invasive species removal (Years 1-5)	$1,000	acre	5	$5,000
Agricultural Use - approximately 50 acres	Topsoil preparation – final grading, discing	$1,000	acre	50	$50,000
	Soil testing and amendment	$800	acre	50	$32,000
	Weed-free mulch (approx. 5 tons/acre)	$1,250	acre	50	$62,500
	Stabilization and forage seed mix and drill seeding	$300	acre	50	$15,000
	Invasive species removal (Years 1 and 2)	$400	acre	50	$20,000

(Table 11 continued)

Temporary Vegetation Erosion Control	Assumption: need to cover 30 acres; seed at 20 lb/acre; mulch at 5 tons/acre;	$1,275	acre	30	$38,250
Erosion Control Measures	Rip Rap Erosion Lining, Erosion Mat on Slopes, Drainage Swales	$450	acre	30	$13,500
Long Term Care and Maintenance	Site Monitoring and Reporting	$6,000	year	5	$30,000
				Total Estimated Landscape Reclamation Cost:	**$784,650**

This report and activity plan will be used by the mine operator and regulatory authorities to: systematically record, plan, and schedule construction activities that will be used to meet reclamation performance standards; schedule operational inspections and maintenance activities; and systematically document for the public the site conditions and current compliance with permit conditions.

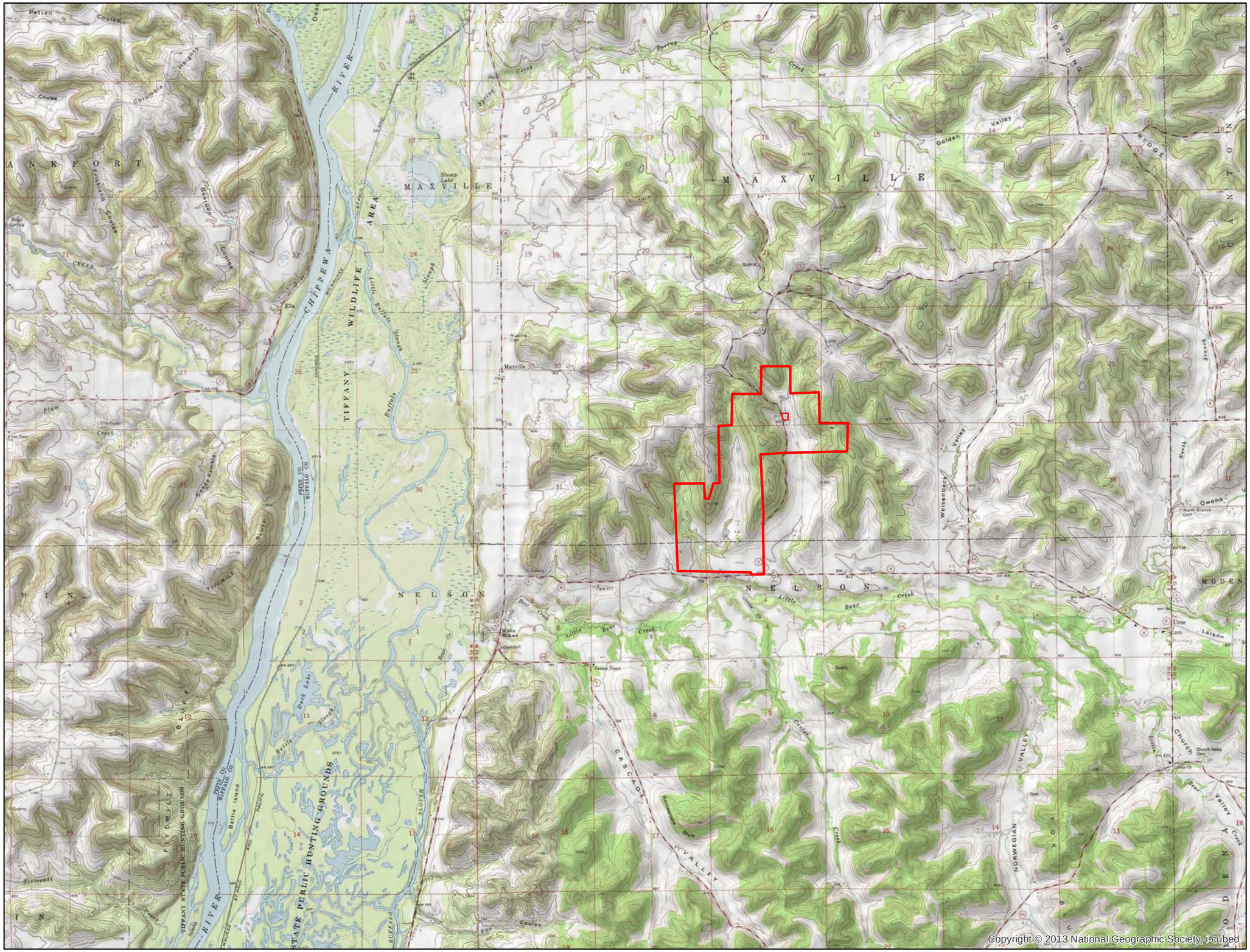
These proposed final post-mine land uses comply with applicable current federal, state, and local laws.

4.0 Certification of Reclamation Plan

The owner hereby certifies that reclamation will be carried out in accordance with the reclamation plan and that the post-mining land use complies with federal, state, and local laws in effect at the time of the submittal.

Eric Clement _____
Operator
Wisconsin Proppant Resources, Inc.

Deric J. Lindstrom _____
Property Owner



Legend

Breezy Point Properties

N
W E
S

0 0.5 1 2

Miles

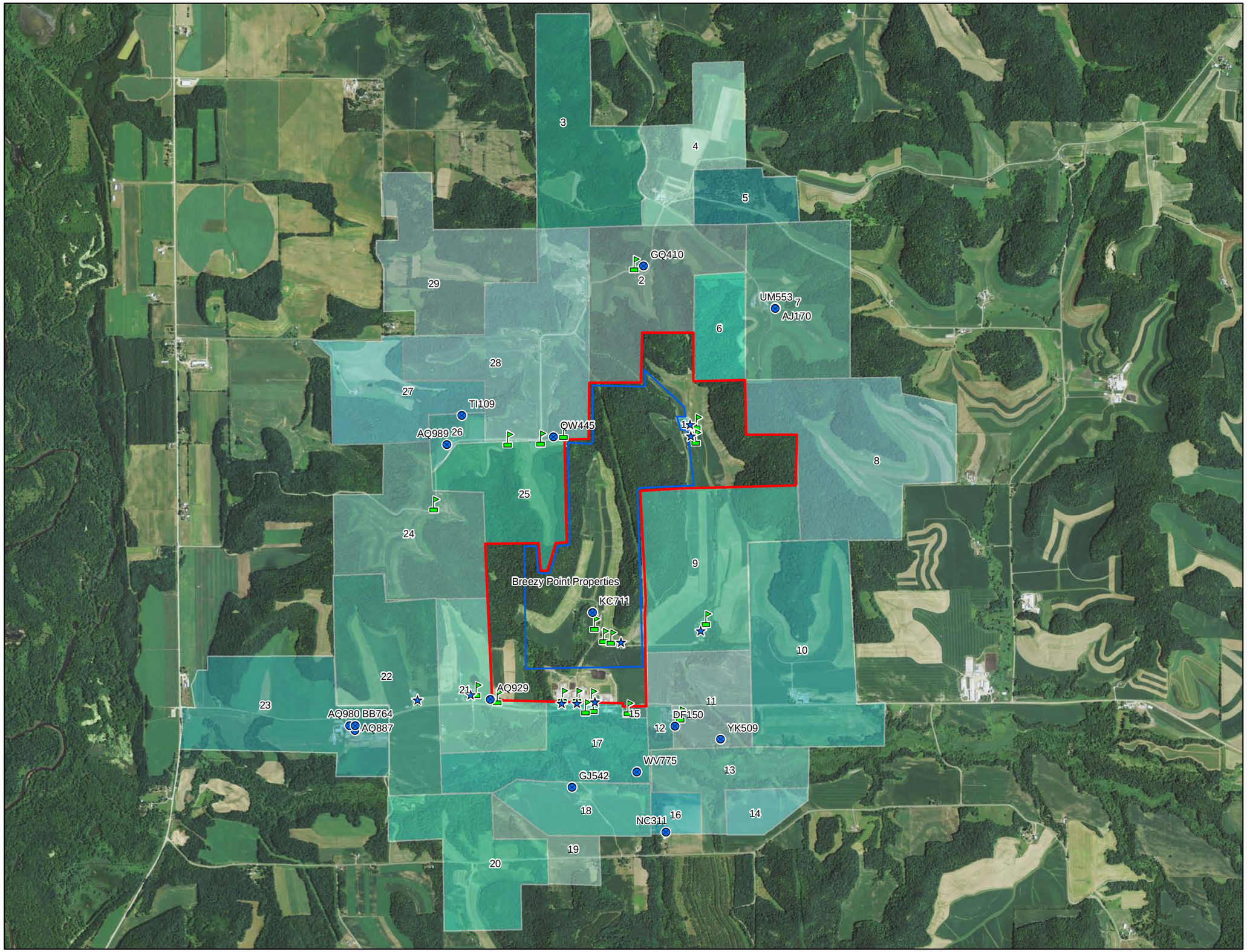
SITE LOCATION

Breezy Point Properties
Towns of Maxville and Nelson, Wisconsin

Figure 1

File: Figure1_SiteLocation
Summit Proj. No.: 2226-0001
Plot Date: 03/09/2015
Arc Operator: KLM
Reviewed by: NRTB

Summit Envirosolutions



Map adapted from NAIP Orthophotography and the Wisconsin Geological and Natural History Survey, Water Well Data, January 2012.

Legend

Breezy Point Properties

Quarry Extent

Houses

Area Well

Wells

Suspected Wells*

* No construction details available

Parcel numbers are associated with land owners. See Appendix I for additional parcel details and house addresses. See Appendix III for Well Construction Reports for all wells within 3,960 feet of the proposed mining site.

N
W E
S

0 0.25 0.5 1

Miles

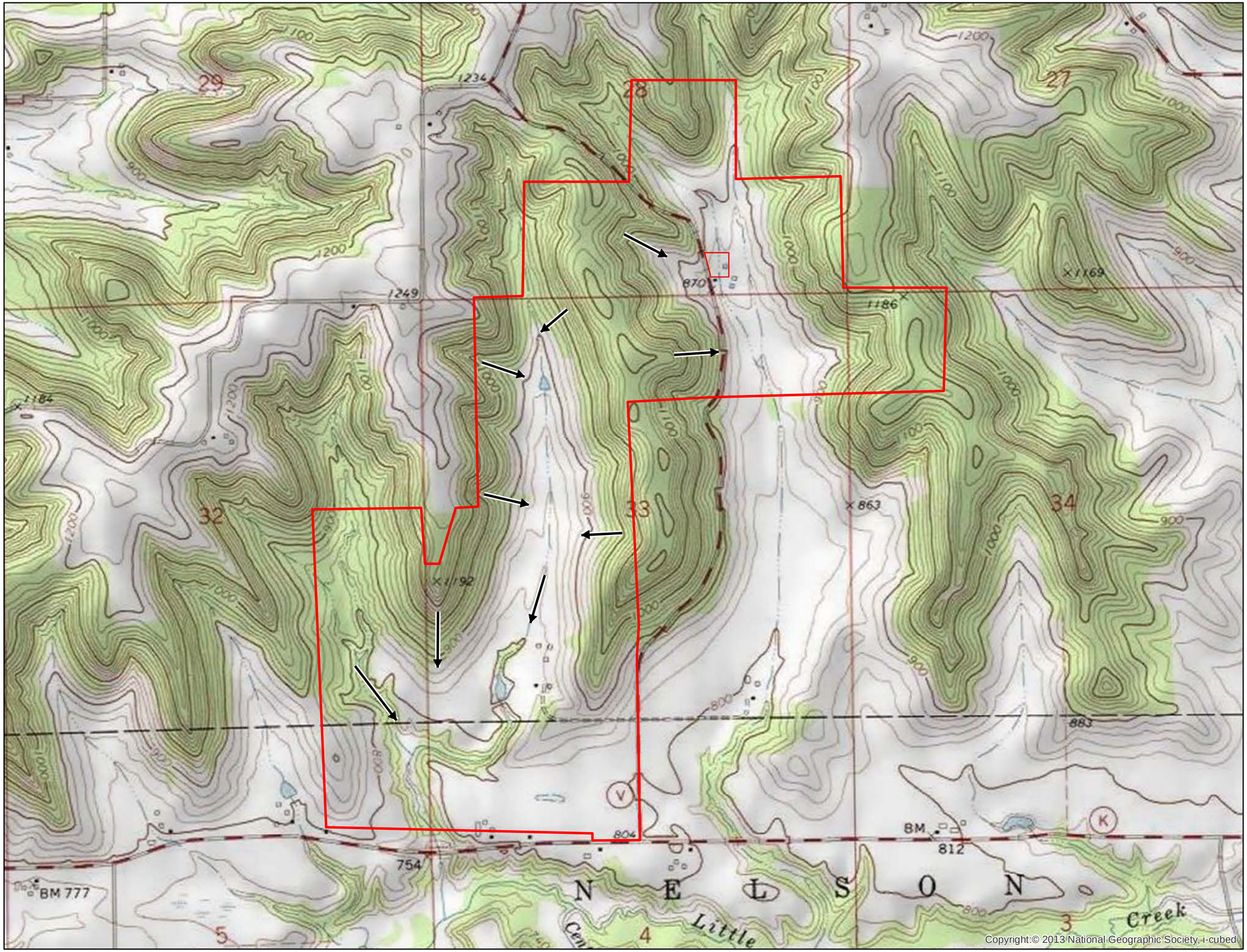
ADJACENT PROPERTY OWNERS AND AREA WELLS

Breezy Point Properties
Towns of Maxville and Nelson, Wisconsin

Figure 2

File: Figure2_LandOwnersAndWells
Summit Proj. No.: 2226-0001
Plot Date: 03/13/2015
Arc Operator: KLM
Reviewed by: NRTB

Summit Envirosolutions



Legend

Breezy Point Properties

Surface Water Drainage

N
W E
S

0 0.125 0.25 0.5

Miles

SITE TOPOGRAPHY AND DRAINAGE

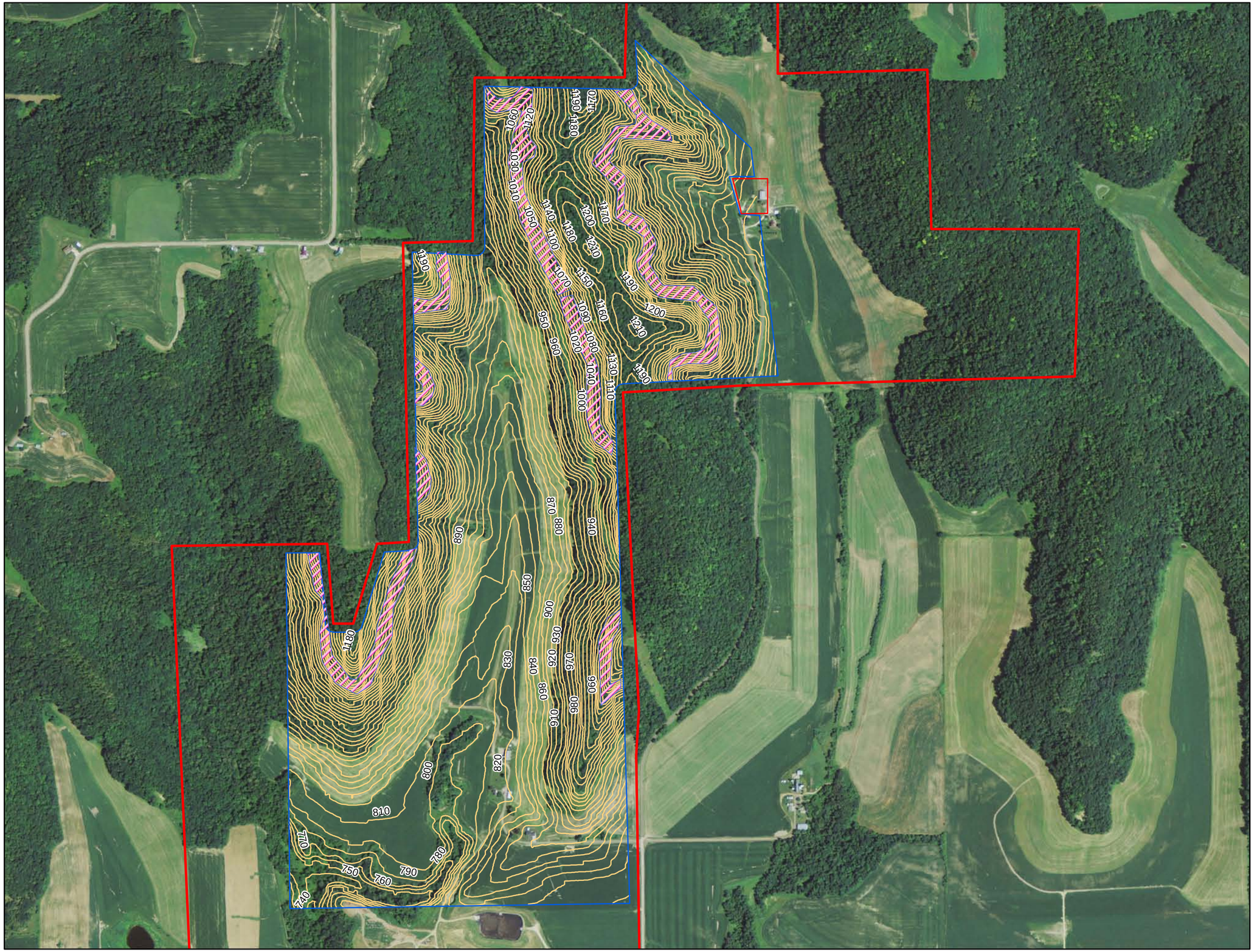
Breezy Point Properties

Towns of Maxville and Nelson, Wisconsin

Figure 3

File: Figure3_SiteTopo
Summit Proj. No.: 2226-0001
Plot Date: 03/13/2015
Arc Operator: KLM
Reviewed by: NRTB

Summit Envirosolutions



Legend

- Breezy Point Properties
- Quarry Extent
- Contour Mining Area
- Elevation Contour (Feet Above Sea Level)

Note: Contour Interval = 10 feet

N
W E
S

0 400 800 1,600
Feet

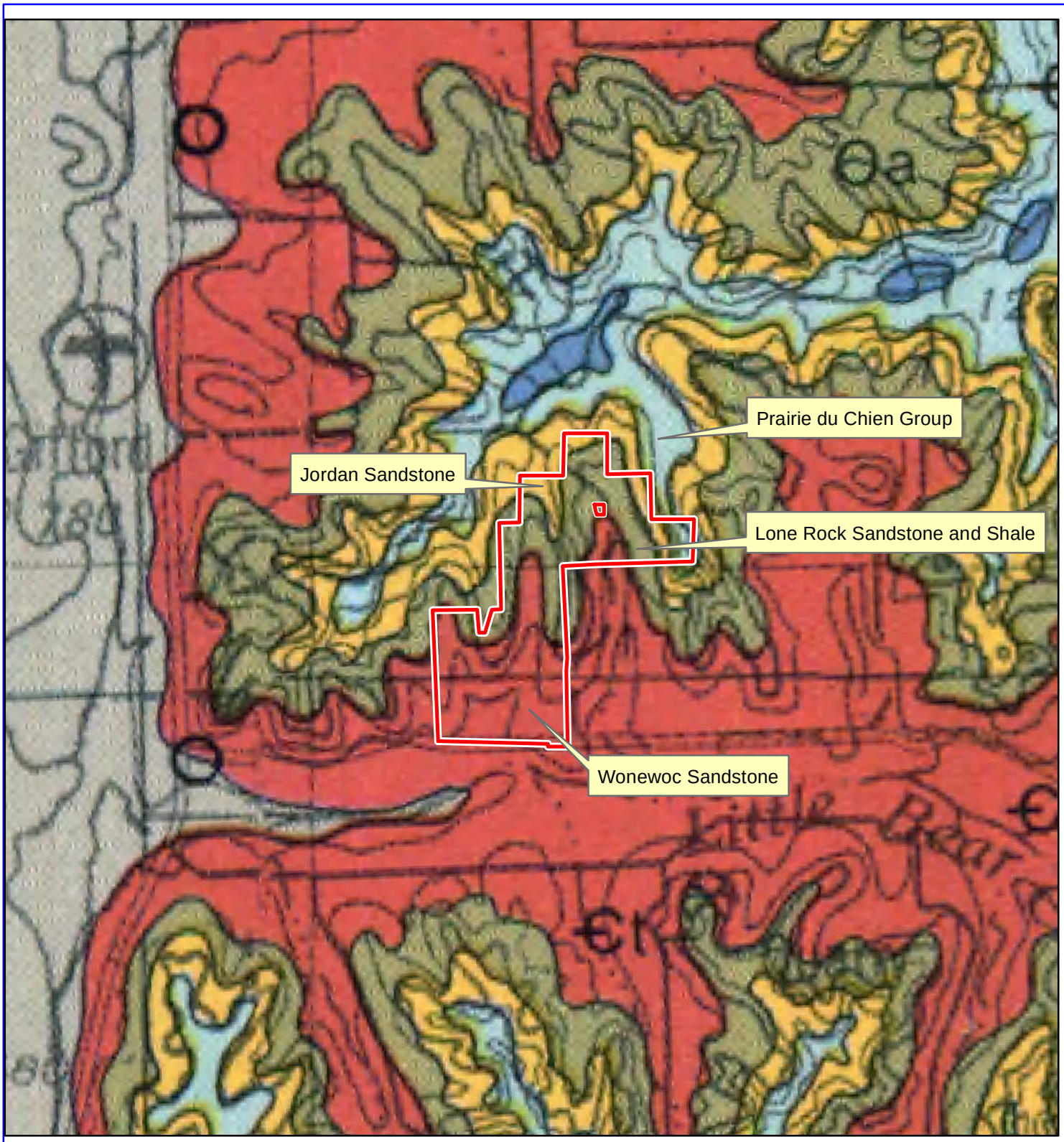
PRE-MINING 10-FOOT CONTOURS

Breezy Point Properties
Towns of Maxville and Nelson, Wisconsin

Figure 4

File: Figure4_10FtContour
Summit Proj. No.: 2226-0001
Plot Date: 03/13/2015
Arc Operator: KLM
Reviewed by: NRTB

Summit Envirosolutions



Map adapted from Bedrock Geology of Wisconsin, West-Central Sheet

Legend

Breezy Point Properties

N
W E
S

Note: See callout boxes for the on-site geologic unit names

0 0.5 1 2
Miles

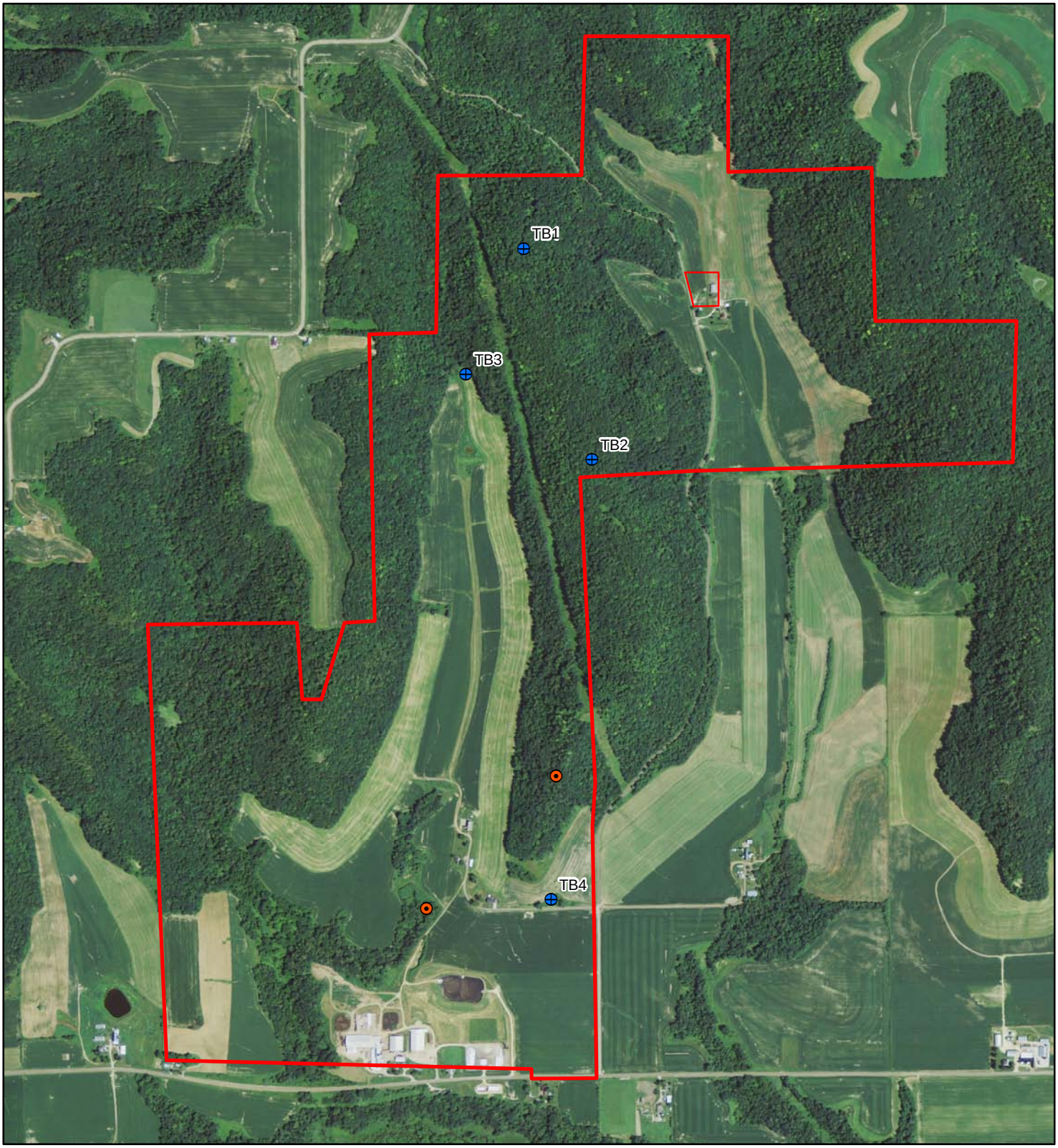
BEDROCK GEOLOGY

Breezy Point Properties
Towns of Maxville and Nelson, Wisconsin

Summit Envirosolutions

Figure 5

File: Figure5_BedRockGeo
Summit Proj. No.: 2226-0001
Plot Date: 03/13/2015
Arc Operator: KLM
Reviewed by: NRTB



Legend

- Breezy Point Properties
- Test Boring
- Outcrop Sample

See Appendix II for Test Boring Logs

N
W E
S

0 1,000 2,000 Feet

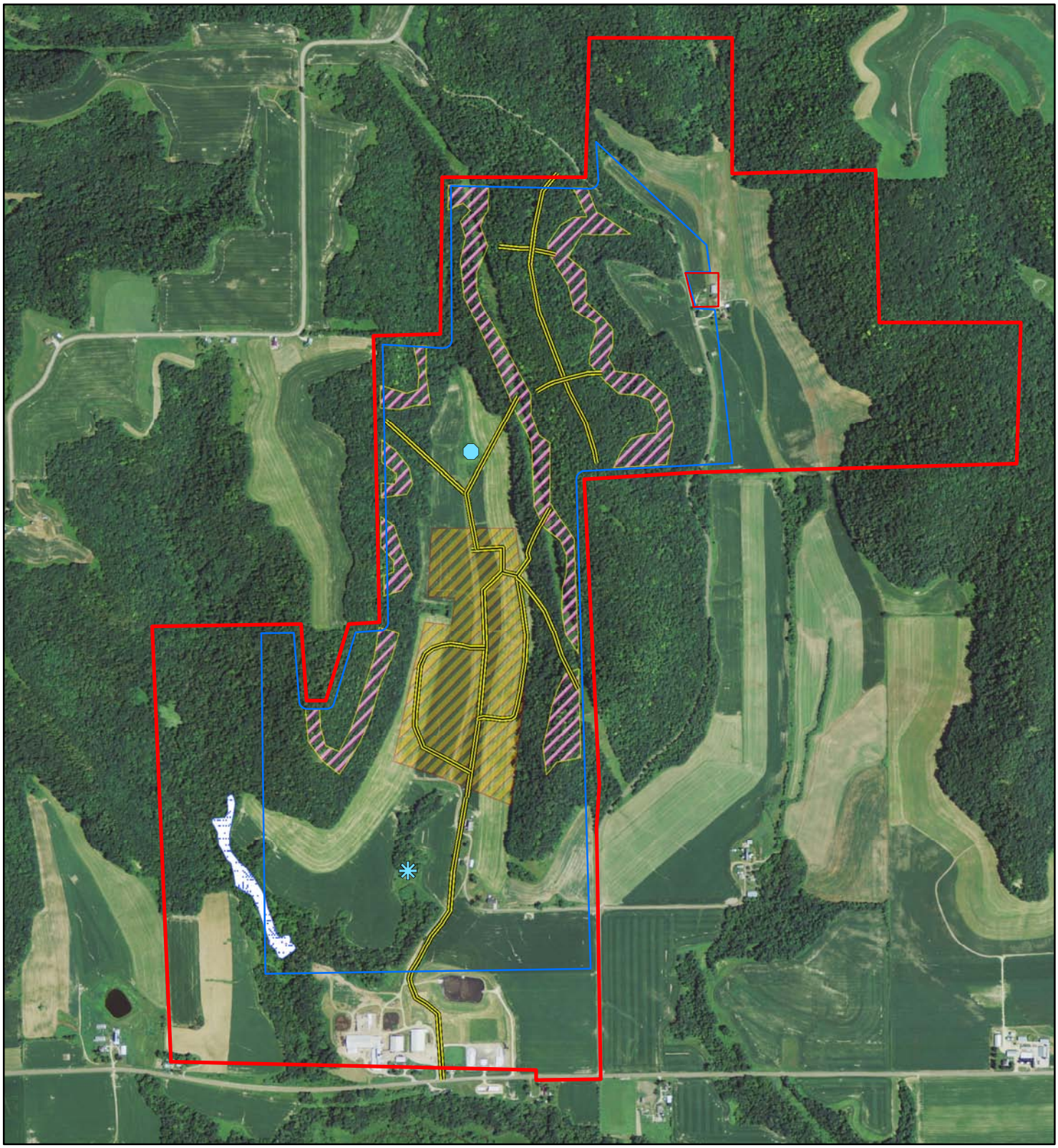
SAMPLING LOCATIONS

Breezy Point Properties
Towns of Maxville and Nelson, Wisconsin

Summit Envirosolutions

Figure 6

File: Figure6_SampleLocations.mxd
Summit Proj. No.: 2226-0001
Plot Date: 03/13/2015
Arc Operator: KLM
Reviewed by: NRTB



Legend

- Breezy Point Properties
- Quarry Extent
- Processing Area Footprint
- Contour Mining Area
- Potential Wetland
- Dammed Pond
- Wetland too Small to Delineate
- Access Road

N
W E
S

* See Figure10 for erosion control methods

0 1,000 2,000 Feet

POTENTIAL WETLANDS

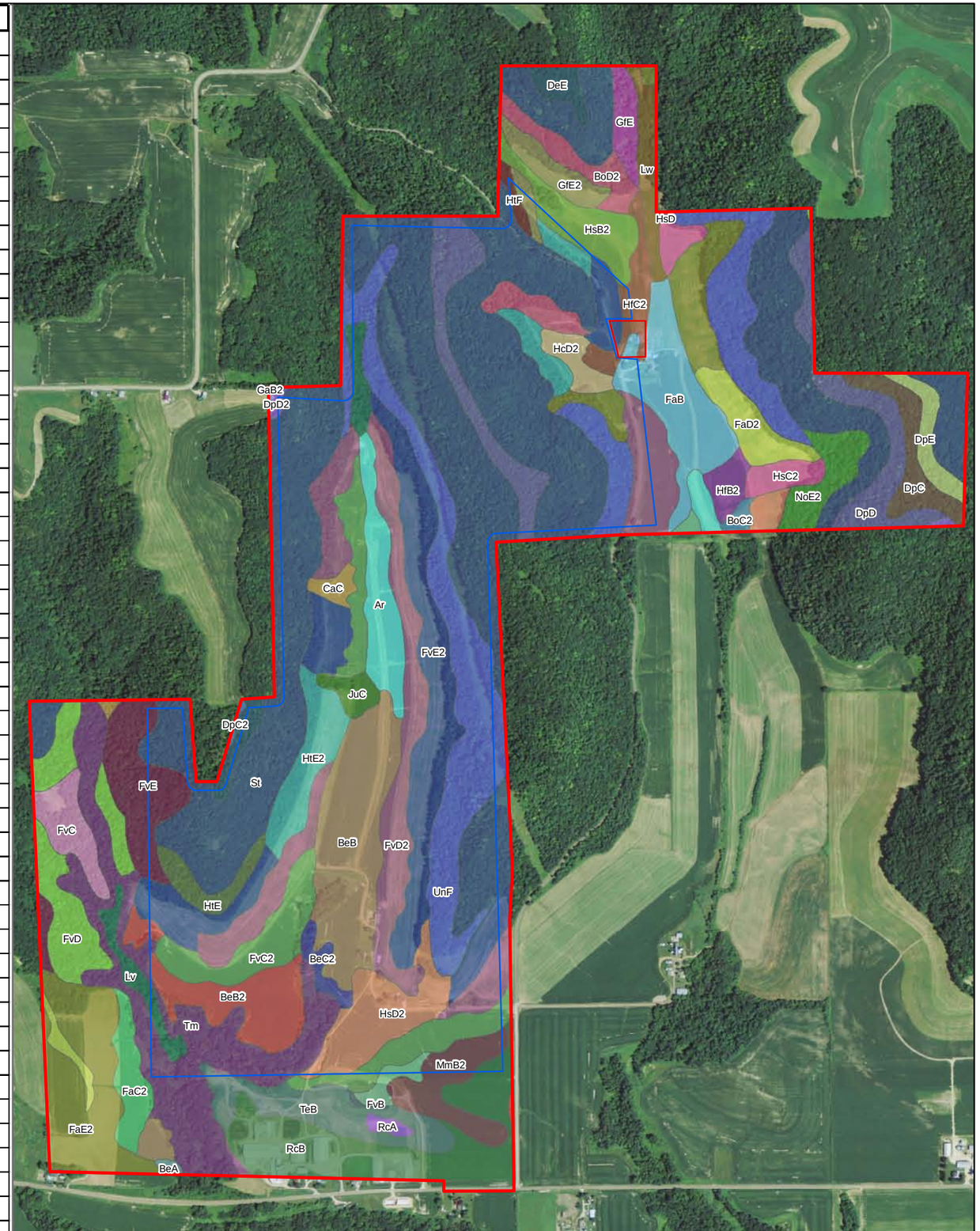
Breezy Point Properties
Towns of Maxville and Nelson, Wisconsin

Summit Envirosolutions

Figure 7

File: Figure7_PotentialWetlands.mxd
Summit Proj. No.: 2226-0001
Plot Date: 05/11/2015
Arc Operator: KLM
Reviewed by: NRTB

Map Symbol	Description	Acres
Ar	Ella silt loam, 1-6% slopes, moderately eroded	12.70
BeA	Festina silt loam, 0-3% slopes, moderately eroded	0.50
BeB	Festina silt loam, 2-6% slopes, moderately eroded	28.54
BeB2	Festina silt loam, 2-6% slopes, moderately eroded	14.32
BeC2	Festina silt loam, 6-12% slopes, moderately eroded	2.55
BoC2	Boone sand, 6-15% slopes	1.12
BoD2	Boone sand, 15-30% slopes	9.85
CaC	Chaseburg silt loam, 4-12% slopes, occasionally flooded	2.23
DeE	New Glarus silt loam, 20-30% slopes, moderately eroded	5.87
DpC	Pepin silt loam, 6-12% slopes, moderately eroded	7.25
DpC2	Pepin silt loam, 6-12% slopes, moderately eroded	0.23
DpD	Pepin silt loam, 12-20% slopes, moderately eroded	24.19
DpD2	Pepin silt loam, 12-20% slopes, moderately eroded	0.99
DpE	Pepin silt loam, 20-30% slopes, moderately eroded	4.19
FaB	Seaton silt loam, 2-6% slopes, moderately eroded	17.96
FaC2	Seaton silt loam, 6-12% slopes, moderately eroded	6.07
FaD2	Seaton silt loam, 12-20% slopes, moderately eroded	8.80
FaE2	Seaton silt loam, 20-30% slopes, moderately eroded	33.44
FvB	Chaseburg silt loam, 1-4% slopes, occasionally flooded	2.80
FvC	Churchtown silt loam, 6-12% slopes moderately eroded	6.57
FvC2	Seaton silt loam, 6-12% slopes, moderately eroded	25.47
FvD	Churchtown silt loam, 12-20% slopes moderately eroded	15.19
FvD2	Seaton silt loam, 12-20% slopes, moderately eroded	46.53
FvE	Churchtown silt loam, 20-30% slopes, moderately eroded	14.89
FvE2	Churchtown silt loam, 20-30% slopes, moderately eroded	45.86
GaB2	Gale silt loam, 2-6% slopes, moderately eroded	0.04
GfE	Norden silt loam, 20-30% slopes, moderately eroded	3.94
GfE2	Norden silt loam, 20-30% slopes, moderately eroded	6.31
HcD2	Hesch sandy loam, deep, 12-20% slopes, moderately eroded	3.56
HfB2	Elevasil sandy loam, 2-6% slopes	3.22
HfC2	Elevasil sandy loam, 6-12% slopes, moderately eroded	6.07
HsB2	Hixton silt loam, 2-6% slopes, moderately eroded	9.06
HsC2	Hixton silt loam, 6-12% slopes, moderately eroded	5.84
HsD	Hixton loam, 12-20% slopes, moderately eroded	0.15
HsD2	Hixton loam, 12-20% slopes, moderately eroded	15.49
HtE	Elevasil sandy loam, 20-30% slopes, moderately eroded	4.31
HtE2	Elevasil sandy loam, 20-30% slopes, moderately eroded	14.74
HtF	Boone-Elevasil complex, 15-50% slopes	1.27
JuC	Chaseburg silt loam, 4-12% slopes, occasionally flooded	2.69
Lv	Ettrick silt loam, 0-2% slopes, shallow, frequently flooded	6.94
Lw	Arenzville silt loam, 0-3% slopes, occasionally flooded	5.72
MmB2	Meridian silt loam, 2-6% slopes, moderately eroded	9.72
NoE2	Norden silt loam, 20-30% slopes, moderately eroded	6.72
RcA	Richwood silt loam, 1-6% slopes	1.12
RcB	Richwood silt loam, 1-6% slopes	26.03
St	Dorerton, very stony-Elbaville complex, 30-60% slopes	180.08
TeB	Meridian silt loam, 2-6% slopes, moderately eroded	13.41
Tm	Plainfield sand, 15-60% slopes	39.77
UnF	Urne fine sandy loam, 30-45% slopes	56.65
	Total:	**760.96**



Legend

Breezy Point Properties

Quarry Extent

N
W E
S

0 500 1,000 2,000

Feet

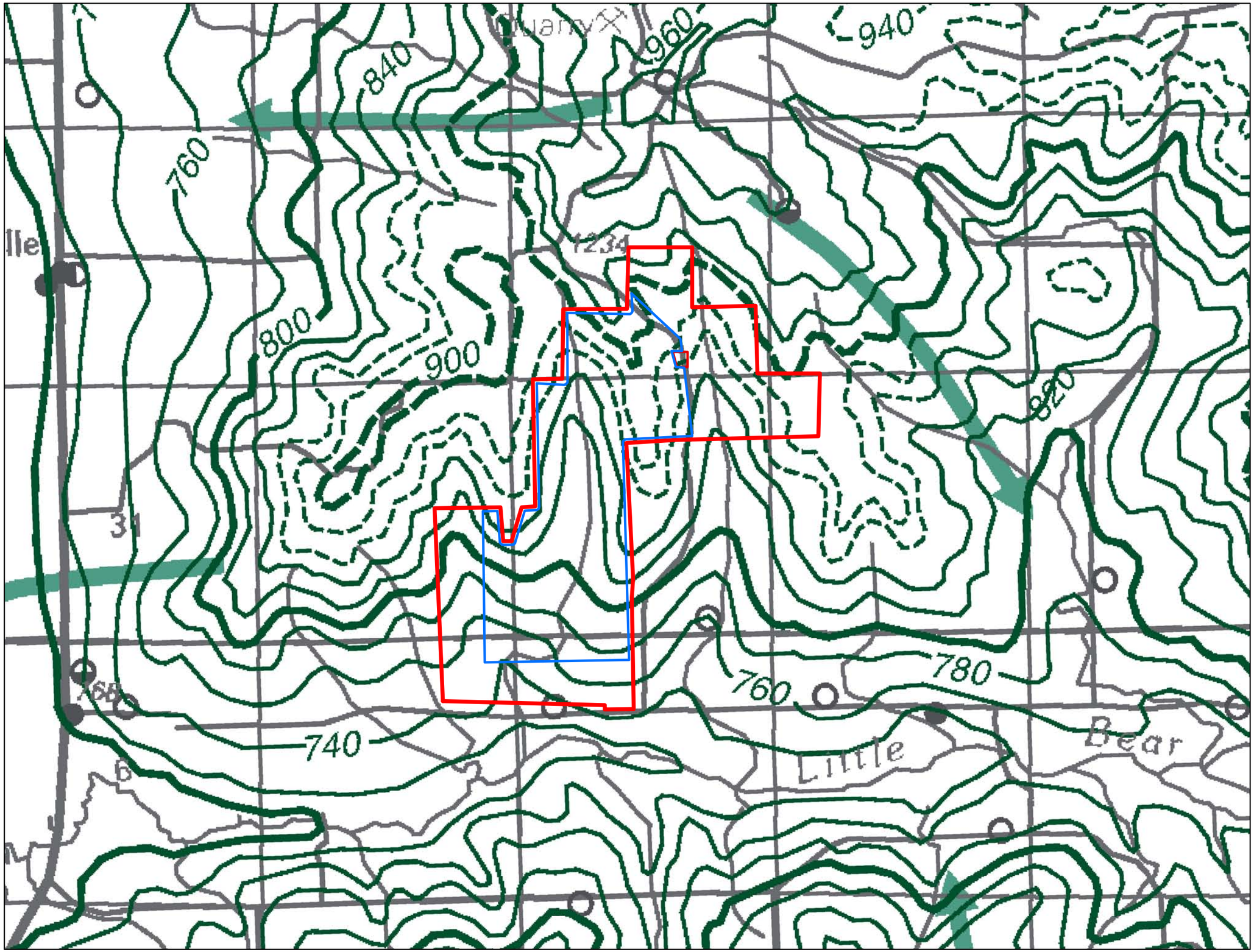
SOILS

Breezy Point Properties
Towns of Maxville and Nelson, Wisconsin

Figure 8

File: Figure8_Soils
Summit Proj. No.: 2226-0001
Plot Date: 03/13/2015
Arc Operator: KLM
Reviewed by: NRTB

Summit Envirosolutions



Legend

- Breezy Point Properties
- Quarry Extent
- General direction of shallow groundwater flow

N
W E
S

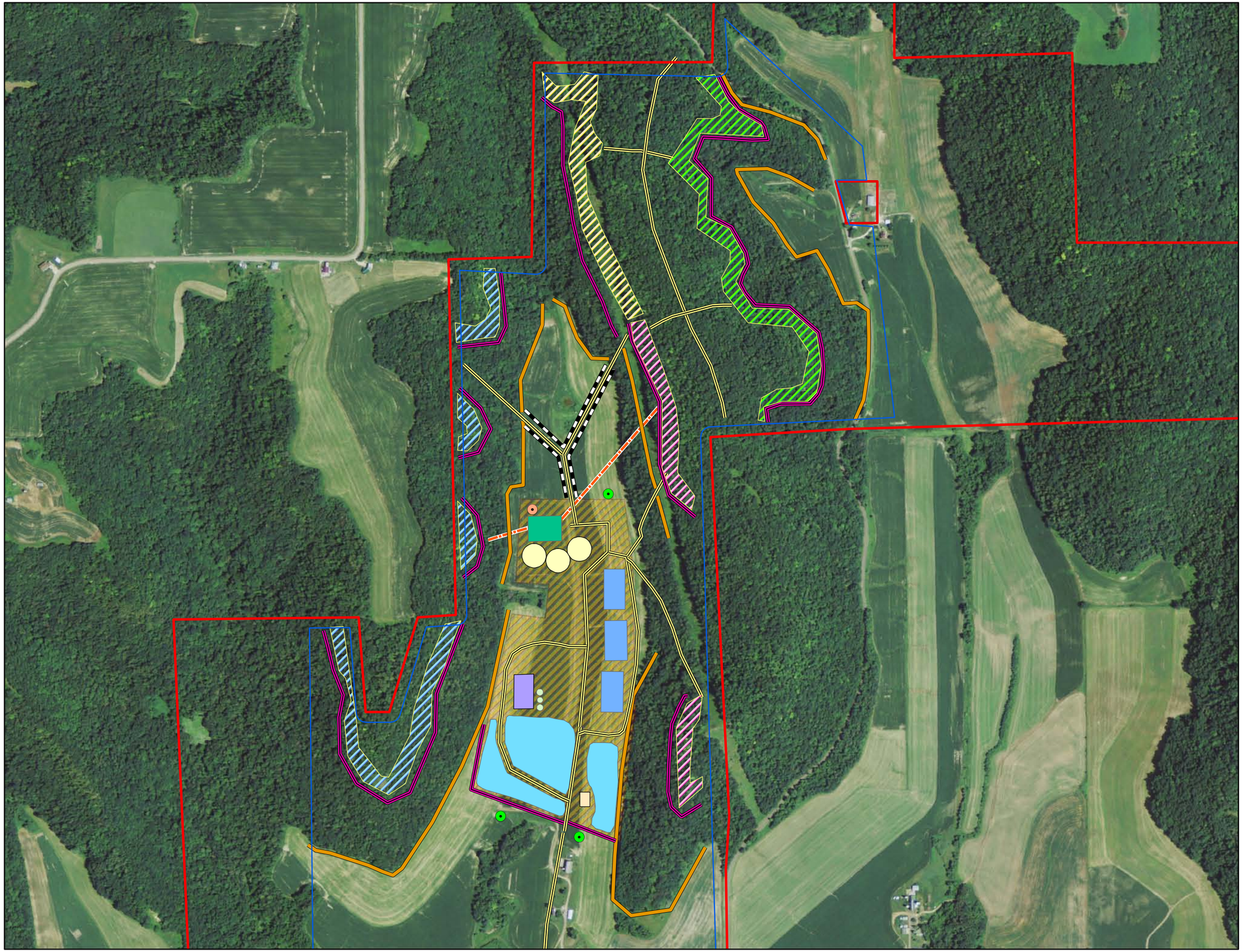
0 1,000 2,000 4,000
Feet

GROUNDWATER ELEVATION CONTOURS
Breezy Point Properties
Towns of Maxville and Nelson, Wisconsin

Figure 9

File: Figure9_GroundWater
Summit Proj. No.: 2226-0001
Plot Date: 03/13/2015
Arc Operator: KLM
Reviewed by: NRTB

Summit Envirosolutions



Legend

- Breezy Point Properties
- Quarry Extent
- Phase 1
- Phase 2
- Phase 3
- Phase 4
- Processing Area
- Wet Processing Building
- Dry Processing Building
- Scale/Office Building
- Sand Stockpile
- Silos
- Settling Pond
- Storm Water Pond
- Top Soil Berm
- Silt Fence
- Mobile Conveyor
- Access Road
- Erosion BMPs
- High Capacity Well
- Monitoring Well

N
W E
S

0 325 650 1,300
Feet

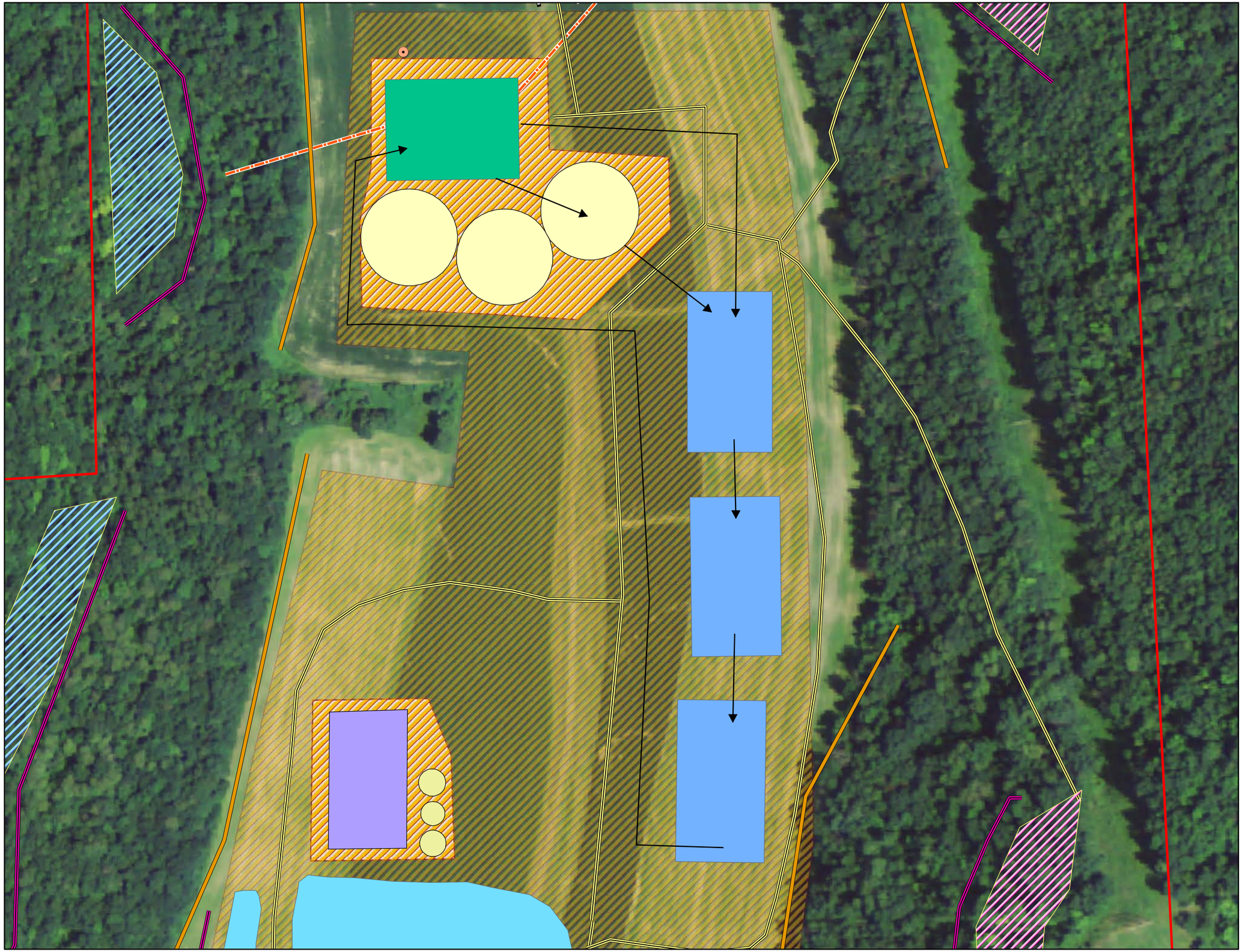
CONCEPTUAL MINE PLAN

Breezy Point Properties
Towns of Maxville and Nelson, Wisconsin

Figure 10

File: Figure10_MinePlan
Summit Proj. No.: 2226-0001
Plot Date: 05/12/2015
Arc Operator: KLM
Reviewed by: NRTB

Summit Envirosolutions



Legend

- Breezy Point Properties
- Phase 1
- Phase 3
- Processing Area
- Concrete Pad
- Wet Processing Building
- Dry Processing Building
- Sand Stockpile
- Silos
- Settling Pond
- Storm Water Pond
- Conceptual Process Water Flow
- Top Soil Berm
- Silt Fence
- Mobile Conveyor
- Access Road
- High Capacity Well

N W E S

0 80 160 320
Feet

CONCEPTUAL LAYOUT FOR PROCESSING AREA
Breezy Point Properties
Towns of Maxville and Nelson, Wisconsin

Figure 10 A

File: Figure10a_ProcessingArea
Summit Proj. No.: 2226-0001
Plot Date: 04/29/2015
Arc Operator: KLM
Reviewed by: NRTB

Summit Envirosolutions

Legend

- Breezy Point Properties
- Quarry Extent
- Post-mining Contour (Feet Above Sea Level)

Note: Contour Interval = 10 feet

N
W E
S

0 400 800 1,600
Feet

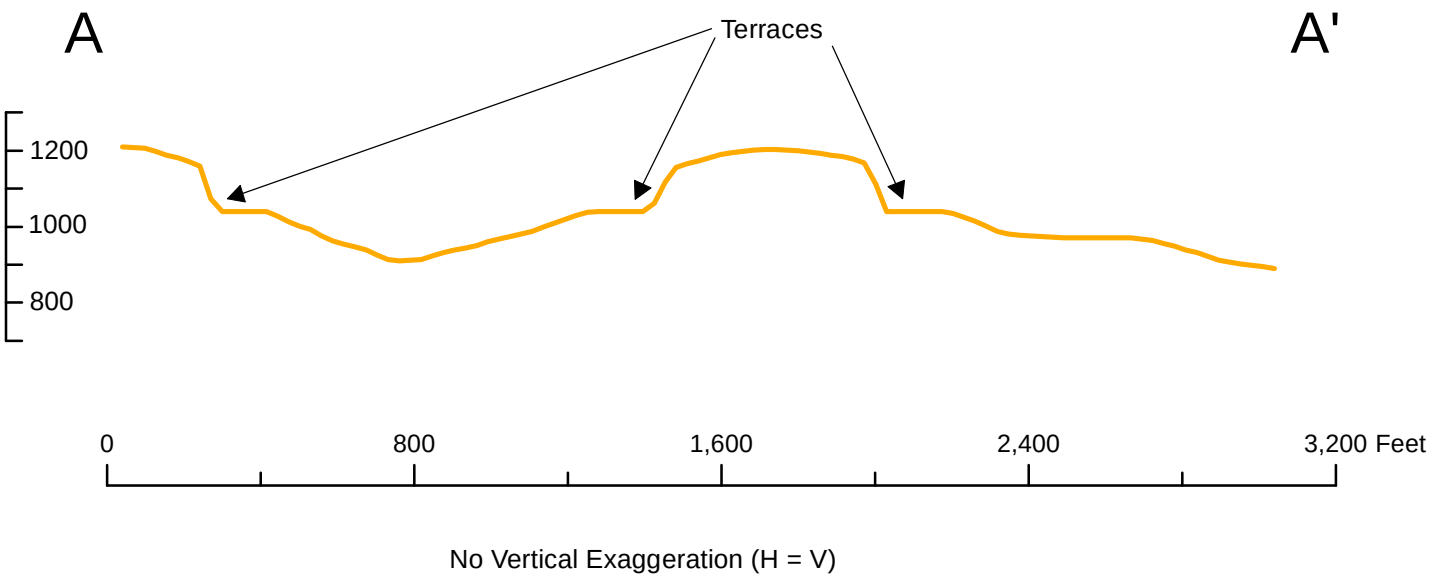
POST-MINING 10-FOOT CONTOURS

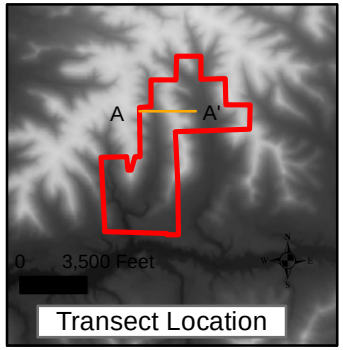
Breezy Point Properties
Towns of Maxville and Nelson, Wisconsin

Figure 11

File: Figure11_PostMining10ftContour
Summit Proj. No.: 2226-0001
Plot Date: 03/13/2015
Arc Operator: KLM
Reviewed by: NRTB

Summit Envirosolutions





1 inch = 500 feet

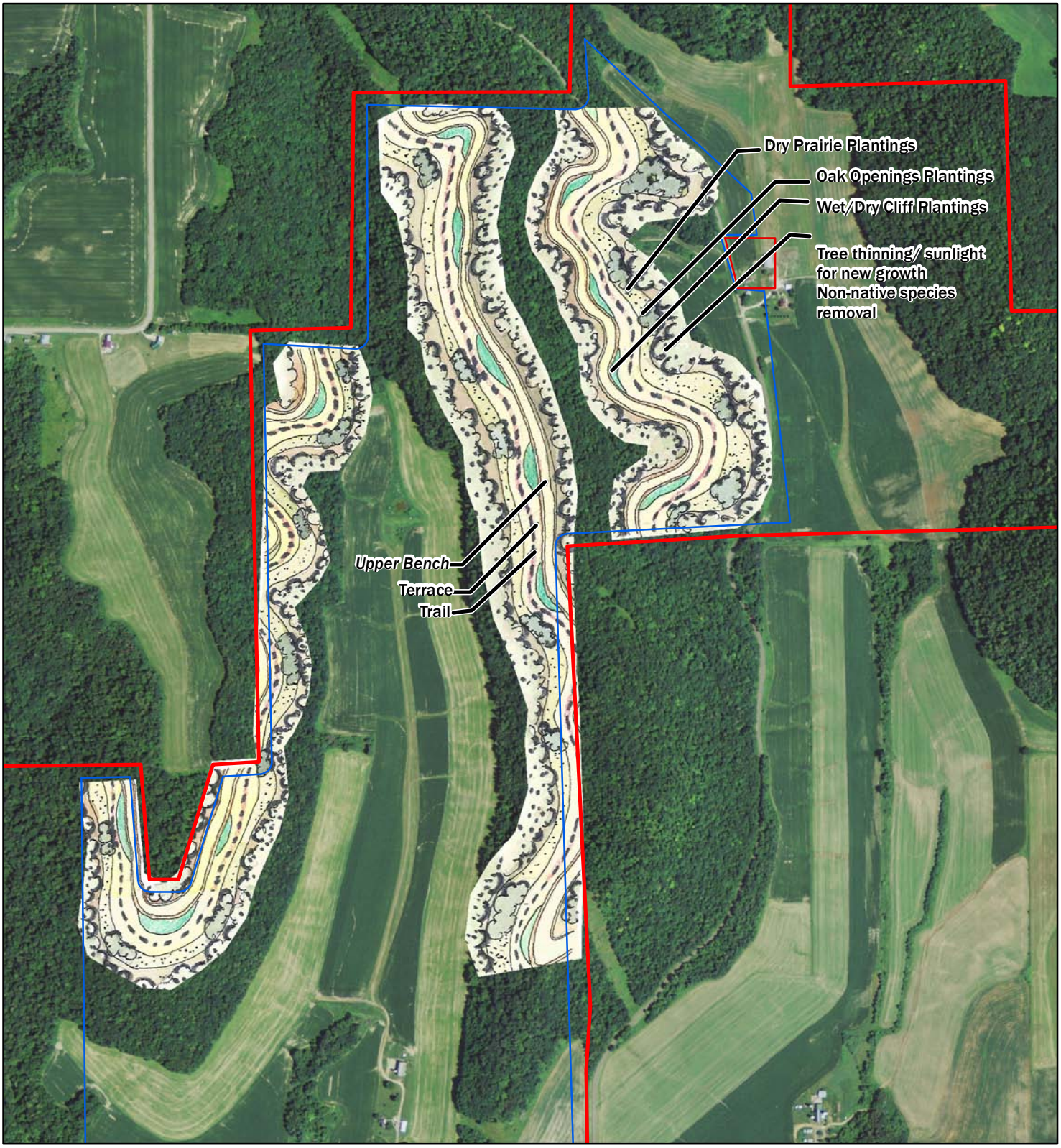
POST MINING CROSS SECTION

Breezy Point Properties
Towns of Maxville and Nelson, Wisconsin

Summit Envirosolutions

Figure 12

File: Figure12_Xsection.mxd
Summit Proj. No.: 2226-0001
Plot Date: 03-13-2015
Arc Operator: KLM
Reviewed by: NRTB



Legend

Breezy Point Properties

Quarry Extent

N
W E
S

0 1,000 2,000 Feet

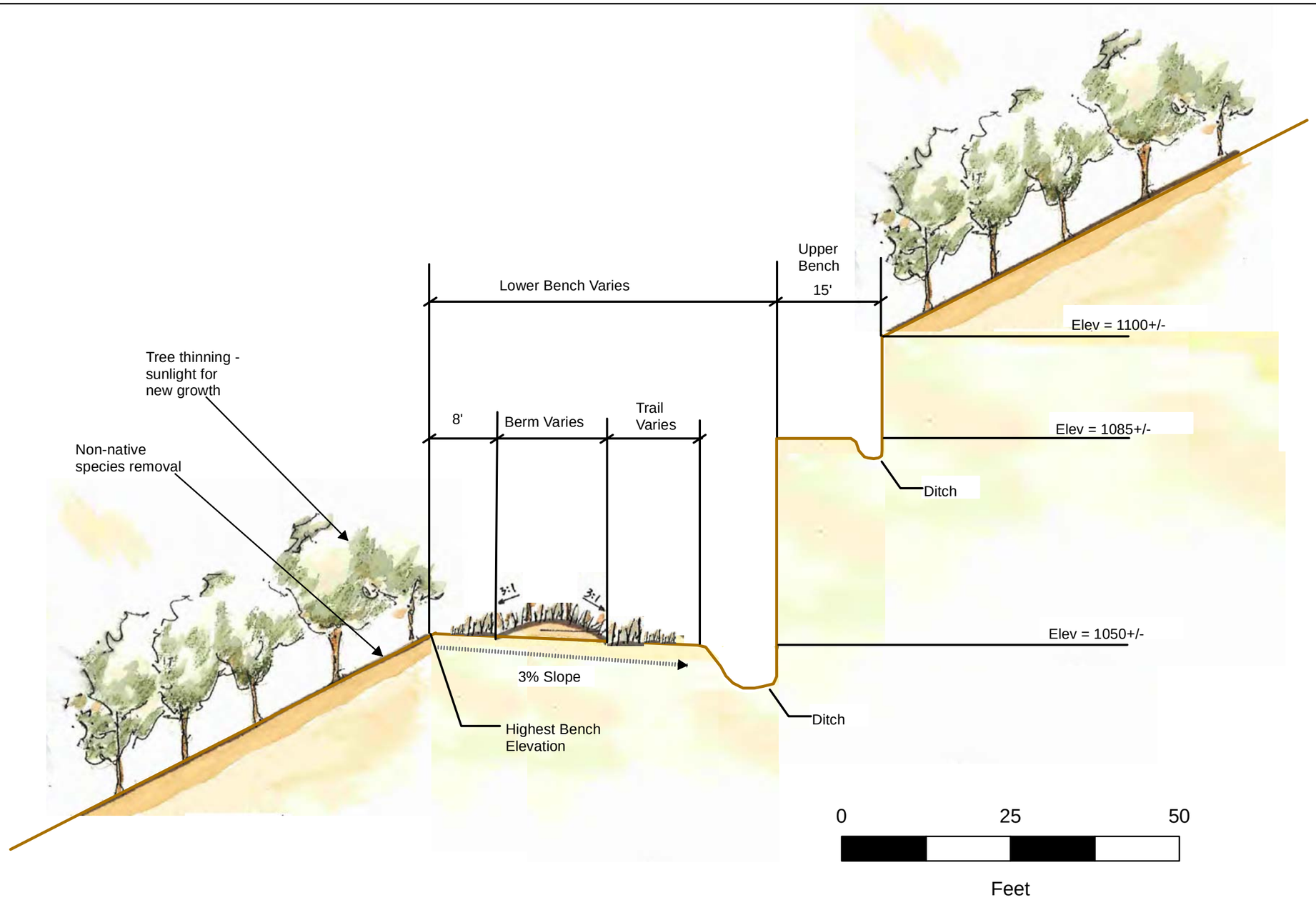
RECLAMATION CONCEPT - PLAN VIEW

Breezy Point Properties
Towns of Maxville and Nelson, Wisconsin

Summit Envirosolutions

Figure 13

File: Figure13_RecConceptPlanView.mxd
Summit Proj. No.: 2226-0001
Plot Date: 03-13-2015
Arc Operator: KLM
Reviewed by: NRTB



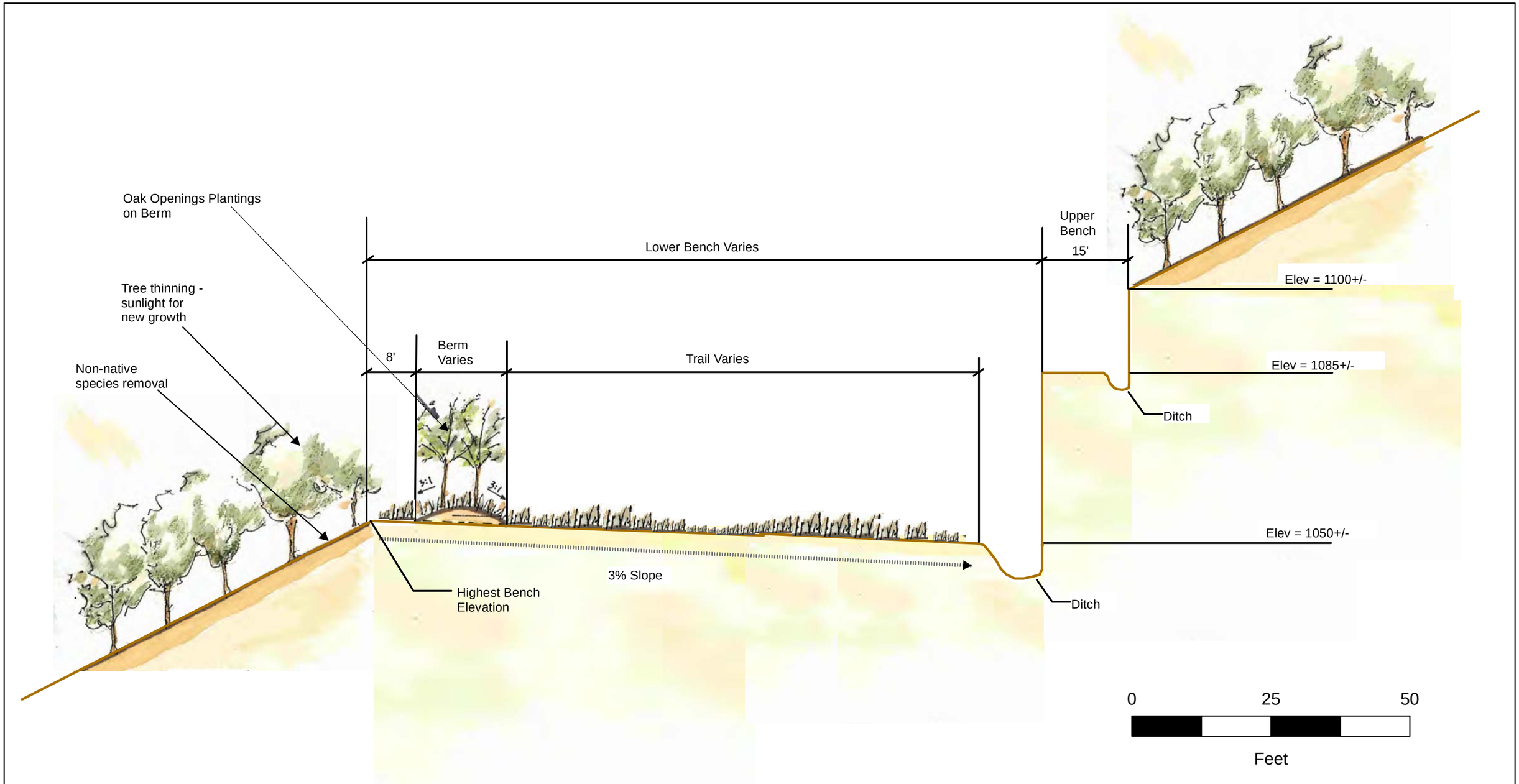
Reclamation concept for a 50 foot wide trail

RECLAMATION CONCEPT CROSS SECTION
Breezy Point Properties
Maxwell and Nelson Townships
Buffalo County, Wisconsin

Summit Envirosolutions

Figure 14 A

File: Figure14A_RecConceptXSection50ft.mxd
Summit Proj. No.: 2226-0001
Plot Date: 04-14-15
Arc Operator: KLM
Reviewed by: NRTB



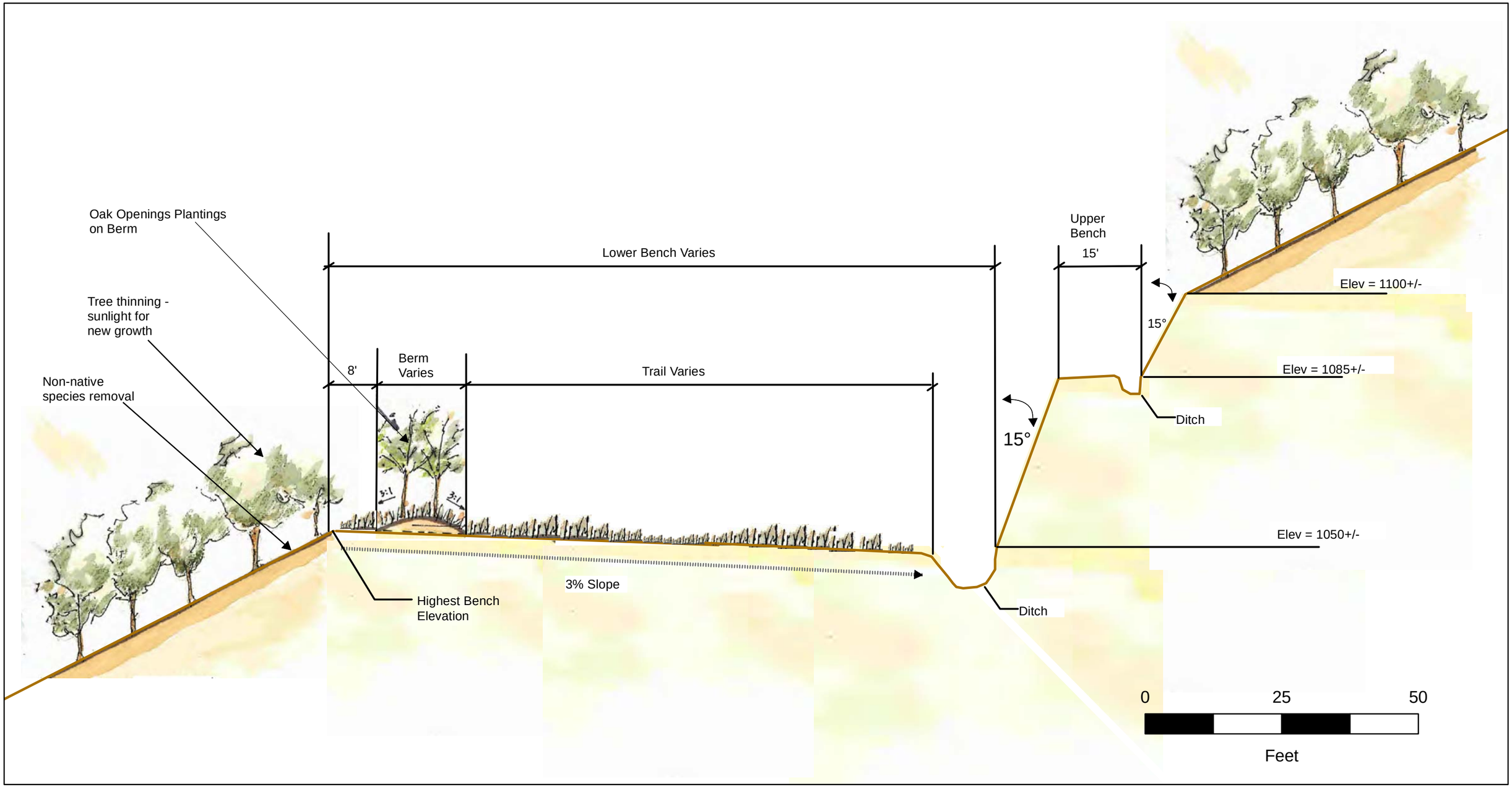
Reclamation concept for a120 foot wide trail

RECLAMATION CONCEPT CROSS SECTION
Breezy Point Properties
Maxwell and Nelson Townships
Buffalo County, Wisconsin

Summit Envirosolutions

Figure 14 B

File: Figure14B_RecConceptXSection120ft.mxd
Summit Proj. No.: 2226-0001
Plot Date: 04-15-15
Arc Operator: KLM
Reviewed by: NRTB



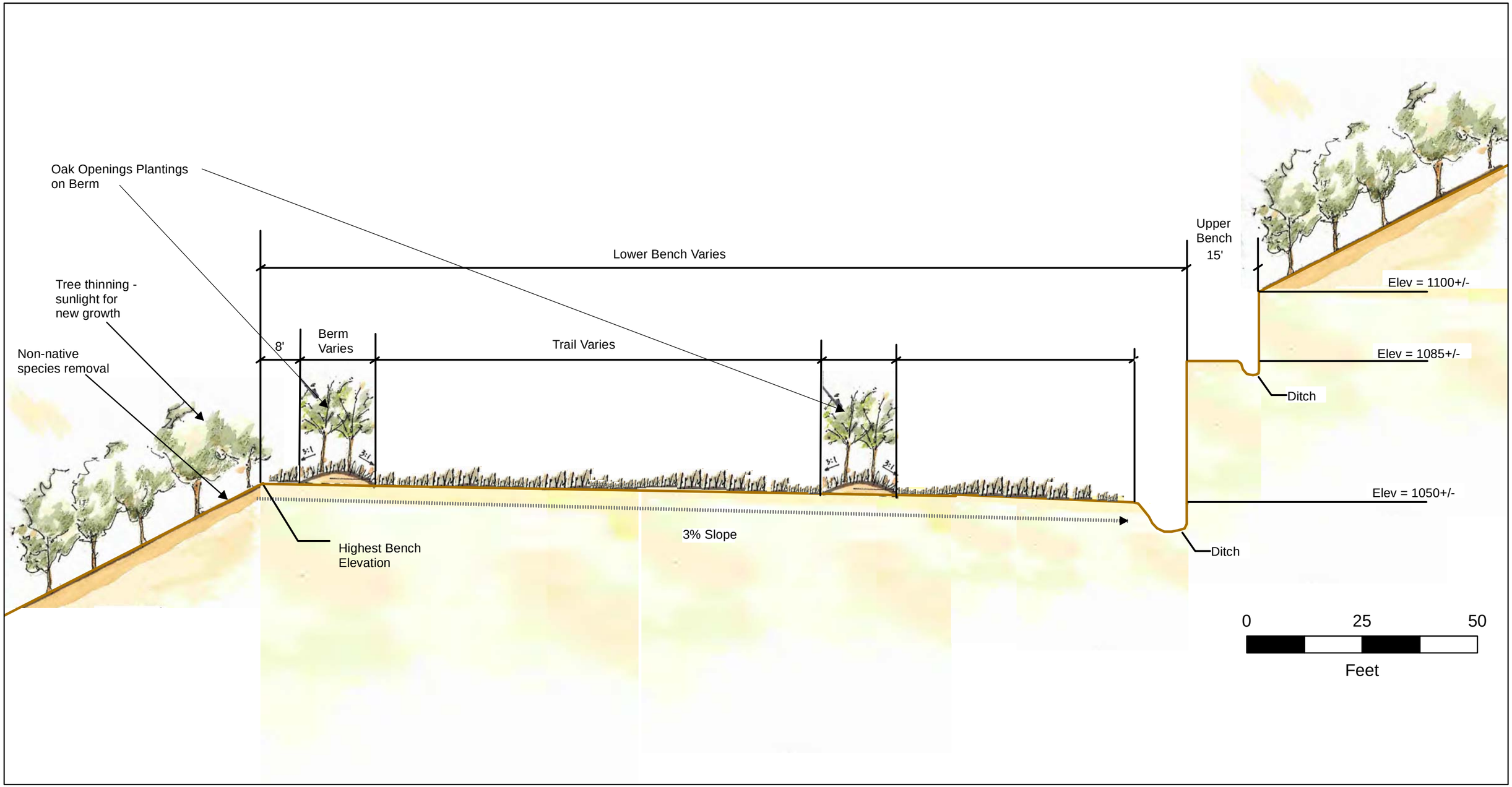
Reclamation concept for a120 foot wide trail with an unstable highwall

RECLAMATION CONCEPT CROSS SECTION
Breezy Point Properties
Maxwell and Nelson Townships
Buffalo County, Wisconsin

Summit Envirosolutions

Figure 14 C

File: Figure14C_RecConceptXSection120Unstable.mxd
Summit Proj. No.: 2226-0001
Plot Date: 04-15-15
Arc Operator: KLM
Reviewed by: NRTB



Reclamation concept for a 200 foot wide trail

RECLAMATION CONCEPT CROSS SECTION
Breezy Point Properties
Maxwell and Nelson Townships
Buffalo County, Wisconsin

Summit Envirosolutions

Figure 14 D

File: Figure14D_RecConceptXSection200ft.mxd
Summit Proj. No.: 2226-0001
Plot Date: 04-15-15
Arc Operator: KLM
Reviewed by: NRTB

Appendix I:
Adjacent Property Information

Adjacent Property Owners Wisconsin Proppant Resources, Inc., Towns of Maxville and Nelson, Buffalo County, Wisconsin					
Parcel ID	Owner Name	Owner Address	Approx. Area (Acres)	Label (Figure 2)	Legal Description
020-00556-0000	Patrick Witting	S494 Lindstrom Valley Rd Durand WI 54736	0.44	1	T 24N R 13W Sec 28 SW ¼ SE ¼ THAT PART OF THE SW OF SE
020-00539-0000	Joan. Traun	318 E Main St #10 Durand WI 54736	40	2	T 24N R 13W Sec 28 NE ¼ NE ¼ NE¼
020-00547-0000	Joan. Traun	318 E Main St #10 Durand WI 54736	40	2	T 24N R 13W Sec 28 SE ¼ NW¼
020-00548-0000	Joan. Traun	318 E Main St #10 Durand WI 54736	40	2	T 24N R 13W Sec 28 NE ¼ SW ¼
020-00540-0000	Joan. Traun	318 E Main St #10 Durand WI 54736	40	2	T 24N R 13W Sec 28 NW ¼ NE ¼
020-00543-0000	Joan. Traun	318 E Main St #10 Durand WI 54736	39	2	T 24N R 13W Sec 28 NE ¼ NW ¼ Exc 1A
020-00541-0000	Joan. Traun	318 E Main St #10 Durand WI 54736	40	2	T 24N R 13W Sec 28 SW ¼ NE ¼
020-00544-0000	Samuel J and Christopher C Traun	W2151 County Rd V Durand WI 54736	1	2	T 24N R 13W Sec 28 1A in the NE ¼ NW ¼
020-00416-0000	Ronald V.Hulburt	S266 State Rd 25 Durand WI 54736	40	3	T 24N R 13W Sec 21 NE ¼ NW ¼
020-00417-0000	Ronald V.Hulburt	S266 State Rd 25 Durand WI 54737	40	3	T 24N R 13W Sec 21 NW ¼ NW ¼
020-00418-0000	Ronald V.Hulburt	S266 State Rd 25 Durand WI 54738	40	3	T 24N R 13W Sec 21 SW ¼ NW ¼
020-00420-0000	Ronald V.Hulburt	S266 State Rd 25 Durand WI 54739	40	3	T 24N R 13W Sec 21 NE ¼ SW ¼
020-00421-0000	Ronald V.Hulburt	S266 State Rd 25 Durand WI 54740	40	3	T 24N R 13W Sec 21 NW ¼ SW ¼

020-00423-0000	Ronald V.Hulburt	S266 State Rd 25 Durand WI 54741	40	3	T 24N R 13W Sec 21 SE ¼ SW ¼
020-00422-0000	Ronald V.Hulburt	S266 State Rd 25 Durand WI 54742	40	3	T 24N R 13W Sec 21 SW ¼ SW ¼
020-00419-0000	Ronald V.Hulburt	S266 State Rd 25 Durand WI 54743	40	3	T 24N R 13W Sec 21 SE ¼ NW ¼
020-00414-0000	Ronald V.Hulburt	S266 State Rd 25 Durand WI 54744	40	3	T 24N R 13W Sec 21 SW ¼ NE ¼
020-00413-0000	Ronald V.Hulburt	S266 State Rd 25 Durand WI 54745	40	3	T 24N R 13W Sec 21 NW ¼ NE ¼
020-00412-0000	Ronald V.Hulburt	S266 State Rd 25 Durand WI 54746	40	3	T 24N R 13W Sec 21 NE ¼ NE ¼
020-00425-0000	Lawrence and Barbara Traun	S386 County Rd AA Durand WI 54736	40	4	T 24N R 13W Sec 21 NW ¼ SE ¼
020-00424-0000	Lawrence and Barbara Traun	S386 County Rd AA Durand WI 54737	40	4	T 24N R 13W Sec 21 NE ¼ SE ¼
020-00415-0000	Lawrence and Barbara Traun	S386 County Rd AA Durand WI 54738	40	4	T 24N R 13W Sec 21 SE ¼ NE ¼
020-00426-0000	Lawrence and Barbara Traun	S386 County Rd AA Durand WI 54739	40	4	T 24N R 13W Sec 21 SW ¼ SE ¼
020-00427-0000	Lawrence and Barbara Traun	S386 County Rd AA Durand WI 54740	40	5	T 24N R 13W Sec 21 SE ¼ SE ¼
020-00439-0000	Lawrence and Barbara Traun	S386 County Rd AA Durand WI 54741	40	5	T 24N R 13W Sec 22 SW ¼ SW ¼
020-00542-0000	Cryil Weisenbeck	609 W Prospect St Durand WI 54736	40	6	T 24N R 13W Sec 28 SE ¼ NE ¼
020-00552-0000	Cryil Weisenbeck	610 W Prospect St Durand WI 54736	40	6	T 24N R 13W Sec 28 NE ¼ SE ¼
020-00527-0000	David and Cheryl Weisenbeck	S387 County Rd AA Durand WI 54736	40	7	T 24N R 13W Sec 27 NW ¼ NW ¼
020-00526-0000	David and Cheryl Weisenbeck	S387 County Rd AA Durand WI 54737	40	7	T 24N R 13W Sec 27 NE ¼ NW ¼

020-00531-0000	David and Cheryl Weisenbeck	S387 County Rd AA Durand WI 54738	40	7	T 24N R 13W Sec 27 NW ¼ SW ¼
020-00529-0000	David and Cheryl Weisenbeck	S387 County Rd AA Durand WI 54739	40	7	T 24N R 13W Sec 27 SE ¼ NW ¼
020-00528-0000	David and Cheryl Weisenbeck	S387 County Rd AA Durand WI 54740	40	7	T 24N R 13W Sec 27 SW ¼ NW ¼
020-00530-0000	David and Cheryl Weisenbeck	S387 County Rd AA Durand WI 54741	40	7	T 24N R 13W Sec 27 NE ¼ SW ¼
020-00532-0000	James Reinhardt	W1921 County Rd K Durand WI 54736	40	8	T 24N R 13W Sec 27 SW ¼ SW ¼
020-00538-0000	James Reinhardt	W1921 County Rd K Durand WI 54737	23	8	T 24N R 13W Sec 27 SE ¼ SE ¼
020-00533-0000	James Reinhardt	W1921 County Rd K Durand WI 54738	40	8	T 24N R 13W Sec 27 SE ¼ SW ¼
020-00536-0000	James Reinhardt	W1921 County Rd K Durand WI 54739	40	8	T 24N R 13W Sec 27 SW ¼ SE ¼
020-00670-0000	James Reinhardt	W1921 County Rd K Durand WI 54740	40	8	T 24N R 13W Sec 34 SW ¼ NE ¼
020-00668-0000	James Reinhardt	W1921 County Rd K Durand WI 54741	40	8	T 24N R 13W Sec 34 NE ¼ NE ¼
020-00672-0000	James Reinhardt	W1921 County Rd K Durand WI 54742	40	8	T 24N R 13W Sec 34 NE ¼ NW ¼
020-00675-0000	James Reinhardt	W1921 County Rd K Durand WI 54743	40	8	T 24N R 13W Sec 34 SE ¼ NW ¼
020-00669-0000	James Reinhardt	W1921 County Rd K Durand WI 54744	40	8	T 24N R 13W Sec 34 NW ¼ NE ¼
020-00674-0000	William and Sandra Lindstrom	S598 Lindstrom Valley Rd Durand WI 54736	40	9	T 24N R 13W Sec 34 SW ¼ NW ¼
020-00667-0000	William and Sandra Lindstrom	S598 Lindstrom Valley Rd Durand WI 54737	40	9	T 24N R 13W Sec 33 SE ¼ SE ¼
020-00652-0000	William and Sandra Lindstrom	S598 Lindstrom Valley Rd Durand WI 54738	40	9	T 24N R 13W Sec 33 SE ¼ NE ¼

020-00651-0000	William and Sandra Lindstrom	S598 Lindstrom Valley Rd Durand WI 54739	40	9	T 24N R 13W Sec 33 SE ¼ NE ¼
020-00664-0000	William and Sandra Lindstrom	S598 Lindstrom Valley Rd Durand WI 54740	40	9	T 24N R 13W Sec 33 NE ¼ SE ¼
020-00665-0000	William and Sandra Lindstrom	S598 Lindstrom Valley Rd Durand WI 54741	40	9	T 24N R 13W Sec 33 NW ¼ SE ¼
020-00666-0000	William and Sandra Lindstrom	S598 Lindstrom Valley Rd Durand WI 54738	40	9	T 24N R 13W Sec 33 SW ¼ SE ¼
020-00676-0000	Milky Way Acres Farm	W2078 County Rd K Durand WI 54736	40	10	T 24N R 13W Sec 34 NE ¼ SW ¼
020-00677-0000	Milky Way Acres Farm	W2078 County Rd K Durand WI 54737	40	10	T 24N R 13W Sec 34 NW ¼ SW ¼
020-00678-0000	Milky Way Acres Farm	W2078 County Rd K Durand WI 54738	40	10	T 24N R 13W Sec 34 SW ¼ SW ¼
020-00679-0000	Milky Way Acres Farm	W2078 County Rd K Durand WI 54739	40	10	T 24N R 13W Sec 34 SE ¼ SW ¼
032-00058-0000	Milky Way Acres Farm	W2078 County Rd K Durand WI 54740	40	10	T 23N R 13W Sec 03 SW ¼ NW ¼
032-00050-0000	Milky Way Acres Farm	W2078 County Rd K Durand WI 54741	18.41	10	T 23N R 13W Sec 03 W ½ SW ¼ NE ¼ Exc Part
032-00059-0000	Milky Way Acres Farm	W2078 County Rd K Durand WI 54742	40	10	T 23N R 13W Sec 03 SE ¼ NW ¼
032-00056-0000	Milky Way Acres Farm	W2078 County Rd K Durand WI 54743	46	10	T 23N R 13W Sec 03 FRL NE ¼ NW ¼
032-00057-0000	Milky Way Acres Farm	W2078 County Rd K Durand WI 54744	45	10	T 23N R 13W Sec 03 FRL NW ¼ NW ¼
032-00070-0000	William M and Linda L Weisenbeck	W1984 Country Rd K Durand WI 54736	44	11	T 23N R 13W Sec 04 FRL NE ¼ NE ¼
032-00071-0000	William M and Linda L Weisenbeck	W1984 Country Rd K Durand WI 54737	43	11	T 23N R 13W Sec 04 FRL NW ¼ NE ¼

032-00074-0000	William M and Linda L Weisenbeck	W1984 Country Rd K Durand WI 54738	40	11	T 23N R 13W Sec 04 SE ¼ NE ¼
032-00072-0000	William M and Linda L Weisenbeck	W1984 Country Rd K Durand WI 54739	20	11	T 23N R 13W Sec 04 E ½ SW ¼ NE ¼
032-00073-0000	Miles S and Penelope A Holt	W2141 County Rd K Durand WI 54736	20	12	T 23N R 13W Sec 04 W ½ SW ¼ NE ¼
032-00061-0010	Robert Frank	S1379 State Rd 35 Nelson WI 54756	37.73	13	T 23N R 13W Sec 03 Part of NW ¼ SW ¼
032-00091-0000	Robert Frank	S1379 State Rd 35 Nelson WI 54757	40	13	T 23N R 13W Sec 04 NW ¼ SE ¼
032-00090-0010	Robert Frank	S1379 State Rd 35 Nelson WI 54758	38.71	13	T 23N R 13W Sec 04 Part of NE ¼ SE ¼
032-00093-0010	Robert Frank	S1379 State Rd 35 Nelson WI 54759	22.69	13	T 23N R 13W Sec 04 Part of SE ¼ SE ¼
032-00093-0000	William M and Linda L Weisenbeck	W1984 Country Rd K Durand WI 54739	15.98	14	T 23N R 13W Sec 04 Part of SE ¼ SE ¼
032-00062-0000	William M and Linda L Weisenbeck	W1984 Country Rd K Durand WI 54740	25	14	T 23N R 13W Sec 03 SW ¼ SW ¼ Exc S 15A
032-00081-0000	Scott L and June A Baker	W2163 County Rd K Durand WI 54736	3.3	15	T 23N R 13W Sec 04 that Part of SE ¼ NW ¼
032-00089-0000	Charles and Diane Brion	W2142 County Rd KK Nelson WI 54756	37.23	16	T 23N R 13W Sec 04 SW ¼ SE ¼ Exc Pt
032-00111-0010	Steven A Lindstrom	718 Robert Rd Durand WI 54736	31.5	17	T 23N R 13W Sec 05 Part of NE ¼ SE ¼
032-00112-0000	Steven A Lindstrom	718 Robert Rd Durand WI 54736	40	17	T 23N R 13W Sec 05 NW ¼ SE ¼
032-00099-0010	Steven A Lindstrom	718 Robert Rd Durand WI 54736	15.95	17	T 23N R 13W Sec 05 Part of N ½ SE ¼ NE ¼
032-00084-0010	Steven A Lindstrom	718 Robert Rd Durand WI 54736	32.1	17	T 23N R 13W Sec 04 Part of NE ¼ SW ¼

032-00085-0010	Steven A Lindstrom	718 Robert Rd Durand WI 54736	30.6	17	T 23N R 13W Sec 04 Part of NW ¼ SW ¼
032-00079-0010	Steven A Lindstrom	718 Robert Rd Durand WI 54736	31.75	17	T 23N R 13W Sec 04 That Part of SW ¼ NW ¼
032-00083-0000	Lindstrom Trust	W2178 County Rd K Durand WI 54736	0.05	17	T 23N R 13W Sec 04 That Part of SE ¼ NW ¼
032-00076-0000	Lindstrom Trust	W2178 County Rd K Durand WI 54737	0.06	17	T 23N R 13W Sec 04 That Part of FRL NE ¼ NW ¼
032-00078-0000	Lindstrom Trust	W2178 County Rd K Durand WI 54738	0.17	17	T 23N R 13W Sec 04 That Part of NW ¼ NW ¼
032-00080-0000	Lindstrom Trust	W2178 County Rd K Durand WI 54739	0.68	17	T 23N R 13W Sec 04 That Part of SW ¼ NW ¼
032-00087-0010	Nora M Lindstrom and Matthew M Gilles	W2184 County Rd K Durand WI 54736	3.2	17	T 23N R 13W Sec 04 Part of SE ¼ SW ¼
032-00099-0000	Breezy Point Farm	W2184 County Rd K Durand WI 54736	4.05	18	T 23N R 13W Sec 05 Part of N ½ SE ¼ NE ¼
032-00111-0000	Breezy Point Farm	W2184 County Rd K Durand WI 54737	8.5	18	T 23N R 13W Sec 05 Part of NE ¼ SE ¼
032-00115-0000	Breezy Point Farm	W2184 County Rd K Durand WI 54738	20	18	T 23N R 13W Sec 05 NE ½ SE ¼ SE ¼
032-00086-0000	Breezy Point Farm	W2184 County Rd K Durand WI 54739	40	18	T 23N R 13W Sec 04 SW ¼ SW ¼
032-00084-0000	Breezy Point Farm	W2184 County Rd K Durand WI 54740	7.9	18	T 23N R 13W Sec 04 Part of NE ¼ SW ¼
032-00085-0000	Breezy Point Farm	W2184 County Rd K Durand WI 54740	9.4	18	T 23N R 13W Sec 04 SE ¼ SW ¼ Exc Part
032-00087-0000	Breezy Point Farm	W2184 County Rd K Durand WI 54741	35.05	18	T 23N R 13W Sec 04 Part of NW ¼ SW ¼
032-00114-0000	Rodney and Donna Harschip	W2177 County Rd KK Nelson WI 54756	20	19	T 23N R 13W Sec 05 SW ½ SE ¼ SE ¼
032-00198-0000	Rodney and Donna Harschip	W2177 County Rd KK Nelson WI 54757	40	19	T 23N R 13W Sec 09 NW ¼ NW ¼

032-00113-0000	Palmer Peterson	1003 S Main St Alma WI 54610	40	20	T 23N R 13W Sec 05 SW ¼ SE ¼ LE-Elmer Peterson
032-00110-0000	Palmer Peterson	1003 S Main St Alma WI 54610	40	20	T 23N R 13W Sec 05 SE ¼ SW ¼ LE-Elmer Peterson
032-00169-0000	Palmer Peterson	1004 S Main St Alma WI 54610	40	20	T 23N R 13W Sec 08 NE ¼ NE ¼ LE-Elmer Peterson
032-00170-0000	Palmer Peterson	1005 S Main St Alma WI 54610	40	20	T 23N R 13W Sec 08 NW ¼ NE ¼ LE-Elmer Peterson
032-00171-0000	Palmer Peterson	1006 S Main St Alma WI 54610	40	20	T 23N R 13W Sec 08 SW ¼ NE ¼ LE-Elmer Peterson
032-00172-0000	Palmer Peterson	1007 S Main St Alma WI 54610	20	20	T 23N R 13W Sec 08 W ½ SE ¼ NE ¼ LE-Elmer Peterson
020-00647-0000	Terry and Brenda Sobottka	W2234 County Rd K Durand WI 54736	40	21	T 24N R 13W Sec 32 SW ¼ SE ¼
032-00100-0000	Terry and Brenda Sobottka	W2234 County Rd K Durand WI 54737	20	21	T 23N R 13W Sec 05 S ½ SE ¼ NE ¼
032-00097-0000	Terry and Brenda Sobottka	W2234 County Rd K Durand WI 54738	42	21	T 23N R 13W Sec 05 FRL NW ¼ NE ¼
032-00098-0000	Terry and Brenda Sobottka	W2234 County Rd K Durand WI 54739	40	21	T 23N R 13W Sec 05 SW ¼ NE ¼
020-00643-0000	Milky Way Acres Farm	W 2078 County Rd K Durand WI 54736	40	22	T 24N R 13W Sec 32 SW ¼ SW ¼
020-00644-0000	Milky Way Acres Farm	W 2078 County Rd K Durand WI 54737	40	22	T 24N R 13W Sec 32 SE ¼ SW ¼
020-00642-0000	Milky Way Acres Farm	W 2078 County Rd K Durand WI 54738	20	22	T 24N R 13W Sec 32 S ½ NW ¼ SW ¼
032-00104-0000	Milky Way Acres Farm	W 2078 County Rd K Durand WI 54739	40	22	T 23N R 13W Sec 05 SE ¼ NW ¼
032-00105-0000	Milky Way Acres Farm	W 2078 County Rd K Durand WI 54740	40	22	T 23N R 13W Sec 05 NE ¼ SW ¼
032-00101-0000	Milky Way Acres Farm	W 2078 County Rd K Durand WI 54741	42	22	T 23N R 13W Sec 05 FRL NE ¼ NW ¼

032-00102-0000	Milky Way Acres Farm	W 2078 County Rd K Durand WI 54742	42	22	T 23N R 13W Sec 05 FRL NW ¼ NW ¼
032-00122-0000	Daniel and Jane Weisenbeck	W2295 County Rd K Durand WI 54736	39.84	23	T 23N R 13W Sec 06 that Part of NW ¼ NW ¼
032-00116-0000	Daniel and Jane Weisenbeck	W2295 County Rd K Durand WI 54737	43	23	T 23N R 13W Sec 06 FRL NE ¼ NE ¼
032-00120-0000	Daniel and Jane Weisenbeck	W2295 County Rd K Durand WI 54738	33.76	23	T 23N R 13W Sec 06 that part of FRL NE ¼ NW ¼
032-00119-0000	Daniel and Jane Weisenbeck	W2295 County Rd K Durand WI 54739	40	23	T 23N R 13W Sec 06 SE ¼ NE ¼
032-00118-0000	Daniel and Jane Weisenbeck	W2295 County Rd K Durand WI 54740	40	23	T 23N R 13W Sec 06 SW ¼ NE ¼
032-00117-0000	Daniel and Jane Weisenbeck	W2295 County Rd K Durand WI 54741	43	23	T 23N R 13W Sec 06 FRL NW ¼ NE ¼
032-00125-0000	Daniel and Jane Weisenbeck	W2295 County Rd K Durand WI 54742	39.82	23	T 23N R 13W Sec 06 SE ¼ NW ¼ Exc Rd
032-00103-0000	Daniel and Jane Weisenbeck	W2295 County Rd K Durand WI 54743	40	23	T 23N R 13W Sec 05 SW ¼ NW ¼
032-00106-0000	Daniel and Jane Weisenbeck	W2295 County Rd K Durand WI 54744	20	23	T 23N R 13W Sec 05 N ½ NW ¼ SW ¼
020-00639-0000	Kurt Hurlburt	S266 State Rd 25 Durand WI 54736	40	24	T 24N R 13W Sec 32 SE ¼ NW ¼
020-00634-0000	Kurt Hurlburt	S266 State Rd 25 Durand WI 54737	40	24	T 24N R 13W Sec 32 SW ¼ NE ¼
020-00636-0000	Kurt Hurlburt	S266 State Rd 25 Durand WI 54738	40	24	T 24N R 13W Sec 32 NE ¼ NW ¼
020-00638-0000	Kurt Hurlburt	S266 State Rd 25 Durand WI 54739	40	24	T 24N R 13W Sec 32 SW ¼ NW ¼
020-00640-0000	Kurt Hurlburt	S266 State Rd 25 Durand WI 54740	40	24	T 24N R 13W Sec 32 NE ¼ SW ¼
020-00641-0000	Kurt Hurlburt	S266 State Rd 25 Durand WI 54741	20	24	T 24N R 13W Sec 32 N ½ NW ¼ SW ¼

020-00646-0000	Kurt Hurlburt	S266 State Rd 25 Durand WI 54742	40	24	T 24N R 13W Sec 32 NW ¼ SE ¼
020-00656-0000	Jeffery D and Michael D Kralewski	W2246 County Rd V Durand WI 54736	20	25	T 24N R 13W Sec 33 W ½ SW ¼ NW ¼
020-00661-0000	Jeffery D and Michael D Kralewski	W2246 County Rd V Durand WI 54737	3	25	T 24N R 13W Sec 33 NW part NW ¼ SW ¼
020-00654-0000	Jeffery D and Michael D Kralewski	W2246 County Rd V Durand WI 54738	17.7	25	T 24N R 13W Sec 33 W ½ OF NW ¼ NW ¼ Exc NW Corner
020-00632-0010	Michael D and Lea M Kralewski	W2197 County Road V Durand WI 54736	1.177	25	T 24N R 13W Sec 32 NE Corner NE ¼ NE ¼
020-00654-0010	Michael D and Lea M Kralewski	W2197 County Road V Durand WI 54737	2.3	25	T 24N R 13W Sec 33 NW Corner of W ½ OF NW ¼ NW ¼
020-00633-0000	Jeffery D and Michael D Kralewski	W2246 County Rd V Durand WI 54738	40	26	T 24N R 13W Sec 32 NW ¼ NE ¼
020-00574-0000	Jeffery D and Michael D Kralewski	W2246 County Rd V Durand WI 54739	20	26	T 24N R 13W Sec 29 S ½ SW ¼ SE ¼
020-00632-0000	Jeffery D and Michael D Kralewski	W2246 County Rd V Durand WI 54739	38.23	26	T 24N R 13W Sec 32 NE ¼ NE ¼ Exc NE Corner
020-00635-0000	Jeffery D and Michael D Kralewski	W2246 County Rd V Durand WI 54740	40	26	T 24N R 13W Sec 32 SE ¼ NE ¼
020-00570-0000	David J Jemilo	S434 Kings Hwy Durand WI 54736	40	27	T 24N R 13W Sec 29 SE ¼ SW ¼
020-00567-0000	David J Jemilo	S434 Kings Hwy Durand WI 54737	20	27	T 24N R 13W Sec 29 SW Part NE ¼ SW ¼
020-00568-0000	David J Jemilo	S434 Kings Hwy Durand WI 54738	40	27	T 24N R 13W Sec 29 NW ¼ SW ¼
020-00575-0000	David J Jemilo	S434 Kings Hwy Durand WI 54739	20	27	T 24N R 13W Sec 29 N ½ SW ¼ SE ¼

020-00573-0000	David J Jemilo	S434 Kings Hwy Durand WI 54740	5	27	T 24N R 13W Sec 29 S5A of NW ¼ SE ¼
020-00569-0000	David J Jemilo	S434 Kings Hwy Durand WI 54741	40	27	T 24N R 13W Sec 29 SW ¼ SW ¼
020-00549-0000	Hurlburt's Liberty Hill Farms	S274 State Road 25 Durand WI 54736	40	28	T 24N R 13W Sec 28 NW ¼ SW ¼
020-00550-0000	Hurlburt's Liberty Hill Farms	S274 State Road 25 Durand WI 54737	40	28	T 24N R 13W Sec 28 SW ¼ SW ¼
020-00546-0000	Hurlburt's Liberty Hill Farms	S274 State Road 25 Durand WI 54738	40	28	T 24N R 13W Sec 28 SW ¼ NW ¼
020-00545-0000	Hurlburt's Liberty Hill Farms	S274 State Road 25 Durand WI 54739	40	28	T 24N R 13W Sec 28 NW ¼NW ¼
020-00576-0000	Hurlburt's Liberty Hill Farms	S274 State Road 25 Durand WI 54740	40	28	T 24N R 13W Sec 29 SE ¼ SE ¼
020-00561-0000	Hurlburt's Liberty Hill Farms	S274 State Road 25 Durand WI 54741	40	28	T 24N R 13W Sec 29 SE ¼ NE ¼
020-00563-0000	Hurlburt's Liberty Hill Farms	S274 State Road 25 Durand WI 54742	40	28	T 24N R 13W Sec 29 NW ¼ NW ¼
020-00564-0000	Hurlburt's Liberty Hill Farms	S274 State Road 25 Durand WI 54743	40	28	T 24N R 13W Sec 29 SW ¼ NW ¼
020-00566-0000	Hurlburt's Liberty Hill Farms	S274 State Road 25 Durand WI 54744	20	28	T 24N R 13W Sec 29 NE Part NE ¼ SW ¼
020-00571-0000	Hurlburt's Liberty Hill Farms	S274 State Road 25 Durand WI 54745	40	28	T 24N R 13W Sec 29 NE ¼ SE ¼
020-00572-0000	Hurlburt's Liberty Hill Farms	S274 State Road 25 Durand WI 54746	35	28	T 24N R 13W Sec 29 NW ¼ SE ¼ Exc 5A
020-00558-0000	Kees Bros., Inc	PO BOX 104 Durand WI 54736	40	29	T 24N R 13W Sec 29 NE ¼ NE ¼
020-00562-0000	Kees Bros., Inc	PO BOX 104 Durand WI 54737	37.53	29	T 24N R 13W Sec 29 NE ¼ NW ¼ Exc Part
020-00559-0000	Kees Bros., Inc	PO BOX 104 Durand WI 54738	40	29	T 24N R 13W Sec 29 NW ¼ NE ¼

020-00565-0010	Kees Bros., Inc	PO BOX 104 Durand WI 54739	27.6	29	T 24N R 13W Sec 29 Part of SE ¼ NW ¼
020-00560-0000	Kees Bros., Inc	PO BOX 104 Durand WI 54740	40	29	T 24N R 13W Sec 29 SW ¼ NE ¼
020-00406-0000	Kees Bros., Inc	PO BOX 104 Durand WI 54741	36.33	29	T 24N R 13W Sec 20 SE ¼ SW ¼ Exc Part
020-00562-0010	Bruce Kees	S414 Kings Hwy Durand WI 54741	2.47	29	T 24N R 13W Sec 29 Part of NE ¼ NW ¼
020-00565-0000	Bruce Kees	S414 Kings Hwy Durand WI 54742	12.4	29	T 24N R 13W Sec 29 Part of the SE ¼ NW ¼ Life Estate for Theone Kees
020-00406-0010	Bruce Kees	S414 Kings Hwy Durand WI 54743	3.67	29	T 24N R 13W Sec 20 Part SE ¼ SW ¼

Appendix II:
Test Boring Logs

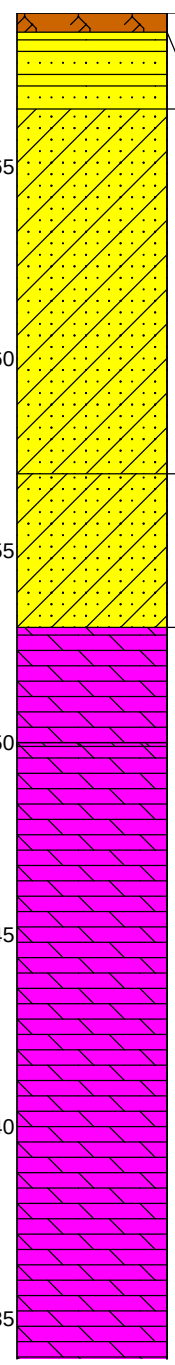
Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name : WPR - Lindstrom
Summit Project No. : 2157-0010
Project Location : Maxville, WI
County : Buffalo
Description Performed by: Brian Gulbranson
Surface grade elelvation: ~1169 ft amsl*

LOG OF BORING TB-1

Date : 4/30/14
Company/Method : Thein Well/Air Rotary
Sample Method : Grab
Field Observer(s) : BLG/RLA
Weather :

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
0			Topsoil, dark brown.	
			Topsoil, sandy silt.	
	1165		Sandy clay, yellow-brown, with dolomite clasts.	
5				
	1160			
10				
			Sandy clay, brown, with dolomite clasts.	
	1155			
15				
			Dolomite, buff-tan, hard, fine-grained/micritic.	
	1150			Shell fragments
20				
	1145			
25				
	1140			
30				
	1135			
35				



End of Boring at 140 feet.
582178 m E, 4930858 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name : WPR - Lindstrom
Summit Project No. : 2157-0010
Project Location : Maxville, WI
County : Buffalo
Description Performed by: Brian Gulbranson
Surface grade elelvation: ~1169 ft amsl*

LOG OF BORING TB-1

Date : 4/30/14
Company/Method : Thein Well/Air Rotary
Sample Method : Grab
Field Observer(s) : BLG/RLA
Weather :

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
35				
	1130			
40				
	1125			
45				
	1120		Sandstone, hard, yellow-brown, very fine lower to medium upper grained, angular to rounded, frosted, poorly sorted, trace accessories.	
50				
	1115		Shale, red-brown, gray, buff, and green, with dolomite and sandstone interbeds.	
55			Sandstone, soft, yellow-brown, very fine lower to medium upper grained, angular to well rounded, frosted, moderately sorted, rare accessories.	
	1110		Shale, red-brown, gray, buff, and green, with dolomite and sandstone interbeds.	
60				
	1105		Sandstone, hard, brown, very fine upper to coarse upper grained, predominantly fine lower to medium lower, angular to well rounded, frosted, poorly sorted, rare accessories, dolomite interbeds.	
65				Shell fragments
			Sandstone, hard, brown, very fine upper to coarse lower grained, subangular to well rounded, frosted, moderately sorted, becoming poorly sorted, rare accessories, rare inclusions, rare prefractures, clusters.	Shell fragments Shell fragments
	1100			
70				

End of Boring at 140 feet.
582178 m E, 4930858 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name : WPR - Lindstrom
Summit Project No. : 2157-0010
Project Location : Maxville, WI
County : Buffalo
Description Performed by: Brian Gulbranson
Surface grade elelvation: ~1169 ft amsl*

LOG OF BORING TB-1

Date : 4/30/14
Company/Method : Thein Well/Air Rotary
Sample Method : Grab
Field Observer(s) : BLG/RLA
Weather :

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
70				
			Sandstone, soft, orange-brown, very fine upper to coarse lower grained, subangular to well rounded, frosted, moderately sorted, trace accessories, rare prefractures.	Brown shale lamina
	1095		Sandstone, soft, orange-brown, very fine upper to coarse upper grained, rare very coarse lower, subrounded to well rounded, frosted, moderately sorted, rare accessories, mica flakes, rare inclusions.	Brown shale lamina
75				Green shale lamina
				Green shale lamina
	1090		Sandstone, soft, tan, fine upper to coarse upper grained, rare very coarse upper, subrounded to well rounded, frosted, well sorted, rare inclusions, rare prefractures, clusters, calcite, feldspar shards.	
80				Brown shale lamina
				Green shale lamina
	1085			
85				Green, yellow, and brown shale lamina
	1080		Sandstone, soft, gray-brown, fine upper to coarse upper grained, rare very coarse upper, subrounded to well rounded, frosted, well sorted, rare inclusions, rare prefractures, clusters, silt- and clay-sized coatings, calcite, feldspar shards.	
90				
	1075			
95				
	1070			
100				
	1065			
105				

End of Boring at 140 feet.
582178 m E, 4930858 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name : WPR - Lindstrom
Summit Project No. : 2157-0010
Project Location : Maxville, WI
County : Buffalo
Description Performed by: Brian Gulbranson
Surface grade elelvation: ~1169 ft amsl*

LOG OF BORING TB-1

Date : 4/30/14
Company/Method : Thein Well/Air Rotary
Sample Method : Grab
Field Observer(s) : BLG/RLA
Weather :

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
105			Sandstone, hard, tan, fine lower to coarse lower grained, subangular to well rounded, frosted, very well sorted, rare inclusions, rare prefractures, clusters.	
	1060		Sandstone, soft, brown, fine lower to coarse upper grained, subangular to well rounded, frosted, moderately sorted, silt- and clay-sized coatings.	
110				
			Sandstone, hard, orange-yellow, very fine lower to coarse lower grained, angular to well rounded, frosted, poorly sorted, rare inclusions, rare prefractures, clusters.	
	1055		Sandstone, hard, orange-yellow, very fine lower to coarse upper grained, angular to well rounded, frosted, poorly sorted, rare accessories, rare inclusions, rare prefractures, minor silt- and clay-sized coatings, calcite and feldspar shards.	
115				
			Sandstone, hard, orange-brown, very fine lower to coarse lower grained, angular to well rounded, frosted, poorly sorted, rare accessories, silt- and clay-sized coatings, clusters, well-cemented layer at 117 ft.	
	1050			
120			Sandstone, hard, orange-brown, fine lower to coarse upper grained, subangular to well rounded, frosted, moderately sorted, clusters, calcite and feldspar shards.	
	1045		Sandstone, hard, tan, very fine upper to fine lower grained, angular to rounded, frosted, very well sorted, trace accessories, mica flakes.	
125				
	1040			
130				
	1035			
135				Brown shale lamina
	1030			
140				

End of Boring at 140 feet.
582178 m E, 4930858 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Summit Envirosolutions

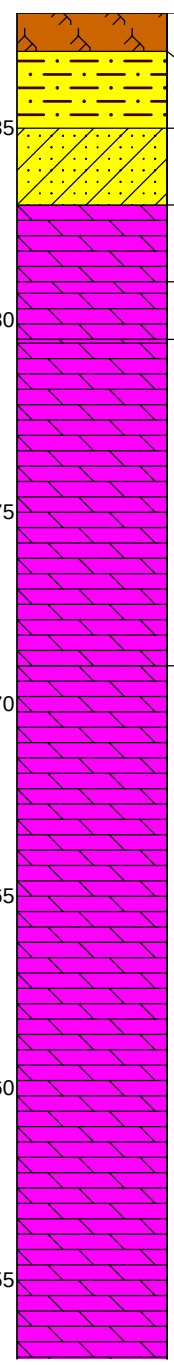
Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name	: WPR - Lindstrom
Summit Project No.	: 2157-0010
Project Location	: Maxville, WI
County	: Buffalo
Description Performed by:	Brian Gulbranson
Surface grade elelvation:	~1188 ft amsl*

LOG OF BORING TB-2

Date	: 4/30/14 - 5/1/14
Company/Method	: Thein Well/Air Rotary
Sample Method	: Grab
Field Observer(s)	: BLG/RLA
Weather	:

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
0			Topsoil, dark brown.	
			Silt, brown.	
	1185		Sandy clay, brown, with buff dolomite clasts.	
5			Dolomite, buff-gray, micritic.	
	1180		Dolomite, orange-brown, sandy.	
			Dolomite, very hard.	
10				
	1175			
15				
	1170		Dolomite, hard, buff, micritic, with very fine-grained sandstone interbeds.	
20				
	1165			
25				
	1160			
30				
	1155			
35				



End of Boring at 149.5 feet.
582367 m E, 4930274 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name : WPR - Lindstrom
Summit Project No. : 2157-0010
Project Location : Maxville, WI
County : Buffalo
Description Performed by: Brian Gulbranson
Surface grade elelvation: ~1188 ft amsl*

LOG OF BORING TB-2

Date : 4/30/14 - 5/1/14
Company/Method : Thein Well/Air Rotary
Sample Method : Grab
Field Observer(s) : BLG/RLA
Weather :

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
35				
	1150			
40				
	1145			
45				
	1140			
50				
	1135			
55				
	1130			
60			Sandstone, hard, yellow-brown, very fine lower to medium upper grained, angular to rounded, poorly sorted, clusters.	Red-brown shale lamina
			Shale, dark brown, buff, and green.	
	1125		Dolomite, hard, yellow-brown, with sandstone interbeds. Sandstone is hard, buff, very fine lower to medium upper grained, angular to rounded, frosted, poorly sorted, trace accessories.	Green shale lamina
65				Red-brown shale lamina and shell fragments
	1120			Red-brown shale
70				Shell fragments

End of Boring at 149.5 feet.
582367 m E, 4930274 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name	: WPR - Lindstrom
Summit Project No.	: 2157-0010
Project Location	: Maxville, WI
County	: Buffalo
Description Performed by:	Brian Gulbranson
Surface grade elelvation:	~1188 ft amsl*

LOG OF BORING TB-2

Date	: 4/30/14 - 5/1/14
Company/Method	: Thein Well/Air Rotary
Sample Method	: Grab
Field Observer(s)	: BLG/RLA
Weather	:

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
70			Dolomite, hard, yellow-brown, with sandstone interbeds, dolomite content decreasing downward. Sandstone is hard, buff-brown, very fine lower to coarse lower grained, angular to well rounded, frosted, poorly sorted, clusters.	Green shale lamina Red-brown shale lamina Olive shale lamina
75	1115			
	1110			
80			Sandstone, hard, buff, very fine lower to fine lower grained, angular to subrounded, frosted, very well sorted.	
	1105			
85			Sandstone, soft, orange-brown, very fine upper to coarse upper grained, subangular to well rounded, frosted, poorly sorted, rare accessories, rare inclusions, rare prefractures, clusters, minor silt- and clay-sized coatings.	Olive shale lamina Olive shale lamina
	1100			
90			Sandstone, hard, yellow-orange, very fine lower to fine lower grained, becoming very fine lower to medium upper, angular to subrounded, frosted, moderately sorted, trace inclusions, rare prefractures, silt- and clay-sized coatings.	
	1095		Sandstone, soft, orange-brown, fine lower to very coarse lower grained, rare very coarse upper, angular to well rounded, frosted, moderately sorted, no accessories, trace inclusions, rare prefractures, silt- and clay-sized coatings.	
95			Sandstone, hard, brown, very fine lower to coarse lower grained, angular to well rounded, frosted, poorly sorted, rare accessories, rare inclusions, clusters, silt- and clay-sized coatings.	Yellow shale lamina
	1090			
100			Sandstone, soft, gray-brown, fine lower to very coarse lower grained, subrounded to well rounded, frosted, moderately sorted, rare inclusions, rare prefractures, silt- and clay-sized coatings.	Shell fragments
	1085		Sandstone, hard, orange-brown, very fine lower to coarse lower grained, angular to well rounded, frosted, poorly sorted, trace accessories, rare prefractures, clusters, calcite and feldspar shards, well-cemented layer at 104 ft.	Shell fragments
105				

End of Boring at 149.5 feet.
582367 m E, 4930274 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name : WPR - Lindstrom
Summit Project No. : 2157-0010
Project Location : Maxville, WI
County : Buffalo
Description Performed by: Brian Gulbranson
Surface grade elelvation: ~1188 ft amsl*

LOG OF BORING TB-2

Date : 4/30/14 - 5/1/14
Company/Method : Thein Well/Air Rotary
Sample Method : Grab
Field Observer(s) : BLG/RLA
Weather :

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
105				
	1080		Sandstone, soft, orange-brown, fine lower to very coarse lower grained, subrounded to well rounded, frosted, moderately sorted, rare accessories, rare inclusions, rare prefractures, minor silt- and clay-sized coatings, calcite shards.	
110			Sandstone, hard, buff, very fine lower to medium lower grained, angular to well rounded, frosted, poorly sorted, rare prefractures, clusters, calcite shards.	Shell fragments
	1075		Sandstone, soft, yellow-brown, fine lower to coarse upper grained, rare very coarse lower, subrounded to well rounded, frosted, moderately sorted, rare inclusions, rare prefractures, minor silt- and clay-sized coatings, calcite shards.	
115				
	1070			
120				
	1065			
125				Shell fragments
	1060		Sandstone, soft, yellow-brown, very fine upper to coarse lower grained, rare coarse upper, subangular to well rounded, frosted, moderately sorted, rare inclusions, rare prefractures, clusters, calcite and feldspar shards.	Shell fragments
130				Shell fragments
	1055			
135				Shell fragments
	1050		Sandstone, hard, tan, very fine upper to medium upper grained, rare coarse upper, angular to well rounded, frosted, bimodal, trace accessories, rare inclusions, calcite and feldspar shards.	
140				

End of Boring at 149.5 feet.
582367 m E, 4930274 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name : WPR - Lindstrom
Summit Project No. : 2157-0010
Project Location : Maxville, WI
County : Buffalo
Description Performed by: Brian Gulbranson
Surface grade elelvation: ~1188 ft amsl*

LOG OF BORING TB-2

Date : 4/30/14 - 5/1/14
Company/Method : Thein Well/Air Rotary
Sample Method : Grab
Field Observer(s) : BLG/RLA
Weather :

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
140				
	1045			
145			Sandstone, hard, buff, very fine lower to fine lower grained, angular to rounded, frosted, well sorted, trace accessories, clusters.	
	1040			

End of Boring at 149.5 feet.
582367 m E, 4930274 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name : WPR - Lindstrom
Summit Project No. : 2157-0010
Project Location : Maxville, WI
County : Buffalo
Description Performed by: Brian Gulbranson
Surface grade elelvation: ~915 ft amsl*

LOG OF BORING TB-3

Date : 5/2/14
Company/Method : Thein Well/Air Rotary
Sample Method : Grab
Field Observer(s) : BLG/RLA
Weather :

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
0	915		Topsoil, dark brown.	
			Sandy clay, dark brown, organic rich.	
5	910		Loess, brown. Poor sample return due to hole stabilization issues. Small chips of glauconitic sandstone encountered near bottom of borehole.	
10	905			
15	900			
20	895			
25	890			
30	885			

End of Boring at 30 feet.
582018 m E, 4930509 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Summit Envirosolutions

Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name	: WPR - Lindstrom
Summit Project No.	: 2157-0010
Project Location	: Maxville, WI
County	: Buffalo
Description Performed by:	Brian Gulbranson
Surface grade elelvation:	~872 ft amsl*

LOG OF BORING TB-4

Date	: 5/2/14
Company/Method	: Thein Well/Air Rotary
Sample Method	: Grab
Field Observer(s)	: BLG/RLA
Weather	:

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
0			Topsoil, dark brown.	
	870		Loess, brown.	
5			Sand, soft, tan, very fine lower to fine lower grained, angular to subrounded, clear to frosted, well sorted, abundant accessories.	Brown clay
	865		Sand, soft, tan, very fine lower to fine upper grained, angular to rounded, clear to frosted, well sorted, abundant accessories, glauconitic, mica flakes.	
10			Sandstone, soft, brown, very fine lower to fine lower grained, angular to well rounded, clear to frosted, well sorted, abundant accessories, glauconitic, mica flakes.	
	860			Yellow shale lamina
15			Sandstone, tan, green, and yellow-orange, very fine lower to fine lower grained, angular to well rounded, clear to frosted, well sorted, abundant accessories, glauconitic, mica flakes, interbedded with yellow, red-brown, green, and buff shale.	
	855			
20				
	850			
25				
	845			
30				
	840			
35				

End of Boring at 120 feet.
582253 m E, 4929055 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name : WPR - Lindstrom
Summit Project No. : 2157-0010
Project Location : Maxville, WI
County : Buffalo
Description Performed by: Brian Gulbranson
Surface grade elelvation: ~872 ft amsl*

LOG OF BORING TB-4

Date : 5/2/14
Company/Method : Thein Well/Air Rotary
Sample Method : Grab
Field Observer(s) : BLG/RLA
Weather :

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
35				
	835			
40				
	830			
45				
	825			
50				
	820			
			Sandstone, very hard, glauconitic.	
55				
	815			
				Shell fragments
				Shell fragments
60				Shell fragments
				Cream and yellow shale lamina
	810		Sandstone, hard, green and brown, very fine lower to fine lower grained, angular to rounded, frosted, well sorted, abundant accessories, glauconitic.	
65				
	805			
			Shale, dark green, glauconitic.	
			Sandstone, hard, green and brown, very fine lower to fine lower grained, angular to rounded, frosted, well sorted, abundant accessories,	
70				

End of Boring at 120 feet.
582253 m E, 4929055 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name : WPR - Lindstrom
Summit Project No. : 2157-0010
Project Location : Maxville, WI
County : Buffalo
Description Performed by: Brian Gulbranson
Surface grade elelvation: ~872 ft amsl*

LOG OF BORING TB-4

Date : 5/2/14
Company/Method : Thein Well/Air Rotary
Sample Method : Grab
Field Observer(s) : BLG/RLA
Weather :

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
70			glauconitic.	Yellow shale lamina
	800			Gray shale lamina
75				
	795			Shell fragments
80			Sandstone, hard, green and brown, very fine lower to medium lower grained, angular to rounded, frosted, well sorted, abundant accessories, glauconitic.	
	790			
85				Shell fragments
	785		Sandstone, hard, yellow-orange to green, very fine lower to coarse lower grained, angular to rounded, frosted, poorly sorted, abudant accessories, silt- and clay-sized coatings, glauconitic.	Shell fragments
90				
	780			
95			Sandstone, hard, yellow-orange, very fine upper to coarse upper grained, rare very coarse lower, subangular to well rounded, frosted, moderately sorted, rare inclusions, rare prefractures, silt- and clay-sized coatings, clusters.	
	775			
100				Brown shale lamina
	770			Green shale lamina Green shale lamina
105				

End of Boring at 120 feet.
582253 m E, 4929055 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Summit Envirosolutions, Inc.
1217 Bandana Boulevard North
St. Paul, MN 55180-5114

Project Name : WPR - Lindstrom
Summit Project No. : 2157-0010
Project Location : Maxville, WI
County : Buffalo
Description Performed by: Brian Gulbranson
Surface grade elelvation: ~872 ft amsl*

LOG OF BORING TB-4

Date : 5/2/14
Company/Method : Thein Well/Air Rotary
Sample Method : Grab
Field Observer(s) : BLG/RLA
Weather :

Depth in feet	ELEV (ft amsl)	GRAPHIC LOG	MAJOR LITHOLOGY DESCRIPTIONS	MINOR LITHOLOGY DESCRIPTIONS
105				Yellow micaceous shale lamina
	765		Sandstone, soft, buff, fine upper to coarse lower grained, rare coarse upper, subrounded to well rounded, frosted, well sorted, rare accessories, rare inclusions, rare prefractures, minor silt- and clay-sized coatings.	Brown shale lamina Green and brown shale lamina
110				
	760			Yellow micaceous shale lamina
115				Green shale lamina Green shale lamina
	755			
			Sandstone, soft, buff, fine upper to coarse upper grained, subrounded to well rounded, well sorted, rare inclusions, rare prefractures, minor silt- and clay-sized coatings, water encountered at 120 ft.	Green shale lamina Green shale lamina
120				

End of Boring at 120 feet.
582253 m E, 4929055 m N. Coordinates are UTM Zone 15N (NAD83).
*Elevation extracted from National Elevation Dataset

Appendix III:
Well Construction Reports

Well Construction Report For
WISCONSIN UNIQUE WELL NUMBER AJ170

State of WI - Private Water Systems - DG/2
Department of Natural Resources, Box 7921
Madison, WI 53707
Please type or Print using a black Pen
Please Use Decimals Instead of Fractions.

Form 3300-77A
(R 8/00)

Property Owner: **CYRIL WEISENBECK**
Telephone Number: **715-672-5723**
Mailing Address: **RT 3 BOX 127**
City: **DURAND** State: **WI** Zip Code: **54736**
County of Well Location: **Buffalo**
County Well Permit No.: **W**
Well Completion Date: **06/07/1989**

1. Well Location: [X] Town [ ] City [ ] Village of **MAXVILLE**
Fire # (if available): **W1985**
Grid or Street Address or Road Name and Number: **COUNTY ROAD V**
Subdivision Name Lot # Block #

Well Constructor (Business Name): **PELKE PLBG AND HTG INC**
License #: **535**
Facility ID Number (Public Wells)
Address: **HC 63 BOX 32**
Public Well Plan Approval #: W--
City: **DURAND** State: **WI** Zip Code: **54736**
Date of Approval (mm/dd/yyyy)
Hicap Permanent well #
Common Well #
Specific Capacity: **.2** gpm/ft

Gov't Lot # or **SW** 1/4 of **NW** 1/4 of
Section **27** T **24** N; R **13** [ ] E [X] W
Latitude Deg. Min.
Longitude Deg Min.

2. Well Type: [X] New [ ] Replacement [ ] Reconstruction
Lat/Long Method: **GPS008**
of previous unique well # constructed in
Reason for replaced or Reconstructed Well?
STOVE PIPE @ HIGH NITRATE
[X] Drilled [ ] Driven Point [ ] Jetted [ ] Other:

3. Well serves **1** # of homes and or **BARN**
(e.g. barn, restaurant, church, school, industry, etc.)
High capacity Well? [ ] Yes [X] No
Property? [ ] Yes [X] No

4. Is the well located upslope or sideslope and not downslope from any contamination source, including those on neighboring properties? [X] Yes [ ] No
Well located within 1,200 feet of a quarry? [ ] Yes [ ] No If yes, distance in feet from quarry:
Well located in floodplain? [ ] Yes [X] No
Distance in Feet from Well to Nearest:

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

5. Drillhole Dimensions and Construction Method

Dia (in.)	From (ft.)	To (ft.)
10	**0**	**40**
6	**40**	**415**

Upper Enlarged Drillhole / Lower Open Bedrock
[ ] ---1. Rotary - Mud Circulation---------- [ ]
[ ] ---2. Rotary - Air---------- [ ]
[ ] ---3. Rotary - Air and Foam---------- [ ]
[ ] ---4.Drill-Through Casing Hammer
[ ] ---5. Reverse Rotary
[X] ---6. Cable-tool Bit **10** in. dia------ [ ]
[ ] 7. Dual Rotary [ ]
[ ] 8. Temp. Outer Casing in. dia. depth (ft)
Removed? [ ] Yes [ ] No
If no, why not?

8. Geology

Type, Caving/Noncaving, Color, Hardness, etc		From (ft.)	To (ft.)
--I-	TOP SOIL	0	2
--C-	CLAY	2	20
--CB	CLAY ROCK MIXTURE	20	30
--L-	LIME STONE	30	175
-HN-	FIRM SANDSTONE	175	270
-HH-	FIRM GRAY SHALE	270	320
-HH-	FIRM GREEN SHALE	320	415

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
6	**6" NEW BLK. ST. T@C ASTM A-53 GR. B 19.45 LBS.SUMITOMA METALS**	**0**	**46**

Dia. (in.)	Screen type, material & slot size		

9. Static Water Level
ft. above ground surface
300 ft. below ground surface

10. Pump Test
Pumping Level **350** ft. below surface
Pumping at **10** GPM for **5** hours

11. Well is: [X] Above Grade [ ] Below Grade
14 in.
Developed? [X] Yes [ ] No
Disinfected? [X] Yes [ ] No
Capped? [X] Yes [ ] No

7. Grout or Other Sealing Material. Method
Method: **TRIMMIE PIPE**

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
DRILL SLURRY	**0**	**8**	
NEAT CEMENT GROUT	**8**	**40**	**18**

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?
[ ] Yes [X] No If no, explain: **STILL IN USE**

13. Signature of the Well Constructor or Supervisory Driller: **DF** Date signed: **06/07/1989**
Signature of Drill Rig Operator (Mandatory unless same as above): **DF** Date signed: **06/07/1989**

Make additional comments on reverse side about geology, additional screens, water quality, etc.
Variance issued [ ] Yes [X] No

WISCONSIN UNIQUE WELL NUMBER **AQ887**

Source: GRN - NO DETAIL

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 **160** FT

Property Owner: DAN WEISENBACK	Telephone Number: 715-673-4981
Mailing Address: W2295 CTY RD K	
City: DURAND	State: WI / Zip Code: 54736
County of Well Location: 6 BUFFALO WC	Co Well Permit No: W
Well Completion Date	

1. Well Location

T=Town C=City V=Village of

Fire#

Street Address or Road Name and Number: W2295 CTY RD K

Subdivision Name | Lot# | Block #

Gov't Lot or **SW** 1/4 of **NW** 1/4 of

Section **5** T **23** N R **13 W**

Well Constructor	License #
Address	
City	State / Zip Code
Hicap Permanent Well #	Common Well #

Facility ID (Public)

Public Well Plan Approval#

Date Of Approval

Specific Capacity gpm/ft

2. Well Type (See item 12 below)

1=New 2=Replacement 3=Reconstruction

of previous unique well # _____ constructed in _____

Reason for replaced or reconstructed Well?

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

3. Well Serves # of homes and or

VM (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? Property?

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

Well located in floodplain?

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)
	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 _ in. 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.)
		surface	

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

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.)

9. Static Water Level

feet ground surface A=Above B=Below

10. Pump Test

Pumping level ft. below surface

Pumping at GP Hrs

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

Developed?

Disinfected?

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 Date Signed

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

Additonal Comments?
Owner Sent Label?

Variance Issued?
More Geology?

Batch

WISCONSIN UNIQUE WELL NUMBER **AQ929**

Source: GRN - NO DETAIL

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 **100** FT

Property Owner: CEDRIC BRANTNER	Telephone Number: 715-673-4924
Mailing Address: W2226 CTY RD K	
City: DURAND	State: WI / Zip Code: 54736
County of Well Location: 6 BUFFALO WC	Co Well Permit No: W
Well Completion Date	

1. Well Location

T=Town C=City V=Village of

Fire#

Street Address or Road Name and Number: W2226 CTY RD K

Subdivision Name | Lot# | Block #

Gov't Lot or **NW** 1/4 of **NE** 1/4 of

Section **5** T **23** N R **13 W**

Well Constructor / License #	Facility ID (Public)
Address	Public Well Plan Approval#
City / State / Zip Code	Date Of Approval
Hicap Permanent Well # / Common Well #	Specific Capacity gpm/ft

2. Well Type (See item 12 below)

1=New 2=Replacement 3=Reconstruction

of previous unique well # _____ constructed in _____

Reason for replaced or reconstructed Well?

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

3. Well Serves # of homes and or

VM (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? Property?

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

Well located in floodplain?

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)
	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 _ in. 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.)
		surface	

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

9. Static Water Level

feet ground surface A=Above B=Below

10. Pump Test

Pumping level ft. below surface

Pumping at GP Hrs

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

Developed?

Disinfected?

Capped?

7. Grout or Other Sealing Material

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

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 Date Signed

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

Additonal Comments?
Owner Sent Label?

Variance Issued?
More Geology?

Batch

WISCONSIN UNIQUE WELL NUMBER **AQ980**

Source: GRN - NO DETAIL

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 **160** FT

Property Owner: DAN WEISENBECK	Telephone Number: 715-673-4981
Mailing Address: W2295 CTY RD K	
City: DURAND	State: WI / Zip Code: 54736
County of Well Location: 6 BUFFALO WC	Co Well Permit No: W
Well Completion Date	

1. Well Location

T=Town C=City V=Village of

Fire#

Street Address or Road Name and Number: W2295 CTY RD K

Subdivision Name | Lot# | Block #

Gov't Lot or **SW** 1/4 of **NW** 1/4 of

Section **5** T **23** N R **13 W**

Well Constructor / License #	Facility ID (Public)
Address	Public Well Plan Approval#
City / State / Zip Code	Date Of Approval
Hicap Permanent Well # / Common Well #	Specific Capacity gpm/ft

2. Well Type (See item 12 below)

1=New 2=Replacement 3=Reconstruction

of previous unique well # _____ constructed in _____

Reason for replaced or reconstructed Well?

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

3. Well Serves # of homes and or

VM (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? Property?

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

Well located in floodplain?

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)
	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 _ in. 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.)
		surface	

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

9. Static Water Level

feet ground surface A=Above B=Below

10. Pump Test

Pumping level ft. below surface

Pumping at GP Hrs

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

Developed?

Disinfected?

Capped?

7. Grout or Other Sealing Material

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

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 Date Signed

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

Additonal Comments?
Owner Sent Label?

Variance Issued?
More Geology?

Batch

WISCONSIN UNIQUE WELL NUMBER **AQ989**

Source: GRN - NO DETAIL

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

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

Property Owner: WILFRED KRALEWSKI
Telephone Number: 715-672-5559

Mailing Address: W2215 HWY V

City: DURAND | State: WI | Zip Code: 54736

County of Well Location: 6 BUFFALO | WC | Co Well Permit No: W | Well Completion Date:

Well Constructor | License # | Facility ID (Public)

Address | Public Well Plan Approval#

City | State | Zip Code | Date Of Approval

Hicap Permanent Well # | Common Well # | Specific Capacity gpm/ft

1. Well Location Depth FT

T=Town C=City V=Village of | Fire#

Street Address or Road Name and Number: W2215 HWY V

Subdivision Name | Lot# | Block #

Gov't Lot or NW 1/4 of NE 1/4 of

Section 32 T 24 N R 13 W

2. Well Type (See item 12 below)

1=New 2=Replacement 3=Reconstruction

of previous unique well # _____ constructed in _____

Reason for replaced or reconstructed Well?

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

3. Well Serves VM # 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? Property?

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

Well located in floodplain?

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)
	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 _ in. 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.)
		surface	

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

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.)

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

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

11. Well Is: in. Grade A=Above B=Below
Developed?
Disinfected?
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 Date Signed

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

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

Batch

WISCONSIN UNIQUE WELL NUMBER **BB764**

Source: GRN - NO DETAIL

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 FT

Property Owner	THELMA WEISENBECK DARREL &	Telephone Number	- -
Mailing Address	ROUTE 3		
City	DURAND	State WI	Zip Code 54736
County of Well Location	6 BUFFALO WC	Co Well Permit No W	Well Completion Date January 2, 1960

1. Well Location

T=Town C=City V=Village of

Fire#

Street Address or Road Name and Number

Subdivision Name | Lot# | Block #

Gov't Lot or SW 1/4 of NW 1/4 of

Section 5 T 23 N R 13 W

Well Constructor	License #	Facility ID (Public)
Address		Public Well Plan Approval#
City	State Zip Code	Date Of Approval
Hicap Permanent Well # 5017	Common Well #	Specific Capacity gpm/ft

2. Well Type (See item 12 below)

1=New 2=Replacement 3=Reconstruction

of previous unique well # _____ constructed in _____

Reason for replaced or reconstructed Well?

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

3. Well Serves # of homes and or

VM (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? Property?

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

Well located in floodplain?

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)
	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 _ in. 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.)
		surface	

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

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.)

9. Static Water Level

feet ground surface A=Above B=Below

10. Pump Test

Pumping level ft. below surface

Pumping at GP Hrs

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

Developed?

Disinfected?

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 Date Signed

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

Additonal Comments?
Owner Sent Label?

Variance Issued?
More Geology?

Batch

Well Construction Report For
WISCONSIN UNIQUE WELL NUMBER DF150

State of WI - Private Water Systems - DG/2
Department of Natural Resources, Box 7921
Madison, WI 53707
Please type or Print using a black Pen
Please Use Decimals Instead of Fractions.

Form 3300-77A
(R 8/00)

Property Owner: **DAVID STELLPFLUG**
Telephone Number: **715-673-4886**
Mailing Address: **RT 3 BOX 93**
City: **DURAND** State: **WI** Zip Code: **54736**
County of Well Location: **Buffalo**
County Well Permit No.: **W**
Well Completion Date: **08/03/1990**

1. Well Location
[X] Town [ ] City [ ] Village
of **NELSON**
Fire # (if available)
Grid or Street Address or Road Name and Number
Subdivision Name Lot # Block #

Well Constructor (Business Name): **PELKE PLBG HTG @ WELL DRLG**
License #: **535**
Facility ID Number (Public Wells)
Address: **HC 63 BOX 32**
Public Well Plan Approval #: W--
City: **DURAND** State: **WI** Zip Code: **54736-9105**
Date of Approval (mm/dd/yyyy)
Hicap Permanent well #
Common Well #
Specific Capacity: **.7** gpm/ft

Gov't Lot # or **SW** 1/4 of **NE** 1/4 of
Section **4** T **23** N; R **13** [ ] E [X] W
Latitude Deg. Min.
Longitude Deg Min.

2. Well Type
[X] Replacement [ ] New [ ] Reconstruction
Lat/Long Method: **GPS008**
of previous unique well # constructed in
Reason for replaced or Reconstructed Well?
OLD WELL PUMPED DRY @ COU
[X] Drilled [ ] Driven Point [ ] Jetted [ ] Other: **HAND DUG**

3. Well serves **1** # of homes and or **BARN**
(e.g. barn, restaurant, church, school, industry, etc.)
High capacity Well? [ ] Yes [X] No
Property? [ ] Yes [X] No

4. Is the well located upslope or sideslope and not downslope from any contamination source, including those on neighboring properties? [X] Yes [ ] No
Well located within 1,200 feet of a quarry? [ ] Yes [ ] No If yes, distance in feet from quarry:
Well located in floodplain? [ ] Yes [X] No
Distance in Feet from Well to Nearest:

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

5. Drillhole Dimensions and Construction Method

Dia (in.)	From (ft.)	To (ft.)
10	**0**	**5**
6	**5**	**172**

Upper Enlarged Drillhole / Lower Open Bedrock
[ ] ---1. Rotary - Mud Circulation---------- [ ]
[ ] ---2. Rotary - Air---------- [ ]
[ ] ---3. Rotary - Air and Foam---------- [ ]
[ ] ---4.Drill-Through Casing Hammer
[ ] ---5. Reverse Rotary
[ ] ---6. Cable-tool Bit in. dia------ [ ]
[ ] 7. Dual Rotary [ ]
[ ] 8. Temp. Outer Casing in. dia. depth (ft)
Removed? [ ] Yes [ ] No
If no, why not?

8. Geology

Type, Caving/Noncaving, Color, Hardness, etc		From (ft.)	To (ft.)
--I-	TOP SOIL	0	1
--C-	CLAY	1	3
--IS	SANDY LOAM	3	15
T-SM	BROWN SILTY SAND	15	50
E-SM	GREEN SILTY SAND	50	90
G-SM	GRAY SILTY SAND	90	140
T-SM	BROWN SILTY SAND	140	153
-SN-	SOFT SANDSTONE	153	157

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
6	**NEW BLK ST T@C ASTM A-53 GR B 19.45LBS.SUMITOMA METALS**	**0**	**160**

Dia. (in.)	Screen type, material & slot size		

9. Static Water Level
ft. above ground surface
75 ft. below ground surface

10. Pump Test
Pumping Level **90** ft. below surface
Pumping at **10** GPM for **8** hours

11. Well is: [X] Above Grade [ ] Below Grade
14 in.
Developed? [X] Yes [ ] No
Disinfected? [X] Yes [ ] No
Capped? [X] Yes [ ] No

7. Grout or Other Sealing Material. Method
Method: **GRAVITY FED**

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
DRILL SLURRY	**0**	**5**	

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?
[ ] Yes [X] No If no, explain: **STILL IN USE**

13. Signature of the Well Constructor or Supervisory Driller: **DSF** Date signed: **08/17/1990**
Signature of Drill Rig Operator (Mandatory unless same as above): **DSF** Date signed: **08/17/1990**

Make additional comments on reverse side about geology, additional screens, water quality, etc.
Variance issued [ ] Yes [X] No

Well Construction Report For
WISCONSIN UNIQUE WELL NUMBER GJ542

State of WI - Private Water Systems - DG/2
Department of Natural Resources, Box 7921
Madison, WI 53707
Please type or Print using a black Pen
Please Use Decimals Instead of Fractions.

Form 3300-77A
(R 8/00)

Property Owner: **BREEZY PT FARMS INC**
Telephone Number: **715-673-4825**
Mailing Address: **W2184 CO RD K**
City: **DURAND** State: **WI** Zip Code: **54736**
County of Well Location: **Buffalo**
County Well Permit No.: **W W00059**
Well Completion Date: **04/21/1997**

1. Well Location: [X] Town [ ] City [ ] Village of **NELSON**
Fire # (if available): **W2184**
Grid or Street Address or Road Name and Number: **CTY RD K**
Subdivision Name Lot # Block #

Well Constructor (Business Name): **KIMMES BAUER WELL DRILLIN**
License #: **59**
Facility ID Number (Public Wells)
Address: **22100 LILLEHEI AVE**
Public Well Plan Approval #: W--
City: **HASTINGS** State: **MN** Zip Code: **55033**
Date of Approval (mm/dd/yyyy): **05/07/1997**
Hicap Permanent well #: **1418**
Common Well #: **001**
Specific Capacity: **6.7** gpm/ft

Gov't Lot # or **NW** 1/4 of **SW** 1/4 of
Section **4** T **23** N; R **13** [ ] E [X] W
Latitude Deg. Min.
Longitude Deg Min.

2. Well Type: [X] New [ ] Replacement [ ] Reconstruction
Lat/Long Method: **GPS008**
of previous unique well # constructed in
Reason for replaced or Reconstructed Well?
IRRIGATION

3. Well serves # of homes and or **IRRIGATION**
(e.g. barn, restaurant, church, school, industry, etc.)
High capacity Well? [X] Yes [ ] No
Property? [X] Yes [ ] No

[X] Drilled [ ] Driven Point [ ] Jetted [ ] Other:

4. Is the well located upslope or sideslope and not downslope from any contamination source, including those on neighboring properties? [ ] Yes [ ] No
Well located within 1,200 feet of a quarry? [ ] Yes [ ] No If yes, distance in feet from quarry:
Well located in floodplain? [ ] Yes [ ] No
Distance in Feet from Well to Nearest:

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

5. Drillhole Dimensions and Construction Method

Dia (in.)	From (ft.)	To (ft.)
22	0	63
15	63	400

Upper Enlarged Drillhole / Lower Open Bedrock
[X] ---1. Rotary - Mud Circulation---------- [ ]
[X] ---2. Rotary - Air---------- [ ]
[X] ---3. Rotary - Air and Foam---------- [ ]
[ ] ---4.Drill-Through Casing Hammer
[ ] ---5. Reverse Rotary
[ ] ---6. Cable-tool Bit in. dia------ [ ]
[ ] 7. Dual Rotary [ ]
[ ] 8. Temp. Outer Casing in. dia. depth (ft)
Removed? [ ] Yes [ ] No
If no, why not?

8. Geology

Type, Caving/Noncaving, Color, Hardness, etc		From (ft.)	To (ft.)
-VC-	CLAY NONCAVING YELLOW MED	0	40
-VN-	SANDROCK NONCAVING BROWN MED	40	80
-VH-	SHALE NONCAVING BLUE HARD	80	120
-MN-	SANDROCK NONCAVING GREEN MED	120	160
-VN-	SANDROCK NONCAVING GREEN GRAY MED	160	260
-VN-	SANDROCK NONCAVING GRAY MED	260	400

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
16	SAWHILL MILL NEW STEEL BLACK WELDED 62 58LBS FT	0	63

Dia. (in.)	Screen type, material & slot size		

9. Static Water Level
ft. above ground surface
50 ft. below ground surface

10. Pump Test
Pumping Level **200** ft. below surface
Pumping at **1000** GPM for **3** hours

11. Well is: [X] Above Grade [ ] Below Grade
24 in.
Developed? [X] Yes [ ] No
Disinfected? [X] Yes [ ] No
Capped? [X] Yes [ ] No

7. Grout or Other Sealing Material. Method
Method: **GROUT P0UMP W TREMIE LINE**

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
NEAT CEMENT GROUT	0	63	60

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

13. Signature of the Well Constructor or Supervisory Driller: **GNP** Date signed
Signature of Drill Rig Operator (Mandatory unless same as above): **MM** Date signed

Make additional comments on reverse side about geology, additional screens, water quality, etc.
Variance issued [ ] Yes [X] No

WISCONSIN UNIQUE WELL NUMBER **GQ410**

Source: GRN - NO DETAIL

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

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

Property Owner: BERNARD TRAUN
Telephone Number: 715-672-5505

Mailing Address: W2148 CTH V

City: DURAND | State: WI | Zip Code: 54736

County of Well Location: 6 BUFFALO WC | Co Well Permit No: W | Well Completion Date:

Well Constructor | License # | Facility ID (Public)

Address | Public Well Plan Approval#

City | State | Zip Code | Date Of Approval

Hicap Permanent Well # | Common Well # | Specific Capacity gpm/ft

1. Well Location Depth FT

T=Town C=City V=Village of | Fire#

Street Address or Road Name and Number

Subdivision Name | Lot# | Block #

Gov't Lot or NE 1/4 of NW 1/4 of

Section 28 T 24 N R 13 W

2. Well Type (See item 12 below)

1=New 2=Replacement 3=Reconstruction

of previous unique well # _____ constructed in _____

Reason for replaced or reconstructed Well?

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

3. Well Serves # of homes and or
VM (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? Property?

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties?
Well located in floodplain?
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)
	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 _ in. 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.)
2241328-F		1	

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
		surface	

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

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

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

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

7. Grout or Other Sealing Material

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

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 Date Signed

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

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

Batch

Well Construction Report For
WISCONSIN UNIQUE WELL NUMBER KC711

State of WI - Private Water Systems - DG/2
Department of Natural Resources, Box 7921
Madison, WI 53707
Please type or Print using a black Pen
Please Use Decimals Instead of Fractions.

Form 3300-77A
(R 8/00)

Property Owner: **LINDSTROM, CHRIS**
Telephone Number: **715-673-4445**
Mailing Address: **W1982 CTY RD K**
City: **DURAND** State: **WI** Zip Code: **54736**
County of Well Location: **Buffalo**
County Well Permit No.: **W**
Well Completion Date: **10/13/1998**

1. Well Location
[X] Town [ ] City [ ] Village
of **MAXVILLE**
Fire # (if available)
Grid or Street Address or Road Name and Number
Subdivision Name Lot # Block #

Well Constructor (Business Name): **PELKE PLBG HTG @ WELL DRLG**
License #: **535**
Facility ID Number (Public Wells)
Address: **N6298 STATE HWY 25**
Public Well Plan Approval #: W--
City: **DURAND** State: **WI** Zip Code: **54736-9105**
Date of Approval (mm/dd/yyyy)
Hicap Permanent well #
Common Well #
Specific Capacity: **1.9** gpm/ft

Gov't Lot # or **SE** 1/4 of **SW** 1/4 of
Section **33** T **24** N; R **13** [ ] E [X] W
Latitude Deg. Min.
Longitude Deg Min.

2. Well Type
[X] New [ ] Replacement [ ] Reconstruction
Lat/Long Method: **GPS008**
of previous unique well # constructed in
Reason for replaced or Reconstructed Well?
NEW CONSTRUCTION

[X] Drilled [ ] Driven Point [ ] Jetted [ ] Other:

3. Well serves **1** # of homes and or
(e.g. barn, restaurant, church, school, industry, etc.)
High capacity Well? [ ] Yes [X] No
Property? [ ] Yes [X] No

4. Is the well located upslope or sideslope and not downslope from any contamination source, including those on neighboring properties? [X] Yes [ ] No
Well located within 1,200 feet of a quarry? [ ] Yes [ ] No If yes, distance in feet from quarry:
Well located in floodplain? [ ] Yes [X] No
Distance in Feet from Well to Nearest:

- 1. Landfill
- **10** 2. Building Overhang
- **>50** 3. Septic [ ] Holding Tank [ ]
- **>100** 4. Sewage Absorption Unit
- 5. Nonconforming Pit
- 6. Buried Home Heating Oil Tank
- 7. Buried Petroleum Tank
- 8. Shoreline [ ] Swimming Pool [ ]
- 9. Downspout/Yard Hydrant
- 10. Privy
- **>10** 11. Foundation Drain to Clearwater
- 12. Foundation Drain to Sewer
- 13. Building Drain [ ] Cast Iron or Plastic [ ] Other
- **>40** 14. Building Sewer [X] Gravity [ ] Pressure [X] Cast Iron or Plastic [ ] Other
- 15. Collector or Street Sewer: [ ] Sanitary units in. diam. [ ] Storm [ ] =< 6 [ ] > 6
- 16. Clearwater Sump
- 17. Wastewater Sump
- 18. Paved Animal Barn Pen
- 19. Animal Yard or Shelter
- 20. Silo
- 21. Barn Gutter
- 22. Manure Pipe [ ] Gravity [ ] Pressure [ ] Cast Iron or Plastic [ ] Other
- 23. Other Manure Storage
- 24. Ditch
- 25. Other NR 812 Waste Storage

5. Drillhole Dimensions and Construction Method

Dia (in.)	From (ft.)	To (ft.)
10	**0**	**60**
6	**60**	**140**

Upper Enlarged Drillhole / Lower Open Bedrock
[ ] ---1. Rotary - Mud Circulation---
[X] ---2. Rotary - Air---
[ ] ---3. Rotary - Air and Foam---
[ ] ---4.Drill-Through Casing Hammer
[ ] ---5. Reverse Rotary
[ ] ---6. Cable-tool Bit in. dia---
[ ] 7. Dual Rotary
[X] 8. Temp. Outer Casing **10** in. dia. depth (ft)
Removed? [X] Yes [ ] No
If no, why not?

8. Geology

Type, Caving/Noncaving, Color, Hardness, etc		From (ft.)	To (ft.)
--I-	TOPSOIL	0	1
--H-	SHALE	1	10
-SN-	SOFT SANDSTONE	10	50
-HN-	HARD BROWN SANDSTONE	50	70
E-N-	LIGHT GREEN SANDSTONE	70	80
T-N-	BROWN SANDSTONE	80	140

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
6	**NEW BLK ST T @ C ASTM A53 GR B 19 45 LBS SAWHILLUSA**	**0**	**60**

Dia. (in.)	Screen type, material & slot size		

9. Static Water Level
ft. above ground surface
106 ft. below ground surface

10. Pump Test
Pumping Level **114** ft. below surface
Pumping at **15** GPM for **2** hours

11. Well is: [X] Above Grade [ ] Below Grade
18 in.
Developed? [X] Yes [ ] No
Disinfected? [X] Yes [ ] No
Capped? [X] Yes [ ] No

7. Grout or Other Sealing Material. Method
Method: **TREMIE PIPE PRESSURE**

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
CEMENT GROUT	**0**	**60**	**18**

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?
[ ] Yes [X] No If no, explain: **DOES NOT APPLY**

13. Signature of the Well Constructor or Supervisory Driller: **REP** Date signed: **10/20/1998**
Signature of Drill Rig Operator (Mandatory unless same as above): **JP** Date signed: **10/20/1998**

Make additional comments on reverse side about geology, additional screens, water quality, etc.
Variance issued [ ] Yes [X] No

Well Construction Report For
WISCONSIN UNIQUE WELL NUMBER NC311

State of WI - Private Water Systems - DG/2
Department of Natural Resources, Box 7921
Madison, WI 53707
Please type or Print using a black Pen
Please Use Decimals Instead of Fractions.

Form 3300-77A
(R 8/00)

Property Owner: **BRION, CHARLES**
Telephone Number: **715-673-4889**
Mailing Address: **W2142 CTY RD KK**
City: **NELSON**
State: **WI**
Zip Code: **54756**
County of Well Location: **Buffalo**
County Well Permit No.: **W**
Well Completion Date: **04/14/1999**

1. Well Location
[X] Town [ ] City [ ] Village
of **NELSON**

Fire # (if available): **W2142**

Grid or Street Address or Road Name and Number: **W2142 CO RD KK**

Subdivision Name | Lot # | Block #

Well Constructor (Business Name): **EDWARD A HARTERT**
License #: **4424**
Facility ID Number (Public Wells)

Gov't Lot # or **SW** 1/4 of **SE** 1/4 of
Section **4** T **23** N; R **13** [ ] E [X] W
Latitude Deg. Min.
Longitude Deg Min.

Address: **54 CO 24**
Public Well Plan Approval #: W--
City: **WABASHA**
State: **MN**
Zip Code: **55981**
Date of Approval (mm/dd/yyyy)

2. Well Type
[ ] New
[X] Replacement
[ ] Reconstruction

Lat/Long Method: **GPS008**

Hicap Permanent well #
Common Well #
Specific Capacity **1.3** gpm/ft

of previous unique well # constructed in
Reason for replaced or Reconstructed Well?
OLD WELL PUMPS DRY

3. Well serves **1** # of homes and or **HOME**
(e.g. barn, restaurant, church, school, industry, etc.)
High capacity Well? [ ] Yes [X] No
Property? [ ] Yes [X] No

[X] Drilled [ ] Driven Point [ ] Jetted [ ] Other:

4. Is the well located upslope or sideslope and not downslope from any contamination source, including those on neighboring properties? [X] Yes [ ] No
Well located within 1,200 feet of a quarry? [ ] Yes [ ] No If yes, distance in feet from quarry:
Well located in floodplain? [ ] Yes [X] No
Distance in Feet from Well to Nearest:

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

5. Drillhole Dimensions and Construction Method

Dia (in.)	From (ft.)	To (ft.)
10	**0**	**8**
6	**8**	**165**

Upper Enlarged Drillhole / Lower Open Bedrock
[ ] ---1. Rotary - Mud Circulation---------- [ ]
[ ] ---2. Rotary - Air---------- [ ]
[ ] ---3. Rotary - Air and Foam---------- [ ]
[ ] ---4.Drill-Through Casing Hammer
[ ] ---5. Reverse Rotary
[ ] ---6. Cable-tool Bit in. dia------ [ ]
[ ] 7. Dual Rotary [ ]
[X] 8. Temp. Outer Casing **10** in. dia. depth (ft)
Removed? [X] Yes [ ] No
If no, why not?

8. Geology

	Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
-QS-	SAND, CAVING, BROWN, SOFT	0	9
T-X-	SAND-CLAY, BROWN, SOFT	9	38
E-X-	SAND-CLAY, GREEN, SOFT	38	123
-MH-	SHALE, GREEN, MED	123	139
-HN-	SANDSTONE, GREY, HARD	139	165

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
6	**STEEL, 19.45LBS. ASTMA53B IPSCO T-N-C**	**0**	**127**

Dia. (in.)	Screen type, material & slot size		

9. Static Water Level
ft. above ground surface
52 ft. below ground surface

10. Pump Test
Pumping Level **64** ft. below surface
Pumping at **16** GPM for **4** hours

11. Well is: [X] Above Grade
16 in. [ ] Below Grade
Developed? [X] Yes [ ] No
Disinfected? [X] Yes [ ] No
Capped? [X] Yes [ ] No

7. Grout or Other Sealing Material. Method
Method:

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
GRANULAR BENTONITE AROUND CASI	**0**		

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

13. Signature of the Well Constructor or Supervisory Driller: **EH** Date signed: **05/10/1999**
Signature of Drill Rig Operator (Mandatory unless same as above): **EH** Date signed: **05/10/1999**

Make additional comments on reverse side about geology, additional screens, water quality, etc.

Variance issued [ ] Yes [X] No

Well Construction Report For
WISCONSIN UNIQUE WELL NUMBER QW445

State of WI - Private Water Systems - DG/2
Department of Natural Resources, Box 7921
Madison, WI 53707
Please type or Print using a black Pen
Please Use Decimals Instead of Fractions.

Form 3300-77A
(R 8/00)

Property Owner: **KRALEWSKI, MIKE**
Telephone Number: **715-673-4415**
Mailing Address: **S679 STATE RD 25**
City: **NELSON**
State: **WI**
Zip Code: **54756**
County of Well Location: **Buffalo**
County Well Permit No.: **W 59**
Well Completion Date: **11/18/2003**

1. Well Location: [X] Town [ ] City [ ] Village of **MAXVILLE TWP**
Fire # (if available):
Grid or Street Address or Road Name and Number: **W2197 CO RD V NELSON WI**
Subdivision Name: Lot #: Block #:

Well Constructor (Business Name): **KIMMES-BAUER WELL DRILLIN**
License #: **59**
Facility ID Number (Public Wells):
Address: **22100 LILLEHEI AVE**
Public Well Plan Approval #: W--
City: **HASTINGS** State: **MN** Zip Code: **55033**
Date of Approval (mm/dd/yyyy):
Hicap Permanent well #:
Common Well #:
Specific Capacity: **.8** gpm/ft

Gov't Lot # or **NW** 1/4 of **NW** 1/4 of
Section **33** T **24** N; R **13** [ ] E [X] W
Latitude Deg. Min.
Longitude Deg Min.

2. Well Type: [X] New [ ] Replacement [ ] Reconstruction
Lat/Long Method: **GPS008**
of previous unique well # constructed in
Reason for replaced or Reconstructed Well?

3. Well serves **1** # of homes and or
(e.g. barn, restaurant, church, school, industry, etc.)
High capacity Well? [ ] Yes [X] No
Property? [ ] Yes [X] No

[X] Drilled [ ] Driven Point [ ] Jetted [ ] Other:

4. Is the well located upslope or sideslope and not downslope from any contamination source, including those on neighboring properties? [ ] Yes [ ] No
Well located within 1,200 feet of a quarry? [ ] Yes [ ] No If yes, distance in feet from quarry:
Well located in floodplain? [ ] Yes [ ] No
Distance in Feet from Well to Nearest:

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

5. Drillhole Dimensions and Construction Method

Dia (in.)	From (ft.)	To (ft.)
14	0	26
10	26	63
6	63	400

Upper Enlarged Drillhole / Lower Open Bedrock
[X] ---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 in. dia------ [ ]
[ ] 7. Dual Rotary [ ]
[ ] 8. Temp. Outer Casing in. dia. depth (ft)
Removed? [ ] Yes [ ] No
If no, why not?

8. Geology

Type, Caving/Noncaving, Color, Hardness, etc		From (ft.)	To (ft.)
YVC-	CLAY/NON/YELLOW/MED	0	26
YHL-	LIME/YELLOW/HARD	26	180
TMN-	SANDROCK/BROWN/MED	180	290
UHH-	SHALE/BLUE/HARD	290	320
EMN-	SANDROCK/GREEN/MED	320	400

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
6	NEW STEEL BLACK WELDED 18.97 LB FT A53B IPSCO	0	63

Dia. (in.)	Screen type, material & slot size		

9. Static Water Level
ft. above ground surface
320 ft. below ground surface

10. Pump Test
Pumping Level **340** ft. below surface
Pumping at **15** GPM for **2** hours

11. Well is: [X] Above Grade [ ] Below Grade
12 in.
Developed? [X] Yes [ ] No
Disinfected? [X] Yes [ ] No
Capped? [X] Yes [ ] No

7. Grout or Other Sealing Material. Method
Method: **PUMPED TREMIE LINE**

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
NEAT CEMENT GROUT	0	63	30

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

13. Signature of the Well Constructor or Supervisory Driller: **MM** Date signed: **11/18/2003**
Signature of Drill Rig Operator (Mandatory unless same as above): **MM** Date signed: **11/18/2003**

Make additional comments on reverse side about geology, additional screens, water quality, etc.
Variance issued [ ] Yes [X] No

Well Construction Report For
WISCONSIN UNIQUE WELL NUMBER TI109

State of WI - Private Water Systems - DG/2
Department of Natural Resources, Box 7921
Madison, WI 53707
Please type or Print using a black Pen
Please Use Decimals Instead of Fractions.

Form 3300-77A
(R 8/00)

Property Owner: **KRALEWSKI, RON**
Telephone Number: --

Mailing Address: **W2246 CO RD V**

City: **DURAND** State: **WI** Zip Code: **54736**

County of Well Location: **Buffalo**
County Well Permit No.: **W**
Well Completion Date: **04/27/2007**

1. Well Location
[X] Town [ ] City [ ] Village
of **MAXVILLE**

Fire # (if available): **W2246**

Grid or Street Address or Road Name and Number: **CO RD V**

Subdivision Name Lot # Block #

Well Constructor (Business Name): **DAHL WELL DRILLING LLC**
License #: **6724**
Facility ID Number (Public Wells)

Address: **1236 HAGAN RD**
Public Well Plan Approval #: W--

City: **GLENWOOD CITY** State: **WI** Zip Code: **54013**
Date of Approval (mm/dd/yyyy)

Hicap Permanent well #
Common Well #
Specific Capacity: **.7** gpm/ft

Gov't Lot # or **SW** 1/4 of **SE** 1/4 of
Section **29** T **24** N; R **13** [ ] E [X] W
Latitude Deg. Min.
Longitude Deg Min.

2. Well Type
[X] New [ ] Replacement [ ] Reconstruction
of previous unique well # constructed in
Reason for replaced or Reconstructed Well?

Lat/Long Method
[X] Drilled [ ] Driven Point [ ] Jetted [ ] Other:

3. Well serves **1** # of homes and or
(e.g. barn, restaurant, church, school, industry, etc.)
High capacity Well? [ ] Yes [X] No
Property? [ ] Yes [X] No

4. Is the well located upslope or sideslope and not downslope from any contamination source, including those on neighboring properties? [ ] Yes [ ] No
Well located within 1,200 feet of a quarry? [ ] Yes [ ] No If yes, distance in feet from quarry:
Well located in floodplain? [ ] Yes [X] No
Distance in Feet from Well to Nearest:

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

5. Drillhole Dimensions and Construction Method

Dia (in.)	From (ft.)	To (ft.)
8.8	**0**	**60**
6	**60**	**501**

Upper Enlarged Drillhole / Lower Open Bedrock
[ ] ---1. Rotary - Mud Circulation---------- [ ]
[X] ---2. Rotary - Air---------- [ ]
[ ] ---3. Rotary - Air and Foam---------- [X]
[ ] ---4.Drill-Through Casing Hammer
[ ] ---5. Reverse Rotary
[ ] ---6. Cable-tool Bit in. dia------ [ ]
[ ] 7. Dual Rotary [ ]
[ ] 8. Temp. Outer Casing in. dia. depth (ft)
Removed? [ ] Yes [ ] No
If no, why not?

8. Geology

	Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
T-C-	**BROWN CLAY**	**0**	**12**
THL-	**TAN LIMESTONE FIRM**	**12**	**112**
YHN-	**YELLOW SANDSTONE FIRM**	**112**	**250**
GHN-	**GRAY SANDSTONE FIRM**	**250**	**280**
UHN-	**BLUE SANDSTONE FIRM**	**280**	**405**
EHN-	**GREEN SANDSTONE FIRM**	**405**	**464**
IHN-	**WHITE SANDSTONE FIRM**	**464**	**501**

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
6	**IPSCO ASTM A53, WELDED STEEL, 18.97 #/FT, .280**	**0**	**60**

Dia. (in.)	Screen type, material & slot size		

9. Static Water Level
ft. above ground surface
431 ft. below ground surface

10. Pump Test
Pumping Level **449** ft. below surface
Pumping at **12** GPM for **2** hours

11. Well is: [X] Above Grade [ ] Below Grade
20 in.
Developed? [X] Yes [ ] No
Disinfected? [X] Yes [ ] No
Capped? [X] Yes [ ] No

7. Grout or Other Sealing Material. Method
Method: **TREMIE PUMPED**

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
NEAT CEMENT	**0**	**60**	**22**

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?
[ ] Yes [X] No If no, explain: **NA**

13. Signature of the Well Constructor or Supervisory Driller: **AD**
Date signed: **04/11/2008**
Signature of Drill Rig Operator (Mandatory unless same as above) Date signed

Make additional comments on reverse side about geology, additional screens, water quality, etc.
Variance issued [ ] Yes [X] No

Well Construction Report For
WISCONSIN UNIQUE WELL NUMBER UM553

State of WI - Private Water Systems - DG/2
Department of Natural Resources, Box 7921
Madison, WI 53707
Please type or Print using a black Pen
Please Use Decimals Instead of Fractions.

Form 3300-77A
(R 8/00)

Property Owner: **WEISENBECK, DAVE & CHERYL**
Telephone Number: **715-672-5769**

Mailing Address: **S387 CO RD AA**

City: **DURAND** State: **WI** Zip Code: **54736**

County of Well Location: **Buffalo**
County Well Permit No.: **W**
Well Completion Date: **05/02/2008**

1. Well Location [X] Town [ ] City [ ] Village of **MAXVILLE**
Fire # (if available): **S387**

Grid or Street Address or Road Name and Number: **S387 CO RD AA**

Subdivision Name Lot # Block #

Well Constructor (Business Name): **PELKE PLBG & WELL DRLG INC**
License #: **535**
Facility ID Number (Public Wells)

Address: **N6298 STATE HWY 25**
Public Well Plan Approval #: W--

City: **DURAND** State: **WI** Zip Code: **54736-9105**
Date of Approval (mm/dd/yyyy)

Hicap Permanent well #
Common Well #
Specific Capacity: **2** gpm/ft

Gov't Lot # or **SW** 1/4 of **NW** 1/4 of
Section **27** T **24** N; R **13** [ ] E [X] W
Latitude Deg. Min.
Longitude Deg Min.
Lat/Long Method

2. Well Type [ ] New [X] Replacement [ ] Reconstruction
of previous unique well # **AJ170** constructed in **1989**
Reason for replaced or Reconstructed Well?
PUMPING DRY

[X] Drilled [ ] Driven Point [ ] Jetted [ ] Other:

3. Well serves **1** # of homes and or
(e.g. barn, restaurant, church, school, industry, etc.)
High capacity Well? [ ] Yes [X] No
Property? [ ] Yes [X] No

4. Is the well located upslope or sideslope and not downslope from any contamination source, including those on neighboring properties? [ ] Yes [ ] No
Well located within 1,200 feet of a quarry? [ ] Yes [X] No If yes, distance in feet from quarry:
Well located in floodplain? [ ] Yes [X] No
Distance in Feet from Well to Nearest:

1. Landfill
>10 2. Building Overhang
>25 3. Septic [X] Holding Tank [ ]
>50 4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. Shoreline [ ] Swimming Pool [ ]
9. Downspout/Yard Hydrant
10. Privy
>10 11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain [ ] Cast Iron or Plastic [ ] Other
>25 14. Building Sewer [X] Gravity [ ] Pressure [X] Cast Iron or Plastic [ ] Other
15. Collector or Street Sewer: [ ] Sanitary units in. diam. [ ] Storm [ ] =< 6 [ ] > 6
16. Clearwater Sump
17. Wastewater Sump
>75 18. Paved Animal Barn Pen
>100 19. Animal Yard or Shelter
>225 20. Silo
21. Barn Gutter
22. Manure Pipe [ ] Gravity [ ] Pressure [ ] Cast Iron or Plastic [ ] Other
23. Other Manure Storage
24. Ditch
25. Other NR 812 Waste Storage

5. Drillhole Dimensions and Construction Method

Dia (in.)	From (ft.)	To (ft.)
10	**0**	**200**
6	**200**	**540**

Upper Enlarged Drillhole / Lower Open Bedrock
[ ] ---1. Rotary - Mud Circulation---
[ ] ---2. Rotary - Air---
[X] ---3. Rotary - Air and Foam---
[ ] ---4.Drill-Through Casing Hammer
[ ] ---5. Reverse Rotary
[ ] ---6. Cable-tool Bit in. dia---
[ ] 7. Dual Rotary
[X] 8. Temp. Outer Casing **10** in. dia. **25** depth (ft)
Removed? [X] Yes [ ] No
If no, why not?

8. Geology

Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
--I- TOP SOIL	0	1
T-C- BROWN CLAY	1	25
--L- LIMESTONE	25	175
T-N- BROWN SANDSTONE	175	270
GHH- HARD GRAY SHALE	270	320
EHH- HARD GREEN SHALE	320	445
I-N- WHITE SANDSTONE	445	540

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
6	**NEW BLK ST T&C ASTM A-53 GR B 19.45 LBS WHEATLAND USA**	**0**	**212**

Dia. (in.)	Screen type, material & slot size		

9. Static Water Level
ft. above ground surface
450 ft. below ground surface

10. Pump Test
Pumping Level **455** ft. below surface
Pumping at **10** GPM for **3** hours

11. Well is: [X] Above Grade [ ] Below Grade
16 in.
Developed? [X] Yes [ ] No
Disinfected? [X] Yes [ ] No
Capped? [X] Yes [ ] No

7. Grout or Other Sealing Material. Method
Method: **TREMIE PIPE PRESSURE**

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
PORTLAND CEMENT	**0**	**200**	**68**

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

13. Signature of the Well Constructor or Supervisory Driller: **MW** Date signed: **05/07/2008**
Signature of Drill Rig Operator (Mandatory unless same as above): **JP** Date signed: **05/07/2008**

Make additional comments on reverse side about geology, additional screens, water quality, etc.

Variance issued [ ] Yes [X] No

Well Construction Report For
WISCONSIN UNIQUE WELL NUMBER WV775

State of WI - Private Water Systems - DG/2
Department of Natural Resources, Box 7921
Madison, WI 53707
Please type or Print using a black Pen
Please Use Decimals Instead of Fractions.

Form 3300-77A
(R 8/00)

Property Owner: **LINDSTROM, NORA**
Telephone Number: **715-495-5435**
Mailing Address: **W2184 CO RD K**
City: **DURAND** State: **WI** Zip Code: **54736**
County of Well Location: **Buffalo**
County Well Permit No.: **W**
Well Completion Date: **07/17/2012**

1. Well Location: [X] Town [ ] City [ ] Village of **NELSON**
Fire # (if available): **W2246**
Grid or Street Address or Road Name and Number: **W2246 CO RD KK**
Subdivision Name Lot # Block #

Well Constructor (Business Name): **PELKE PLBG & WELL DRLG INC** License #: **535**
Facility ID Number (Public Wells)
Address: **N6298 STATE HWY 25**
Public Well Plan Approval #: W--
City: **DURAND** State: **WI** Zip Code: **54736-9105**
Date of Approval (mm/dd/yyyy)
Hicap Permanent well #
Common Well #
Specific Capacity: **.6** gpm/ft

Gov't Lot # or **SE** 1/4 of **SW** 1/4 of
Section **4** T **23** N; R **13** [ ] E [X] W
Latitude Deg. Min.
Longitude Deg Min.
Lat/Long Method

2. Well Type: [X] New [ ] Replacement [ ] Reconstruction
of previous unique well # constructed in
Reason for replaced or Reconstructed Well? **NEW CONSTRUCTION**
[X] Drilled [ ] Driven Point [ ] Jetted [ ] Other:

3. Well serves **1** # of homes and or
(e.g. barn, restaurant, church, school, industry, etc.)
High capacity Well? [ ] Yes [X] No
Property? [ ] Yes [X] No

4. Is the well located upslope or sideslope and not downslope from any contamination source, including those on neighboring properties? [ ] Yes [ ] No
Well located within 1,200 feet of a quarry? [ ] Yes [X] No If yes, distance in feet from quarry:
Well located in floodplain? [ ] Yes [X] No
Distance in Feet from Well to Nearest:

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

5. Drillhole Dimensions and Construction Method

Dia (in.)	From (ft.)	To (ft.)
6	0	180

Upper Enlarged Drillhole / Lower Open Bedrock
[ ] ---1. Rotary - Mud Circulation---------- [ ]
[ ] ---2. Rotary - Air---------- [ ]
[ ] ---3. Rotary - Air and Foam---------- [ ]
[ ] ---4.Drill-Through Casing Hammer
[ ] ---5. Reverse Rotary
[ ] ---6. Cable-tool Bit in. dia------ [ ]
[ ] 7. Dual Rotary [ ]
[ ] 8. Temp. Outer Casing in. dia. depth (ft)
Removed? [ ] Yes [ ] No
If no, why not?

8. Geology

Type, Caving/Noncaving, Color, Hardness, etc		From (ft.)	To (ft.)
T-S-	BROWN SAND	0	22
T-C-	BROWN CLAY	22	38
G-C-	GRAY CLAY	38	50
T-X-	BROWN SAND & CLAY	50	62
G-X-	GRAY CLAY & SAND	62	110
T-N-	LIGHT BROWN SANDSTONE	110	132
E-N-	LIGHT GREEN/GRAY SANDSTONE	132	180

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
6	NEW BLK ST PE ASTM A-53 GR B 18.97 LBS WHEATLAND USA	0	119

Dia. (in.)	Screen type, material & slot size		

9. Static Water Level
ft. above ground surface
97 ft. below ground surface

10. Pump Test
Pumping Level **115** ft. below surface
Pumping at **10** GPM for **2** hours

11. Well is: [X] Above Grade [ ] Below Grade
16 in.
Developed? [X] Yes [ ] No
Disinfected? [X] Yes [ ] No
Capped? [X] Yes [ ] No

7. Grout or Other Sealing Material. Method
Method: **GRAVITY FED**

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
GRANULAR BENTONITE	0		

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?
[ ] Yes [X] No If no, explain: **DOES NOT APPLY**

13. Signature of the Well Constructor or Supervisory Driller: **JP** Date signed: **07/24/2012**
Signature of Drill Rig Operator (Mandatory unless same as above): **MW** Date signed: **07/24/2012**

Make additional comments on reverse side about geology, additional screens, water quality, etc.
Variance issued [ ] Yes [X] No

Well Construction Report For
WISCONSIN UNIQUE WELL NUMBER YK509

State of WI - Private Water Systems - DG/2
Department of Natural Resources, Box 7921
Madison, WI 53707
Please type or Print using a black Pen
Please Use Decimals Instead of Fractions.

Form 3300-77A
(R 8/00)

Property Owner: **WEISENBECK, BILL & HEATHER**
Telephone Number: **715-498-4061**
Mailing Address: **HWY K**
City: **DURAND** State: **WI** Zip Code: **54736**
County of Well Location: **Buffalo**
County Well Permit No.: **W**
Well Completion Date: **07/10/2014**

1. Well Location [X] Town [ ] City [ ] Village of **NELSON**
Fire # (if available)
Grid or Street Address or Road Name and Number: **HWY K**
Subdivision Name Lot # Block #

Well Constructor (Business Name): **KELLY OIUM WELL DRILLING I**
License #: **8217**
Facility ID Number (Public Wells)
Address: **N50021 MISSELL ROAD**
Public Well Plan Approval #: W--
City: **STRUM** State: **WI** Zip Code: **54770**
Date of Approval (mm/dd/yyyy)
Hicap Permanent well #
Common Well #
Specific Capacity: **4** gpm/ft

Gov't Lot # or **SE** 1/4 of **NE** 1/4 of
Section **4** T **23** N; R **13** [ ] E [X] W
Latitude Deg. Min.
Longitude Deg Min.
Lat/Long Method

2. Well Type [X] New [ ] Replacement [ ] Reconstruction
of previous unique well # constructed in
Reason for replaced or Reconstructed Well?

3. Well serves **1** # of homes and or **HOME**
(e.g. barn, restaurant, church, school, industry, etc.)
High capacity Well? [ ] Yes [X] No
Property? [ ] Yes [X] No

[X] Drilled [ ] Driven Point [ ] Jetted [ ] Other:

4. Is the well located upslope or sideslope and not downslope from any contamination source, including those on neighboring properties? [X] Yes [ ] No
Well located within 1,200 feet of a quarry? [ ] Yes [X] No If yes, distance in feet from quarry:
Well located in floodplain? [ ] Yes [X] No
Distance in Feet from Well to Nearest:

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

5. Drillhole Dimensions and Construction Method

Dia (in.)	From (ft.)	To (ft.)
10	**0**	**6**
6	**6**	**100**

Upper Enlarged Drillhole / Lower Open Bedrock
[ ] ---1. Rotary - Mud Circulation---------- [ ]
[ ] ---2. Rotary - Air---------- [ ]
[ ] ---3. Rotary - Air and Foam---------- [ ]
[ ] ---4.Drill-Through Casing Hammer
[ ] ---5. Reverse Rotary
[ ] ---6. Cable-tool Bit in. dia------ [ ]
[ ] 7. Dual Rotary [ ]
[ ] 8. Temp. Outer Casing in. dia. depth (ft)
Removed? [ ] Yes [X] No
If no, why not?

8. Geology

Type, Caving/Noncaving, Color, Hardness, etc		From (ft.)	To (ft.)
T-X-	**Brown, Sand & Clay**	**0**	**6**
T-XM	**Brown, Sand & Clay, Silty**	**6**	**68**
GSC-	**Gray, Soft/Loose, Clay**	**68**	**75**
GHN-	**Gray, Hard/Firm, Sandstone**	**75**	**100**

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
6	**6.620 X A53B.280 EW TC**	**0**	**76**

Dia. (in.)	Screen type, material & slot size		

9. Static Water Level
ft. above ground surface
35 ft. below ground surface

10. Pump Test
Pumping Level **40** ft. below surface
Pumping at **20** GPM for **2** hours

11. Well is: [X] Above Grade [ ] Below Grade
30 in.
Developed? [X] Yes [ ] No
Disinfected? [X] Yes [ ] No
Capped? [X] Yes [ ] No

7. Grout or Other Sealing Material. Method
Method:

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
DRILL SLURRY	**0**	**6**	

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

13. Signature of the Well Constructor or Supervisory Driller: **KO** Date signed: **07/29/2014**
Signature of Drill Rig Operator (Mandatory unless same as above): **BG** Date signed: **07/29/2014**

Make additional comments on reverse side about geology, additional screens, water quality, etc.
Variance issued [ ] Yes [X] No

Appendix IV:

Dairyland Power Cooperative Letter

DAIRYLAND POWER
COOPERATIVE

March 20, 2015

RE15-0279

Mr. Derek Lindstrom
W2184 County Road K
Durand, WI 54736

Dear Mr. Lindstrom:

SUBJECT: Dairyland Power Cooperative's Q-17 161kV Electrical Transmission Line (Town of Maxville, Buffalo County, Wisconsin)

Thank you for your inquiry regarding limitations for sand mining operations adjacent to Dairyland Power Cooperative electrical transmission line facilities.

The following is a summary of our discussions and conditions related to your sand mine project.

Dairyland Power Cooperative has no objection to excavation and mining activities that may take place between and adjacent to pole structures and anchoring devices, and specifically amid transmission line spans, provided that no machinery or equipment will be operated within the electrical transmission line right of way which will extend to within twenty (20) feet of any part of said electrical transmission line and conductor wires nor within ten (10) feet of any line pole structures and anchoring systems. Please refer to the Code of Federal Regulations 29 (Labor), Chapter 17, Parts 1900-1910, (rev. 07-01-2013), Occupational Safety and Health Administration, Labor (OSHA) Part 1910.333 and specifically refer to 1910.333 (c)(2) which references to work near electric lines by unqualified persons.

Access to and from Dairyland's electrical transmission line facilities (structures) may not be impeded at any time. More specifically, excavation, mining and grading activities must include preservation of continuous roadways with compacted surfaces 12'-16' in width to each pole site capable of travel by Dairyland's 30-40 ton digger/derrick equipment during routine and emergency maintenance operations.

No material, spoil or overburden may be accumulated or stored within the eighty (80) foot wide electrical transmission line right of way or in such a manner so as to impede access to pole structures. No berms may be placed within that right of way area without confirmation of clearances and consent from Dairyland.

No other improvement(s) of any kind, including buildings and lighting fixtures, will be placed within the eighty (80) foot wide electrical transmission line right of way without the prior and express written approval of Dairyland Power Cooperative.

Thank you for checking with us. Good luck with your project. If you have any questions, please write or call me at (608) 787-1367.

Sincerely,

DAIRYLAND POWER COOPERATIVE

Kurt D. Childs, Director
Land & Design Services

KDC:

CC: C. Norgren

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Appendix V:

Natural Resource Conservation Service (NRCS) Custom Soil Survey

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Buffalo County, Wisconsin

January 12, 2015

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

Contents

How Soil Surveys Are Made

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

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

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

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

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

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

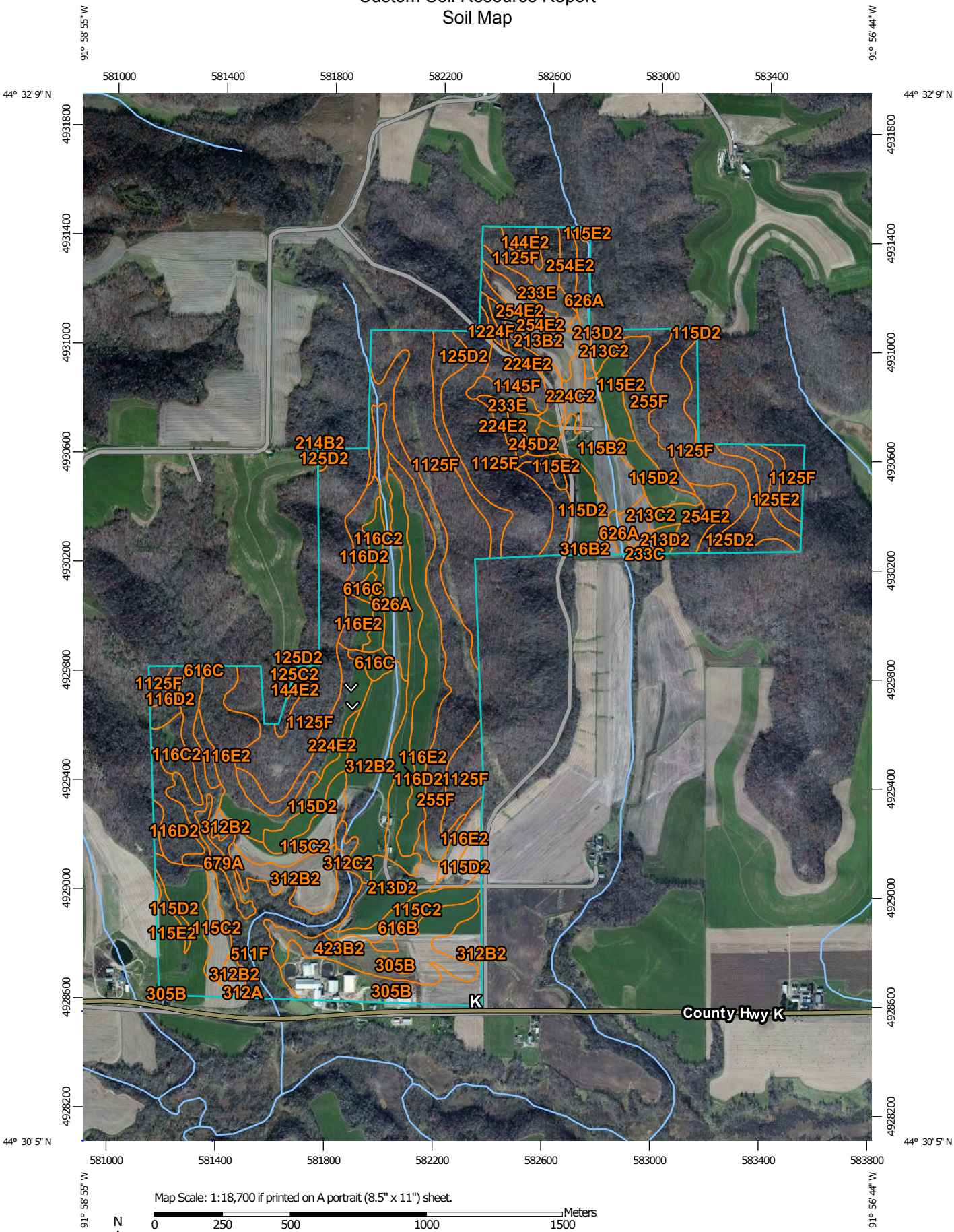
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree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

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

Soil Map

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

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

Soil Survey Area: Buffalo County, Wisconsin
Survey Area Data: Version 8, Sep 8, 2014

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

Date(s) aerial images were photographed: Nov 1, 2010—Jul 20, 2011

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

Map Unit Legend

Buffalo County, Wisconsin (WI011)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
115B2	Seaton silt loam, 2 to 6 percent slopes, moderately eroded	17.9	2.4%
115C2	Seaton silt loam, 6 to 12 percent slopes, moderately eroded	25.5	3.3%
115D2	Seaton silt loam, 12 to 20 percent slopes, moderately eroded	29.9	3.9%
115E2	Seaton silt loam, 20 to 30 percent slopes, moderately eroded	33.4	4.4%
116C2	Churchtown silt loam, 6 to 12 percent slopes, moderately eroded	12.7	1.7%
116D2	Churchtown silt loam, 12 to 20 percent slopes, moderately eroded	40.5	5.3%
116E2	Churchtown silt loam, 20 to 30 percent slopes, moderately eroded	60.7	8.0%
125C2	Pepin silt loam, 6 to 12 percent slopes, moderately eroded	7.4	1.0%
125D2	Pepin silt loam, 12 to 20 percent slopes, moderately eroded	25.3	3.3%
125E2	Pepin silt loam, 20 to 30 percent slopes, moderately eroded	4.2	0.6%
144E2	NewGlarus silt loam, 20 to 30 percent slopes, moderately eroded	5.8	0.8%
213B2	Hixton silt loam, 2 to 6 percent slopes, moderately eroded	9.1	1.2%
213C2	Hixton silt loam, 6 to 12 percent slopes, moderately eroded	5.8	0.8%
213D2	Hixton silt loam, 12 to 20 percent slopes, moderately eroded	15.7	2.1%
214B2	Gale silt loam, 2 to 6 percent slopes, moderately eroded	0.0	0.0%
224B	Elevasil sandy loam, 2 to 6 percent slopes	3.2	0.4%
224C2	Elevasil sandy loam, 6 to 12 percent slopes, moderately eroded	6.1	0.8%
224E2	Elevasil sandy loam, 20 to 30 percent slopes, moderately eroded	19.1	2.5%
233C	Boone sand, 6 to 15 percent slopes	1.1	0.1%

Buffalo County, Wisconsin (WI011)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
233E	Boone sand, 15 to 30 percent slopes	9.9	1.3%
245D2	Hesch sandy loam, deep, 12 to 20 percent slopes, moderately eroded	3.6	0.5%
254E2	Norden silt loam, 20 to 30 percent slopes, moderately eroded	16.9	2.2%
255F	Urne fine sandy loam, 30 to 45 percent slopes	56.7	7.4%
305B	Richwood silt loam, 1 to 6 percent slopes	27.4	3.6%
312A	Festina silt loam, 0 to 3 percent slopes	0.5	0.1%
312B2	Festina silt loam, 2 to 6 percent slopes, moderately eroded	42.9	5.6%
312C2	Festina silt loam, 6 to 12 percent slopes, moderately eroded	2.5	0.3%
316B2	Ella silt loam, 1 to 6 percent slopes, moderately eroded	0.6	0.1%
423B2	Meridian silt loam, 2 to 6 percent slopes, moderately eroded	23.2	3.0%
511F	Plainfield sand, 15 to 60 percent slopes	39.9	5.2%
616B	Chaseburg silt loam, 1 to 4 percent slopes, occasionally flooded	2.2	0.3%
616C	Chaseburg silt loam, 4 to 12 percent slopes, occasionally flooded	4.9	0.6%
626A	Arenzville silt loam, 0 to 3 percent slopes, occasionally flooded	21.4	2.8%
679A	Ettrick silt loam, 0 to 2 percent slopes, shallow, frequently flooded	4.1	0.5%
1125F	Dorerton, very stony-Elbaville complex, 30 to 60 percent slopes	172.8	22.7%
1145F	Gaphill-Rockbluff complex, 30 to 60 percent slopes	7.2	0.9%
1224F	Boone-Elevasil complex, 15 to 50 percent slopes	1.3	0.2%
Totals for Area of Interest		**761.5**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly

indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

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

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

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

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

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

Buffalo County, Wisconsin

115B2—Seaton silt loam, 2 to 6 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: h6r2
Elevation: 800 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Seaton

Setting

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

Typical profile

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

Properties and qualities

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

Interpretive groups

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

115C2—Seaton silt loam, 6 to 12 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 2psvg
Elevation: 800 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Seaton

Setting

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

Typical profile

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

Properties and qualities

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

Interpretive groups

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

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

Map Unit Setting

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

Map Unit Composition

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

Description of Seaton

Setting

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

Typical profile

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

Properties and qualities

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

Interpretive groups

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

Minor Components

Timula

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

115E2—Seaton silt loam, 20 to 30 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 1lmw9
Elevation: 500 to 1,400 feet
Mean annual precipitation: 28 to 42 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 135 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Seaton

Setting

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

Typical profile

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

Properties and qualities

Slope: 20 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Very high (about 12.7 inches)

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

Minor Components

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

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

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

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

Description of Churchtown

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

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

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Very high (about 12.4 inches)

Interpretive groups

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

Minor Components

Norden

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

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

Map Unit Setting

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

Map Unit Composition

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

Description of Churchtown

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Down-slope shape: Concave

Across-slope shape: Linear
Parent material: Loamy slope alluvium over loess

Typical profile

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

Properties and qualities

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

Interpretive groups

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

Minor Components

Norden

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

Brownchurch

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

Beavercreek

Percent of map unit: 2 percent
Landform: Drainageways on hills, alluvial fans on hills
Down-slope shape: Linear
Across-slope shape: Concave, convex
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

116E2—Churchtown silt loam, 20 to 30 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 2psvt
Elevation: 700 to 1,340 feet
Mean annual precipitation: 28 to 34 inches
Mean annual air temperature: 43 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Churchtown

Setting

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

Typical profile

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

Properties and qualities

Slope: 20 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Very high (about 12.4 inches)

Interpretive groups

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

Minor Components

Norden

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

Beavercreek

Percent of map unit: 2 percent
Landform: Drainageways on hills, alluvial fans on hills
Down-slope shape: Linear
Across-slope shape: Concave, convex
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Brownchurch

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

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

Map Unit Setting

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

Map Unit Composition

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

Description of Pepin

Setting

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

Typical profile

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

Properties and qualities

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

Interpretive groups

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

Minor Components

Newglarus

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

Seaton

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

Hersey

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

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

Map Unit Setting

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

Map Unit Composition

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

Description of Pepin

Setting

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

Typical profile

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

Properties and qualities

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

Interpretive groups

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

Minor Components

Newglarus

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

Seaton

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

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

Map Unit Setting

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

Map Unit Composition

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

Description of Pepin

Setting

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

Typical profile

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

Properties and qualities

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

Interpretive groups

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

Minor Components

Newglarus

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

Fivepoints

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

Seaton

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

144E2—NewGlarus silt loam, 20 to 30 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: h6rx
Elevation: 800 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Newglarus

Setting

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

Typical profile

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

Properties and qualities

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

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C

Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Minor Components

Fivepoints

Percent of map unit: 4 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Low AWC, adequately drained with limitations (G105XY003WI)

Elbaville

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

Pepin

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

213B2—Hixton silt loam, 2 to 6 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: h6s2
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 130 to 165 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Hixton

Setting

Landform: Hills

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

Typical profile

Ap - 0 to 9 inches: silt loam
Bt1, Bt2 - 9 to 28 inches: loam
2Bt3 - 28 to 32 inches: loam
3C - 32 to 39 inches: channery sand
3Cr - 39 to 60 inches: weathered bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Minor Components

Elevasil

Percent of map unit: 6 percent
Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Merit

Percent of map unit: 2 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Hixton, thin solum

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

213C2—Hixton silt loam, 6 to 12 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: h6s3
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Hixton

Setting

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

Typical profile

Ap - 0 to 9 inches: silt loam
Bt1, Bt2 - 9 to 28 inches: loam
2Bt3 - 28 to 32 inches: loam
3C - 32 to 39 inches: channery sand
3Cr - 39 to 60 inches: weathered bedrock

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Minor Components

Elevasil

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

Hixton, thin solum

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

Lambeau

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

213D2—Hixton silt loam, 12 to 20 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 1lmwr
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Hixton

Setting

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

Typical profile

Ap - 0 to 9 inches: silt loam
Bt1, Bt2 - 9 to 28 inches: loam
2Bt3 - 28 to 32 inches: loam
3C - 32 to 39 inches: channery sand
3Cr - 39 to 60 inches: weathered bedrock

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups

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

Minor Components

Elevasil

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

Lambeau

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

Boone

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

214B2—Gale silt loam, 2 to 6 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 2kpyp
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Gale

Setting

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

Typical profile

Ap - 0 to 9 inches: silt loam
Bt - 9 to 28 inches: silt loam
2C - 28 to 36 inches: channery sand
2Cr - 36 to 60 inches: weathered bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Minor Components

Elevasil

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

Pepin

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

Newglarus

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

224B—Elevasil sandy loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2psvk
Elevation: 680 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 130 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Elevasil

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy slope alluvium over sandy residuum

Typical profile

Ap - 0 to 9 inches: sandy loam
Bt - 9 to 27 inches: sandy loam
2BC - 27 to 31 inches: loamy sand
2C - 31 to 39 inches: sand
2Cr - 39 to 60 inches: weathered bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: B
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Minor Components

Bilson

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Boone

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Low AWC, adequately drained (G105XY002WI)

Hixton

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

Elkmound

Percent of map unit: 1 percent
Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Convex
Across-slope shape: Convex

Other vegetative classification: Low AWC, adequately drained (G105XY002WI)

224C2—Elevasil sandy loam, 6 to 12 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 2psvl
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 130 to 165 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Elevasil

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy slope alluvium over sandy residuum

Typical profile

Ap - 0 to 9 inches: sandy loam
Bt - 9 to 27 inches: sandy loam
2BC - 27 to 31 inches: loamy sand
2C - 31 to 39 inches: sand
2Cr - 39 to 60 inches: weathered bedrock

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Minor Components

Boone

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Low AWC, adequately drained (G105XY002WI)

Hixton

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

Tarr

Percent of map unit: 1 percent
Landform: Pediments
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Other vegetative classification: Low AWC, adequately drained (G105XY002WI)

Elkmound

Percent of map unit: 1 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Low AWC, adequately drained (G105XY002WI)

224E2—Elevasil sandy loam, 20 to 30 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 2psw2
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Elevasil

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy slope alluvium over sandy residuum

Typical profile

Ap - 0 to 9 inches: sandy loam
Bt - 9 to 27 inches: sandy loam
2BC - 27 to 31 inches: loamy sand
2C - 31 to 39 inches: sand
2Cr - 39 to 60 inches: weathered bedrock

Properties and qualities

Slope: 20 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Minor Components

Elkmound

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

Boone

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

233C—Boone sand, 6 to 15 percent slopes

Map Unit Setting

National map unit symbol: 1lmwx
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Boone

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy slope alluvium over siliceous sandy residuum weathered from sandstone

Typical profile

Ap - 0 to 8 inches: sand
Bw - 8 to 21 inches: sand
C - 21 to 35 inches: sand
Cr - 35 to 60 inches: weathered bedrock

Properties and qualities

Slope: 6 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Other vegetative classification: Low AWC, adequately drained (G105XY002WI)

Minor Components

Tarr

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Low AWC, adequately drained (G105XY002WI)

Elevasil

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

233E—Boone sand, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 20rb2
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Boone

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy slope alluvium over siliceous sandy residuum weathered from sandstone

Typical profile

Ap - 0 to 8 inches: sand
Bw - 8 to 21 inches: sand
C - 21 to 35 inches: sand
Cr - 35 to 60 inches: weathered bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

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

Minor Components

Tarr

Percent of map unit: 5 percent
Landform: Pediments
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Other vegetative classification: Low AWC, adequately drained with limitations (G105XY003WI)

245D2—Hesch sandy loam, deep, 12 to 20 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 2kpz8
Elevation: 800 to 1,200 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Hesch, deep, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hesch, Deep

Setting

Landform: Hills

Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy slope alluvium over siliceous sandy residuum weathered from sandstone

Typical profile

Ap,A - 0 to 12 inches: sandy loam
BA,Bt1,Bt2 - 12 to 31 inches: sandy loam
2C - 31 to 40 inches: sand
2Cr - 40 to 60 inches: weathered bedrock

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: 30 to 60 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups

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

Minor Components

Urne

Percent of map unit: 8 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Brownchurch

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

254E2—Norden silt loam, 20 to 30 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 1lmx2
Elevation: 800 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Norden

Setting

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

Typical profile

Ap - 0 to 8 inches: silt loam
Bt - 8 to 20 inches: silt loam
2Bt - 20 to 37 inches: fine sandy loam
2Cr - 37 to 60 inches: weathered bedrock

Properties and qualities

Slope: 20 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Minor Components

Urne

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

Churchtown

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

Greenridge

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

255F—Urne fine sandy loam, 30 to 45 percent slopes

Map Unit Setting

National map unit symbol: h6sw
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Urne

Setting

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

Across-slope shape: Convex
Parent material: Loamy slope alluvium over loamy and sandy residuum weathered from glauconitic sandstone

Typical profile

A - 0 to 2 inches: fine sandy loam
Bw1,Bw2 - 2 to 28 inches: fine sandy loam
Bw3 - 28 to 36 inches: fine sandy loam
Cr - 36 to 60 inches: weathered bedrock

Properties and qualities

Slope: 30 to 45 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

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

Minor Components

Norden

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

Council

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

Rockbluff

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

Urne, shallow

Percent of map unit: 1 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Low AWC, adequately drained with limitations (G105XY003WI)

305B—Richwood silt loam, 1 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2kpzx
Elevation: 700 to 1,950 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Richwood, Stratified Substratum

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess and/or silty alluvium over stratified silty to sandy slackwater deposits

Typical profile

Ap,A - 0 to 14 inches: silt loam
BA,Bt1,Bt2 - 14 to 42 inches: silt loam
2Bt3 - 42 to 45 inches: sandy loam
2C - 45 to 60 inches: sand

Properties and qualities

Slope: 1 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: High (about 10.2 inches)

Interpretive groups

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

Minor Components

Toddville

Percent of map unit: 5 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

312A—Festina silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2mbj3
Elevation: 500 to 1,300 feet
Mean annual precipitation: 32 to 34 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 160 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Festina, Stratified Substratum

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess and/or silty alluvium over stratified silty to sandy slackwater deposits

Typical profile

Ap - 0 to 7 inches: silt loam
E - 7 to 12 inches: silt loam
BE,Bt - 12 to 38 inches: silt loam
BC,C - 38 to 68 inches: silt loam
2C - 68 to 80 inches: stratified silty clay loam to sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Available water storage in profile: Very high (about 12.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Minor Components

Ella

Percent of map unit: 5 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

312B2—Festina silt loam, 2 to 6 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 1lmx4
Elevation: 500 to 1,300 feet
Mean annual precipitation: 28 to 34 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 135 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Festina, Stratified Substratum

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Loess and/or silty alluvium over stratified silty to sandy slackwater deposits

Typical profile

Ap - 0 to 7 inches: silt loam
E - 7 to 12 inches: silt loam
BE,Bt - 12 to 38 inches: silt loam
BC,C - 38 to 68 inches: silt loam
2C - 68 to 80 inches: stratified silty clay loam to sand

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Available water storage in profile: Very high (about 12.7 inches)

Interpretive groups

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

Minor Components

Ella

Percent of map unit: 5 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

312C2—Festina silt loam, 6 to 12 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 2mbj4
Elevation: 500 to 1,300 feet
Mean annual precipitation: 28 to 34 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 135 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Festina, Stratified Substratum

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess and/or silty alluvium over stratified silty to sandy slackwater deposits

Typical profile

Ap - 0 to 7 inches: silt loam
E - 7 to 12 inches: silt loam
BE,Bt - 12 to 38 inches: silt loam
BC,C - 38 to 68 inches: silt loam
2C - 68 to 80 inches: stratified silty clay loam to sand

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Available water storage in profile: Very high (about 12.7 inches)

Interpretive groups

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

Minor Components

Ella

Percent of map unit: 5 percent
Landform: Stream terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

316B2—Ella silt loam, 1 to 6 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 1vgb8
Elevation: 500 to 1,300 feet
Mean annual precipitation: 28 to 34 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 135 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Ella

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess and/or silty alluvium over stratified silty to sandy slackwater deposits

Typical profile

Ap - 0 to 8 inches: silt loam
Bt - 8 to 55 inches: silt loam
2Bt - 55 to 72 inches: stratified silty clay loam to sandy loam
2C - 72 to 80 inches: stratified silty clay loam to sandy loam

Properties and qualities

Slope: 1 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 42 to 66 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: High (about 11.9 inches)

Interpretive groups

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

Minor Components

Festina, stratified substratum

Percent of map unit: 5 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

Bearpen

Percent of map unit: 3 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: High AWC, high water table (G105XY007WI)

Arenzville

Percent of map unit: 2 percent
Landform: Drainageways on stream terraces
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

423B2—Meridian silt loam, 2 to 6 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 1vgbf
Elevation: 600 to 1,100 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Meridian

Setting

Landform: Valley trains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty alluvium over sandy and gravelly outwash

Typical profile

Ap - 0 to 9 inches: silt loam
Bt1-Bt3 - 9 to 28 inches: silt loam
Bt4 - 28 to 32 inches: sandy loam
2BC - 32 to 41 inches: loamy coarse sand
2C - 41 to 72 inches: stratified gravelly coarse sand to sand

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Minor Components

Forkhorn

Percent of map unit: 4 percent
Landform: Valley trains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Kevilar

Percent of map unit: 3 percent
Landform: Valley trains
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

Meridian, sandstone substratum

Percent of map unit: 3 percent
Landform: Valley trains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Mod AWC, adequately drained (G105XY005WI)

511F—Plainfield sand, 15 to 60 percent slopes

Map Unit Setting

National map unit symbol: 1lmxv
Elevation: 600 to 1,950 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 39 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Plainfield

Setting

Landform: Valley trains
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and gravelly outwash

Typical profile

Oe,A - 0 to 4 inches: sand
Bw - 4 to 32 inches: sand
C - 32 to 80 inches: stratified gravelly coarse sand to sand

Properties and qualities

Slope: 15 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.7 inches)

Interpretive groups

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

Minor Components

Boplain

Percent of map unit: 2 percent
Landform: Valley trains
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Low AWC, adequately drained with limitations (G105XY003WI)

Aquic udipsamments, seep areas

Percent of map unit: 1 percent
Landform: Valley trains
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Low AWC, high water table (G105XY001WI)

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

Map Unit Setting

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

Map Unit Composition

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

Description of Chaseburg

Setting

Landform: Alluvial fans on hills, drainageways on hills
Down-slope shape: Linear
Across-slope shape: Convex, concave
Parent material: Silty slope alluvium

Typical profile

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

Properties and qualities

Slope: 1 to 4 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

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

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

Minor Components

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

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

616C—Chaseburg silt loam, 4 to 12 percent slopes, occasionally flooded

Map Unit Setting
National map unit symbol: 2qr2d
Elevation: 700 to 1,200 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

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

Description of Chaseburg

Setting
Landform: Alluvial fans on hills, drainageways on hills
Down-slope shape: Linear

Across-slope shape: Convex, concave
Parent material: Silty slope alluvium

Typical profile

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

Properties and qualities

Slope: 4 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: Very high (about 12.6 inches)

Interpretive groups

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

Minor Components

Arenzville

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

Churchtown

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

626A—Arenzville silt loam, 0 to 3 percent slopes, occasionally flooded

Map Unit Setting

National map unit symbol: 1lmyd
Elevation: 690 to 1,120 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Arenzville

Setting

Landform: Drainageways on stream terraces
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Silty alluvium

Typical profile

A - 0 to 10 inches: silt loam
C - 10 to 25 inches: silt loam
Ab - 25 to 40 inches: silt loam
C' - 40 to 60 inches: stratified silt loam to very fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 42 to 60 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: Very high (about 12.3 inches)

Interpretive groups

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

Minor Components

Arenzville, very rarely flooded

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

Orion

Percent of map unit: 3 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: High AWC, high water table (G105XY007WI)

Ettrick

Percent of map unit: 2 percent
Landform: Flood plains
Down-slope shape: Linear

Across-slope shape: Linear
Other vegetative classification: High AWC, high water table (G105XY007WI)

Arenzville, loamy-skeletal substratum
Percent of map unit: 2 percent
Landform: Drainageways on stream terraces
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: High AWC, adequately drained (G105XY008WI)

679A—Ettrick silt loam, 0 to 2 percent slopes, shallow, frequently flooded

Map Unit Setting
National map unit symbol: 2psvc
Elevation: 600 to 1,100 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 120 to 165 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition
Ettrick, shallow, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ettrick, Shallow

Setting
Landform: Depressions on flood plains, drainageways on flood plains
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Silty alluvium over sandy alluvium derived from sandstone

Typical profile
A1 - 0 to 6 inches: silt loam
A2 - 6 to 37 inches: very fine sandy loam
2BCg - 37 to 42 inches: stratified silt loam to fine sand
2Cg - 42 to 60 inches: sand

Properties and qualities
Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Ponded
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: B/D
Other vegetative classification: High AWC, high water table (G105XY007WI)

Minor Components

Orion

Percent of map unit: 7 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: High AWC, high water table (G105XY007WI)

Adder

Percent of map unit: 3 percent
Landform: Backswamps on flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Unnamed (G105XY010WI)

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

Map Unit Setting

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

Map Unit Composition

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

Description of Dorerton, Very Stony

Setting

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

Typical profile

A - 0 to 3 inches: loam

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

Properties and qualities

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

Interpretive groups

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

Description of Elbaville

Setting

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

Typical profile

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

Properties and qualities

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

Interpretive groups

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

Minor Components

Churchtown

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

Brodale

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

Dorerton, nonstony

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

Rockbluff

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

1145F—Gaphill-Rockbluff complex, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 1lmyr

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

Map Unit Composition

Gaphill and similar soils: 50 percent
Rockbluff and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Gaphill

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy colluvium over sandy residuum weathered from sandstone

Typical profile

Oe,A - 0 to 5 inches: sandy loam
E - 5 to 11 inches: sandy loam
Bt - 11 to 32 inches: sandy loam
2BC - 32 to 50 inches: sand
2C - 50 to 56 inches: sand
2Cr - 56 to 80 inches: weathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 40 to 80 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

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

Description of Rockbluff

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy colluvium over sandy residuum weathered from sandstone

Typical profile

Oe,A - 0 to 4 inches: loamy sand
E - 4 to 9 inches: loamy sand
Bw - 9 to 35 inches: sand
C - 35 to 52 inches: sand
Cr - 52 to 80 inches: weathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 40 to 80 inches to paralithic bedrock
Natural drainage class: Excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

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

Minor Components

Gaphill, very stony

Percent of map unit: 8 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Mod AWC, adequately drained with limitations (G105XY006WI)

Brownchurch

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

Dorerton, very stony

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

Rock outcrop, sandstone

Percent of map unit: 2 percent

Landform: Hills
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Convex

1224F—Boone-Elevasil complex, 15 to 50 percent slopes

Map Unit Setting

National map unit symbol: h6yd
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Boone and similar soils: 60 percent
Elevasil and similar soils: 30 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Boone

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy slope alluvium over sandy residuum

Typical profile

Oe,A - 0 to 3 inches: sand
E,Bw - 3 to 21 inches: sand
C - 21 to 35 inches: sand
Cr - 35 to 60 inches: weathered bedrock

Properties and qualities

Slope: 15 to 50 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Other vegetative classification: Low AWC, adequately drained with limitations (G105XY003WI)

Description of Elevasil

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy slope alluvium over sandy residuum

Typical profile

Oe,A - 0 to 3 inches: sandy loam
Bt1, Bt2 - 3 to 27 inches: sandy loam
2BC - 27 to 31 inches: loamy sand
2C - 31 to 39 inches: sand
2Cr - 39 to 60 inches: weathered bedrock

Properties and qualities

Slope: 15 to 50 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

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

Minor Components

Tarr

Percent of map unit: 4 percent
Landform: Pediments
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Other vegetative classification: Low AWC, adequately drained with limitations (G105XY003WI)

Rock outcrop, sandstone

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Convex

Council

Percent of map unit: 2 percent
Landform: Hills
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: High AWC, adequately drained with limitations (G105XY009WI), Acer rubrum-Circaea (ArCi)

Urne

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

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Appendix VI:

Wisconsin Natural Heritage Working List Key

Wisconsin Natural Heritage Working List

The Wisconsin Natural Heritage Working List contains species known or suspected to be rare in the state and natural communities native to Wisconsin. It includes species legally designated as "Endangered" or "Threatened" as well as species in the advisory "Special Concern" category. Most of the species and natural communities on the list are actively tracked and we encourage data submissions for all elements on the list. This list is meant to be dynamic and may be updated as often as new information regarding the biological status of species becomes available. The Natural Heritage Program welcomes your input on any aspect of this list. Wisconsin's extirpated species list is at the end. **Changes from the previous list (06/11) are bolded.**

Key

ELCODE: Unique 10 digit code for each element (plant, animal, or natural community).

Scientific Name: Scientific name used by the Wisconsin Natural Heritage Inventory Program.

S: Indicates that the element is a Species of Greatest Conservation Need based on Wisconsin's Wildlife Action Plan (WWAP). For more information see **http://dnr.wi.gov, keywords "Wildlife Action Plan"**.

Common Name: Standard, contrived, or agreed upon common names.

Global Rank: Global element rank. Refer to the Rank Definition Sheet below.

State Rank: State element rank. Refer to the Rank Definition Sheet below.

US Status: Current federal protection status designated by the U.S. Fish and Wildlife Service indicating the biological status of a species in Wisconsin. LE = listed endangered; LT = listed threatened; PE = proposed for listed as endangered; NEP = nonessential experimental population(s) in part of its range; C = candidate for future listing; CH = Critical Habitat; **SOC = *Species of Concern; HPR = High Potential Range.**

***Federal Species of Concern are those species that may be in need of concentrated conservation actions, which vary depending on the health of the populations and degree and types of threats. They receive no legal protection and are not necessarily species that will eventually be proposed for listing as threatened or endangered.**

State Status: Protection category designated by the Wisconsin DNR. END = Endangered; THR = Threatened; SC = Special Concern;

WDNR and federal regulations regarding Special Concern species range from full protection to no protection. The current categories and their respective levels of protection are as follows: SC/P = protected wild animal; SC/N = no laws regulating use, possession, or harvesting; SC/H = take regulated by establishment of open closed seasons; SC/FL = federally protected as endangered or threatened, but not so designated by WDNR; SC/M = fully protected by federal and state laws under the Migratory Bird Act.

Special Concern species are those species about which some problem of abundance or distribution is suspected but not yet proven. The main purpose of this category is to focus attention on certain species before they become threatened or endangered.

GLOBAL & STATE ELEMENT RANK DEFINITIONS
WISCONSIN NATURAL HERITAGE INVENTORY PROGRAM

GLOBAL ELEMENT RANKS:

G1 Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single state or physiographic region), or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

G4 Apparently globally secure, though it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

GH Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered.

GNR Not ranked. Replaced G? rank, and some GU ranks.

GU Possibly in peril range-wide, but their status is uncertain. More information is needed.

GX Believed to be extinct throughout its range (e.g. Passenger pigeon) with virtually no likelihood that it will be rediscovered.

Species with a questionable taxonomic assignment are given a "Q" after the global rank.

Subspecies and varieties are given subranks composed of the letter "T" plus a number or letter. The definition of the second character of the subrank parallels that of the full global rank. (Examples: a rare subspecies of a rare species is ranked G1T1; a rare subspecies of a common species is ranked G5T1.)

STATE ELEMENT RANKS

S1 Critically imperiled in Wisconsin because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.

S2 Imperiled in Wisconsin because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.

S3 Rare or uncommon in Wisconsin (21 to 100 occurrences).

S4 Apparently secure in Wisconsin, with many occurrences.

S5 Demonstrably secure in Wisconsin and essentially ineradicable under present conditions.

SNA Accidental, not of significant conservation concern, reported, but unconfirmed, or reported falsely.

SH Of historical occurrence in Wisconsin, perhaps having not been verified in the past 20 years, and suspected to be still extant. Naturally, an element would become SH without such a 20-year delay if the only known occurrence were destroyed or if it had been extensively and unsuccessfully looked for.

SNR Not Ranked.

SU Possibly in peril in the state, but their status is uncertain. More information is needed.

SX Apparently extirpated from the state.

STATE RANKING OF LONG-DISTANCE MIGRANT ANIMALS:

Ranking long distance aerial migrant animals presents special problems relating to the fact that their non-breeding status (rank) may be quite different from their breeding status, if any, in Wisconsin. In other words, the conservation needs of these taxa may vary between seasons. In order to present a less ambiguous picture of a migrant's status, it is necessary to specify whether the rank refers to the breeding (B) or non-breeding (N) status of the taxon in question. (e.g. S2B,S5N).

Appendix VII:

Notice of Intent: Information Summary for Nonmetallic Mining Operations

State of Wisconsin
Department of Natural Resources

NOTICE OF INTENT

Information Summary for *Nonmetallic Mining Operations*

Notice: Pursuant to s. 283.33 & 283.35, Wis. Stats., this form is required to be completed and submitted by any owner or operator of a nonmetallic mining operation that must apply for a permit in accordance with 40 CFR Part 122 or ch. 283, Wis. Stats. The Department of Natural Resources (DNR) will use the information requested on this form to determine if process wasted and/or storm water discharges from nonmetallic mining operation are eligible for coverage under the Wisconsin Pollutant Discharge Elimination System (WPDES) generalized permit No. WI-0046515-5. Failure to obtain coverage for pollutant discharges under the nonmetallic mining general permit or other applicable WPDES permit may result in forfeitures up to $10,000 per day. Personal information collected will be used for administrative purposes and may be provided to requesters to the extent required by Wisconsin's Open Records Law (ss. 19.31-19.39, Wis. Stats.).

Enter N/A for questions not applicable to your operation.

Section I: Parent Company/Owner Information – To be completed by all requesting coverage

Company/Owner Name: Wisconsin Proppant Resources, LLC

Contact Name Last	First	MI	Title
Clement	Eric		President

Street Address	City	State	Zip Code
103 - 20th Street Northeast	Stewartville	MN	55976

Phone Number	Fax Number	E-mail address (if available)
563-203-7377		eclement@fthrc.com

1. What are the Standard Industrial Classification (SIC) codes for your company's nonmetallic mining operations?

   ☐ 1410 Dimension Stone ☐ 1420 Crushed and Broken Stone ☑ 1440 Sand and Gravel
   ☐ 1450 Clay, Ceramic & Refractory ☐ 1470 Chemicals & Fertilizers ☐ 1480 Nonmetallic Mineral Services

   Others?

2. Has your company been issued any other wastewater (WPDES) permits that authorize the discharge of other wastewaters (such as from asphalt or concrete operations) to Wisconsin surface or underground waters?

   ☐ Yes List the site names and WPDES permit numbers:

   ☑ No

3. To the best of your knowledge, do any of your operations have process wastewater (from aggregate washing, pit dewatering, stack scrubbing, boiler blowdown, etc.) that contains any of the substances listed below? _____ Do any of your sites have stormwater that comes in direct contact with any of the substances listed below? _____ Check all the substances that apply.

   ☐ 4,4'-DDD ☐ 4,4'-DDE ☐ 4,4'-DDT
   ☐ alpha – BHC ☐ Dieldrin ☐ Chlordane
   ☐ Mercury ☐ Mirex ☐ Octachlorostyrene
   ☐ Photomirex ☐ PCB ☐ Pentachlorobenzene
   ☐ 1,2,3,4-Tetrachlorobenzene ☐ 1,2,4,5-Tetrachlorobenzene ☐ 2,3,7,8-Tetrachlorodibenzo-p-dioxin
   ☐ Toxaphene ☐ gamma - BHC (Lindane) ☐ tech. – BHC
   ☐ Hexachlorobenzene ☐ Hexachlorobutadiene
   ☐ Other substances that are known to be harmful to human health or aquatic life (such as solvents or dissolved metals)

   If you answered yes to either question above, and <u>any</u> of the above substances are checked, you may be required to segregate that wastewater and not discharge it to waters of the state. If you wish to pursue obtaining a permit to discharge wastewater containing these chemicals, indicate that you want the Department to send an application for a site specific WPDES discharge permit by checking here ☐.

   Check here ☑ if none of the above substances are expected to be in the discharge.

4. To the best of your knowledge, have any leaks, spills, overflows or similar instances resulted in contamination of stormwater runoff from any of your nonmetallic mining operations in the last three years?

   ☐ Yes List the site names and actions taken to prevent future problems, (attach additional sheets if necessary).

   ☑ No

Section II: Site/Property Information – To be completed for coverage of individual mine sites. Make copies of this section or use a table format to apply for more than one mining site. (Go to Section III to apply for a mobile equipment operation whose sites are not known at this time)

Site/Property Name	Site/Property Identification # [FID] (if known)
Breezy Point Properties	

Contact Name Last	First	MI	Title
Lindstrom	Deric		

Street Address	City	State	Zip Code
W2184 County Highway K	Durand	WI	54736

Property location: Qtr/Qtr	Quarter	Section	Township	Range	County	Lat/Long-GPS Coordinates (if known)
Section 33			24 N	13 ☐ E ☑ W	Buffalo	-91.966/44.51

Phone Number	Fax Number	E-mail address (if available)
715-495-5021 (cell)	715-673-4982 (home)	thedairy&breezypointfarms.com

Attach a site map, such as an air photo, USGS topographic map or survey map, showing the mining site location, the nearest public roadway and surface water resources within 1000 feet. Wastewater treatment, seepage and discharge points should also be shown.

1. What is the flow pattern of stormwater run-off at the site?

☐ Externally Drained – storm water that contacts mining areas, processing areas or stockpiled materials runs beyond the site property boundary. External drainage includes storm water to ponds or drainage channels that overflow to areas outside of the mining site property boundaries.

☑ Internally Drained – storm water runoff is captured within the mining site. All storm water that contacts mining areas, processing areas or stockpiled materials runs off to onsite seepage areas or ponds that retain the water within the site property boundaries.

☐ Internally Drained, but the storm water is discharged to on-site protected wetlands or other on-site natural surface water resources.

2. Briefly describe the industrial activity at this site. What Standard Industrial Classification (SIC) code would the operation be included under? Are there any adjacent mining, concrete or asphalt operations?

The proposed silica sand mine project is SIC Code 1440. There are no other adjacent mining, concrete, or asphalt operations. The site is currently used as farmland.

3. Is this site to be "permitted" for the discharge of mining wastewater (such as from mine dewatering pumpage, product or equipment washing, cooling, etc.) to surface waters, wetlands or seepage areas?
   - ☐ Yes, and section IV has been used to describe the mining process wastewater discharges
   - ☑ No

4. Check here ☐, if ALL of the site's process wastewater and stormwater goes to a municipal or sewerage district treatment plant that has its own WPDES discharge permit. Such a mining site does not need an additional WPDES permit. If future operations at this site result in a direct discharge to waters of Wisconsin, you will need to inform the Dept.

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☐ G. P. Coverage

☐ Individual Permit

☐ NPR

Section III: Mobile Unit Information – To be completed for coverage of a machinery group or "spread" that operates at a number of sites. This section may be copied for describing multiple machinery groupings. Also, complete property descriptions (using section II, above) for any known or expected operating sites, so that discharge permit eligibility can be established prior to the start of operations.

Mobile Unit Operator Name/Contact	Last	First	MI	Title

Facility Identifier (FID) # (if known)	Anticipated Sites for Mobile Unit Operation [attach additional sheets if necessary and check here ☐]

Phone Number	Mobile Phone Number	E-mail address (if available)

Number of Wash plants	Number of Crushing plants

Section IV: Mining Process Wastewater Information – To be completed for sites or equipment that discharge wastewater generated during the process of mining. (This section may be copied for multiple sites or machinery groupings)

1. Indicate the **receiving water** for the process wastewater discharges. Check all that apply. (**NOTE**: Part 3, below, describes types of process wastewater. An outfall is an individual discharge point , such as a seepage pond bottom, or a sewer pipe, channel, or ditch that conveys the wastewater to underground water or surface water resources).

See attached narrative.

☐ **Seepage to Groundwater** (this includes infiltration of wastewater through the soil via drain fields, seepage areas, pond bottoms, ditches, trenches, etc. that do not reach surface water resources).
a. Outfall #(s):

☐ Discharge to **Surface Water Resources** (this includes surface water drainage ways that contain aquatic life, tributaries, protected wetlands, creeks, streams, rivers, lakes, etc):
a. Outfall #(s):

b. How far is it from the discharge point to a surface water resource (i.e. distance traveled through storm sewers or drainage ditches)? ☐ Less than 1000 feet ☐ Between 1000 and 5000 feet ☐ Greater than 5000 feet

c. What is the first named surface water the discharge enters?

d. If the discharge is to a wetland indicate whether it is believed to be ☐ natural or ☐ artificial

☐ **Municipal or Sewage District Treatment Plant** – Outfall #(s):
These discharges would travel in a sanitary sewer to an off-site treatment facility that has its own WPDES permit.

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☐ Eligible

☐ Ineligible
☐ ERW
☐ ORW

☐ NR 103 Completed

☐ NPR

Additive follow-up necessary:
☐ Yes
☐ No

2. Are water treatment or conditioning additives used in waste streams that are discharged to surface waters or seeped into groundwater?

☐ No No water treatment additives (such as, separation aids, boiler treatments, scale/rust inhibitors, biocides, chlorine, etc.) are used.

☑ Yes Additives are used and **described in Appendix A**. Are any of the additives considered a biocide? ☑ No ☐ Yes (Biocides are designed to control biological growth, such as algae, in tanks, cooling towers, and other equipment)?

3. **List the Process Wastewater Types and Flows**. Common types of mining process wastewaters are listed below. "Other" process wastewater types could be softener regeneration wastewater, scrubber water or wastewater from internal building floor drains. Dust suppression water may be omitted if there is no runoff. Outfalls described below should be located on the site map requested in Section II, page 2.

Type of Wastewater (check all that apply):	Outfall # (#1, #2, etc.)	Average Daily Flow (gallons per day)	Type of Wastewater (check all that apply):	Outfall # (#1, #2, etc.)	Average Daily Flow (gallons per day)
☑ Washwater Associated with Material Processing	# N/A		☐ Sanitary wastewater from toilets, sinks, etc. *If the sanitary waste-waters are **not** mixed with the mining process water, write the **type** of sanitary waste treatment system in the daily flow column in place of a flow estimate.*	#	
	# See attached narrative.			#	
	#			#	
☐ Mine Site Dewatering	#		☐ Other (describe type)	#	
	#		Will be using self-contained portable restrooms.	#	
	#			#	
☐ Noncontact Cooling Water, Condensate or Boiler Water	#		☐ Other (describe type)	#	
	#			#	
	#			#	
☐ Vehicle or Equipment Washwater	#		☐ Other (describe type)	#	
	#			#	
	#			#	

Section V: Signatory Requirements

Information about the person completing this form:

Name, Last | First | MI

Street Address | City | State | Zip Code

Phone Number | Fax Number | Email Address (if available)

Title of the person completing the form.

☐ Check here if you should receive Discharge Monitoring Reports (DMR's) for annual reporting of discharge test results.

Official Representative's Signature. This form must be signed by the official representative of the permitted facility who is**:** the proprietor for a sole proprietorship; a general partner for a partnership; a principal executive officer, ranking elected official or other duly authorized representative for a unit of government; a member or manager for a limited liability company; or, for a corporation, an executive officer of at least the level of vice president, or by the executive officer's authorized representative having overall responsibility for the operation of the facility. If this form is not signed below, or is found to be incomplete, it will be returned.

I certify that I am familiar with the information contained in this application and that to the best of my knowledge and belief such information is true, complete and accurate.

Printed or Typed Name of Official Representative | Title

Signature of Official Representative | Date

MAIL COMPLETED APPLICATION TO:

Department of Natural Resources
Water Permits Central Intake
P.O. Box 7185
Madison, WI 53707-7185

For Department Use Only

Date Application Received:

Date permit coverage approved:

Status: ___ Denied
___ Approved
___ Specific permit

Internally Drained - Yes No
SWPPP Required - Yes No
Site Number or FIN:

AFSCI Frequency – Annual 1 per 3 years
Contaminant Control System Insp. - ¼ly 1 per 3 years
Visual Runoff Quality Check - ¼ly 1 per 3 years

Comments:

APPENDIX A - WATER TREATMENT ADDITIVE INFORMATION

[Use this appendix to provide details on the additives affirmed to be used in question #2, Section IV on page 3]

Submit the following information for each water treatment or conditioning additive that could be contained in the wastewater discharged to seepage or surface waters:

a. Commercial name, and the amount or concentration of the additive that will be used.
b. Proposed frequency of usage, and the anticipated discharge concentration of the additive.
c. Material Safety Data Sheets (MSDS's) for each additive.

NOTE: The information requested in this section should be available from your additive supplier

If your discharge enters a surface water, you must also submit the following information:

d. At least one 48-hour LC_{50} or EC_{50} value for Daphnia magna and at least one 96-hour LC_{50} or EC_{50} value for fathead minnow, rainbow trout, or bluegill.

If available from suppliers:

Outfall #	Additive Name and Manufacturer	Additive Type Biocide, pH adjuster, scale, inhibitor, rust inhibitor, etc.	Amount or Concentration Used (mg/l or lbs/day)	Anticipated Discharge Concentration (mg/l)	Frequency of use (Continuous, 1x/week, etc.)	Daphnia Magna 48-HR LC_{50} or EC_{50} (mg/l)	Fathead Minnow 96-HR LC_{50} or EC_{50} (mg/l)	Rainbow Trout 96-HR LC_{50} or EC_{50} (mg/l)	Blue Gill 96-HR LC_{50} or EC_{50} (mg/l)

ATTACH MATERIAL SAFETY DATA SHEETS (MSDS's) TO BACK OF THIS APPENDIX

Appendix VIII:

Wisconsin Department of Natural Resources (WDNR) Conservation Practice Standards (NRCS Best Management Practices); NRCS Critical Area Planting Code 342; Wisconsin Agronomy Technical Note 5

Site Evaluation for Stormwater Infiltration
(1002)

Wisconsin Department of Natural Resources
Conservation Practice Standards

I. Definition

This standard defines site evaluation procedures to:

1. Perform an initial screening of a *development site*[1] to determine its suitability for infiltration.

2. Evaluate each area within a development site that is selected for infiltration.

3. Prepare a site evaluation report.

II. Purpose

1. Establish methodologies to characterize the site and screen for exclusions and exemptions under Chapter NR 151 Wis. Adm. code.

2. Establish requirements for siting an *infiltration device* and the selection of design infiltration rates.

3. Define requirements for a site evaluation report that insures appropriate areas are selected for infiltration and an appropriate *design infiltration rate* is used.

III. Conditions where Practice Applies

This standard is intended for development sites being considered for stormwater infiltration devices. Additional site location requirements may be imposed by other stormwater infiltration device technical standards.

IV. Federal, State and Local Laws

Users of this standard shall be aware of applicable federal, state and local laws, rules, regulations or permit requirements governing infiltration devices. This standard does not contain the text of federal, state or local laws.

V. Criteria

The site evaluation consists of four steps for locating the optimal areas for infiltration, and properly sizing infiltration devices.

- Step A. Initial Screening.
- Step B. Field Verification of information collected in Step A.
- Step C. Evaluation of Specific *Infiltration Areas*.
- Step D. Soil and Site Evaluation Reporting.

The steps shall coincide, as much as possible, for when the information is needed to determine the following: 1) the potential for infiltration on the site, 2) the optimal locations for infiltration devices, and 3) the design of the infiltration device(s). Steps A and B shall be completed as soon as possible in the approval process. See Consideration VI.M for an example.

Step A. Initial Screening

The initial screening identifies potential locations for infiltration devices. The purpose of the initial screening is to determine if installation is limited by ss. NR 151.12(5)(c)5. or NR 151.12(5)(c)6., and to determine where field work is needed for Step B. Optimal locations for infiltration are verified in Step B.

Information collected in Step A will be used to explore the potential for multiple infiltration areas versus relying on a regional infiltration device. Smaller infiltration devices dispersed around a development are usually more sustainable than a single *regional device* that is more likely to have maintenance and groundwater mounding problems.

The initial screening shall determine the following: Note: Useful references for the existing resource maps and information are listed in Considerations VI.I and J.

1. Site topography and slopes greater than 20%.
2. Site soil infiltration capacity characteristics as defined in NRCS County soil surveys.
3. *Soil parent material.*
4. Regional or local depth to groundwater and bedrock. Use seasonally *high groundwater* information where available.

[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.

5. Distance to sites listed on the GIS Registry of Closed Remediation sites within 500 feet from the perimeter of the development site.
6. Distance to sites listed on the Bureau of Remediation and *Redevelopment* Tracking System within 500 feet from the perimeter of the development site.
7. Presence of endangered species habitat.
8. Presence of flood plains and flood fringes.
9. Location of hydric soils based on the USDA County Soil Survey and wetlands from the WDNR Wisconsin Wetland Inventory map.
10. Sites where the installation of stormwater infiltration devices is excluded, due to the potential for groundwater contamination, by chapter NR 151 Wis. Adm. Code.
11. Sites exempted by chapter NR 151 Wis. Adm. Code from the requirement to install infiltration devices.
12. Potential impact to adjacent property.

Step B. Field Verification of the Initial Screening

A. Field verification is required for areas of the development site considered suitable for infiltration. This includes verification of Step A.1, 2, 3, 4, 9, 10 and 11.

B. Sites shall be tested for depth to groundwater, depth to bedrock and *percent fines* information to verify any exemption and exclusion found in Step A.10 and 11. The following is a description of the percent fines expected for each type of soil textural classification.

   1. Several textural classes are assumed to meet the percent fines limitations of Ch. NR 151.12(5)(c)5.i. for both 3 and 5 foot soil layers. These classifications include the sandy loams, loams, silt loams and all the clay textural classifications. *Coarse sand* is the only soil texture that by definition will not meet NR 151.12(5)(c)5.i. limitations for a 3 foot soil layer consisting of 20% fines. Other sand textures and loamy sands may need the percent fines level verified with a laboratory analysis.

   2. Borings and pits shall be dug to verify soil infiltration capacity characteristics and to determine depth to groundwater and bedrock.

C. The following information shall be recorded for Step B:

   1. The date or dates the data was collected.

   2. A legible site plan/map that is presented on paper that is no less than 8 ½ X 11 inches in size and:

      a. Is drawn to scale or fully dimensional.
      b. Illustrates the entire development site.
      c. Shows all areas of planned filling and/or cutting.
      d. Includes a permanent vertical and horizontal reference point.
      e. Shows the percent and direction of land slope for the site or contour lines. Highlight areas with slopes over 20%.
      f. Shows all flood plain information that is pertinent to the site.
      g. Shows the location of all pits/borings included in the report.
      h. Location of wetlands as field delineated and surveyed.
      i. Location of karst features, private wells within 100 feet of the development site, and public wells within 400 feet of the development site.

   3. Soil profile descriptions must be written in accordance with the descriptive procedures, terminology and interpretations found in the Field Book for Describing and Sampling Soils, USDA, NRCS, 1998. Frozen soil material must be thawed prior to conducting evaluations for soil color, texture, structure and consistency. In addition to the data determined in Step B, soil profiles must include the following information for each soil horizon or layer:

      a. Thickness, in inches or decimal feet.
      b. Munsell soil color notation.
      c. Soil mottle or redoximorphic feature color, abundance, size and contrast.
      d. USDA soil textural class with rock fragment modifiers.
      e. Soil structure, grade size and shape.
      f. Soil consistence, root abundance and size.
      g. Soil boundary.
      h. Occurrence of saturated soil, groundwater, bedrock or disturbed soil.

Step C. Evaluation of Specific Infiltration Areas

This step is to determine if locations identified for infiltration devices are suitable for infiltration, and to provide the required information to design the device.

A minimum number of borings or pits shall be constructed for each infiltration device (Table 1). The following information shall be recorded for Step C:

1. All the information under Step B.C.3.

2. A legible site plan/map that is presented on paper no less than 8 1/2 X 11 inches in size and:

   a. Is drawn to scale or fully dimensional.
   b. Illustrates the location of the infiltration devices.
   c. Shows the location of all pits and borings.
   d. Shows distance from device to wetlands.

3. An analysis of groundwater mounding potential is required as per Table 1. The altered groundwater level, based on mounding calculations, must be considered in determining the vertical separation distance from the infiltration surface to the *highest anticipated groundwater elevation* as specified in NR 151. References include but are not limited to Finnemore 1993 and 1995, and Hantush 1967.

4. One of the following methods shall be used to determine the design infiltration rate:

   a. Infiltration Rate Not Measured - Table 2 shall be used if the infiltration rate is not measured. Select the design infiltration rate from Table 2 based on the least permeable soil horizon five feet below the bottom elevation of the infiltration system.

   b. Measured Infiltration Rate - The tests shall be conducted at the proposed bottom elevation of the infiltration device. If the infiltration rate is measured with a *Double-Ring Infiltrometer* the requirements of ASTM D3385 shall be used for the field test.

      The measured infiltration rate shall be divided by a correction factor selected from Table 3. The correction factor adjusts the measured infiltration rates for the occurrence of less permeable soil horizons below the surface and the potential variability in the subsurface soil horizons throughout the infiltration site.

      A less permeable soil horizon below the location of the measurement increases the level of uncertainty in the measured value. Also, the uncertainty in a measurement is increased by the variability in the subsurface soil horizons throughout the proposed infiltration site.

      To select the correction factor from Table 3, the ratio of design infiltration rates must be determined for each place an infiltration measurement is taken. The design infiltration rates from Table 2 are used to calculate the ratio. To determine the ratio, the design infiltration rate for the surface textural classification is divided by the design infiltration rate for the least permeable soil horizon. For example, a device with a loamy sand at the surface and a least permeable layer of loam will have a design infiltration rate ratio of about 6.8 and a correction factor of 4.5. The depth of the least permeable soil horizon should be within five feet of the proposed bottom of the device or to the depth of a limiting layer.

5. To determine if infiltration is not required under NR 151.12(5)(c)6.a., a scientifically credible field test method is required unless the least permeable soil horizon five feet below the bottom of infiltration system is one of the following: sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, or clay. The infiltration rate used to claim the exemption shall be the actual field measurement and shall be used without the correction factors found in Table 3.

Step D. Soil and Site Evaluation Report Contents

The site's legal description and all information required in Steps B and C shall be included in the Soil and Site Evaluation Report. These reports shall be completed prior to the *construction plan* submittal.

Table 1: Evaluation Requirements Specific to Proposed Infiltration Devices

Infiltration Device	Tests Required[1]	Minimum Number of Borings/Pits Required	Minimum Drill/Test Depth Required Below the Bottom of the Infiltration System
Irrigation Systems[2]	Pits or borings	NA[2]	5 feet or depth to *limiting layer*, whichever is less.
Rain Garden[2]	Pits or Borings	NA[2]	5 feet or depth to limiting layer, whichever is less.
Infiltration Trenches (≤ 2000 sq feet impervious drainage area)	Pits or borings	1 test/100 linear feet of trench with a minimum of 2, and sufficient to determine variability	5 feet or depth to limiting layer, whichever is less.
Infiltration Trenches (> 2000 sq ft of impervious drainage area)	• Pits or borings • Mounding potential	1 pit required and an additional 1 pit or boring/100 linear feet of trench, and sufficient to determine variability	Pits to 5 feet or depth to limiting layer Borings to 15 feet or depth to limiting layer
Bioretention Systems	• Pits or borings • Mounding potential	1 test/50 linear feet of device with a minimum of 2, and sufficient to determine variability	5 feet or depth to limiting layer
Infiltration Grassed Swales	Pits or borings	1 test/1000 linear feet of swale with a minimum of 2, and sufficient to determine variability	5 feet or depth to limiting layer
Surface *Infiltration Basins*	• Pits or borings • Mounding potential	2 pits required per infiltration area with an additional 1 pit or boring for every 10,000 square feet of infiltration area, and sufficient to determine variability	Pits to 10 feet or depth to limiting layer Borings to 20 feet or depth to limiting layer
Subsurface Dispersal Systems greater than 15 feet in width.	• Pits or borings • Mounding potential	2 pits required per infiltration area with an additional 1 pit or boring for every 10,000 square feet of infiltration area, and sufficient to determine variability	Pits to 10 feet or depth to limiting layer Borings to 20 feet or depth to limiting layer

[1]Continuous soil borings shall be taken using a bucket auger, probe, split-spoon sampler, or shelby tube. Samples shall have a minimum 2-inch diameter. Soil pits must be of adequate size, depth and construction to allow a person to enter and exit the pit and complete a morphological soil profile description.

[2]Information from Step B is adequate to design rain gardens and irrigation systems.

Table 2: Design Infiltration Rates for Soil Textures Receiving Stormwater

Soil Texture[1]	Design Infiltration Rate Without Measurement inches/hour[2]
Coarse sand or coarser	3.60
Loamy coarse sand	3.60
Sand	3.60
Loamy sand	1.63
Sandy loam	0.50
Loam	0.24
Silt loam	0.13
Sandy clay loam	0.11
Clay loam	0.03
Silty Clay loam	0.04[3]
Sandy clay	0.04
Silty clay	0.07
Clay	0.07

[1]Use sandy loam design infiltration rates for fine sand, loamy fine sand, very fine sand, and loamy fine sand soil textures.

[2] Infiltration rates represent the lowest value for each textural class presented in Table 2 of Rawls, 1998.

[3] Infiltration rate is an average based on Rawls, 1982 and Clapp & Hornberger, 1978.

Table 3: Total Correction Factors Divided into Measured Infiltration Rates

Ratio of Design Infiltration Rates[1]	Correction Factor
1	2.5
1.1 to 4.0	3.5
4.1 to 8.0	4.5
8.1 to 16.0	6.5
16.1 or greater	8.5

[1]Ratio is determined by dividing the design infiltration rate (Table 2) for the textural classification at the bottom of the infiltration device by the design infiltration rate (Table 2) for the textural classification of the least permeable soil horizon. The least permeable soil horizon used for the ratio should be within five feet of the bottom of the device or to the depth of the limiting layer.

Required Qualifications

A. Site Evaluations - Individuals completing site evaluations shall be a licensed professional acceptable to the authority having jurisdiction and have experience in soil investigation, interpretation and classification.

B. Soil Evaluations - Individuals completing the soils evaluation shall be a Soil Scientist licensed by the Department of Regulation and Licensing or other licensed professional acceptable to the authority having jurisdiction.

VI. Considerations

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

A. Groundwater monitoring wells, constructed as per chapter NR 141, Wis. Adm. Code, can be used to determine the seasonal *high groundwater level*. Large sites considered for infiltration basins may need to be evaluated for the direction of groundwater flow.

B. Karst Inventory Forms on file with the Wisconsin Geological and Natural History Survey should be filled out if a karst feature is located within the site.

C. Cation Exchange Capacity (CEC) of the soil can indicate the number of available adsorption sites. Sandy soils have limited adsorption capacity and a CEC ranging from 1-10 meq/100g. Clay and organic soils have a CEC greater than 20 and have a high adsorption rate.

D. Soil organic matter and pH can be used to determine adsorption of stormwater contaminants. A pH of 6.5 or greater is optimal. A soil organic content greater than 1 percent will enhance adsorption.

E. NR 151 provides for a maximum area to be dedicated for infiltration depending upon land use. This cap can be voluntarily exceeded.

F. One or more areas within a development site may be selected for infiltration. A development site with many areas suitable for infiltration is a good candidate for a dispersed approach to infiltration. It may be beneficial to contrast regional devices with onsite devices that receive runoff from one lot or a single source area within a lot, such as rooftop or parking lot.

G. Stormwater infiltration devices may fail prematurely if there is:

1. An inaccurate estimation of the Design Infiltration Rate;
2. An inaccurate estimation of the seasonal high water table;
3. Excessive compacting or sediment loading during construction;
4. No pretreatment for post-development and lack of maintenance.

H. No construction erosion should enter the infiltration device. This includes erosion from site grading as well as home building and construction. If possible, rope off areas selected for infiltration during grading and construction. This will preserve the infiltration rate and extend the life of the device.

I. Resources available for completing Step A. Initial screening:

1. Sites listed on the GIS Registry of Closed Remediation sites. http://gomapout.dnr.state.wi.us/org/at/et/geo/gwur/index.htm
2. Sites listed in the Bureau of Remediation and Redevelopment Tracking System. http://dnr.wi.gov/org/aw/rr/brrts/index.htm
3. Flood plain areas as regulated under s. 87.30, Wis. Stats. and NR 116, NR 30 and NR 31, Wis. Adm. Code.
4. Wetlands as defined in Ch. NR 103, Wis. Adm. Code.
5. Endangered species habitat as shown on National Heritage Inventory County maps
6. Access points and road setbacks as determined by county or municipal zoning plans.
7. Existing reports concerning the groundwater and bedrock. Examples include: Publications from USGS, NRCS, Regional Planning Commissions, DNR, DATCP, DOT, UW system or WGNHS.
8. The Drinking Water and Groundwater pages of the DNR http://dnr.wi.gov/org/water/dwg/
9. The Wisconsin Grain Size Database http:\\www.geology.wisc.edu/~qlab/

J. The development site should be checked to determine the potential for archeological sites. This search may be conducted by state staff for projects required or funded by the state.

K. Slopes 20% or greater are inappropriate for some infiltration devices.

L. Expect to complete the preliminary design work (Criteria Step A through Step C) before the approval process (platting). Once required information is compiled, the initial design work for an infiltration device can begin.

M. The approval process requirements for development sites vary across the state and may also vary within a municipality depending on the number of lots being developed. The timing of Steps A, B, and C might have to be adjusted for the type of approval process. The following is an example of when the steps might be completed for a typical development site requiring a plat. The sequence in the example would comply with the criteria for timing of Steps A, B, and C.

Step A should be completed before the preliminary plat and Step B should be completed before the final plat, or CSM is approved. For regional infiltration devices, and for devices constructed on public right-of-ways, public land or jointly owned land, Step C should be completed before the final plat or final CSM approval.

It can be difficult to select the final location and drainage area for an infiltration device before the use of the lot is known. Sometimes it is more desirable to design an infiltration device for an individual lot after the lot is purchased. For this situation Step C would be completed after the final plat is approved. The information for Step C would be collected when the lot is purchased. To give future devices credit towards achieving the infiltration performance standard, the final plat would contain approximate sizing information for each device. Information from Step A and B would be used to determine the approximate sizing information.

N. The inner ring of the Double-Ring Infiltrometer should be at least 12 inches in diameter.

O. Section NR 151.12(5)(c)5., is included in the administrative code as a means to discourage infiltration of runoff from or into the listed areas, due to potential concerns of groundwater contamination. Although it is not illegal to infiltrate storm water in areas with the listed limitations, DNR will not give credit for this infiltration towards meeting the infiltration requirements of ss. NR 151.12(5)(c)1. or NR 151.12(5)(c)2. Runoff that is infiltrated must be in compliance with s. NR 151.12(5)(c)8., which requires minimizing infiltration of pollutants so that groundwater quality standards are maintained.

VII. References

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VIII. Definitions

Bioretention systems (Table 1): Bioretention is an infiltration device consisting of an excavated area that is back-filled with an engineered soil, covered with a mulch layer and planted with a diversity of woody and herbaceous vegetation. Storm water directed to the device percolates through the mulch and engineered soil, where it is treated by a variety of physical, chemical and biological processes before infiltrating into the native soil.

Construction Plan (V.Step D): A map and/or plan describing the built-out features of an individual lot.

Coarse sand (V.Step B.B.1): Soil material that contains 25% or more very coarse and coarse sand, and <50% any other one grade of sand.

Design infiltration rate (II.3): A velocity, based on soil structure and texture, at which precipitation or runoff enters and moves into or through soil. The design rate is used to size an infiltration device or system. Rates are selected to be minimal rates for the different types of soils. Selection of minimal rates will provide a robust design and maximize the longevity of the device.

Development site (I.1): The entire area planned for development, irrespective of how much of the site is disturbed at any one time or intended land use. It can be one lot or multiple lots.

Double-ring infiltrometer (V.Step C.4.b): A device that directly measures infiltration rates into a soil surface. The double-ring infiltrometer requires a fairly large pit excavated to depth of the proposed infiltration device and preparation of a soil surface representative of the bottom of the infiltration area.

High groundwater level (V.Step A.4): The higher of either the elevation to which the soil is saturated as observed as a free water surface in an unlined hole, or the elevation to which the soil has been seasonally or periodically saturated as indicated by soil color patterns throughout the soil profile.

Highest anticipated groundwater elevation (V.Step C.3): The sum of the calculated mounding effects of the discharge and the seasonal high groundwater level.

Infiltration areas (V): Areas within a development site that are suitable for installation of an infiltration device.

Infiltration basin (Table 1): An open impoundment created either by excavation or embankment with a flat densely vegetated floor. It is situated on permeable soils and temporarily stores and allows a designed runoff volume to infiltrate the soil.

Infiltration device (II.2): A structure or mechanism engineered to facilitate the entry and movement of precipitation or runoff into or through the soil. Examples of infiltration devices include irrigation systems, rain gardens, infiltration trenches, bioretention systems, infiltration grassed swales, infiltration basins, subsurface dispersal systems and infiltration trenches.

Infiltration trench (Table 1): An excavated trench that is usually filled with coarse, granular material in which stormwater runoff is collected for temporary storage and infiltration. Other materials such as metal pipes and plastic domes are used to maintain the integrity of the trench.

Irrigation system (Table 1): A system designed to disperse stored stormwater to lawns or other pervious areas.

Limiting layer (Table 1): A limiting layer can be bedrock, an aquatard, aquaclude or the seasonal high groundwater table.

Percent fines (V. Step B.B): the percentage of a given sample of soil, which passes through a # 200 sieve.

Rain garden (Table 1): A shallow, vegetated depression that captures stormwater runoff and allows it to infiltrate.

Regional device (V.Step A): An infiltration system that receives and stores stormwater runoff from a large area. Infiltration basins are the most commonly used regional infiltration devices.

Redevelopment (V.Step A.6): Areas where new development is replacing older development.

Soil parent material (V.Step A.3): The unconsolidated material, mineral or organic, from which the solum develops.

Subsurface dispersal systems (Table 1): An exfiltration system that is designed to discharge stormwater through piping below the ground surface, but above the seasonal high groundwater table.

Infiltration Basin

(Acre-Feet)
(1003)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

An infiltration basin is defined as an open impoundment (greater than 15 feet wide in its minimum dimension) created either by excavation or embankment with a flat, densely vegetated floor dedicated to the infiltration of runoff through the ground surface.

II. Purpose

The practice may be applied as part of a structural stormwater management practice system to support one or more of the following purposes:

- Reduce stormwater pollutants
- Increase discharge to groundwater
- Decrease runoff peak flow rates and volumes
- Preserve base flow in streams
- Reduce temperature impacts of runoff.

III. Conditions Where Practice Applies

The infiltration basin practice applies to urban areas where increased pollutant loadings, thermal impacts, or increased runoff volumes are a concern and the area is suitable for infiltration. (See NR 151.12(5) (c) 5 and 6 and WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002).)

IV. Federal, State and Local Laws

Users of this standard shall be aware of applicable federal, state and local laws, rules, regulations or permit requirements governing infiltration basins. This standard does not contain the text of federal, state or local laws.

V. Criteria

A. Screening criteria located in the WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002) shall be followed. In addition, the following site location criteria shall be met.

1. Building location – The basin shall not be *hydraulically connected*[1] to foundations or pavements, or cause negative impacts to structures. These negative impacts could include: water in basements and foundation instability.

2. 20% Slopes - Infiltration shall not cause seepage, contribute to hill slope failure or increase erosion on down gradient slopes. A minimum horizontal setback distance of 200 feet shall be maintained from down gradient slopes greater than 20% unless slope stability calculations demonstrate that the slope is stable under saturated conditions at a shorter distance from the practice. Note: Berms constructed as part of the practice are not included in this separation distance.

B. Design

1. Bypass/Dewatering – The basin shall be designed with a maintenance draw down capability. An example of this device is shown on Figure #3.

   When infiltration cells are used, a *draw down device* shall be provided for each cell.

2. Pretreatment Practices – Space must be allotted for pretreatment prior to infiltration to remove the following percentage of total suspended solids, on an average annual basis, based on the following land uses.

   a. 60% for residential (and associated roads)

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

b. 80% for commercial, industrial, institutional (and associated roads)

3. Infiltration Rates - See WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002) for design infiltration rates.

4. Dimensions

   a. Depth – Depth is a function of the maximum draw down time of 24 hours (for the infiltration portion of the practice only), using the design infiltration rate, with a not to exceed depth of 24 inches.

      The maximum depth of 24 inches applies to all infiltration cells within the practice.

   b. *Target Stay-on Depth* – The target stay-on depth shall meet the requirements of NR 151. (See Consideration L.)

   c. Effective Infiltration Area – The maximum depth along with the storage volume of water to be infiltrated can be used to determine the preliminary *effective infiltration area* necessary for the infiltration basin. (See Consideration L.)

   d. Slopes

      1. Longitudinal Slope – If used, the longitudinal slope shall not exceed 1% (0% longitudinal slope is recommended). If any longitudinal slope is specified, "infiltration cells" as described in V.B.4.f. shall be required.

      2. Lateral Slopes in the effective infiltration area shall be 0%.

Example: (This example is a continuation of the 20 acre mixed land use example presented in "Technical Note for Sizing Infiltration Basins and Bioretention Devices to Meet State of Wisconsin Stormwater Infiltration Performance Standards." See Consideration L. for reference.)

This example assumed an average pre-development curve number of 75 for the pre-development soil condition in the drainage basin, sandy loam soils at the infiltration site and a post-development curve number of 70 for the pervious areas in the drainage basin. From that example, the preliminary effective infiltration area is 8,930 square feet or 0.2 acres. Therefore, the storage volume (SV) at a one-foot maximum depth (MD) is 0.2 acre-ft or 8,930 cu. ft.

Calculate the dimensions of the basin. Assume a rectangular basin with a length to width ratio of 3:1
SV=MD * L * W substitute L=3W
SV=MD * $3W^2$.
Solve for W:
8,930 cu. ft. = 1 X $3W^2$ 2,977 = W^2
W = 55 ft
L= 3W so L = 164 ft

If using a longitudinal slope, it is still required that the maximum depth, at any point in the basin, not exceed 24 inches (or in this case 12 inches due to the soil type). This slope results in a 3D triangle of infiltration volume versus the cubic volume created by a basin with a flat floor.

To correct for this and to provide the required infiltration volume, the preliminary effective infiltration area originally calculated must be divided by 0.5. This will correct for the triangle of lost volume created by the sloped floor of the basin, the maximum depth and the water surface.

8,930 sq. ft. / 0.5 = 17,860 sq. ft.
The new W and L are now W = 77ft. and L = 3W = 231ft.

Note: The surface area calculated is the minimum effective infiltration area and does not include slopes or setbacks. Additional site area will be needed to account for berms and slopes.

e. Side Slopes – All side slopes for interior and exterior berms shall have a 4:1 slope (horizontal: vertical) or flatter.

f. Infiltration Cells – To maximize the effective infiltration area utilized and to prevent channelized flow, the effective infiltration area shall be subdivided into multiple smaller "cells" using *level spreaders* (example shown in Figure 1 & 2). These "cells" shall be used if a longitudinal slope is specified or if the length of the flow path exceeds 300 linear feet.

   The effective infiltration area shall be divided such that as a downstream cell reaches the depth of its level spreader, the elevation of the water in that cell does not exceed the downstream toe of slope from the next upstream level spreader. The height of any level spreader shall not exceed the maximum ponding depth.

Example (continued)

Given: MD = 12 inches, SA = 17, 860 sq. ft., longitudinal slope = 1%. W = 77 ft. L = 231 ft.

With a length of 231 feet and a slope of 1% we know the basin rises 2.3 feet along its length from the outlet to the toe of the pre-treatment area. Given a 12-inch maximum depth of water in the practice for infiltration, the basin needs to be divided into multiple cells with each cell a maximum 300 feet length or a maximum of 12 inches of depth in each cell.

As this example has a longitudinal slope of 1% the maximum cell is 100 feet in length (100 * 1% = 1 feet which is the maximum depth). Had this basin had no longitudinal slope on the floor, a cell up to 300 feet long could have been utilized.

The first level spreader should be located 100 feet upstream from the outlet structure. This leaves us with 131 feet to the pretreatment area. At 1% slope, the height of the level spreader should be 1.3 feet, which is greater than allowed. So the second level spreader should be 1 foot in height, with the third being 100 more feet upstream with a height of 0.43 feet.

Note: To improve the aesthetics of the basin, the second and third cells may be evened out to two cells of 66 feet each and level spreader heights of 0.66 feet.

5. Basin Inlets and Cell Dividers / Level Spreader – The design shall evenly spread the outflow from the pretreatment device or between cells across the width of the basin. The pretreatment discharge pipes and stone trench shown in Figures 1 & 2 (plan and profile view) provide an example of level spreaders.

6. Basin Outlets – The infiltration basin outlet shall safely convey stormwater

from the basin through all of the following mechanisms. An example of outlet pipes is shown in Figures 3 & 4 (front and side view)

a. Draw Down Device – A means shall be provided to quickly remove standing water from the basins for maintenance and winter diversion.

b. Emergency Spillway – A means shall be provided to release discharge in excess of the infiltration volume safely into the downstream stormwater conveyance system. The spillway shall be designed for a 100 year 24-hour storm event.

c. Freeboard – One foot of freeboard above the flow depth in the spillway shall be provided.

7. Maintenance Access – Provide a 12 foot wide access route, with a 6:1 slope, to the floor of the basin for sediment and debris removal.

8. Embankment Construction – Embankments shall conform with WDNR Conservation Practice Standard Wet Detention Basin (1001). A basin embankment may be regulated as a dam under ch. 31 Stats., and further restricted under ch. NR 333, Wis. Adm. Code, which includes regulations for embankment heights and storage capacities.

C. Construction

1. Construction shall be suspended during periods of rainfall or snowmelt. Construction shall remain suspended if ponded water is present or if residual soil moisture contributes significantly to the potential for soil smearing, clumping or other forms of compaction.

2. An assessment of the active erosion in the drainage area to the infiltration basin shall be performed to determine when to bring the infiltration basin on-line. The basin shall be brought on-line when the area draining to the basin has achieved 90% build out of all lots in any of the first 3 years or 75% build out in any subsequent year. By 5 years from the start of construction in the drainage area, all infiltration basins shall be brought on-line. Build out means that the lot has been fully developed and stabilized from erosion. If the infiltration basin area is to also provide peak flow control for the fully built out 5-year, 24-hour event or greater, then a bypass device to divert those flows into the practice will be allowed until the infiltration basin is brought fully on-line. Erosion and sediment control practices shall be implemented for the remaining 10-25% of the undeveloped lots with the goal of preventing any sediment from reaching the infiltration basin.

3. During construction one of the following methods shall be used:

a. No disturbance – The infiltration area shall be fenced off to prevent heavy equipment access during development.

b. Compaction Mitigation – If the active infiltration area is graded the effects of compaction shall be mitigated using the following methods:

(1) Incorporate soil additives consisting of two inches of compost mixed into two inches of topsoil.

(2) The soil mix (V.C.3.b.1) shall be incorporated into the existing soil using a chisel plow or rotary device with the capability of reaching to 12 inches below the existing surface.

(3) The compost component shall meet the following WDNR Specification S100 Compost.

4. The basin shall be constructed to the grades, elevations, and specifications in the plan. After grading and top soiling, the elevation of the basin shall be surveyed for conformance to design specifications.

D. Vegetation Cover

1. Establishment – Cover crops need to be applied in conjunction with the initial seeding of permanent vegetation. When establishing turf type grass, use the criteria contained in the DNR Conservation Practice Standard Seeding for Construction Site Erosion Control (1059). Sod shall not be used.

   If turf grass is utilized, the basin cannot be used for recreational purposes due to compaction concerns.

2. Native Seeding – Native vegetation shall be established in conformance with recommendations from a qualified native nursery in the area. If trees are to be used, species shall be selected that will not interfere with the function of the basin, or cause maintenance problems. Section IX References, lists sources that provide suggested seed mixtures.

   Native (prairie) seeding shall be completed in the fall (as dormant seeding prior to first snowfall) or in the spring (between May 1 and June 20), or plugs shall be used.

3. Fertilizer – Soil testing shall be used to determine proper applications for nutrients and liming. Fertilizer application shall conform to the criteria located in NRCS Conservation Practice Technical Standard, Critical Area Planting (342) or WDNR Conservation Practice Standard Seeding for Construction Site Erosion Control (1059).

4. Mulch – Mulch shall conform to the criteria located in WDNR Conservation Practice Standard Mulching for Construction Sites (1058).

VI. Considerations

A. Pretreatment Options - See WDNR Conservation Practice Technical Standards Wet Detention Basin (1001), Ditch Check (1062), and Vegetated Infiltration Swale (1005) for guidance. Estimates of pollutant reduction by proprietary devices should be based on monitoring using the EPA Environmental Testing Verification protocol.

B. Well Locations - If well locations in relation to the basin are a concern, the site should be evaluated for the direction of ground water flow.

C. Multiple Uses - Basins can be used for both infiltration and peak shaving as shown on Figure 1 and 2. However, another option is to include a *flow splitter* or diversion prior to pretreatment. By limiting the inflow into a BMP, a flow splitter can enhance the longevity of the BMP by reducing the volumetric rate of treatment, erosion or scour, and vegetation damage. Flow splitters need to be designed to address site conditions and flows.

D. Drainage Area Size – The drainage area should be between 5 and 50 acres. If the drainage area is more than 50 acres, multiple basins should be provided.

E. Regulatory Caps - Ch. NR 151 provides for a maximum area to be dedicated for infiltration depending upon land use. This cap can be voluntarily exceeded.

F. Native Vegetation - The use of prairie grass or other deep-rooted plants is encouraged because these plants can increase the infiltration capacity of the basin. Dense vegetation will also reduce soil erosion on the basin floor.

G. Level Spreader - Since it is often difficult to construct a level spreader, a combination of a berm and stone trench is recommended. Other methods to disperse flows include irrigation practices such as ridge and furrow irrigation systems. Refer to American Society of Agricultural Engineering Standards for guidelines on construction of irrigation dispersal systems.

H. Tracked vehicles should be used during construction to lessen compaction.

I. The final grading should be conducted by the landscape contractor so that the drainage area can be stabilized first.

J. Snow should not be placed in the effective infiltration area. It may be placed on the

pretreatment area or areas draining into the pretreatment area.

K. Internally Drained Watersheds – There are unique considerations for watersheds that are closed basins which are internally drained. Infiltration basins constructed in internally drained watersheds shall meet the requirements of NR 151 and this standard. Storms with a recurrence interval greater than a 2-year 24-hour storm must also be considered in the design and engineering judgment may determine that criteria such as draw down time and maximum depth may be exceeded for these larger storms. Infiltration basins in internally drained watershed may have different needs for plants, pretreatment, safety, maintenance or other characteristic that must be considered during design and construction.

L. The DNR has created a technical note that may be used to size infiltration basins. The "Technical Note for Sizing Infiltration Basins and Bioretention Devices To Meet State Of Wisconsin Stormwater Infiltration Performance Standards" contains an approved method to determine the target stay-on depth and 12 design charts that can be used to size these basins for a variety of conditions. In addition, the technical note contains a reference to an approved infiltration model (RECARGA) that can also be used to determine effective infiltration area requirements. Other models may be used if approved. The Technical Note can be accessed at: http://dnr.wi.gov/org/water/wm/nps/stormwater/techstds.htm#Post

VII. 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 specify the materials, construction processes, location, size and elevations of all components of the practice to allow for certification of construction upon completion.

VIII. Operations 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. There may be state and local laws that require adequate O&M of public and private facilities and the identification of responsible parties. At a minimum, the plan shall include:

A. Inspection Intervals – At minimum, quarterly inspections shall occur. Inspection shall include spreader and overflow spillway for indication of failure. Note the condition of vegetation as part of inspection. If standing water is observed over 50% of the basin floor 3 days after rainfall, the basin is clogged and measures should be undertaken to unclog it. (See section VIII.C).

B. Native Vegetation - Maintenance of Native Vegetation – Mowing (cutting) or burning shall be used to maintain the vegetation.

1. Establishment - The first mowing of newly planted seed shall occur once it reaches a height of 10 to 12 inches.
2. Mowing
   a. Mowing shall reduce the height of plants to 5 to 6 inches.
   b. After establishment, if burning cannot be accommodated, mowing shall occur once in the fall (after November 1). The area shall be mowed to a height of 5 to 6 inches.
3. Burning
   a. Routine Maintenance - Beginning the second year, burning shall occur in the early spring (prior to May 1st) or in the late fall (after November 1st)
   b. Burning shall be done two consecutive years and then up to three years can pass before the next burning.
   c. Under no circumstances shall burning occur every other year.

C. Restoration Procedures – these include removing the top 2 to 3 inches, chisel plowing and adding topsoil and compost. If deep tilling is used, the basin shall be drained and the soils dried to a depth of 8 inches. If the basin was planted in turf grass and clogging again occurs after these restoration procedures have been used, the owner /operator shall replant with prairie

style vegetation using the soil preparation method recommended by the native nursery in the area.

D. Trash shall be removed as quickly as possible once observed.

E. Pretreatment – If wet detention is used, see WDNR Conservation Practice Technical Standard Wet Detention Basin (1001) for operations and maintenance requirements.

F. Winter Maintenance – All draw down devices in the pond shall be opened during winter months to discourage infiltration of runoff water containing high levels of chlorides. If this practice is an enclosed basin, the use of chloride deicers shall be limited in the area draining to the basin to reduce the chance of exceeding the limits in ch. NR 140.

IX. References

Metropolitan Council, 2003. Urban Small Sites Best Management Practice Manual, Chapter 3, Vegetative Methods 3-85 – 3-91. Minneapolis.

United States Department of Agriculture – Natural Resources Conservation Service. Engineering Field Handbook, Chapters 16 and 18.

UWEX Publication A3434 Lawn and Establishment & Renovation.

WisDOT, 2003. State of Wisconsin Standard Specifications for Highway and Structure Construction. Section 630, Seeding.

X. Definitions

Draw down device (V.B.1): A draw down device can consist of any device that allows for the dewatering of the infiltration basin or the infiltration cells down to the ground elevation. Examples include removable weir plates (shown in Figure 3), pipes with valves, weirs with removable stop logs.

Effective infiltration area (V.B.4.c.): An effective infiltration area means the area of the infiltration system that is used to infiltrate runoff and does not include the area used for site access, berms or pretreatment.

Flow Splitter (VI.C): A flow splitter is a device used to direct a fraction of runoff into the BMP facility while bypassing excess flows from larger storm events.

Hydraulically connected (V.A.1.): Two entities are said to be hydraulically connected if a surface or subsurface conduit exists between the two such that water is transmitted from one entity to the other.

Level spreader (V.B.4.f): A level spreader is a device used to disperse concentrated flows back over a wide area, dissipating the energy of the runoff and promoting sheet flow. Common types of level spreaders include vegetated, earthen or stone berms, weirs and stone trenches.

Target Stay-on Depth (IV.B.4.b.): The amount of infiltration required on an average annual basis. It is the portion of the annual rainfall (inches) on the development site that must be infiltrated on an annual basis to meet the infiltration goal.

Channel Erosion Mat

(1053)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A protective soil cover of straw, wood, coconut fiber or other suitable plant residue, or plastic fibers formed into a mat, usually with a plastic or biodegradable mesh on one or both sides. Erosion mats are rolled products available in many varieties and combination of materials and with varying life spans.

II. Purpose

The purpose of this practice is to protect the channel from erosion or act as turf reinforcement during and after the establishment of grass or other vegetation in a channel. This practice applies to both *Erosion Control Revegative Mats* (*ECRM*[1]) and *Turf-Reinforcement Mats* (*TRM*).

III. Conditions Where Practice Applies

This standard applies where runoff channelizes in intermittent flow and vegetation is to be established. Some products may have limited applicability in projects adjacent to navigable waters.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of erosion mat. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements. To complete the shear calculations, a 2 year, 24 hour storm event shall be used to calculate depth of flows for an ECRM. For sizing a TRM, use the depth of flow corresponding to the maximum design capacity of the channel.

Only mats listed in the Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL) will be accepted for use in this standard.

To differentiate applications WisDOT organizes erosion mats into three classes of mats, which are further broken down into various Types.

A. **Class I**: A short-term duration (minimum of 6 months), light duty, organic ECRM with plastic or biodegradable netting.

   1. **Type A** – Only suitable for slope applications, not channel applications.

   2. **Type B** – Double netted product for use in channels where the calculated (design) shear stress is 1.5 lbs/ft^2 or less.

B. **Class II**: A long-term duration (three years or greater), organic ECRM.

   1. **Type A** – Jute fiber only for use in channels to reinforce sod.

   2. **Type B** – For use in channels where the calculated (design) shear stress is 2.0 lbs/ft^2 or less. Made with plastic or biodegradable mat.

   3. **Type C** – A woven mat of 100% organic material for use in channels where the calculated (design) shear stress is 2.0 lbs/ft^2 or less. Applicable

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

for use in environmentally sensitive areas where plastic netting is inappropriate.

C. **Class III**: A permanent 100% synthetic ECRM or TRM. Class I, Type B erosion mat or Class II, Type B or C erosion mat must be placed over a soil filled TRM.

1. **Type A** – An ECRM for use in channels where the calculated (design) shear stress of 2.0 lbs/ft^2 or less.

2. **Type B** – A TRM for use in channels where the calculated (design) shear stress of 2.0 lbs/ft^2 or less.

3. **Type C** – A TRM for use in channels where the calculated (design) shear stress of 3.5 lbs/ft^2 or less.

4. **Type D** – A TRM for use in channels where the calculated (design) shear stress of 5.0 lbs/ft^2 or less.

D. **Installation**

1. ECRM shall be installed after all topsoiling, fertilizing, liming, and seeding is complete.

2. Erosion mats shall extend for whichever is greater: upslope one-foot minimum vertically from the ditch bottom or 6 inches higher than the design flow depth.

3. The mat shall be in firm and continuous contact with the soil. It shall be anchored, overlapped, staked and entrenched per the manufacturer's recommendations.

4. TRM shall be installed in conjunction with the topsoiling operation and shall be followed by ECRM installation.

5. At time of installation, document the manufacturer and mat type by saving material labels and manufacturer's installation instructions. Retain this documentation until the site is stabilized.

VI. Considerations

A. Erosion mats shall be selected so that they last long enough for the grass or other vegetation to become densely established.

B. Consider using Class II, Type C mats adjacent to waterways where trapping small animals is to be avoided.

C. Class III TRM may be appropriate as a replacement for riprap as a channel liner. Check the shear stress criteria for the channel to determine mat applicability.

D. Once a gully has formed in a channel, it is difficult to stabilize due to loss of soil structure. Even when the gully is filled with topsoil and reseeded, the soil has a tendency to dislodge in the same pattern. If gully formation continues to be a problem the design should be reevaluated, including other mat classes or riprap.

E. It may be difficult to establish permanent vegetation and adequate erosion protection in a channel with continuous flow. Consider riprap or planting wetland species with an ECRM.

F. Documentation of materials used, monitoring logs, project diary, and weekly inspection forms including erosion and stormwater management plans, should be provided to the authority charged with long term maintenance of the site.

G. Channel cross sections may be parabolic, v-shaped or trapezoidal. The use of "V" channels is generally discouraged due to erosion problems experienced.

H. To help determine the appropriate channel liner, designers can refer to the design matrix in the back of the WisDOT PAL. However, for channels not conforming to the typical section shown in the channel matrix or having a depth of flow greater than 6 inches (150 mm), the designer will need to design

for an appropriate channel liner. One way to do this is to use the "tractive force" method presented in FHWA's Hydraulic Engineering Circular (HEC) No. 15. This method requires that the calculated maximum shear stress of a channel is not to exceed the permissible shear stress of the channel liner. To use this method, permissible shear stress values are stated next to each device listed in the channel matrix.

VII. Plans and Specifications

A. Plans and specifications for installing erosion mat shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of erosion mat
2. Installation sequence
3. Material specification conforming to standard

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Erosion mats shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.

B. If there are signs of rilling under the mat, install more staples or more frequent anchoring trenches. If rilling becomes severe enough to prevent establishment of vegetation, remove the section of mat where the damage has occurred. Fill the eroded area with topsoil, compact, reseed and replace the section of mat, trenching and overlapping ends per manufacturer's recommendations. Additional staking is recommended near where rilling was filled.

C. If the reinforcing plastic netting has separated from the mat, remove the plastic and if necessary replace the mat.

D. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

WisDOT "Erosion Control Product Acceptability List" is available online at http://www.dot.wisconsin.gov/business/engrserv/pal.htm.

X. Definitions

Channel Erosion: The deepening and widening of a channel due to soil loss caused by flowing water. As rills become larger and flows begin to concentrate, soil detachment occurs primarily as a result of shear.

Erosion Control Revegative Mats (*ECRM)* (II): Erosion control revegetative mats are designed to be placed on top of soil.

Turf-Reinforcement Mats (*TRM)* (II): Turf-reinforcement mats are permanent devices constructed from various types of synthetic materials and buried below the surface to help stabilize the soil. TRMs must be used in conjunction with an ECRM or an approved soil stabilizer Type A (as classified in the WisDOT PAL)

Ditch Check
(Channel)
(1062)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A temporary dam constructed across a swale or drainage ditch to reduce the velocity of water flowing in the channel. *Ditch checks*[1] can be constructed out of stone, a double row of straw bales or from engineered products found on the Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL).

II. Purpose

The purpose of this practice is to reduce flow velocity and to pond water, thereby reducing active channel erosion and promoting settling of suspended solids behind the ditch check.

III. Conditions Where Practice Applies

This Standard applies where grading activity occurs in areas of channelized flows and a temporary measure is needed to control erosion of the channel until permanent stabilization practices can be applied.

Under no circumstance shall ditch checks be placed in intermittent or perennial stream without permission from WDNR. This Practice may not be substituted for major perimeter trapping measures.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of ditch checks. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Height

1. Installed, the minimum height of ditch checks shall be 10 inches and shall not exceed a maximum height of 16 inches for manufactured or biodegradable materials and 36 inches for stone (or other inorganic materials).

2. Ditch checks must be installed with the center lower than the sides forming a weir. If this is not done stormwater flows are forced to the edge of the ditch check thus promoting scour, or out of the channel causing excessive erosion

3. Stone ditch checks shall have a minimum top width of 2-feet measured in the direction of flow with maximum slopes of 2:1 (2 horizontal to 1 vertical) on the upslope side and 2:1 on the down slope side.

B. Placement

1. At a minimum install one ditch check for every two feet of drop in the channel.

2. Ditch checks shall be placed such that the resultant ponding will not cause inconvenience or damage to adjacent areas.

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

C. Material Specifications

1. Stone ditch checks shall be constructed of a well-graded angular stone, a D_{50} of 3 inch or greater, sometimes referred to as breaker run or shot rock.

2. Ditch checks may be constructed of other approved materials but must be capable of withstanding the flow velocities in the channel. Manufactured products listed in WisDOT's PAL are also acceptable for temporary ditch checks.

   Note: Silt fence and single rows of straw bales are ineffective as ditch checks and are not permitted.

D. Construction - Refer to Figure 1 & 2

1. Ditch checks shall be utilized during rough grading and shall be removed once the final grading and channel stabilization is applied, unless intended to be part of a permanent stormwater management plan.

2. Channel erosion mat or other non-erodible materials shall be placed at the base of a ditch check, and extended a minimum of 6 feet, to prevent scour and washing out the toe of the ditch check. DNR Conservation Practice Channel Erosion Mat (1053) contains criteria for the placement of erosion mat in this location.

3. Chink or seal stone and rock ditch checks to minimize the flow through the ditch check.

VI. Considerations

A. For added stability, the base of a stone or rock ditch check should be keyed into the soil to a depth of 6-inches.

B. Stone ditch checks may be underlain by a nonwoven geotextile fabric to ease installation and removal. If the geotextile fabric is extended, it can serve purpose specified in section V.D.2

C. Ditch checks installed in grass lined channels may kill the vegetation if water is ponded for extended periods or excessive siltation occurs. Proper maintenance is required to keep areas above and below the ditch check stabilized.

D. The best way to prevent sediment from entering the storm sewer system is to stabilize the disturbed area of the site as quickly as possible, preventing erosion and stopping sediment transport at its source.

E. When placing ditch checks in swales adjacent to roadways consider designating a 'clear zone' free of obstacles posing a threat to out of control vehicles.

F. Mowing operations may throw stones from ditch checks causing a potential safety hazard.

VII. Plans and Specifications

A. Plans and specifications for installing ditch checks shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

   1. Location and spacing of ditch check

   2. Schedules and sequence of installation and removal

   3. Standard drawings and installation details

   4. Rock gradation

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Ditch checks shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24 hour period.

B. Unless incorporated into a permanent stormwater management system, ditch

checks shall be removed once the final grading and channel stabilization is applied.

C. Sediment deposits shall be removed when deposits reach 0.5 the height of the barrier. Removal of sediment may require replacement of stone. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

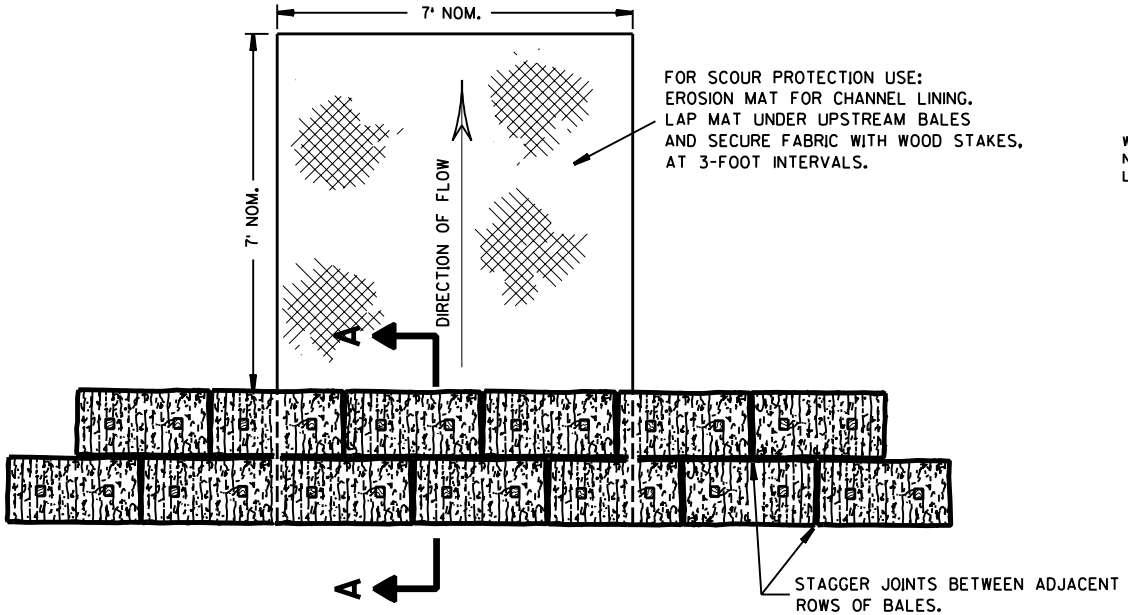
WisDOT "Erosion Control Product Acceptability List" is available online at: http://www.dot.wisconsin.gov/business/engrserv/pal.htm Printed copies are no longer distributed.

X. Definitions

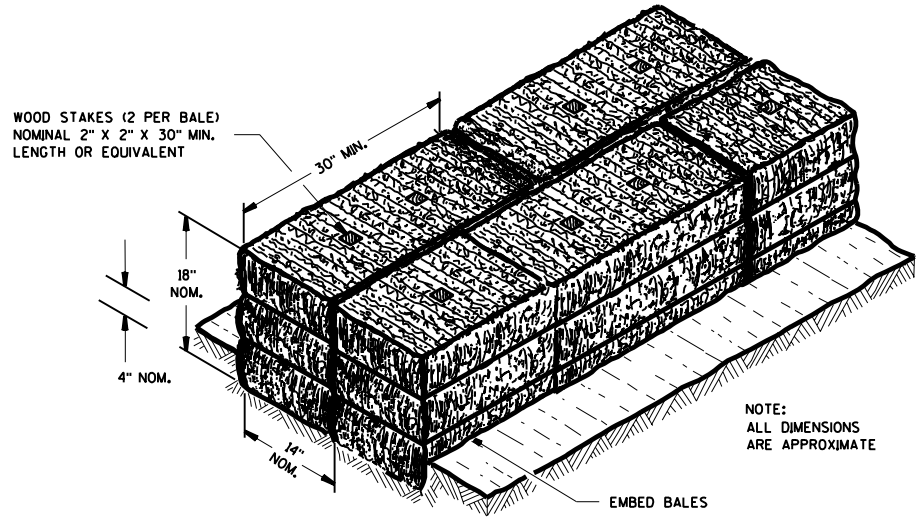
D_{50} (V.C.1): The particle size for which 50% of the material by weight is smaller than that size.

Ditch Checks (I) Are commonly referred to as temporary check dams. Stone ditch checks refer to those made out of either stone or rock.

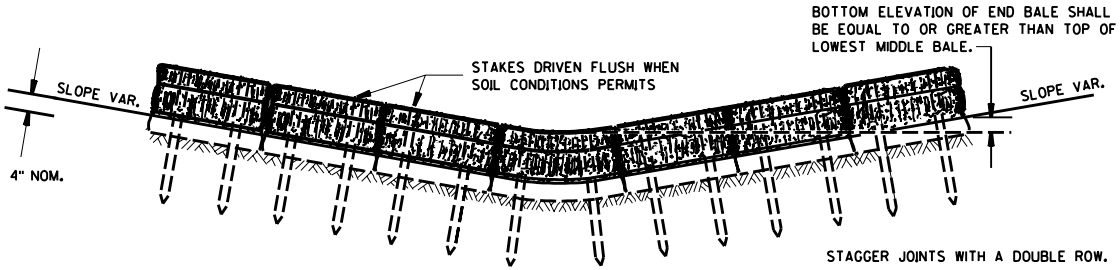
Figure 1



PLAN VIEW



SECTION A-A



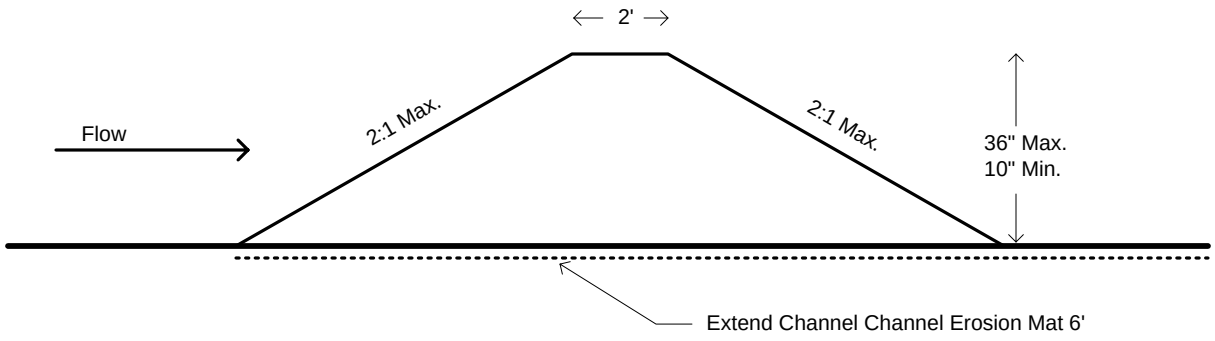
FRONT ELEVATION

TEMPORARY DITCH CHECK USING EROSION BALES ①

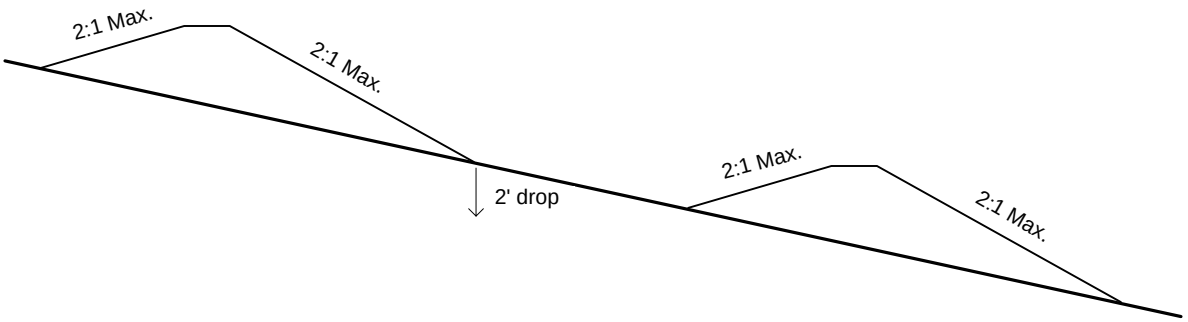
This drawing based on Wisconsin Deptartment of Transportation Standard Detail Drawing 8 E 8-3.

TYPICAL INSTALLATIONS OF EROSION BALES / TEMPORARY DITCH CHECKS

Figure 2. Stone Ditch Check



Side View



Side View

Not to Scale

WDNR

Mulching For Construction Sites
(1058)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

Mulching is the application of organic material to the soil surface to protect it from raindrop impact and overland flow. Mulch covers the soil and absorbs the erosive impact of rainfall and reduces the flow velocity of runoff.

II. Purpose

This practice may be used to:

- Reduce soil erosion
- Aid in seed germination and establishment of plant cover
- Conserve soil moisture

III. Conditions Where Practice Applies

This practice may be applied on exposed soils as a temporary control where soil grading or landscaping has taken place or in conjunction with temporary or permanent seeding. Mulching is generally not appropriate in areas of concentrated flow.

IV. Federal, State, and Local Laws

Users of this standard shall comply with applicable federal, state and local laws, rules, regulations or permit requirements governing mulching. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Site Preparation:

Soil surface shall be prepared prior to the application of mulch in order to achieve the desired purpose and to ensure optimum contact between soil and mulch. All areas to be mulched shall be reasonably free of rills and gullies.

B. Materials:

Mulch shall consist of natural biodegradable material such as plant residue (including but not limited to straw, hay, wood chips, bark and wood cellulose fiber), or other equivalent materials of sufficient dimension (depth or thickness) and durability to achieve the intended effect for the required time period.

Mulch shall be environmentally harmless to wildlife and plants. Materials such as gravel, plastic, fabric, sawdust, municipal solid waste, *solid waste byproducts*[1], shredded paper, and non-biodegradable products shall not be used.

Mulch shall be free of diseased plant residue (i.e. oak wilt), *noxious weed* seeds, harmful chemical residues, heavy metals, hydrocarbons and other known environmental toxicants.

Marsh hay shall not be used as mulch in lowland areas but may be used on upland sites to prevent the spread of invasive, non-native species (i.e. reed canary grass) commonly found in marsh hay.

Straw and hay mulch that will be crimped shall have a minimum fiber length of 6 inches.

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

Wood chips or wood bark shall only be used for sites that are not seeded.

C. Application Rate:

1. Mulch shall cover a minimum of 80% of the soil surface for unseeded areas. For seeded areas, mulch shall be placed loose and open enough to allow some sunlight to penetrate and air to circulate but still cover a minimum of 70% of the soil surface.

2. Mulch shall be applied at a uniform rate of 1½ to 2 tons per acre for sites that are seeded, and 2 to 3 tons per acre for sites that are not seeded. This application results in a layer of ½ to 1½ inches thick for seeded sites, and 1½ to 3 inches thick for sites not seeded.

3. Wood chips or wood bark shall be applied at a rate of 6 to 9 tons per acre to achieve a minimum of 80% ground cover. This application should result in a layer of wood chips or wood bark ½ to 1½ inches thick.

D. Mulch Anchoring Methods

Anchoring of mulch shall be based on the type of mulch applied, site conditions, and accomplished by one of the following techniques:

1. Crimping

   Immediately after spreading, the mulch shall be anchored by a mulch crimper or equivalent device consisting of a series of dull flat discs with notched edges spaced approximately 8 inches apart. The mulch shall be impressed in the soil to a depth of 1 to 3 inches.

2. Polypropylene Plastic, or Biodegradable Netting

   Apply plastic netting over mulch application and staple according to manufacturer's recommendations.

3. Tackifier

   Tackifier shall be sprayed in conjunction with mulch or immediately after the mulch has been placed. Tackifiers must be selected from those that meet the WisDOT Erosion Control Product Acceptability List (PAL). Asphalt based products shall not be applied.

   The tackifiers shall be applied at the following minimum application rates per acre:

   a. Latex-Base: mix 15 gallons of adhesive (or the manufacturer's recommended rate which ever is greater) and a minimum of 250 pounds of recycled newsprint (pulp) as a tracer with 375 gallons of water.

   b. Guar Gum: mix 50 pounds of dry adhesive (or the manufacturer's recommended rate which ever is greater) and a minimum of 250 pounds of recycled newsprint (pulp) as tracer with 1,300 gallons of water.

   ~~c.~~ Other Tackifiers: (Hydrophilic Polymers) mix 100 pounds of dry adhesive (or the manufacturer's recommended rate which ever is greater) and a minimum of 250 pounds of recycled newsprint (pulp) as a tracer with 1,300 gallons of water.

VI. Considerations

A. Wood products typically absorb available soil nitrogen as they degrade, thus making it unavailable for seed.

B. The use of mulch behind curb and gutter may not be desirable unless anchored by netting, because air turbulence from nearby traffic can displace the mulch. Consider the use of erosion mat or sod as an alternative.

C. In areas where lawn type turf will be established, the use of tackifiers is the preferred anchoring method. Crimping will tend to leave an uneven surface and plastic netting can become displaced and entangled in mowing equipment.

D. A heavier application of mulch may be desired to prevent seedlings from being damaged by frost.

E. It may be beneficial to apply polyacrylimide in addition to mulch. Refer to WDNR Conservation Practice Standard (1050) Erosion Control Land Application of Anionic Polyacrylamide for information about the advantages and proper use of polymers.

F. Concentrated flows above the site where mulch is applied should be diverted.

G. Mulch should be placed within 24 hours of seeding.

H. Mulching operations should not be performed during periods of excessively high winds that would preclude the proper placement of mulch.

I. Materials such as gravel may be effective for erosion control but are not considered mulches.

VII. Plans and Specifications

A. Plans and specifications for mulching shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

   1. Type of mulch used

   2. Application rate

   3. Timing of application

   4. Method of anchoring

B. All plans, standard detail drawings, or specifications shall include schedules for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

Mulch shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24 hour period.

Mulch that is displaced shall be reapplied and properly anchored. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

WisDOT's Erosion Control Product Acceptability List (PAL) can be found on the WisDOT web site: http://www.dot.wisconsin.gov/business/engrserv/pal.htm Printed copies are no longer being distributed.

X. Definitions

Noxious weed (V.B): Any weed a governing body declares to be noxious within its respective boundaries. The State of Wisconsin list of noxious weeds can be found in Statute 66.0407.

Solid Waste Byproducts (V.B): Includes industrial, commercial, residential, and agricultural wastes that have been processed, incinerated, or composted and still contain inorganic wastes such as glass and metals and organic wastes including plastics, textiles, rubber, leather, and other miscellaneous organic wastes which may be toxic or hazardous in nature.

Non-Channel Erosion Mat

(1052)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A protective soil cover made of straw, wood, coconut fiber or other suitable plant residue, or plastic fibers formed into a mat, usually with a plastic or biodegradable mesh on one or both sides. Erosion mats are rolled products available in many varieties and combinations of material and with varying life spans.

II. Purpose

The purpose of this practice is to protect the soil surface from the erosive effect of rainfall and prevent *sheet erosion* [1] during the establishment of grass or other vegetation, and to reduce soil moisture loss due to evaporation. This practice applies to both *Erosion Control Revegetative Mats (ECRM*) and *Turf-Reinforcement Mats* (*TRM*).

III. Conditions Where Practice Applies

This standard applies to erosion mat selection for use on erodible slopes.

This standard is not for channel erosion; for channel applications reference WDNR Conservation Practice Standard (1053) Channel Erosion Mat.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of erosion mat. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum allowable standards for design, installation and performance requirements. Only Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL) approved mats will be accepted for use in this standard.

Slope and slope length shall be taken into consideration. This information can be found in the Slope Erosion Control Matrix located in the PAL.

To differentiate applications Erosion mats are organized into three Classes of mats, which are further broken down into various Types.

A. **Class I**: A short-term duration (minimum of 6 months), light duty, organic mat with photodegradable plastic or biodegradable netting.

   1. **Type A** – Use on erodible slopes 2.5:1 or flatter.

   2. **Type B** – Double netted product for use on erodible slopes 2:1 or flatter.

B. **Class I, Urban**: A short-term duration (minimum of 6 months), light duty, organic erosion control mat for areas where mowing may be accomplished within two weeks after installation.

   1. **Urban, Type A** – Use on erodible soils with slopes 4:1 or flatter.

   2. **Urban, Type B** – A double netted product for use on slopes 2.5:1 or flatter.

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

C. **Class II**: A long-term duration (three years or greater), organic erosion control revegetative mat.

1. **Type A** – Jute fiber only for use on slopes 2:1 or flatter for sod reinforcement.

2. **Type B –** For use on slopes 2:1 or greater made with plastic or biodegradable net.

3. **Type C** – A woven mat of 100% organic fibers for use on slopes 2:1 or flatter and in environmentally and biologically sensitive areas where plastic netting is inappropriate.

D. **Class III**: A permanent 100% synthetic ECRM or TRM. Either a soil stabilizer Type A or Class I, Type A or B erosion mat must be placed over the soil filled TRM.

1. **Type A** – An ECRM for use on slopes 2:1 or flatter.

2. **Type B or C** – A TRM for use on slopes 2:1 or flatter.

3. **Type D** – A TRM for use on slopes 1:1 or flatter.

E. **Material Selection**

1. For mats that utilize netting, the netting shall be bonded to the parent material to prevent separation of the net for the life of the product.

2. For urban class mats the following material requirements shall be adhered to:

a. Only 100% organic biodegradable netted products are allowed, including parent material, stitching, and netting.

b. The netting shall be stitched with biodegradable thread/yarn to prevent separation of the net from parent material.

c. All materials and additive components used to manufacture the anchoring devices shall be completely biodegradable as determined by ASTM D 5338.

d. Mats with photodegradable netting shall not be installed after September 1st.

F. **Installation**

1. ECRMs shall be installed after all topsoiling, fertilizing, liming and seeding is complete.

2. The mat shall be in firm and intimate contact with the soil. It shall be installed and anchored per the manufacturer's recommendation.

3. TRM shall be installed in conjunction with the topsoiling operation and shall be followed by ECRM installation.

4. At time of installation, document the manufacturer and mat type by retention of material labels and manufacturer's installation instructions. Retain this documentation until the site has been stabilized.

VI. Considerations

A. Urban mats may be used in lieu of sod.

B. Documentation of materials used, monitoring logs, project diary and weekly inspection forms, including erosion and stormwater management plans, should be turned over to the authority charged with long term maintenance of the site.

VII. Plans and Specifications

A. Plans and specifications for installing erosion mat shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of erosion mat

2. Installation Sequence

3. Material specification conforming to standard

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Erosion mat shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.

B. If there are signs of rilling under the mat, install more staples or more frequent anchoring trenches. If rilling becomes severe enough to prevent establishment of vegetation, remove the section of mat where the damage has occurred. Fill the eroded area with topsoil, compact, reseed and replace the section of mat, trenching and overlapping ends per manufacturer's recommendations. Additional staking is recommended near where rilling was filled.

C. If the reinforcing plastic netting has separated from the mat, remove the plastic and if necessary replace the mat.

D. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

WisDOT "Erosion Control Product Acceptability List" is available online at http://www.dot.wisconsin.gov/business/engrserv/pal.htm Printed copies are no longer distributed.

Field Code Changed

X. Definitions

Sheet and Rill Erosion (II): Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. As flow becomes more concentrated rills occur. As soil detachment continues or flow increases, rills will become wider and deeper forming gullies.

Erosion Control Revegetative Mats (ECRM) (II): erosion control revegetative mats designed to be placed on the soil surface.

Turf-Reinforcement Mats (TRM) (II): turf-reinforcement mats are permanent devices constructed from various types of synthetic materials and buried below the surface to help stabilize the soil. TRMs must be used in conjunction with an ECRM or an approved Type A soil stabilizer.

Sediment Bale Barrier (Non-Channel)

(1055)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A temporary sediment barrier consisting of a row of entrenched and anchored straw bales, hay bales or equivalent material used to intercept sediment-laden sheet flow from small drainage areas of disturbed soil.

II. Purpose

The purpose of this practice is to reduce slope length of the disturbed area and to intercept and retain transported sediment from disturbed areas.

III. Conditions Where Practice Applies

A. This standard applies to the following applications where:

1. Erosion occurs in the form of *sheet and rill erosion*[1]. There is no concentration of water flowing to the barrier (*channel erosion*).

2. Where adjacent areas need protection from sediment-laden runoff.

3. Effectiveness is required for less than 3 months.

4. Conditions allow for the bales to be properly entrenched and staked as outlined in the Criteria Section V.

B. Under no circumstance shall sediment bale barriers be used in the following applications:

1. Below the ordinary high watermark or placed perpendicular to flow in streams, swales, ditches or any place where flow is concentrated.

2. Where the maximum gradient upslope of the sediment bale barriers is greater than 50% (2:1).

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of the sediment bale barrier. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Placement

1. At a minimum, sediment bale barriers shall be placed in a single row, lengthwise on the contour, with the ends of adjacent sediment bale barriers tightly abutting one another. The holes between bales shall be chinked (filled by wedging) with straw, hay or equivalent material to prevent water from escaping between the bales.

2. The maximum allowable slope lengths contributing runoff to a sediment bale barrier are specified in Table 1.

[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.

Table 1.	
Slope	**Barrier Row Spacing**
< 2%	100 feet
2 to 5%	75 feet
5 to 10%	50 feet
10 to 33%	25 feet
33 to 50%	20 feet
> 50%	Not Permitted

3. Sediment bale barriers shall not be placed perpendicular to the contour.

4. The end of the sediment bale barrier shall be extended upslope to prevent water from flowing around the barrier ends.

B. Height – Installed sediment bale barrier shall be a minimum of 10 inches high and shall not exceed a maximum height of 20 inches from ground level.

C. Anchoring and Support

1. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a sediment bale barrier and the length of the proposed barrier to a minimum depth of 4 inches. After bales are staked and chinked, the excavated soil shall be backfilled and compacted against the barrier. Backfill to ground level on the down slope side. On the upslope side of the sediment bale barrier backfill to 4 inches above ground level.

2. At least two wood stakes, “T" or "U" steel posts, or ½ inch rebar driven through at equidistance along the centerline of the barrier shall securely anchor each bale. The minimum cross sectional area for wood stakes shall be 2.0 by 2.0 inches nominal. The first stake in each bale shall be driven toward the previously laid bale to force the bales together. Stakes shall be driven a minimum 12-inches into the ground to securely anchor the sediment bale barriers.

3. Bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings.

VI. Considerations

A. Improper placement as well as improper installation and maintenance of sediment bale barriers will significantly decrease the effectiveness of this practice.

B. Sediment bale barriers should not be used upslope of the disturbed area.

C. A double row of sediment bale barriers may be installed in areas where additional protection is needed.

D. For safety, place all anchoring flush with the sediment bale barrier or cap any exposed anchoring device.

VII. Plans and Specifications

A. Plans and specifications for installing sediment bale barriers shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of sediment bale barrier

2. Contributory drainage area

3. Schedules

4. Standard drawings and installation details

5. Restoration after removal

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Sediment bale barriers shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.

B. Damaged or decomposed sediment bale barriers, any undercutting, or flow channels

around the end of the sediment bale barriers shall be repaired.

C. Sediment shall be properly disposed of once the deposits reach 1/2 the height of the sediment bale barrier.

D. Sediment bale barriers and anchoring devices shall be removed and properly disposed of when they have served their usefulness, but not before the upslope areas have been permanently stabilized.

E. Any sediment deposits remaining in place after the sediment bale barrier is no longer required shall be dressed to conform to the existing grade, prepared and seeded.

IX. Definitions

Channel Erosion (III.A.1): The deepening and widening of a channel due to soil loss caused by flowing water. As rills become larger and flows begin to concentrate soil detachment occurs primarily as a result of shear. The transport capacity of the flow in a channel is based on the availability of sediment and is a monatomic function of velocity.

Sheet and Rill Erosion (III.A.1): Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. As flow becomes more concentrated rills occur. As soil detachment continues or flow increases, rills will become wider and deeper forming gullies.

Seeding For Construction Site Erosion Control

(1059)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

Planting seed to establish temporary or permanent vegetation for erosion control.

II. Purpose

The purpose of *temporary seeding*[1] is to reduce runoff and erosion until permanent vegetation or other erosion control practices can be established. The purpose of *permanent seeding* is to permanently stabilize areas of exposed soil.

III. Conditions Where Practice Applies

This practice applies to areas of exposed soil where the establishment of vegetation is desired. Temporary seeding applies to disturbed areas that will not be brought to final grade or on which land-disturbing activities will not be performed for a period greater than 30 days, and requires vegetative cover for less than one year. Permanent seeding applies to areas where perennial vegetative cover is needed.

IV. Federal, State and Local Laws

Users of this standard shall be aware of all applicable federal, state and local laws, rules, regulations or permit requirements governing seeding. This standard does not contain the text of federal, state or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Site and Seedbed Preparation

Site preparation activities shall include:

1. Temporary Seeding

   a. Temporary seeding requires a seedbed of loose soil to a minimum depth of 2 inches.

   b. Fertilizer application is not generally required for temporary seeding. However, any application of fertilizer or lime shall be based on soil testing results.

   c. The soil shall have a pH range of 5.5 to 8.0.

2. Permanent Seeding

   a. *Topsoil* installation shall be completed prior to permanent seeding.

   b. Permanent seeding requires a seedbed of loose topsoil to a minimum depth of 4 inches with the ability to support a *dense* vegetative cover.

   c. Application rates of fertilizer or lime shall be based on soil testing results.

   d. Prepare a tilled, fine, but firm seedbed. Remove rocks, twigs foreign material and clods over two inches that cannot be broken down.

   e. The soil shall have a pH range of 5.5 to 8.0.

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

B. Seeding

1. Seed Selection

   a. Seed mixtures that will produce dense vegetation shall be selected based on soil and site conditions and intended final use. Section IX References, lists sources containing suggested seed mixtures.

   b. All seed shall conform to the requirements of the Wisconsin Statutes and of the Administrative Code Chapter ATCP 20.01 regarding noxious weed seed content and labeling.

   c. Seed mixtures that contain potentially invasive species or species that may be harmful to native plant communities shall be avoided.

   d. Seed shall not be used later than one year after the test date that appears on the label.

   e. Seed shall be tested for purity, germination and noxious weed seed content and shall meet the minimum purity and germination requirements as prescribed in the current edition of Rules for Testing Seed, published by the Association of Official Seed Analysts.

2. Seed Rates

   a. Temporary Seeding (Cover Crop)

      Areas needing protection during periods when permanent seeding is not applied shall be seeded with annual species for temporary protection. See Table 1 for seeding rates of commonly used species. The residue from this crop may either be incorporated into the soil during seedbed preparation at the next permanent seeding period or left on the soil surface and the planting made as a no-till seeding.

Table 1 Temporary Seeding Species and Rates

Species	Lbs/Acre	Percent Purity
Oats	131[1]	98
Cereal Rye	131[2]	97
Winter wheat	131[2]	95
Annual Ryegrass	80[2]	97

[1] Spring and summer seeding
[2] Fall seeding

   b. Permanent Seeding

      Rates shall be based on pounds or ounces of Pure Live Seed (PLS) per acre. Section IX contains some possible reference documents that provide seeding rates. Permanent seeding rates may be increased above the minimum rates shown in the reference documents to address land use and environmental conditions.

      If a *nurse crop* is used in conjunction with permanent seeding, the nurse crop shall not hinder establishment of the permanent vegetation.

      A nurse crop shall be applied at 50% its temporary seeding rate when applied with permanent seed.

3. Inoculation

   Legume seed shall be inoculated in accordance with the manufacturer's recommendations. Inoculants shall not be mixed with liquid fertilizer.

4. Sowing

   Seed grasses and legumes no more than ¼ inch deep. Distribute seed uniformly. Mixtures with low seeding rates require special care in sowing to achieve proper seed distribution.

   Seed may be broadcast, drilled, or hydroseeded as appropriate for the site.

   Seed when soil temperatures remain consistently above 53° F. *Dormant seed* when the soil temperature is consistently below 53° F (typically

Nov. 1st until snow cover). Seed shall not be applied on top of snow.

VI. Considerations

A. Consider seeding at a lower rate and making two passes to ensure adequate coverage.

B. Compacted soil areas may need special site preparation prior to seeding to mitigate compaction. This may be accomplished by chisel plowing to a depth of 12 inches along the contour after heavy equipment has left the site.

C. Sod may be considered where adequate watering is available.

D. When working in riparian areas refer to the NRCS Engineering Field Handbook, Chapter 16, Streambank and Shoreline Protection and Chapter 18, *Soil Bioengineering* for Upland Slope Protection and Erosion Reduction.

E. A site assessment should be conducted to evaluate soil characteristics, topography, exposure to sunlight, proximity to natural plant communities, proximity to nuisance, noxious and/or invasive species, site history, moisture regime, climatic patterns, soil fertility, and previous herbicide applications.

F. Use *introduced species* only in places where they will not spread into existing natural areas.

G. Lightly roll or compact the area using suitable equipment when the seedbed is judged to be too loose, or if the seedbed contains clods that might reduce seed germination.

H. See Section IX. References for suggested seed mixes (NRCS, WisDOT, UWEX) or use their equivalent.

I. Turf seedlings should not be mowed until the stand is at least 6 inches tall. Do not mow closer than 3 inches during the first year of establishment.

J. Seeding should not be done when the soil is too wet.

K. Consider watering to help establish the seed. Water application rates shall be controlled to prevent runoff and erosion.

L. Prairie plants may not effectively provide erosion control during their establishment period without a nurse crop.

M. Topsoil originating from agricultural fields may contain residual chemicals. The seedbed should be free of residual herbicide or other contaminants that will prevent establishment and maintenance of vegetation. Testing for soil contaminants may be appropriate if there is doubt concerning the soil's quality.

N. Consider using mulch or a nurse crop if selected species are not intended for quick germination. When mulching refer to WDNR Conservation Practice Standard Mulching for Construction Sites (1058).

VII. Plans and Specifications

Plans and specifications for seeding shall be in keeping with this standard and shall describe the requirements for applying this practice.

All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. During construction areas that have been seeded shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period. Inspect weekly during the growing season until vegetation is densely established or permit expires. Repair and reseed areas that have erosion damage as necessary.

B. Limit vehicle traffic and other forms of compaction in areas that are seeded.

C. A fertilizer program should begin with a soil test. Soil tests provide specific fertilizer recommendations for the site and can help to avoid over-application of fertilizers.

IX. References

A. Seed Selection References

United States Department of Agriculture – Natural Resource Conservation Service Field Office Technical Guide Section IV, Standard 342, Critical Area Planting.

UWEX Publication A3434 Lawn and Establishment & Renovation.

WisDOT, 2003. State of Wisconsin Standard Specifications For Highway and Structure Construction. Section 630, Seeding.

B. General References

Association of Official Seed Analysts, 2003. Rules for Testing Seed. http://www.aosaseed.com.

Metropolitan Council, 2003. Urban Small Sites Best Management Practice Manual, Chapter 3, Vegetative Methods 3-85 – 3-91. Minneapolis.

The State of Wisconsin list of noxious weeds can be found in Statute 66.0407.

United States Department of Agriculture – Natural Resources Conservation Service. Engineering Field Handbook, Chapters 16 and 18.

UWEX Publication GWQ002 Lawn & Garden Fertilizers.

X. Definitions

Dense (V.A.2.b) A stand of 3-inch high grassy vegetation that uniformly covers at least 70% of a representative 1 square yard plot.

Dormant seed (V.B.4): Seed is applied after climatic conditions prevent germination until the following spring.

Introduced Species (VI.F) Plant species that historically would not have been found in North America until they were brought here by travelers from other parts of the world. This would include smooth bromegrass and alfalfa. Some of these species may have a wide distribution such as Kentucky bluegrass.

Nurse Crop (V.B.2.b): Also known as a companion crop; is the application of temporary (annual) seed with permanent seed.

Permanent seeding (II) Seeding designed to minimize erosion for an indefinite period after land disturbing construction activities have ceased on the site.
Soil Bioengineering (VI.D) Practice of combining mechanical, biological and ecological concepts to arrest and prevent shallow slope failures and erosion.

Temporary Seeding (II) Seeding designed to control erosion for a time period of one year or less that is generally removed in order to perform further construction activities or to permanently stabilize a construction site.

Topsoil (V.A.2.a) Consists of loam, sandy loam, silt loam, silty clay or clay loam humus-bearing soils adapted to sustain plant life with a pH range of 5.5 – 8.0. Manufactured topsoil shall through the addition of sand or organic humus material, peat, manure or compost meet the above criteria.

Silt Fence
(1056)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

Silt fence is a temporary sediment barrier of entrenched permeable geotextile fabric designed to intercept and slow the flow of sediment-laden sheet flow runoff from small areas of disturbed soil.

II. Purpose

The purpose of this practice is to reduce slope length of the disturbed area and to intercept and retain transported sediment from disturbed areas.

III. Conditions Where Practice Applies

A. This standard applies to the following applications:

1. Erosion occurs in the form of *sheet and rill erosion*[1]. There is no concentration of water flowing to the barrier (*channel erosion*).

2. Where adjacent areas need protection from sediment-laden runoff.

3. Where effectiveness is required for one year or less.

4. Where conditions allow for silt fence to be properly entrenched and staked as outlined in the Criteria Section V.

B. Under no circumstance shall silt fence be used in the following applications:

1. Below the ordinary high watermark or placed perpendicular to flow in streams, swales, ditches or any place where flow is concentrated.

2. Where the maximum gradient upslope of the fence is greater than 50% (2:1).

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of silt fence. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Placement

1. When installed as a stand-alone practice on a slope, silt fence shall be placed on the contour. The parallel spacing shall not exceed the maximum slope lengths for the appropriate slope as specified in Table 1.

Table 1.

Slope	Fence Spacing
< 2%	100 feet
2 to 5%	75 feet
5 to 10%	50 feet
10 to 33%	25 feet
> 33%	20 feet

2. Silt fences shall not be placed perpendicular to the contour.

3. The ends of the fence shall be extended upslope to prevent water from flowing around the ends of the fence.

B. Height – Installed silt fences shall be a minimum 14 inches high and shall not exceed 28 inches in height measured from the installed ground elevation.

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

C. Support – Silt fences shall be supported by either steel or wood supports as specified below:

1. Wood supports

   a. The full height of the silt fence shall be supported by 1 1/8 inches by 1 1/8 inches air or kiln dried posts of hickory or oak.

   b. The silt fence fabric shall be stapled, using at least 0.5-inch staples, to the upslope side of the posts in at least 3 places.

   c. The posts shall be a minimum of 3 feet long for 24-inch silt fence and a minimum of 4 feet for 36-inch silt fence fabric.

2. Steel supports

   a. The full height of the silt fence shall be supported by steel posts at least 5 feet long with a strength of 1.33 pounds per foot and have projections for the attachment of fasteners.

   b. The silt fence fabric shall be attached in at least three places on the upslope side with 50 pound plastic tie straps or wire fasteners. To prevent damage to the fabric from fastener, the protruding ends shall be pointed away from the fabric.

3. The maximum spacing of posts for non-woven silt fence shall be 3 feet and for woven fabric 8 feet.

4. Silt fence shall have a support cord.

5. Where joints are necessary, each end of the fabric shall be securely fastened to a post. The posts shall then be wrapped around each other to produce a stable, secure joint or shall be overlapped the distance between two posts.

6. A minimum of 20 inches of the post shall extend into the ground after installation.

D. Anchoring – Silt fence shall be anchored by spreading at least 8 inches of the fabric in a 4 inch wide by 6 inch deep trench, or 6 inch deep V-trench on the upslope side of the fence. The trench shall be backfilled and compacted. Trenches shall not be excavated wider and deeper than necessary for proper installation.

On the terminal ends of silt fence the fabric shall be wrapped around the post such that the staples are not visible.

E. Geotextile Fabric Specifications – The geotextile fabric consists of either woven or non-woven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Non-woven fabric may be needle punched, heat bonded, resin bonded, or combinations thereof. All fabric shall meet the following requirements as specified in Table 2.

Table 2.

Test Requirement	Method	Value[1]
Minimum grab tensile strength in the machine direction	ASTM D 4632	120 lbs. (550 N)
Minimum grab tensile strength in the cross machine direction	ASTM D 4632	100 lbs. (450 N)
Maximum apparent opening size equivalent standard sieve	ASTM D 4751	No. 30 (600 µm)
Minimum permittivity	ASTM D 4491	0.05 scc^{-1}
Minimum ultraviolet stability percent of strength retained after 500 hours of exposure	ASTM D 4355	70%

(WisDOT Standard Specifications for Road and Bridge Construction, 2001)

[1] All numerical values represent minimum / maximum average roll values. (For example, the average minimum test results on any roll in a lot should meet or exceed the minimum specified values.)

Silt fence shall have a maximum flow rate of 10-gallons/minute/square foot at 50mm constant head as determined by multiplying permittivity in 1/second as determined by ASTM D-4491 by a conversion factor of 74.

F. Removal – Silt fences shall be removed once the disturbed area is permanently stabilized and no longer susceptible to erosion.

VI. Considerations

A. Improper placement as well as improper installation and maintenance of silt fences will significantly decrease the effectiveness of this practice.

   Silt fences should be considered for trapping sediment where sheet and rill erosion may be expected to occur in small drainage areas. Silt fences should not be placed in areas of concentrated flow.

B. Silt fences should be installed prior to disturbing the upslope area.

C. Silt fences should not be used to define the boundaries of the entire project. Silt fence should be placed only in areas where it is applicable due to its cost and the fact that it is not biodegradable. For example, silt fence should not be placed in locations where the natural overland flow is from an undisturbed area into disturbed areas of the project. It should also not be used as a diversion.

D. Silt fence should not be used in areas where the silt fence is at a higher elevation than the disturbed area.

E. When placing silt fence near trees, care should be taken to minimize damage to the root system. Avoid compaction and root cutting within 1.5 feet multiplied by the inch diameter of the tree (for example: for 10-inch trees keep out a 15-foot radius from the trunk). Refer to UWEX publication Preserving Trees During Construction for more information.

F. To protect silt fence from damage in areas of active construction or heavy traffic, silt fence should be flagged, marked, or highlighted to improve visibility.

G. Silt fence effectiveness is generally increased when used in conjunction with other upslope erosion control practices. To further strengthen the silt fence, straw / hay bales can be placed on the down slope side.

H. To help ensure effectiveness, silt fence should be inspected and repaired as necessary prior to forecasted rain events.

I. Where installation with wood posts is difficult, such as when hard or frozen ground is encountered, the use of steel post is recommended.

J. Silt fence can be mechanically installed with a plow type device provided that the silt fence is trenched in a manner such that equivalent performance is achieved to that specified in Section V.D.

VII. Plans and Specifications

A. Plans and specifications for installing silt fence shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

   1. Location of silt fence
   2. Contributory drainage area
   3. Schedules
   4. Material specification conforming to standard
   5. Standard drawings and installation details
   6. Restoration after removal

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Silt fences shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24 hour period.

B. Damaged or decomposed fences, undercutting, or flow channels around the end of barriers shall be repaired or corrected.

C. Sediment shall be properly disposed of once the deposits reach ½ the height of the fence.

IX. References

UWEX Publication A0327 "Preserving Trees During Construction"

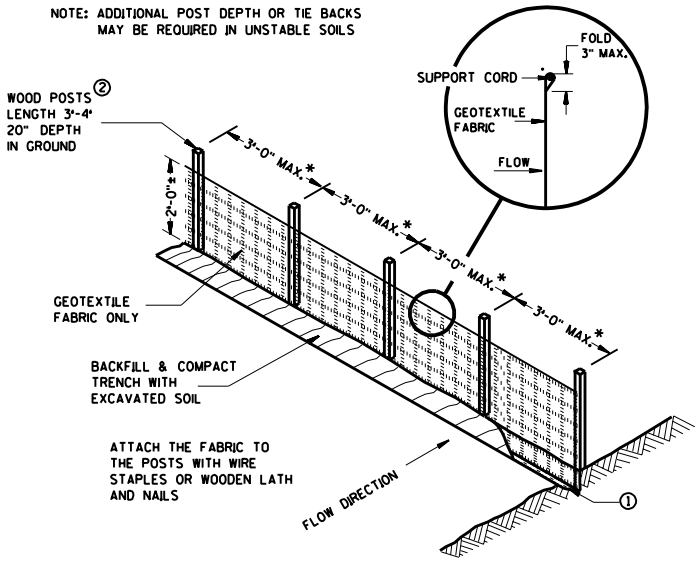
X. Definitions

Channel Erosion (III.A.1): The deepening and widening of a channel due to soil loss caused by flowing water. As rills become larger and flows begin to concentrate, soil detachment occurs primarily as a result of shear.

Sheet and Rill Erosion (III.A.1): Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. As flow becomes more concentrated rills occur. As soil detachment continues or flow increases, rills will become wider and deeper forming gullies.

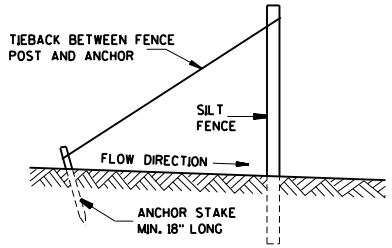
GENERAL NOTES

1. TRENCH SHALL BE A MINIMUM OF 4" WIDE & 6" DEEP TO BURY AND ANCHOR THE GEOTEXTILE FABRIC. FOLD MATERIAL TO FIT TRENCH AND BACKFILL & COMPACT TRENCH WITH EXCAVATED SOIL.
2. WOOD POSTS SHALL BE A MINIMUM SIZE OF 1 1/8" X 1 1/8" OF OAK OR HICKORY.
3. CONSTRUCT SILT FENCE FROM A CONTINUOUS ROLL IF POSSIBLE BY CUTTING LENGTHS TO AVOID JOINTS. IF A JOINT IS NECESSARY USE ONE OF THE FOLLOWING TWO METHODS: A) TWIST METHOD -- OVERLAP THE END POSTS AND TWIST, OR ROTATE, AT LEAST 180 DEGREES. B) HOOK METHOD -- HOOK THE END OF EACH SILT FENCE LENGTH.

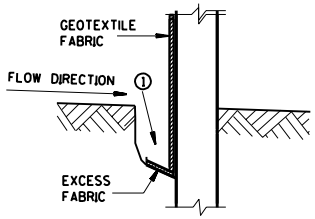


*NOTE: 8'-0" POST SPACING ALLOWED IF A WOVEN GEOTEXTILE FABRIC IS USED.

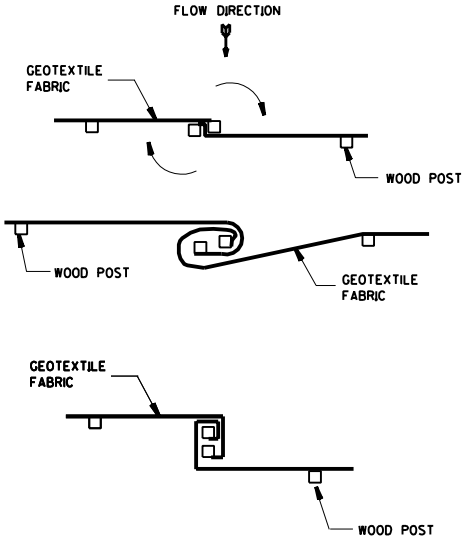
SILT FENCE



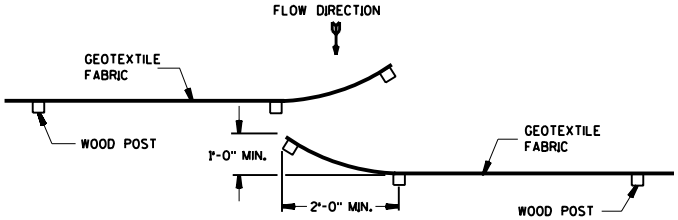
SILT FENCE TIE BACK
(WHEN ADDITIONAL SUPPORT REQUIRED)



TRENCH DETAIL



TWIST METHOD



HOOK METHOD

JOINING TWO LENGTHS OF SILT FENCE ④

This drawing based on Wisconsin Department of Transportation Standard Detail Drawing 8 E 9-6.

SILT FENCE

Stone Tracking Pad and Tire Washing
(1057)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A stabilized pad of stone aggregate or tire washing station located at any point where traffic will egress a construction site.

II. Purpose

The purpose of this standard is to reduce off-site sedimentation by eliminating the tracking of sediment from construction sites.

III. Conditions Where Practice Applies

Either a stone tracking pad or tire washing station shall be used at all points of construction egress. This standard applies where construction traffic is likely to transport sediment off site.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of this practice. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Tracking Pad:

1. The tracking pad shall be installed prior to any traffic leaving the site

2. The aggregate for tracking pads shall be 3 to 6 inch clear or washed stone. All material to be retained on a 3-inch sieve.

3. The aggregate shall be placed in a layer at least 12 inches thick. On sites with a high water table, or where saturated conditions are expected during the life of the practice, stone tracking pads shall be underlain with a WisDOT Type R geotextile fabric to prevent migration of underlying soil into the stone.

4. The tracking pad shall be the full width of the egress point. The tracking pad shall be at a minimum 50 feet long.

5. Surface water must be prevented from passing through the tracking pad. Flows shall be diverted away from tracking pads or conveyed under and around them by using a variety of practices, such as culverts, *water bars*[1], or other similar practices.

B. Tire washing: If conditions on the site are such that the sediment is not removed from vehicle tires by the tracking pad, then tires shall be washed utilizing pressurized water before entering a public road.

1. The washing station shall be located on-site in an area that is stabilized and drains into suitable sediment trapping or settling device.

2. The wash rack shall consist of a heavy grating over a lowered area. The rack shall be strong enough to support the vehicles that will cross it.

C. Rocks lodged between the tires of dual wheel vehicles shall be removed prior to leaving the construction site.

[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.

VI. Considerations

A. Vehicles traveling across the tracking pad should maintain a slow constant speed.

B. The best approach to preventing off-site tracking is to restrict vehicles to stabilized areas.

C. It is always preferable to prevent sediment from being deposited upon the road than cleaning the road later. Sediment on a road can create a safety hazard as well as a pollution problem.

D. Any sediment tracked onto a public or private road should be removed by street cleaning, not flushing, before the end of each working day.

VII. Plans and Specifications

A. Plans and specifications for installing tracking pads shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of all points of egress with tracking pad locations shown

2. Material specifications conforming to standard

3. Schedule for installation and removal

4. Standard drawings and installation details

5. Stabilization after removal

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Tracking pads and tire washing stations shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.

B. The tracking pad performance shall be maintained by scraping or top-dressing with additional aggregate.

C. A minimum 12-inch thick pad shall be maintained.

IX. Definitions

Water bar (V.A.5): A shallow trench or diversion dam that diverts surface water runoff into a dispersion area.

CRITICAL AREA PLANTING

(Acre)
Code 342

Natural Resources Conservation Service
Conservation Practice Standard

I. Definition

Establishing permanent vegetation on sites that have or are expected to have high erosion rates, and on sites that have physical, chemical, or biological conditions that prevent the establishment of vegetation with normal practices.

II. Purposes

This practice may be applied as part of a conservation management system to support one or more of the following purposes.

- Stabilize and restore riparian areas.
- Stabilize stream and channel banks and shorelines.
- Stabilize areas with existing or expected high rates of soil erosion by water or wind.
- Rehabilitate and revegetate degraded sites that cannot be stabilized using normal establishment techniques.

III. Conditions Where Practice Applies

This practice applies to highly disturbed areas such as:

- active or abandoned surface mine sites,
- urban conservation sites,
- road construction areas,
- conservation practice construction sites,
- areas needing stabilization before or after natural disasters such as floods, tornados, and wildfires,
- eroded banks of natural channels, banks of newly constructed channels, and lake shorelines, and
- areas degraded by human activities.

IV. Federal, Tribal, State and Local Laws

Critical area planting practices shall comply with all federal, tribal, state and local laws, rules or regulations. The landowner and/or operator is responsible for securing required permits. This standard does not contain the text of the federal, tribal, state or local laws.

V. Criteria

A. General Criteria Applicable To All Purposes.

1. Site Assessment

   A site investigation shall be conducted to identify any physical, chemical, or biological conditions that could affect the successful establishment of vegetation. The site investigation shall include evaluation of: soil characteristics, soil fertility, slope, *aspect*[1], moisture regime, climatic patterns, proximity to natural plant community, and site history.

   Areas to be planted will be cleared of unwanted materials and smoothed or shaped, if needed, to meet planting and landscaping purposes.

   Compacted layers will be ripped and the soil re-firmed prior to seedbed preparation.

   On tilled or disturbed sites, prepare a firm seedbed. The seedbed shall contain enough fine particles for uniform shallow coverage of seed and contact with moisture and nutrients. For details on seedbed preparation, refer to Wisconsin Agronomy Technical Notes 5, Establishing and Maintaining Native Grasses, Legumes, and Forbs; and 6, Establishing and Maintaining Introduced Grasses and Legumes.

2. Specie Selection and Seed Quality

   Species selected for planting shall be suited to current site conditions, intended use, and be resistant to diseases and insects common to the site location.

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

Selected species will have the capacity to achieve adequate density and vigor to stabilize the site within an appropriate period.

Native herbaceous or woody vegetation selected for planting shall be suitable for the site.

Species identified as restricted or prohibited by law shall not be planted.

Certified Seed shall be used, and seeding rates will be based on *Pure Live Seed* (PLS). Seed tag information such as purity and germination and any computations to adjust seeding rates must be submitted to document actual seeding rates. *Actual adjusted seeding rates* will be based on the equivalent of 100 percent PLS, determined by multiplying the percent purity by total percent germination.

Untested introduced and native grass and forb seed are not approved for planting.

When certified seed is unavailable or difficult to locate, *non-certified* seed can be used, after testing for varietal purity, germination, and other mechanical qualities, such as inert matter and other crop or weed seeds.

If more than 20 percent of legume seed is hard seed, increase the seeding rate for legumes by the percentage of hard seed.

Introduced and native legume seed shall be inoculated immediately prior to planting. Rhizobia inoculant shall be specific to the legume seeded. When more than one legume specie is used, each specie will be inoculated separately.

3. Seeding Periods

The specific date that provides the best chance for success will vary from south to north and from year to year with prevailing moisture and temperature conditions. Late summer seeding is generally riskier than spring seeding. Planting at either end of the allowable range is riskier than the middle of the range. Refer to Figure 1 for planting zones and Tables 1 and 2 for seeding dates.

Seeding outside of the recommended dates must be approved by the Area Resource Conservationist or State Agronomist.

Frost seeding is not an authorized seeding method when using this standard.

Dormant seeding can be used when planting introduced species. When using dormant seedings in concentrated flow areas, the site must be mulched according to the engineering design (if applicable) and Wisconsin NRCS Field Office Technical Guide, Section IV, (WI FOTG) Conservation Practice Standard 484, Mulching.

4. Nutrient and Soil Amendment Requirements

When seeding *introduced species*, soil fertility and pH level will be amended to satisfy the needs of the plant species to be established. Fertilizer and lime recommendations will be determined by a soil test, and all nutrients will be applied following WI FOTG Standard 590, Nutrient Management. If no soil test is available, apply a minimum of 150 pounds of 20-10-10 fertilizer and 2 tons of 80-89 lime or equivalent per acre. Soil amendments may be waived at the discretion of a certified conservation planner. The basis for waiving the use of soil amendments shall be documented in the client's case file.

For establishment of *native species*, use of soil amendments are not required.

5. Seedbed Preparation

Prior to planting into cropland fields, verify that herbicides previously applied to the site will not "carry over" and damage the new seeding.

Site preparation shall be adequate to assure weed suppression and to promote germination and growth of the species planted.

Planting equipment type, use, and timing shall be appropriate for the site conditions, soil characteristics, and type of seeds (size, etc.) selected to assure uniform placement and germination.

Refer to Wisconsin Agronomy Technical Notes 5 and 6 for detailed guidance for specific situations.

6. Mulching, Temporary Cover, and Companion Crop

Mulching, temporary cover, and companion crops are vital practices utilized to support the establishment of a critical area planting. Temporary cover and companion crops suppress weed growth and limit soil erosion during the establishment period. Use depends on the site conditions, method of planting, and seed mixture.

For further details on mulching, temporary cover and companion crop recommendations, refer to Wisconsin Agronomy Technical Notes 5 and 6.

B. Criteria for Seed Mixture Development

Seeding rates are based on seeds per square foot of Pure Live Seeds. Refer to Tables 3 and 4 for common species and seeding rates.

Additional approved species for critical area planting can be found in Wisconsin Agronomy Technical Notes 5 and 6. Species not listed in the technical notes must be approved in advance by the State Agronomist.

a. Introduced Grass and Legume Plantings on Critical Sites

Custom and standard mixtures will comprise of at least 50 percent grass seed, consisting of at least 25 percent sod forming grass seed per square foot.

A minimum of 160 seeds per square foot is required for either a solid stand of grasses or a combination of grasses and legumes. Increase seeding rate by 15 percent when dormant seeding occurs.

Standard mixes listed in Table 5 will meet the minimum seed mixture criteria.

b. Native Herbaceous Plantings on Critical Sites

Native species are generally not recommended for critical area plantings due to their slow establishment and because they are clump grasses, not the preferred sod-forming grasses. Native plantings are not permitted in concentrated flow channels.

1) A minimum of 60 seeds per square foot for solid native grass plantings is required.

2) For native grass and forb/legume mixtures, a minimum of 40 seeds per square foot of grass and a minimum of 20 seeds per square foot for the forb/legume component is required. The minimum of 20 forb/legume seeds per square foot is not required when the solid stand native grass mixture comprise of 60 grass seeds per square foot is utilized.

Canada/Virginia wildrye and sideoats grama shall not exceed a maximum of 20 percent of the required grass seeds per square foot in custom seed mixtures.

C. Additional Criteria to Stabilize Stream Channel Banks and Shorelines

Wisconsin FOTG Standard 580, Streambank and Shoreline Protection, shall be used to stabilize the toe and/or bank hydrologic zones before vegetation establishment.

1. Bank and Channel Slopes

Identify, mark, and protect desirable existing vegetation during practice installation.

On sites with a disturbed soil profile, topsoil will be stockpiled and spread over areas to be planted as needed to meet planting and land shaping needs.

Channel side slopes shall be shaped to a stable slope to facilitate establishment and maintenance of desired vegetation.

Slopes steeper than 2H:1V shall not be stabilized using vegetation alone. A combination of vegetative and structural measures will be used on these slopes to ensure adequate stability.

Grazing shall be permanently excluded on high hazard sites, such as cut banks, areas of seepage or other potentially unstable areas.

2. Species Selection

Plant material used for this purpose shall:

- be adapted to the hydrologic zone into which they will be planted.
- be adapted and proven in the regions in which they will be used.
- when mature, produce plant communities that are compatible with those already existing in the area.
- protect the channel banks but not restrict channel capacity.

D. Additional Criteria to Stabilize Areas of Erosion By Wind and Water

1. The amount of plant biomass and cover needed to reduce wind and water erosion to the planned soil loss objective shall be determined using the current approved wind and/or water erosion prediction technology.

2. Do not use tillage where desirable vegetation is already present or where soil disturbance will increase the potential for erosion or cause sedimentation to environmentally sensitive areas.

3. Use a companion crop as added protection.

E. Additional Criteria to Rehabilitate and Revegetate Degraded Sites That Cannot Be Stabilized Using Normal Establishment Techniques

Slope Stabilization

1. On sites that are too steep for regular seeding equipment to operate, the use of hydroseeding and mechanically blown mulch is recommended. For more information regarding hyrdoseeding, refer to Wisconsin Agronomy Technical Note 6.

2. Grade to a stable slope when shaping and eliminate all overfalls. For slopes steeper than 2H:1V, enhanced stabilization activities such as soil bioengineering may be required. These practice concepts shall follow approved design procedures located in the NRCS Engineering Field Handbook, Chapter 18.

3. The toe of the slope, or the outlet of the concentrated flow channel, shall be stable before attempting seeding on the slope.

4. Concentrated flow may need to be diverted from the critical area during the establishment period.

5. All gullies and deep rills will be filled and leveled during seedbed preparation.

6. A minimum of 4 inches of friable soil material or topsoil shall be added and mixed to exposed rocky, sandy, gravelly, shaley material, or extremely fine textured subsoil.

7. Sod placement shall be limited to areas that can naturally supply needed moisture or sites that can be irrigated during the establishment period.

8. Sod will be placed and anchored using techniques to ensure that it remains in place until established.

Figure 1
Planting Zones

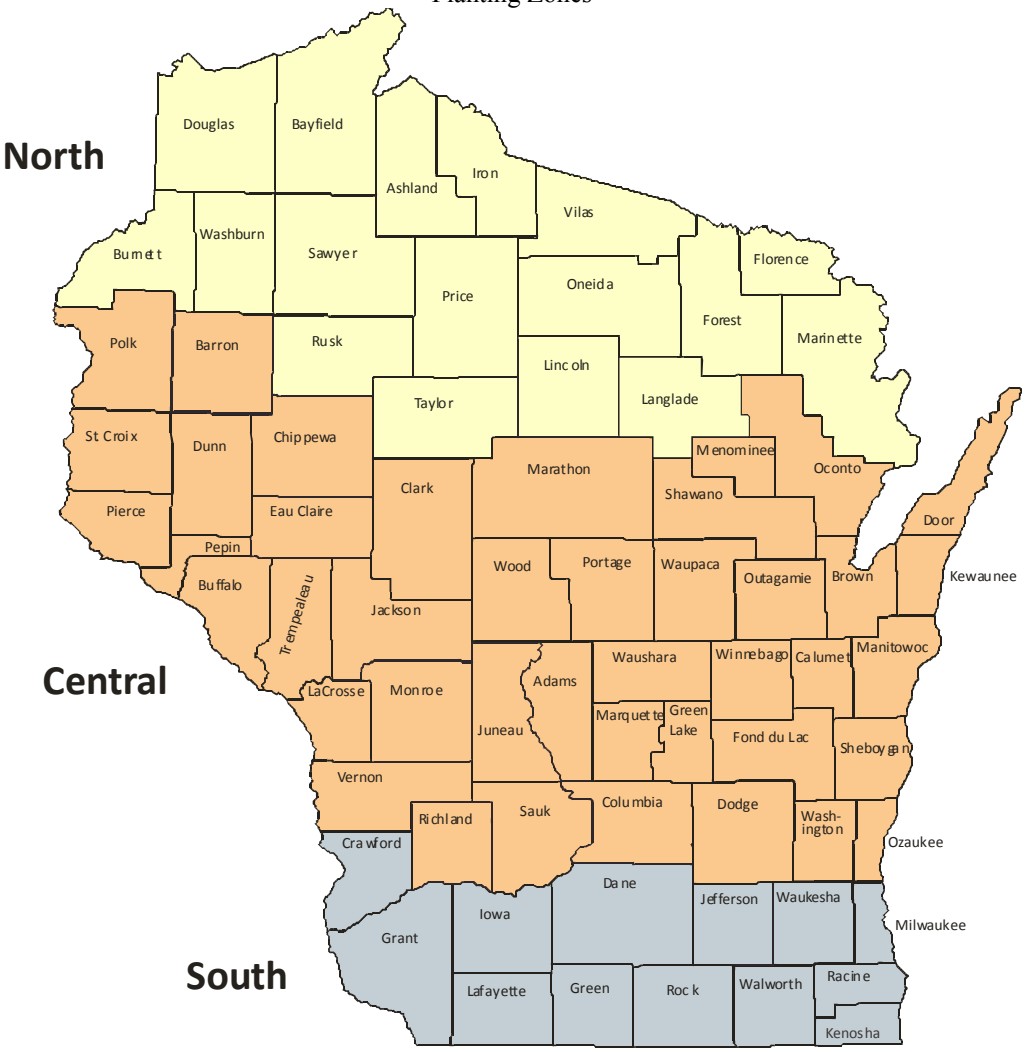


Table 1
Seeding Date/Ranges for Native Mixtures and Companion Crops

Zone	Spring Seeding
Northern	Thaw - 7/15
Central	Thaw - 6/30
Southern	Thaw - 6/30

Table 2
Seeding Date/Ranges for Introduced Grasses, Legumes, and Companion Crops

Planting Zone	Spring	Late Summer	Dormant
North	5/1 - 6/15	7/15 - 8/10	11/1 - Freeze up
Central	4/15 - 6/1	8/1 - 8/21	11/1 - Freeze up
South	4/1 - 5/15	8/7 - 8/29	11/1 - Freeze up

VI. Considerations

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

A. Minimize activities which disturb wildlife during the primary nesting season May 15 through August 1.

B. Consider seeding at a lower rate and making 2 passes to ensure uniform coverage. Check seed boxes regularly to ensure even distribution.

C. Heavy traffic and/or compacted soil areas may need special site preparation prior to seeding.

D. Sprigs, root stocks, crowns, cones, culms, and sod may be considered where appropriate to accelerate the establishment of cover.

E. Woody shrubs or trees may be used only after initial stabilization. Plant in accordance with the purpose of the planting. See WI FOTG Standards 612, Tree/Shrub Planting; and 580, Streambank and Shoreland Protection. Also see NRCS Engineering Field Handbook, Chapter 16, Streambank and Shoreline Protection and Chapter 18, Soil Bioengineering for Upland Slope Protection.

F. Consider using carriers such as vermiculite, sawdust, and soybean meal to increase volume and weight for uniform seed distribution.

G. Consider limited or no use of herbicides one year prior to seeding. If herbicides must be used, ensure there is no potential for carryover and follow label recommendations. Follow WI FOTG Standard 595, Integrated Pest Management, for pesticide use and safety.

H. Consider sodding to establish vegetation on steep slopes. For further details on this special erosion control measure, refer to Wisconsin Agronomy Technical Note 6.

I. Consider establishing a buffer of trees and/or grasses next to intermittent or perennial streams.

J. Consider planting native vegetation and/or local *genotypes* when restoring riparian corridors to its pre-settlement conditions.

K. High seed counts per square foot much above the recommended minimums may lead to excessive competition and poor establishment of some species. Seeds per square foot should not exceed 25 percent of the minimum requirement, with the exception of mixtures designed for wet mesic and wet sites.

L. Consider the use of *soil bioengineering* techniques to arrest and prevent slope failures and erosion. For approved design procedures, refer to Chapter 18 of the NRCS Engineering Field Handbook (EFH).

M. Consider alternatives to reduce or eliminate the delivery of sediment and associated pollutants into the riparian zone by implementing upland treatment practices.

VII. Plans and Specifications

Prepare plans and specifications for each field or management unit according to the Criteria and Operation and Maintenance sections of this standard. Specifications shall describe the requirements for applying this practice to meet the intended purpose using the appropriate specification and/or job sheets. The following elements shall be addressed in the plan, as applicable, to meet the intended purpose.

- Site preparation.
- Fertilizer application.
- Methods of seeding/planting.
- Selection of species.
- Analysis of seed quality.
- Seeding rate (adjusted based on pure live seed calculations).
- Target number of plants per square foot after emergence.
- Mulching (if applicable).
- Temporary cover (if applicable).
- Companion crop (if applicable).
- Weed control activities during the establishment period.

Specifications shall be recorded using Wisconsin Job Sheets 134, How to Establish and Maintain Introduced Grasses and Legumes; and 135, How to Establish and Maintain Native Grasses, Forbs, and Legumes.

VIII. Operation and Maintenance

A. Noxious weeds and other undesirable species must be controlled at all sites. During the first year, mow plantings at 14 to 21-day intervals or when weeds are 12-14 inches high and before the development of mature seed. Mowing height

should be 4 inches for introduced and 7 inches for native plants. Small grain companion crops should be mowed at boot stage and prior to heading. Spot spraying or hand pulling may be needed for some invasive species such as thistles and purple loosestrife.

B. Sites may require on-going periodic maintenance consisting of mowing, burning, or herbicide treatment.

C. Sites should be inspected periodically to ensure site stabilization objectives are being met.

IX. References

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Packard, S. and Mutel, C. 1997. The Tallgrass Restoration Handbook for Prairies, Savannas and Woodlands. Society for Ecological Restoration.

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

USDA, NRCS, Wisconsin Agronomy Technical Note 5, Establishing and Maintaining Native Grasses, Forbs, and Legumes.

USDA, NRCS, Wisconsin Agronomy Technical Note 6, Establishing and Maintaining Introduced Grasses and Legumes.

USDA, NRCS, Wisconsin Job Sheet 134, How to Establish and Maintain Introduced Grasses and Legumes.

USDA, NRCS, Wisconsin Job Sheet 135, How to Establish and Maintain Native Grasses, Forbs, and Legumes.

X. Definitions

Actual Adjusted Seeding Rates (V.A.2.) – an increase in seeds per square foot or pounds per acre, when the PLS is less than 100 percent.

Aspect (V.A.1.) – The exposure of the site to direct sunlight, prevailing winds, and other factors that influence plant growing conditions. For example, a north slope tends to be cooler and moister while a south-facing slope tends to be drier and warmer.

Soil Bioengineering (VI.L.) – Practice of combining mechanical, biological, and ecological concepts to arrest and prevent shallow slope failures and erosion.

Certified Seed (V.A.2.) – Seed that meets the standards established by the designated official seed certifying agency for the purpose of ensuring species/variety, species/varietal purity and mechanical quality. The Wisconsin Crop Improvement Association is the official seed certifying agency for Wisconsin.

Genotype (VI.J.) – A group of individual plants which share a specified genetic makeup. For example, all big bluestem plants that are genetically adapted to grow and mature in the climatic conditions found in the driftless region could be considered a genotype.

Introduced Species (V.A.4.) – Plant species that historically were not native to North America and were brought here from other parts of the world, for example, smooth bromegrass and alfalfa.

Native Species (V.A.4.) – Plants species that historically would have been found growing in North America such as big bluestem or green needle-grass.

Non-Certified Seed (V.A.2.) – Seed that is grown, processed, tested and labeled for species/variety and mechanical quality factors, but is not certified by an official seed certifying agency.

Pure Live Seed (PLS) (V.A.2.) – PLS is a means of expressing seed quality, based on the percentage of seed in a seed lot that is both pure and viable. PLS is calculated by multiplying the percentage of total viable seed (germination + hard seed + dormant seed) by the percentage of pure seed divided by 100.

Untested Seed (V.A.2.) – Seed that has no assurances of testing for species/variety and mechanical quality, i.e., species/variety purity, inert matter, other crop or weed seeds and germination potential. Untested seed legally cannot be labeled.

Table 3
Common Species and Seeding Rates for Critical Area Plantings

Common Name	Scientific Name	Moisture Regime	Single Species Seeding Rate (PLS) Lbs./Ac.	Seeds/Lb.	Seeds/Square Ft./Lb./Ac.
Native Grasses					
Big Bluestem[1]	Andropogon gerardii[1]	D, DM, M, WM	11	165,000	3.8
Canada Wild Rye	Elymus canadensis	DM, M, WM	12	83,200	1.9
Indian Grass[1]	Sorghastrum nutans[1]	D, DM, M, WM, W	10	192,000	4.4
Little Bluestem	Schizachyrium scoparium	D, DM, M	8	240,000	5.5
Prairie June Grass	Koeleria macrantha[1, 2]	D, DM, M	0.5	2,308,672	53
Sideoats Grama	Bouteloua curtipendula	D, DM, M	8	127,000	2.9
Switch Grass[1]	Panicum virgatum[1]	D, DM, M, WM, W	7	389,000	8.9
Virginia Wild Rye	Elymus virginicus	M, WM, W	17	67,200	1.5
Introduced Grasses					
Chewings Red Fescue[2]	Festuca rubra L. ssp. fallax[2]	D, DM, M	5	350,000	8
Creeping Red Fescue[1, 2]	Festuca rubra[1, 2]	DM, M, WM	5	350,000	8
Festulolium	Festuca x Lolium	DM, M, WM	10	227,000	5.2
Italian or Annual Ryegrass	Lolium perenne L. ssp. multiflorum	DM, M, WM	20	227,000	5.2
Kentucky Bluegrass[1, 2]	Poa pratensis[1, 2]	D, DM, M, WM, W	8	2,177,000	50
Orchard Grass	Dactylis glomerata L.	D, DM, M, WM	10	653,000	15
Perennial Ryegrass	Lolium perenne	DM, M, WM	20	227,000	5.2
Redtop[1, 2]	Agrostis gigantea[2]	M, WM, W	4	4,990,000	114.5
Smooth Bromegrass[1, 2]	Bromus inermis[1, 2]	D, DM, M, WM	20	136,000	3.1
Tall Fescue	Schedonorus arundinaceus	D, DM, M, WM	12	227,000	5.2
Timothy	Phleum pratense	DM, M, WM, W	8	1,230,000	28.2
Legumes					
Alfalfa	Medicago sativa	D, DM, M	12	219,000	5.0
Alsike Clover	Trifolium hybridum	M, WM, W	3	680,000	15.6
Birdsfoot trefoil	Lotus corniculatus	DM, M, WM, W	7	375,000	8.6
Red Clover	Trifolium pratense	DM, M, WM	10	275,000	6.3
White Ladino Clover	Trifolium repens	DM, M, WM	3	871,650	20

[1] Species approved for seeding individually at the recommended Pure Stand Rates based on Pure Live Seeds (PLS) depending on the erosiveness of the site.

It is required that at least 50% of the seeds per square foot of mixtures planted to introduced and native species on critical areas are composed of grasses, and 25% of the seeds per square foot are sod-forming grasses for introduced species.

If more than 20% of the legume seed is hard seed, increase the seeding rate for legumes by the percent of hard seed.

Seeds per square foot for a particular specie can be calculated by multiplying the number of seeds per pound of the specie by the rate of the specie in pound(s) per acre divided by 43,560 square feet.

[2] Sod-forming grass plants.

Table 4
Seeding Chart for Native Grass Species

Common Name	Scientific Name	Percent of Mixture	Pure Stand Seeding Rate	Seeds per Square Foot
Big Bluestem	Andropogon gerardii	0-100	11 lbs/ac	42
Canada Wildrye	Elymus canadensis	0-20	12 lbs/ac	23
Indian grass	Sorghastrum nutans	0-100	10 lbs/ac	44
Little Bluestem	Schizachyrium scoparium	0-20	8 lbs./ac	44
Sideoats Grama	Bouteloua curtipendula	0-20	8 lbs/ac	23
Switchgrass	Panicum virgatum	0-100	7 lbs/ac	63
Virginia Wild Rye	Elymus virginicus	0-20	17 lbs/ac	26
Praire June Grass	Koeleria macrantha	0-20	0.5 lbs/ac	26
Hairy Grama	Bouteloua hirsuta	0-25	1 lb/ac	26

Canada Wild Rye, Virginia Wild Rye and Sideoats Grama when combined will not comprise of more than 20% of the total grass seeds per square foot. Pure stand seeding rates for Big Bluestem and Indiangrass must be increased by 5 lbs/acre to meet the minimum seeds per square foot as required by this standard. Refer to Table 3 for suggested moisture regimes per specie.

Table 5
Seeding Mixtures Suitable for Critical Area Plantings

Seed Calculator Code*	Moisture Regimes	Common Name	Scientific Name	Seeding Rate in lb/ac PLS	Seeding Rate in Seeds/Ft^2 PLS	Capacity Retardance	Type of Site**
342-1	*Dry-Mesic* and *Mesic* Sites	Smooth Bromegrass	Bromus inermis	10	31	B	EB, WW,CSB
		Creeping Red Fescue	Festuca rubra	3	24		
		Alfalfa	Medicago sativa	3	15		
		Red Clover	Trifolium pratense	3	19		
		Kentucky bluegrass	Poa pratensis	1.5	75		
342-2	Dry-Mesic and Mesic Sites***	Smooth Bromegrass	Bromus inermis	15	47	B	EB,WW
		Alfalfa	Medicago sativa	7	35		
		Timothy	Phleum pratense	3	85		
342-3	Dry-Mesic and Mesic Sites	Kentucky bluegrass	Poa pratensis	1	50	B	CSB, EB, WW
		Smooth Bromegrass	Bromus inermis	10	31		
		Timothy	Phleum pratense	2	56		
		Tall Fescue	Schedonorus arundinacea	2	10		
		Perennial Ryegrass	Lolium perenne	5	26		
342-4	Dry-Mesic and Mesic Sites	Smooth Bromegrass	Bromus inermis	20	62	B	EB, WW, CSB
		Creeping Red Fescue	Festuca rubra	5	40		
		Alfalfa	Medicago sativa	8	40		
		Red Clover	Trifolium pratense	4	25		
342-5	Dry-Mesic and Mesic Sites	Smooth Bromegrass	Bromus inermis	30	93	B	EB, WW, CSB
		Alfalfa	Medicago sativa	14	70		
342-6	Dry-Mesic, Mesic, and Wet Mesic Sites	Smooth Bromegrass	Bromus inermis	7	22	B	CSB, EB, WW
		Timothy	Phleum pratense	2	56		
		Creeping Red Fescue	Festuca rubra	1	8		
		Kentucky Bluegrass	Poa pratensis	1	50		
		Perennial Ryegrass	Lolium perenne	3	16		
		Red Clover	Trifolium pratense	3	19		
342-7	Mesic Sites***	Smooth Bromegrass	Bromus inermis	7	22	B	EB, WW
		Creeping Red Fescue	Festuca rubra	2	16		
		Kentucky bluegrass	Poa pratensis	3	150		
		Birdsfoot trefoil	Lotus corniculatus	2	17		
342-8	Mesic Sites***	Smooth Bromegrass	Bromus inermis	15	47	B	WW,EB
		Creeping Red Fescue	Festuca rubra	2	16		
		Kentucky Bluegrass	Poa pratensis	2	100		
342-9	Mesic Sites***	Kentucky Bluegrass	Poa pratensis	3	150	C	WW,EB
		Creeping Red Fescue	Festuca rubra	4	32		
		Perennial Ryegrass	Lolium perenne	10	52		
342-10	Mesic Sites	Smooth Bromegrass	Bromus inermis	14	43	B	EB, WW, CSB
		Timothy	Phleum pratense	3	85		
		Red Clover	Trifolium pratense	3	19		
		Perennial Ryegrass	Lolium perenne	4	21		
342-11	Mesic Sites	Smooth Bromegrass	Bromus inermis	32	99	B	EB, WW
		Creeping Red Fescue	Festuca rubra	8	64		
342-12	Mesic Sites	Kentucky bluegrass	Poa pratensis	4	200	C	EB, WW
		Creeping Red Fescue	Festuca rubra	3	24		

Seed Calculator Code*	Moisture Regimes	Common Name	Scientific Name	Seeding Rate in lb/ac PLS	Seeding Rate in Seeds/Ft^2 PLS	Capacity Retardance	Type of Site**
342-13	Mesic Sites	Smooth Bromegrass	Bromus inermis	14	43	B	EB, WW, CSB
		Timothy	Phleum pratense	4	113		
		Red Clover	Trifolium pratense	3	19		
342-14	Mesic Sites	Smooth Bromegrass	Bromus inermis	15	47	B	EB, WW, CSB
		Timothy	Phleum pratense	3.5	99		
		Alsike Clover	Trifolium hybridum	2	32		
342-15	Mesic Sites	Smooth Bromegrass	Bromus inermis	15	47	B	EB, WW
		Timothy	Phleum pratense	3.5	99		
		Birdsfoot trefoil	Lotus corniculatus	3	26		
342-16	Wet Mesic Sites	Tall Fescue	Schedonorus arundinacea	5	26	B	CSB, EB, WW
		Timothy	Phleum pratense	3	85		
		Perennial Ryegrass	Lolium perenne	3	16		
		Red Clover	Trifolium pratense	3	19		
		Smooth Bromegrass	Bromus inermis	6	19		
		Kentucky Bluegrass	Poa pratensis	2	100		
342-17	Wet Mesic Sites	Redtop	Agrostis gigantea	1	115	C	WW, CSB, EB
		Timothy	Phleum pratense	3	85		
		Red Clover	Trifolium pratense	5	32		
342-18	Wet Mesic Sites	Timothy	Phleum pratense	3	85	B	WW, CSB, EB
		Perennial Ryegrass	Lolium perenne	3	16		
		Red Clover	Trifolium pratense	3	19		
		Smooth Bromegrass	Bromus inermis	6	19		
		Kentucky Bluegrass	Poa pratensis	2	100		
342-19	*Wet Mesic* Sites	Redtop	Agrostis gigantea	1	115	C	WW,CSB, EB
		Timothy	Phleum pratense	1	28		
		Red Clover	Trifolium pratense	4	25		
		Kentucky Bluegrass	Poa pratensis	2	100		
342-20	*Wet* Sites***	Redtop	Agrostis gigantea	2	229	C	WW
		Alsike Clover	Trifolium hybridum	2	31		
		Kentucky Bluegrass	Poa pratensis	2	100		
342-21	Wet Mesic Sites	Redtop	Agrostis gigantea	3	344	C	WW
		Alsike Clover	Trifolium hybridum	3	47		

*These codes represent the mixtures used in the Wisconsin Seed Calculator.
**EB = Embankments; WW = Waterways; CSB = Channel and Streambanks
***Mixtures can be used on other site descriptions when not listed.

Wisconsin Agronomy Technical Note 5

Establishing and Maintaining Native Grasses, Forbs and Legumes

INTRODUCTION

This technical note may be used to guide prairie restoration seedings for the purposes of Wisconsin Natural Resources Conservation Service (NRCS) Field Office Technical Guide (FOTG) Conservation Practice Standards 327, Conservation Cover; 645, Wildlife Upland Habitat Establishment; 512, Forage and Biomass Planting, and occasionally 342, Critical Area Planting. Other ecological science and certain engineering standards may refer to this technical note. Each standard has a specific purpose and requirement for vegetation establishment.

BACKGROUND

A prairie is a diverse plant community characterized by the number of grass, legume, shrub, and forb species. In Wisconsin, a typical prairie averages six species per square foot. Exceptionally rich sites can average as many as eight species per square foot. High quality remnants of original prairie can harbor 40 to 80 species per acre.

Prairie restoration is the art and science of reconstructing a diverse native plant community. Constructing an exact copy of the tall grass prairie plant community is not very likely. However, the more common components of the prairie can be established and will evolve into a prairie with many of the same visual and ecological components of a natural undisturbed prairie.

The vast majority of native herbaceous plants are warm season species with the exception of a few cool season native grasses and forbs. Warm season plants (C4) produce most of their annual biomass during hot summer months from late June through early September. The growth of this group of plants does not begin until the minimum air temperature reaches 60 to 65 degrees Fahrenheit and soil temperatures reach 50 degrees Fahrenheit. Optimum biomass production occurs when daytime temperatures elevate to 85 degrees Fahrenheit. At higher temperatures C4 plants have a greater potential photosynthetic rate and use nitrogen and phosphorus more efficiently. Native plants survive and adapt better than introduced species under conditions of high temperatures.

TABLE OF CONTENTS

LIST OF TABLES

SITE ASSESSMENT

Prairies are generally divided into five soil moisture regimes: Wet, Wet-Mesic, Mesic, Dry-Mesic, and Dry. There is often no sharp division between moisture regimes and one group may blend into another or multiple groups and should be considered when planning a successful prairie.

Some plant species are restricted to certain soil moisture regimes, while other plant species can be present on several if not all of the soil moisture regimes.

Wet organic soils are the most challenging when establishing most native plant species due to site conditions as well as competition from cool season and invasive plants. Wet organic soils pose issues with management activities such as mowing and spraying in a timely manner, a prerequisite to a successful planting.

PRAIRIE SOIL MOISTURE REGIMES AND SITE CONDITIONS

Wet Prairie

Wet prairies occur on mineral soils with poor drainage. They can also be found on some frequently flooded sites.

Wet-Mesic

Wet-Mesic Prairies are transitional between Wet Prairie and Mesic Prairies. Most Wet-Mesic Prairies occur on somewhat poorly drained mineral soils.

Mesic Prairie

Mesic Prairies will be found on most moderately well and well drained mineral soils that have moderate to very high Available Water Capacity. Mesic Prairies may occur on some somewhat poorly drained soils with low or very low Available Water Capacity or perched water tables.

Dry-Mesic Prairie

Dry-Mesic Prairies are transitional prairies between Dry Prairie and Mesic Prairie. They occur on some somewhat excessively drained and some well drained soils.

Dry Prairie

Dry Prairies occur mostly on well to excessively drained soils.

SPECIE SELECTION AND SEED QUALITY INFORMATION

- Evaluate the winter hardiness of species being selected for planting.
- Species identified as restricted or prohibited shall not be planted.
- Plant all the desired species at one time.
- Select species based on the site conditions for soil type and moisture regime.
- Seed as many forbs from the appropriate tables in this technical note as the budget will allow.
- If the objective is to create pollinator habitat, select species so that the prairie will be in flower throughout the growing season. Select at least three species from each bloom period (early, mid, late).
- Bunch grasses are recommended when pollinator habitat is planned.
- Due to the aggressive nature of the following plants, it is recommended to limit the seeding rates of the following species:
  - June Grass (2 oz/ac or 7 seeds/sq. ft.)
  - Switchgrass (16 oz/ac or 9 seeds/sq. ft.)
  - Blackeyed Susan (2 oz/ac or 5 seeds/sq. ft.)
  - Purple Coneflower (3 oz/ac or 2 seeds/sq. ft.)
  - Bergamot (2 oz/ac or 4 seeds/sq. ft.)
- Legumes must be inoculated with the appropriate bacteria for the specific species being planted. Inoculant must not be exposed to sunlight or allowed to dry out prior to planting native legumes.
- If more than 20 percent of the legume seed is hard seed, increase the seeding rate for legumes by the percent of hard seed in the seeding mixture.
- When using Standards 327, Conservation Cover; and 342, Critical Area Planting, Canada and Virginia Wildrye and Sideoats Grama, when combined, will not comprise of more than 20 percent of the total grass seed per square foot.
- The minimum seeding requirements are based on seeds per square foot.
- Increase seeds per square foot by 15 percent when dormant and frost seeding occurs.
- Use non-sod forming grass species in locations where shrubs and trees are planned.
- Where an existing native remnant prairie is near a planting site, it may be desirable to use locally harvested genotype seed. If this seed is

harvested locally it may be difficult to test for germination or purity in order to determine PLS. The use of locally harvested untested seed for USDA program participants must be approved by the Wisconsin NRCS State Agronomist.

- The order of preference for seed source selection is:
  1. Local genotypes.
  2. Genotypes from the same latitude.
  3. A named variety from the same latitude.
  4. Other named varieties.
- Use of local genotypes is the first preference because plants grown on or near the restoration site will be best adapted to the conditions of the site. It is especially important to use local genotypes when working with remnant prairies; introducing species from other areas may contaminate the local native plant gene pool.
- Seed purchased should be harvested within a 250 mile radius of the area where the planting will occur.
- Ideally, 40 percent of the total seeds per square foot should consist of forbs and or legumes.
- Below are species with multiple scientific names. The underlined specie is the most recognized genus and specie in Wisconsin and is referenced in vegetative Standards 327, Conservation Cover; 342, Critical Area Planting; and 512, Forage and Biomass Planting.
  - **False Boneset:** Brickellia eupatorioides, Kuhnia eupatorioides
  - **Great St. John's Wort:** Hypericum ascyron, Hypericum pyramidatum
  - **Heath Aster:** Symphyotrichum ericoides, Aster ericoides
  - **Joe-Pye Weed:** Eutrochium maculatum, Eupatoriadelphus maculates and Eupatorium maculates
  - **Porcupinegrass:** Hesperostipa spartea, Stipa spartea
  - **Silky Aster:** Symphyotrichum sericeum, Aster sericeus
  - **Smooth Blue Aster:** Symphyotrichum laeve, Aster laevis
  - **Softstem Bulrush:** Schoenoplectus tabernaemontani, Scirpus validus
  - **Stiff Goldenrod:** Oligoneuron rigidum, Solidago rigida
  - **Upland Boneset/Tall Boneset**: Eupatorium sessifolium, Eupatorium altissimum
  - **Wild Quinine:** Parthenium integrifolium, Parthenium auriculatum

Table 1
Recommended Varieties of Warm Season Grasses

Specie	Variety	Area of Adaptability
Big Bluestem	Bison	North
	Bonilla	Central
	Champ	South
	Pawnee	South
	Rountree	Central and South
Indiangrass	Holt	Central and South
	Rumsey	South
	Tomahawk	North
Switchgrass	Blackwell	South
	Cave-in-Rock	South
	Dacotah	North
	Forestburg	Central
	Nebraska 28	Central
	Pathfinder	South
	Sunburst	Central
	Trailblazer	South
Little Bluestem	Blaze	Statewide
	Aldous	South
	Camper	Central and South

PURE LIVE SEED (PLS)

PLS is a means of expressing seed quality. PLS is the percentage of seed (i.e. good viable seed) that has the potential to germinate for a measured one pound weight of any seed lot. Nearly all species recommended for conservation plantings by NRCS uses Pure Live Seed (PLS) expressed in pounds or ounces per acre which is calibrated to seeds per square foot as the basis for the calculation of seeding rates. PLS provides a basis for comparing the quality of seed lots of the same species that differ in purity and germination. PLS is calculated by multiplying the purity percentage by the total germination percentage.

Seeding rates in this Technical Note are shown in pounds or ounces of Pure Live Seed (PLS) and is calibrated to seeds per square foot. All seed shall be of high quality and labeled in accordance as required by the Wisconsin Seed Law. Seed should always be

purchased on a PLS basis. Seed tags should specify the percentage of Total Viable Seed (TVS) germination/dormant/hard and purity to determine the correct seeding rates as specified in the seeding plan.

Example: Pure Live Lupine seed

	Pure Seed:	99.93%
	Inert Matter:	0.06%
	Other Crop:	0.01%
Lupine	Weed Seeds:	0.00%
Lupinus perennis	Germination:	11.00%
Harvest ID: 018040-01	Hard Seed:	0.00%
Test Date: 2/24/2012	Dormant Seed:	85.00%
	Tetrazolium:	0.00%
Name and # of Noxious Seed:	NONE FOUND	

Pure seed x TVS = PLS
99.93% x 96.0% = 95.9%

The PLS for Lot Number 018040-01 is 95.9.

CRITERIA FOR SEED MIXTURE DEVELOPMENT

Seed mixtures developed from this section will be composed of a grass component only or a grass and forb/legume component, depending on the standard criteria and purpose of the planting.

It is important to reference program rules when determining seed mixtures. Some programs have preapproved required mixtures to meet program and cost requirements.

STANDARD 327 CONSERVATION COVER

NATIVE OR WARM SEASON PLANTINGS

1. Basic Prairie Plantings
   - A minimum of 3 grasses seeded at a minimum rate of 20 grass seeds per square foot and a minimum of 3 forbs and or legumes seeded at a minimum rate of 2.0 seed per square foot.
2. Restoration of Native Prairie Plantings
   - A minimum of 5 grasses consisting of a minimum of 15 grass seeds per square foot and a minimum of 10 forbs comprising of at least one legume in the mixture amounting to a minimum of 8 seeds per square foot.
3. Untested Local Genotype Seed

The use of local genotype seed for USDA program seedings must be approved by the NRCS State Agronomist. Approval will only be considered for sites where the use of local genotype seed is necessary to address or maintain the ecological value of an area as identified in a NRCS conservation plan or similar planning document.

In order to obtain the highest quality seed possible:

- The harvesting of seeds will be supervised by someone experienced in the harvest of native seeds.
- All seed will be cleaned.
- Seed will be separated and properly stored by specie so that it can be mixed later at the planned rates.
- Collected seed will be tested for germination and viability unless a variance is granted by the NRCS State Agronomist.
- Use the following guidance for locally collected prairie seed that is untested.

a) Seed will be planted at a minimum seeding rate of 50 seeds per square foot. Limit seeding rates so that one specie does not comprise more than 20 percent of the seeds/square foot. When a specie is seeded at a seeding rate so that its number of seeds planted per square foot makes up more than 20 percent of the total planted seeds per square foot; only the seeds per square foot that fall within the 20 percent requirement will be counted toward the total required number of seeds per square foot.

   The seeding rate of plant species known to germinate aggressively in new plantings such as Switchgrass, Purple Cone Flower, Blackeyed Susan and Bergamot shall be limited to 15 percent or less of the total seed per square foot planted.

b) At least 25 seeds per square foot must be native grasses or sedges and a minimum of 10 seeds per square foot of forbs and legumes.

c) At least five species of grasses and 10 species of forbs and at least 1 legume must be seeded. In situations, where the number of species required are unavailable during the harvest of untested genotype, the

mixture may be supplemented with certified pure live seed to satisfy this requirement.

d) A final list of the species planted and the ounces of each specie actually planted must be provided to the NRCS office for review and approval.

4. Pollinator Herbaceous Plantings

- At least 1 and a maximum of 2 bunch grass species seeded at a maximum rate of 10 seeds per square foot and a minimum of 9 forbs and or legumes consisting of at least 3 species from each bloom period (early, mid, late) seeded at a minimum rate of 30 seeds per square foot.

Short bunch grasses are preferred over tall bunch grasses.

Recommended short bunch grasses are: Sideoats Grama, Prairie Junegrass, Little Bluestem, Woolgrass, and Prairie Dropseed.

Recommended tall bunch grasses are: Switchgrass, Indiangrass and Big Bluestem.

STANDARD 512 FORAGE AND BIOMASS PLANTING

5. Warm Season Pasture and Hayland Plantings

- The minimum seeds per square foot by specie is as follows: Big Bluestem (42), Indiangrass (44), Switchgrass (63).

For pasture and hayland purposes, warm-season grasses will be established in stands of single species only.

6. Warm Season Biomass Plantings

- Switchgrass is currently the only approved specie for biomass production in Wisconsin. The minimum seeding rate is 63 seeds per square foot.

STANDARD 342 CRITICAL AREA PLANTING

7. Native Herbaceous Plantings on Critical Sites

- A minimum of 60 seeds per square foot for solid native grass plantings is required.
- For grass and forb/legume mixtures, a minimum of 40 seeds per square foot for the grass component and a minimum of 20 seeds per square foot for the forb/legume component is required. The minimum of 20 forb/legume seeds per square foot is not required when native grass seed per square foot is greater than or equal to 60.

Native species are generally not recommended for critical sites due to slow establishment and because native plants grow in clumps and are not sod forming.

SEEDING DATES

Native plantings can be seeded either late fall, winter(frost seeding) or spring .

Warm season plants require a soil temperature of at least 50 degrees Fahrenheit before they will germinate. Spring is the traditional time to seed these plants and plantings are successful when recommendations are followed. Spring conditions favor warm season grasses over forbs and legumes. Under normal spring conditions moisture conditions are considered ideal or adequate.

If site conditions in the spring are not adequate due to weather, fall seedings offer an excellent opportunity for seeding native species. Fall seedings favor forbs due the cold weather stratification. The majority of forbs are stratified before purchase of seed. Fall seeding of natives in Wisconsin is considered a dormant seeding and must be seeded after the growing season has ended to ensure that the seed does not germinate before freeze up.

Frost seeding in late winter is permissible in Wisconsin and has been proven successful. These seedings are made in late winter, mid-February to early March during the freeze and thaw cycle. Seedings should not occur when snow cover is greater than 2 inches. Frost seeding timeframes will vary according to weather conditions and from year to year.

Seeding shall be carried out within the dates specified for the appropriate planting zone. See **Figure 1** and **Table 2** to determine the recommended seeding dates.

Seeding outside of the established dates may be approved by the NRCS State Agronomist or Area Resource Conservationist. All variance requests shall provide documentation of the current soil moisture conditions and proposed timeframes for seeding to be completed.

TEMPORARY COVER AND COMPANION CROPS

Temporary Cover

All land will be established to permanent vegetative cover during the first year of the land use conversion when possible. Temporary cover, during the first year, may be used if: 1) required seeds or plant stock are not available, 2) the normal planting period for species has passed or 3) where chemical residue will not allow establishment of permanent cover immediately. If temporary cover is used, the permanent vegetative cover must be established by the end of the normal planting period of the following year.

Temporary Seeding Recommendations

1. Fields where planting is delayed due to lack of suitable seed or late planting, select one of the following species:

   - Forage sorghum – ½ bu./ac. (5/15 - 7/15
   - Sorghum - Sudangrass hybrid – 1 bu./ac. (5/15 - 7/15)
   - Sudangrass – 1 bu./ac. (5/15 - 7/15)
   - Winter wheat - 2 bu/ac. (8/1-10/1)
   - Winter cereal rye - 2 bu/ac. (8/1-10/15)
   - Oats - 2 bu/ac. (4/1-9/1)
   - Annual ryegrass - 20 lbs/ac. (4/1-9/1)

   A temporary cover will typically not be necessary on those areas where at least 50 percent of the ground is covered with either crop residue or vegetative cover.

   Temporary cover crops must be clipped or destroyed before plants develop a viable seed, preventing excessive competition to the permanent seeding. Winter wheat and winter cereal rye must be terminated by tillage or herbicides before planting the permanent seeding.

2. For fields with triazine herbicide carryover, select one of the following species:

   - Forage sorghum – ½ bu./ac. (5/15 - 7/15)
   - Sorghum - Sudangrass hybrid – 1 bu./ac. (5/15 - 7/15)
   - Sudangrass – 1 bu./ac. (5/15 - 7/15)

   A bioassay test may be used to better determine chemical carryover.

Companion Crops

Companion crops can be used to reduce the amount of erosion on critical sites. The companion crops listed below are compatible with most native grass and forb plantings; will grow quickly under cooler conditions, suppress weeds and will not compete with the slower growing grasses and forbs.

Canada wildrye (*Elymus canadensis)* for mesic sites or Virginia wildrye (*Elymus virginicus)* for wet sites can be seeded at a rate of 1.0 pound PLS/acre. In addition, sideoats grama (*Bouteloua curtipendula)* can be seeded as a companion crop at a rate of 1.0 - 2.0 pounds PLS/acre on dry to dry mesic and mesic sites.

Sideoats grama or the wildrye species seeded as companion crops for the purpose of wildlife habitat and critical area plantings can be counted toward the minimum seeds per square foot, up to 20 percent of the required grass seed per square foot.

Oats (2 bu/ac) can be used as an alternative companion crop and is recommended on critical erosive sites that can be mowed before boot stage. Winter wheat or winter cereal rye is not the preferred companion crop due to the aggressive tillering nature of these plants.

SPECIAL EROSION CONTROL MEASURES

Since warm-season plants may be slow to establish, special erosion control measures will be needed on certain sites due to landscape conditions.

- Temporary cover crops may be seeded to obtain the required cover, prior to seeding.
- Seed site using no-till seeding methods.
- Divert surface water from location until vegetation has been established.
- Tillage and planting should occur on the contour only.
- Increase seeding rates by 25 percent to expedite cover establishment.
- Surface apply a mulch or solid manure on critical areas.
- Use a small grain companion crop.
- Plant species identified as aggressive in this technical note located in the section “Specie Selection and Seed Information”.

Figure 1
Planting Zone Map

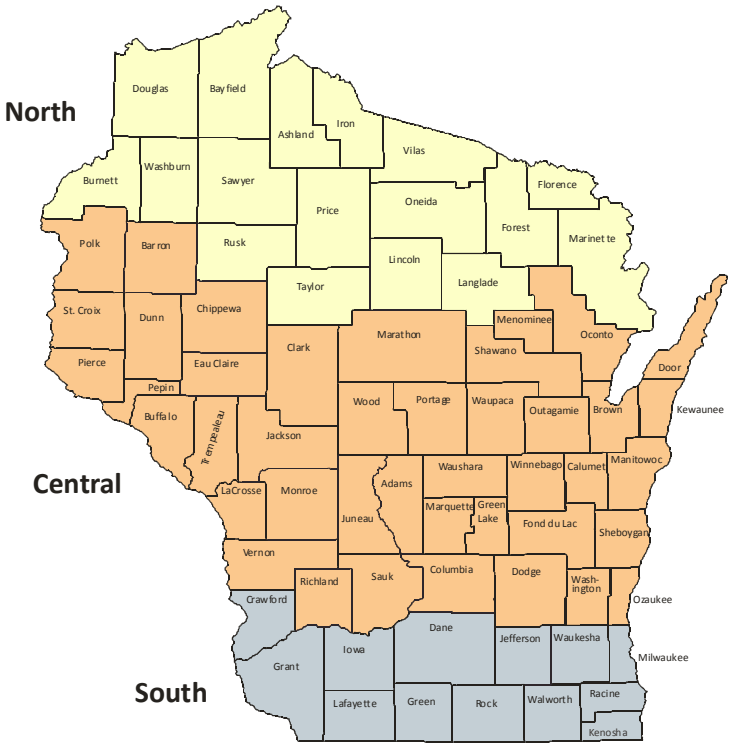

Table 2
Seeding Date/Ranges for
Warm Season Native Mixtures

Zone	Spring Seeding	Fall Dormant Seeding*
Northern	Thaw - 7/15	10/8 - Freeze Up
Central	Thaw - 6/30	10/15 - Freeze Up
Southern	Thaw - 6/30	10/20 - Freeze Up

*Dormant seeding is not allowed when using Practice Standard 342, Critical Area Planting.

GENERAL PRE-PLANT SEEDING RECOMMENDATIONS

Pre-Planting Weed Control

Pre-plant weed control is a critical step in the establishment of native plant materials. Weeds compete with seedlings for moisture, light and nutrients. Inadequate weed control causes more stand failures than any other single factor. Ideally, 6 months to a year prior to planting native species, consider this window as a pre plant weed control year. During that year a concerted effort should be made to control persistent perennials such as Canada thistle or knapweed. During the pre-plant weed control time period, evaluate the seed bed for the presence of weed seedlings. Where a significant number of weeds or invasive plants emerge consider tillage summer fallow, herbicide summer fallow, or a combination of tillage and herbicide summer fallow. Herbicide summer fallow is recommended for sites prone to erosion. For sites not susceptible to erosion, tillage or in combination with herbicide are recommended. The most effective strategy involves the integrated use of two or more weed control activities during the same growing season. Perennial weeds cannot be controlled effectively with herbicides after natives are planted.

Herbicide Carryover

Prior to planting check to ensure that any herbicides used on the previous crop will not “carry over” and

negatively impact newly seeded prairie plants. Residues of some herbicides such as Atrazine may prevent the establishment of some native plant materials for up to two years. If the residual effects of herbicides are possible, delay planting until after the recommended interval to allow residual herbicide levels to dissipate.

Fertilizing

For establishment of native species, soil testing and application of soil amendments is not a requirement; however, for maximum forage production (nutritional forage quality) and maximum biomass production for bio-energy, the application of nutrients will be based on the guidelines below.

The recommendations in this section are based on native grasses planted for hay, pasture, biomass production, and not for wildlife purposes. For pasture and hay land plantings of natives, a soil test is recommended prior to establishing vegetation. A current soil test is defined as test results no older than 4 years from the time last tested to the date of the planned seeding. Guidelines for soil testing can be found in Publication A2100, Sampling Soils for Testing. All nutrients will be applied following Wisconsin NRCS FOTG, Section IV, Standard 590, Nutrient Management.

Nitrogen should not be applied to warm season plantings until the second growing season to avoid stimulating weed growth. Applications of nutrients should not be made until spring growth has reached four to six inches.

Seedbed Preparation

When native materials are planted into undisturbed ground, the crop residue should be uniformly distributed over the soil surface prior to planting to minimize the smothering of new seedlings and to provide conditions for the operation of planting equipment. Planting native material into undisturbed soybean residue is preferred. Soybeans produce a moderate amount of crop residue that can be effectively managed and tend to leave the soil in a mellow condition that is well suited to no-till planting of prairie plants. Native material planted into undisturbed corn residue has proven successful at times. It is recommended that soil disturbance is necessary to ensure uniform germination by exposing soil, orienting and burying the corn residue, leaving 50-70 percent residue prior to planting.

Ground that has been tilled will require a firm seedbed prior to planting. A firm seedbed is important when planting native material. A firm seedbed helps conserve moisture evenly and ensures good seed to soil contact. Recently tilled ground should be firmed with a roller packer. The seedbed is firm enough when a footprint penetrates ¼ to ½ inch deep.

Sites tilled and packed are normally in a suitable condition for most seeding methods and with most types of native seed planters.

Seeding into existing sod will present special challenges. While the root and top growth of the old vegetation provide excellent erosion control, this biomass can make it difficult to achieve good seed placement. When planting native material into existing sod comprising of introduced species, the introduced species should be totally eradicated. The options available for eradicating introduced species include: tillage, tillage and herbicide, burn and herbicide, grazing, and mowing. Anytime tillage is performed, a firm seedbed is strongly recommended.

Seedbed preparation for frost seeding must occur before freeze-up. The fall before seeding occurs, evaluate the seedbed conditions to ensure that the remaining crop residue is well distributed and soil surface is level following tillage. Packing is not necessary; the weight of winter precipitation such as rain, ice and snow will naturally pack the soil, firming the seedbed. Undisturbed soybean residue is an ideal scenario for frost seeding. Frost seeding should not occur on existing sod or undisturbed corn ground. The corn stubble must be fall tilled to bury at least 30 percent of the residue and expose soil followed by a leveling tool.

A site that contains a significant remnant native plant population, consideration should be given to managing the site that would favor maintaining the species rather than eliminating them and reseeding. Stand improvement of existing natives will require a management program that allows the new seedlings to become established while maintaining the existing vegetative stand. Options available include: mowing and removing the biomass and interseeding, burn and interseed with persistent mowing until new seedlings become established. These options will require patience and persistence.

Planting Equipment and Seeding Methods

The equipment used to seed native materials should provide a consistent rate of seed flow and place the seed at a uniform depth in close contact with the soil. The characteristics of some native seeds require the use of specialized equipment or modification of

standard agricultural equipment such as grain drills. Some native seed are awned, light, fluffy, smooth, small, large and irregular in shape. Little Bluestem, Indiangrass, Big Bluestem all have light fluffy chaffy seed. Switchgrass has a small hard seed that will have several hundred thousand seeds per pound and Eastern Gamagrass has a large irregularly shaped seed and has about 8,000 seeds per pound. Any of these seed characteristics can result in uneven rates of seed flow and undesirable skips in seed rows in standard gravity fed grain drills. This makes it extremely important for the producer to understand planting methods commonly used and the need to have specialized equipment available to properly plant native species.

Whether a person is using conventional or no-till seeding methods, planting depth for native seeds should not exceed ¼ of an inch in depth. Either technique will be successful if specific guidelines are followed. There are advantages and disadvantages for using either seeding method.

Conventional seeding normally entails seedbed preparation involving some degree of tillage. The new planting is established by broadcasting or drilling into a partial or clean seedbed. The advantages and disadvantages of conventional seeding methods are:

- Advantages: may incorporate nutrients and provide the opportunity to destroy perennial weeds.
- Disadvantages: soil erosion increases greatly, erosion can wash new seedlings out or sediment can bury them, higher field preparation cost, weed competition can be greater especially from annual weeds, the need of a companion crop for erosion control and reduce weed competition.

No-till seeding is the planting of grasses, forbs and or legumes in the absence of tillage using planting tools capable of drilling into an undisturbed soil surface, interseeding into existing herbaceous cover or prior year crop residue. The advantages and disadvantages of no-till planting are:

- Advantages: soil erosion is minimized, reduced energy usage, no companion crop required, greater moisture availability, can seed under adverse conditions, carbon sequestrating approves, and proper seed placement ensured.
- Disadvantages: increased herbicide use, no-till drill required, nutrients cannot be incorporated.

Drill Seeding

Drill seeding is probably the most commonly used method of planting seed of any type. Seed is metered out from multiple seed boxes containing specialized components to mix, stir and meter seed, each adapted to planting different seed types. The soil opening and planting operation is followed by a set of packers, with no further soil preparation after seeding is completed. Drills may be classified as conventional or no-till type. A prepared seedbed is needed when using a conventional planter or drill. A no-till type drill can operate under both disturbed and undisturbed site conditions.

Whether a conventional or no-till type drill is used, prior to planting, calibrate the drill or seeder according to the manufacturer's instructions. Use a carrier material (or a small amount of seed if the carrier is not used) to test and adjust the seeding rate, distribution pattern, and planting depth.

Broadcast Seeding

Broadcast seeding is the planting or sowing seeds across an area by scattering seed either by mechanical means or by hand. Most common used mechanical broadcast planters are the rotary, cyclone and fertilizer cart with a spinning plate to evenly distribute seed material. Aerial seeding using an airplane or helicopter are common methods by which seed is broadcasted.

Broadcast planters work on the principle of centrifugal force and the inherent weight of the seed to distribute the seed uniformly across the site. When planting light, fluffy and chaffy seed, a carrier should be mix with the seed such as pelletized lime, fertilizer, damp sand, cracked corn, saw dust, vermiculite, etc. When fertilizer is used as a seed carrier, the seed must be spread immediately after mixing to prevent "salt effect" damage to the seed.

A prepared seedbed is critical to guaranteeing good seed to soil contact for uniform germination. Before and after seeding, a cultipacker or similar tool should be used to help incorporate, improve seed to soil contact and improve germination. Under certain conditions, broadcasting in an undisturbed seedbed can be successful for example on soybean stubble, when frost seeding, or fall dormant seedings. Broadcasting seed onto undisturbed ground consisting of large amounts of non-fragile residue is not recommended.

Calibration of broadcast spreaders is not as accurate as with drill seeding. To calibrate a broadcast seeder

determine your bulk seeding rate per acre and convert to an anticipated seeds per square foot. Place several tarps at multiple locations across the path of the seeder. Operate the seeder across the tarps and check each tarp for the average seed count per square foot, increasing or decreasing the rate of seed flow.

Frost Seeding

Frost seeding is the broadcasting of seed late winter through early spring. In Wisconsin, frost seeding normally should occur mid February to early March. The exact seeding date is not predetermined and will vary from year to year depending on climate.

Seed surface applied, absence of snow or onto snow cover of less than 2 inches. Seeding onto snow cover greater than 2 inches increases the risk for seeding failure. Frost seeding should not occur immediately before a predicted thaw event that could produce significant runoff. The soil surface is usually "honeycombed" with small cracks at this time during the year. The freeze/thaw cycles that occur at this time of year will embed the seed into the soil where it can germinate as growing conditions become more favorable. When the freeze-thaw cycle ends, seed according to the recommended spring seeding dates.

Frost seeding is allowed when using Practice Standards 327, Conservation Cover; and 512 Forage and Biomass Planting. Frost seeding is not allowed when using Standard 342, Critical Area Planting.

Dormant Seeding

Seed is broadcasted, no-tilled or conventional drilled into an undisturbed or disturbed partial or clean seedbed after the growing season and before freeze-up. The seed remains dormant until the following spring. A firm seedbed is required for disturbed or tilled sites. The advantages and disadvantages are:

- Advantages: seeding at a time of year when labor is more available, seedlings take advantage of early spring moisture, soil erosion is minimized.
- Disadvantage: seeding rates should be increased.

Dormant seeding is allowed when using Practice Standards 327, Conservation Cover; and 512, Forage and Biomass Planting. Dormant seeding is not allowed when using Standard 342, Critical Area Planting.

POST-PLANTING WEED CONTROL

Planting Year Post Emergence Weed Control Mowing – New Seedings

Mesic and wet sites in particular are prone to weed competition. Currently, there are limited herbicides available to control weeds in a prairie restoration planting without potentially impacting native legumes and most forbs. To combat this problem, repeated mowing is essential throughout the establishment period.

The first year following seeding, mow growing plants to a height of 7 inches whenever the canopy reaches a height of 12 inches. Depending on rainfall and growing conditions, three mowings may be required. In a normal growing season, mowing should occur around the middle of June, early to mid July as well as the first part of August. It may be necessary to remove the clippings to avoid smothering the seedlings. Utilize a rotary mower or flail chopper to uniformly distribute mowed material over the field surface. It is essential to monitor the canopy height to avoid the accumulation of excess clipped material over top of seedlings and to ensure sunlight reaches the soil surface for the new seeding. Use of this mowing strategy will stress the weeds and will not harm the prairie plants in this first year.

Second Year Weed Control

Routinely evaluate the stand in the second year to determine if mowing for weed control is necessary. When necessary to control weed canopy, mow the planting to a height of 7 inches as often as required. The strategy in year two will mirror year one maintenance activities. Establishment of your native planting will have precedent over nesting season concerns. Once the prairie is established, wildlife habitat concerns should be mitigated with seasonal or spot treatment activities that will minimally impact wildlife.

DETERMINING SUCCESS OF THE PLANTING

In determining stand adequacy, there are two major considerations: 1) adequate protection of the soil resource, and 2) adequate stand for the planned purpose.

It may be difficult to determine if the prairie restoration is successful, particularly during the seeding year. Most native species are long-lived, but develop slowly. It may take two to five years for a

stand to be fully successful. For native plantings determined to be questionable or inadequate, a final evaluation deciding whether to reseed should not be done until after the third growing season. It is often said prairie sleeps the first year (sets root structure), creeps the second year (starts to spread slowly) and leaps in the third year (distinct and prominent). Patience is a virtue.

POST ESTABLISHMENT MANAGEMENT

Any planned maintenance (except for noxious weed control) after the establishment period, should be done before May 15 or after August 1 to protect nesting cover and reduce disruption of nesting activities.

Spot Treatment By Clipping

Spot clipping can be used to control annual weeds and to suppress other weeds. Spot clipping must be done before the target plant forms viable seed and must continue throughout the growing season. Spot clipping is not an effective control for biennial and perennial weeds but can be used to contain these plants until other control treatments can be implemented.

Spot Treatment With Herbicide

It is often necessary to spot treat invasive plants in a prairie. Introduced grasses and legumes and other aggressive weeds can severely impact a prairie when these undesirable plants are not controlled. The timing of herbicide product application is an important factor to protect prairie plants. Improper herbicide selection or application timing can severely damage a prairie planting. Early spring spot treatment with herbicides is often highly effective in addressing aggressive weeds while native plants are dormant. Spot treatment should be timed to treat weeds during active growth periods. Effective herbicide spot treatment can prevent the target plants from setting seed and spreading in the prairie.

Spot Treatment By Hand Pulling/Digging

Hand pulling or digging can be an effective control if the entire root is removed from the soil. Hand pulling/digging is most effective in the spring when the soil is moist and loose from the winter freeze/thaw cycles.

Prescribed Burning – Established Cover

Burning is a good tool for long-term stand management of native vegetation. Burning may be used to manage weeds once the prairie has been established if there is enough material to carry a fire. Time of burning and frequency will impact the species that are present on the site. Fall burns and to a lesser extent early spring burns, will tend to promote forbs. Late spring burns tend to stimulate the growth of warm season grasses and suppress cool season plants. Burn when the cool season plants are growing and the warm season plants are dormant or starting to grow to control cool season species. Do not conduct sequential prescribed burns on a given site at the same time of year. This tends to reduce stand diversity and can create a negative impact on desirable prairie plants. For longevity and plant diversity, burning should be conducted periodically, every other year to every fifth year.

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Table 3
Common Species and Recommended Seeding Rates

Name	Scientific Name	Moisture Regime	Single Species Seeding Rate (PLS)		
Native Grasses			**Lbs./Ac.**	**Seeds/Lb.**	**Seeds/Ft^2/Lb./Ac.**
Big Bluestem	Andropogon gerardii	D, DM, M, WM	11	165,000	3.8
Canada Wildrye	Elymus canadensis	DM, M, WM	12	83,200	1.9
Fowl Mannagrass	Glyceria striata	WM, W	0.5	2,560,000	58.7
Indiangrass	Sorghastrum nutans	D, DM, M, WM, W	10	192,000	4.4
Little Bluestem	Schizachyrium scoparium	D, DM, M	8	240,000	5.5
Prairie Cordgrass	Spartina pectinata	M, WM, W	8	105,600	2.4
Prairie Dropseed	Sporobolus heterolepis	D, DM, M	3	256,000	5.9
Prairie Junegrass	Koeleria macrantha	D, DM, M	0.5	2,308,672	53
Sideoats Grama	Bouteloua curtipendula	D, DM, M	8	127,000	2.9
Switchgrass	Panicum virgatum	D, DM, M, WM, W	7	389,000	8.9
Virginia Wildrye	Elymus virginicus	M, WM, W	17	67,200	1.5
Rush			**Oz./Ac.**	**Seeds/Oz.**	**Seeds/Ft.^{2}/Oz./Ac.**
Woolgrass	Scirpus cyperinus	W	1.5	1,700,000	39

Table 4
Wisconsin NRCS Authorized Native Plant List
(Grasses, Rushes, Sedges)

Plant Type	Common Name	Scientific Name	Seeds/oz	Seeds/sq ft @ 1 oz/ac	Moisture Regime
Grass	Big Bluestem	Andropogon gerardii	10,313	0.24	D, DM, M, WM
Grass	Bluejoint	Calamagrostis canadensis	280,004	6.428	WM, W
Grass	Canada Wildrye	Elymus canadensis	5,200	0.12	DM, M, WM
Grass	Fowl Mannagrass	Glyceria striata	159,996	3.673	WM, W
Grass	American Mannagrass	Glyceria grandis	79,976	1.836	WM, W
Grass	Hairy Grama	Bouteloua hirsuta	70,000	1.607	D, DM
Grass	Indiangrass	Sorghastrum nutans	12,000	0.28	D, DM, M, WM, W
Grass	Prairie Junegrass	Koeleria macrantha	144,292	3.312	D, DM, M
Grass	Little Bluestem	Schizachyrium scoparium	15,000	0.344	D, DM, M
Grass	Porcupinegrass	Hesperostipa spartea	11,000	0.253	D, DM
Grass	Prairie Cordgrass	Spartina pectinata	6,600	0.152	M, WM, W
Grass	Prairie Dropseed	Sporobolus heterolepis	16,000	0.37	D, DM, M
Grass	Sand Dropseed	Sporobolus cryptandrus	332,125	7.625	D, DM, M
Grass	Sideoats Grama	Bouteloua curtipendula	7,938	0.183	D, DM, M
Grass	Switchgrass	Panicum virgatum	24,313	0.562	D, DM, M, WM, W
Grass	Virginia Wildrye*	Elymus virginicus*	4,200	0.096	M, WM, W
Rush	Common Rush	Juncus effusus	1,000,007	22.957	WM, W
Rush	Green Bulrush	Scirpus atrovirens	459,994	10.56	WM, W
Rush	River Bulrush	Schoenoplectus fluviatilis	4,299	0.0987	M, WM, W
Rush	Softstem Bulrush	Schoenoplectus tabernaemontani	31,015	0.712	WM, W
Rush	Woolgrass	Scirpus cyperinus	1,700,000	39.027	W
Sedge	Longhair Sedge	Carex comosa	30,013	0.689	WM, W
Sedge	Fox Sedge	Carex vulpinoidea	99,970	2.295	WM, W
Sedge	Bottlebrush Sedge	Carex hystericina	30,013	0.689	WM, W

**Virginia wildrye (Elymus virginicus) is better adapted than Canada wildrye (Elymus canadensis) for wet site condition seedings in the south planting zone (Figure 1).*

Table 5
Wisconsin NRCS Authorized Native Plant List
(Forbs, Legumes, Shrubs)

Plant Type	Common Name	Scientific Name	Seeds/oz	Seeds/sq ft @ 1 oz/ac	Moisture Regime	Blooming Period
Forb	Angelica	Angelica atropurpurea	5401	0.124	W	Middle
Forb	Bergamot	Monarda fistulosa	77,800	1.786	DM, M, WM	Middle – Late
Forb	Biennial Beeblossom	Gaura biennis	2,700	0.062	M	Middle – Late
Forb	Bird's Foot Violet	Viola pedata	26,000	0.597	D, DM	Early, Middle, Late
Forb	Black-Eyed Susan	Rudbeckia hirta	99,600	2.287	D, DM, M, WM	Middle – Late
Forb	Blue Vervain	Verbena hastata	93,000	2.134	WM, W	Middle – Late
Forb	Blue-Eyed Grass	Sisyrinchium campestre	45,000	1.033	D, DM, M	Early – Middle
Forb	Boneset	Eupatorium perfoliatum	160,000	3.67	WM, W	Middle – Late
Forb	Bottle Gentian	Gentiana andrewsii	280,000	6.428	M	Middle – Late
Forb	Butterfly Milkweed	Asclepias tuberosa	3,480	0.08	D, DM, M	Middle
Forb	Cardinal Flower	Lobelia cardinalis	400,000	9.18	WM, W	Middle – Late
Forb	Common Ironweed	Vernonia fasciculata	20,000	0.459	WM, W	Late
Forb	Compass Plant	Silphium laciniatum	650	0.015	DM, M, WM	Middle – Late
Forb	Culver's Root	Veronicastrum virginicum	750,000	17.218	M, WM, W	Middle
Forb	Cupplant	Silphium perfoliatum	1,400	0.032	M, WM, W	Middle – Late
Forb	Downy Gentian	Gentiana puberulenta	435,000	9.986	DM, M	Late
Forb	Downy Wood Mint	Blephilia ciliata	400,000	9.18	DM, M, WM	Middle – Late
Forb	Evening Primrose	Oenothera biennis	90,000	2.07	D, DM, M	Late
Forb	False Boneset	Brickellia eupatorioides	24,000	0.551	D, DM	Middle – Late
Forb	False Toadflax	Comandra umbellata	700	0.016	D, DM, M, WM	Early – Middle
Forb	Few Leaf Sunflower	Helianthus occidentalis	12,960	0.298	DM, M	Middle – Late
Forb	Flowering Spurge	Euphorbia corollata	8,000	0.184	D, DM, M, WM	Middle – Late
Forb	Foxglove Beard Tongue	Penstemon digitalis	115,000	2.64	M, WM	Early – Middle
Forb	Goat's Rue	Tephrosia virginiana	2,500	0.057	D, DM	Early – Middle
Forb	Golden Alexanders	Zizia aurea	11,000	0.25	M, WM, W	Early
Forb	Golden Ragwort	Packera aurea	73,000	1.68	M, WM, W	Early – Middle
Forb	Great Blue Lobelia	Lobelia siphilitica	500,000	11.478	W	Middle – Late
Forb	Great St. Johnswort	Hypericum ascyron	200,000	4.59	M, WM	Middle
Forb	Green Milkweed	Asclepias viridiflora	3,600	0.083	D, DM	Early – Middle
Forb	Grooved Yellow Flax	Linum sulcatum	94,000	2.158	D, DM	Early, Middle, Late
Forb	Harebell	Campanula rotundifolia	900,000	20.66	D, DM	Middle – Late
Forb	Harelequin Blue Flag Iris	Iris versicolor	1,300	0.029	W	Early – Middle
Forb	Heath Aster	Symphyotrichum ericoides	140,000	3.214	D, DM, M, WM	Late
Forb	Hoary Vervain	Verbena stricta	32,000	0.734	D, DM	Middle – Late
Forb	Joe-Pye Weed	Eutrochium maculatum	95,000	2.18	W	Middle – Late
Forb	Large Beard Tongue	Penstemon grandiflorus	14,000	0.321	DM	Middle
Forb	Marsh Milkweed	Asclepias incarnata	4,800	0.11	W	Middle
Forb	Meadow Anemone	Anemone canadensis	8,000	0.184	M, WM	Early – Middle
Forb	Mountain Mint	Pycnanthemum virginianum	220,000	5.05	DM, M, WM, W	Middle – Late
Forb	New England Aster	Symphyotrichum novae-angliae	69,900	1.605	M, WM	Late
Forb	Nodding Beggartick	Bidens cernua	21,000	0.482	WM, W	Late
Forb	Nodding Wild Onion	Allium cernuum	7,680	0.176	DM, M	Middle
Forb	Ox-Eye Sunflower	Heliopsis helianthoides	6,480	0.149	M	Middle – Late
Forb	Pale Purple Coneflower	Echinacea pallida	4,580	0.105	DM, M	Middle
Forb	Pale Spiked Lobelia	Lobelia spicata	900,000	20.661	D, DM, M, WM	Middle
Forb	Pasque Flower	Pulsatilla patens	18,000	0.413	D, DM	Early
Forb	Prairie Alum-Root	Heuchera richardsonii	750,000	17.22	D, DM, M, WM	Early – Middle

Plant Type	Common Name	Scientific Name	Seeds/oz	Seeds/sq ft @ 1 oz/ac	Moisture Regime	Blooming Period
Forb	Prairie Blazing Star	Liatris pycnostachya	11,970	0.275	D, DM, M, WM	Middle – Late
Forb	Prairie Cinquefoil	Potentilla arguta	200,000	4.591	D, DM, M	Middle – Late
Forb	Prairie Dock	Silphium terebinthinaceum	1,110	0.025	DM, M, WM	Middle – Late
Forb	Prairie Loosestrife	Lysimachia quadriflora	90,000	2.07	M, WM, W	Middle
Forb	Prairie Milkweed	Asclepias sullivantii	4,500	0.103	D, DM, M, WM	Early – Middle
Forb	Prairie Parsley	Polytaenia nuttallii	4,000	0.0918	D, DM, M, WM	Early – Middle
Forb	Prairie Phlox	Phlox pilosa	19,000	0.436	DM, M	Early – Middle
Forb	Prairie Smoke	Geum triflorum	27,000	0.62	D, DM	Early
Forb	Prairie Sunflower	Helianthus pauciflorus	4,580	0.105	D, DM, M	Middle – Late
Forb	Prairie Tickseed	Coreopsis palmata	11,970	0.275	D, DM	Middle – Late
Forb	Prairie Violet	Viola pedatifida	28,000	0.643	D, DM, M	Early, Middle, Late
Forb	Purple Coneflower	Echinacea purpurea	6,600	0.15	D, DM, M	Middle
Forb	Purple Meadow-Rue	Thalictrum dasycarpum	11,000	0.252	M, WM, W	Middle
Forb	Rattlesnake Master	Eryngium yuccifolium	7,980	0.183	DM, M, WM	Middle – Late
Forb	Rosinweed	Silphium integrifolium	3,990	0.092	DM, M, WM	Middle – Late
Forb	Rough Blazing Star	Liatris aspera	13,470	0.309	D, DM, M	Late
Forb	Sawtooth Sunflower	Helianthus grosseserratus	15,000	0.344	D, DM, M, WM, W	Middle – Late
Forb	Shootingstar	Dodecatheon meadia	75,000	1.722	D, DM, M, WM	Early
Forb	Showy Goldenrod	Solidago speciosa	95,000	2.18	D, DM, M	Late
Forb	Silky Aster	Symphyotrichum sericeum	56,000	1.29	D, DM	Late
Forb	Sky-Blue Aster	Symphyotrichum oolentangiense	82,000	1.882	D, DM, M	Late
Forb	Smooth Blue Aster	Symphyotrichum laeve	47,830	1.098	DM, M, WM	Late
Forb	Sneezeweed	Helenium autumnale	130,000	2.98	WM, W	Middle – Late
Forb	Spiderwort	Tradescantia ohiensis	7,980	0.183	D, DM, M, WM	Early – Middle
Forb	Spotted Jewelweed	Impatiens capensis	1,600	0.037	M, WM, W	Middle – Late
Forb	Spotted Mint	Monarda punctata	93,700	2.151	D, DM	Middle – Late
Forb	Stiff Goldenrod	Oligoneuron rigidum	45,850	1.053	D, DM, M	Late
Forb	Sweet Black-Eyed Susan	Rudbeckia subtomentosa	45,850	1.053	DM, M, WM	Middle – Late
Forb	Thimbleweed	Anemone cylindrica	20,000	0.459	D, DM	Early – Middle
Forb	Turk's Cap Lily	Lilium superbum	5,000	0.115	M, WM	Middle
Forb	Upland Boneset	Eupatorium sessilifolium	50,000	1.15	M	Late
Forb	Whorled Milkweed	Asclepias verticillata	4,000	0.092	D, DM	Middle – Late
Forb	Wild Garlic	Allium canadense	560	0.013	M, WM	Middle
Forb	Wild Quinine	Parthenium integrifolium	6,790	0.156	DM, M, WM	Middle – Late
Forb	Winged Loosestrife	Lythrium alatum	3,000,000	68.87	WM, W	Middle – Late
Forb	Wood Betony	Pedicularis canadensis	33,000	0.758	D, DM, M	Early
Forb	Yellow Cone Flower	Ratibida pinnata	26,940	0.618	D, DM, M, WM	Middle – Late
Forb	Yellow Star Grass	Hypoxis hirsuta	80,000	1.837	DM, M, WM	Early, Middle, Late
Legume	Canada Milk Vetch	Astragalus canadensis	15,960	0.366	M, WM	Middle
Legume	Cream Wild Indigo	Baptisia bracteata	1,700	0.039	M	Early
Legume	Illinois Tick Trefoil	Desmodium illinoense	4,500	0.103	DM, M	Early – Middle
Legume	Leadplant	Amorpha canescens	16,950	0.389	D, DM, M	Middle
Legume	Purple Prairie Clover	Dalea purpurea	19,950	0.458	D, DM, M	Early, Middle, Late
Legume	Round-Headed Bush-Clover	Lespedeza capitata	9,960	0.229	D, DM	Late
Legume	Showy Tick-Trefoil	Desmodium canadense	4,500	0.103	M	Middle – Late
Legume	White Prairie Clover	Dalea candida	15,850	0.364	D, DM, M	Middle
Legume	White Wild Indigo	Baptisia alba	1,585	0.036	DM, M, WM	Middle
Legume	Wild Lupine	Lupinus perennis	990	0.023	D, DM, M	Early – Middle
Shrub	New Jersey Tea	Ceanothus americanus	7,000	0.161	DM, M	Middle - Late

Table 6
Sample Seed Mix for Basic Dry Prairie
(Seed Calculator Code 327-1)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Sq. Foot
Stiff Goldenrod	Oligoneuron rigidum	1.00	1.0
Yellow cone flower	Ratibida pinnata	1.00	0.6
Purple prairie clover	Dalea purpurea	2.00	0.9
Big bluestem	Andropogon gerardii	16.00	3.8
Little bluestem	Schizachyrium scoparium	28.00	9.6
Indiangrass	Sorghastrum nutans	16.00	4.4
Sideoats grama	Bouteloua curtipendula	28.00	5.1

Table 7
Sample Seed Mix for Basic Dry Mesic Prairie
(Seed Calculator Code 327-2)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Sq. Foot
Purple prairie clover	Dalea purpurea	2.00	0.9
Bergamot	Monarda fistulosa	1.00	1.8
Yellow cone flower	Ratibida pinnata	1.00	0.6
Big bluestem	Andropogon gerardii	8.00	1.9
Little bluestem	Schizachyrium scoparium	24.00	8.3
Indiangrass	Sorghastrum nutans	16.00	4.4
Switchgrass	Panicum virgatum	8.00	4.5
Sideoats grama	Bouteloua curtipendula	16.00	2.9

Table 8
Sample Seed Mix for Basic Mesic Prairie
(Seed Calculator Code 327-3)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Sq. Foot
Yellow cone flower	Ratibida pinnata	1.00	0.6
Blackeyed Susan	Rudbeckia hirta	1.00	2.2
Bergamot	Monarda fistulosa	1.00	1.8
Big bluestem	Andropogon gerardii	16.00	3.8
Switchgrass	Panicum virgatum	8.00	4.5
Little bluestem	Schizachyrium scoparium	20.00	6.9
Indiangrass	Sorghastrum nutans	16.00	4.4
Canada wildrye	Elymus canadensis	16.00	1.9

Table 9
Sample Seed Mix for Basic Wet Mesic Prairie
(Seed Calculator Code 327-4)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Sq. Foot
Bergamot	Monarda fistulosa	1.00	1.8
Yellow cone flower	Ratibida pinnata	1.00	0.6
New England aster	Symphyotrichum novae-angliae	1.00	1.6
Switchgrass	Panicum virgatum	16.00	8.9
Prairie cordgrass	Spartina pectinata	8.00	1.2
Big bluestem	Andropogon gerardii	24.00	5.8
Virginia wildrye	Elymus virginicus	16.00	1.5
Indiangrass	Sorghastrum nutans	16.00	4.4

Table 10
Sample Seed Mix for Basic Wet Prairie
(Seed Calculator Code 327-5)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Sq. Foot
Common ironweed	Vernonia fasciculata	1.00	0.5
Cupplant	Silphium perfoliatum	2.00	0.1
Blue vervain	Verbena hastata	1.00	2.1
Switchgrass	Panicum virgatum	16.00	8.9
Prairie cordgrass	Spartina pectinata	8.00	1.2
Big bluestem	Andropogon gerardii	16.00	3.8
Indiangrass	Sorghastrum nutans	16.00	4.4
Virginia wildrye	Elymus virginicus	20.00	1.9

Table 11
Sample Seed Mix for Dry Prairie Restoration
(Seed Calculator Code 327-6)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Sq. Foot
Prairie cinquefoil	Potentilla arguta	0.50	2.3
Silky Aster	Symphyotrichum sericeum	1.00	1.3
Leadplant	Amorpha canescens	1.00	0.4
Spotted mint	Monarda punctata	0.50	1.1
Prairie tickseed	Coreopsis palmata	1.00	0.3
Stiff Goldenrod	Oligoneuron rigidum	1.00	1.0
Hoary vervain	Verbena stricta	1.00	0.7
Yellow cone flower	Ratibida pinnata	1.00	0.6
Spiderwort	Tradescantia ohiensis	2.00	0.4
Purple prairie clover	Dalea purpurea	4.00	1.8
Big bluestem	Andropogon gerardii	4.00	1.0
Sideoats grama	Bouteloua curtipendula	24.00	4.4
Little bluestem	Schizachyrium scoparium	24.00	8.3
Indiangrass	Sorghastrum nutans	8.00	2.2
Prairie June Grass	Koeleria macrantha	2.00	6.6
Sand dropseed	Sporobolus cryptandrus	2.00	15.3

Table 12
Sample Seed Mix for Dry Mesic Prairie Restoration
(Seed Calculator Code 327-7)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Sq. Foot
Prairie cinquefoil	Potentilla arguta	0.25	1.1
Leadplant	Amorpha canescens	1.00	0.4
Silky Aster	Symphyotrichum sericeum	1.00	1.3
Purple prairie clover	Dalea purpurea	3.00	1.4
Rough blazing star	Liatris aspera	0.50	0.2
Roundheaded Bushclover	Lespedeza capitata	3.00	0.7
Bergamot	Monarda fistulosa	1.00	1.8
Yellow cone flower	Ratibida pinnata	1.00	0.6
Stiff Goldenrod	Oligoneuron rigidum	1.00	1.1
Spiderwort	Tradescantia ohiensis	1.00	0.2
Little bluestem	Schizachyrium scoparium	24.00	8.3
Indiangrass	Sorghastrum nutans	8.00	2.2
Prairie June Grass	Koeleria macrantha	2.00	6.6
Prairie dropseed	Sporobolus heterolepis	2.00	0.7
Switchgrass	Panicum virgatum	4.00	2.2
Sideoats grama	Bouteloua curtipendula	24.00	4.4

Table 13
Sample Seed Mix for Mesic Native Prairie Restoration
(Seed Calculator Code 327-8)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Sq. Foot
Yellow cone flower	Ratibida pinnata	0.50	0.3
Blackeyed Susan	Rudbeckia hirta	0.50	1.1
Sky blue aster	Aster oolentangiense	0.50	0.9
Ox-eye sunflower	Heliopsis helianthoides	1.00	0.1
Bergamot	Monarda fistulosa	0.50	0.9
Culvers root	Vernonia virginicum	0.25	4.3
Purple prairie clover	Dalea purpurea	1.00	0.5
Rosinweed	Silphium integrifolium	1.00	0.1
Prairie blazing star	Liatris pycnostachya	1.00	0.3
New england aster	Symphyotrichum novae-angliae	0.50	0.8
Big bluestem	Andropogon gerardii	16.00	3.8
Switchgrass	Panicum virgatum	8.00	4.5
Little bluestem	Schizachyrium scoparium	24.00	8.3
Canada wildrye	Elymus canadensis	8.00	1.0
Indiangrass	Sorghastrum nutans	16.00	4.4

Table 14
Sample Seed Mix for Wet Mesic Prairie Restoration
(Seed Calculator Code 327-9)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Sq. Foot
Blackeyed Susan	Rudbeckia hirta	1.00	2.2
Bergamot	Monarda fistulosa	1.00	1.8
Yellow cone flower	Ratibida pinnata	1.00	0.6
Prairie blazing star	Liatris pycnostachya	1.00	0.4
Common Ironweed	Vernonia fasciculata	1.00	0.5
Cupplant	Silphium perfoliatum	4.00	0.1
Golden Alexanders	Zizia aurea	1.00	0.3
Great St John's Wort	Hypericum ascyron	0.25	1.1
White wild indigo	Baptisia alba	1.50	0.1
New England aster	Symphyotrichum novae-angliae	1.00	1.6
Switchgrass	Panicum virgatum	16.00	8.9
Prairie cordgrass	Spartina pectinata	4.00	0.6
Big bluestem	Andropogon gerardii	20.00	4.8
Canada wildrye	Elymus canadensis	16.00	1.9
Indiangrass	Sorghastrum nutans	12.00	3.4

Table 15
Sample Seed Mix for Wet Prairie Restoration
(Seed Calculator Code 327-10)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Sq. Foot
Culver's root	Veronicastrum virginicum	0.25	4.3
Common ironweed	Vernonia fasciculata	0.50	0.2
Cupplant	Silphium perfoliatum	2.00	0.1
Marsh milkweed	Asclepias incarnata	2.00	0.2
Joe pye weed	Eutrochium maculatum	1.00	2.2
Blue vervain	Verbena hastata	2.00	4.3
Showy tick trefoil	Desmodium canadense	3.00	0.3
Boneset	Eupatorium perfoliatum	0.50	1.8
Golden alexanders	Zizia aurea	2.00	0.5
Switchgrass	Panicum virgatum	8.00	4.5
Prairie cordgrass	Spartina pectinata	4.00	0.6
Big bluestem	Andropogon gerardii	4.00	1.0
Canada wildrye	Elymus canadensis	8.00	1.0
Indiangrass	Sorghastrum nutans	4.00	1.1
Fowl mannagrass	Glyceria striata	4.00	14.7
Fox sedge	Carex vulpinoidea	4.00	9.2

Table 16
Seed Mix for Dry Mesic Karner Blue Prairie Restoration
(Seed Calculator Code 327-11)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Sq. Foot
Prairie cinquefoil	Potentilla arguta	0.50	2.2
Leadplant	Amorpha canescens	1.00	0.4
Silky Aster	Symphyotrichum sericeum	1.0	1.3
Purple prairie clover	Dalea purpurea	4.00	1.8
Rough blazing star	Liatris aspera	1.00	0.3
Wild lupine	Lupinus perennis	6.00	0.1
Bergamot	Monarda fistulosa	0.50	0.9
Yellow cone flower	Ratibida pinnata	1.00	0.6
Stiff Goldenrod	Oligoneuron rigidum	1.00	1.1
Pale Purple Coneflower	Echinacea pallida	2.00	0.2
Sideoats grama	Bouteloua curtipendula	20.00	3.7
Little bluestem	Schizachyrium scoparium	24.00	8.3
Indiangrass	Sorghastrum nutans	8.00	2.2
Prairie June Grass	Koeleria macrantha	1.00	3.3
Prairie dropseed	Sporobolus heterolepis	2.00	0.7
Switchgrass	Panicum virgatum	4.00	2.2

Table 17
Sample Seed Mix for Native Pollinator Seeding for Dry Mesic Sites
(Seed Calculator Code 327-12)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Square Foot
Little Bluestem	Schizachyrium scoparium	16	5.5
Sideoats Grama	Bouteloua curtipendula	16	2.9
Illinois Tick Trefoil	Desmodium illinoense	5	0.5
Spiderwort	Tradescantia ohiensis	5	0.9
Purple Prairie Clover	Dalea purpurea	6	2.7
Yellow Coneflower	Ratibida pinnata	1	0.6
Prairie Blazing Star	Liatris pycnostachya	3	0.8
Rattlesnake Master	Eryngium yuccifolium	6	1.1
Showy Goldenrod	Solidago speciosa	4	8.7
Stiff Goldenrod	Oligoneuron rigidum	3	3.2
Smooth Blue Aster	Symphyotricum laeve	2	2.2
Prairie Cinquefoil	Potentilla arguta	2	9.2

Table 18
Sample Seed Mix for Native Pollinator Seeding for Mesic Sites
(Seed Calculator Code 327-13)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Square Foot
Little Bluestem	Schizachyrium scoparium	16	5.5
Sideoats Grama	Bouteloua curtipendula	16	2.9
Foxglove Beardtongue	Penstemon digitalis	4	10.6
Spiderwort	Tradescantia ohiensis	6	1.1
Golden Alexanders	Zizia aurea	6	1.5
Yellow Coneflower	Ratibida pinnata	1	0.6
Purple Prairie Clover	Dalea purpurea	6	2.7
Prairie Blazing Star	Liatris pycnostachya	4	1.1
Rattlesnake Master	Eryngium yuccifolium	6	1.1
New England Aster	Symphyotrichum novae-angliae	3	4.8
Stiff Goldenrod	Oligoneuron rigidum	3	3.2
Smooth Blue Aster	Symphyotrichum laeve	3	3.3

Table 19
Sample Seed Mix for Native Pollinator Seeding for Wet Mesic Sites
(Seed Calculator Code 327-14)

Common Name	Scientific Name	PLS Oz/Ac	Seeds/Square Foot
Big Bluestem	Andropogon gerardii	16	3.8
Indiangrass	Sorghastrum nutans	16	4.4
Foxglove Beardtongue	Penstemon digitalis	4	10.6
Spiderwort	Tradescantia ohiensis	6	1.1
Golden Alexanders	Zizia aurea	5	1.3
Yellow Coneflower	Ratibida pinnata	1	0.6
Prairie Blazing Star	Liatris pycnostachya	3	0.8
Rattlesnake Master	Eryngium yuccifolium	6	1.1
New England Aster	Symphyotrichum novae-angliae	3	4.8
Blue Vervain	Verbena hastata	4	8.5
Common Ironweed	Vernonia fasciculata	3	1.4
Cupplant	Silphium perfoliatum	3	0.1

Table 20
Seeding Chart for Native Grass Species

Grass	Percent of Mixture	Pure Stand Seeding Rate	Seeds per Square Foot
Big Bluestem, Andropogon gerardii	0-100	11 lbs/ac	42
Canada Wildrye, Elymus canadensis	0-20	12 lbs/ac	23
Indiangrass, Sorghastrum nutans	0-100	10 lbs/ac	44
Little Bluestem, Schizachyrium scoparium	0-20	8 lbs./ac	44
Sideoats Grama, Bouteloua curtipendula	0-20	8 lbs/ac	23
Switchgrass, Panicum virgatum	0-100	7 lbs/ac	63
Virginia Wildrye, Elymus virginicus	0-20	17 lbs/ac	26
Prairie Junegrass, Koeleria macrantha	0-20	0.5 lbs/ac	26
Hairy Grama, Bouteloua hirsuta	0-25	1 lb/ac	26

Canada Wildrye, Virginia Wildrye and Sideoats Grama when combined will not comprise of more than 20 percent of the total grass seeds per square foot. Pure stand seeding rates for Big Bluestem and Indiangrass must be increased by 5 lbs/acre to meet the minimum seeds per square foot as required by this standard. Refer to Table 3 for suggested moisture regimes per specie.

Table 21
Biomass Planting Recommendations

Forage Suitability Group	Species	Lbs. PLS/Acre	Seeds per Square Foot
Biomass/Biofuel			
Group: 1-9	Switchgrass Varieties: Blackwell Cave-in-Rock Pathfinder Sunburst	 7 7 7 7	63

Table 22
Solid Native Grass Plantings
(Seed Calculator Code 327-15 A to C, 512 H7 to H9)

Seed Calculator Code	Mixtures	Pounds PLS per Acre	Seeds per Square Foot	Moisture Regime
327-15A, 512-H7	Switchgrass (Panicum virgatum)	7.0	63	DM-WM
327-15B, 512-H8	Big Bluestem (Andropogon gerardii)	11.0	42	
327-15C, 512-H9	Indiangrass (Sorghastrum nutans)	10.0	44	

Table 23
Summary of Seeding Requirements for Standards 327, 342, and 512 (Native Species)

Standard 327 - Conservation Cover									
Mix Type	Grasses		Forbs/Legumes[a]		Seeding Periods				Notes
	No.	Seeds/Ft^2	No.	Seeds/Ft^2	Spring	Late Summer	Dormant[b]	Frost[b]	
Basic Prairie[c]	≥3	≥20	≥3	≥2	X	NR	X	X	At least 50% of mix must be grasses (mix can have up to 20% Canada and Virginia Wildrye and Sideoats Grama).
Prairie Restoration[c]	≥5	≥15	≥10	≥8	X	NR	X	X	At least 1 forb must be legume and at least 50% of seeds per square foot must be grasses (mix can have up to 20% Canada and Virginia Wildrye and Sideoats Grama).
Pollinator Habitat	1-2	≤10	≥9	≥30	X	NR	X	X	- At least 3 early, 3 mid, and 3 late blooming forbs. - Grasses must be bunch-type and maximum of 10 seeds per square foot.
Untested Local Genotype Seed	≥5	≥25	≥10	≥10	X	NR	X	X	- At least 50 seeds per square foot total. - Grasses must be at least 50% of mix. - If single specie makes up more than 20% of mix, only count 20% towards the total seeds per square foot. - At least 1 forb must be legume.

(a) If more than 20% of legumes are hard seed, increase rate by % hard seed.
(b) Increase rate 15% for frost and dormant seedings.
(c) Maximum rates/acre for the following species: Switchgrass (1 lb.), Prairie Junegrass (2.0 oz.), Black-eyed Susan (2.0 oz.), Bergamot (2.0 oz.), or Purple Coneflower (3.0 oz.)

Standard 342 - Critical Area Planting									
Mix Type	Grasses		Forbs/Legumes		Seeding Periods				Notes
	No.	Seeds/Ft^2	No.	Seeds/Ft^2	Spring	Late Summer	Dormant	Frost	
Grasses Only	≥1	≥60			X	NR	NR	NR	Limit Canada Wildrye, Virginia Wildrye, and Sideoats Grama to 20% of the total grasses.
Mixtures	≥1	≥40	≥1	≥20	X	NR	NR	NR	- Mix must be at least 60 seeds per square foot total. - Grasses must be at least 50% of the mix (can have up to 20% Canada and Virginia Wildrye and Sideoats Grama).

Standard 512 - Forage and Biomass Planting									
Mix Type	Grasses		Forbs		Seeding Periods				Notes
	No.	Seeds/Ft^2	No.	Seeds/Ft^2	Spring	Late Summer	Dormant[a]	Frost[a]	
Pasture/Hayland	1	See Notes			X	NR	X	X	- Big Bluestem: 42 seeds per square foot. - Indiangrass: 44 seeds per square foot. - Switchgrass: 63 seeds per square foot.
Biomass Seeding	1	≥60			X	NR	X	X	Only Switchgrass is approved.

(a) Increase rate 15% for frost and dormant seedings.

Wet Detention Pond
(1001)
Wisconsin Department of Natural Resources
Conservation Practice Standard

Appendix D—Pond Liner Design, Decision Flowchart

Pond Liner Design Specifications for Three Levels of Liners

A. Type A Liners—for sites with the highest potential for groundwater pollution. They include:
- Clay (natural soil, not bentonite)
- High Density Polyethylene (HDPE)
- Geosynthetic Clay Liners (GCL)

1. Clay liner criteria (essentially the same as the clay below landfills but not as thick):
   a. 50% fines (200 sieve) or more.
   b. An in-place hydraulic conductivity of 1×10^{-7} cm./sec. or less.
   c. Average liquid limit of 25 or greater, with no value less than 20.
   d. Average PI of 12 or more, with no values less than 10.
   e, Clay installed wet of optimum if using standard Proctor, and 2% wet of optimum if using modified Proctor.
   f. Clay compaction and documentation as specified in NRCS Wisconsin Construction Specification 300, Clay Liners.
   g. Minimum thickness of two feet.
   h. Specify method for keeping the pool full or use of composite soils below liner.
2. HDPE liner criteria:
   a. Minimum thickness shall be 60 mils.
   b. Design according to the criteria in Table 3 of the NRCS 313, Waste Storage Facility technical standard.
   c. Install according to NRCS Wisconsin Construction Specification 202, Polyethylene Geomembrane Lining.
3. GCL liner criteria:
   a. Design according to the criteria in Table 4 of NRCS 313, Waste Storage Facility technical standard.
   b. Install according to NRCS Wisconsin Construction Specification 203, Geosynthetic Clay Liner.

B. Type B Liners—for sites with medium potential for groundwater pollution or where need for a full pool level is high. They include:
- All liners meeting Type A criteria
- Clay
- HDPE
- Polyethylene Pond Liner (PPL)

1. Clay liner criteria:
   a. 50% fines (200 sieve) or more.
   b. An in-place hydraulic conductivity of 1×10^{-6} cm./sec. or less.
   c. Average liquid limit value of 16 or greater, with no value less than 14.
   d. Average PI of 7 or more with no values less than 5.
   e. Clay compaction and documentation as specified in NRCS Wisconsin Construction Specification 204, Earthfill for Waste Storage Facilities.
   f. Minimum thickness of two feet.
   g. Specify method for keeping the pool full or use of composite soils below liner.
2. HDPE liner criteria:
   a. Minimum thickness shall be 40 mils.
   b. All other criteria same as for Type A HDPE liner.
3. PPL liner criteria:
   a. Minimum thickness shall be 30 mils.
   b. All other criteria same as for Type A HDPE liner.

C. Type C Liners—for sites with little potential for groundwater pollution or where the need for a full pool is less important. They include:
- All liners meeting Type A or B criteria
- Silts and clays
- HDPE (<40 mil)
- PPL (20-24 mil)
- PVC (30-40 mil)
- EPDM (45 mil)

1. Silt/Clay liner criteria:
   a. 50% fines (200 sieve), or 20% fines and a PI of 7.
   b. Soil compaction and documentation as specified in NRCS Wisconsin Construction Specification 204, Earthfill for Waste Storage Facilities.
   c. Minimum thickness of two feet.
   d. Specify method for keeping the pool full or use of composite soils below liner.

D. Liner Elevation—All liners must extend above the permanent pool up to the elevation reached by the 2-yr., 24-hour storm event.

E. For synthetic liners, follow the manufacturers' recommendations for installation.

State of Wisconsin
Department of Natural Resources
dnr.wi.gov

CONSTRUCTION SITE INSPECTION REPORT

Form 3400-187 (rev. 9/04)

Notice: Use of this specific form is voluntary, but the information contained on this form must be collected and kept by the permittee under s. NR 216.48(4), Wis. Adm. Code, for a construction site covered under the General WPDES Construction Site Storm Water Discharge Permit, Permit No. WI-0067831-2. This form is provided for the convenience of the permittee to meet the requirements of s. NR 216.48(4), Wis. Adm. Code. Multiple copies of this form may be made to compile the inspection report.

Inspections of implemented erosion and sediment control best management practices must be performed weekly and within 24 hours after a precipitation event 0.5 inches or greater which results in runoff.

Weekly written reports of all inspections conducted by or for the permittee must be maintained throughout the period of general permit coverage.

The information maintained in accordance with s. NR 216.48 (4) must be submitted to the Department upon request.

Name of Permittee:	
Construction Site Name (Project):	**Construction Site ID No.:**
Location:	**County:**
Contractor:	**Field Office Phone:**

Note: Weekly inspection reports, along with erosion control and stormwater management plans, are required to be maintained on site and made available upon request.

Date of inspection (mm/dd/yy): _____	**Type of inspection:** ☐ **Weekly** ☐ **Precipitation Event** ☐ **Other (specify)** _____
Time of inspection: Start: _____ **a.m./p.m.** **End:** _____ **a.m./p.m.**	**Name(s) of individual(s) performing inspection:**
Weather:	
Description of present phase of construction:	

Modifications Required	**Yes**	**No**	**Not Applicable**	**Comments/Recommendations** about the overall effectiveness of the erosion and sediment control measures. **Note**: For each item checked "Yes", complete the follow-up information on page 2.
Ditch Checks	☐	☐	☐	
Erosion Control Plan	☐	☐	☐	
Erosion Mat	☐	☐	☐	
Grading Practices	☐	☐	☐	
Inlet Protection	☐	☐	☐	
Mulch	☐	☐	☐	
Offsite Sediment	☐	☐	☐	
Permanent Seeding	☐	☐	☐	
Schedule / Phasing	☐	☐	☐	
Silt Fence	☐	☐	☐	
Silt Screen	☐	☐	☐	
Sod	☐	☐	☐	
Stabilized Outlet	☐	☐	☐	
Temp. Diversion Channel	☐	☐	☐	
Temp. Settling Basin	☐	☐	☐	
Temporary Seeding	☐	☐	☐	
Tracking Pads	☐	☐	☐	
Turbidity Barrier	☐	☐	☐	
Other (specify) _____	☐	☐	☐	

Name of Permittee:	
Construction Site Name (Project):	**Construction Site ID No.:**

Use the space below for detailed follow-up action items.

Exact place of erosion/sediment control inspected	Type of erosion/sediment control and its observed condition	Description of any necessary maintenance or repair to erosion/sediment control, including anticipated date of completion

Appendix IX:

Storm Water Calculations and

Reference Information

Stormwater Runoff Calculations

25-Year, 24-hour Rain Event (in) 3.5

Pre-Mining, Fair Soil Conditions

Cover type	Hydrologic Soil Group	Area (ft^2)	Area (ac)	CN	S	Q (in)	Runoff Volume (ft^3)
AGRICULTURE: corn	A	37138.65	0.85	72	3.89	1.12	3469.11
AGRICULTURE: forage crops	A	53309.86	1.22	72	3.89	1.12	4979.65
FOREST: mixed/other broad-leaved deciduous	A	435.60	0.01	48	10.83	0.15	5.30
GRASSLAND	A	43813.39	1.01	49	10.41	0.17	621.08
AGRICULTURE: corn	**B**	**2197070.48**	**50.44**	**81**	**2.35**	**1.71**	**312818.59**
AGRICULTURE: forage crops	**B**	**1164542.14**	**26.73**	**81**	**2.35**	**1.71**	**165807.35**
AGRICULTURE: other row crops	**B**	**747256.68**	**17.15**	**81**	**2.35**	**1.71**	**106394.30**
FOREST: mixed deciduous/coniferous	**B**	**100452.93**	**2.31**	**58**	**7.24**	**0.45**	**3791.91**
FOREST: mixed/other broad-leaved deciduous	**B**	**9562824.51**	**219.53**	**48**	**10.83**	**0.15**	**116442.31**
GRASSLAND	**B**	**1074367.59**	**24.66**	**69**	**4.49**	**0.95**	**85408.04**
AGRICULTURE: corn	C	**1934.50**	0.04	**88**	**1.36**	**2.27**	**365.73**
AGRICULTURE: forage crops	C	270294.81	6.21	88	1.36	2.27	51100.97
FOREST: mixed/other broad-leaved deciduous	C	505965.30	11.62	57	7.54	0.42	17533.02
GRASSLAND	C	239467.48	5.50	79	2.66	1.57	31250.15
						TOTAL (ft3) :	**899,987.52**
						TOTAL (gal):	**6,731,906.66**

CN: Runoff Curve Number (Based on land characteristics)

S: Potential Maximum Retention After Runoff Begins

Q: Runoff

Hydrologic Soil Group based on NRCS Soil Survey (Appendix V)

Active Mining, Fair Soil Conditions

Cover type	Hydrologic Soil Group	Area (ft^2)	Area (ac)	CN	S	Q Runoff (in)	Runoff Volume (ft^3)
AGRICULTURE: corn	A	37138.65	0.85	72	3.89	1.12	3469.11
AGRICULTURE: forage crops	A	53309.86	1.22	72	3.89	1.12	4979.65
FOREST: mixed/other broad-leaved deciduous	A	435.60	0.01	48	10.83	0.15	5.30
GRASSLAND	A	43813.39	1.01	49	10.41	0.17	621.08
AGRICULTURE: corn	**B**	**802618.61**	**18.43**	**81**	**2.35**	**1.71**	**114276.73**
AGRICULTURE: forage crops	**B**	**901351.27**	**20.69**	**81**	**2.35**	**1.71**	**128334.27**
AGRICULTURE: other row crops	**B**	**639575.10**	**14.68**	**81**	**2.35**	**1.71**	**91062.61**
FOREST: mixed deciduous/coniferous	**B**	**72853.40**	**1.67**	**58**	**7.24**	**0.45**	**2750.08**
FOREST: mixed/other broad-leaved deciduous	**B**	**8625300.35**	**198.01**	**48**	**10.83**	**0.15**	**105026.49**
GRASSLAND	**B**	**861335.32**	**19.77**	**69**	**4.49**	**0.95**	**68472.81**
AGRICULTURE: corn	C	1934.50	0.04	88	1.36	2.27	365.73
AGRICULTURE: forage crops	C	270294.81	6.21	88	1.36	2.27	51100.97
FOREST: mixed/other broad-leaved deciduous	C	505965.30	11.62	57	7.54	0.42	17533.02
GRASSLAND	C	239467.48	5.50	79	2.66	1.57	31250.15
Impervious Area: Paved	**B**	**283519.54**	**6.51**	**98**	**0.20**	**3.27**	**77175.71**
Impervious Area: Gravel	**B**	**1873308.73**	**43.01**	**85**	**1.76**	**2.02**	**314775.03**
Newly Graded Areas	**B**	**786652.00**	**18.06**	**86**	**1.63**	**2.10**	**137555.57**
						TOTAL (ft^3) :	**1,148,754.32**
						TOTAL (gal):	**8,592,682.28**

CN: Runoff Curve Number (Based on land characteristics)

S: Potential Maximum Retention After Runoff Begins

Q: Runoff

Hydrologic Soil Group based on NRCS Soil Survey (Appendix V)

	Total Runoff Vol. Increase	Mine Phases Vol. Increase	Processing Area Vol. Increase
ft^3	**248,766.79**	**125,097.92**	**123,668.87**
gal	**1,860,775.62**	**935,732.47**	**925,043.15**

Area that will change during project (in phases):

Cover Type	Soil Type	Acreage	
AGRICULTURE: corn	B	32.01	Processing Area
AGRICULTURE: forage crops	B	6.04	
AGRICULTURE: other row crops	B	2.47	
FOREST: mixed/other broad-leaved deciduous	B	4.10	
GRASSLAND	B	4.89	
AGRICULTURE: corn	B	4.81	Processing Area Paved
AGRICULTURE: other row crops	B	1.69	
AGRICULTURE: forage crops	B	0.01	
FOREST: mixed deciduous/coniferous	B	0.63	Mine Phase
FOREST: mixed/other broad-leaved deciduous	B	17.43	

0.35 Percentage of mining area Phase 2 accounts for

326435.57 (gal) increase due to mining all of Phase 2

925043.15 (gal) increase from processing area

1251478.72 (gal) total runoff increase with largest Phase open

Formulas and CN values obtained from NRCS Technical Release-55

Appendix X:

Wisconsin Department of Transportation (WisDOT) Standard Specifications

Section 630 Seeding

630.1 Description

(1) This section describes preparing seed beds and furnishing and sowing the required seed on slopes, appurtenances, and other areas, and on borrow pits and material disposal sites.

(2) This section also describes furnishing and sowing temporary seed mixture on the slopes and appurtenances of temporary embankments and roadways.

630.2 Materials

630.2.1 Seed

630.2.1.1 General Requirements

(1) Conform to the Wisconsin statutes and Wisconsin administrative code chapter ATCP 20 regarding noxious weed seed content and labeling.

http://docs.legis.wi.gov/statutes/statutes/

http://docs.legis.wi.gov/code/admin_code/atcp/020/20.pdf

(2) Use seed within one year of the test date appearing on the label.

(3) Seed mixtures 70, 70A, 75, and 80 contain wild type forbs and grasses. Wild type is defined as seed that is derived directly from native, wild stock, including seed that was wild collected and placed into production or has been harvested directly from native stands.

630.2.1.2 Purity and Germination

(1) Test seed according to the methods and procedures used for sampling and analyzing seed for purity, germination, and noxious weed seed content specified in the current edition of Rules for Testing Seed, published by the Association of Official Seed Analysts.

630.2.1.3 Inoculation

(1) Inoculate legume seed (white clover, red clover, ladino clover, alsike clover, alfalfa, partridge pea, purple prairie clover, Canada tick-trefoil, and lupine) unless it has been pre-inoculated by the vendor. Follow the inoculation instructions that come with the culture purchases. If applying the seed according to method B, 630.3.3.2, treat seeds requiring inoculation with 5 times the amount of inoculant recommended in the instructions.

(2) Avoid exposure of the culture or inoculated seed to the sunlight, and in no case shall any exposure exceed 1/2 hour.

630.2.1.4 Storing Seed

(1) Store any seed delivered before use in a way that protects it from damage by heat, moisture, rodents, or other causes. Discard and replace any previously tested and accepted seed that becomes damaged.

630.2.1.5 Seed Mixtures

630.2.1.5.1 Right of Way

630.2.1.5.1.1 Permanent

630.2.1.5.1.1.1 Composition

(1) Seed mixtures for use on the right of way and easements shall, unless specified otherwise, be composed of seeds of the purity, germination, and proportions, by weight, as given in the Table of Highway Seed Mixtures and the Table of Native Seed Mixtures.

(2) Use seed of the species and varieties listed below. If no variety is listed, there will be no restriction on the variety furnished, except as follows:

1. Species composed of pure live seed (PLS) shall contain no named or improved varieties. PLS shall be grown in Wisconsin or northern Illinois, northeastern Iowa, or eastern Minnesota. Seed produced out-of-state must be grown in one of the following counties:

1.1 From northern Illinois:

Boone	Bureau	Carroll	Cook	De Kalb	Du Page	Grundy
Henry	Jo Daviess	Kane	Kendall	Lake	La Salle	Lee
McHenry	Ogle	Putnam	Rock Island	Stevenson	Whiteside	Will
Winnebago						

1.2 From northeastern Iowa:

Allamakee	Benton	Black Hawk	Bremer	Buchanan	Cedar	Chickasaw
Clayton	Clinton	Delaware	Dubuque	Fayette	Floyd	Howard
Jackson	Johnson	Jones	Linn	Mitchell	Muscatine	Scott
Winneshiek						

1.3 From eastern Minnesota:

Aitkin	Anoka	Carlton	Carver	Chisago	Dakota	Dodge
Fillmore	Goodhue	Hennepin	Houston	Isanti	Kanabec	La Sueur
Mille Lacs	Mower	Olmsted	Pine	Ramsey	Rice	Scott
Sherburne	Steele	Wabasha	Washington	Winona	Wright	

2. PLS for seed mixtures 70, 70A, 75, and 80 shall be packaged separately by species and clearly labeled with the vendor's name, species common and botanical names, gross weight, percent PLS, year of harvest and any specialized treatments that have been applied to ensure or enhance germination. If PLS is not listed, determine PLS by multiplying the percent germination times the percent purity.

3. Minimum percent purity for native for species is 90 percent. If a listed species is not available, substitutions may be made with engineer's approval and must be documented.

(3) Mix native species at the project site. Clean and debeard seeds having awns or excessive hairs before mixing.

SPECIES COMMON NAME	SPECIES BOTANICAL NAME	ACCEPTABLE VARIETIES
Kentucky Bluegrass	Poa pratensis	Low Maintenance
Red Fescue	Festuca rubra	Creeping
Hard Fescue	Festuca ovina var. duriuscula	Improved
Tall Fescue	Festuca arundinacea	Improved turf type
Salt Grass	Puccinella distans	Fult's
	Puccinella distans	Salty
Redtop	Agrostis alba	
Timothy	Phleum pratense	
Canada Wild Rye[1]	Elymus canadensis	
Perennial Ryegrass	Lolium perenne	
Perennial Ryegrass	Lolium perenne	Improved Fine
Annual Ryegrass	Lolium multiflorum	
Alsike Clover	Trifolium hybridum	
Red Clover	Trifolium pratense	
White Clover	Trifolium repens	
Japanese Millet	Echinochola crusgalli var. frumentacea	
Annual Oats	Avena sativa	
Alfalfa	Medicago sativa	
Bromegrass	Bromus inermis	
Orchardgrass	Dactylis glomerata	
Ladino Clover	Trifolium repens var. latum	Ladino
Agricultural Rye	Secale cereale	
Winter Wheat	Triticum aestivum	

[1] Pure live seed

TABLE 630-1 HIGHWAY SEED MIXTURES

SPECIES	PURITY minimum %	GERMINATION minimum %	MIXTURE PROPORTIONS in percent				
			NO.10	NO.20	NO.30	NO.40	NO.60
Kentucky Bluegrass	98	85	40	6	10	35	
Red Fescue	97	85	25		30	20	
Hard Fescue	97	85		24	25	20	
Tall Fescue	98	85		40			
Salt Grass	98	85			15		
Redtop	92	85	5				
Timothy	98	90					12
Canada Wild Rye		PLS[1]					10
Perennial Ryegrass	97	90	20	30			
Improved Fine Perennial Ryegrass	96	85			20	25	
Annual Ryegrass	97	90					30
Alsike Clover	97	90					4
Red Clover	98	90					4
White Clover	95	90	10				
Japanese Millet	97	85					20
Annual Oats	98	90[1]					20

[1] Substitute winter wheat for annual oats in fall plantings started after September 1.

TABLE 630-2 NATIVE SEED MIXTURES

SPECIES		SPECIES BOTANICAL NAME	PURITY & GERMINATION minimum %	MIXTURE PROPORTIONS in percent			
				NO. 70	NO. 70A	NO. 75	NO. 80
FORBES	Canada Anemone	*Anemone canadensis*	PLS	2			
	Butterflyweed	*Asclepias tuberosa*	PLS		2		
	New England Aster	*Aster novae-angliae*	PLS	2	2		
	Partridge-pea	*Chamaecrista (Cassia) fasciculata*	PLS		2		
	Purple Prairie Clover	*Dalea (Petalostemum) purpurea*	PLS	2	2	4	
	Canada Tick-trefoil	*Desmodium canadense*	PLS	2			
	Flowering Spurge	*Euphorbia corollata*	PLS		2		
	Wild Geranium	*Geranium maculatum*	PLS	2			
	Western Sunflower	*Helianthus occidentalis*	PLS	3	2		
	Rough Blazingstar	*Liatris aspera*	PLS		2		
	Prairie Blazingstar	*Liatris pycnostachya*	PLS	2			
	Lupine	*Lupinus perennis*	PLS		3		
	Wild Bergamot	*Monarda fistulosa*	PLS	2			
	Horse Mint	*Monarda punctata*	PLS		2		
	Yellow Coneflower	*Ratibida pinnata*	PLS	2	2		
	Blackeyed Susan	*Rudbeckia hirta*	PLS			1	
	Showy Goldenrod	*Solidago speciosa*	PLS	2	2		
	Spiderwort	*Tradescantia ohiensis*	PLS	2	2		
	Golden Alexanders	*Zizia aurea*	PLS	2			
GRASSES	Big Bluestem	*Andropogon gerardi*	PLS	15	15	10	
	Sideoats Grama	*Bouteloua curtipendula*	PLS	15	20	20	25
	Canada Wildrye	*Elymus Canadensis*	PLS	15	15	35	23
	Slender Wheatgrass	*Elymus trachycaulus*	PLS				20
	Junegrass	*Koeleria macrantha*	PLS		5		
	Annual Ryegrass	*Lolium multiflorum*	[1]			10	10
	Switchgrass	*Panicum virgatum*	PLS				10
	Salt Grass	*Puccinella distans*	[1]				2
	Little Bluestem	*Schizachyrium (Andropogon) scoparium*	PLS	15	20	10	10
	Indiangrass	*Sorgastrum nutans*	PLS	15		10	
ALTERNATE FORBES	Sky Blue Aster	*Aster azureus*	PLS	[2]	[2]		
	White Wild Indigo	*Baptisia leucantha*	PLS	[2]	[2]		
	Pale Purple Coneflower	*Echinacea pallida*	PLS	[2]	[2]		
	White Prairie Clover	*Petalostemum candidum*	PLS	[2]	[2]		
	Stiff Goldenrod	*Solidago rigida*	PLS	[2]	[2]		
	Hoary Vervain	*Verbena stricta*	PLS	[2]	[2]		

[1] Provide the minimum purity and germination specified in 630.2.1.5.1.1.1(3) in the table of highway seed mixtures.

(2) For the borrow pit mixture use, by weight, 60 percent temporary species seeds and 40 percent permanent species seeds.

(3) For the temporary component, use any combination of temporary seeds listed in the table above.

(4) For the permanent component, use seeds from not more than 4 of the permanent species listed in the table above in any combination.

(5) When nurse crop is required for spring seeding before June 15, use annual oats. For fall seeding after October 15, use winter wheat, or annual ryegrass.

630.3 Construction

630.3.1 General

(1) If not protecting with a mulch cover, perform seeding, except Nos. 60, 70 and 70A mixtures at times of the year when temperature and moisture conditions are suitable for seeding, except during midsummer.

(2) Perform seeding, except Nos. 60, 70 and 70A mixtures, in conjunction with mulching as specified in 627 at any time the engineer allows.

(3) The contractor may perform seeding of Nos. 60, 70 and 70A mixtures at any time soil conditions are suitable, except between June15 and October 15, unless the engineer allows otherwise.

(4) Perform seeding with the selected seed mixture, sown at the specified rate.

630.3.2 Preparation of Seed Bed

(1) Complete grading, shouldering, topsoiling, and fertilizing, if part of the work under contract, before permanent seeding, except the contractor may place the fertilizer and seed mixture in one operation if using equipment designed for the purpose.

(2) Just before seeding, work the area being seeded with discs, harrows, or other appropriate equipment to obtain a reasonably even and loose seedbed. Place topsoil as specified in 625.3.3.

630.3.3 Sowing

(1) Select the method of sowing from either method A, method B, method C, or an appropriate combination of methods A, B, and C. Obtain the engineer's approval for the sowing method and specific procedures used for each seed mixture used before sowing that mixture.

630.3.3.1 Method A

(1) Sow the selected seed mixture using equipment adapted to the purpose, or by scattering it uniformly over the areas to be seeded. Lightly rake or drag to cover the seed with approximately 1/4 inch of soil. After seeding, lightly roll or compact the areas using suitable equipment, preferably the cultipacker type, when the engineer judges the seedbed too loose, or if the seedbed contains clods that might reduce seed germination. The contractor shall not roll slopes steeper than 1:3.

(2) If scattering seed by hand, perform this work with satisfactory hand seeders and only when the air is calm enough to prevent seeds from blowing away.

630.3.3.2 Method B

(1) Sow or spread the seed upon the prepared bed using a stream or spray of water under pressure and operated from an engineer-approved machine designed for that purpose. Place the selected seed mixture and water into a tank, provided within the machine, in sufficient quantities that when spraying the seed on a given area it is uniformly spread at the required application rate. During this process, keep the tank contents stirred or agitated to provide uniform distribution. Spread the tank contents within one hour after adding the seed to the tank. The engineer will reject seed that remains mixed with the water for longer than one hour. The engineer will not require dragging or rolling.

630.3.3.3 Method C

(1) For spring seeding of seed mixtures 70 and 70A into existing ground cover, mow existing vegetation to 4 inches or less in height 2 to 4 weeks before seeding. Ten to 14 days after mowing, spray with vegetation control herbicide conforming to 632.2.12.

(2) For fall seeding of seed mixtures 70 and 70A into existing ground cover, mow existing vegetation to 4 inches or less in height 4 to 6 weeks before seeding. Ten to 14 days after mowing, spray with vegetation control herbicide conforming to 632.2.12. Retreat with vegetation control herbicide 10 to 14 days after initial application if live vegetation persists.

[2] The contractor may, if the engineer approves, substitute an alternate forb for a required forb that is not available using the same percentage as specified for the required forb. Use a different alternate forb for each unavailable required forb. Provide documentation showing that a required forb is not available before using an alternate.

630.2.1.5.1.1.2 Mixture

(1) The contractor shall select a seed mixture or mixtures that meet with the engineer's approval, and unless specified otherwise in the contract, shall conform to the following:

1. Use seed mixture No. 10 where average loam, heavy clay, or moist soils predominate.
2. Use seed mixture No. 20 where light, dry, well-drained, sandy, or gravelly soils predominate and for all high cut and fill slopes generally exceeding 6 to 8 feet, except where using No. 70.
3. Use seed mixture No. 10 or No. 20 on all ditches, inslopes, median areas, and low fills, except where using No. 30 or No. 70.
4. Use seed mixture No. 30 for medians and on slopes or ditches generally within 15 feet of the shoulder where a salt-tolerant turf is preferred.
5. Use seed mixture No. 40 in urban or other areas where a lawn type turf is preferred.
6. Use seed mixture No. 60 only on areas, the contract designates or the engineer specifies. Use it as a cover seeding for newly graded wet areas or as a nurse crop for specified wetland seed mixtures. The contractor shall not apply it to flooded areas.
7. Use seed mixture Nos. 70 and 70A on slopes and upland areas the contract designates or the engineer specifies. Use seed mixture No. 70 on loamy soils and seed mixture No. 70A on sandy soils.
8. Use seed mixture No. 75 where native grasses are desired for erosion control.
9. Use seed mixture No. 80 on inslopes where a salt tolerant seed mix containing native grasses is desired.

630.2.1.5.1.2 Temporary

(1) Under the Seeding Temporary bid item, use a temporary seed mixture conforming to 630.2.1.5.1.4. Use oats in spring and summer plantings. Use winter wheat or rye for fall plantings started after September 1.

630.2.1.5.1.3 Nurse Crop

(1) If seeding bare soil with either mixture 70, 70A, 75, or 80, include the Seeding Nurse Crop bid item.

630.2.1.5.1.4 Borrow Pits and Material Disposal Sites

(1) For seeding borrow pits and material disposal sites beyond the right of way, use seed mixtures conforming to seed mixture 10, 20, 70, 70A, or 75 of 630.2.1.5.1.1 or a borrow pit mixture composed of seeds of the species, purity, germination and proportions, by weight as given below:

PERMANENT

SPECIES	% MINIMUM PURITY	% MINIMUM GERMINATION
Alfalfa	98	90
Bromegrass	85	85
Orchardgrass	80	85
Timothy	98	90
Red Clover	98	90
Alsike Clover	97	90
Ladino Clover	95	90
Kentucky Bluegrass	98	85

TEMPORARY

SPECIES	% MINIMUM PURITY	% MINIMUM GERMINATION
Annual Oats	98	90
Agricultural Rye	97	85
Winter Wheat	95	90

NURSE CROP

SPECIES	% MINIMUM PURITY	% MINIMUM GERMINATION
Annual Oats	98	90
Annual Ryegrass	97	90
Winter Wheat	95	90

(3) Seed with a rangeland type drill with one or more seed boxes that can be calibrated independently to deliver different sized seeds uniformly at the required rate and equipped with a rear-mounted press wheel for each seed drop tube. If seeding into existing vegetation or thatch, use a rangeland type drill equipped with a no-till attachment that can cut through the vegetation or thatch in front of the V disc and seed drop tube. If the configuration of the area to be seeded allows, apply seed at 1/2 the specified seed rate and apply the second 1/2 in a perpendicular direction.

630.3.3.4 Borrow Pits and Material Disposal Sites

(1) Seed borrow pits, and material disposal sites off the right of way, with the selected seed mixture specified in 630.2.1.5.1.4. Consult with the landowner or the landowner's agent when selecting the seed mixture.

630.3.3.5 Seeding Rates

630.3.3.5.1 Right of Way

(1) Use the following sowing rate for seeds in pounds per 1000 square feet:

- Seed mixture No. 10 at 1.5 pounds
- Seed mixture No. 20 at 3 pounds
- Seed mixture No. 30 at 2 pounds
- Seed mixture No. 40 at 2 pounds
- Seed mixture No. 60 at an equivalent seeding rate of 1.5 pounds[1]
- Seed mixture No. 70 or 70A at 0.4 pounds
- Seed mixture No. 75 at an equivalent seeding rate of 0.7 pounds[1]
- Seed mixture No. 80 at an equivalent seeding rate of 0.8 pounds[1]
- Temporary seeding at 3 pounds
- Nurse crop seeding at 0.8 pounds

[1] Determine the actual seeding rate by multiplying the equivalent seeding rate by the sum of the unadjusted and adjusted percentages of the various species in the seed mixtures as sown.

(2) The unadjusted percentage equals the minimum percent of purity and germination specified in the table of seed mixtures contained in 630.2.1.5.1.1.1 for the applicable species.

(3) Obtain the adjusted percentage for each of the PLS species by dividing the specified percentage of the species by the product of the percent of purity and the percent of germination for each of the PLS species as delivered.

630.3.3.5.2 Borrow Pits and Material Disposal Areas

(1) For seeding borrow pits and material disposal off the right of way, sow the seed mixtures specified in 630.2.1.5.1.4 at the following rates per pound per 1000 square feet:

- Seed mixture No. 10 at 0.75 pound
- Seed mixture No. 20 at 1 pound
- Seed mixture No. 70 or 70A at 0.4 pounds
- Seed mixture No 75 at 0.7 pounds
- Borrow pit mixture at 1.5 pounds

630.3.3.6 Establishment Period for Native Seeding

(1) During the growing season after planting seed mixture 70 or 70A, mow all seeded areas twice as the engineer directs. Mow vegetation back to 6 inches when it has reached a height of at least 12 inches.

(2) During the growing season after planting seed mixture 70 or 70A, eradicate the following species from the seeded areas as soon as they become evident:

SPECIES COMMON NAME	SPECIES BOTANICAL NAME
Musk thistle	Carduus nutans
Spotted knapweed	Centaurea maculosa
Canada thistle	Cirsium arvense
Bull thistle	Cirsium vulgare
Field bindweed	Convolvulus arvensis
Leafy spurge	Euphorbia esula
Sweetclover	Melilotus species
Wild parsnip	Pastinaca sativa

(3) Eradicate by hand pulling or by applying a vegetation control herbicide conforming to 632.2.12 to individual plants.

630.4 Measurement

(1) The department will measure the Seeding bid items by the pound acceptably completed.

(2) The department will measure quantities based on net weights of seed shipments, or on quantities weighed on department-approved scales the contractor furnishes.

(3) The department will make deductions for all quantities wasted or not actually incorporated in the work according to the contract.

(4) The department will determine the equivalent pounds of seed furnished and applied by dividing the actual pounds of seed applied by the sum of the unadjusted and adjusted percentages of the various species in the seed mixture sown.

(5) The department will use the unadjusted and adjusted percentages determined in 630.3.3.5.1.

630.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
630.0100 - 0199	Seeding (mixture)	LB
630.0200	Seeding Temporary	LB
630.0300	Seeding Borrow Pit	LB
630.0400	Seeding Nurse Crop	LB

(2) Payment for the Seeding bid items is full compensation for providing, handling, and storing all seed; for providing the required culture and inoculating seed as specified; and for preparing the seed bed, sowing, covering and firming the seed. If the landowner does not want the pit or material disposal site seeded, or seeded with any of the mixtures allowed, the department will not pay for fertilization or seeding of those areas.

6-40.1 Topsoil

Topsoils are those humus-bearing soils that can sustain plant life. Upon completion of the finish grading, they are spread over the graded earth surfaces where seeds are to be sown or sod is to be placed, to provide a growing medium for the development of turf.

To motivate contractors to spread topsoil as early as possible, the engineer may at times want to consider allowing a contractor to spread topsoil on the sideslopes before placement of "bluetop" grade stakes. This consideration assumes the rough grading is performed to reasonably close conformity with the slope stakes and reasonable care is taken to maintain an aesthetically pleasing, shoulder-to-topsoil transition at the bluetop location. Minor variations in the bluetop elevation or location will not materially affect either the function or appearance of the project for this purpose. This will permit the contractor to perform topsoiling operations to better fit the contractor's schedules and should expedite the other associated landscaping operations.

The topsoil is placed and uniformly spread over the areas to a uniform depth of 3 inches, unless otherwise specified. During spreading and shaping of the placed topsoil, all clods and lumps are to be broken down so the placed topsoil is of a fine, uniform texture. Where topsoil is placed on steep slopes, to preclude the formation of planes of slippage the surface of the underlying soil should be roughened to permit bonding with the topsoil. If slippage planes develop, sloughing of the placed topsoil may occur at any time during wet periods before sufficient root growth has developed to retain the mass in place. Also, where there is a significant difference in texture of topsoil and subsoil, such as clay over sand, it is better to blend the soils to obtain a more uniform growing medium.

Subbase areas of the inslope should be left bare unless the subbase material is highly susceptible to erosion by wind or rain. In this case, topsoil should be placed over the subbase material; however, precautions should be taken to apply no more than the designated quantity so drainage from the subbase will not be impeded or destroyed by blocking the drainage with impervious material. Materials from marsh disposal have a tendency to retain water and should not be used to cover subbase material at the inslope.

Standard spec 625.3.3 contains special requirements for urban areas where a lawn-type turf is desired. During finishing operations all loose or waste stones that will not pass a one-inch sieve must be removed. Topsoil for use over these areas must pass a one-inch sieve and at least 90% must pass a No. 10 sieve. Some topsoils containing large, hard clods may need to be pulverized or screened.

Table 1 defines the various soil classifications (sand, silt, clay) on the basis of particle size. Topsoil recently treated with herbicides to prevent plant growth may not allow seed germination or support plant growth. If herbicide contamination is suspected, the engineer should contact the Bureau of Highway Operations.

It may be possible to treat small amounts of topsoil to neutralize the effect of the herbicide. For large amounts, treatment may not be cost-effective, the topsoil will have to be rejected, and an alternative source of topsoil found.

Occasionally, such as where shallow (less than 6 feet) fills are being built, to ensure the stability of the fill, the contractor will have to excavate more topsoil than the amount necessary to cover the graded surfaces. This excess volume is regarded as excavation below subgrade and is eligible for payment as common excavation. To minimize the amount of excess, the engineer may direct the contractor to remove the topsoil from the shallow fill sites before stripping other areas. The engineer is encouraged to discuss with the contractor early on in the project the amounts of topsoil necessary and available.

Table 1 Soil Classification Particle Sizes

Soil Class	Diameter Range (inch)
Clay	< 0.00008
Silt	0.00008 - 0.002
Very fine sand	0.002 - 0.004
Fine sand	0.004 - 0.01
Medium sand	0.01 - 0.02
Coarse sand	0.02 - 0.04
Very coarse sand	0.04 - 0.08

6-40.1.1 Topsoil Testing

In an effort to improve the success of standard spec 630.2.1.5.1.1.2, soil pH analysis and analysis of prior herbicide use should be performed. Topsoil and salvaged topsoil can be tested to determine if the pH range will sustain grass. In addition, soil that is suspected of prior herbicide use can also be tested.

When topsoil and/or salvaged topsoil is accepted from a wetland, low land, or conifer (evergreen trees) area, an analysis should be performed to find out if appropriate pH levels exist. Often the pH level is so low that the soil will not sustain plant growth without addition of lime.

An analysis for the presence of herbicides should be performed when topsoil and/or salvaged topsoil is accepted from areas which have been in agricultural crop production. Before performing any analysis, try to obtain field history data information from the land owner(s) about the crop production/herbicides use of the land to be used as a source for topsoil. The land owners are required to retain this information. This data should indicate which herbicides were used in the field.

If any of the herbicides listed below were used in the field's history information, it may cause problem in establishing grass. A soil analysis may have to be performed if history information is not available. This applies especially if the parcel had field corn, sweet corn, or soybeans the year before.

Table 2 below indicates which type of crop is associated with what type of herbicide. The numbers in the table indicate the number of months the particular herbicide will have an impact on grass establishment.

The result of the soil analysis for trizine may also indicate presence of the majority of the herbicides as listed in the table.

Testing soils for the presence of herbicides is expensive, so testing requests must be limited. A complete outline of herbicide persistence (residue) in soil is available in Pest Management in Wisconsin Field Crops-1998 (A3646), Appendix Table (Page 184). It is authored by C.M. Boerboom, J.D. Doll, R.A. Flashinski, C.R. Grau, J.L. Wedberg.

This material is available from:

Wisconsin County Extension Office or Cooperative Extension Publication

Room 170

630 W. Mifflin Street, Madison, WI 53703

Phone # (608) 262-3346.

Table 2 Herbicide Effects on Grass Establishment

Herbicide	Effect on Grass Establishment (Months)		
	Field Corn	Sweet Corn	Soybean
Atrazine	24	24	
Bicep II/Bicep Lite II	24	24	
Bullet/Lariat	24	24	
Command 4EC/3ME	16		12
DoublePlay	24		
Guardsman	24	24	
Harness Xtra	24		
Lightning	12		
Marksman	24		
Princep	24	24	
Surpass 100	24		

6-40.1.2 Topsoil Sampling Guidelines

Topsoil may be sampled either from a stockpile, or in-place.

6-40.1.2.1 Sampling from a stockpile:

1. Do not obtain sample from the stockpile face. First remove the surface of the pile at the point of sample then obtain material from inside the stockpile. This will be more representative of the material in the stockpile.
2. Obtain material from at least three different locations from the stockpile. These samples will be combined into one sample that will be 3 to 4 times larger than the final sample size required.
3. Mix the large sample and remove from it enough material to be placed in one of the department's cement sample boxes. Ensure that the sample is bagged and sealed (twist tie) before placing it in the box.
4. Fill out the DT1499 Sample Shipping Tag and enclose the form in the box. Make sure to write the word "Topsoil" on the outside of the box before submitting.

6-40.1.2.2 Sampling topsoil in-place:

1. The procedure for sampling topsoil in-place is the same as for sampling existing topsoil that is planned to be used, or sampling topsoil that has been placed.
2. Remove the surface of the topsoil so that the sample taken will not be from the surface and is representative of the material in place. For existing topsoil, ensure that the sample is as free as possible of plant material (grass, roots, etc.).
3. Obtain material from at least three different locations. These samples will be combined into one sample that will be 3 to 4 times larger than the final sample size required.
4. Mix the large sample and remove from it enough material to be placed in one of the department's cement sample boxes. Ensure that the sample is bagged and sealed (twist tie) before placing it in the box.
5. Fill out the DT1499 Sample Shipping Tag and enclose the form in the box. Make sure to write the word "Topsoil" on the outside of the box before submitting.
6. Send topsoil samples to:

Tom Brokaw

3502 Kinsman Blvd.

Madison, WI 53704

Phone # (608) 246-7934

6-40.1.3 Topsoil Acceptance

The department encourages contractors to topsoil, seed, and install long-term erosion control measures as soon as practicable. Consequently, the department may entertain contractor requests for partial acceptance upon completion of significant portions of that work. If the contractor requests partial acceptance, the engineer needs to inspect the work and make sure it was completed correctly and all erosion control measures are installed

properly. If partial acceptance is granted, the department assumes maintenance responsibility for the work under standard spec 105.11.1. If the topsoil is washed out or damaged due to erosion, the department pays for that restoration as specified in standard spec 625.5. The department does not reimburse the contractor for washouts or damage caused by contractor operations.

6-40.2 Fertilizer

Fertilizers Type A and Type B have been developed to ensure adequate fertilization of seed or sod located over most soil types in Wisconsin. Selection of Type A or Type B is made by the region design section based upon soil type and the mixture of seed to be sown. Refer to standard spec 629.

Where fertilizer is required, it should be spread upon the soil at the required rate and worked into the soil during the preparation of the seedbed, unless seeds are sown with a hydro-seeder, in which case, the fertilizer may be applied in the water along with the seed.

The rates of fertilizer application for Type A and Type B are 7 lbs. per 1,000 ft^2, as set forth in standard specs, when they are applied at the minimum percentage of components of nitrogen, phosphoric acid and soluble potash (N-P-K) required. However, the standard specs permit the application of fertilizers containing percentages of components greater than the minimum specified. When fertilizers containing percentages of N-P-K components greater than minimum are to be paid for, the quantity to be measured can be obtained by multiplying the weight used by the ratio of the actual percentage of N-P-K components used to 32% for Type A, or to 50% for Type B.

Example 1

Type A fertilizer is supplied which contains 40% N-P-K, instead of the minimum 32% The adjusted application rate would be:

$$7 \text{x} \frac{32}{40} = 5.6 \text{ lbs.}/1{,}000 \text{ ft}^2 \text{ applied}$$

Actual use =2,200 lbs. of a Type A fertilizer containing 40% N-P-K.

$$2{,}200 \text{ lbs. x } \frac{40}{32} = 2{,}750 \text{ lbs.} = 27.5 \text{ CWT to be paid.}$$

Example 2

Type B fertilizer is supplied which contains 70% N-P-K, instead of the minimum 50%. The adjusted application rate would be:

$$7 \text{x} \frac{50}{70} = 5 \text{ lbs.}/1000 \text{ ft}^2 \text{ applied}$$

Actual use = 2,400 lbs. of a Type B fertilizer containing 70% N-P-K.

$$2{,}400 \text{ lbs. x } \frac{70}{50} = 3{,}360 \text{ lbs.} = 33.6 \text{ CWT to be paid.}$$

In addition to the total N-P-K requirements for type A and B fertilizers, standard spec 629.2.1.2 contains specific minimum requirements for nitrogen, phosphoric acid, and potash as individual components.

6-40.2.1 Agricultural Limestone

Agricultural limestone treatment is applied at the rate specified in standard spec 629.3.2 for the particular index zone (neutralizing index). The index zone is a material property that varies with the material source location.

Agricultural limestone treatment is paid by the ton. To determine the quantity to be measured for payment, the base application rate of 100 lbs. per 1,000 ft^2 from Index Zone 60-69 is used. The actual weight of lime used is multiplied by 100 and divided by the application rate.

Example 3

Index Zone = 95
Application Rate = 70 lbs. per 1,000 ft^2 from Table in standard spec 629.3.2
Actual usage = 3,600 lbs.
Payment =

$$3{,}650 \text{ lbs. x } \frac{100}{70} \text{ x } \frac{1 \text{ ton}}{2{,}000 \text{ lbs.}} = 2.6 \text{ tons to be paid.}$$

6-40.3 Seeding

In the past, seeding and final finishing were usually delayed by the contractor until the entire project had been graded and substantially completed. The contract was accepted shortly thereafter, at which time the contractor was relieved of responsibility for maintenance. Generally, only minor amounts of reseeding were necessary and contractors took care of the restoration at their cost.

In our continued efforts to minimize erosion and the associated negative environmental impacts, we now allow seeding to be done as shown in Table 3 below.

Table 3 Seeding Guidelines

Seed Mixes	Can Be Sown	Mulch Required?[1]	Mgr. Approval Required?
10,20,30 & 40	Anytime, except midsummer and late fall	Yes	No
10,20,30 & 40	Midsummer or late fall	Yes	Yes
60	Anytime, except from 7-15 to 10-15		
60	From 7-15 to 10-15	Yes	Yes
70 & 70A	Anytime, except from 6-15 to 10-15	Yes	No
70 & 70A	From 6-15 to 10-15	Yes	Yes
Temporary seed	Anytime on temporary or permanent slopes	Yes on permanent slopes	No

[1] WisDOT Guidelines Recommend the use of mulch on all disturbed permanent slopes.

[2] WisDOT Guidelines Recommend the use of temporary seed at half the normal rate on all permanent slopes to promote quick re-vegetation. Use winter wheat or winter rye during the late fall (see No. 9 below).

The specification is broad and general in nature and subject to interpretation as to the calendar dates of midsummer. Midsummer could be regarded as falling between July 15 and August 15; however, the important point is that erosion needs to be controlled any time, mid-summer or otherwise, by the application of temporary or permanent measures.

Liberal use of temporary erosion control measures and emphasis on early completion of roadway finishing has led to substantially more reseeding either anticipated, as in the case of a temporary seeding bid item, or unanticipated, resulting from our emphasis and direction to complete early finishing. Because of our direct involvement in the prosecution of the fertilizing and seeding work, and the intermix of temporary and permanent seeding it has become very difficult to clearly distinguish the pay or no pay status of areas of seeding or reseeding done by the contractor. Therefore, in the interest of sound erosion control practice and consistent contract administration, we will pay for all re-fertilizing and reseeding within the limits designated in the contract or ordered by the engineer, unless caused by the contractor's negligence.

6-40.3.1 Late Seeding

Use the following guidelines when determining how late to seed in the fall. While effective erosion control is important, it is also improper practice to jeopardize permanent seeding by placing it when it will almost surely die.

1. Seed germinates only when the soil temperature and moisture are adequate.
2. The seed plant is most vulnerable when it has just germinated. Drought and/or freezing can kill a newly germinated grass plant.
3. Determine when the area is prone to receive its first “killing” frost, then allow a safety factor.
4. Weigh the risk. Is it worth gambling? Are environmental or customer sensitive areas a factor?
5. “Dormant Seeding” is acceptable in some cases and is desirable with seed mixes 70 and 70A. Non-germinated seed will normally remain dormant and germinate in the spring.
6. If there is a “killing-freeze”, it is likely that all new germinated seed plants will die, as they have not had enough time to establish themselves.
7. As a rule, it is risky if permanent seed is planted between September 30th and November 15th for the central part of the state. Adjust according to farther north or south project locations.
8. Late seeding can be helped by a heavier application of mulch. Instead of the normal 1/2" to 1-1/2", increase it to 2" to 2-1/2". This will allow for added protection of the grass plants during cold weather.
9. These guidelines DO NOT apply for temporary seed. WisDOT guidelines call for the use of temporary seed at half the normal rate on all permanent slopes, but the use of temporary seed as an erosion control measure, during late fall, is encouraged. Temporary seed is more likely to germinate in cold conditions, and is so inexpensive that

any risk is minimal.

6-40.3.2 Failing to Water

Perhaps as many as 90% of seeding disappointments are due to a failure to keep the seedlings moist after they germinate. Seed can lay dormant in the soil for months without water, but once germination begins the tender young seedlings will die without moisture. Best advice: water frequently and don't let the top inch of soil dry out until the grass is well established.

For this reason the bid item of water should be considered for urban seeding where a lawn type turf is desired. Water should continue for a period of at least 30 days when rainfall is not adequate to maintain soil moisture.

6-40.3.3 Temporary Seeding

Temporary seeding is the establishment of a temporary vegetative cover on disturbed areas by seeding with an annual herbaceous plant, usually grass, which is quick to germinate.

Temporary seeding is used for both temporary and permanent stabilization measures to include:

1. Disturbed areas that will not be brought to final grade for more than 30 days.
2. Borrow pit and waste area sites.
3. Other disturbed areas such as sides of sediment basins, temporary road banks, intercepting embankments, etc.

Temporary seeding should be included on all projects where exposed soils are expected and/or re-vegetation is required. It is the least expensive of all erosion control measures, germinates quickly, and is highly effective.

Temporary seeding is an important tool to prevent erosion not only at the time of final seeding but it can also be used on sites that will stand idle over the winter months. Also remember that temporary seed may be used on sites that do not have topsoil placed yet. However, sandy soils tend to be too dry for good temporary cover to establish. When final seed-bed preparation occurs, disking or tilling may have to occur to allow for permanent vegetation growth. Past experience has indicated that annual oats and rye work best onsite with this application.

When erosion control is a crucial action item, permanent and/or temporary seed with mulch maybe placed in the late fall. But, WisDOT's normal application rate for mulch of 1/2" to 1-1/2" should be increased to 2" to 2-1/2". This will allow for added protection of the seed during the winter months.

6-40.3.4 Mixtures Containing Pure Live Seed

6-40.3.4.1 Background and Definitions

This is the method for determining sowing rate and method of measurement for seed mixes Nos. 60, 70, 70A, 75 and 80 containing seeds to be supplied and applied PLS (Pure Live Seed).

Purity The percentage of the specified species or variety that is actually contained in a given quantity of the seed.

Germination The percentage of the designated species or variety that will actually sprout.

Pure Live Seed (PLS) The percentage purity multiplied by the percentage germination equals the percentage of pure live seed.

The commonly used cool season grasses are specified as having a minimum purity and germination. Unless purity and germination of seed specified PLS are both 100%, the amount of seed required to be sown will always be greater than the amount specified and measured.

6-40.3.4.2 Determining the Sowing Rate for Seed Mix No. 60

Step1: Total the percentages of species or varieties in the mix with a specified minimum purity and germination. Convert to a decimal form.

Step 2: Divide the percentage of each species or variety designated PLS by the percentage PLS shown on the seed certificate for that species or variety.

Step 3: Total the numbers obtained in Step 2.

Step 4: Add the numbers from Steps 1 and 3.

Step 5: Multiply the result from Step 4 by the specified rate per thousand square feet of the mix to determine the actual pounds to sow per thousand square feet.

Step 6: Divide the total actual weight sown by the amount from Step 4. This will be the amount to be paid for as Seeding, Wetlands (mix No. 60).

Example for Seed Mix No. 60

Species	Purity	Germination	Percentage of Mix (Actual)	Percentage of Mix (PLS)
Timothy	98	90	12	
Canada Wild Rye	PLS			12.0%
Annual Ryegrass	97	90	35	
Alsike Clover	97	90	4	
Red Clover	98	90	4	--
Japanese Millet	97	85	8	
Annual Oats	98	90	25	___
TOTALS			88 %	12.0%

Step 1: Unadjusted %= 88% = 0.88

Step 2: The PLS used in this example is hypothetical. The actual PLS must be taken from the label of the seed supplied. For this example, the percentage PLS for Canada Wild Rye is 65%.

12.0÷ 65 = 0.185

Step 3: 0.185

Step 4: 0.88 + 0.185 = 1.065

Step 5: The application rate per standard spec 630.3.3.5 is 1.5 pounds per 1,000 square feet

1.5 x 1.065 = 1.60 pounds per 1,000 square feet actual sowing rate

Step 6: Say 113 pounds were sown

113 ÷ 1.065 = 106 pounds measured for payment.

6-40.3.4.3 Determining the Sowing Rate for Seed Mix No. 70 and 70A

Step 1: The actual pounds Pure Live Seed (PLS) may be listed on the seed package label. If so, proceed to Step 3.

Step 2: If, instead of the actual pounds PLS, the seed package lists gross weight and percent PLS, convert the percent PLS to decimal form and multiply the gross weight by the percent PLS to get pounds PLS in the package.

Step 3: Divide the gross weight of the package of each species by the pounds PLS in the respective package.

Step 4: For each species, convert the percent PLS in the seed mix to decimal form and multiply the percent PLS of that species in the seed mix by the seeding rate per thousand square feet to find the PLS rate of that species.

Step 5: For each species, multiply the result from Step 3 by the result from Step 4 to find the gross weight of that species to apply per thousand square feet.

Step 6: Add the results for each species from Step 5 to determine the gross weight of the seed mix to apply per thousand square feet.

Example for Seed Mix No. 70 (The seed mix in this example is hypothetical.)

Species	Of Mix (PLS)	Gross Weight	Percent PLS
Yellow Coneflower	5	50 lb.	70
Wild Bergamot	5	50 lb.	70
Butterflyweed	5	60 lb.	60
Prairie Blazingstar	5	40 lb.	80
Little Bluestem	35	50 lb.	90
Sideoats Grama	35	50 lb.	90
Canada Wildrye	10	50 lb.	95

Step 1.

The actual pounds Pure Live Seed (PSL) may be listed on the seed package label. If so, proceed to Step 3.

Step 2	Gross Weight	X	% PLS	=	PLS Weight
Yellow Coneflower	50 lb.	X	0.7	=	35 lb.
Wild Bergamot	50 lb.	X	0.7	=	35 lb.
Butterflyweed	50 lb.	X	0.6	=	36 lb.
Prairie Blazingstar	50 lb.	X	0.8	=	32 lb.
Little Bluestem	50 lb.	X	0.9	=	45 lb.
Sideoats Grama	50 lb.	X	0.9	=	45 lb.
Canada Wildrye	50 lb.	X	0.95	=	47.5 lb.

Step 3	Gross Weight	÷	PLS Weight	=	Conversion Factor
Yellow Coneflower	50 lb.	÷	35 lb.	=	1.43
Wild Bergamot	50 lb.	÷	35 lb.	=	1.43
Butterflyweed	60 lb.	÷	36 lb.	=	1.67
Prairie Blazingstar	40 lb.	÷	32 lb.	=	1.25
Little Bluestem	50 lb.	÷	45 lb.	=	1.11
Sideoats Grama	50 lb.	÷	45 lb.	=	1.11
Canada Wildrye	50 lb.	÷	47.5 lb.	=	1.05

Step 4	% Species in Mix	X	Seeding Rate/1,000 Sq. Ft.	=	PLS Weight/1,000 Sq. Ft.
Yellow Coneflower	0.05	X	0.4	=	0.02 lb.
Wild Bergamot	0.05	X	0.4	=	0.02 lb.
Butterflyweed	0.05	X	0.4	=	0.02 lb.
Prairie Blazingstar	0.05	X	0.4	=	0.02 lb.
Little Bluestem	0.35	X	0.4	=	0.14 lb.
Sideoats Grama	0.35	X	0.4	=	0.14 lb.
Canada Wildrye	0.10	X	0.4	=	0.04 lb.

Step 5	Conversion Factor	X	PLS Weight/1,000 Sq. Ft.	=	Gross Weight/1,000 Sq. Ft.
Yellow Coneflower	1.43	X	0.02 lb	=	0.03 lb.
Wild Bergamot	1.43	X	0.02 lb	=	0.03 lb.
Butterflyweed	1.67	X	0.02 lb	=	0.03 lb.
Prairie Blazingstar	1.25	X	0.02 lb	=	0.03 lb.
Little Bluestem	1.11	X	0.14 lb	=	0.16 lb.
Sideoats Grama	1.11	X	0.14 lb	=	0.16 lb.
Canada Wildrye	1.05	X	0.04 lb	=	0.04 lb.

Step 6	Gross Weight/1,000 Sq. Ft.
Yellow Coneflower	0.03 lb.
Wild Bergamot	0.03 lb.
Butterflyweed	0.03 lb.
Prairie Blazingstar	0.03 lb.
Little Bluestem	0.16 lb.
Sideoats Grama	0.16 lb.
Canada Wildrye	0.04 lb.
TOTAL	0.48 lb.

Therefore, the actual gross weight of seed that needs to be applied per 1,000 square feet is 0.48 pounds in order to get the required PLS rate of 0.4 pounds per 1,000 square feet which will be measured for payment.

6-40.3.5 Testing Seed

WisDOT can test standard seed mixes for germination rates, seed type, and ratios if the engineer suspects a problem. This is an effort to continuously improve recommended seed mixes, and to determine the reason of failure on standard seeding projects. It will also provide the project manager with an opportunity to require some of the standard seed mixes to be tested. Contact Leif Hubbard at (608) 267-6884 with soil and seed related questions.

6-40.3.6 Seed Sampling Guidelines

Take seed samples from two locations representing seed that will be used on the specific project. Sample locations include sampling from the seed bags, or from the seeding equipment.

The seed used contains many species, and these may tend to stratify in the bag or seeding equipment. Care should be taken to ensure that the sample is representative of the seed overall. This may be accomplished by mixing the seed by hand before taking a sample, or by obtaining parts of the sample from different layers from within the bag or equipment.

Take a sample large enough to be placed in one of the department's cement sample boxes. Ensure that the sample is bagged and sealed (twist tie) before placing it in the box.

Fill out the "WisDOT Seed & Topsoil Testing Request Form" and enclose the form in the box. Include the information that is requested on the form, along with a copy of the seed ticket from the bag sampled. Also, please write "Seed" on the outside of the box before submitting.

Send seed samples to:

Tom Brokaw
3502 Kinsman Blvd.
Madison, WI 53704
Phone # (608) 246-7934

6-40.3.7 Native Seeding Mixtures

Seeding Mixtures 70 and 70A are primarily composed of native grasses and wildflowers. They are intended to be used in areas where it is desirable to re-establish native species on the project, either for aesthetic or environmental reasons. They are particularly appropriate in instances where the DNR liaison requests a native seed mix that is compatible with plant communities beyond the right-of-way. They were not, however, intended to be used primarily for erosion control or for other large-scale uses on highway rights-of-way for several reasons:

They are relatively expensive because of the wildflower component. It is not necessary that an erosion control seed mix contain wildflowers, especially when the areas are often not visible from the highway so they cannot be enjoyed by travelers. If the seeding takes place on the inslopes, periodic mowing may preclude the wildflower plants from flowering anyway, depending on the timing of the mowing in relation to the phenology of the plant.

Wildflower seed germinates most effectively if it is dormant-seeded in the fall so that it goes through a cold stratification process over the winter to soften up the hard seed coat. This may require that temporary seed be used in the likely event that ground cover for erosion control needs to be established earlier in the season.

Diverse native grass/wildflower mixes like 70 and 70A require 2-3 years of management after seeding. These mixes should only be planted if Regional PDS staff are willing to commit the resources necessary to do this management and SPO staff are willing to make the same commitment for any necessary follow-up

management.

Seeding Mixture 75 is designed to be used for erosion control purposes and can be seeded at any time during the growing season. This mixture consists almost entirely of native grasses along with a couple of inexpensive, easy-to-grow wildflower species. It should be used in conjunction with the Seeding Nurse Crop item as described in standard spec 630.

Seeding Mixture No. 80 consists of a combination of relatively salt tolerant native and non-native species and is intended to be used on inslopes. The species in this mixture are non-invasive so it should be especially suitable for areas where the DNR liaison or others have concerns about adjacent natural areas. This mix should also be used in conjunction with the Seeding Nurse Crop item.

6-40.3.8 Seeding with a No-Till Rangeland Type Drill (Method C)

No-till rangeland type drills are typically equipped with 3 seed boxes: one for cool season seeds such as lawn-type grasses and nurse crop species, one for light fluffy seeds such as most native grass seeds, and one for small seeds such as most wildflower seeds. Each box is capable of being calibrated independently from the other boxes. A press wheel is mounted to the rear of each drop tube to firm the soil over the seed.

When seeding into existing vegetation or thatch, the drill should be equipped with a no-till attachment consisting of coulters which slice through the vegetation or thatch in front of the furrow openers and seed drop tubes. This no-till attachment is not necessary when seeding into bare soil.

As an alternative to using a drill with 3 separate seed boxes, each seed type (cool season, light fluffy and small) may be seeded separately with the drill being recalibrated for each seed type.

6-40.4 Sodding

Standard spec 631.2.1 requires that sod must be indigenous to the general locality in which it is used. In other words, the sod should grow naturally under the same general climatic and soil conditions as those at the site of the work. For example, sods grown on peaty soils would not be acceptable for use on sandy soils. Varieties of grasses that require a high degree of maintenance should not be planted either.

Sodding is the quickest method of securing a vegetative cover on graded areas of the roadway. However, due to the high cost of sodding it is generally used only on those areas where serious erosion might occur before turf could be established by seeding, or in urban areas.

The inspector will lay out the areas to be sodded and determine that the soil forming the bed upon which the sod is to be placed is properly prepared. If erosion has taken place, the gullies are to be backfilled and compacted by the contractor. The finished bed should have a uniformly even surface and be shaped, especially for flumes and ditches, to the required dimensions. Before laying the sod, the soil surface should be loosened to a fine texture and to a depth of at least 1" in order to provide a condition suitable for the penetration of the grass roots. If the soil is dry, water should be applied to properly condition the bed.

During the laying of the sod, the inspector should check on the work to ensure the following:

- The sod is laid as tight as possible
- Joints are properly made
- Edges of the sod where water is apt to flow over it are properly embedded in the soil
- Laid sod is tamped or rolled to make continuous contact with the underlying soil
- The sod is properly held in place with stakes

Sod placed on slopes steeper than 1 unit vertical to 4 unit horizontal, and all sod placed on flumes, ditches, or other areas that may be subjected to a concentrated flow of water, regardless of the slope, is required to be staked. It is important that sufficient stakes are used to ensure retention of the sod in place until the grass roots have developed and entered the underlying soil, anchoring the sod in place. Only stakes made of wood can be used, and they must be driven to within 1/2" of the surface of the sod to avoid interference with subsequent mowing.

Sod may be anchored with a jute fabric (class II, Type A) of specified weight.

Refer to standard spec 631.3 for requirements for fertilizing, rolling, tamping, and watering the placed sod. Also refer to SDD 8E4 for details on sod and sod-masonry ditch checks, and to SDD 8E5 for sodded flume details in FDM chapter 16.

6-40.5 Mulching

6-40.5.1 Material

The purpose of mulch is to break up rainfall, prevent compaction of the soil surface, lessen the erosive effects of

water and wind, moderate soil temperatures, supply shade for germinating seedlings, and prevent excessive evaporation of water from the soil.

Standard spec 627.2 permits the use of straw, hay, wood chips, wood excelsior fiber, or other material that is suitable. All mulch must be substantially free of noxious weed seeds and objectionable foreign material. Rotten or partially decayed straw or hay is not acceptable. Short-stemmed straw is not acceptable for crimping purposes but should work well for tacking.

Standard spec 627.2 further provides that straw or hay used for mulch shall be in an air-dry condition. As a guide, any straw or hay having 10% or less of moisture will be considered air-dry. It is important that the straw or hay be air-dry when weighed for payment by the ton. Generally, baled hay or straw coming from sheds, barns, under tarps, or even interiors of stacks will be air-dry unless exposed to rain prior to weighing. Should the engineer believe the straw or hay contains moisture greater than 10%, the moisture can be determined by randomly obtaining handfuls of hay or straw from bales and stuffing them into a soil sample bag. The sample should be weighed to obtain the net mass and then heated at moderate heat in an oven or suitable container to drive off the moisture. Moisture content is then determined by the following formula:

$$\text{Moisture Content (\%)} = \frac{\text{Wet Mass of Sample - Air Dry Mass of Sample}}{\text{Air - Dry Mass of Sample}} \quad \text{X } 100$$

6-40.5.2 Equipment

Equipment used in mulching operations should be specifically designed for applying, tacking, or crimping mulch. Equipment that is of inadequate capacity, jerrybuilt, poorly designed, badly worn, or malfunctioning is not acceptable.

6-40.5.3 Application

Mulch shall be applied to seeded areas within two days after completion of the seeding in order to conserve the moisture necessary for germination of the seed within the soil.

The contractor has the option to use one of the following three methods, unless restricted to a specific method by the contract. Contracts with counties should specify the mulching method to be used if the standard county practices differ from ours. If the special provisions do not address mulching methods, the WisDOT standard specifications are to be followed. When mulching areas of slopes that are too steep for tilling or otherwise inaccessible to a tiller, the contractor must anchor the mulch, using method A or B.

6-40.5.3.1 Method A: Netting

This method allows spreading mulch in place to a loose, uniform depth of 1/2 to 1 1/2 inches, and then anchoring by means of approved netting or twine secured by pegs or staples. When using this method, begin mulching at the top of the slopes, and proceed downward. Usually, the contractor selects a lightweight plastic netting rather than twine. This lightweight netting ultimately degrades under action of sunlight.

The contractor may use department-approved erosion control mats, listed in the PAL, instead of separately applying mulch and netting.

6-40.5.3.2 Method B: Tackifier

With this method, mulch is blown by machine to a uniform depth of 1/2 to 1 inch, using 1/2 to 3 tons of mulch per acre. The mulch covering should be loose enough to allow some sunlight to penetrate and air to circulate, but thick enough to shade the ground, conserve soil moisture, and prevent or reduce erosion. Mulch material from compacted bales should be loosened or fluffed before or during the placing so that no matted lumps of the material are placed on a seeded area. A spray of non-asphaltic tack sufficient to hold the mulch in place achieves anchoring.

Straw or hay mulch is usually applied with a mulch blower. The mulch blower is equipped with one or more nozzles, a storage tank, and a pump. It allows for combined application of a non-asphaltic binder with the mulch. Experience indicates that the blower must be equipped with at least three operating nozzles when combined application of binder is permitted.

Hydro-seeders are used for spraying a non-asphaltic tackifier over mulch that has been previously placed. Positive agitation must be provided in the tanks during application to assure a homogeneous mixture of water, tackifier, dye, and mulch when applied simultaneously.

Tackifiers, if used, must be pre-qualified by the department prior to use. Tackifiers shall be selected from the erosion control product acceptability list (PAL) developed and maintained by the department. A copy of the PAL may be obtained at:

http://www.dot.wisconsin.gov/business/engrserv/docs/pal.pdf

Specifications, application rates, and general information on tackifiers are contained within the PAL.

The inspector must verify that the correct proportions of binder and water are mixed uniformly. Likewise, the rate of application of binder and tackifier must be checked and verified. Increased rates of application may be required based on inspection of the mulch after placing and tacking.

6-40.5.3.3 Method C: Crimping

This method involves spreading the mulch uniformly to a loose depth of 1/2 to 1 1/2 inches by blowing from a machine or other means. Anchoring will be by a mulch tiller specially designed for crimping mulch into the soil. Experience to date indicates that anchoring mulch by tilling is a superior method for most soils. For desirable results, especially in heavier soils such as clays, the mulch should be applied and tilled into the soil while the topsoil and seedbed are still in a loose and friable condition. Tiller ballast should be added or discarded to achieve the required penetration.

One pass of the tiller is usually sufficient, but short-strand straw or hay may require several passes. Several passes may also be needed to anchor the mulch next to shoulders, in medians or in areas exposed to frequent or high-velocity winds.

When wood excelsior fiber is used for mulch, the fiber need not be anchored as required for other mulch types. The wood fiber tends to swell and expand and the many tiny fibers and barbs interact to secure the mulch in place.

Plastic nettings designed for use over mulches to secure the mulch in place can be used in areas where crimping is not feasible or where tacking agents cannot be applied or are ineffective.

A mulch tiller is used for crimping mulch. An agricultural disc is not a mulch tiller. A mulch tiller has flat, notched disks, whereas a farm disk has curved smooth disks and is designed to turn over soil. An agricultural disk should not be used for crimping mulch because it will bury the mulch rather than pressing it into the soil.

Random checks should subsequently be made as necessary to assure continued conformance. Areas that have been crimped may need additional passes of the tiller to secure the mulch depending on soil conditions and exposure to wind. Inspection of mulched areas must be made to assure that areas that have not been crimped have been secured by another method.

6-40.5.4 End Results

Mulch should remain on the seedbed until the grass has grown through the mulch. Mulch lost before acceptance is assumed to have been improperly placed and must be replaced by the contractor at the contractor's expense. Mulch properly placed and anchored, but lost from exceptional or severe rain or wind shall be replaced by the contractor and paid for by the department to encourage early landscaping and erosion control. Mulch replaced by the contractor must undergo inspection to assure the mulch is properly secured.

6-40.5.5 Mulch Inspection

An inspector must be present during initial applications to inspect the straw and hay for moisture content, state of deterioration, and length of straw. The inspector must also check the equipment for suitability and operational capability.

6-40.5.6 Diary Entries

Appropriate information relating to mulching should be entered into the grading or erosion control diary. Entries relating to the following are suggested:

- Kind of mulch
- Condition of mulch, including air-dry context or moisture percent if 10% or more, average length and state of deterioration if any
- Kind and condition of equipment, number of nozzles, etc.
- Method of application
- Binding or tacking agent used, if any
- Actual rate of application of tacking agent
- Dates of initial and random inspections
- Condition of mulch after anchoring or tacking.
- Amounts lost to wind and replaced by contractor at the contractor's expense
- Items of interest, special problems, recommendations, etc.

6-40.6 Trees, Shrubs and Vines

WisDOT Bureau of Highway Operations has a staff of landscape architects who have expertise in all areas of vegetation management. They should be invited to participate in the preconstruction conference for projects that have a significant amount of planting involved. They are also available to answer questions and assist with field checking of staking, inspections of plants and planting operations, advising on care requirements during the plant establishment period, determining plant survival, etc.

6-40.6.1 Materials

Planting of trees, shrubs, and vines under the contract will be made with plant stock grown by and furnished from nurseries, unless the contract provides for the use of collected or plantation-grown stock.

The plant material to be used in the planting project is perishable and therefore requires special care and handling. Acceptable plant material as described in standard spec 632 has been grown, dug, stored, packaged, and transported in a manner designed to keep it alive and in good condition. The intent of the specifications is that all reasonable means should be used during the term of the contract to keep the plant material in good condition.

It is recommended the engineer have available a copy of the American Standards for Nursery Stock; a Plant Hardiness Zones map, published by the U. S. Department of Agriculture, and the latest AASHTO Inspection Guide for Landscape Planting. The AASHTO guide is not a contract document, but can provide helpful information. These standards, maps, and guides are available in the region and from the Bureau of Highway Operations landscape architects.

The contractor is to furnish a list of sources for all plant material at least 15 days before the delivery of the material. The addresses on this list should be checked against the Plant Hardiness Zone map to make sure that all plants come from within the specified acceptable area.

Nursery-grown, plantation-grown, or "collected" stock, are three levels of plant culture. Nursery-grown stock has generally been better managed, grown under more controlled conditions, and received more care than plantation or collected stock. Plantation-grown stock has been systematically planted in friable soils free of stones, but has received only a minimum of aftercare. The most common examples of plantation-grown stock are evergreens grown for Christmas trees. Collected stock has been taken from wild or native stands and generally is subject to greater shock when transplanted than the same kind when nursery-grown.

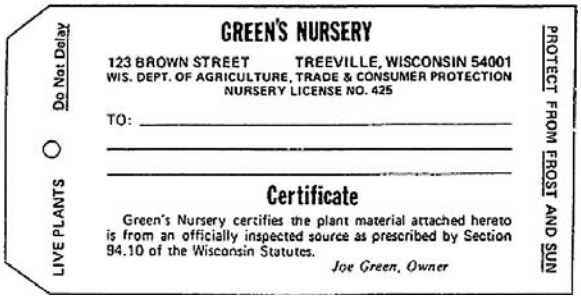
6-40.6.2 Certification for Nursery Stock

A Certificate of Compliance should accompany each shipment of nursery-grown planting material received on the project, and is to be filed with the engineer.

Wisconsin Statutes Section 94.10(5) sets out the requirements for labeling nursery stock. Shipments of nursery stock must be labeled with the name and address of the person selling or distributing the shipment. Nursery stock sold at retail must bear a tag or label giving the common or botanical name of the plants.

Each nursery or dealer is responsible for obtaining their own tags. An example of an approved label-type certificate is shown in Figure 1.

Figure 1 Example Certification for Nursery Stock



6-40.6.3 Inspection

Usually, a general inspection of the plant stock is made at the nursery or source of supply or a central collection area by a plant specialist. If the specialist has not inspected the project plant stock, the engineer or inspector may use the checklist shown in Figure 2 as a guide to acceptance or rejection. When inspection is made at the source, approved stock is usually tagged. An approval tag may be attached to each large size tree; however, small size trees and shrubs may have only representative samples of each species and size tagged.

Regardless of any prior approval, the inspector will examine each shipment of plant stock upon its arrival at the

job site, noting the condition of plants and compliance with contract requirements, and obtaining accompanying certificates of inspection relative to injurious insects and diseases. Plants that are not satisfactory upon arrival should be rejected.

Figure 2 Checklist for Inspection of Trees, Shrubs and Vines

If a plant specialist has not inspected the stock before its delivery to the project site, the engineer or inspector should check each plant at the time of delivery for the following desirable characteristics:

___1. Size and quantity meet contract requirements for the species

___2. Natural, uniform leaf or needle color.

___3. Well-developed, firm, moist buds uniformly spaced out to the end of branches on dormant stock. The cambium layer just under the bark should be green and moist.

___4. No visible decay in the roots, trunk, or branches.

___5. No sun scald, as shown by lighter-colored areas of bark. The cambium layer just under the light-colored bark will be dry and brown if the plant has been sun scalded.

___6. A good root system. Roots should not be on or close to the surface, crowded, twisted, or encircling the plant.

___7. No frost cracks. These are long, vertical splits in the bark that will allow insects and fungi to enter the plant.

___8. No signs of injury; such as abrasions, cuts, or breaks.

___9. Correct pruning, with no protruding stubs, cutting of the bark, or decay at the cut.

___10. No diseases. These may appear as discharges of sap; discolored leaves, needles, or bark; abnormal growth of branches, etc.

___11. No insects. Evidence of insects may be clusters of eggs, feeding patterns on bark and leaves, and holes drilled into the bark.

___12. Proper habit of growth.

a. Shade trees and flowering trees should be balanced, symmetrical, with a single leader. Side branches should be well developed.

b. Evergreens should have full foliage with uniform density.

c. Shrubs should have at least the minimum number of branches for the species and be uniformly branched.

___13. Trees with wrapped trunks should be unwrapped at time of delivery and immediately checked for defects under the wrap. If unwrapping is not allowed, the trees should be rejected.

___14. A firm, intact ball on balled and burlapped stock. The trunk should not be free to move inside the ball.

___15. Necessary certificates should accompany the shipment.

Failure of plant stock to pass this checklist is cause for rejection. Rejected plant stock should be immediately reloaded onto the delivery vehicle and not allowed to remain on the project.

The following items and procedures should be considered or employed when accepting plant material on arrival:

- A nursery inspection tag should accompany each shipment.
- The stock should be protected from the wind, sun, and other detrimental climatic effects during transit. According to standard spec 632.2.2.9, all stock must be dug, handled, packed, transported, and planted in the appropriate manner as applicable to BR, B&B, B&P, CG, or MT stock. These acronyms are defined below:

BR Bare root stock

B&B Balled and burlapped stock

B&P Balled and potted stock

CG Container grown stock

MT Machine transplanted stock

- The earth ball of B&B material should be firm and unbroken. Remove burlap from a random plant. If cut ends of several large fleshy roots appear on the surface of the earth ball, break the ball and examine the root system. If there are very few fibrous roots, chances of plant survival are reduced, especially in evergreens.

- B&B plant material should always be handled by the ball with no exceptions.
- Dormant deciduous plant material should have green tissue just under bark on all parts of the plant top. Check by cutting a small secondary branch and laying back a small piece of bark.
- Roots of bare root material should be of an average minimum spread as described in the American Standards for Nursery Stock.
- Permission to substitute plants should be extended only after consultation with the landscape architect to ensure the substituted plants are suitable for the purpose intended.

6-40.6.4 Measurement

The information in Table 4 below is derived from the American Standard for Nursery Stock.

Table 4 Method of Measurement for Various Tree Types

Tree Type	Method of Measurement
Shade and flowering trees (caliper measurement)	Take caliper measurement of trunk at 6 in above ground level [1] if diameter is 4 in or less. If greater than 4 in, take trunk caliper measurement at 12 in above ground level.
Shade and flowering trees (height measurement)	Measure height vertically from ground level to top of tallest trunk.
Deciduous shrubs	Measure height vertically from ground level to top of tallest branch.
Coniferous evergreens (upright growth)	Measure height vertically from top of ball to top middle of leader.
Coniferous evergreens (creeping or low spreading growth)	Measure horizontally the widest spread of the branches from one side to the other, measure the least spread, and average the results.
Vines	Measure from top of root to end of stem.

[1] Ground level refers to the top of the ball for B&B plants or the plant root collar for bare root and containerized plants.

6-40.6.5 Storage

All plant stock not planted on the day of delivery to the job site is required to be properly stored and protected from the sun and wind in the manner specified for temporary storage in standard spec 632.3.2. Special care should be taken so that roots of bare root plants are covered at all times except at planting time when brief exposure is necessary. Do not allow several bare-root plants to be distributed to their individual planting locations and left with their roots unprotected before they are planted. The fine hair roots will dry out very quickly when exposed to sun and wind.

Earth balls of B&B stock should be completely covered with approved moist mulch material. Evergreens being stored for more than a week should be spaced and have tops untied to prevent yellowing which occurs when they are stored too close together. Potted plants should be spaced to provide air circulation, have the top spread, be protected from the wind if possible, and watered when necessary. It is important that stored plants receive proper care until all are planted.

6-40.6.6 Location Staking

The location of trees and shrubs shown on the plans will be staked or otherwise indicated in the field by the engineer, and the contractor's planting will be inspected for compliance. The plan location should be accurately staked in the field using a base line or other methods for large areas.

Trees should not be planted at locations that would be hazardous to occupants of vehicles leaving the roadway. Generally, newly planted trees with an ultimate trunk diameter of more than 4 in should have a minimum setback of 36 ft from the edge of the traffic lane - 50 to 60 ft is desirable. If the trees are located behind walls, abutments, or other obstructions that separate the roadway from the trees, they may be planted closer.

The staking of plant locations should be done early so that staking is completed or nearly so before planting operations begin. The plant locations should be scaled off the plan. A full size plan rather than a "D" size plan will work better for this. If plant locations conflict with some existing feature such as power lines or if the plant would be in an undesirable location, for example, in a ditch that did not appear on the plan, or would be located within the minimum setback, the necessary adjustment in location should be made. These adjustments should be noted on the plan and brought to the attention of the engineer before planting begins.

6-40.6.7 Planting

During planting operations, the inspector should determine that the performance of the work complies with the

specified requirements. Specific attention should be paid to the following:

- Proper size of excavated plant holes
- Correct placing of plants
- Backfill of plant holes with specified materials
- Correct manner of placing backfill material around plants
- Proper application of fertilizer
- Adequate watering
- Any required pruning, mulching, wrapping, staking, or guying of plants

As a general rule, planting should be done in a manner that storage time is reduced to a minimum. Where many plants are involved and the planting time is drawn out, it is usually best to concentrate on getting the material planted, leaving guying, wrapping, and mulching for later. An exception to this may be evergreens, which offer much wind resistance and which should be braced or guyed as required at or soon after planting time. Constant wind action usually breaks small roots, keeping the tree from becoming established, defeating the purpose of the earth ball.

Usually, machine transplanting should be done as early in the spring as possible.

Evergreens desirably should be planted either in the spring before the buds open, or in September. Deciduous trees desirably should be planted before the buds have opened in the spring or after the leaves have dropped naturally in the fall. Project conditions may require adjustments to these ideal planting times.

Potted plants are usually planted last because an adequate root system is contained in the pot, and with proper care they can be held for some time without ill effect. In some cases, potted shrubs have been potted by the contractor and should be held for a specified period to ensure a live, healthy plant at the time of planting.

Care should be taken to set the plant at its proper elevation. This should be as close as possible to that at which it was previously growing. If the hole is too deep, backfill it until the plant will rest at its proper height. The depth of the hole should be carefully measured for large B&B stock to eliminate unnecessary handling that loosens the roots from the ball. It is better for a plant, especially a tree, to be planted slightly too high than for it to be planted too low. Soil under large balled and burlapped trees should be firm; otherwise, loose soil will turn to mud after watering and the tree will settle into the hole.

Backfilling of bare root plants should be done carefully so that the soil fills in between small roots. The plant should be worked around slightly to cause soil to filter down between the roots. Firming by stamping with a boot should be avoided because this breaks many small roots. The required watering will also compact the soil and assist in eliminating air pockets.

Standard spec 632.3.7 requires that backfill material for plant holes must be a combination of six parts native topsoil and one part compost. Holes for MT plants must be filled half-full with a slurry of one part water and one part compost just before placing the tree.

In planting potted plants, the elevation should be based on the plant root crown rather than the pot. Plantable fiber pots should be planted intact, with several gashes made in the pot to speed up deterioration. If the top of the pot will not be covered by the mulch material, the top portion should be cut off after planting, but before mulching. If plastic or metal pots, which do not readily decompose, are used, the pot should be removed from each plant as it is planted.

The contractor, upon completion of the planting, must remove and dispose of all excess excavation, waste materials, or other debris resulting from the planting.

6-40.6.8 Pruning

The philosophy for pruning at planting time has changed dramatically in recent years. It is now not acceptable to prune up to half of the growth from a plant to compensate for root loss incurred during the digging operation at the nursery. Research has shown that leaving as much leaf surface as possible on the newly planted plant increases it’s photosynthesis capability that allows it to overcome the shock of transplanting much more quickly. The only recommended pruning operation at planting time is the removal of broken, dead or rubbing branches.

Pruning to improve the structure of the plant should wait at least one growing season or to the end of the final year of a multi-year plant establishment period. Plants should be pruned so that after pruning the plant still retains the character and appearance typical of the species. The thinning of small branches of some species of low growing trees may be warranted at this time. For instance, lower branches of crab apple trees may need to be removed to accommodate rodent control material, and the interior branches of hawthorns may need to be thinned to allow air and light to penetrate.

The following procedures should be employed when pruning:

- Evergreens normally should not be pruned; however, all dead or broken branches and all leaders, except one, should be removed.
- All broken, dead, or rubbing limbs of deciduous trees should be removed.
- Cuts should be made as close as possible to the branch collar at the base of the limb without injuring the collar.
- Painting of pruning cuts is no longer required, except on oaks to prevent oak wilt.
- Pruning tools should be suitable for the purpose and sharp enough to make a clean, smooth cut.

6-40.6.9 Anti-Desiccant

If specified, an emulsion formulated to reduce water loss by transpiration should be sprayed on the needles of evergreens at or before the time of planting, on the roots of BR stock before shipment, and on MT stock before transplanting unless deciduous trees are dormant. When dry, the anti-desiccant will leave an odorless, colorless, thin film of wax on the roots, needles, and branches. Comparison with unsprayed plants and experience with the process are the best ways the inspector has to detect if anti-desiccant has been applied.

6-40.6.10 Landscape Planting Surveillance and Care

The contractor is obligated to care for plantings, and must be made aware of the responsibilities as described in standard spec 632, especially standard spec 632.3.19. This subsection pertains to watering, weeding, spraying, etc., after the initial planting. This work is an important part of the planting project that ensures the survival of the plants and protects the taxpayer's investment.

Mulching, watering, wrapping, guying, bracing, and application of rodent protection and anti-desiccant materials, when required, are a definite part of the bid item for which the contractor is remunerated. The contractor's obligation to perform this work is as clear cut and binding as that of furnishing and planting the plant material.

Ties used to secure wrappings should not be of nylon, plastic, or other materials that do not degrade rapidly.

Payment for the care of the plant material after planting is not included in the bid price for the plants. It is paid for under a separate bid item entitled Landscape Planting Surveillance and Care (see standard spec 632.3.19). The care cycles described should occur every 10 to 14 days. For estimating purposes, the number of cycles is typically figured on the basis of 1 cycle in late May, 2 cycles each month from June through September and 1 cycle in early October. The actual number of cycles may vary depending on whether adequate rainfall or drought occurs.

If the contractor fails to adequately perform landscape surveillance and care as described in standard spec 632.3.19, the engineer should assess daily damages using the administrative item 806.0632 Failing to Perform Landscape Surveillance. The daily damages are intended to offset the cost of hiring an outside source to perform the work. The dollar value to be used is provided in the contract special provisions. Daily damages specified in the special provision should be dependent upon the value of planting items in the contract, as shown in FDM 27-25-10.

Replacement of dead plants during the appropriate planting season is still incidental to the bid item for furnishing and planting that species and size.

6-40.6.11 Establishment Period and Payment

The contractor will be responsible for care of plants and necessary replacements for a 2-year establishment period, unless a 1-year period is specified in the contract.

The 2-year establishment period must extend until October 15 of the second full growing season. The 1-year establishment period must extend until October 15 of the first growing season, if planting is done in the spring; the period must extend until October 15 of the succeeding year, if the planting is done in the fall.

When a 2-year plant establishment period has been specified, care and general condition of plantings should be monitored at least every month from the time the plants leaf out in the spring, until they lose their leaves in the fall. A comprehensive inspection should be conducted in late August or early September following the first growing season. Any dead plants should be tagged or marked. These are to be replaced by the contractor during that fall planting season. Another inspection should be conducted the following spring in case any plants die during the winter, with replacements again being made at that time.

The contractor must complete all replacements by June 1 of the year the final inspection is made so that all plants are top quality and in prime condition as of the inspection date. The final inspection is normally conducted late in August or early in September of the final year of the plant establishment period using the criteria set forth in standard spec 632.3.20 for determining plant acceptability and qualification for payment. Partial and final payments will be in accord with standard spec 632.5.

A diagrammatic flow chart in Figure 3 shows the payment schedule for plants installed under a two-year growing season establishment period. Future payments made under the plant payment schedule in the standard specifications for a two growing season establishment period should follow this chart.

Figure 3 Plant Payment Schedule