United States Department of Agriculture
Natural Resources Conservation Service

WISCONSIN STANDARD
DRAWING NO. WI-001C 03/16

CONSTRUCTION PLAN

PRACTICE(S) Streambank and Shoreline Protection (580)

LANDOWNER Vernon & Mary Doering

SITE ADDRESS W3487 County Rd D Tomahawk, WI 54487

LANDOWNER PHONE NO. 715-470-0121 COUNTY Lincoln

TOWNSHIP King T 35 N, R 07 E/W, Sec. 34

FIELD OFFICE Lincoln County TELEPHONE NO. 715-539-1087

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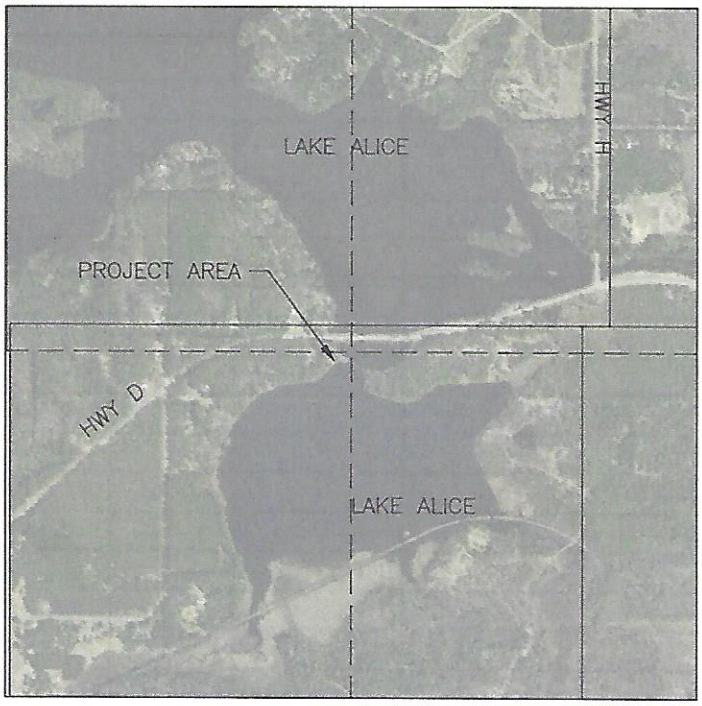


N

Not to Scale

LOCATION MAP

NOTICE TO LANDOWNERS AND EXCAVATORS

Any representation made by the USDA, Natural Resources Conservation Service, or the Lincoln County LCD, as to the approximate location or nonexistence of above or under ground hazards does not relieve the owner of the property or the excavator that is hired to complete construction, from notifying Diggers Hotline of the pending construction. You will be liable for damages resulting from construction activities.
Call Diggers Hotline! Ticket Number _____

CONSTRUCTION DRAWINGS AND SPECIFICATIONS ACCEPTANCE

I have reviewed and understand the construction plans and specifications and agree to complete the work accordingly. Failure to meet these plans and specifications may jeopardize any continued NRCS technical assistance or program cost sharing applied for. I understand that it is my responsibility to secure all necessary permits and licenses, and to complete the work in accordance with all local, state, and federal laws. Modification of these construction plans or specifications must be approved by the NRCS before installation. I assume all responsibility for negotiations and contract agreements with the construction contractors.

Landowner Signature: _____ Date: _____

Designed by: Mitch McCarroll Date: 1-16-19

Checked by: Stacy D. Dehne Date: 1-17-19

Approved by: Stacy D. Dehne Date: 1-24-19

The installed practices comply with applicable NRCS technical standards and specifications. The "redlined" construction plans (as-built drawings) reflect changes made during construction.

Construction Approved by: _____ Date: _____

Job Approval Class I

Sheet 1 of 10

ESTIMATED QUANTITIES

ITEM	UNIT	QUANTITY	SHEET NUMBER	WI CONSTRUCTION SPEC. OR JOB SHEET NUMBER
MOBLIIZATION & DEMOBILIZATION	JOB	1		007 – MOBILIZATION
POLLUTION CONTROL	JOB	1		005 – POLLUTION CONTROL
EXCAVATION	JOB	1		002 – EXCAVATION
EARTHFILL	JOB	1		003 – EARTHFILL
CLASS I NONWOVEN GEOTEXTILE	SQ. YD	250	7	013 – GEOTEXTILES
D50 6" ROCK RIPRAP	CU. YD.	60	4,6,7	009 – ROCK RIPRAP
TIMBER SEAWALL REMOVAL	JOB	1	5	002 – EXCAVATION
SEEDING DISTURBED AREAS	JOB	1	4,9,10	WI–710 SEEDING ESTAB.
UPLAND PLANTING	JOB	1	4,8	WI BIOLOGY TECH NOTE 1

Quantities are estimated to the neat lines and grades of in–place materials shown on the construction plan unless otherwise stated. Truck yardage, loose fill, shrinkage, etc., must be calculated and compensated for by the contractor preparing a bid or constructing the project.

CONSTRUCTION NOTES

All necessary permits shall be acquired before construction begins.

1. It is the landowner's and contractor's responsibility to notify the owners of any utility, such as buried cable or pipelines, that may be present in the construction area, before the start of construction so that they may locate and stake such utilities.

2. Lincoln County and DATCP offices must be contacted at least 3 days before the start of construction, to stake the project and review the plans with the foreman. No work will be performed prior to the contract and the operation and maintenance agreement being signed.

3. Follow Wisconsin Construction Specifications 2 (Excavation), 5 (Site Pollution Control) 7 (Mobilization & Demobilization), 9 (Rock riprap), 13 (Geotextiles) 710 Seeding establishment, and WI Biology Tech Note 1 attached for related aspects of the project.

4. Earthwork shall consist of removal of any garbage (i.e. bottles, glass, metals, etc) encountered.

5. Rock to be placed will have a D50 rock size of six (6) inch. The rock for the riprap will be placed on top of Class I non woven geotextile fabric. Rock and Geotextile shall meet WI Construction specs 9 and 13 attached to this plan.

6. The riprap shall have a 2:1 slope on the face of the rock and extend no further than 8 feet waterward.

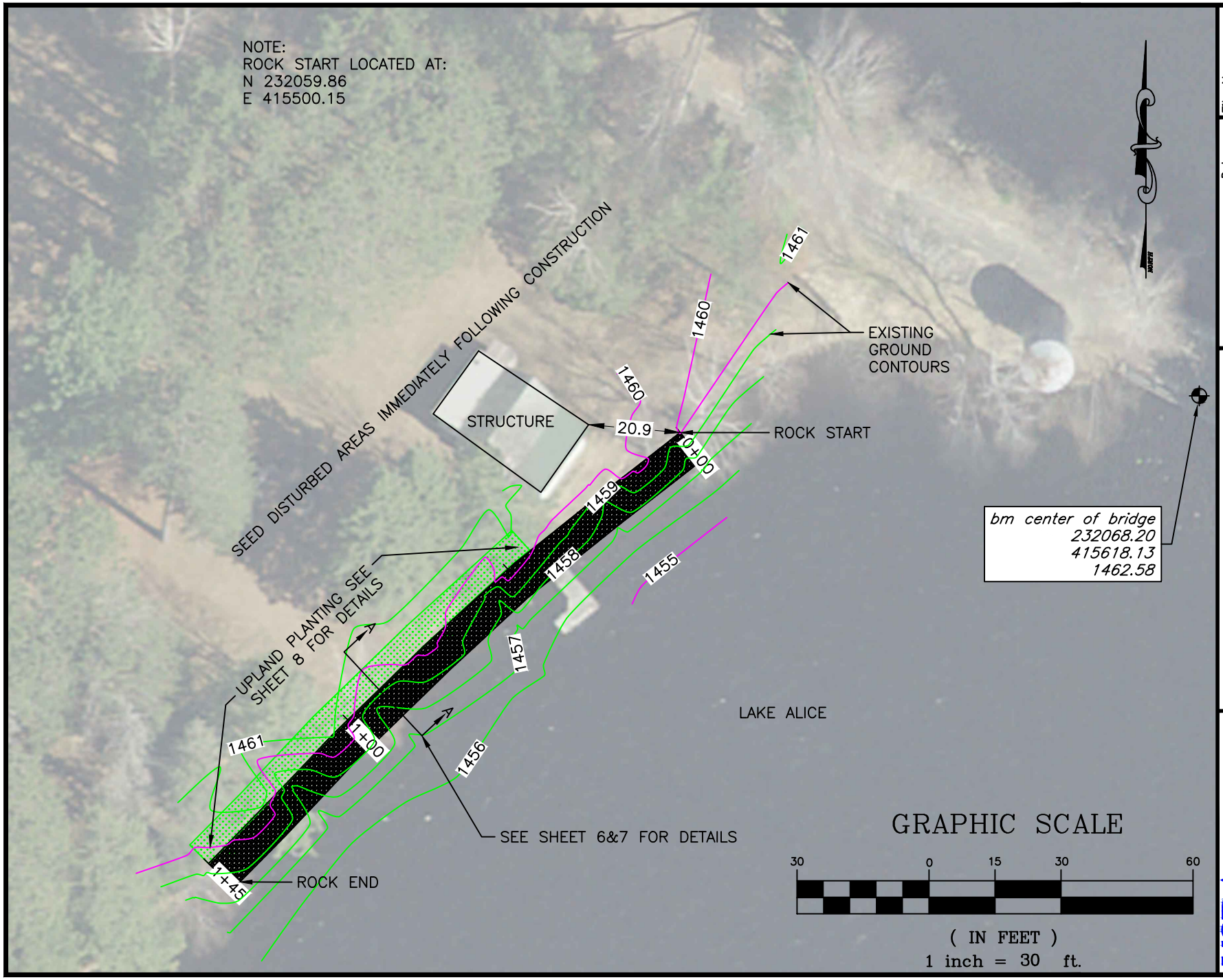
7. Lakebed will be excavated the entire length to create a 1' X 1' trench to be filled with rock. Taper ends to shore.

8. Vegetated planting shall be installed as shown on the plan along the entire frontage.

9. All heavy equipment used within the construction site shall be clean to prevent spread of invasive species and well maintained. All equipment lines and fittings shall be checked on a daily basis to ensure that they are in good working order. The contractor is responsible for all aspects of cleanup from accidental spills. Refer to WI Construction Spec. 5 (attached) for details on Construction Site Pollution Control.

10. If a significant archaeological or historical site is found, cease construction immediately and relocate, redesign, or delete the cost share practice, as needed, to prevent damage to the archaeological or historical site.

11. Immediately seed disturbed areas along the bank following construction activities.



File Name WI-007

Date 08/14

Sheet 4 of 10

		Date
Designed	MRM	01-2019
Drawn	MRM	01-2019
Checked		
Approved		

PLAN VIEW

CLIENT: DOERNING

COUNTY: Lincoln

USDA United States Department of Agriculture

Natural Resources Conservation Service

United States Department of Agriculture

Natural Resources Conservation Service

SEAWALL PHOTO

CLIENT: DOERNING

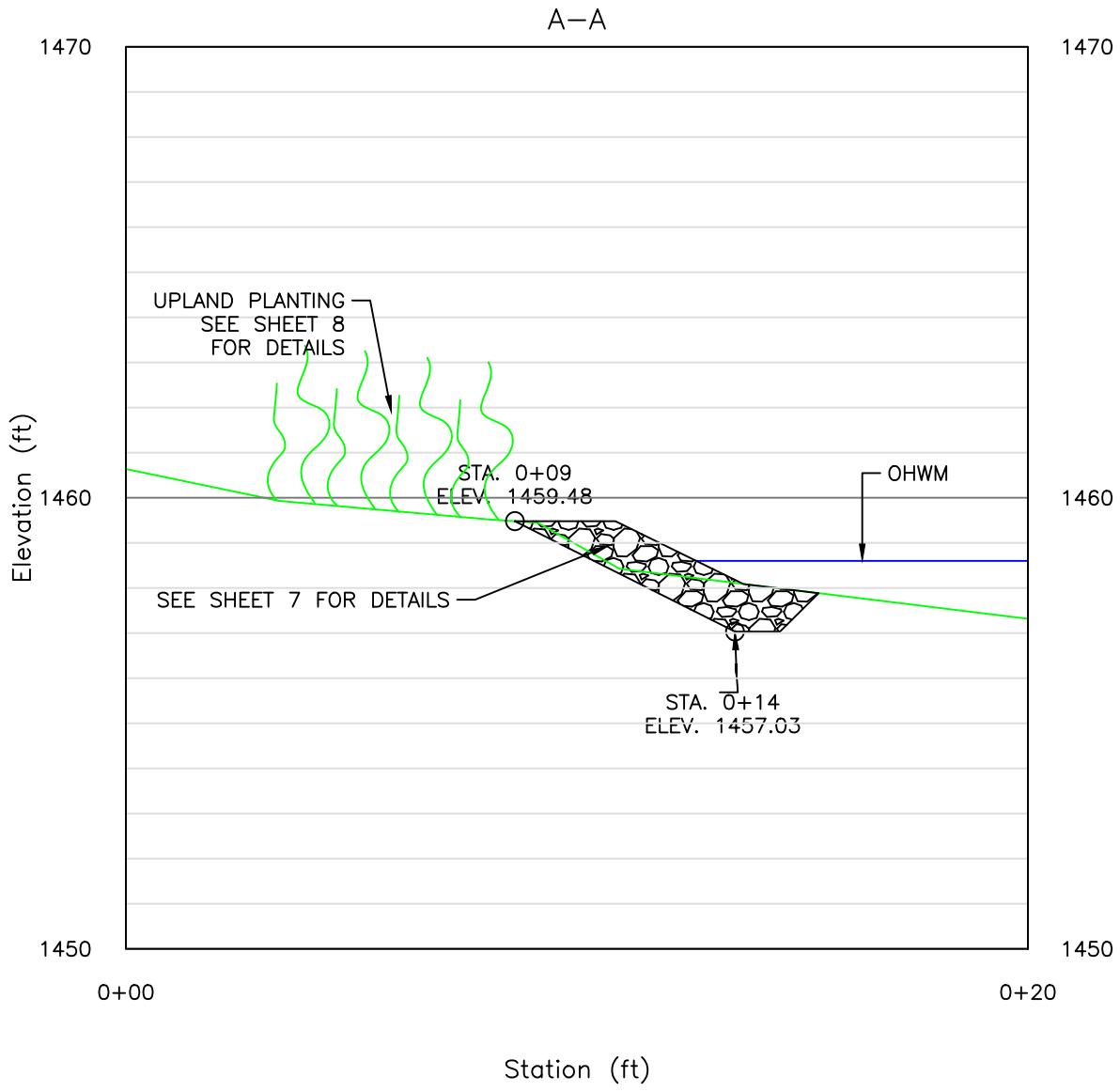
COUNTY: Lincoln

		Date
Designed	MRM	01–2019
Drawn	MRM	01–2019
Checked		
Approved		

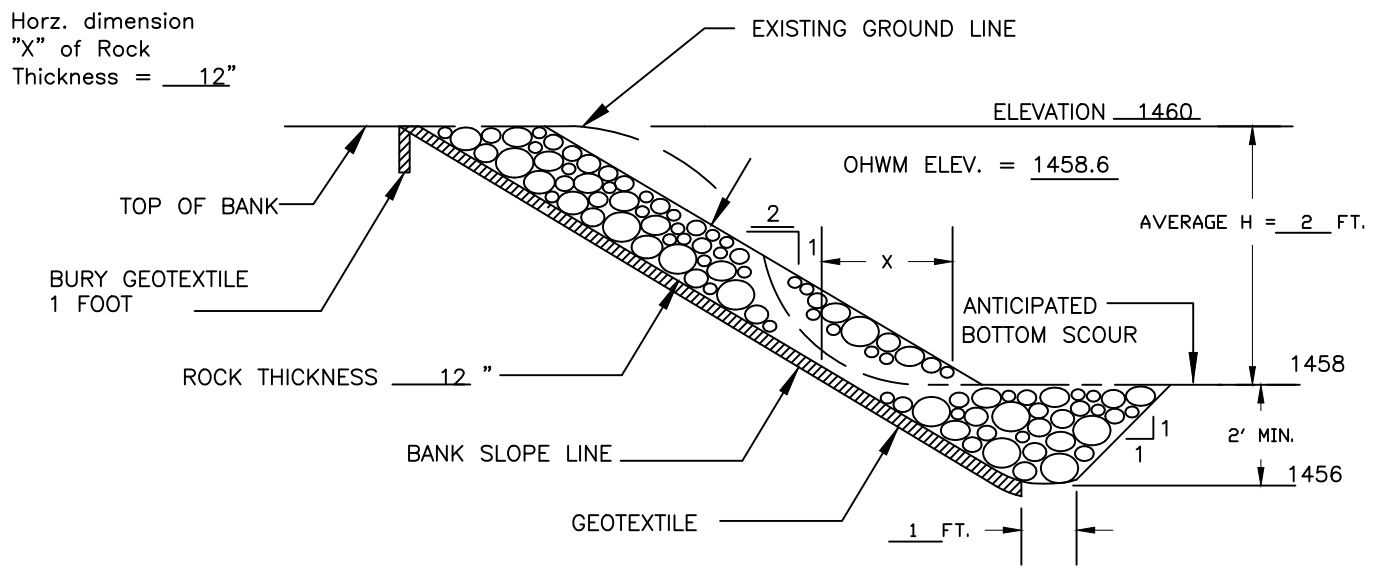
File Name WI–002

Date 08/14

Sheet 5 of 10



USDA United States Department of Agriculture Natural Resources Conservation Service	PLAN VIEW CLIENT: DOERNING COUNTY: Lincoln	Designed MRM 01–2019 Drawn MRM 01–2019 Checked Approved	File Name WI–002 Date 08/14 Sheet 6 of 10



TYPICAL CROSS SECTION

GRADATION OF ROCK

PERCENT PASSING BY WEIGHT	SIZE (INCHES)
100	12
60–85	9
25–50	6
5–20	3
0–5	1.2

QUANTITY ESTIMATE*

BANK SLOPING FOR RIPRAP		LIN. FT.
BANK SLOPING (SEEDING ONLY)		LIN. FT.
ROCK FOR RIPRAP (WI CONST. SPEC. 9)	60	CU. YD.
GEOTEXTILE (WI CONST. SPEC. 13) CLASS 1 NONWOVEN	250	SQ. YD.
SEEDING		ACRES

*ESTIMATED TO THE NEAT LINES AND GRADE

NOTES:

1. DOUBLE THE ROCK THICKNESS FOR A DISTANCE OF 2 FEET AT THE UPSTREAM AND DOWNSTREAM ENDS OF THE RIPRAP. BLEND THE ROCK SURFACE TO MATCH THE EXISTING STABLE BANK SURFACE.

THIS STANDARDIZED DESIGN MUST BE ADAPTED TO THE SPECIFIC SITE.

SITE _____

EXCAVATED KEYWAY

USDA United States Department of Agriculture Natural Resources Conservation Service	SHORELINE PROTECTION WITH GEOTEXTILE (FULL BANK HEIGHT) CLIENT: DOERNING COUNTY: LINCOLN	Designed MRM Date 01–2019 Drawn MRM 01–2019 Checked Approved	File Name WI–404D Date 07/14 Sheet 7 of 10

Doering Plant List

VsB Soil - loamy sands, 1-6% slopes

Minimum planting densities per 100 sq ft = 1 tree, 2 shrubs, 25 groundcover

****For 1, 609 sq ft planting area: Plant a minimum of 6 trees, 12 shrubs, 150 groundcovers****

Shrubs (12 total)		**Groundcover cont...**	
Black Chokeberry	*Aronia melanocarpa*	*Part Sun*	
Blue false indigo	*Baptisia australis*	Blue Giant Hyssop	*Agastache foeniculum*
American New Jersey Tea	*Ceanothus americanus*	Canada Anemone	*Anemone canadensis*
Sweet Fern	*Comptonia peregrina*	White Turtlehead	*Chelone glabra*
Bush Honeysuckle	*Diervilla lonicera*	Fireweed	*Epilobium angustifolium*
Partridgeberry	*Mitchella repens*	Large Leaved Aster	*Eurybia macrophylla*
Prairie Rose	*Rosa arkansana*	Wild Strawberry	*Fragaria virginiana*
Swamp rose	*Rosa palustris*	Ox Eye Sunflower	*Heliopsis helianthoides*
White Meadowsweet	*Spiraea alba*	Cardinal Flower	*Lobelia cardinalis*
Steeplebush	*Spiraea tomentosa*	Bracken Fern	*Pteridium aquilinum*
Snowberry	*Symphoricarpos albus*	Ironweed	*Vernonia fasciculata*
Lowbush Blueberry	*Vaccinium angustifolium*	Culver's Root	*Veronicastrum virginicum*
		Golden Alexanders	*Zizia aurea*
Groundcover (150 total)			
Full Sun		*Shade*	
Pearly Everlasting	*Anaphalis margaritacea*	Maidenhair Fern	*Adiantum pedatum*
Big Bluestem	*Andropogon gerardii*	Hog Peanut	*Amphicarpaea bracteata*
Columbine	*Aquilegia canadensis*	Lady Fern	*Athyrium filix-femina*
Swamp Milkweed	*Asclepias incarnata*	Pennsylvania Sedge	*Carex pensylvanica*
Fringe Sedge	*Carex crinita*	Bunchberry	*Cornus canadensis*
Porcupine Sedge	*Carex hystericina*	Canada Mayflower	*Maianthemum canadense*
Common Boneset	*Eupatorium perfoliatum*	Ostrich Fern	*Matteuccia struthiopteris*
Spotted Joe Pye Weed	*Eutrochium maculatum*	Mayapple	*Podophyllum peltatum*
Bottle Gentian	*Gentiana andrewsii*	Zigzag Goldenrod	*Solidago flexicaulis*
Junegrass	*Koeleria macrantha*	Early Meadow Rue	*Thalictrum dioicum*
Great Blazing Star	*Liatris pycnostachya*		
Great Lobelia	*Lobelia siphilitica*	**Trees (6 total)**	
Yellow Loosestrife	*Lysimachia terrestris*	Paper Birch	*Betula papyrifera*
Wild Bergamot	*Monarda fistulosa*	Black Willow	*Salix nigra*
Bergamot	*Monarda fistulosa*	Silver Maple	*Acer saccharinum*
Black Eyed Susan	*Rudbeckia hirta*	Cottonwood	*Populus deltoides*
Stiff Goldenrod	*Solidago rigida*	Red Oak	*Quercus rubra*
Indian Grass	*Sorghastrum nutans*	Basswood	*Tilia americana*
Panicled Aster	*Symphyotrichum lanceolatum*	Tamarack	*Larix larcina*
New England Aster	*Symphyotrichum novae-angliae*	White Pine	*Pinus strobus*
Red Stemmed Aster	*Symphyotrichum puniceum*		
Blue Vervain	*Verbena hastata*		

SEEDING DATES NORTH

TIME PERIOD	DATES			TYPE OF SEEDING
Spring	May 1	through	June 15	Permanent
Summer	June 16	through	see WI-710ss pg 2	Temporary *
Late Summer	July 15	through	August 10	Permanent
Fall	August 11	through	see WI-710ss pg 2	Temporary *
Late Fall	November 1	through	Snow Cover	Dormant
Winter	Snow Cover	through	April 30	Not Allowed

MATERIALS

If no soil test is available, apply a minimum of 150 pounds of 20-10-10 fertilizer per acre. This is equivalent to 30 pounds nitrogen (N), 15 pounds phosphate (P205), and 15 pounds potash (K2O) per acre. Apply two tons of 80-89 lime or equivalent.

* Seed a temporary cover crop of _____ at #N/A # /ac (#N/A bu/ac)
A permanent seeding shall be completed during the next acceptable time period following a temporary seeding.

MINIMUM PURE LIVE SEED (PLS) [1] RATE PER ACRE AND TOTAL POUNDS OF SEED NEEDED

SEEDING MIX (DESIGN) 9	LOCATION: 1 ACRES: 0.25	
SPECIES	RATE	POUNDS
Kentucky Bluegrass	3.0	0.8
Creeping Red Fescue	4.0	1.0
Perennial Ryegrass	10.0	2.5
**	#N/A	#N/A

SEEDING MIX (AS-BUILT)	LOCATION ACRES	
SPECIES	RATE	POUNDS

[1] PLS lbs. = (total % Germination / 100 * % Purity / 100) * Net Weight (lbs.)

** Companion Crop

ADDITIONAL SEED PERCENT: _____ %

Mulching Required: No

Total % Germination may also be termed *Total %* Viable Seed on a tag. If a tag only shows % Germination, the user must *include percentage of the seed that germinated during the lab test* (% Germination) **plus** the *percentage of hard and/or dormant seed.* Hard seed and dormant seed are seeds that are still capable of germinating and producing a plant but did not germinate under the conditions of the test in the lab.

Additional native seeds may be required by permitting agencies. These addition are allowed.

Seed mixture shall meet all requirements of the WI weed laws.

Species identified as restricted or prohibited by law shall not be planted.

Certified seed shall be used, and the seeding rates will be based on pure live seed.

For dormant seedings, increase the seeds per square foot by 15%.

SEEDBED PREPARATION

Seedbed preparation shall immediately follow construction activities.

Prepare a fine, firm seedbed to a minimum depth of three inches. A seedbed is considered firm when a footprint penetrates 1/4 to 1/2 inch deep.

SEEDING

Inoculate legumes with the specific inoculum for the species in accordance with the manufacturer's recommendations. When using a hydroseeder, five times the recommended rate of inoculant shall be added to the hydroseeder. Inoculant shall not be mixed with liquid fertilizer.

Seed may be broadcast or drilled as appropriate to the site.
Seed, fertilize, and lime as soon as possible after construction.
Seeding perpendicular to direction of flow is required to limit erosion.

Seed grasses and legumes no more than 1/4 inch deep.

Consider seeding at a lower rate and making 2 passes to ensure more uniform distribution.

TEMPORARY SEEDING OPTIONS

Select one of the following species for temporary cover if:

1) The required seeds or plant stock are not available or the normal permanent seeding period for the species has passed
   - Forage Sorghum - 1/2 bushel per acre (May 15-July 15)
   - Sorghum - Sudangrass Hybrid - 1 bushel per acre (May 15-July 15)
   - Sudangrass - 1 bushel per acre (May 15-July 15)
   - Winter Wheat - 2 bushels per acre (Aug 1-Oct 1)
   - Winter Cereal Rye - 2 bushels per acre (Aug 1-Oct 15)
   - Oats - 2 bushels per acre (Apr 1-Sept 1)
   - Annual Ryegrass - 20 Pounds per acre (Apr 1-Sept 1)

2) Triazine herbicide carryover will not allow establishment of permanent cover immediately.
   - Forage Sorghum - 1/2 Bushel per acre (May 15-July 15)
   - Sorghum - Sudangrass Hybrid - 1 Bushel per acre (May 15-July 15)
   - Sudangrass - 1 Bushel per acre (May 15-July 15)

   Mulching not required

DORMANT SEEDING

Seed is broadcast and incorporated, no-tilled, or drilled into the seedbed .
Seedbed preparations and conditions are similar to conventional seeding.

MULCHING Mulching not required

OPERATIONS AND MAINTENANCE PLAN

Cooperator: Vernon & Mary Doering Date: January 2019

By: Mitchell McCarthy Title: Conservation Program Manager

Project Location: W3487 County Rd D Tomahawk, WI 54487

The owner or sponsor of this project is responsible for the rock riprap shoreline protection. It must be recognized that any project needs to be properly operated and maintained including periodic inspection. The following guidelines have been prepared for the operation and maintenance of this protection measure.

1. Inspect the project regularly, especially following strong winds and spring break–up of the ice, for erosion or displacement of rock. Repair damage immediately by replacing any dislodged rock, removing debris, and filling and/or reseeding as necessary. Be especially careful to cover all exposed filter material (granular or geotextile).

2. Check for sloughing, erosion, or damage to vegetative cover. Damaged areas shall be graded, shaped, and re–vegetated as soon as possible.

3. Equipment used on the shoreline (for dock removal, boat launching, yard maintenance, etc.) must be kept away from the project to avoid damage to the project and the soil it is protecting.

4. Maintain vegetated areas in adequate cover to reduce the potential for erosive velocities of water moving on bare soils – particularly on the slope toward the lake.

5. Maintain and water installed plants.

6. Vegetation Removal
   a) Weeding: weeds may be pulled for the first 3 years to promote native plants.
   b) Trees and shrubs: remove dead or windblown trees only if they pose a safety hazard, otherwise they provide habitat for fish and wildlife
   c) Exotic/invasive species control: control exotic plants and monitor annually.

7. Eliminate access or foot traffic over the planting area to the shoreline slope with the exception of a designated pathway area.

8. Protect against deer and other animals browsing in the "no–mow" zone and planted area with the use of fencing and/or landscape products available to spray on plants to deter them (such as red pepper spray).

9.. Notify County within two weeks if issues arise.

I have read the guidelines for the maintenance of the lakeshore stabilization project and agree to follow the guidelines for 10 years.

Cooperator's signature: _____ Date: _____

I have discussed the maintenance guidelines with the above cooperator.

Conservationist's signature: _____ Date: _____

USDA United States Department of Agriculture Natural Resources Conservation Service	OPERATIONS & MAINTENANCE PLAN CLIENT: DOERING COUNTY: Lincoln	Designed MRM Date 01–2019 Drawn MRM 01–2019 Checked Approved	File Name Date 08/14 Sheet 1 of 1

Construction Quality Assurance Plan
Shoreline Protection

LANDOWNER: Vernon & Mary Doering

LOCATION OF PRACTICE OR PLAN ID: W3487 County RD D Tomahawk, WI 54487

INSPECTOR: Mitchell McCarthy APPROVER: _____ Date: _____

ENGINEERING JOB CLASS: I

Initial and date items as completed. Date all additional documentation and keep in construction file.

PRE–CONSTRUCTION

- ☐ Verify that the landowner or contractor notified all utilities prior to construction. Document DIGGERS HOTLINE Ticket Number _____.
- ☐ Obtain copies of PERMITS, or documentation that they aren't needed.
- ☐ Inspect EROSION CONTROL PRACTICES (silt fence, etc.) Document proper installation with photographs or diary notation.

MATERIALS

- ☐ ROCK RIPRAP MATERIAL. Verify that the material meets the soundness requirements in Wisconsin Construction Specification 9; obtain a document for the case file or record observations in writing. Verify the gradation using the Wisconsin Engineering Spreadsheets and Wisconsin Construction Specification 9 and the Wisconsin Supplement to the USDA Engineering Field Handbook Chapter 17. Print the spreadsheet for documentation.
- ☐ GEOTEXTILE MATERIALS. Verify that the material meets the requirements in Wisconsin Construction Specification 13, Table 2, geotextile. Attach a copy of the manufacturer's material specifications. Record observations in the job diary and take photographs of the material tag.
- ☐ SEED. Document species, quantities of pure live seed, and date seeded. Verify that it meets requirements of WI–710 drawing. Place seed tag in construction documentation file.

CONSTRUCTION

- ☐ STAKE the location of the Shoreline protection at each end.

Construction Quality Assurance Plan
Shoreline Protection

(page 2 of 2)

- ☐ OBSERVE that topsoil stripping and stockpiling is accomplished according to plans / Wisconsin Construction Specification 2. Document the observation in the job diary.
- ☐ Verify that EXCAVATED MATERIALS are used / disposed of according to sections 2 and 3 of Wisconsin Construction Specification 2. Document the observation in the job diary.
- ☐ STAKE STREAM BANK. STAKE the location and sub–grades of the slope. Record the staking notes in the engineering field book.
- ☐ SURVEY CROSS–SECTIONS of completed streambank excavation PRIOR TO RIP RAP placement. Minimum is one cross–section for each 300'. Verify:
  - _____ Slopes – Planned slopes are 2:1
  - _____ Final Length – Planned length is 145'
- ☐ OBSERVE THE GEOTEXTILE PLACEMENT. Verify correct overlap and anchorage per plans and Wisconsin Construction Specification 13. Obtain photographs and record observations in the job diary.
- ☐ OBSERVE THE ROCK RIPRAP PLACEMENT. Verify that geotextile material is not damaged or displaced during riprap placement. Note height of rock drop onto geotextile. Obtain photographs and record observations in the job diary.

FINAL INSPECTION

- ☐ SURVEY FINAL CROSS–SECTIONS of completed stream bank AFTER RIPRAP placement. Minimum is one cross–section for each 300'. Verify:
  - _____ Slopes – Planned slopes are 2:1
  - _____ Riprap thickness – Compare with sub–grade survey. Planned riprap thickness is 12"
  - _____ Final Length – Planned length 2:1
- ☐ Verify that all disturbed areas not to be cropped are SEEDED, FERTILIZED, LIMED AND MULCHED. Document seeding date.

Document installed quantities (payment units) of the practices.

Document all of the above with photographs, data in engineering field book and job diary.

I have reviewed this plan and understand my responsibilities in the quality assurance needed for my project.

Landowner's Signature: _____ Date: _____

USDA United States Department of Agriculture Natural Resources Conservation Service	QUALITY ASSURANCE PLAN CLIENT: DOERING COUNTY: Lincoln	Designed MRM Date 01–2019 Drawn MRM 01–2019 Checked Approved	File Name Date 08/14 Sheet 2 of 2

WISCONSIN CONSTRUCTION SPECIFICATION

2. EXCAVATION

A. SCOPE

The work shall consist of the excavation of all materials necessary for the construction of the work.

B. USE OF EXCAVATED MATERIALS

To the extent that they are needed, all suitable materials removed from the specified excavations shall be used in the construction of the required earthfill. The suitability of materials for specific purposes will be determined by the Technician. The Contractor shall not waste or otherwise dispose of suitable excavated materials.

C. DISPOSAL OF WASTE MATERIALS

All surplus or unsuitable excavated materials will be designated as waste and shall be disposed of at the locations shown on the drawings or as approved by the Technician. Waste materials shall not be placed in wetlands or regulated floodplains.

Material placed in designated waste disposal areas shall be left in a sightly condition and sloped to provide positive drainage. Compaction of the waste materials will not be required unless specified by the construction plans.

Waste material excavated from channels may be deposited in leveled spoilbanks or areas adjacent to the channel work (if permissible). The shape and slopes of the spoilbanks shall be indicated on the drawings or as approved by the Technician. Spoil piles shall be located a minimum of 12 feet from the top of the channel side slope.

Spoil piles or disposal areas shall be protected to minimize site erosion and the production of sediment. Protective measures may include but are not limited to diversions, seeding, mulching, sediment basins, and silt fences.

D. SPECIAL REQUIREMENTS FOR STRUCTURE AND TRENCH EXCAVATION

The required dimensions and side slopes of all structure and trench excavations shall be as shown on the drawings.

Excavation beyond the limits of the specified lines and grades shall be corrected by filling the resulting voids with approved compacted materials.

Excavation for the installation of pipes shall follow the practices contained in the Occupational Safety and Health Administration (OSHA) Subpart P, Excavation, of 29 CFR 1926.650, .651 and .652.

Side slopes shall be excavated or braced to safeguard the work and workers. When bracing or supporting is required, the width of the excavation shall be adjusted to allow for the space occupied by the sheeting, bracing, or other supporting installations. The Contractor shall furnish, place, and subsequently remove such supporting installations.

E. REMOVAL OF WATER

The Contractor shall construct and maintain all necessary cofferdams, channels, flumes, pumping equipment, and/or other temporary diversion and protective work for dewatering the various parts of the work. Foundations, cutoff trenches, and other parts of the work shall be maintained free from water as required for constructing each part of the work. After having served their purpose, all cofferdams and other temporary protective works shall be removed or leveled to give a sightly appearance and so as not to interfere in any way with the operation, usefulness, or stability of the permanent structure.

F. BORROW EXCAVATION

When the quantities of suitable materials obtained from specified excavations are insufficient to construct the specified fill portions of the permanent works, additional materials shall be obtained from the designated borrow areas.

When shown on the drawings, sediment basins, terraces, diversions, or other measures shall be constructed to protect the borrow areas from erosion and retain sediment within the borrow area.

The upper six (6) inches of soil shall be stripped from all borrow areas. This stripping shall be performed immediately prior to use of the borrow material to reduce the time the area is exposed to erosion. For large borrow areas, only a portion of the area should be stripped at a time. This material shall be redistributed over the area from which it came after borrow excavation is completed.

The extent of excavation and the selection of materials from the borrow area shall be as directed by the Technician. On completion of excavation, all borrow areas shall be left in a sightly condition. All borrow areas shall be graded to blend with existing topography and sloped to prevent ponding and provide positive drainage.

WISCONSIN CONSTRUCTION SPECIFICATION

3. EARTHFILL

A. SCOPE

The work shall consist of placing the earthfill required by the drawings. This specification does not apply to the earthfill required for waste storage facilities.

B. MATERIALS

All fill materials shall be obtained from required excavations and designated borrow areas. The selection, blending, routing, and disposition of materials in the various fills shall be subject to approval by the Technician.

Fill materials shall contain no sod, brush, roots, frozen soil, or other perishable materials. Stones larger than two-thirds of the uncompacted layer thickness shall be removed from the materials prior to compaction of the fill.

C. FOUNDATION PREPARATION

The foundation area shall be cleared of trees, stumps, roots, brush, rubbish, and stones having a maximum dimension greater than six (6) inches. Foundations shall be stripped to remove vegetation and other unsuitable materials or to the depth shown on the drawings, whichever is greater. Topsoil shall be stripped from the foundation area and stockpiled for use as a top dressing for vegetation establishment unless otherwise shown on the drawings.

Earth foundations shall be graded to remove surface irregularities and slopes steeper than 1:1.

The foundation surfaces shall be scarified parallel to the centerline of the fill to a minimum depth of 2 inches. The surface materials of the foundation shall be compacted and bonded with the first layer of earthfill. The moisture content of the scarified materials shall be maintained as specified for the earthfill.

D. PLACEMENT

Fill shall not be placed until the required excavation and preparation of the underlying foundation is completed and inspected and approved by the Technician. No fill shall be placed upon a frozen surface nor shall snow, ice, or frozen material be incorporated in the fill.

Fill shall be placed in approximately horizontal layers beginning at the lowest elevation of the foundation. The thickness of each layer of fill prior to compaction shall be as specified in Table 1. Materials placed by dumping in piles or windrows shall be spread uniformly to not more than the specified layer thickness prior to compaction.

Adjacent to structures, earthfill shall be placed in 4-inch lifts (prior to compaction) in a manner adequate to prevent damage to the structure and to allow the structure to gradually and uniformly assume the backfill loads.

The height of the fill shall be increased at approximately the same rate on all sides of the structure.

Placement of fill adjacent to concrete structures may begin after the concrete has cured for the minimum time specified.

Earthfill in dams, levees, and other structures designed to impound water shall be placed to meet the following additional requirements:

(1) The distribution of materials throughout each zone shall be essentially uniform, and the fill shall be free from lenses, pockets, streaks, or layers of material differing substantially in texture, moisture content, or gradation from the surrounding material.

(2) The embankment top shall be maintained approximately level during construction except for sectional construction as described in Section 7.

(3) Dam embankments shall be constructed in continuous layers from abutment to abutment, except where openings to facilitate construction or to allow passage of stream flow during construction are specified.

(4) If the surface of any layer becomes too hard and smooth to achieve a suitable bond with the succeeding layer, it shall be scarified parallel to the axis of the fill to a depth of not less than 2 inches before the next layer is placed.

E. CONTROL OF MOISTURE CONTENT

Fill materials shall have a moisture content sufficient to insure the required compaction. When kneaded in the hand, the soil will form a ball which does not readily separate and will not extrude out of the hand when squeezed tightly. The adequacy of the moisture content will be determined by the Technician.

Fill material or the top surface of the preceding layer of compacted fill that becomes too dry to permit suitable bond shall either be removed or scarified and wetted by sprinkling to an acceptable moisture content prior to placement of the next layer of fill.

Fill material that is too wet when deposited or the top surface of the preceding layer of compacted fill that becomes too wet shall be either removed or allowed to dry to an acceptable moisture content before compaction or placing additional layers of fill.

F. COMPACTION

The Contractor shall furnish and operate the types and kinds of equipment necessary to compact the fill materials.

Unless otherwise specified on the plans or approved by the Technician, compaction requirements for each layer of fill material are as shown in Table 1. The Technician shall determine the adequacy of compaction. Equipment passes in addition to those shown in Table 1 may be required.

Each pass shall consist of at least one complete coverage by the wheel, track, or roller over the entire surface of the fill layer in a direction parallel to the main axis of the fill.

Adjacent to structures or in confined areas, compaction of the fill shall be accomplished by means of manually directed or backhoe mounted power tampers or plate vibrators, hand tamping, or other methods approved by the Technician. The Technician shall determine if adequate compaction is being achieved. Heavy equipment shall not be operated within 2 feet of any structure. Compaction by means of drop weights operating from a crane or hoist of any type will not be permitted.

G. SPECIAL REQUIREMENTS FOR SECTIONAL CONSTRUCTION OF EMBANKMENTS

When sectional (or phase) construction of embankments is authorized, the work shall be accomplished in the following manner:

(1) Each section of the embankment that is constructed in the first phase shall be so placed that a slope not steeper than 3 feet horizontal to 1 foot vertical is maintained at the end of the embankment section adjacent to the gap in construction or closure section.

(2) Prior to placement of the closure sections, the surfaces of completed fills and excavations that will be in contact with the closure shall be stripped of all loose material, scarified, moistened, and recompacted as necessary.

Table 1. Equipment Compaction Requirements

Equipment Type		Applicable Soils[1]	Maximum Fill Height[2] (feet)	Layer Thickness[3] (inches)	Minimum Passes
Sheepsfoot roller (10,000 lb. min. operating weight)		ML, MH, CL, CH or SM, SC, GM, GC with >20% fines	None	9	1
Vibratory tamping roller (9,000 lb. min. operating weight)		SM, SC, GM, GC	None	9	2
Rubber-tired scraper or articulated haul truck (fully loaded)		GM, GC, SM, SC, ML, MH, CL, CH	None	9	1
Rubber-tired front end loader (fully loaded)		GM, GC, SM, SC, ML, MH, CL, CH	20	6	1
Track-type crawler (standard tracks)	30,000 lb. min.	GM, GC, SM, SC, ML, CL	10**	6	2
		SP, SW, GP, GW	6**	12	4
		CL, ML, SC, SM	15##	3	2
	less than 30,000 lb.	GM, GC, GP, GW, SM, SC, SP, SW, ML, CL	6**	6	2
Farm tractor (2,400 lb. min.)		GM, GC, SM, SC, ML, MH, CL, CH	15	6	2
Smooth steel drum vibratory roller (10,000 lb. min.)		SP, SW, GP, GW	None**	12	2

[1] Unified Soil Classification System.

[2] Measured from the top of the fill to the lowest point along the centerline of the fill.

[3] Prior to Compaction.

** The fill shall not have a permanent body of water stored against it.

This method may only be used for embankments that will not have the potential for a permanent body of water stored against it that is greater than 1/4 acre in surface area or more than 6 feet deep.

WISCONSIN CONSTRUCTION SPECIFICATION

5. CONSTRUCTION SITE POLLUTION CONTROL

A. SCOPE

The work shall consist of installing measures or performing work to control erosion and minimize the production of sediment and other pollutants to water and air from construction activities.

B. MEASURES

Erosion and sediment control measures and works shall be installed to prevent or minimize sediment production and transport off-site. The measures and works shall include, but are not limited to, the following:

(1) Diversions - Divert water from work areas and collect water from work areas for treatment and safe disposition. Temporary diversions shall be removed and the area restored to its near original condition when the diversions are no longer required or when permanent measures are installed.

(2) In-Channel Sediment Control - Sediment produced within the stream channel during construction will be retained in the work area. Sediment retention will be accomplished by using a temporary, excavated sediment trap and/or a barrier constructed of geotextile and hay bales. Turbid water in the retention area may be pumped to a well-vegetated area away from the stream. The vegetation will serve to filter the sediments before the flow returns to the stream. Discharge areas from all pump hoses shall be stabilized. At no time shall the pump discharge be allowed to cause erosion at the discharge point.

(3) Mulching - Mulch provides temporary protection of the soil surface from erosion. The method of application is specified on the construction drawings.

(4) Sediment Basins - Sediment basins collect, settle, and eliminate sediment from eroding areas from impacting properties and streams below the construction site(s). These basins are temporary and shall be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.

(5) Sediment Filters - Straw bale filters or geotextile sediment fences (silt fence) trap sediment from areas of limited runoff. Sediment filters shall be properly anchored to prevent erosion under or around them as shown on the construction drawings. These filters are temporary and shall be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.

(6) Seeding - Seeding to protect disturbed areas shall occur as soon as reasonably possible following completion of the earthwork activity. All seeding operations shall be performed in such a manner that the seeds are applied in the specified quantities uniformly in the designated areas. The method and rate of seed application are specified on the construction drawings.

(7) Silt Curtain or Turbidity Barrier - Silt Curtain and Turbidity Barriers can be used to minimize the transport of sediment from an area where construction activities are occurring within or directly adjacent to a waterway or waterbody. The fabric shall be removed after the construction activities have ceased and the sediment has settled. Care should be taken to prevent the re-suspension of sediment during removal.

(8) Staging of Earthwork Activities - The excavation and moving of soil materials shall be staged to minimize the area disturbed and the time these locations are vulnerable to erosion.

(9) Stockpiling Material - The stockpiled materials shall be protected from concentrated flows and/or flooding, to minimize sediment movement off-site.

(10) Stream Crossings - Culverts or bridges should be used where equipment crosses streams. They are temporary and shall be removed and the area restored to its near original condition when the crossings are no longer required or when permanent measures are installed.

(11) Waterways - Waterways shall be used to safely dispose of runoff from fields, diversions, and other structures or measures. These works are temporary and shall be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.

(12) It is the responsibility of the contractor or their designee for the cleanup or removal of sediment transported off-site due to failure to maintain erosion control measures during all phases of the construction.

C. CHEMICAL POLLUTION

The contractor shall safely dispose of chemical pollutants (such as drained lubricating or transmission fluids, grease, soaps, concrete mixer washwater, or asphalt, produced as a byproduct of the construction activities) off site. The contractor is responsible for reporting and clean up of all accidental spills and leaks.

In the event a piece of equipment develops a leak during the construction work, the leak shall be repaired before work continues. All excess fluids will be cleaned from the machine prior to its return to the work area.

If a leak occurs when equipment is working in or near a waterbody, the machine shall be immediately moved a safe distance away from the waterbody.

D. AIR POLLUTION

The burning of brush or slash and the disposal of other materials shall adhere to state and local regulations.

Fire prevention measures shall be taken to prevent the start or spreading of wildfires that may result from project activities. Firebreaks or guards shall be constructed and maintained.

All public access or haul roads used by the contractor during construction of the project shall be treated to suppress dust. All dust control methods shall ensure safe construction operations at all times. If chemical dust suppressants are applied, the material shall be a commercially available product specifically designed for dust suppression. The application shall follow manufacturer's requirements and recommendations. A copy of the product data sheet and manufacturer's recommended application procedures shall be provided to the Technician before the first application.

E. MAINTENANCE, REMOVAL AND RESTORATION

All pollution control measures and temporary works shall be adequately maintained in a functional condition for the duration of the construction period. All temporary measures shall be removed and the site restored to near original condition.

All equipment used within the construction site shall be well maintained. All equipment lines and fittings shall be checked on a daily basis to ensure that they are in good working order.

WISCONSIN CONSTRUCTION SPECIFICATION

7. MOBILIZATION AND DEMOBILIZATION

A. SCOPE

The work consists of the mobilization and demobilization of the Contractor's forces and equipment necessary for performing the work.

B. EQUIPMENT AND MATERIAL

Mobilization shall include:

- All activities and associated costs for transportation of the Contractor's personnel, equipment, and operating supplies to the site.
- Establishment of necessary general facilities for the Contractor's operations at the site.
- Premiums paid for performance and payment bonds, if required.
- Construction and maintenance of haul roads and equipment parking areas.
- Other job related items.

Demobilization shall include:

- All activities and costs for transportation of personnel, equipment, and supplies not utilized in the project from the site.
- Disassembly, removal, and site cleanup of facilities assembled on the site.
- Repair of access roads, temporary haul roads, and equipment parking areas leaving the project site in the same or better condition than at the start of the project.
- General cleanup and housekeeping needed to restore a neat and orderly project site.

Access to the site, equipment parking, and staging areas are limited to that shown on the drawings or as approved by the technician.

WISCONSIN CONSTRUCTION SPECIFICATION

9. ROCK RIPRAP

A. SCOPE

The work shall consist of testing, furnishing, transporting, and placing rock riprap, including filter, bedding or geotextile materials where specified, in the construction of loose rock riprap revetments, blankets, rock toes, crossings, rock chutes, channel linings and other similar structures.

B. QUALITY OF MATERIALS

The rock shall be obtained from tested sources unless exempted below. Rock sources used for streambank protection, lined waterways, rock chutes, or other similar major projects (Engineering Job Approval Authority Job Class II and greater) shall be tested prior to use. A test is required a minimum of every ten (10) years. The Technician may require a more current test.

Rock riprap from igneous or metamorphic origins such as granite, basalt, and quartzite may be used without testing. Dolomite from quarries within the map legend units shown in Figure 1 may also be used without testing:

- Dolomite (Sd) - all counties.
- Sinnipee Group (Os) and Prairie du Chien (Opc) exempt only in the following counties: Marinette, Oconto, Shawano, Brown, Outagamie, Calumet, Winnebago, Green Lake, and Fond du Lac.

The Technician shall inspect and approve sources of these rock types prior to use and determine if testing is required.

Rock for equipment or cattle channel crossings, access roads, heavy use area protection or similar minor structures need not be tested.

Individual rock fragments shall be dense, sound and free from cracks, seams and other defects conducive to accelerated weathering. The rock fragments shall be angular to subrounded in shape. The least dimension of each individual rock fragment shall be not less than one-third the greatest dimension of the fragment. It should also be free from dirt, clay, sand, rock fines and other materials not meeting the gradation limits. Rock shall be excavated, selected and handled as necessary to meet the grading requirements stated in the construction plans.

Representative samples of rock requiring testing shall conform to the following requirements:

Bulk Specific Gravity (saturated surface-dry basis). Not less than 2.50 when tested in accordance with ASTM Specification C 127 on samples prepared as described for soundness testing.

Absorption. Not more than four (4.0) percent when tested in accordance with ASTM C 127 on samples prepared as described for soundness testing.

Soundness. The weight loss in five cycles shall not be more than 28 percent when tested by the sodium sulfate soundness test method in the modified ASTM C 88 or AASHTO T 104. Losses in excess of 20 percent are acceptable only when the design D_{50} rock size has been increased by 10 percent for a loss of 20-23.9 percent or 20 percent for a loss of 24-28 percent.

C. METHODS OF TESTING

Bulk Specific Gravity and Absorption shall be determined by ASTM C 127 on samples prepared as described for rock cube soundness testing.

Rock Cube Soundness. Soundness testing shall be performed by ASTM C 88 for coarse aggregate modified as follows.

The sodium sulfate soundness test shall be performed on a test sample of 5000 ± 300 grams of rock fragments, reasonably uniform in size and cubical in shape and weighing, after sampling, approximately 100 grams each. The test sample shall be obtained from rock samples that are representative of the total rock mass, as noted in ASTM Specification D 4992, and that have been sawed into slabs as described in ASTM Specification D 5121. The samples shall be further reduced in size by sawing the slabs into cubic blocks. The thickness of the slabs and the size of the sawed blocks shall be determined by the size of the available test apparatus and as necessary to provide, after sawing, the approximate 100 gram samples.

Due to internal defects, some of the cubes may break during the sawing process or during the initial soaking period. Cubes that break during this preparatory process shall not be tested. Such breakage, including an approximation of the percentage of cubes that break, shall be noted in the test report.

After the sample has been dried, following completion of the final test cycle and washing to remove the sodium sulfate, the loss of weight shall be determined by subtracting from the original weight of the sample the final weight of all fragments which have not broken into three or more fragments. (Samples that break into three or more large fragments during testing will be assigned a final weight of 0.0.) The test report shall show the percentage loss of the weight. Photographic documentation of all samples before and after testing shall be part of the test report.

A rock source may be rejected if the rock from that source deteriorates in less than 5 years under similar use and exposure conditions expected for the rock to be installed under this specification, even though it meets the testing requirements stated above.

Deterioration is defined as the visual loss of more than one-quarter of the original rock volume, or severe cracking that would cause a rock to split.

D. GRADATION

The gradation of the rock riprap and filter or bedding material shall be as shown in the construction plans.

Rock used for streambank protection, lined waterways, rock chutes, or other similar major projects (Engineering Job Approval Authority Job Class II and greater) shall have a gradation verification be done by one of the following methods.

Method A

Measurement of a random truck load of stone (reference sample) according to the procedure outlined in EFH-17, Procedure for Determining Rock Weights, Sizes, and Gradations; or ASTM D5519, Standard Test Methods for Particle Size Analysis of Natural and Man-Made Riprap Materials (Test Method A).

Method B

Creation of reference samples of rock of at least 0.5 tons, made according to the procedure outlined in EFH-17 (Tables 1 - 5), creating the envelope limits of the gradation specified.

Control of project gradation will be by visual inspection comparing rock delivered to the reference samples.

The reference sample(s) may be used as part of the finished riprap or remain at the quarry.

Any difference of opinion between the Technician and the Contractor shall be resolved by dumping and checking (by measurement) the gradation of a random truck load of stone by Method A. Mechanical equipment, a sorting site, and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost.

E. SUBGRADE PREPARATION

The subgrade surfaces on which the riprap, filter or bedding material is to be placed shall be cut or filled and graded to the lines and grades as shown on the drawings or as directed by the Technician. When fill to subgrade lines is required, it shall consist of approved materials and shall be compacted as specified in Wisconsin Construction Specification 3, Earthfill. Riprap, filter, bedding or geotextile shall not be placed until the foundation preparation is completed, and approved by the Technician.

F. FILTER AND BEDDING

Filter or bedding material, when required, shall be spread uniformly on the prepared subgrade surfaces to the depth shown on the drawings. The surfaces of the layers shall be finished reasonably free of mounds, dips or windrows and shall meet the gradation shown on the plans or as specified in Wisconsin Construction Specification 8.

Geotextile, when required, shall meet the requirements shown on the drawings and as specified in Wisconsin Construction Specification 13, Geotextiles.

G. PLACING ROCK RIPRAP

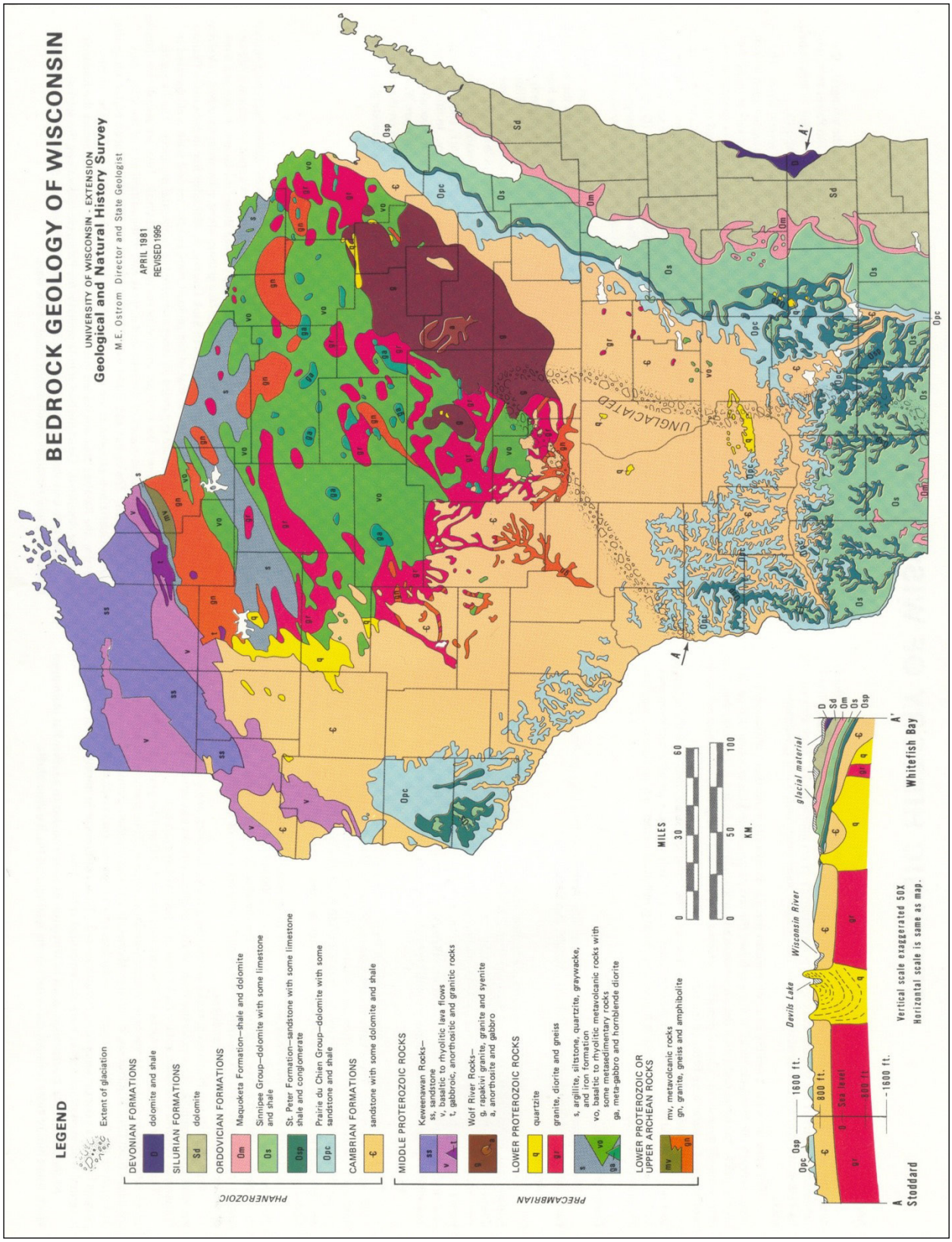
The rock riprap shall be placed by equipment on the surfaces and to the depths specified. The rock riprap shall be installed to the full course thickness in one operation and in such a manner as to avoid displacement of underlying materials. The rock for riprap shall be delivered and placed in a manner that will ensure that the riprap in-place shall be reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks and spalls filling the voids between the larger rocks. Some hand placing may be required to provide a neat and uniform surface or to prevent damage to structures.

H. VEGETATED ROCK RIPRAP

If the rock riprap is to be vegetated, topsoil shall be placed by equipment in the riprap voids (surface) and on the surface of the rock to the depth specified. The topsoil placement shall not take place before the placement of the rock riprap is approved by the Technician. Topsoil shall be placed in such a manner as to avoid displacement of the underlying rock.

The topsoil may extend from the top of the riprap down to the bankfull elevation (OHWM) or as shown on the drawings. Care shall be taken so topsoil is retained on the rock and is not allowed into the water body. The area shall be seeded and mulched within 12 hours following topsoil placement.

Figure 1


BEDROCK GEOLOGY OF WISCONSIN
UNIVERSITY OF WISCONSIN - EXTENSION
Geological and Natural History Survey
M.E. Ostrom Director and State Geologist
APRIL 1981
REVISED 1995
LEGEND
Extent of glaciation
PHANEROZOIC
DEVONIAN FORMATIONS
D dolomite and shale
SILURIAN FORMATIONS
Sd dolomite
ORDOVICIAN FORMATIONS
Om Maquoketa Formation—shale and dolomite
Os Sinnipee Group—dolomite with some limestone and shale
Osp St. Peter Formation—sandstone with some limestone shale and conglomerate
Opc Prairie du Chien Group—dolomite with some sandstone and shale
CAMBRIAN FORMATIONS
€ sandstone with some dolomite and shale
PRECAMBRIAN
MIDDLE PROTEROZOIC ROCKS
Keweenawan Rocks—
ss, sandstone
v, basaltic to rhyolitic lava flows
t, gabbroic, anorthositic and granitic rocks
Wolf River Rocks—
g, rapakivi granite, granite and syenite
a, anorthosite and gabbro
LOWER PROTEROZOIC ROCKS
q quartzite
gr granite, diorite and gneiss
s, argillite, siltstone, quartzite, graywacke, and iron formation
vo, basaltic to rhyolitic metavolcanic rocks with some metasedimentary rocks
ga, meta-gabbro and hornblende diorite
LOWER PROTEROZOIC OR UPPER ARCHEAN ROCKS
mv, metavolcanic rocks
gn, granite, gneiss and amphibolite
MILES
0 30 60
0 50 100
KM.
UNGLACIATED
A
A'
Stoddard
Whitefish Bay
Devils Lake
Wisconsin River
glacial material
1600 ft.
800 ft.
Sea level
-800 ft.
-1600 ft.
Vertical scale exaggerated 50X
Horizontal scale is same as map.

WISCONSIN CONSTRUCTION SPECIFICATION

13. GEOTEXTILES

1. SCOPE

This work shall consist of furnishing all materials, equipment, and labor necessary for the installation of geotextiles.

2. MATERIALS

The class and type of geotextile shall be as shown on the drawings.

Geotextiles shall be manufactured from synthetic long chain or continuous polymeric filaments or yarns composed of at least 95 percent by weight of polypropylene, polyethylene, polyester, polyamide, or polyvinylidene-chloride. Fibers shall contain stabilizers and/or inhibitors to enhance its resistance to ultraviolet light. The geotextile shall be formed into a stable network of filaments or yarns that retain dimensional stability relative to each other, including selvages. The geotextile shall be free of any chemical treatment or coating that might significantly reduce its permeability and shall have no flaws or defects that significantly alter its physical properties.

Thread used for factory or field sewing shall be of a contrasting color to the fabric and made of polypropylene, polyester, or polyamide thread. The sewing thread shall have a minimum breaking strength of 28 pounds when tested in accordance to ASTM D 2256. The thread shall be as resistant to ultraviolet light as the geotextile being sewn.

Additional requirements for geotextile materials are as follows:

a. Slit Tape Geotextile

Slit tape geotextile shall conform to the physical properties listed in Table 1. The slit tape geotextile shall be manufactured from a filament that is woven. The edges of the material shall be selvaged or otherwise finished to prevent the outer filament from unraveling.

b. Woven Geotextile

Woven geotextile shall conform to the physical properties listed in TABLE 1. The woven geotextile shall be manufactured from monofilament yarn that is woven into a uniform pattern with distinct and measurable openings. The fabric shall be manufactured so that the yarns will retain their relative position with regard to each other. The edges of the material shall be selvaged or otherwise finished to prevent the outer yarn from unraveling.

c. Nonwoven Geotextile

Nonwoven geotextile shall conform to the physical properties listed in TABLE 2. Nonwoven geotextile shall be manufactured from randomly oriented fibers that have been bonded together by needle-punching.

3. SHIPPING AND STORAGE

Geotextiles labeling, shipment, and storage shall follow ASTM D 4873. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number. Each geotextile roll shall be wrapped with a material that will protect the geotextile, including the ends of the roll, from damage due to shipment, water, sunlight, and contaminants. The protective wrapping shall be maintained during periods of shipment and storage.

Prior to use, the geotextile shall be inspected and approved by the Technician, then stored in a clean, dry, place, out of direct sunlight, not subject to temperature extremes, and with the manufacturer's protective cover in place.

4. SURFACE PREPARATION

The surface on which the geotextile is to be placed shall be graded to the neat lines and grades as shown on the drawings. The surface shall be reasonably smooth and free of holes, vegetation, excessive mud, and projections. The surface preparation will be inspected and approved by the Technician prior to placing the geotextile.

5. PLACEMENT

a. General

The geotextile shall be placed on the approved, prepared surface at the locations and in accordance with the details shown on the drawings. The geotextile shall be unrolled along the placement area and loosely laid (not stretched) in such a manner that it will conform to the surface irregularities when the stone or other material is placed on or against it. The geotextile may be folded and overlapped to permit proper placement in the designated area.

No cuts, punctures, tears, or gaps in sewn or overlapped joints will be permitted in the geotextile.

The panel length shall be placed parallel to the direction of water flow, except as stated below in paragraph b. Slope Protection and d. Road Stabilization.

The geotextile panels may be joined by overlapping the roll ends 36 inches and sides a minimum of 18 inches and securing the overlap against the underlying foundation materials. The fabric shall be restrained as needed to prevent lifting and displacement during construction. Allowable restrainment methods include backfilled trenches, stitching, sandbags, rocks, and securing pins that are approved and provided by the geotextile manufacturer. The upstream or up-slope geotextile shall overlap the abutting down-slope geotextile.

The geotextile panels may be joined by machine sewing using thread described under 2. Materials. The seam shall conform to Federal Standard SSa-2, SSn-2 or SSd-2.The sewing shall consist of two parallel stitched rows spaced approximately 1 inch apart. Each row of stitching shall be located a minimum of 2 inches from the geotextile edge. The seam type and sewing machine to be used shall produce a seam strength, in the specified geotextile, that provides a minimum of 90 percent of the tensile strength in the weakest principal direction of the geotextile being used, when tested in accordance with ASTM D 4884. The seams may be factory or field sewn. All seaming and stitching of woven geotextiles shall be in the selvage.

Non-woven geotextiles shall be sewn a minimum of ½ inch from the edge. Geotextile shall be installed with the sewn seams pointing up.

The geotextile shall be restrained as needed during placement of overlying materials to prevent slippage, folding, or other movements of the geotextile.

Prior to covering, the geotextile shall be inspected by the Technician to ensure that the geotextile has not been damaged during construction. Backfill shall be placed by end dumping onto the geotextile from the edge of the geotextile or over previously placed backfill. Vehicles shall not be allowed directly on the geotextile. Materials shall be placed on the geotextile without causing tears, punctures, or separations of overlaps or sewn joints. Should such damage occur, the backfill around the damaged or displaced area will be removed and the subgrade restored to the original approved condition. Repair of the area shall consist of a patch of the same type of geotextile overlaying the existing geotextile. The patch shall extend a minimum of 2 feet from the edge of any damaged area.

b. Slope Protection

The geotextile shall not be placed until it can be anchored and protected with the intended covering within 48 hours. Temporary cover, for protection from ultraviolet light, may be used if the 48-hour limit will be exceeded. Material will not be dropped from a height of more than 3 feet on to uncovered geotextile. In lakeshore applications, the geotextile may be unrolled parallel or perpendicular to the bank. The geotextile shall be joined by machine sewing if the panel length is placed perpendicular to the direction of water flow (wave runup).

c. Subsurface Drains

The geotextile shall not be placed until drainfill or other material can be used to cover it within the same working day. Material will not be dropped from a height of more than 5 feet on to the geotextile and sharp, angular aggregates will not be used unless the drawing details state otherwise.

d. Road Stabilization

The geotextile shall be unrolled in a direction parallel to the roadway centerline in a loose manner permitting it to conform to surface irregularities when the roadway fill material is placed on it. Overlap shall be in the direction of construction. The minimum overlap of geotextile panels joined without sewing shall be 24 inches. The geotextile may be temporarily secured with pins recommended by the manufacturer. They shall be removed prior to placement of the covering material. Slit tape geotextile shall not be used in a wet location. Material will not be dropped from a height of more than 5 feet on to uncovered geotextile.

Table 1. Requirements for Woven Geotextiles by Use

Property	Test Method	Slope Protection		Road Stabilization	
		Unprotected (Class I)	Protected (Class II)	(Class IV)	Slit Tape
Tensile Strength (lbs.)[1]	ASTM D 4632 Grab Test	≥ 250 in any principal direction	≥ 120 in any principal direction	≥ 180 in any principal direction	≥ 200 in any principal direction
Elongation at failure (Percent)[1]	ASTM D 4632 Grab Test	≤ 20	≤ 35	≤ 35	≤ 10
Puncture (lbs.) [1]	ASTM D 6241	≥ 900	≥ 350	≥ 350	≥ 700
Ultraviolet Light (percent residual tensile strength)	ASTM D 4355 150 hours exposure	70 minimum	70 minimum	70 minimum	70 minimum
Apparent Opening Size (AOS)	ASTM D 4751	≥ #100 (.150 mm) and ≤ #70 (.212 mm) [3]	≥ #100 (.150 mm) and ≤ #70 (.212 mm) [3]	≥ #100 (.150 mm) and ≤ #70 (.212 mm) [3]	As specified or a min. size > #50 [3]
Percent Open Area (POA)	CW-02215 [2]	4.0 min.	4.0 min.	1.0 min.	N/A
Permittivity (1/seconds)	ASTM D 4491	0.20 minimum	0.10 minimum	0.10 minimum	0.05 minimum
Water Flow (gal/sq. ft./minute)	ASTM D 4491	15 minimum	7.5 minimum	7.5 minimum	3.8 minimum

[1]Minimum average roll values (MARV); calculated as the mean minus two standard deviations, yielding a 95 percent confidence level that the table value will be equaled or exceeded.

[2]Test Methods prepared by U. S. Army Corps of Engineers

[3]U. S. Standard Sieve Size

Table 2. Requirements for Nonwoven Geotextiles by Use

Property	Test Method	Slope Protection		Subsurface Drainage	Road Stabilization
		Unprotected (Class I)	Protected (Class II)	(Class III)	(Class IV)[3]
Tensile Strength (lbs.) [1]	ASTM D 4632 Grab Test	≥ 180	≥ 120	≥ 90	≥ 180
Elongation At failure (percent)[1]	ASTM D 4632 Grab Test	≥ 50	≥ 50	≥ 50	≥ 50
Puncture (lbs.) [1]	ASTM D 6241	≥ 350	≥ 250	≥ 200	≥ 200
Ultra-Violet Light (percent residual tensile strength)	ASTM D 4355 150 hours exposure	70 minimum	70 minimum	70 minimum	70 minimum
Apparent Opening Size (AOS)	ASTM D 4751	As specified or max. #40 [2]	As specified or max. #40 [2]	As specified or max. #40 [2]	As specified or max. #40 [2]
Permittivity (1/seconds)	ASTM D 4491	0.70 minimum	0.70 minimum	0.70 minimum	0.10 minimum
Water Flow (gal/sq. ft./ minute)	ASTM D 4491	52.5 minimum	52.5 minimum	52.5 minimum	7.5 minimum

[1]minimum average roll values (MARV); calculated as the mean minus two standard deviations, yielding a 95 percent confidence level that the table value will be equaled or exceeded.

[2]U. S. Standard Sieve Size.

[3]Heat-bonded or resin-bonded geotextile may be used.

Wisconsin Biology Technical Note 1: Shoreland Habitat

Introduction

Definition of Shoreland Habitat:
An area adjacent to a water body in a non-agricultural setting that is vegetated with a diverse mixture of native species that include grasses, grass-like species, forbs, shrubs, and trees.

Purposes:

- Provide habitat for aquatic and terrestrial fauna
- Enhance adjacent shallow water habitat by providing shade and overhanging vegetation and promoting natural recovery of emergent species
- Promote shoreland corridors
- Increase the presence and diversity of native species
- Reduce the environmental and visual impact of nearby human activities
- Improve water quality
- Enhance bank stability

Interim Standard # 643A, Shoreland Habitat provides specific criteria for Shoreland Habitat establishment and for determining the dimensions of the practice (Section V). It identifies the necessary components of a Shoreland Habitat establishment plan (Section VII), and lists criteria for operation and maintenance of the practice (Section VIII). Local shoreland zoning ordinances and local shoreland restoration design standards may provide additional requirements and guidance. These may include greater buffer depths, more restrictive requirements for viewing/access corridors, and plant selection.

This technical note provides detailed guidance on the following:

Vegetation Establishment Technique ..... p. 2
Plan Components ..... p. 3
Plant Materials Selection and Density ..... p. 4
Additional Planning Considerations ..... p. 7
Steps for Accelerated Recovery ..... p. 9
- Site Preparation
- Planting Techniques

Site Care and Maintenance ..... p. 14
Resources ..... p. 17
Appendices ..... p. 19

Vegetation Establishment Techniques

Determining the appropriate vegetation establishment technique requires an assessment of the existing vegetative cover. In many cases a combination of the two general techniques described below will be appropriate due to varying existing vegetation conditions.

Initial site assessment should include:

- Identification of any native species present and their location, density, and vigor.
- Identification of any invasive species or noxious weeds present and their location, density, and vigor.
- Assessment of the density and vigor of any turf grasses present.

Natural Recovery

Natural recovery or "no-mow" zones are encouraged where feasible. Native vegetation will recover naturally when the site is protected from disturbance and where adequate seed and/or root sources and appropriate site conditions are present. Wet shoreline margins, where turf grasses are not well established, are particularly suited to natural recovery. Results may be slower than for planted buffers, but there is virtually no cost, and the end result may appear more natural.

An area where a dense growth of turf grasses has been maintained for several years is usually not well suited to natural recovery. Turf grasses frequently out-compete native vegetation, and the area may lack native seed sources. Areas with extensive stands of invasive weeds should also not be left to recover naturally.

Accelerated Recovery — Planted Buffers

Accelerated recovery techniques are most appropriate where insufficient native vegetation is present for natural recovery techniques, or where quick results are desired. Accelerated recovery techniques can include planting trees and shrubs, planting native grass and wildflower seedlings, or seeding native grasses and wildflowers. Steps for each of these accelerated recovery-planting techniques are described later in this Tech Note.

On many sites, natural and accelerated recovery techniques can be combined. For example, natural recovery might be used along the shoreline where there are native plants, and accelerated recovery used for the remainder of the restoration, where turf grasses dominate.

Plan Components

A plan shall be developed to guide the restoration process to ensure that restoration requirements and goals for the site are met. An example plan is included in Appendix 1.

The plan shall include:

- Site diagram or map
- Preparation schedule
- Planting dates and schedule
- Care and handling of plant materials
- Watering plan
- Maintenance plan including management of invasive species
- Plant and seed calculation worksheet

Site Diagram

Appendix 2 contains the "*Shoreland Habitat Plan – Site Diagram*" job sheet to assist with plan development.

The site diagram must be to scale and shall include:

- Location of existing primary structures
- Boundary of the practice
- Scale (1inch = 10 feet recommended)
- North arrow
- Location of ordinary high water mark
- Location of viewing/access corridor
- Existing shrubs and trees
- Locations where shrubs and trees are to be planted
- Areas where herbaceous cover will be planted and planting density
- A species list for the site
- Location of erosion control practices to be installed during practice establishment
- Location of practices to address channelized/concentrated flow

Plant Materials

Species Selection

Plants shall be selected from species lists of plant communities that are native to the county or region. Plants should further be chosen based on site soil, moisture, and light conditions. In some cases, such as lack of plant or seed availability, substitutions may be allowed. In addition, references such as those included at the end of this document may be used to make selections. For example, the herbarium website [http://wiscinfo.doit.wisc.edu/herbarium/Countysearch.html] can be queried based on counties, habitat types, or individual plant species.

Planting Densities

The table below describes planting standards for two major shoreland types: woodland, and barrens/dry prairie/wet prairie. The woodland has a nearly complete canopy of trees while the barrens/prairie and wetland are more open. Plant numbers are to be calculated based on the area in square feet to be reestablished and the appropriate density. The area to be reestablished shall be calculated for each layer. See Worksheet 1 for example area calculations.

Table 1. Shoreland Habitat Planting Densities

	Woodland		Wetland or Barrens/Dry Prairie/Wet Prairie	
Layer	**Minimum Number of Species[1]**	**Density**	**Minimum Number of Species[1]**	**Density**
Trees[2]	2	0.5 – 5 per 100 sq. ft.	0	0 - 0.2 per 100 sq. ft.
Shrubs	3	1 - 4 per 100 sq. ft. *If clumped, maintain min. 2 foot spacing*	2	0.2 - 0.5 per 100 sq. ft. *If clumped, maintain min. 2 foot spacing*
Herbaceous Cover[3]				
- Plant plugs	3	25 –75 plants per 100 sq. ft. *Soil must be mulched*	5	50 – 100 plants per 100 sq. ft. *Soil must be mulched*
- Seeding	3	Grass/Sedges: 4-8 oz. per 1000 sq. ft. Forbs: 2-4 oz per 1000 sq. ft.	5[4]	Grass/Sedges: 4-8 oz per 1000 sq. ft. Forbs: 2-4 oz. per 1000 sq. ft.

[1] Select species from established plant lists for shoreland habitat. Trees, shrubs, and groundcovers may be transplanted from adjacent woodland or open areas outside the restoration area.
[2] Trees must be at least 2 year old seedlings, 8 inches or taller.
[3] The herbaceous cover layer shall be comprised of a minimum of 30% grasses and/or sedges.
[4] Consider the use of plants rather than seeds in wet areas.

Planting Dates

The table below provides approximate dates for planting. Weather and soil conditions, which vary year-to-year, determine the most appropriate planting time. Please note that adequate moisture levels are assumed due to required watering practices.

Table 2. Recommended Planting Dates

	North	Central	South
Seeded Herbaceous Covers *Seeding early favors cool season plants. Seeding after soil temperature increases above 55 degrees favors warm season plants. Seed after July 1 to reduce weed seed germination.*	May 15 – August 10 *Best dates:* *June 1 – July 15*	May 1 – August 31 *Best dates:* *May 10 – July 20*	May 1- August 31 *Best dates:* *May 5 – July 31*
Plugs (Seedlings) and Potted Herbaceous Covers *Plant after danger of frost is past, and up to first frost. Later plantings may require more frequent watering because of increased temperatures.*	May 20 – September 15	May 1- October 31	May 1 – Nov. 15
Bare-root Trees and Shrubs	Any time soil is not frozen and before leaf-out, or after leaves fall.		
Potted Trees and Shrubs	Any time soil is not frozen.		

Worksheets for Calculating Plant and Seed Needs

Worksheet 1 can be used to calculate the square footage of area to be restored for each vegetative layer. Worksheet 2 can be used to calculate the amount of trees, shrubs, plants and seeds needed.

Worksheet 1: Area Calculations							
	Total Area of Shoreland Habitat (Square Feet)		**Total Area of Viewing/ Access Corridor**		**Total Area of Existing Layer to Preserve and/or Natural Recovery Zones**		**Total Area to be Planted**
Tree Layer		-		-		=	
Shrub Layers		-		-		=	
Herbaceous Layer - Plants		-		-		=	
Herbaceous Layer - Seeds		-		-		=	
SAMPLE[5] Herbaceous Layer-Plants	***6,000***	-	***1,500***	-	***1,000***	=	***3,500***

Worksheet 2: Seed or Plant Densities							
	Total Area to be Planted (Square Feet)		**Density Factor[6]**		**Seed or Plant Densities from Table 1.**		**Total Plants or Seeds to Install**
Tree Layer		÷	100	×		=	
Shrub Layer		÷	100	×		=	
Herbaceous Layer							
Plants		÷	100	×		=	
Grass Seeds		÷	1000	×		=	
Forbs Seeds		÷	1000	×		=	
SAMPLE[7] Herbaceous Layer-Plants	***3,500***	÷	***100***	×	***70***	=	***2450***

[5] This sample is 60x100 foot restoration (6,000 sq. ft.), with a 25x60 view corridor (1,500 sq. ft), and 1,000 sq. ft. of natural recovery.

[6] See Table 1, column 3, on page 4. Trees, shrubs and plant densities are given in number of plants/100 sq. ft., and seeding densities are given in number of ounces/1000 sq. ft.

[7] Sample site is 3,500 sq. ft., to be planted at 70 plant plugs per 100 sq. ft., for a total of 2450 plants needed.

Additional Planning Considerations

Exposed soil may be encountered because of erosion from runoff, bank instability, heavy use, or construction activities. Eliminate or minimize the cause of the bare soil and then stabilize the area following the guidelines below. Filter fabric fences may be necessary to capture sediment below exposed slopes. Specifications found in the Wisconsin Construction Site Best Management Practices Handbook must be followed.

Companion Seeding for Steep Slopes

When seeding on steep slopes, a companion seeding and/or other erosion control practices shall be used. See companion seeding rates table below.

Slopes >12%: Companion seeding of oats, side oats grama, or Canada wild rye.[8]
Slopes >20%: Companion seeding of oats, side oats grama, or Canada wild rye, and use either mulch and netting or an erosion control blanket.

Table 3. Seeding Rates for Companion Crops	
Oats	0.5 lbs./1000 ft.^{2}
Canada Wild Rye	1 oz./1000 ft.^{2}
Side Oats Grama	1 oz./1000 ft.^{2}

Temporary Cover Crop for Exposed Soil

A temporary cover crop should be planted only if soils have been exposed, and the restoration planting is delayed. In most cases this would only occur in the late fall, generally after September 15th depending upon the location.

Table 4. Seeding Rates for Cover Crop	
Cereal Rye	0.5 – 1.0 lbs./ 1000 ft.^{2}
Winter Wheat	0.5 – 1.0 lbs./ 1000 ft.^{2}

[8] Oats are annuals that will temporarily stabilize an area and then be killed by a hard frost. Canada wild rye and side oats grama are short-lived native perennial grasses.

Runoff Control

Runoff from impervious surfaces and roof gutter downspouts should be directed to maximize infiltration. Runoff should be maintained in sheet flow (not channels) to the greatest extent possible. In soils where adequate infiltration cannot be achieved, outletting through a tile may be an option.

Fire Prevention

Areas with sandy soils are prone to forest fires. Conifer trees are especially susceptible to fire. To reduce fire danger, avoid planting conifers close to structures in those sandy areas of the state. Fire hazard is lower if conifers are planted on the waterward rather than the landward side of the house. Contact your local Department of Natural Resources Forest Ranger for information about fire-prone areas.

Cost of Buffer Preparation

Costs for completing a shoreland habitat project vary greatly. Planting shrubs or trees as bare-root stock greatly saves on the cost. Costs are kept to a minimum when landowners do the work themselves. If contractors are used, costs generally increase, but an experienced contractor may save money in the long run because the project may be more successful. Costs increase as the design shifts from "natural recovery" to "accelerated recovery." Seeding is generally cheaper than planting seedlings. However, seed takes longer to establish and there may be poor germination and seedling survival and excessive weed growth. Larger more established stock increases the price of the restoration. Balance budget constraints with concerns regarding timeliness and appearance.

Plant and Seed Sources

The DNR, counties, lake associations, and conservation groups sponsor shrub and tree sales annually in the spring. Statewide lists of native plant and seed sources are available from both the University of Wisconsin Extension (UWEX)[http://clean-water.uwex.edu/pubs/native/index.html] and the WDNR [http://www.dnr.state.wi.us/org/land/er/invasive/info/nurseries.htm].Lists of sources of plants and seeds may also be available from your local government office.

Viewing and Access Corridor Design

Viewing corridors that are oriented somewhat obliquely to the shoreline, or are curved, are preferable to those that are perpendicular to the shoreline. This reduces the visual impact of human activities in the shoreland area. Corridor dimensions shall be determined by applicable county standards and ordinances; however, the maximum width of the viewing and access corridor shall be 30 feet.

Steps for Accelerated Recovery

Proper site preparation is one of the most important steps in establishing a native plant landscape. Reducing competition on the site by first removing the existing non-native vegetation is especially important. Turf grasses can quickly out-compete newly planted native plants if left in place.

Sometimes removing existing vegetation is not necessary, and it is possible to plant among existing scattered native plants or to leave zones of vegetation intact. The moist zone near the water's edge often consists mostly of native plants because turf grasses are flooded out. Seeds and underground stems may quickly revegetate the area if allowed to grow. Selected native flowers, grasses, and shrubs can usually be planted among existing native vegetation to fill in bare spots or to add color and variety. Plant flowers and grasses in a manner that will allow them to spread over the entire area. Stands of invasive plants like reed canary grass or purple loosestrife should be removed from wet areas.

Site Preparation

Removing Undesirable Vegetation

Techniques to remove existing vegetation by smothering and/or applying herbicide are described below.

Smothering – Use Black Plastic

Black plastic spread over vegetation eliminates light and creates heat that kills existing plants. This method is suitable for almost any site. In areas with high exposure to wind, extra care must be taken to anchor the plastic in place.

1. You will need
    a. 3.5 mil or thicker black plastic to adequately cover the area, plus extra to overlap sheets at least 6 inches.
    b. 4 inch or longer, 11 gauge or heavier U-shaped metal staples (enough to space 1 foot apart where plastic overlaps and at the edges).
    c. Heavy objects like logs, cement blocks, boards, or tires to hold the plastic in place.
2. Prepare the site by mowing, weed whacking, or trimming vegetation to be removed.
3. If soil is dry, water thoroughly. This will increase the weed killing effectiveness.
4. Lay down the plastic. Overlap the plastic at least 6 inches if using more than one piece. Staple in place at one-foot intervals as it is laid down.

5. Place heavy objects over plastic. All seams and edges must be firmly anchored to exclude light. Edges can also be buried in a shallow trench to help hold them in place.
6. Leave the plastic in place for 4-6 weeks during spring or summer. Make certain there is no sign of living vegetation before removing it.
7. Remove plastic, but leave dead vegetation in place. If using plant mulch over the dead vegetation, plant directly through the mulch.

Applying Herbicide

A glyphosate herbicide like *Roundup*® is recommended. Avoid drift of herbicide to water. If herbicide is to be applied in or over the water, an aquatic glyphosate formulation such as *Rodeo*® must be used, and a Department of Natural Resources permit is required. *Always follow label instructions carefully.*

Timing of herbicide applications is crucial. Do not apply when rain is forecast in the next 24 hours. Do not apply on windy days, since vegetation you wish to preserve may be damaged by herbicide drift. Vegetation must be actively growing for glyphosate herbicides to be effective. To encourage growth, mow grass and allow it to regrow several inches. Air temperature must be between 50 and 75 degrees Fahrenheit for cool season plants like quack grass and brome grass to be actively growing, and therefore effectively killed by the herbicide.

Be certain that vegetation is dead before planting. If turf is still green or yellow-green after 7 – 10 days, a repeated herbicide application is recommended.

Soil Amendments

In most cases soil amendments are **not** required to plant native plants. Adding black dirt or manure can be detrimental to lakeshore plantings. These soil amendments will favor weed growth, and the native plants may grow more quickly and be less sturdy.

Planting Techniques

Seedlings

Fertilizer use is recommended where mulches are used because they demand nitrogen as they decompose. Fertilizer should never be broadcast due to the potential for runoff into the lake. Instead, apply a very small amount of slow release *phosphorous free* fertilizer in each planting hole. Phosphorus levels are adequate in most soils, and phosphorus can increase algae growth in the lake. Phosphorus is the middle number of the three given on the fertilizer bag.

Application amounts will vary depending on nutrient concentration. For a 6-0-6 NPK ratio, use one teaspoon of organic fertilizer per grass or wildflower plant and ¼ cup per shrub or tree. Up to one cup can be added to larger shrub or tree planting holes.

Dead vegetation left in place after smothering or an herbicide application does not need to be removed. Leave the dead material to serve as a mulch to capture moisture, reduce weed growth,

and add organic material to the soil. Plant seedlings directly through the dead material. Roots must be buried in soil and not in the thatch of dead lawn, where the plant would quickly dry out and die.

Plants Installation

1. ***Lay mulch down prior to planting.*** Spread 2 to 3 inches of straw, wood chips, leaves, or pine needles to conserve moisture and reduce weed growth. Avoid using field hay because it generally contains weed seeds. Do not use marsh hay, which is reed canary grass, and is an invasive species.
2. ***Be ready to water.*** Watering plant plugs is critical to their success. Be ready with hoses and sprinklers before planting. Water seedlings immediately after they are planted.
3. ***Dig holes for plants***. A bulb planter or bulb auger drill bit attached to an electric drill will work well to speed up planting. Be sure the holes for the plants penetrate the dead grass.
4. ***Fertilize.*** A small amount of slow release, phosphorus-free fertilizer is recommended. The second number on the fertilizer label represents phosphorus. To fertilize, place a small amount in each plant hole. Excess fertilizer will encourage weed growth.
5. ***Place live plants in the ground soon after they are brought to the site.*** To store plants for a few days before planting, keep them in an area with partial sun such as on the east side of a building or under a deciduous tree. Do not leave them in a dark area for long periods; this will weaken plants. Water to keep packs moist once or twice a day.
6. ***Plant in the cool hours of the day.*** Plants will have a greater survival rate if planted on a cool day or during the morning or evening hours. To plant, separate the mulch, dig a hole, sprinkle organic fertilizer, place the plug in the hole, press the soil gently around the plug, and replace the mulch, being careful to keep mulch 1/2" from stem of plants.
7. ***Water.*** Water immediately after planting. Plan to water at least daily for the first few weeks or until plants are well established. If plants wilt or droop, a repeated watering may be necessary during the day. Once plants are established, water only if prolonged dry periods occur.

Seed Installation

1. ***Rake or till only enough to expose soil for planting seed***, no more than 1–2 inches deep.
2. ***Select seed.*** Refer to Table 1 for seeding densities. Greater amounts of seed will result in denser growth and better chances for success. Include 1 ounce of Canada wild rye per 1,000 square feet if desired. This seed will germinate readily to indicate areas where seeding is successful and help to hold the soil in place. Canada wild rye is a short-lived native perennial grass.
3. ***Mix seeds with slightly moist sand or sawdust.*** Fill an ice cream pail or similar one gallon bucket 2/3 full with moist, but not wet, sand or sawdust. Add up to 4 ounces of seed and mix well. The seeds will adhere to the sand or sawdust, so they can be spread more thinly and evenly.
4. ***Broadcast the seed/sand mixture.*** Use half of the seed/sand mixture to cover the entire area. Sow the remaining half while walking perpendicular to the line of the first pass to assure good

seed distribution. The sand or sawdust will make it easier to see places that have not been seeded.

5. ***Press seed in by tamping down the soil*** with a rake or lightly raking the seeds in. The site may be rolled with a water-filled roller to insure good soil/seed contact. Do not roll when soil is wet, this will compact the soil, decrease levels of oxygen in the soil, and reduce seed germination.
6. ***Mulch lightly*** with 1/2 inch of weed free straw. Soil must be visible between the straw stems, or the mulch is too thick to allow seedlings to grow. If mulch is used on steep slopes, hold it in place with jute or biodegradable net. A biodegradable erosion control blanket up to ½ inch thick may be used as an alternative to mulch.
7. ***Water.*** Water immediately following seeding. Watering seeds and small seedlings after sprouting is critical for sandy soils. Plan to water daily, preferably in the morning, for the first few weeks or until plants are well established. Check to see that soil is moist beneath the mulch. Very sandy sites may require watering more than once daily for the first few weeks. Once plants are established, water only if prolonged dry periods occur.

   Note: Watering *may* not be necessary for spring plantings in areas with loamy or clay soils as long as regular (weekly) rainfall of ½ inch or more occurs.

Shrubs and Trees

1. ***Keep bare-root stock moist and cool before planting.*** Dormant bare-root shrubs can be ordered in fall or winter for delivery in the spring. Plant bare-root stock as soon as it arrives if possible. If necessary, store bare-root stock close to 34 degrees Fahrenheit, to avoid breaking dormancy. Keep tree roots moist by periodically sprinkling with water. Do not soak roots in water because this will deprive them of oxygen.

2. ***Dig the hole deeply enough*** so that the roots won't curl or bunch up. The trees and shrubs should be planted about one-half inch deeper than they were in the nursery. Paler colored bark and a slight swelling on the stem show where the old soil line was. Bare rootstock may need to be root pruned. For more information about bare rootstock refer to WDNR website [http://www.dnr.state.wi.us/org/land/forestry/nursery/generalinfo/plantingprocs.htm#seedling] and contact your local forester.

3. ***Pack soil firmly around the roots.*** Air pockets left around the roots will dry them out. Press soil around the roots with your foot, but do not stomp on them.

4. ***Water regularly*** to keep soil moist but not saturated.

5. ***Mulch*** a two-foot diameter circle around each plant 2 to 3 inches deep with wood chips, straw, or leaves. This will reduce competition with other plants. Keep this area free of other growth by weed whacking or hand-pulling weeds for the first couple of years. Avoid mulching where there are steep slopes. In this case, reduce competition by weed whacking.

Transplanting Trees and Shrubs

It is best to transplant when trees and shrubs are dormant in the early spring or late fall. Identify and label trees and shrubs when leaves are on the plant. Obtain permission from the landowner before removing plant material. Dig up as much of the root as possible. Replace the duff layer of leaves and stems to reduce erosion at the site. Only dig up trees and shrubs if they are part of a large stand or if the seedlings are numerous. If the tree or shrub is uncommon or rare, do not move it. Only remove a small percentage of any one type of plant. Leave behind a large enough population to allow further reproduction of the native population.

Site Care and Maintenance

The most ideal maintenance is to simply leave the site alone. Do not fertilize, do not mow, do not rake, do not "clean up" fallen limbs or trees. Allow native vegetation to regrow.

In accelerated recovery areas, some initial maintenance may be required. Pulling invasive weeds around native shrubs, trees, and groundcovers the first year or two eliminates competition and will help to give them a good start. Maintenance over the long-term must be in accordance with the local shoreland ordinance requirements.

The duff layer, made up of fallen leaves and pine needles, should be left intact. This layer covers the soil, thereby conserving moisture, preventing erosion, and allowing water to infiltrate into the soil.

Year One

Watering

Regular watering in the first two months of a spring or summer planting is one of the most important factors for success. Without supplemental watering, roots may not reach the soil moisture they need. Watering at least 30 minutes each day allows vigorous root growth for plants to become quickly established. Timers to turn water on and off automatically are available from hardware and garden supply stores.

Where drainage is poor, water only in the morning, not at night when evaporation is reduced. Fungal diseases that start with excess moisture can kill young seedlings. Use lake water if feasible, since this water often is warmer and more nutrient-rich than well water. Pumping water from the lake is allowed in Wisconsin as long as no type of structure is left in the lake.

Protection Against Deer Browsing

Whitetail deer and other animals may damage plantings, especially trees and shrubs. Protect against damage by physical or chemical means. Surround newly planted trees and shrubs with 4 – 6 foot high, galvanized mesh fence supported with wooden stakes or fence posts, or cover plants with bird netting. Landscape products available to spray on plants deter browsing through strong tastes or odors. Red pepper spray is an example. Use of these products may need to be varied as deer become accustomed to their taste or smell. Protection against deer browsing is particularly important if deer are fed on the site or nearby. Deer feeding should be discouraged near restoration areas. For more information about deer damage refer to Craven et. al and the following Web site: [http://www1.uwex.edu/ces/pubs/pdf/G3083.PDF].

Weeding Planted Areas

Pull weeds out as early as possible being careful to not disturb the native plants. Be especially diligent in areas where non-native invasive species like purple loosestrife, mullein, lamb's quarter, quack grass, reed canary grass or bluegrass are known to be present.

Weeding Seeded Areas

It can be difficult to tell weeds from the native plants in a seeded area. Sprouting a small sample of the native seeds in a plant tray will assist with their identification. Cut off flowering heads of weeds before they go to seed. Perennial natives will eventually out-compete annual weeds that sprout from seed.

Another alternative is to repeatedly trim weedy vegetation to 6 to 8 inches with a weed-whacker. Remove clippings immediately if they cover the native seedlings. This will discourage weed growth, remove shade, and allow native seedlings to grow.

Fertilizing And Applying Insecticides

Fertilizers and insecticides should be avoided. Applying fertilizers may encourage weed growth. If native plants are selected appropriately, supplemental fertilization should not be required. Also avoid applying insecticides since so many are non-specific and can harm or even kill non-target species.

Vegetative Cover

At the end of the growing season, allow all dead vegetation to remain in place. It becomes a valuable seed source for next year's growth, provides food and cover for wildlife, and will help to cover the soil and slow spring runoff. The grass seed and dried flower heads add another level of appeal to the native landscape in the winter months.

Year Two

Watering

Water only during periods of severe drought.

Weeding

Thoroughly weed early in the summer. After this initial weeding, check for and remove weeds at least once a month.

Year Three and Beyond

No watering or weeding should be necessary except for extreme drought conditions or stubborn invasive weed problems. Leave vegetation in place in the fall and through the winter months. Approval from the zoning or land conservation office is required for extensive weed removal in the shoreland zone.

Prairie and savanna areas may be trimmed or burned only under an approved management plan. Additional permits or approval may be necessary before trimming or burning. Trim groundcover

in prairie areas no more than once every three to five years. Groundcover should be cut no less than 6-8 inches high. Cut vegetation in the late winter when the ground is still frozen, or in late spring, when the ground is dry enough to walk on without damaging new growth. Leave all dead plant clippings on-site. They will add to the shoreland soil structure. A controlled burn may be appropriate only in prairie and savanna areas. A burn should not be attempted until the prairie or savanna is well established – usually after five or more years. To determine if a controlled burn is appropriate evaluate the site for safety considerations; threats to structures, shrubs, and trees; and weed species present. In addition to any required permits, Department of Natural Resources broadcast burning permits are required in intensive fire zones.

Except in prairie areas that are identified in an approved management plan, any native trees, shrubs, and groundcover in the restoration area shall be left undisturbed. Trees and shrubs are intended to move in to create multiple layers of canopy cover. Tree thinning or removal of dead or diseased trees requires approval of the appropriate administering agency.

Vehicles shall be excluded from the buffer except for limited use in the viewing/access corridor. Docks and boatlifts shall be stored outside the buffer or in the viewing/access corridor.

Resources

References for Plant Selection

Please note that counties may have approved or recommended plant lists.

Curtis, J.T. (1971) *Vegetation of Wisconsin.* University of Wisconsin Press.

Cochrane, T.S., and Iltis, H. (2000) *Atlas of Wisconsin Prairie and Savanna Flora.* Technical Bulletin No. 191. Department of Natural Resources. Madison, WI 53707.

Dickerson, J, et. al. (1998) *Vegetating with Native Grasses in Northeastern North America*. Ducks Unlimited Canada.

Eggers, S.D., Reed, D.M. (1997) *Wetland Plants and Plant Communities of Minnesota & Wisconsin*. U.S. Army Corps of Engineers. St. Paul District.

Fassett, N.C. (1980) *A Manual of Aquatic Plants*. The University of Wisconsin Press.

Henderson, R.A. (1995) *Plant Species Composition of Wisconsin Prairies*. Technical Bulletin No. 188, Department of Natural Resources.

Kotar, J., Kovach J. and Locey, C. (1988*) Field Guide to Forest Habitat Types of Northern Wisconsin*. Department of Forestry, University of Wisconsin- Madison.

Kotar, J. and Burger, T. (1996) *A Guide to Forest Communities and Habitat Types of Central and Southern Wisconsin.* Department of Forestry, University of Wisconsin-Madison.

Ladd and Oberle (1995*) Tallgrass Prairie Wildflowers*. Falcon Publishing Inc.

Messer, G. (2001) *Wisconsin Native Plant Sources*. University of Wisconsin-Extension. Madison, WI. [http://clean-water.uwex.edu/pubs/native/hinative.pdf].

Kearns, K. (2001) *Native Plant Nurseries and Restoration Consultants in Wisconsin*. Wisconsin Department of Natural Resources. Madison. [http://www.dnr.state.wi.us/org/land/er/invasive/info/nurseries.htm].

Preston, R.J. (1976) *North American Trees*. Iowa State University Press.

Snyder, L.C. *Native Plants for Northern Gardens*. Andersen Horticultural Library. University of Minnesota Libraries. Minnesota Landscape Arboretum.

United States Department of Agriculture, Natural Resources Conservation Service (species specific information) [http://www.plants.usda.gov/plants/index.html].

General Resources

Baumann, J. 1993. *Wisconsin Construction Site Best Management Practice Handbook*. Wisconsin Department of Natural Resources, Bureau of Watershed Management. Madison, WI.

Burnett County Land & Water Conservation Department (2001) *Shoreline Restoration Design and Preservation Standards*. Burnett County Land & Water Conservation Department. Siren, WI.

Craven, S. and Hygnstrom, S. (1996) Controlling Deer Damage in Wisconsin (G3083). University of Wisconsin-Extension. Madison, WI. [http://www1.uwex.edu/ces/pubs/pdf/G3083.PDF].

Henderson, C., Dindorf, C. and Rozumalski, C. (1998) *Lakescaping for Wildlife and Water Quality*. Minnesota Department of Natural Resources, Section of Wildlife, Nongame Wildlife Program. St. Paul, MN. 176 pp.

Shoreland Restoration: A Growing Solution, (A fifteen-minute video that provides instructions for planting native trees, shrubs, and seedlings) To obtain a copy call: 1-877-947-7827. Ask for GWQ032.

The Living Shore, (A seventeen-minute video about shoreline buffer zones) To obtain a copy call 1-800-876-8630. Ask for VH7129.

Petrides, G.A. (1972) *A Field Guide to Trees and Shrubs*. Houghton Mifflin Company.

Thompson, A. and Luthin, C. (2000) *Wetland Restoration Handbook for Wisconsin Landowners.* Wisconsin Department of Natural Resources, Bureau of Integrated Science Services. Madison, WI. 108 pp.

Baumann, J. (1993) *Wisconsin Construction Site Best Management Practice Handbook.* Wisconsin Department of Natural Resources, Bureau of Watershed Management. Madison, WI.

United States Department of Agriculture – Natural Resources Conservation Service. *Wisconsin Agronomy Technical Note 5: Prairie Restoration.*

UW Madison Herbarium website (an aide to finding county species lists) [http://www.wisc.edu/botany/herbarium/home.html]

For more information about bare rootstock see the following DNR website: [http://www.dnr.state.wi.us/org/land/forestry/nursery/generalinfo/plantingprocs.htm#seedling]

Appendix One

Sample Shoreland Habitat Restoration SITE PLAN

Appendix one includes a completed shoreland habitat restoration site plan for an example site. The narrative component of the plan includes:

- Plant density calculations
- Narrative to accompany the restoration site diagram
- Preparation schedule
- Planting dates and schedule
- Care and handling of plant materials
- Maintenance plan
- Plant lists appropriate for the site

The site diagram component of the plan (Appendix Two) includes labeled drawings, not to scale, of (a) existing site conditions and (b) planned restoration components.

Sample Shoreland Habitat Restoration SITE PLAN

SHORELAND HABITAT RESTORATION SITE PLAN PREPARED FOR:
LANDOWNER NAME
SHORELAND ADDRESS
MAILING ADDRESS

Plan Components

This shoreland habitat restoration site plan, prepared for your property, contains several components:

- A site diagram of existing conditions. This diagram was used in calculating areas for restoration and developing the site plan.
- A site diagram of the proposed restoration for your property. This diagram identifies the areas to be restored, and the type of site preparation, planting and maintenance needed.
- A copy of Wisconsin Biology Technical Note 1: Shoreland Habitat Restoration. This booklet contains detailed instructions for shoreland habitat restoration.
- Written information about your site plan and instructions for carrying out your site restoration.

Shoreland Habitat Restoration Standards

[Technician Note: In this section, you will give a brief description of the shoreland habitat restoration plan and its maintenance requirements.]

Your restoration site plan has been developed so that it meets the requirements of the Shoreland Habitat restoration practice, NRCS Code 643A (Interim). Some of these requirements are summarized here.

The minimum practice depth is 35 feet. Where the principal structure (home) is within 50 feet of the ordinary high water mark, land within 15 feet of the structure may be excluded from the practice. A single viewing/access corridor up to 30 feet wide may extend from the lake inland. Viewing corridors that are oriented somewhat obliquely to the shoreline, or are curved, are preferable to those that are perpendicular to the shoreline. This reduces the visual impact of human activities in the shoreland area.

Vegetation removal and land disturbing activities are prohibited in the restoration area. Mowing and limited pruning are allowed in the viewing/access corridor. Walkways, pathways, and stairs must be located in the viewing/access corridor; and piers, wharfs, and lifts must be placed in water immediately in front of the corridor.

Sample

Plant Density Calculations

[Technician Note: Provide the calculations for plant densities.]

Total restoration area: 3500 ft^2 (above ordinary high water mark). See the attached site map. Worksheets 1and 2 below show the calculations for the numbers of plants that are needed for this site.

Worksheet 1: Area Calculations							
	Total Area of Shoreland Habitat (Square Feet)		**Total Area of Viewing/ Access Corridor**		**Total Area of Existing Layer to Preserve and/or Natural Recovery Zones**		**Total Area to be Planted**
Tree Layer	3,500	-	1,050	-	925	=	1,525
Shrub Layer	3,500	-	1,050	-	700	=	1,750
Herbaceous Layer - Plants	3,500	-	1,050	-	1,450	=	1,000
Herbaceous Layer - Seeds	N/A	-	N/A	-	N/A	=	N/A

Worksheet 2: Seed or Plant Densities							
	Total Area to be Planted (Square Feet)		**Density Factor**		**Seed or Plant Densities from Table 1.**		**Total Plants or Seeds to Install**
Tree Layer	1,525	÷	100	×	.1	=	2
Shrub Layer	1,750	÷	100	×	0.25	=	4
Herbaceous Layer							
Plants	1,000	÷	100	×	100	=	1000
Grass Seeds	N/A	÷	1000	×	N/A	=	N/A
Forbs Seeds	N/A	÷	1000	×	N/A	=	N/A

Sample

Shoreland Habitat Restoration Site Diagram

[Technician Note: In this section, describe the different components of the shoreland habitat restoration plan. The technician should include appropriate plant lists on the back of the restoration site diagram.]

The attached Shoreland Revegetation Plan/Site Diagram provides guidance for planting your restoration. Plant selections are found on the reverse of the plan drawing. Vegetation that is native to [Sample] County has been selected for soil moisture and light conditions on the site. Substitutions may be made from the attached plant lists.

Site Diagram Specifications

[Technician Note: Describe the different areas located on the site plan.]

Natural Recovery Zone (Wet Mesic Prairie)

Allow existing vegetation to grow in this area. You may wish to plant some wet mesic prairie wildflowers or grasses to add color and diversity.

Accelerated Recovery Zone (Oak Savanna/Dry Mesic Prairie)

It will be necessary to eliminate the turf grasses to lessen competition for the newly planted native plants. Prepare area "21" by spraying with herbicide or smothering with black plastic to kill existing vegetation. Plant prairie flowers and grasses from the **Oak Savanna/Dry Mesic Prairie** list. Plant flowers and grasses in a manner that will allow them to spread over the entire area.

In area "22", turf grasses were never fully established. Plant native trees and shrubs and allow native grasses and wildflower plants to regrow. Additional plants from the Oak Savanna/Dry Mesic Prairie list may be added as needed.

Viewing/Access Corridor

A 30-foot wide viewing/access corridor is permitted for this practice. Within the viewing/access corridor, there is a stairway to the lake and a fire pit area. ***This area may remain in turf, and the fire pit may be left in place.***

Sample

Preparation Schedule

[*Technician Note: Provide approximate dates for completion of restoration plan elements.]* Refer to Wisconsin Biology Technical Note 1 (included in this packet) for specific instructions for preparing your restoration site.

Table 4. Preparation Schedule		
Remove existing vegetation in prairie area:	Plastic	2 months before planting
	Herbicide	3 weeks before planting
Order plants:	Winter/early spring before planting	
Gather supplies	2 weeks before planting	

Planting Dates and Schedule

Table 5. Planting Dates and Schedules		
Prairie	May 20th – September 15th	
Shrubs and Trees	Bare root	Before leaf-out or after leaves fall
	Potted	Any time soil is not frozen

Plant Materials

[Technician Note: Describe how property owners should obtain, store, and install plant materials.]

Obtaining Plants

[Technician Note: The technician should supply the options for plant procurement in this section].

Prices and plant availability vary. The [Sample] County Conservation Department sells appropriate plant mixes in a spring (early June) native plant sale. Plugs of 48 seedlings are available for under $25 each. Orders are taken beginning in January.

Storing Plant Materials

Follow supplier's instructions. Use plugs/seedlings as soon as possible. To hold plants or potted shrubs, store them in an area with partial sun such as on the east side of a building or under a deciduous tree. Do not leave them in a dark area for long periods; this will weaken plants. Water to keep packs moist once or twice a day.

Plant bare-root stock as soon as it arrives if possible. Store bare-root stock at about 34 degrees Fahrenheit, to avoid breaking dormancy. Keep tree roots moist by periodically sprinkling with water. Do not soak roots in water because this will deprive them of oxygen.

Sample

Planting Instructions

[Technician Note: The technician should provide planting information specific to site and plant materials chosen. ***Please refer to Wisconsin Biology Technical Note 1 and other appropriate sources.****]*

Wisconsin Biology Technical Note 1 is enclosed. This booklet includes the information you and/or your landscaper will need to prepare your site and complete your planting. Plant lists suitable for your site are also included in this packet.

Sample

Site Care and Maintenance

[Technician Note: Provide instructions on the maintenance of the shoreland habitat restoration. Address site specific concerns as appropriate.]

Over the long term, keep the following guidelines in mind: Do not fertilize, do not mow, do not rake, do not "clean up" fallen limbs or trees. Allow native vegetation to regrow. The duff layer, made up of fallen leaves and pine needles, should be left intact. This layer covers the soil, thereby conserving moisture, preventing erosion, and allowing water to soak into the soil. Plants lost due to desiccation, deer browsing or for any other reason must be replaced.

Guidelines for caring for your restoration during establishment are given below. In addition, Wisconsin Biology Technical Note 1, which is enclosed in this packet, contains detailed care and maintenance instructions.

Year One

Watering

Regular watering in the first two months of a spring or summer planting is one of the most important factors for success. Without supplemental watering, roots may not reach the soil moisture they need. Watering at least 30 minutes each day allows vigorous root growth for plants to become quickly established. Timers to turn water on and off automatically are available from hardware and garden supply stores. Use lake water if feasible, since this water often is warmer and more nutrient-rich than well water. Pumping water from the lake is allowed in Wisconsin as long as no type of structure is left in the lake. Contact your local DNR water management specialist if you have any concerns or questions.

Protection Against Deer Browsing

Whitetail deer and other animals may damage plantings, especially shrubs. Protect against damage by physical or chemical means. Surround newly planted shrubs and trees with 4 – 6 foot high, galvanized mesh fence supported with wooden stakes or fence posts, or cover plants with bird netting. Landscape products available to spray on plants deter browsing through strong tastes or odors. Red pepper spray is an example. Use of these products may need to be varied as deer become accustomed to their taste or smell. Protection against deer browsing is particularly important if deer are fed on the site or nearby. Deer feeding should be discouraged near restoration areas.

Weeding

Check for weeds once every two weeks. Pull weeds out as early as possible being careful to not disturb the native plants. Do not allow invasive species like purple loosestrife, mullein, lamb's quarter, quack grass, reed canary grass, bluegrass, and others to take over the planting.

Fertilizing And Applying Pesticides

The use of fertilizers and pesticides is prohibited. Applying fertilizers may encourage weed growth. If native plants are selected appropriately, supplemental fertilization should not be

Sample

required. Also avoid applying pesticides since so many are non-specific and can harm or even kill non-target species.

Vegetative Cover

At the end of the growing season, allow all dead vegetation to remain in place. It becomes a valuable seed source for next year's growth, provides food and cover for wildlife, and will help to cover the soil and slow spring runoff. The grass seed and dried flower heads add another level of appeal to the native landscape in the winter months.

Year Two

Continue maintenance practices for year one except as noted below.

Watering

Water should only be needed during periods of severe drought.

Weeding

Thoroughly weed early in the summer. After this initial weeding, check for and remove weeds at least once a month.

Year Three and Beyond

No watering or weeding should be necessary except for extreme drought conditions or stubborn invasive weed problems. Leave vegetation in place in the fall and through the winter months. Tree thinning or removal of dead or diseased trees requires special approval from the [insert name of administering agency].

Prairie and savanna areas may be trimmed only under an approved management plan. Trim groundcover in prairie areas no more than once every three to five years. Groundcover should be cut no less than 6-8 inches high. Cut vegetation in the late winter when the ground is still frozen, or in late spring, when the ground is dry enough to walk on without damaging new growth. Leave dead plant clippings on-site. They will add to the shoreland soil structure.

Except in prairie areas that are identified in an approved management plan, any native trees, shrubs, and groundcover in the restoration area should be left undisturbed. Trees and shrubs are intended to move in to create multiple layers of canopy cover. Collection of seeds for use outside of the practice area is prohibited until the planting has been in place for at least three years.

Vehicles should be excluded from the restoration area except for limited use in the viewing/access corridor. Docks and boatlifts should be stored outside the restoration area or in the viewing/access corridor, if possible.

Sample

Plant Lists

[Technician Note: Supply a list of native plant materials to be used in the shoreland habitat restoration. Select plant species based on appropriate plant communities for the region, as well as site conditions. Make certain the list is extensive enough to provide substitutions for species.]

Oak Savanna/Dry Mesic Prairie

Select a minimum of three grass species and five forb species from the list below.

Dry to medium soils Full sun 8 hours

Common Name	Scientific Name	Height	Flower Color
Grasses			
Big bluestem	*Andropogon gerardii*	3-8'	NA
Blue grama*	*Bouteloua gracilis*	1-2'	NA
Bottlebrush grass	*Elymus hystrix*	3'	NA
Canada wild rye	*Elymus canadensis*	3-6'	NA
Indian grass	*Sorghastrum nutans*	3-6'	NA
June grass*	*Koeleria macrantha*	1-2'	NA
Little bluestem*	*Schizachyrium scorparium*	2-3'	NA
Needle grass*	*Stipa spartea*	3-4'	NA
Prairie dropseed*	*Sporobolus heterolepsis*	2-4'	NA
Side oats grama*	*Bouteloua curtipendula*	2-3'	NA
Forbs			
Anise hyssop*	*Agastache foeniculum*	2-4'	Lavender
Bergamot*	*Monarda fistulosa*	2-4'	Lavender
Black-eyed Susan*	*Rudbeckia hirta*	1-3'	Yellow
Bush clover*	*Lespedeza capitata*	3-4'	Green
Butterfly weed*	*Asclepias tuberosa*	2-3'	Orange
Canada milkvetch	*Astragalus canadensis*	2-3'	White
Common oxeye daisy*	*Heliopsis helianthoides*	2-5'	Yellow
Dotted mint	*Monarda punctata*	1-3'	Lavender
Fireweed*	*Epilobium angustifolium*	2-6'	Pink
Frost aster	*Aster epilosus*	1-3'	White
Harebell*	*Campanula rotundifolia*	4-20"	Purple
Heart-leaf golden alexander	*Zizia aptera*	1-3'	Yellow
Hoary vervain*	*Verbena stricta*	2-3'	Blue
Lance-leaf coreopsis*	*Coreopsis lanceolata*	2-3'	Yellow
Leadplant*	*Amorpha canescens*	2-3'	Blue
Lupine*	*Lupinus perennis*	1-2'	Blue
Pasque flower*	*Anemone patens*	2-14"	Lavender

** = Best for driest sites*
NA = Not Applicable, no flowers or inconspicuous flowers

Sample

Oak Savanna/Dry Mesic Prairie (continued)

Dry to medium soils Full sun 8 hours

Common Name	Scientific Name	Height	Flower Color
Forbs (continued)			
Prairie sage*	*Atemesia ludoviciana*	2-3'	White
Prairie smoke*	*Geum triflorum*	6-13"	Red
Prairie violet	*Viola pedatifida*	6-8"	Blue
Pearly everlasting*	*Anaphalis margaritacea*	1-2'	White
Purple prairie clover*	*Dalea purpureum*	1-3'	Purple
Rough blazing star*	*Liatris aspera*	2-3'	Purple
Showy goldenrod	*Solidago speciosa*	2-4'	Yellow
Smooth blue aster	*Aster laevis*	2-3'	Blue
Sky blue aster	*Aster oolentangiensis*	1-4'	Blue
Spike lobelia*	*Lobelia spicata*	8-40"	Lavender
Stiff goldenrod	*Solidago rigida*	1-5'	Yellow
Upland white aster	*Aster ptarmicoides*	1-2'	White
Western sunflower*	*Helianthus occidentalis*	2-3'	Yellow
White prairie clover*	*Dalea candidum*	1-3'	White
Yarrow*	*Achillea millefolium*	2-3'	White
Shrubs			
New Jersey tea*	*Ceanothus americanus*	1-3'	White
Prairie rose	*Rosa arkansana*	2-3'	Pink

** = Best for driest sites*
NA = Not Applicable, no flowers or inconspicuous flowers

Sample

Appendix Two

Shoreland Habitat Plan Site Diagram Job Sheet

Appendix two includes a blank Shoreland Habitat Plan Site Diagram Job Sheet followed by a sample intended for guidance. Ordinarily this job sheet would be provided on a double-sided 11 ½ X 17 size of paper, but for the purposes of this technical note publication, the following four pages represent the sample site diagram job sheet as can be viewed on 8 ½ X 11 size paper front and back.

The sample site diagram drawing (page 33) is not to scale, but it includes site conditions and planned restoration components. The accompanying vegetation specifications for the sample site diagram are to be found on page 34. This sample site plan can be used as a template for the plans and specifications required for the Standard 643A, (Interim) Shoreland Habitat.

If you would like a copy of the full-size Shoreland Habitat Plan Site Diagram Job Sheet, please contact either your local county conservationist or the USDA – Natural Resources Conservation Service (NRCS) offices for a hard copy.

Appendix Two
Shoreland Habitat Site Plan Diagram Job Sheet

Scale: 1 inch = _____ Feet

Please indicate north by drawing an arrow.

Blank Job Sheet – Site Diagram

Use the direction and symbols found on the back of this page to complete the diagram

Contact the local NRCS office or Land Conservation Department for a full-size (11 x 17) version of this form.

Project Location (Include Fire #, Road Name, and Lake)

_____

_____

Owner _____ Phone Number _____

Landscaper _____ Phone Number _____

Worksheet Completed By _____

Date _____

Shoreland Habitat Restoration Plan Legend	What to Include in Your Plan
Property Line	❖ Boundary of the buffer
Ordinary High Water Mark	❖ Location of Ordinary High Water Mark
Viewing Corridor/Access	❖ Location of the viewing/access corridor
Buffer Boundary	❖ Existing shrubs and trees
XXXXXXXX **"No-Touch" Boundary**	❖ Locations of shrubs and trees to be planted
Existing Channelized Drainage	❖ Areas where native ground will be planted
Existing Trees	❖ Erosion control practices to be installed during buffer establishment
Existing Shrubs	❖ Practices to eliminate channel flow in the buffer
Existing Groundcover	❖ Source of water for watering
Existing Structures	❖ Location of existing primary structures within the buffer
1 **New Trees** (Corresponds to Plant List #)	
11 **New Shrubs** (Corresponds to Plant List #)	
21 **New Ground Cover** (Corresponds to Plant List #)	

Vegetation Specifications (attach additional pages if necessary)

List the plants selected for the project and the number to be planted (Include all trees, shrubs and ground cover)

Trees		
	Tree Name	**# of Trees**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Shrubs		
	Shrub Name	**# of Shrubs**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Erosion Control Practices

Draw on Site Plan

- ☐ Silt Fence
- ☐ Mulch
- ☐ Erosion Blanket
- ☐ Hay Bales
- ☐ Runoff Diversions
- ☐ Shoreland Erosion Protection
- ☐ Other

_____

_____

_____

Ground Cover		
	Plant Community	**# of Plants**
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		

Buffer Restoration Plan - Site Diagram

Use the directions and symbols found on the back of this page to complete the diagram

Scale: 1 INCH = 20 FEET

Please indicate north by drawing an arrow. N ↑

TOTAL AREA OF RESTORATION = 35' x 100' = 3500 sq. ft.

VIEW CORRIDOR = 35' x 30' = 1050 sq. ft.

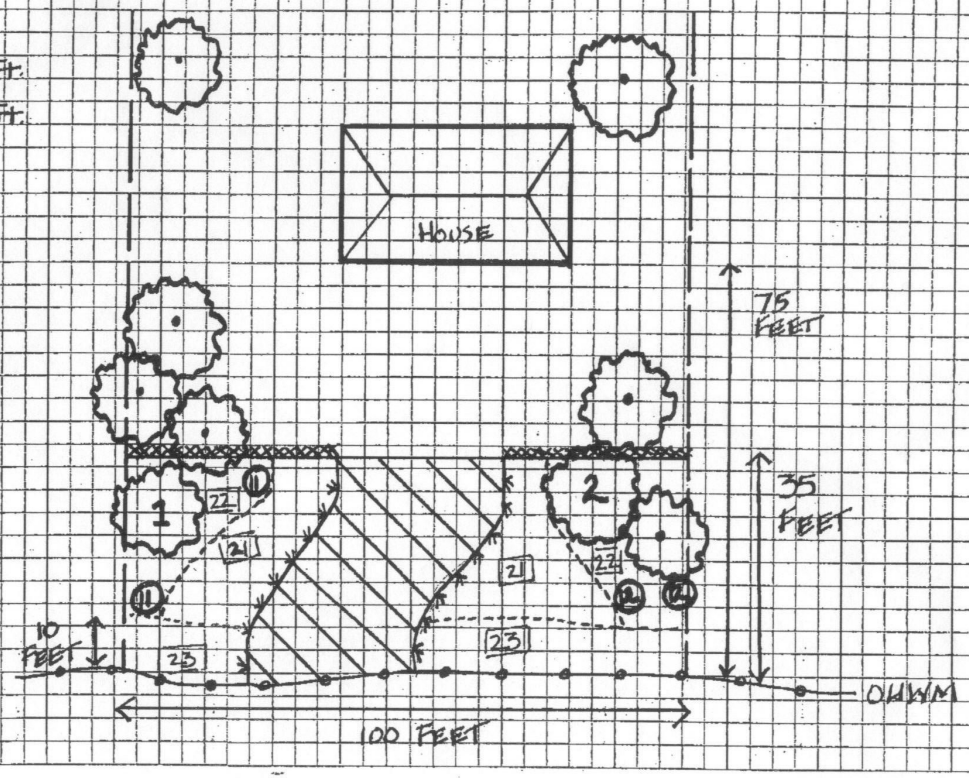
ACCELERATED RECOVERY AREAS

[21] = 450 sq. ft. & 550 sq. ft. = 1000 sq. ft.

[22] = 310 sq. ft. & 440 sq. ft. = 750 sq. ft.

NATURAL RECOVERY AREA

[23] = 10' x 70' = 700 sq. ft.



Sample

Project Location (Include Fire #, Road Name and Lake)

Owner _____ Phone Number _____

Landscaper _____ Phone Number _____

Worksheet Completed By _____

Date _____

Plan Approved By: _____

Date: _____

NOT TO SCALE

Vegetation Specifications (attach additional pages if necessary)

List the plants selected for the project and the number to be planted (Include all trees, shrubs and ground cover)

Trees

	Tree Name	# of Trees
1	1 RED OAK	1
2	2 SHAGBARK HICKORY	1
3		
4		
5		
6		
7		
8		
9		
10		

Erosion Control Practices

Draw on Site Plan

- ☐ Silt Fence
- ☐ Mulch
- ☐ Erosion Blanket
- ☐ Hay Bales
- ☐ Runoff Diversions
- ☐ Shoreland Erosion Protection
- ☐ Other

_____

_____

_____

Shrubs

	Shrub Name	# of Shrubs
1	11 WILD ROSE	2
2	12 NEW JERSEY TEA	2
3		
4		
5		
6		
7		
8		
9		
10		

Ground Cover

	Plant Community	# of Plants
21	21 OAK SAVANNA	
22	22 OAK SAVANNA	
23	22 WET MESIC PRAIRE	N/A
24		
25		
26		
27		
28		
29		
30		

*500 GRASSES & 500 WILDFLOWERS

Sample