Diversion Berm, Perimeter Ditch, and Spillway Design Calculations

Purpose/Methodology/Assumptions/Results/References

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
Dairyland Power Cooperative	BJK	9/00			3081.40

DIVERSION BERM, PERIMETER DITCH, AND SPILLWAY DESIGN CALCULATIONS

Purpose

To size the diversion berms, perimeter ditches and spillway at the proposed Dairyland Power Cooperative Landfill to adequately handle the surface water runoff from a 100-year, 24-hour storm.

Methodologies

Ditches, diversion berms and spillways were designed to channel the surface water runoff from the landfill drainage areas to the sedimentation basins, receiving ditches, or spillways. The direction of surface water runoff from the drainage areas surrounding the proposed landfill is towards the proposed landfill. Perimeter drainage ditches were therefore incorporated into the design to route the surface water runoff from outside the proposed landfill limits along the perimeter of the landfill area to the existing main channel at the south end of the landfill. These ditches are labeled as the NW, NE, West, SE, and SW ditches. The perimeter ditches sized in this subsection of the appendix, then, include ditches to collect runoff from the landfill drainage areas as well as ditches to collect surface water run-on from the drainage areas surrounding the landfill.

The adequacy of the diversion berms and ditches in handling the surface water runoff and run-on and in limiting the amount of erosion is based on the depth of flow and velocity, respectively, in the ditch. An in-house RMT spreadsheet incorporating Manning's equation was used to assist in the design of the diversion berms and ditches. This program allows the user to input the ditch geometry, the peak flow (as determined by the surface water runoff calculation), and the vegetative retardance factor (Chow, 1959). The program then begins an iterative process which adjusts the flow depth and Manning's coefficient until the trial velocity and the resultant velocity are within 0.002 feet per second (fps) of each other. The end result is the peak flow depth and peak velocity for the geometry and peak flow entered. Design software provided by Synthetic Industries was also used to select erosion control matting for ditches and grouted riprap for spillways.

Permanent ditches, diversion berms, and spillways will be constructed as early in the site development as practicable. Where temporary ditching is required, these temporary ditches have been designed to the same standards as the permanent ditches. Calculations for the sizing of the temporary ditches are also attached.

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	By:	Date:	By:	Date:	
Dairyland Power Cooperative	BJK	9/00			3081.40

It is noted that the storm water control structures have been designed using a 100-year, 24-hour storm event and a TR-55 Type II storm distribution. As noted in the surface water runoff calculations, the peak flows calculated using this method meet or exceed the peak flows calculated using a 25-year, time of concentration storm event (required by NR 504.09).

Assumptions

The following assumptions were used to design the diversion berms and perimeter ditches:

- Diversion berms, perimeter ditches and the spillway were designed to handle the runoff from the 100-year, 24-hour storm event.
- Diversion berm ditches were designed as V-notch ditches with a minimum 0.5 foot of freeboard for the 25-year, 24-hour storm. Diversion berm ditches were designed to convey the 100-year, 24-hour storm without overtopping.
- Perimeter ditches were designed as both V-notch and flat bottom (10-foot and 20-foot-wide) ditches with a minimum 0.5 foot of freeboard for the 25-year, 24-hour storm. Perimeter ditches were designed to convey the 100-year, 24-hour storm without overtopping.
- Grass-lined diversion berm and perimeter ditches were designed for a maximum velocity of 4 fps. Ditches with velocities exceeding 4 fps were designed to be lined with erosion mat or riprap, as appropriate.
- The spillway was designed as 20-foot-wide, flat-bottom spillway with a minimum 0.5 foot of freeboard.
- The peak flows in the diversion berms, perimeter ditches and the spillway were obtained from the hydrographs generated in the "Surface Water Runoff Calculations" subsection of this appendix.
- Manning's numbers were selected for both "low" retardance (Type "D") and "moderate" retardance (Type "C") as given by the U.S. Soil and Conservation Service. Type "D" is typical of spring conditions while Type "C" is typical of summer conditions. For ditches lined with erosion matting, default Manning numbers from the Synthetic Industries design software were utilized.

Results

The diversion berms and perimeter ditches were adequately sized to handle the surface water runoff from a 100-year, 24-hour storm event. The diversion berms at a 2 percent slope will be grass-lined. To limit erosion, permanent erosion matting will be placed in the diversion berms at a 6 percent slope, as well as in most of the perimeter ditching. Grouted riprap will be constructed in the spillways. The attached figure highlights the ditch sizing results.

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
Dairyland Power Cooperative	BJK	9/00			3081.40

References

Chow, V.T. 1959. Open Channel Hydraulics, McGraw Hill, New York.

Wisconsin Department of Transportation. 1994. Facilities Development Manual. February 1994.

U.S. Department of Agriculture, Soil Conservation Service. 1986. Engineering Field Manual for Conservation Practices. November 1986.

Goldman, S.J., et al. Erosion and Sediment Control Handbook. New York: McGraw-Hill. 1986.

Synthetic Industries. EC-Design 2000. Stormwater Management and Erosion Control Design Software. V.1.2.

Wisconsin DNR, Bureau of Water Resources Management. 1989. Wisconsin Construction Site Best Management Practice Handbook, Publication WR-222-89.

TRANSFER PIPE FROM STORAGE TANK CONNECTS TO EXISTING PIPE OUTSIDE PROCESSING FACILITY. SEE DETAIL (5/21)

APPROXIMATE LIMITS OF EXISTING ASH

LEACHATE STORAGE TANK SEE DETAIL (1/18)

EXISTING BOX CULVERT

ACCESS ROAD TO EXISTING PHASE II LANDFILL

10' WIDE FLAT BOTTOM DITCH @ 8%

CULVERT INLET I.E. 812.0 OUTLET I.E. 809.0

V-NOTCH DITCH @ 8%

CULVERT I.E. 784.0N I.E. 750.0S

ACCESS ROAD @ 5%

10' WIDE FLAT BOTTOM DITCH @ 5%

10' WIDE FLAT BOTTOM DITCH @ 7%

CULVERT

8' WIDE BERM ELEV. 784.0

10' WIDE FLAT BOTTOM DITCH @ 2%

V-NOTCH DRAINAGE DITCH @ 8%

CULVERTS

FINAL COVER SEE DETAIL (1/18)

FINAL COVER DRAINAGE LAYER TRANSFER AND DISCHARGE PIPE SEE DETAIL (4/18)

V-NOTCH DRAINAGE DITCH @ 1% SEE DETAIL (8/23)

LANDFILL PERIMETER BERM AND DRAINAGE DITCH SEE DETAILS (3/17) (5/18)

FINAL COVER DOWNSLOPE FLUME NO. 3 SEE DETAILS (3/20) (1/21) (4/21) (4/21)

SEDIMENTATION BASIN NO. 1 SEE DETAIL (1/22)

20' WIDE FLAT BOTTOM DITCH @ 20% AND DIVERSION BERM

EMERGENCY OVERFLOW PIPE

MAINTENANCE ROAD 10% SLOPE

RISER AND DISCHARGE PIPE SEE DETAIL (3/23)

E 1477500

20' WIDE FLAT BOTTOM DITCH @ 6% SEE DETAIL (6/23)

DITCH @ 2%

FINAL COVER DOWNSLOPE FLUME NO. 1 AND NO. 2 SEE DETAILS (1/20) (2/20) (4/20) (1/21) (2/21) (3/21) (4/21)

MANHOLE SEE DETAIL (2/16)

BM104

SEDIMENTATION BASIN NO. 2 SEE DETAIL (1/22)

MAINTENANCE ROAD 10% SLOPE

RISER/CULVERT I.E. 873.0W I.E. 872.0E

EMERGENCY SPILLWAY

FINAL COVER DIVERSION BERM SEE DETAIL (2/19)

BM101

10' WIDE FLAT BOTTOM DITCH @ 2%

LEACHATE TRANSFER LINE SEE DETAIL (3/23)

RIPRAP SPILLWAY

20' WIDE FLAT BOTTOM DITCH @ 1%

FILL AREA

E 1478000

E 1478500

19 18
20 17

CONSTRUCTION ACTIVITIES

PHASE 4B CLOSURE

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL GRADING LAYER.
3. INSTALL CCL.
4. INSTALL GEOMEMBRANE.
5. INSTALL DOWNSLOPE FLUME.
6. INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE, ROOTING ZONE LAYER, AND TOPSOIL.
7. INSTALL DIVERSION BERMS.
8. SEED, FERTILIZE, AND MULCH.

CONSTRUCTION QUANTITIES

PHASE 4B CLOSURE	VOLUME / AREA
TOPSOIL PLACED	9,800 CY
GRADING LAYER SOIL	9,800 CY
GENERAL FILL	19,600 CY
SELECT GRANULAR FILL	19,600 CY
GEOTEXTILE	66,700 SY
CCL	58,600 SY
GEOMEMBRANE	58,600 SY
SEED, FERTILIZER, MULCH	12.1 ACRES
DOWNSLOPE FLUME	1 EACH
4-INCH DIA. HDPE CORRUGATED PIPE W/ SMOOTH INTERIOR	3,150 LF
SELECT AGGREGATE FILL	470 CY

LEGEND

EROSION MATTING

GROUTED RIPRAP

Channel Lining Results

0 100 200 300 400
SCALE: 1" = 100'

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY. (NOT FOR CONSTRUCTION)

NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT: DAIRYLAND POWER COOPERATIVE
PLAN OF OPERATION
BUFFALO COUNTY, WISCONSIN

SHEET TITLE: PROPOSED FINAL GRADES

DRAWN BY: STORMER	SCALE: 1"=100'	PROJ. NO. 3081.40
CHECKED BY: DM		FILE NO. FGRADES.PLT
APPROVED BY: BJK	DATE PRINTED:	SHEET 12 OF 23
DATE: OCTOBER 2000		

RMT

744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923
Madison, WI 53708-8923
Phone: 608-831-4444

RMT COMPUTER AIDED DESIGN & DRAFTING

FIGURE K-10

Calculations – Post-closure Landfill Conditions

RMT, Inc.
Grass Channel Sizing Calculations

Site:	Dairyland Power Cooperative	Date:	10/1/98
Project #:	3081.33	User:	BLP
Channel:	Diversion Berm (2%) - worst case flow		
	Area 1F		

VBLP 10/19/98

==========

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	4.000	ft/ft
B. Side slope, Z2 (hor/vert) =	2.000	ft/ft
C. Bottom width, B =	0.000	ft
D. Design channel slope, S =	0.020	ft/ft
E. Channel Peak Flow, Q =	25.000	cfs
F. Enter - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	1	← Summer Conditions

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until Va=Vb)	1.570	ft 0.4' freeboard
B. Channel flow area, Ac = (.5*Z1*D^2) + (B*D) + (.5*Z2*D^2)	7.390	sq ft
C. Wetted Perimeter, Pw = (D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5)	9.981	ft
D. Hydraulic radius, Rh = (Ac/Pw)	0.740	ft
E. Velocity and hydraulic radius, VR = (Va * Rh)	2.505	sfps
F. Channel flow Manning's coeff, nc = 0	0.051	
G. Trial velocity, Va = (Q/Ac)	3.383	fps
H. Resultant velocity, Vb = (1.49/nc) * (Rh^.667) * (S^.5)	3.383	fps < 4 fps

Invoke Solution Macro by typing - 'ctrl' D

RMT, Inc.

Grass Channel Sizing Calculations

Site:	Dairyland Power Cooperative	Date:	10/1/98
Project #:	3081.33	User:	BLP
Channel:	Diversion Berm (2%) - worst case flow Area 1F		

VBJL 10/98

==========

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	4.000	ft/ft
B. Side slope, Z2 (hor/vert) =	2.000	ft/ft
C. Bottom width, B =	0.000	ft
D. Design channel slope, S =	0.020	ft/ft
E. Channel Peak Flow, Q =	25.000	cfs
F. Enter - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	2	← Spring Conditions

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until Va=Vb)	**1.456**	**ft** 0.5' freeboard
B. Channel flow area, Ac = (.5*Z1*D^2) + (B*D) + (.5*Z2*D^2)	6.357	sq ft
C. Wetted Perimeter, Pw = (D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5)	9.257	ft
D. Hydraulic radius, Rh = (Ac/Pw)	0.687	ft
E. Velocity and hydraulic radius, VR = (Va * Rh)	2.701	sfps
F. Channel flow Manning's coeff, nc = 0	0.042	
G. Trial velocity, Va = (Q/Ac)	3.933	fps
H. Resultant velocity, Vb = (1.49/nc) * (Rh^.667) * (S^.5)	**3.933**	**fps** < 4 fps

Invoke Solution Macro by typing - 'ctrl' D

h:\data\common\template\sc-51\grasscha.xls

RMT, Inc.

Grass Channel Sizing Calculations

Site:	Dairyland Power Corp.	Date:	31-July-98
Project #:	3081.33	User:	SRC
Channel:	Ditch (8%)		
	Area 1G - Flow From Landfill Portion - 15 cfs		

VBK 10/1/98

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	3.000	ft/ft
B. Side slope, Z2 (hor/vert) =	2.000	ft/ft
C. Bottom width, B =	0.000	ft
D. Design channel slope, S =	0.080	ft/ft
E. Channel Peak Flow, Q =	15.000	cfs
F. Enter - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	1	← summer conditions

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until Va=Vb)	1.071	ft 0.9' freeboard
B. Channel flow area, Ac = (.5*Z1*D^2) + (B*D) + (.5*Z2*D^2)	2.870	sq ft
C. Wetted Perimeter, Pw = (D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5)	5.784	ft
D. Hydraulic radius, Rh = (Ac/Pw)	0.496	ft
E. Velocity and hydraulic radius, VR = (Va * Rh)	2.593	sfps
F. Channel flow Manning's coeff, nc = 0	0.051	
G. Trial velocity, Va = (Q/Ac)	5.226	fps
H. Resultant velocity, Vb = (1.49/nc) * (Rh^.667) * (S^.5)	5.226	fps > 4fps

use permanent erosion

RMT, Inc.
Grass Channel Sizing Calculations

Site:	Dairyland Power Corp.	Date:	31-July-98
Project #:	3081.33	User:	SRC
Channel:	Ditch (8%)		
	Area 1G - Flow From Landfill Portion - 15 cfs		

VBJJR 10/99

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	3.000	ft/ft
B. Side slope, Z2 (hor/vert) =	2.000	ft/ft
C. Bottom width, B =	0.000	ft
D. Design channel slope, S =	0.080	ft/ft
E. Channel Peak Flow, Q =	15.000	cfs
F. Enter - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	2	← Spring conditions

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until Va=Vb)	0.992	ft 1' freeboard
B. Channel flow area, Ac = (.5*Z1*D^2) + (B*D) + (.5*Z2*D^2)	2.459	sq ft
C. Wetted Perimeter, Pw = (D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5)	5.353	ft
D. Hydraulic radius, Rh = (Ac/Pw)	0.459	ft
E. Velocity and hydraulic radius, VR = (Va * Rh)	2.802	sfps
F. Channel flow Manning's coeff, nc = 0	0.041	
G. Trial velocity, Va = (Q/Ac)	6.101	fps
H. Resultant velocity, Vb = (1.49/nc) * (Rh^.667) * (S^.5)	6.101	fps > 4 fps use permanent erosion matting

BJK 10/6/98

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NORTH AMERICAN GREEN - ECMDS VER.IV - CHANNEL PROTECTION - ENGLISH

USER SPECIFIED CHANNEL LINING ANALYSIS

****

PROJECT NAME: Dairyland Power
PROJECT NO.: 3081.33
COMPUTED BY: BJK
DATE: 10-06-1998
FROM STATION/REACH: Area 1G - Fl
TO STATION/REACH:
DRAINAGE AREA:
DESIGN FREQUENCY: 100

Channel Bottom Width (ft)	Side Slope Lt. (Horz. to 1)	Side Slope Rt. (Horz. to 1)	Channel Slope (ft/ft)
0.00	3.0	2.0	0.080

✓

Discharge (cfs)	Peak Flow Period (hrs)	Velocity (ft/sec)	Area (ft^2)	Hydraulic Radius (ft)	Normal Depth (ft)
15.0	2.0	5.34	2.81	0.49	1.06

OK

Lining Type	Growth Habit	Veg. Den	Manning Coefficient	Permissible Shear (lb/sf)	Calculated Shear (lb/sf)	Safety Factor	Remark
P300 Staple E Phase 3 (Mature Vegetation)			0.049	8.00	5.29	1.51	STABLE

✓

RMT, Inc.

Grass Channel Sizing Calculations

Site:	Dairyland Power Corp.	Date:	31-July-98
Project #:	3081.33	User:	SRC
Channel:	Ditch (1%)		
	Area 2B		

VBWL 10 Yr

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	3.000	ft/ft
B. Side slope, Z2 (hor/vert) =	2.000	ft/ft
C. Bottom width, B =	0.000	ft
D. Design channel slope, S =	0.010	ft/ft
E. Channel Peak Flow, Q =	73.000	cfs
F. Enter - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	1	← Summer conditions

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until Va=Vb)	2.593	ft 0.4' freeboard
B. Channel flow area, Ac = (.5*Z1*D^2) + (B*D) + (.5*Z2*D^2)	16.814	sq ft
C. Wetted Perimeter, Pw = (D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5)	14.000	ft
D. Hydraulic radius, Rh = (Ac/Pw)	1.201	ft
E. Velocity and hydraulic radius, VR = (Va * Rh)	5.214	sfps
F. Channel flow Manning's coeff, nc = 0	0.039	
G. Trial velocity, Va = (Q/Ac)	4.342	fps
H. Resultant velocity, Vb = (1.49/nc) * (Rh^.667) * (S^.5)	4.341	fps > 4 fps

use permanent erosion matting

RMT, Inc.

Grass Channel Sizing Calculations

Site:	Dairyland Power Corp.	Date:	31-July-98
Project #:	3081.33	User:	SRC
Channel:	Ditch (1%)		
	Area 2B		

VBK 10/98

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	3.000	ft/ft
B. Side slope, Z2 (hor/vert) =	2.000	ft/ft
C. Bottom width, B =	0.000	ft
D. Design channel slope, S =	0.010	ft/ft
E. Channel Peak Flow, Q =	73.000	cfs
F. Enter - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	2	← Spring conditions

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until Va=Vb)	2.512	ft 0.5' freeboard
B. Channel flow area, Ac = (.5*Z1*D^2) + (B*D) + (.5*Z2*D^2)	15.774	sq ft
C. Wetted Perimeter, Pw = (D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5)	13.560	ft
D. Hydraulic radius, Rh = (Ac/Pw)	1.163	ft
E. Velocity and hydraulic radius, VR = (Va * Rh)	5.383	sfps
F. Channel flow Manning's coeff, nc = 0	0.036	
G. Trial velocity, Va = (Q/Ac)	4.628	fps
H. Resultant velocity, Vb = (1.49/nc) * (Rh^.667) * (S^.5)	4.627	fps > 4 fps

use permanent erosion matting

BJK 10/6/98

****

NORTH AMERICAN GREEN - ECMDS VER.IV - CHANNEL PROTECTION - ENGLISH
USER SPECIFIED CHANNEL LINING ANALYSIS

****

PROJECT NAME: Dairyland Paower Coop.
PROJECT NO.: 3081.33
COMPUTED BY: BJK
DATE: 10-06-1998
FROM STATION/REACH: Area 2B
TO STATION/REACH:
DRAINAGE AREA:
DESIGN FREQUENCY: 100

Channel Bottom Width (ft)	Side Slope Lt. (Horz. to 1)	Side Slope Rt. (Horz. to 1)	Channel Slope (ft/ft)
0.00	3.0	2.0	0.010

Discharge (cfs)	Peak Flow Period (hrs)	Velocity (ft/sec)	Area (ft^2)	Hydraulic Radius (ft)	Normal Depth (ft)
73.0	2.0	3.64	20.08	1.31	2.83

Lining Type	Growth Habit	Veg. Den	Manning Coefficient	Permissible Shear (lb/sf)	Calculated Shear (lb/sf)	Safety Factor	Remark
P300 Staple E Phase 3 (Mature Vegetation)		0.049	8.00	1.77	4.52	STABLE	

COMPUTATION SHEET

RMT, Inc.
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

SHEET 1 OF 3.3

PROJECT / PROPOSAL NAME	PREPARED	CHECKED	PROJECT / PROPOSAL NO.
DAIRYLAND POWER COOP.	By: BJK Date: 5/9/97	By: [illegible] Date: 6/17/97	3081.24

Rev BLP/BJK 10/96
Rev BJK 9/00

DITCH DESIGN CALCULATIONS - DESIGN INFORMATION (25 YR-24 HR STORM)

SOUTH SPILLWAY

WIDTH = 20'
SLOPE = 20%
MIN DEPTH = 4'

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS
3C + 4C + EAST + NORTHEAST + NORTH + BASIN 2 OUTFLOW ✓

18 + 11 + 445 + 68 + 194 + 10 = 746 CFS (25-YEAR)
↳ Round to 750 For calc's

28 + 18 + 857 + 110 + 360 + 21 = 1,374 CFS (100-year) ✓

Note: All Flows @ 12.6 HRS (25 year)
and @ 12.6 HRS (100-YR Fallow)

SE DITCH (2%) & (5%)

WIDTH = 20'
SLOPE = 2%
MIN DEPTH = 5'

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS
3C + 4C + EAST + NORTHEAST + NORTH + BASIN 2 OUTFLOW ✓

See above = 750 CFS (25-YEAR)
= 1,374 (100-yr Fallow)

SE DITCH (1%)

SAME FLOWS AS ABOVE

WIDTH - 20'
SLOPE - 1%
MIN DEPTH - 6'

NE DITCH

WIDTH = 10'
SLOPE = 2%
MIN DEPTH = 10+'

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS
4C + NORTH + BASIN 2 OUT ✓

11 + 194 + 10 = 215 CFS (25-YEAR) ✓

18 + 360 + 21 = 399 CFS (100-YEAR FALLOW)
- NE FLOWS AT 12.6 HRS (25 yr) and AT 12.5 HRS (100-YR FALLOW)

E Ditch

Width = 10'
Slope = 2%
Min Depth = 10'+

Peak Flow - Contributing Drainage Areas
4C + Northeast + North + Basin 2 out
= 18 + 110 + 360 + 21 = 509 cfs (100 yr)

COMPUTATION SHEET

744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT / PROPOSAL NAME	PREPARED By: BJK Date:	CHECKED By: CJS Date: 6/17/97	PROJECT / PROPOSAL NO.
DAIRYLAND POWER COOP.			3081.24

NW DITCH

WIDTH - 0' (V-NOTCH)
SLOPE - 19%
MIN DEPTH - 4 FT

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

28 - 48 CFS (25 YR) ✓

73 CFS (100 YR FALLOW)

WEST DITCH

WIDTH = 10'
SLOPE = 6%
MIN DEPTH = 6'

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

2C + WEST AREA ✓

10 + 111. = 121 CFS (25-YEAR) ✓

18 + 223 = 241 CFS (100 YEAR - FALLOW) ✓

- FLOWS @ 12.5 HRS (25-YEAR) AND AT 12.5 HRS (100-YEAR FALLOW)

SW DITCH

WIDTH = 10'
SLOPE = 2%, 5%, 7%
MIN DEPTH = 4' +

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

1C + 2C + WEST AREA ✓

46 + 10 + 111 = 167 CFS (25-YEAR) ✓

94 + 20 + 209 = 323 cfs (100-YEAR FALLOW) ✓

FLOWS @ 12.5 HRS (25-YEAR) AND @ 12.4 HRS (100-YEAR FALLOW)

MAIN CHANNEL

WIDTH ~ 20' MIN
SLOPE ~ 0.3%
MIN DEPTH ~ 6'

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

1C + 2C + 3C + 4C + EAST + NE + NORTH + WEST + BASIN1 + BASIN2 ✓

887 CFS + 8 + 10 = 905 CFS (25 YR)

1618 CFS + 21 + 21 = 1660 CFS (100-YR FALLOW) ✓

FLOWS @ 12.6 HRS (25-YEAR) AND @ 12.6 HRS (100-YEAR FALLOW)

RMT
744 Heartland Trail
Madison, WI 53717-1934
Tel. (608) 831-4444 • Fax (608) 831-3334

PROJECT / PROPOSAL NAME / LOCATION:		PROJECT / PROPOSAL NO.
SUBJECT: Dairyland Power Coop		3081.40
PREPARED BY: [illegible]	DATE: 9/00	FINAL ☒
CHECKED BY:	DATE:	REVISION ☐

AREA 1G DITCH

Width - V-NOTCH
SLOPE - 8%
MIN DEPTH = 4'

PEAK FLOW - CONTRIBUTING DRAINAGE AREA

= 15 CFS FLOW FROM LF.

PHASE 2 DITCH

WIDTH: V-NOTCH
SLOPE : 6%
MIN DEPTH: 2'

PEAK FLOW - CONTRIBUTING DRAINAGE AREA

~ 1.5 ACRES OF PHASE 2 COVER
DRAINAGE AREA -1C = 42 ACRES

$\frac{1.5}{42}$ (96 CFS) = 3.4 CFS

USE 4 CFS

EC-Design 2000 Channel Analysis Report

Analysis By:

User Information:	Generated by EC-Design:
Bernie Krantz **RMT, Inc.** **744 Heartland Trail** **Madison, WI 53717**	SYNTHETIC INDUSTRIES *Geosynthetic Products Division* 4019 Industry Drive • Chattanooga, TN 37416 • USA (423) 899-0444 • (800) FIX-SOIL www.fixsoil.com

General Information:

Project Details:		Project Notes:
Project Name:	**DPC Plan of Operation**	
Description:	**Channel Lining**	
State\Country:	**WI**	
City:	**La Crosse**	
Units:	**English**	
Created:	**01/19/99 @ 10:43**	

Disclaimer:

The information presented herein is for general information only. While every effort has been made to ensure its accuracy, this information should not be used for a specific application without independent professional examination and verification of its suitability, applicability and accuracy.

EC-Design 2000 Channel Analysis Report

Channel Analysis Information:

Name:

Channel Analysis Name: **South Spillway**

Channel Geometry & Hydraulics:

Design By:	Flow\Velocity:	Channel Geometry:
Designed By: **FLOW**	Discharge (cfs): **1374.00** Flow Duration (hrs): **1.00** Average Velocity (ft/s): **0.00**	Bed Slope (ft/ft): **0.20000** Req. Freeboard (ft): **0.00** Channel Length (ft): **270.00** Bottom Width (ft): **20.00** Channel Depth (ft): **4.00**
Channel Side Slopes:		
Left Slope (xH:1V): **2.00** Right Slope (xH:1V): **2.00**		
Channel Bend:	**Vegetation:**	**Soil Filled:**
Channel Bend: **No** Bend Radius (ft): **1.00** Outside Bend:	Vegetated: **Yes** Vegetation Class: **C**	Soil Filled: **No**

Factor of Safety: 1.10 **Functional Longevity:** 999

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Max. Allowed	Safety Factor	Shear Stress (lbs/sqft) Actual	Max. Allowed	Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	PYRAMAT	0.0280	24.0	23.3	1.0	20.2	9.4	0.5	2.0857	1374.0	No
	Bottom:	PYRAMAT	0.0280	27.3	23.3	0.9	26.0	9.4	0.4			
	Right:	PYRAMAT	0.0280	24.0	23.3	1.0	20.2	9.4	0.5			
Analysis #2	Left:	GABIONS	0.0270	28.6	17.0	0.6	17.3	35.0	2.0	1.7968	1374.0	No
	Bottom:	GABIONS	0.0270	32.6	17.0	0.5	22.4	35.0	1.6			
	Right:	GABIONS	0.0270	28.6	17.0	0.6	17.3	35.0	2.0			
Analysis #3	Left:	ROCK RIPRAP	0.0300	26.6	50.0	1.9	18.3	45.0	2.5	1.9093	1374.0	Yes
	Bottom:	ROCK RIPRAP	0.0300	30.4	50.0	1.6	23.8	45.0	1.9			
	Right:	ROCK RIPRAP	0.0300	26.6	50.0	1.9	18.3	45.0	2.5			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	50.4146	1.7190	0.0351	4.6638	4.6638	29.3276	27.2540	1374.0	3.06
Analysis #2	42.3935	1.5121	0.0270	4.0178	4.0178	28.0356	32.4106	1374.0	3.94
Analysis #3	45.4772	1.5935	0.0300	4.2694	4.2694	28.5387	30.2130	1374.0	3.55

EC-Design 2000 Channel Analysis Report

Channel Analysis Information:

Name:

Channel Analysis Name: **SE Ditch (2%)**

Channel Geometry & Hydraulics:

Design By:	Flow\Velocity:	Channel Geometry:
Designed By: **FLOW**	Discharge (cfs): **1374.00** Flow Duration (hrs): **1.00** Average Velocity (ft/s): **0.00**	Bed Slope (ft/ft): **0.02000** Req. Freeboard (ft): **0.00** Channel Length (ft): **200.00** Bottom Width (ft): **20.00** Channel Depth (ft): **5.00**
Channel Side Slopes:		
Left Slope (xH:1V): **2.00** Right Slope (xH:1V): **2.00**		
Channel Bend:	**Vegetation:**	**Soil Filled:**
Channel Bend: **No** Bend Radius (ft): **0.00** Outside Bend:	Vegetated: **Yes** Vegetation Class: **C**	Soil Filled: **No**

Factor of Safety: 1.10 **Functional Longevity:** 999

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Max. Allowed	Safety Factor	Shear Stress (lbs/sqft) Actual	Max. Allowed	Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	LANDLOK TRM	0.0250	10.0	16.5	1.6	4.2	4.7	1.1	4.2678	1374.0	No
	Bottom:	LANDLOK TRM	0.0250	11.3	16.5	1.5	5.3	4.7	0.9			
	Right:	LANDLOK TRM 435	0.0250	10.0	16.5	1.6	4.2	4.7	1.1			
Analysis #2	Left:	LANDLOK TRM	0.0250	10.0	16.8	1.7	4.2	6.5	1.6	4.2678	1374.0	Yes
	Bottom:	LANDLOK TRM	0.0250	11.3	16.8	1.5	5.3	6.5	1.2			
	Right:	LANDLOK TRM 450	0.0250	10.0	16.8	1.7	4.2	6.5	1.6			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	121.7841	3.1158	0.0397	9.5431	9.5431	39.0862	11.2823	1374.0	.890
Analysis #2	121.7841	3.1158	0.0397	9.5431	9.5431	39.0862	11.2823	1374.0	.890
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

EC-Design 2000 Channel Analysis Report

Channel Analysis Information:

Name:

Channel Analysis Name: **SE Ditch (5%)**

Channel Geometry & Hydraulics:

Design By:

Designed By: **FLOW**

Channel Side Slopes:

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

Flow\Velocity:

Discharge (cfs): **1374.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

Channel Geometry:

Bed Slope (ft/ft): **0.05000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **750.00**
Bottom Width (ft): **20.00**
Channel Depth (ft): **5.00**

Channel Bend:

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

Vegetation:

Vegetated: **Yes**
Vegetation Class: **C**

Soil Filled:

Soil Filled: **No**

Factor of Safety: **1.10**

Functional Longevity: **999**

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Max. Allowed	Safety Factor	Shear Stress (lbs/sqft) Actual	Max. Allowed	Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	LANDLOK TRM	0.0260	14.3	19.1	1.3	7.8	7.5	1.0	3.2178	1374.0	No
	Bottom:	LANDLOK TRM	0.0260	16.2	19.1	1.2	10.0	7.5	0.8			
	Right:	LANDLOK TRM	0.0260	14.3	19.1	1.3	7.8	7.5	1.0			
Analysis #2	Left:	PYRAMAT	0.0280	14.3	23.3	1.6	7.8	9.4	1.2	3.2184	1374.0	No
	Bottom:	PYRAMAT	0.0280	16.2	23.3	1.4	10.0	9.4	0.9			
	Right:	PYRAMAT	0.0280	14.3	23.3	1.6	7.8	9.4	1.2			
Analysis #3	Left:	ROCK RIPRAP	0.0300	17.6	50.0	2.8	6.6	45.0	6.8	2.7285	1374.0	Yes
	Bottom:	ROCK RIPRAP	0.0300	19.9	50.0	2.5	8.5	45.0	5.3			
	Right:	ROCK RIPRAP	0.0300	17.6	50.0	2.8	6.6	45.0	6.8			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	85.0635	2.4735	0.0378	7.1952	7.1952	34.3903	16.1526	1374.0	1.47
Analysis #2	85.0856	2.4739	0.0378	7.1967	7.1967	34.3933	16.1484	1374.0	1.47
Analysis #3	69.4578	2.1569	0.0280	6.1010	6.1010	32.2020	19.7818	1374.0	1.96

EC-Design 2000 Channel Analysis Report

Channel Analysis Information:

Name:

Channel Analysis Name: **SE Ditch (1%)**

Channel Geometry & Hydraulics:

Design By:

Designed By: **FLOW**

Channel Side Slopes:

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

Flow\Velocity:

Discharge (cfs): **1374.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

Channel Geometry:

Bed Slope (ft/ft): **0.01000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **1000.0**
Bottom Width (ft): **20.00**
Channel Depth (ft): **6.00**

Channel Bend:

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

Vegetation:

Vegetated: **Yes**
Vegetation Class: **C**

Soil Filled:

Soil Filled: **No**

Factor of Safety: **1.10**

Functional Longevity: **999**

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Max. Allowed	Safety Factor	Shear Stress (lbs/sqft) Actual	Max. Allowed	Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	LANDLOK TRM 435	0.0250	7.7	16.5	2.2	2.6	4.7	1.8	5.2542	1374.0	Yes
	Bottom:	LANDLOK TRM	0.0250	8.6	16.5	1.9	3.3	4.7	1.4			
	Right:	LANDLOK TRM	0.0250	7.7	16.5	2.2	2.6	4.7	1.8			
Analysis #2	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	160.2976	3.6852	0.0413	11.7488	11.7488	43.4975	8.5716	1374.0	.615
Analysis #2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

EC-Design 2000 Channel Analysis Report

Channel Analysis Information:

Name:

Channel Analysis Name: **NE Ditch**

Channel Geometry & Hydraulics:

Design By:

Designed By: **FLOW**

Channel Side Slopes:

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

Flow\Velocity:

Discharge (cfs): **399.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

Channel Geometry:

Bed Slope (ft/ft): **0.02000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **1800.0**
Bottom Width (ft): **10.00**
Channel Depth (ft): **5.00**

Channel Bend:

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

Vegetation:

Vegetated: **Yes**
Vegetation Class: **C**

Soil Filled:

Soil Filled: **No**

Factor of Safety: **1.10**

Functional Longevity: **999**

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Velocity (ft/s) Max. Allowed	Velocity (ft/s) Safety Factor	Shear Stress (lbs/sqft) Actual	Shear Stress (lbs/sqft) Max. Allowed	Shear Stress (lbs/sqft) Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	LANDLOK TRM	0.0250	7.1	16.5	2.3	3.1	4.7	1.5			
	Bottom:	LANDLOK TRM	0.0250	7.9	16.5	2.1	3.9	4.7	1.2	3.1235	399.0	Yes
	Right:	LANDLOK TRM 435	0.0250	7.1	16.5	2.3	3.1	4.7	1.5			
Analysis #2	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	50.7483	2.1173	0.0440	6.9844	6.9844	23.9689	7.8623	399.0	.735
Analysis #2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

EC-Design 2000 Channel Analysis Report

Channel Analysis Information:

Name:

Channel Analysis Name: **East Ditch**

Channel Geometry & Hydraulics:

Design By:	Flow\Velocity:	Channel Geometry:
Designed By: **FLOW**	Discharge (cfs): **509.00** Flow Duration (hrs): **1.00** Average Velocity (ft/s): **0.00**	Bed Slope (ft/ft): **0.02000** Req. Freeboard (ft): **0.00** Channel Length (ft): **350.00** Bottom Width (ft): **10.00** Channel Depth (ft): **5.00**
Channel Side Slopes:		
Left Slope (xH:1V): **2.00** Right Slope (xH:1V): **2.00**		
Channel Bend:	**Vegetation:**	**Soil Filled:**
Channel Bend: **Yes** Bend Radius (ft): **200.00** Outside Bend: **L**	Vegetated: **Yes** Vegetation Class: **C**	Soil Filled: **No**

Factor of Safety: 1.10 **Functional Longevity:** 999

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Max. Allowed	Safety Factor	Shear Stress (lbs/sqft) Actual	Max. Allowed	Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	LANDLOK TRM	0.0250	7.8	16.5	2.1	3.6	4.7	1.3			
	Bottom:	LANDLOK TRM	0.0250	8.6	16.5	1.9	4.4	4.7	1.1	3.4942	509.0	No
	Right:	LANDLOK TRM	0.0250	7.8	16.5	2.1	3.6	4.7	1.3			
Analysis #2	Left:	LANDLOK TRM	0.0250	7.8	16.8	2.2	3.6	6.5	1.8			
	Bottom:	LANDLOK TRM	0.0250	8.6	16.8	1.9	4.4	6.5	1.5	3.4942	509.0	Yes
	Right:	LANDLOK TRM 450	0.0250	7.8	16.8	2.2	3.6	6.5	1.8			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	59.3615	2.3164	0.0429	7.8133	7.8133	25.6267	8.5746	509.0	.760
Analysis #2	59.3615	2.3164	0.0429	7.8133	7.8133	25.6267	8.5746	509.0	.760
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

EC-Design 2000 Channel Analysis Report

Channel Analysis Information:

Name:

Channel Analysis Name: **NW Ditch**

Channel Geometry & Hydraulics:

Design By:	Flow\Velocity:	Channel Geometry:
Designed By: **FLOW**	Discharge (cfs): **73.00** Flow Duration (hrs): **1.00** Average Velocity (ft/s): **0.00**	Bed Slope (ft/ft): **0.01000** Req. Freeboard (ft): **0.00** Channel Length (ft): **1000.0** Bottom Width (ft): **0.01** Channel Depth (ft): **4.00**
Channel Side Slopes: Left Slope (xH:1V): **2.00** Right Slope (xH:1V): **2.00**		
Channel Bend:	**Vegetation:**	**Soil Filled:**
Channel Bend: **No** Bend Radius (ft): **0.00** Outside Bend:	Vegetated: **Yes** Vegetation Class: **C**	Soil Filled: **No**
Factor of Safety: **1.10**		**Functional Longevity:** **999**

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Velocity (ft/s) Max. Allowed	Velocity (ft/s) Safety Factor	Shear Stress (lbs/sqft) Actual	Shear Stress (lbs/sqft) Max. Allowed	Shear Stress (lbs/sqft) Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	LANDLOK TRM	0.0250	3.4	16.5	4.8	2.1	4.7	2.3	3.2826	73.0	Yes
	Bottom:	LANDLOK TRM	0.0250	3.4	16.5	4.8	2.0	4.7	2.3			
	Right:	LANDLOK TRM	0.0250	3.4	16.5	4.8	2.1	4.7	2.3			
Analysis #2	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	21.5836	1.4693	0.0564	7.3401	7.3401	14.6902	3.3822	73.0	.331
Analysis #2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

EC-Design 2000 Channel Analysis Report

Channel Analysis Information:

Name:

Channel Analysis Name: **West Ditch**

Channel Geometry & Hydraulics:

Design By:	Flow\Velocity:	Channel Geometry:
Designed By: FLOW	Discharge (cfs): 241.00 Flow Duration (hrs): 1.00 Average Velocity (ft/s): 0.00	Bed Slope (ft/ft): 0.06000 Req. Freeboard (ft): 0.00 Channel Length (ft): 1020.0 Bottom Width (ft): 10.00 Channel Depth (ft): 6.00
Channel Side Slopes:		
Left Slope (xH:1V): 2.00 Right Slope (xH:1V): 2.00		
Channel Bend:	**Vegetation:**	**Soil Filled:**
Channel Bend: No Bend Radius (ft): 0.00 Outside Bend:	Vegetated: Yes Vegetation Class: C	Soil Filled: No

Factor of Safety: 1.10 **Functional Longevity:** 999

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Max. Allowed	Safety Factor	Shear Stress (lbs/sqft) Actual	Max. Allowed	Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	PYRAMAT	0.0280	8.9	23.3	2.6	5.1	9.4	1.8	1.7595	241.0	Yes
	Bottom:	PYRAMAT	0.0280	10.1	23.3	2.3	6.6	9.4	1.4			
	Right:	PYRAMAT	0.0280	8.9	23.3	2.6	5.1	9.4	1.8			
Analysis #2	Left:	LANDLOK TRM	0.0260	8.9	19.1	2.1	5.1	7.5	1.5	1.7684	241.0	No
	Bottom:	LANDLOK TRM	0.0260	10.1	19.1	1.9	6.6	7.5	1.1			
	Right:	LANDLOK TRM	0.0260	8.9	19.1	2.1	5.1	7.5	1.5			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	23.7860	1.3312	0.0439	3.9343	3.9343	17.8685	10.1320	241.0	1.24
Analysis #2	23.9376	1.3367	0.0438	3.9541	3.9541	17.9083	10.0679	241.0	1.23
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

EC-Design 2000 Channel Analysis Report

Channel Analysis Information:

Name:

Channel Analysis Name: **SW Ditch (7%)**

Channel Geometry & Hydraulics:

Design By:

Designed By: **FLOW**

Channel Side Slopes:

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

Flow\Velocity:

Discharge (cfs): **323.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

Channel Geometry:

Bed Slope (ft/ft): **0.07000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **225.00**
Bottom Width (ft): **10.00**
Channel Depth (ft): **4.00**

Channel Bend:

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

Vegetation:

Vegetated: **Yes**
Vegetation Class: **C**

Soil Filled:

Soil Filled: **No**

Factor of Safety: **1.10**

Functional Longevity: **999**

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Velocity (ft/s) Max. Allowed	Velocity (ft/s) Safety Factor	Shear Stress (lbs/sqft) Actual	Shear Stress (lbs/sqft) Max. Allowed	Shear Stress (lbs/sqft) Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	PYRAMAT	0.0280	10.6	23.3	2.2	6.6	9.4	1.4	1.9335	323.0	No
	Bottom:	PYRAMAT	0.0280	12.0	23.3	1.9	8.4	9.4	1.1			
	Right:	PYRAMAT	0.0280	10.6	23.3	2.2	6.6	9.4	1.4			
Analysis #2	Left:	ROCK RIPRAP	0.0300	13.4	50.0	3.7	5.5	45.0	8.2	1.6178	323.0	Yes
	Bottom:	ROCK RIPRAP	0.0300	15.2	50.0	3.3	7.1	45.0	6.4			
	Right:	ROCK RIPRAP	0.0300	13.4	50.0	3.7	5.5	45.0	8.2			
Analysis #3	Left:		0.0280	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	26.8125	1.4379	0.0419	4.3235	4.3235	18.6470	12.0466	323.0	1.40
Analysis #2	21.4118	1.2424	0.0300	3.6174	3.6174	17.2348	15.0851	323.0	1.94
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

Channel Analysis Information:

Name:

Channel Analysis Name: **SW Ditch (2%)**

Channel Geometry & Hydraulics:

Design By:	Flow\Velocity:	Channel Geometry:
Designed By: FLOW	Discharge (cfs): 323.00 Flow Duration (hrs): 1.00 Average Velocity (ft/s): 0.00	Bed Slope (ft/ft): 0.02000 Req. Freeboard (ft): 0.00 Channel Length (ft): 300.00 Bottom Width (ft): 10.00 Channel Depth (ft): 4.00
Channel Side Slopes:		
Left Slope (xH:1V): 2.00 Right Slope (xH:1V): 2.00		
Channel Bend:	**Vegetation:**	**Soil Filled:**
Channel Bend: No Bend Radius (ft): 0.00 Outside Bend:	Vegetated: Yes Vegetation Class: C	Soil Filled: No

Factor of Safety: 1.10 **Functional Longevity:** 999

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Max. Allowed	Safety Factor	Shear Stress (lbs/sqft) Actual	Max. Allowed	Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	PYRAMAT	0.0280	6.5	23.3	3.6	2.8	9.4	3.3	2.8325	323.0	Yes
	Bottom:	PYRAMAT	0.0280	7.3	23.3	3.2	3.5	9.4	2.7			
	Right:	PYRAMAT	0.0280	6.5	23.3	3.6	2.8	9.4	3.3			
Analysis #2	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	44.3719	1.9575	0.0451	6.3337	6.3337	22.6675	7.2794	323.0	.709
Analysis #2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

EC-Design 2000 Channel Analysis Report

Channel Analysis Information:

Name:

Channel Analysis Name: **SW Ditch (5%)**

Channel Geometry & Hydraulics:

Design By:

Designed By: **FLOW**

Channel Side Slopes:

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

Flow\Velocity:

Discharge (cfs): **323.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

Channel Geometry:

Bed Slope (ft/ft): **0.05000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **240.00**
Bottom Width (ft): **10.00**
Channel Depth (ft): **4.00**

Channel Bend:

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

Vegetation:

Vegetated: **Yes**
Vegetation Class: **C**

Soil Filled:

Soil Filled: **No**

Factor of Safety: **1.10**

Functional Longevity: **999**

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Velocity (ft/s) Max. Allowed	Velocity (ft/s) Safety Factor	Shear Stress (lbs/sqft) Actual	Shear Stress (lbs/sqft) Max. Allowed	Shear Stress (lbs/sqft) Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	PYRAMAT	0.0280	9.3	23.3	2.5	5.2	9.4	1.8	2.1429	323.0	Yes
	Bottom:	PYRAMAT	0.0280	10.5	23.3	2.2	6.7	9.4	1.4			
	Right:	PYRAMAT	0.0280	9.3	23.3	2.5	5.2	9.4	1.8			
Analysis #2	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	30.6135	1.5632	0.0427	4.7917	4.7917	19.5835	10.5509	323.0	1.17
Analysis #2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

EC-Design 2000 Channel Analysis Report

Channel Analysis Information:

Name:

Channel Analysis Name: **Main Channel**

Channel Geometry & Hydraulics:

Design By:	Flow\Velocity:	Channel Geometry:
Designed By: **FLOW**	Discharge (cfs): **1660.00** Flow Duration (hrs): **1.00** Average Velocity (ft/s): **0.00**	Bed Slope (ft/ft): **0.01300** Req. Freeboard (ft): **0.00** Channel Length (ft): **3500.0** Bottom Width (ft): **20.00** Channel Depth (ft): **6.00**
Channel Side Slopes:		
Left Slope (xH:1V): **2.00** Right Slope (xH:1V): **2.00**		
Channel Bend:	**Vegetation:**	**Soil Filled:**
Channel Bend: **No** Bend Radius (ft): **0.00** Outside Bend:	Vegetated: **Yes** Vegetation Class: **C**	Soil Filled: **No**

Factor of Safety: 1.10 **Functional Longevity:** 999

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Velocity (ft/s) Max. Allowed	Velocity (ft/s) Safety Factor	Shear Stress (lbs/sqft) Actual	Shear Stress (lbs/sqft) Max. Allowed	Shear Stress (lbs/sqft) Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	LANDLOK TRM	0.0250	9.1	16.5	1.8	3.4	4.7	1.4	5.3260	1660.0	No
	Bottom:	LANDLOK TRM	0.0250	10.2	16.5	1.6	4.3	4.7	1.1			
	Right:	LANDLOK TRM	0.0250	9.1	16.5	1.8	3.4	4.7	1.4			
Analysis #2	Left:	LANDLOK TRM	0.0250	9.1	16.8	1.8	3.4	6.5	1.9	5.3260	1660.0	Yes
	Bottom:	LANDLOK TRM	0.0250	10.2	16.8	1.6	4.3	6.5	1.5			
	Right:	LANDLOK TRM	0.0250	9.1	16.8	1.8	3.4	6.5	1.9			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	163.2521	3.7256	0.0400	11.9093	11.9093	43.8185	10.1683	1660.0	.723
Analysis #2	163.2521	3.7256	0.0400	11.9093	11.9093	43.8185	10.1683	1660.0	.723
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

EC-Design 2000 Channel Analysis Report

Channel Analysis Information:

Name:

Channel Analysis Name: **Area 1G Ditch**

Channel Geometry & Hydraulics:

Design By:	Flow\Velocity:	Channel Geometry:
Designed By: **FLOW**	Discharge (cfs): **15.00** Flow Duration (hrs): **1.00** Average Velocity (ft/s): **0.00**	Bed Slope (ft/ft): **0.08000** Req. Freeboard (ft): **0.00** Channel Length (ft): **140.00** Bottom Width (ft): **0.10** Channel Depth (ft): **4.00**
Channel Side Slopes: Left Slope (xH:1V): **2.00** Right Slope (xH:1V): **2.00**		
Channel Bend:	**Vegetation:**	**Soil Filled:**
Channel Bend: **No** Bend Radius (ft): **0.00** Outside Bend:	Vegetated: **Yes** Vegetation Class: **C**	Soil Filled: **No**

Factor of Safety: 1.10 **Functional Longevity:** 999

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Velocity (ft/s) Max. Allowed	Velocity (ft/s) Safety Factor	Shear Stress (lbs/sqft) Actual	Shear Stress (lbs/sqft) Max. Allowed	Shear Stress (lbs/sqft) Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	LANDLOK TRM	0.0250	4.7	16.5	3.5	6.3	4.7	0.8	1.2450	15.0	No
	Bottom:	LANDLOK TRM	0.0250	4.6	16.5	3.5	6.2	4.7	0.8			
	Right:	LANDLOK TRM	0.0250	4.7	16.5	3.5	6.3	4.7	0.8			
Analysis #2	Left:	LANDLOK TRM	0.0250	4.7	16.8	3.6	6.3	6.5	1.0	1.2450	15.0	No
	Bottom:	LANDLOK TRM	0.0250	4.6	16.8	3.6	6.2	6.5	1.1			
	Right:	LANDLOK TRM	0.0250	4.7	16.8	3.6	6.3	6.5	1.0			
Analysis #3	Left:	PYRAMAT	0.0280	4.7	23.3	5.0	6.3	9.4	1.5	1.2502	15.0	Yes
	Bottom:	PYRAMAT	0.0280	4.7	23.3	5.0	6.2	9.4	1.5			
	Right:	PYRAMAT	0.0280	4.7	23.3	5.0	6.3	9.4	1.5			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	3.2247	0.5689	0.0624	2.7840	2.7840	5.6680	4.6516	15.0	.737
Analysis #2	3.2247	0.5689	0.0624	2.7840	2.7840	5.6680	4.6516	15.0	.737
Analysis #3	3.2511	0.5713	0.0622	2.7956	2.7956	5.6912	4.6138	15.0	.741

EC-Design 2000 Channel Analysis Report

Channel Analysis Information:

Name:

Channel Analysis Name: **Phase 2 Ditch**

Channel Geometry & Hydraulics:

Design By:

Designed By: **FLOW**

Channel Side Slopes:

Left Slope (xH:1V): **4.00**
Right Slope (xH:1V): **2.00**

Flow\Velocity:

Discharge (cfs): **4.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

Channel Geometry:

Bed Slope (ft/ft): **0.06000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **560.00**
Bottom Width (ft): **0.01**
Channel Depth (ft): **2.00**

Channel Bend:

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

Vegetation:

Vegetated: **Yes**
Vegetation Class: **C**

Soil Filled:

Soil Filled: **No**

Factor of Safety: **1.10**

Functional Longevity: **999**

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Max. Allowed	Safety Factor	Shear Stress (lbs/sqft) Actual	Max. Allowed	Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	LANDLOK TRM	0.0250	2.3	16.5	7.1	4.0	4.7	1.2			
	Bottom:	LANDLOK TRM	0.0250	2.0	16.5	8.1	3.1	4.7	1.5	0.8207	4.0	Yes
	Right:	LANDLOK TRM	0.0250	2.1	16.5	8.0	3.1	4.7	1.5			
Analysis #2	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	2.0287	0.3880	0.0955	3.3837	1.8351	5.2288	1.9717	4.0	.415
Analysis #2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

Suggested Vegetation for: La Crosse,WI

All Season Grasses					
Species	Scentific Name	Retardance Class	Seed Rate (lbs/ac)	Height at Maturity (in)	Recommended Planting Dates
Alsike Clover	Trifolium hybridum	A - E	15		4/1 - 5/31 or8/16 - 10/15
Reed Canarygrass	Phalaris arundinacea	A- E	20		4/1 - 5/31 or 8/16 - 10/15
Colonial Bentgrass	Agrostis tenius	A - E	50		4/1 - 5/31 or 8/16 - 10/15
Creeping Bentgrass	Agrostis palustris	A - E	50		4/1 - 5/31 or 8/16 - 10/15
Poa Trivialis	Poa trivialis	A - E	50		4/1 - 5/31 or 8/16 - 10/15
Creeping Foxtrail	Alopecurus arundinaceus	A - E	50		4/1 - 5/31 or 8/16 - 10/15
Meadow Foxtail	Alopecurus pratensis	A - E	50		4/1 - 5/31 or 8/16 - 10/15
Perennial Ryegrass	Lolium perenne	A - E	240		4/1 - 5/31 or 8/16 - 10/15
RedTop	Agrostis alba	A - E	80		4/1 - 5/31 or 8/16 - 10/15
Meadow Fescue	Festuca elatior	A - E	160		4/1 - 5/31 or 8/16 - 10/15
Cold Season Grasses					
Species	Scentific Name	Retardance Class	Seed Rate (lbs/ac)	Height at Maturity (in)	Recommended Planting Dates
Crested Wheatgrass	Agropyron desertorum	A		2 - 3	
Green Needlegrass	Stipa viridula	A		3 - 4	
Russian WildRye	Psathyrostachys gunceus	A		3 - 4	
Smooth Bromegrass	Bromus inermis	A		3 - 4	
Tall Fescue	Festuca arundinacea	A		3 - 4	
Tall Wheatgrass	Elytriga pontica	A		4 - 5	
Western Wheatgrass	Agropyron smithii	A		2 - 3	
Warm Season Grasses					
Species	Scentific Name	Retardance Class	Seed Rate (lbs/ac)	Height at Maturity (in)	Recommended Planting Dates
Bermuda Grass	Cynodon dactylon	C		3/4 - 2	
Big Bluestem	Andropogon gerardii	B		4 - 6	
Blue grama	Boutelova gracillis	B		1 - 2	
Buffalo grass	Buchloe dactyloides	D		1/3 - 1	
Green Sprangletop	Leptochloa dubia	A		3 - 4	
Indian grass	Sorghastrum nutans	A		5 - 6	
Kleingrass	Panicum coloratum	A		3 - 4	
Little bluestem	Schizachyrium scoparium	A		3 - 4	
Plains bristlegrass	Setaria macrostachya	B		1 - 2	
Sand bluestem	Andropogon hallii	A		5 - 6	
Sideoats grama	Bouteloua curtipendula	A		2 - 3	
Switch grass	Panicum Virgatum	A		4 - 5	
Vine mesquitegrass	Panicum Obtusum	B		1 - 2	
Weeping lovegrass	Eragrostis Curvula	A		3 - 4	

Calculations – Operational Landfill Conditions

RMT
744 Heartland Trail
Madison, WI 53717-1934
Tel. (608) 831-4444 • Fax (608) 831-3334

PROJECT / PROPOSAL NAME / LOCATION: OPC-POO		PROJECT / PROPOSAL NO. 3078.40
SUBJECT: OPERATIONAL DITCH SIZING		
PREPARED BY: BJF	DATE: 10/00	FINAL ☒
CHECKED BY:	DATE:	REVISION ☐

OPERATIONAL DITCHES (SEE FIGURES K-4 to K-9, OPERATIONAL RUNOFF CALCULATIONS)

DITCH	LOCATION	100-YR FLOW	SLOPE	SHAPE
V-NOTCH DITCH A	CELL 1 ACTIVE	5 CFS	6%	V-NOTCH
DITCH B	CELL 1 ACTIVE	~~583~~ 561 CFS[1]	2%	10' FLAT
DITCH C	CELL 2A ACTIVE	6 CFS	6.3%	V-NOTCH
DITCH D	CELL 2B ACTIVE	3 CFS	12%	V-NOTCH
DITCH E	CELL 3 ACTIVE	~~583~~ 561 CFS[1] ✓	1%	10' FLAT
DITCH F	CELL 4A ACTIVE	~~433~~ 373 CFS[2]	1%	10' FLAT
DITCH G	CELL 2A ACTIVE	360 CFS[4]		

NOTES
1. FLOWS FROM PREDEVELOPMENT AREAS NORTH + WEST (See p. 96) @ 12.6 hrs
2. FLOWS FROM PREDEVELOPMENT AREAS NORTH + 2B @ 12.6 HRS (See p. 66/96)
3. PERMANANT DITCHES SIZED UNDER POST-DEVELOPMENT CALCULATIONS.
4. FLOW FROM PREDEVELOPMENT ~~AREA~~ AREA NORTH (See p. 95)

SW DITCH	CELL 2A ACTIVE	561 CFS[1]	5%	10' FLAT

RMT, Inc.
Grass Channel Sizing Calculations

Site:	Dairyland Power Cooperative	Date:	10/00
Project #:	3081.40	User:	BJK
Channel:	Ditch A		

==========

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	3.000	ft/ft
B. Side slope, Z2 (hor/vert) =	16.000	ft/ft
C. Bottom width, B =	0.000	ft
D. Design channel slope, S =	0.060	ft/ft
E. Channel Peak Flow, Q =	5.000	cfs
F. Enter - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	2	

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until Va=Vb)	**0.533**	**ft**
B. Channel flow area, Ac = (.5*Z1*D^2) + (B*D) + (.5*Z2*D^2)	2.703	sq ft
C. Wetted Perimeter, Pw = (D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5)	10.239	ft
D. Hydraulic radius, Rh = (Ac/Pw)	0.264	ft
E. Velocity and hydraulic radius, VR = (Va * Rh)	0.488	sfps
F. Channel flow Manning's coeff, nc = 0	0.081	
G. Trial velocity, Va = (Q/Ac)	1.850	fps
H. Resultant velocity, Vb = (1.49/nc) * (Rh^.667) * (S^.5)	**1.850**	**fps** ✓OK

Invoke Solution Macro by typing - 'ctrl' D

Channel Analysis Information:

Name:

Channel Analysis Name: **Ditch B**

Channel Geometry & Hydraulics:

Design By:	Flow\Velocity:	Channel Geometry:
Designed By: **FLOW**	Discharge (cfs): **583.00** Flow Duration (hrs): **1.00** Average Velocity (ft/s): **0.00**	Bed Slope (ft/ft): **0.02000** Req. Freeboard (ft): **0.00** Channel Length (ft): **530.00** Bottom Width (ft): **10.00** Channel Depth (ft): **4.00**
Channel Side Slopes: Left Slope (xH:1V): **3.00** Right Slope (xH:1V): **3.00**		
Channel Bend:	**Vegetation:**	**Soil Filled:**
Channel Bend: **No** Bend Radius (ft): **0.00** Outside Bend:	Vegetated: **No** Vegetation Class:	Soil Filled: **Yes**
Factor of Safety: **1.00**		**Functional Longevity:** **48**

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Max. Allowed	Safety Factor	Shear Stress (lbs/sqft) Actual	Max. Allowed	Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	LANDLOK TRM 450	0.0250	13.4	16.5	1.2	2.5	6.2	2.5	2.3594	583.0	Yes
	Bottom:	LANDLOK TRM	0.0250	14.5	16.5	1.1	2.9	6.2	2.1			
	Right:	LANDLOK TRM	0.0250	13.4	16.5	1.2	2.5	6.2	2.5			
Analysis #2	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	40.2945	1.6168	0.0200	7.4611	7.4611	24.9222	14.4685	583.0	1.58
Analysis #2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

RMT, Inc.
Grass Channel Sizing Calculations

Site:	Dairyland Power Cooperative	Date:	10/00
Project #:	3081.40	User:	BJK
Channel:	Ditch C		

==========

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	3.000	ft/ft
B. Side slope, Z2 (hor/vert) =	16.000	ft/ft
C. Bottom width, B =	0.000	ft
D. Design channel slope, S =	0.063	ft/ft
E. Channel Peak Flow, Q =	6.000	cfs
F. Enter - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	2	

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until Va=Vb)	**0.550**	**ft**
B. Channel flow area, Ac = (.5*Z1*D^2) + (B*D) + (.5*Z2*D^2)	2.870	sq ft
C. Wetted Perimeter, Pw = (D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5)	10.549	ft
D. Hydraulic radius, Rh = (Ac/Pw)	0.272	ft
E. Velocity and hydraulic radius, VR = (Va * Rh)	0.569	sfps
F. Channel flow Manning's coeff, nc = 0	0.075	
G. Trial velocity, Va = (Q/Ac)	2.091	fps
H. Resultant velocity, Vb = (1.49/nc) * (Rh^.667) * (S^.5)	**2.091**	**fps** ✓OK

Invoke Solution Macro by typing - 'ctrl' D

RMT, Inc.
Grass Channel Sizing Calculations

Site:	Dairyland Power Cooperative	Date:	10/00
Project #:	3081.40	User:	BJK
Channel:	Ditch D		

==========

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	3.000	ft/ft
B. Side slope, Z2 (hor/vert) =	3.000	ft/ft
C. Bottom width, B =	0.000	ft
D. Design channel slope, S =	0.120	ft/ft
E. Channel Peak Flow, Q =	3.000	cfs
F. Enter - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	2	

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until Va=Vb)	**0.547**	**ft**
B. Channel flow area, Ac = (.5*Z1*D^2) + (B*D) + (.5*Z2*D^2)	0.897	sq ft
C. Wetted Perimeter, Pw = (D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5)	3.459	ft
D. Hydraulic radius, Rh = (Ac/Pw)	0.259	ft
E. Velocity and hydraulic radius, VR = (Va * Rh)	0.867	sfps
F. Channel flow Manning's coeff, nc = 0	0.063	
G. Trial velocity, Va = (Q/Ac)	3.344	fps
H. Resultant velocity, Vb = (1.49/nc) * (Rh^.667) * (S^.5)	**3.344**	**fps** ✓ OK

Invoke Solution Macro by typing - 'ctrl' D

Channel Analysis Information:

Name:

Channel Analysis Name: **Ditch E**

Channel Geometry & Hydraulics:

Design By:	Flow\Velocity:	Channel Geometry:
Designed By: **FLOW**	Discharge (cfs): **583.00** Flow Duration (hrs): **1.00** Average Velocity (ft/s): **0.00**	Bed Slope (ft/ft): **0.01000** Req. Freeboard (ft): **0.00** Channel Length (ft): **1000.0** Bottom Width (ft): **10.00** Channel Depth (ft): **3.00**
Channel Side Slopes: Left Slope (xH:1V): **3.00** Right Slope (xH:1V): **10.00**		
Channel Bend:	**Vegetation:**	**Soil Filled:**
Channel Bend: **No** Bend Radius (ft): **0.00** Outside Bend:	Vegetated: **No** Vegetation Class:	Soil Filled: **Yes**

Factor of Safety: 1.00 **Functional Longevity:** 60

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Velocity (ft/s) Max. Allowed	Velocity (ft/s) Safety Factor	Shear Stress (lbs/sqft) Actual	Shear Stress (lbs/sqft) Max. Allowed	Shear Stress (lbs/sqft) Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	LANDLOK TRM	0.0250	8.9	16.5	1.9	1.3	6.2	4.9	2.3865	583.0	Yes
	Bottom:	LANDLOK TRM	0.0250	9.6	16.5	1.7	1.5	6.2	4.2			
	Right:	LANDLOK TRM	0.0250	9.3	16.5	1.8	1.4	6.2	4.5			
Analysis #2	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	60.8850	1.4660	0.0200	7.5468	23.9840	41.5308	9.5754	583.0	1.06
Analysis #2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

Channel Analysis Information:

Name:

Channel Analysis Name: **Ditch F**

Channel Geometry & Hydraulics:

Design By:

Designed By: **FLOW**

Channel Side Slopes:

Left Slope (xH:1V): **3.00**
Right Slope (xH:1V): **5.00**

Flow\Velocity:

Discharge (cfs): **433.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

Channel Geometry:

Bed Slope (ft/ft): **0.01000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **750.00**
Bottom Width (ft): **10.00**
Channel Depth (ft): **3.00**

Channel Bend:

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

Vegetation:

Vegetated: **No**
Vegetation Class:

Soil Filled:

Soil Filled: **Yes**

Factor of Safety: **1.00**

Functional Longevity: **0**

Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s) Actual	Max. Allowed	Safety Factor	Shear Stress (lbs/sqft) Actual	Max. Allowed	Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
Analysis #1	Left:	LANDLOK TRM	0.0250	9.1	16.5	1.8	1.2	6.2	5.1	2.2978	433.0	Yes
	Bottom:	LANDLOK TRM	0.0250	9.9	16.5	1.7	1.4	6.2	4.4			
	Right:	LANDLOK TRM	0.0250	9.5	16.5	1.7	1.3	6.2	4.7			
Analysis #2	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Veleocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	44.0967	1.5215	0.0200	7.2662	11.7164	28.9826	9.8193	433.0	1.10
Analysis #2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

EC-DESIGN(R) 2000 Channel Analysis Report

Project Information

Project Name: DPC
Description: Cell 2A operational Calcs
Last Update: 8/25/2003 10:58:10 A
Units: English
Nearest City:

Notes: Calculated for 1% slope section
Backwater from culvert 1 will
Protect 5% slope section

Channel Design

Channel Name: SW Ditch - Operational 100 yr
Units: English
Design life: 1,200 months

Design Criteria	
Flow Rate (Q)	

Vegetation and Soil	
Vegetated	Yes
Vegetation Class	B
Soil Filled	No

Channel Side Slopes	
Left (H:1 V)	2.000
Right (H:1 V)	2.000

Channel Bend	No
Bend Radius (ft)	0.000
Outside Bend	

Channel Geometry	
Bed Slope (ft/ft)	0.010
Req. Freeboard (ft)	0.000
Channel Length (ft)	475.000
Bottom Width (ft)	10.000
Channel Depth (ft)	6.000

Flow/Velocity	
Discharge (cf/s)	561.000
Flow Duration (hrs)	1.000
Avg. Velocity (ft/s)	5.490

Required Factor of Safety 1.00

Results

Lining Materials		Velocity (ft/s)			Shear Stress (lbs/sqft)			Avg. Flow Depth (ft)
		Computed	Max Allowed	Safety Factor	Computed	Max Allowed	Safety Factor	5.070
Left	PYRAMAT	5.100	23.340	4.580	2.720	9.400	3.460	
Bottom	PYRAMAT	5.510	23.340	4.240	3.170	9.400	2.970	
Right	PYRAMAT	5.100	23.340	4.580	2.720	9.400	3.460	

Calculation Results:

Flow Depth (ft)	5.070	**Left Wetted Perimeter (ft)**	11.350
Flow Area (ft)	102.230	**Bottom Wetted Perimeter (ft)**	9.990
		Right Wetted Perimeter (ft)	11.350
		Total Wetted Perimeter (ft)	32.690
Hydraulic Radius (ft)	3.130	**Avg. Velocity (ft/s)**	5.490
Composite 'n'	0.0580	**Avg. Discharge (cf/s)**	561.000

EC-DESIGN(R) 2000 Channel Analysis Report

Project Information

Project Name: DPC
Description: Cell 2A operational Calcs
Notes: FOR 5% SLOPE SECTION 25-YR STORM

Last Update: 8/25/2003 10:53:12 A
Units: English
Nearest City:

Channel Design

Channel Name: SW Ditch - Operational 25 yr
Units: English
Design life: 48 months

Design Criteria
Flow Rate (Q)

Vegetation and Soil	
Vegetated	Yes
Vegetation Class	B
Soil Filled	No

Channel Side Slopes	
Left (H:1 V)	2.000
Right (H:1 V)	2.000

Channel Bend	No
Bend Radius (ft)	0.000
Outside Bend	

Channel Geometry	
Bed Slope (ft/ft)	0.050
Req. Freeboard (ft)	0.000
Channel Length (ft)	450.000
Bottom Width (ft)	10.000
Channel Depth (ft)	4.000

Flow/Velocity	
Discharge (cf/s)	355.000
Flow Duration (hrs)	1.000
Avg. Velocity (ft/s)	8.940

Required Factor of Safety 1.00

Results

Lining Materials		Velocity (ft/s)			Shear Stress (lbs/sqft)			Avg. Flow Depth (ft)
		Computed	Max Allowed	Safety Factor	Computed	Max Allowed	Safety Factor	2.610
Left	PYRAMAT	8.030	23.340	2.910	6.450	9.400	1.460	
Bottom	PYRAMAT	9.020	23.340	2.590	8.140	9.400	1.150	
Right	PYRAMAT	8.030	23.340	2.910	6.450	9.400	1.460	

Calculation Results:

Flow Depth (ft)	2.610	**Left Wetted Perimeter (ft)**	5.830
Flow Area (ft)	39.690	**Bottom Wetted Perimeter (ft)**	10.000
		Right Wetted Perimeter (ft)	5.830
		Total Wetted Perimeter (ft)	21.660
Hydraulic Radius (ft)	1.830	**Avg. Velocity (ft/s)**	8.940
Composite 'n'	0.0554	**Avg. Discharge (cf/s)**	355.000

EC-DESIGN(R) 2000 Channel Analysis Report

Project Information

Project Name:	**DPC**	**Last Update:**	8/25/2003 11:00:48 A
Description:	Cell 2A operational Calcs	**Units:**	English
		Nearest City:	

Notes:

Channel Design

Channel Name: Phase III South Slope Ditch **Units:** English **Design life:** 24 months

Design Criteria	
Flow Rate (Q)	

Vegetation and Soil	
Vegetated	No
Vegetation Class	
Soil Filled	Yes

Channel Side Slopes	
Left (H:1 V)	2.000
Right (H:1 V)	3.000

Channel Bend	No
Bend Radius (ft)	0.000
Outside Bend	

Channel Geometry	
Bed Slope (ft/ft)	0.060
Req. Freeboard (ft)	0.000
Channel Length (ft)	500.000
Bottom Width (ft)	1.000
Channel Depth (ft)	1.500

Flow/Velocity	
Discharge (cf/s)	4.000
Flow Duration (hrs)	1.000
Avg. Velocity (ft/s)	6.280

Required Factor of Safety 1.00

Results

Lining Materials		Velocity (ft/s)			Shear Stress (lbs/sqft)			Avg. Flow Depth (ft)
		Computed	Max Allowed	Safety Factor	Computed	Max Allowed	Safety Factor	0.340
Left	LANDLOK TRM 450	6.080	16.490	2.710	1.050	6.250	5.950	
Bottom	LANDLOK TRM 450	6.730	16.490	2.450	1.280	6.250	4.880	
Right	LANDLOK TRM 450	6.350	16.490	2.600	1.140	6.250	5.480	

Calculation Results:

Flow Depth (ft)	0.340	**Left Wetted Perimeter (ft)**	0.770
Flow Area (ft)	0.640	**Bottom Wetted Perimeter (ft)**	1.000
		Right Wetted Perimeter (ft)	1.080
		Total Wetted Perimeter (ft)	2.850
Hydraulic Radius (ft)	0.220	**Avg. Velocity (ft/s)**	6.280
Composite 'n'	0.0200	**Avg. Discharge (cf/s)**	4.000

EC-DESIGN(R) 2000 Channel Analysis Report

Project Information

Project Name: DPC
Description: Cell 2A operational Calcs
Notes:

Last Update: 8/25/2003 11:00:48 A
Units: English
Nearest City:

Channel Design

Channel Name: Ditch G
Units: English
Design life: 48 months

Design Criteria
Flow Rate (Q)

Vegetation and Soil	
Vegetated	No
Vegetation Class	
Soil Filled	No

Channel Geometry	
Bed Slope (ft/ft)	0.015
Req. Freeboard (ft)	0.000
Channel Length (ft)	1.000
Bottom Width (ft)	10.000
Channel Depth (ft)	4.000

Flow/Velocity	
Discharge (cf/s)	360.000
Flow Duration (hrs)	1.000
Avg. Velocity (ft/s)	10.930

Channel Side Slopes	
Left (H:1 V)	3.000
Right (H:1 V)	3.000

Channel Bend	No
Bend Radius (ft)	0.000
Outside Bend	

Required Factor of Safety 1.00

Results

Lining Materials		Velocity (ft/s)			Shear Stress (lbs/sqft)			Avg. Flow Depth (ft)
		Computed	Max Allowed	Safety Factor	Computed	Max Allowed	Safety Factor	2.040
Left	LANDLOK TRM 450	10.170	16.490	1.620	1.610	6.250	3.880	
Bottom	LANDLOK TRM 450	11.090	16.490	1.490	1.910	6.250	3.270	
Right	LANDLOK TRM 450	10.170	16.490	1.620	1.610	6.250	3.880	

Calculation Results:

Flow Depth (ft)	2.040	Left Wetted Perimeter (ft)	6.460
Flow Area (ft)	32.920	Bottom Wetted Perimeter (ft)	9.990
		Right Wetted Perimeter (ft)	6.460
		Total Wetted Perimeter (ft)	22.910
Hydraulic Radius (ft)	1.440	Avg. Velocity (ft/s)	10.930
Composite 'n'	0.0210	Avg. Discharge (cf/s)	360.000

Reference Information

roughness) varies with VR. The term VR is the product of velocity and the hydraulic radius. This relationship will be referred to as the "n-VR relationship", which is the recommended basis for vegetated channel design.

The five general retardance curves, designated as A, B, C, D, and E in Exhibit 7-1, have been developed for various cover conditions. The vegetal conditions under which the various retardance values apply are shown in Exhibit 7-2. These cover classifications are based on tests in experimental channels when the covers were green and generally uniform.

Most of the vegetation used in waterways does not exceed 18 inches in height and may be much shorter at times during the year. Therefore, it is recommended that when designing the channel for safe velocity, a retardance not greater than "D" be used. After designing the channel for safe velocity, it must be checked for capacity to accommodate the peak flow under conditions where vegetation gives the highest retardance. The retardance used in this instance is the curve corresponding to the expected vegetal cover and, in most cases, it will be retardance "C", though curve "B" may be used where considered appropriate.

All pertinent design data and computations should be recorded.

DESIGN DATA

The following information is required for designing a waterway:

1. Watershed area in acres, together with the soil characteristics, cover and topography. This information is used to estimate runoff by the procedures set forth in Chapter 2 of this manual.

2. Grade of the proposed waterway in percent slope (this is the fall in feet per 100 feet of length).

3. Vegetal cover adapted to site conditions.

4. Erodibility of the soil in the waterway.

5. Expected height at which vegetative cover will be maintained.

6. The permissible velocity for the conditions encountered.

7. Allowance for space that will be occupied by the vegetative lining.

8. Allowance for freeboard, if required by State Standards and Specifications.

NON-EROSIVE VELOCITY OF FLOW

In designing grassed waterways, care must be taken to insure that the design velocity is well within the limits of permissible velocities given in Exhibit 7-3. These values apply to average, uniform stands of each type of cover.

Source: U.S. Department of Agriculture, Soil Conservation Service. Engineering Field Manual. November 1986.

Cover	Slope range 2/ (percent)	Permissible velocity 1/	
		Erosion resistant soils (ft.per sec.)	Easily eroded soils (ft.per sec.)
Bermudagrass	0-5 5-10 over 10	8 7 6	6 5 4
Bahia Buffalograss Kentucky bluegrass Smooth brome Blue grama Tall fescue	0-5 5-10 over 10	7 6 5	5 4 3
Grass mixtures Reed canarygrass	2/ 0-5 5-10	5 4	4 3
Lespedeza sericea Weeping lovegrass Yellow bluestem Redtop Alfalfa Red fescue	3/ 0-5	3.5	2.5
Common lespedeza 4/ Sudangrass 4/	5/ 0-5	3.5	2.5

1/ Use velocities exceeding 5 feet per second only where good covers and proper maintenance can be obtained.

2/ Do not use on slopes steeper than 10 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

3/ Do not use on slopes steeper than 5 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

4/ Annuals--use on mild slopes or as temporary protection until permanent covers are established.

5/ Use on slopes steeper than 5 percent is not recommended.

Exhibit 7-3. Permissible velocities for channels lined with vegetation

Source: U.S. Department of Agriculture, Soil Conservation Service. Engineering Field Manual. November 1986.

Culvert/Downslope Flume Design Calculations

Purpose/Methodology/Assumptions/Results/References

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
Dairyland Power Cooperative	BJK	9/00	RAA	10/00	3081.40

CULVERT DESIGN CALCULATIONS

Purpose

To determine the appropriate culvert and downslope flume sizes for the anticipated peak flows resulting from the 100-year, 24-hour storm at the proposed Dairyland Power Cooperative Landfill.

Methodologies

Culvert design involves the process of selecting an appropriate culvert size capable of allowing the estimated peak storm water runoff to pass through it without creating surface water breaching (i.e., berm overflow) or excessive backwater levels. Culvert sizing was performed using design charts developed by the U.S. Department of Transportation Federal Highway Administration.

Downslope flumes will convey flow from the final cover diversion berms to the sedimentation basin. Downslope flumes were also sized using design charts developed by the U.S. Department of Transportation Federal Highway Administration. The energy dissipater for the downslope flume was sized using design guidance from the US Department of the Interior, Bureau of Reclamation.

Assumptions

The following assumptions were used in the culvert and downslope flume sizing analysis:

1. Culvert and downslope flume layout and allowable headwater levels are shown on the accompanying plan set.
2. Tailwater depths were assumed based on anticipated flows within the ditching. For culverts discharging into sedimentation basins, the tailwater elevation in the basin from the routing calculations.
3. Culverts are assumed to be corrugated metal culvert pipes or concrete box culverts.
4. Culverts were designed to maintain a minimum 1 to 2 feet of freeboard, depending on the location.

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
Dairyland Power Cooperative	BJK	9/00	RAA	10/00	3081.40

Results

The table below summarizes the results of the culvert pipe sizing analyses:

CULVERT	SLOPE (%)	LENGTH (ft)	100-YR. FLOW (cfs)	SIZE
Culvert #1	7.0	96	323	4'x 7' Box
Culvert #2	7.7	126	323	4'x 7' Box
Culvert #3	11.2	125	15	30" CMP
Culvert #4	9.3	75	15	30" CMP
Culvert #5	5	85	323	4' x 7' Box

Note:
Culvert lengths to be adjusted based on available culvert section lengths.

Downslope pipe and energy dissipater sizing are shown on the engineering details included in the Plan Set.

References

U.S. Department of Transportation. Hydraulics charts for the selection of highway culverts. Hydraulic engineering circular no. 5. December 1965.

U.S. Department of the Interior, Bureau of Reclamation. Hydraulic Design of Stilling Basins and Energy Dissipaters. Engineering Nomograph No. 25. May 1984.

N 170500

N 171000

N 171500

EXISTING PROCESSING FACILITY

SILO

SILO

TRANSFER PIPE FROM STORAGE TANK CONNECTS TO EXISTING PIPE OUTSIDE PROCCESSING FACILITY. SEE DETAIL (5/21)

APPROXIMATE LIMITS OF EXISTING ASH

LEACHATE STORAGE TANK SEE DETAIL (1/18)

EXISTING BOX CULVERT

ACCESS ROAD TO EXISTING PHASE II LANDFILL

10' WIDE FLAT BOTTOM DITCH @ 6%

CULVERT 5
INLET I.E. 812.0
OUTLET I.E. 808.0

V-NOTCH DITCH @ 6%

CULVERT 1
I.E. 762.0N
I.E. 755.5S

ACCESS ROAD @ 8%

10' WIDE FLAT BOTTOM DITCH @ 5%

10' WIDE FLAT BOTTOM DITCH @ 7%

CULVERT 4

8' WIDE BERM ELEV. 784.0

10' WIDE FLAT BOTTOM DITCH @ 2%

V-NOTCH DRAINAGE DITCH @ 8%

CULVERT 2

CULVERT 3

SEDIMENTATION BASIN NO. 1 SEE DETAIL (1/22)

20' WIDE FLAT BOTTOM DITCH @ 20% AND DIVERSION BERM

MAINTENANCE ROAD 10% SLOPE

EMERGENCY OVERFLOW PIPE

RISER AND DISCHARGE PIPE SEE DETAIL (3/22)

E 1477500

DITCH @ 2%

4:1

FIGURE K-11
CULVERT SIZING

N

Calculations – Post-closure Landfill Conditions

COMPUTATION SHEET

RMT INC.

SHEET _____ OF _____

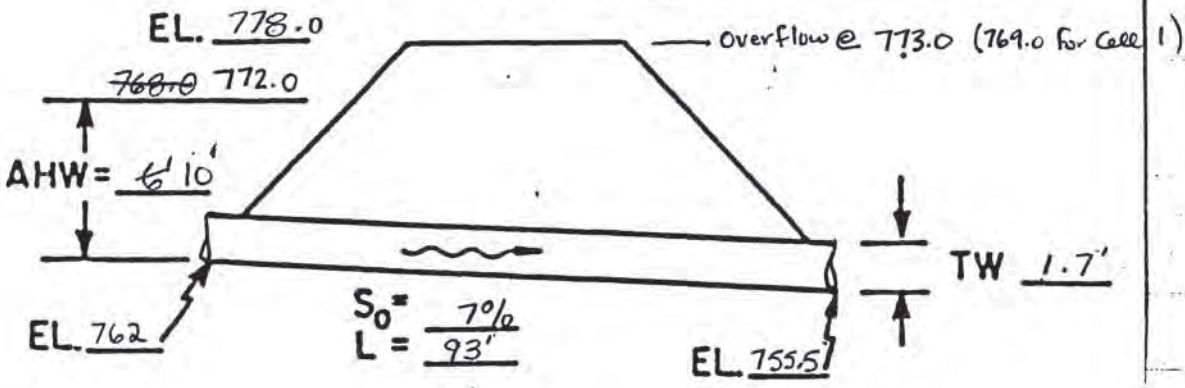
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

PROJECT / PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
DPC - PLAN OF OPERATION	By: BJK	Date: 9/00	By:	Date:	3081.40

Rev. 7/03
BJK

SKETCH

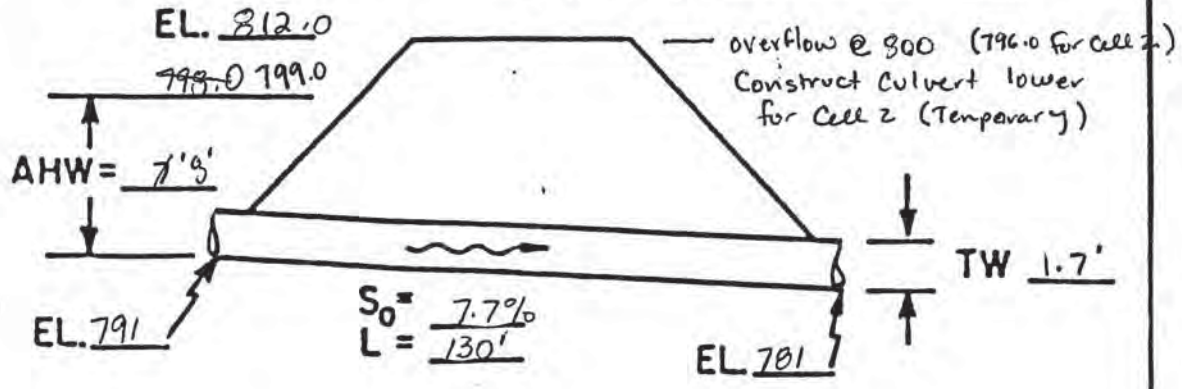
STATION : CULVERT #1



MAX. STREAM FLOW= 323 cfs

SKETCH

STATION : CULVERT #2



MAX. STREAM FLOW= 323 cfs

COMPUTATION SHEET

RMT INC.

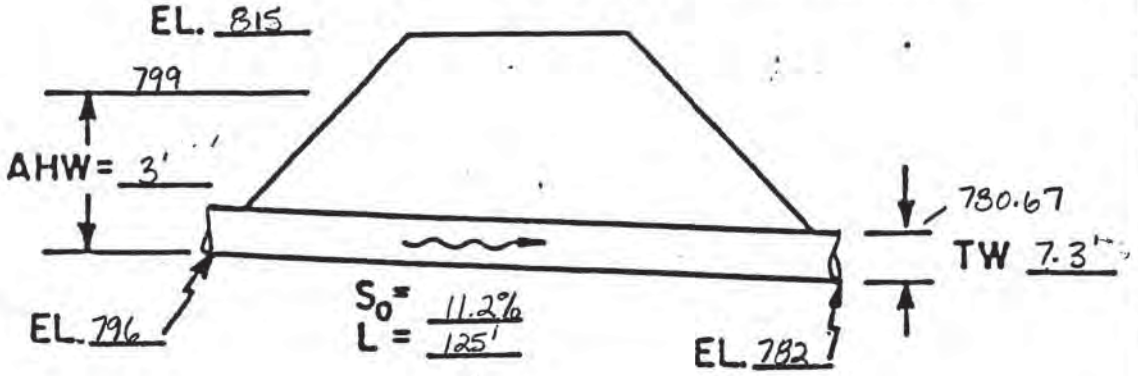
SHEET _____ OF _____

744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

PROJECT / PROPOSAL NAME	PREPARED By:	Date	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
DPC - PLAN OF OPERATION	BJN	9/00			3081.40

SKETCH

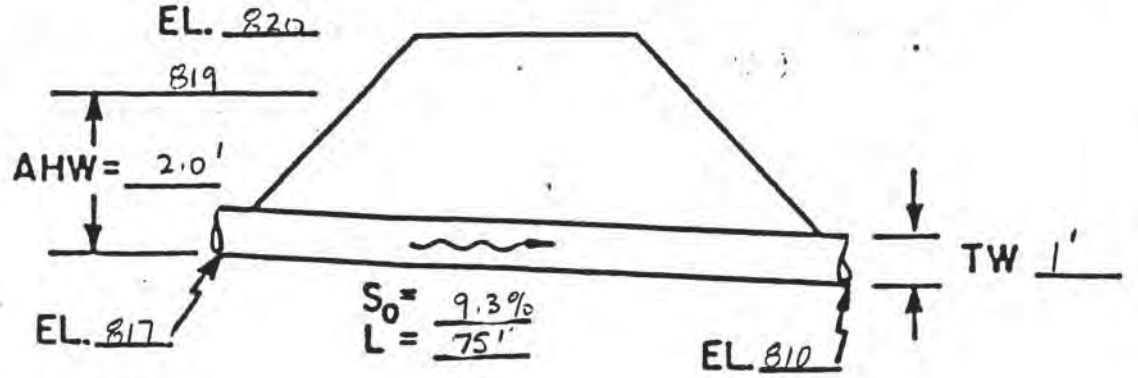
STATION : CULVERT #3



MAX. STREAM FLOW= 15 cfs

SKETCH

STATION : CULVERT #4



MAX. STREAM FLOW= 15 cfs

COMPUTATION SHEET

RMT INC.

SHEET _____ OF _____

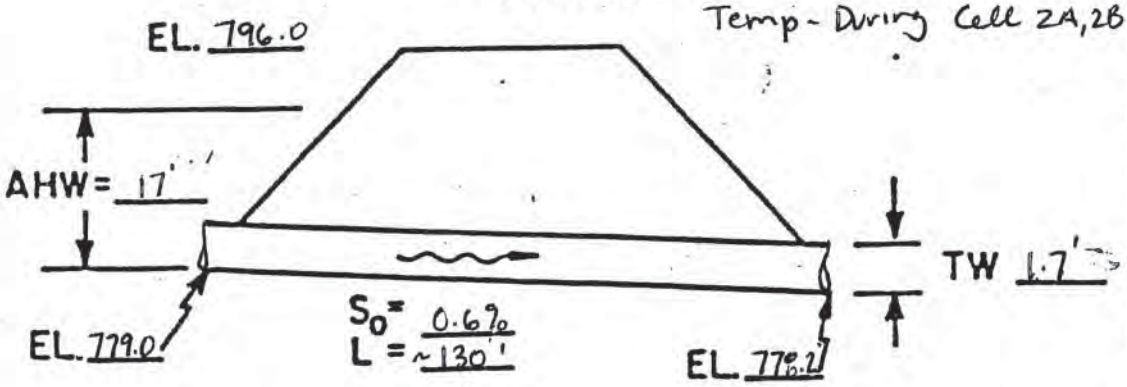
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

PROJECT / PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
Dairyland Power – Phase IV	BJT	7/03			3061.56

SKETCH

STATION: Culvert #2

Temp - During Cell 2A, 2B

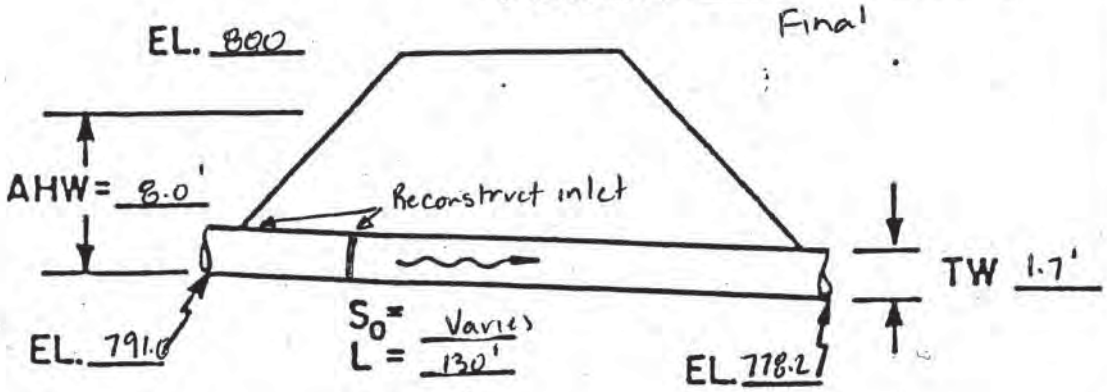


MAX. STREAM FLOW= 561 ~~323~~ cfs

SKETCH

STATION: Culvert #2

Final



MAX. STREAM FLOW= 323 cfs

Culvert Calculator Report
Culvert 2 - Operational

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	796.00 ft	Headwater Depth/ Height	3.86
Computed Headwater Elevation	794.45 ft	Discharge	561.00 cfs
Inlet Control HW Elev	792.30 ft	Tailwater Elevation	779.90 ft
Outlet Control HW Elev	794.45 ft	Control Type	Outlet Control

Grades			
Upstream Invert	779.00 ft	Downstream Invert	778.20 ft
Length	130.00 ft	Constructed Slope	0.006154 ft/ft

Hydraulic Profile			
Profile	Pressure	Depth, Downstream	4.00 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	4.00 ft
Velocity Downstream	20.04 ft/s	Critical Slope	0.022277 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	794.45 ft	Upstream Velocity Head	6.24 ft
Ke	0.50	Entrance Loss	3.12 ft

Inlet Control Properties			
Inlet Control HW Elev	792.30 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft²
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		

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Culvert Calculator Report
Culvert 2 - Final

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	799.00 ft	Headwater Depth/ Height	1.78
Computed Headwater Elevation	798.10 ft	Discharge	323.00 cfs
Inlet Control HW Elev	797.44 ft	Tailwater Elevation	779.90 ft
Outlet Control HW Elev	798.10 ft	Control Type	Entrance Control

Grades			
Upstream Invert	791.00 ft	Downstream Invert	778.20 ft
Length	130.00 ft	Constructed Slope	0.098462 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	1.60 ft
Slope Type	Steep	Normal Depth	1.32 ft
Flow Regime	Supercritical	Critical Depth	4.00 ft
Velocity Downstream	28.87 ft/s	Critical Slope	0.007385 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	798.10 ft	Upstream Velocity Head	2.07 ft
Ke	0.50	Entrance Loss	1.03 ft

Inlet Control Properties			
Inlet Control HW Elev	797.44 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft²
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		

RMT, Inc. 37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

COMPUTATION SHEET

RMT INC.

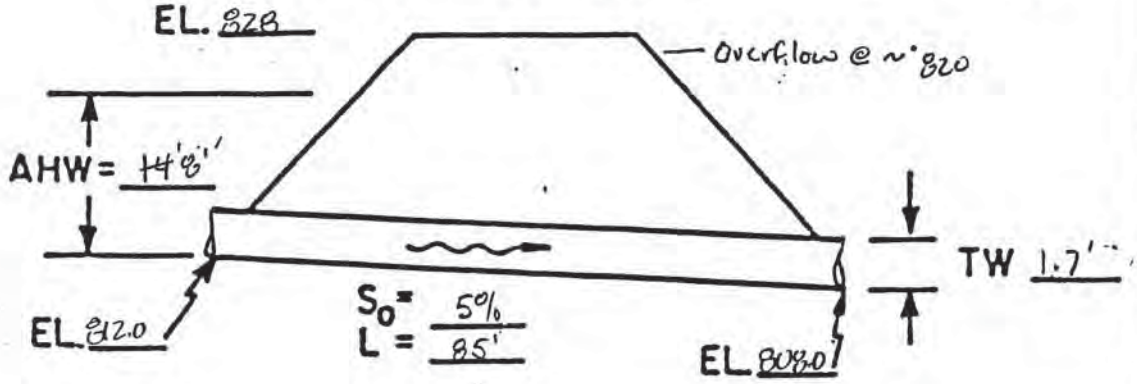
SHEET _____ OF _____

744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

PROJECT / PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
OPC POO	BJP	9/00			3091.40

SKETCH

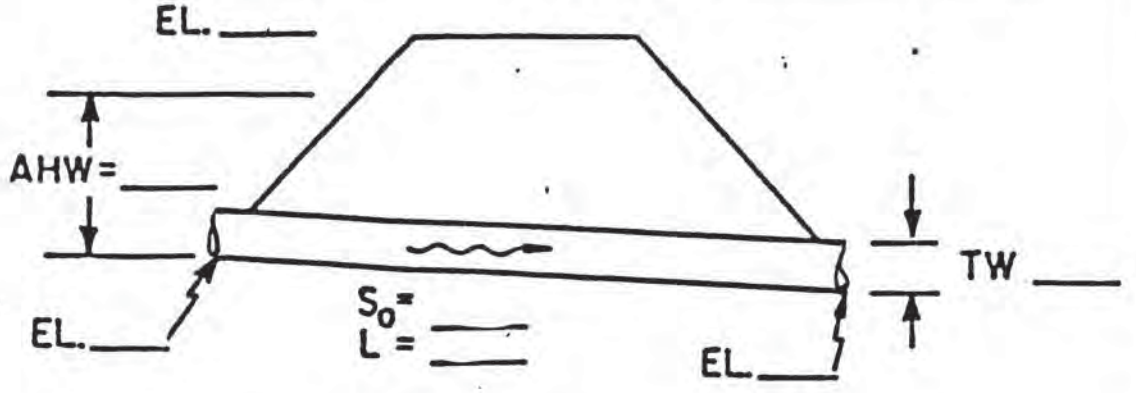
STATION : CULVERT # 5



MAX. STREAM FLOW= 323

SKETCH

STATION : _____



MAX. STREAM FLOW= _____

PROJECT: DPC POO

DESIGNER: BJK

DATE: 9/2000

HYDROLOGIC AND CHANNEL INFORMATION

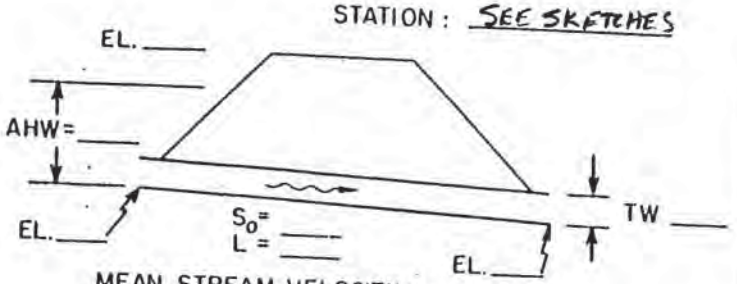
Q_1 = SEE SKETCHES TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: SEE SKETCHES



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
CULVERT #1 CMP	162 EA	2-60"	1.2	6'												
CULVERT #1 BOX CULVERT	323 46/ft	7'x 4'	~~1.45~~ 1.95	~~5.8~~ 7.8	0.4	3.8'	4.0'	4.0'	1.7'	4.0	6.5'	1.3	~~5.8~~ 7.8			Not Rec.
																Recommended
CULVERT #2 BOX CULVERT	323 46/ft	7'x 4'	~~1.45~~ 1.95	~~5.8'~~ 7.8	0.4	3.8	4.0'	4.0'	1.7	4.0	10'	—	~~5.8'~~ 7.8			
																Recommended
CULVERT #3 CMP	15	24"	1.15	2.3'	0.5	2.8'	1.4	1.7	7.3'	7.3'	6'	4.1				Not Rec.
CULVERT #3 CMP	15	30"	0.77	1.9	0.5	0.8	1.3	1.9	7.3'	7.3'	6'	2.1				Recommended

SUMMARY & RECOMMENDATIONS:

ACTUAL LENGTHS OF CULVERTS #1 & 2 = 96' and 126' RESPECTIVELY
BASED ON 6' CULVERT SECTION LENGTHS

Figure 7

PROJECT: DPC - P00

DESIGNER: BJK

DATE: 9/2000

HYDROLOGIC AND CHANNEL INFORMATION

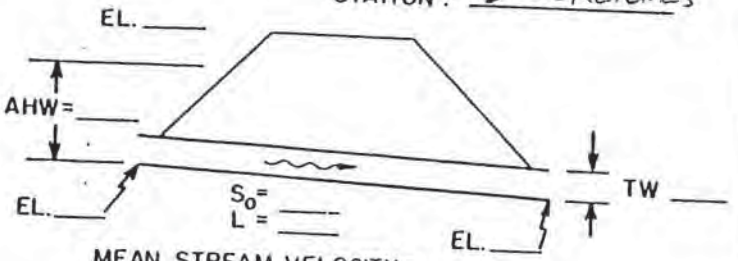
Q_1 = SEE SKETCHES TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : SEE SKETCHES



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW = H + h_o - LS_o$											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
CULVERT #4 CMP	15	30"	0.77	1.9'	0.5	0.7	1.3	1.9	1.0	1.9	7'	—	1.9'			Recommended
CULVERT #5 BOX CULVERT	323 46/F1	7'x 4'	~~1.45~~ 1.95	~~5.6~~ ~~7.8~~	0.4	3.8	4.0	4.0	1.7	4.0	4'	3.8	~~5.8~~ 7.8			Recommended

SUMMARY & RECOMMENDATIONS:

Figure 7

TABLE 1 - ENTRANCE LOSS COEFFICIENTS

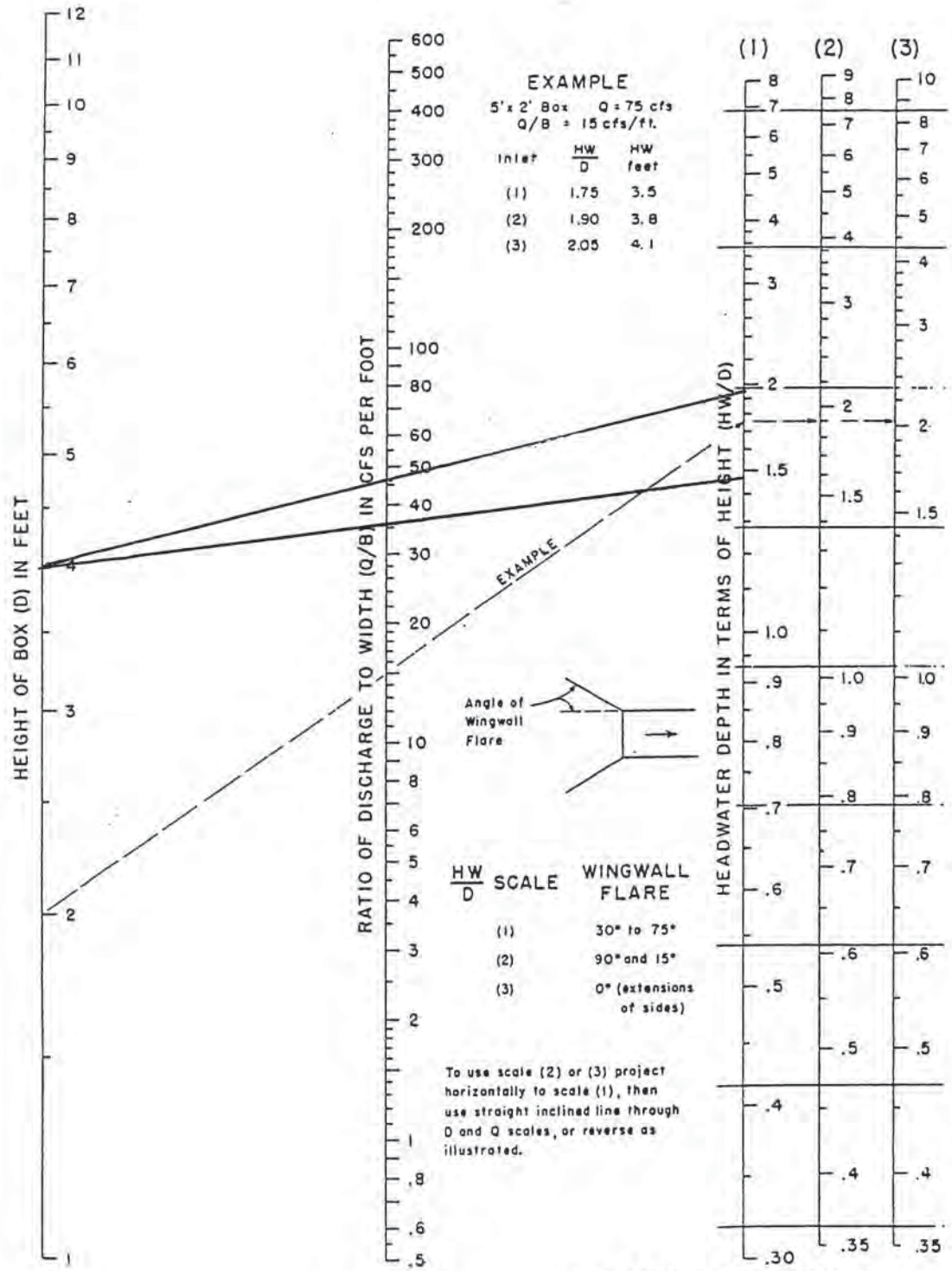
Outlet Control, Full or Partly Full

Entrance head loss $H_e = k_e \frac{V^2}{2g}$

Type of Structure and Design of Entrance	Coefficient k_e	
Pipe, Concrete		
Projecting from fill, socket end (groove-end)	0.2	
Projecting from fill, sq. cut end	0.5	
Headwall or headwall and wingwalls		
Socket end of pipe (groove-end)	0.2	
Square-edge	0.5	
Rounded (radius = 1/12D)	0.2	
Mitered to conform to fill slope	0.7	
*End-Section conforming to fill slope	0.5	
Beveled edges, 33.7° or 45° bevels	0.2	
Side-or slope-tapered inlet	0.2	
Pipe, or Pipe-Arch, Corrugated Metal		
Projecting from fill (no headwall)	0.9	
Headwall or headwall and wingwalls square-edge	0.5	
Mitered to conform to fill slope, paved or unpaved slope	0.7	
*End-Section conforming to fill slope	0.5	← CULVERTS 3, 4
Beveled edges, 33.7° or 45° bevels	0.2	
Side-or slope-tapered inlet	0.2	
Box, Reinforced Concrete		
Headwall parallel to embankment (no wingwalls)		
Square-edged on 3 edges	0.5	
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2	
Wingwalls at 30° to 75° to barrel		
Square-edged at crown	0.4	← CULVERTS 1, 2
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2	
Wingwall at 10° to 25° to barrel		
Square-edged at crown	0.5	
Wingwalls parallel (extension of sides)		
Square-edged at crown	0.7	
Side-or slope-tapered inlet	0.2	

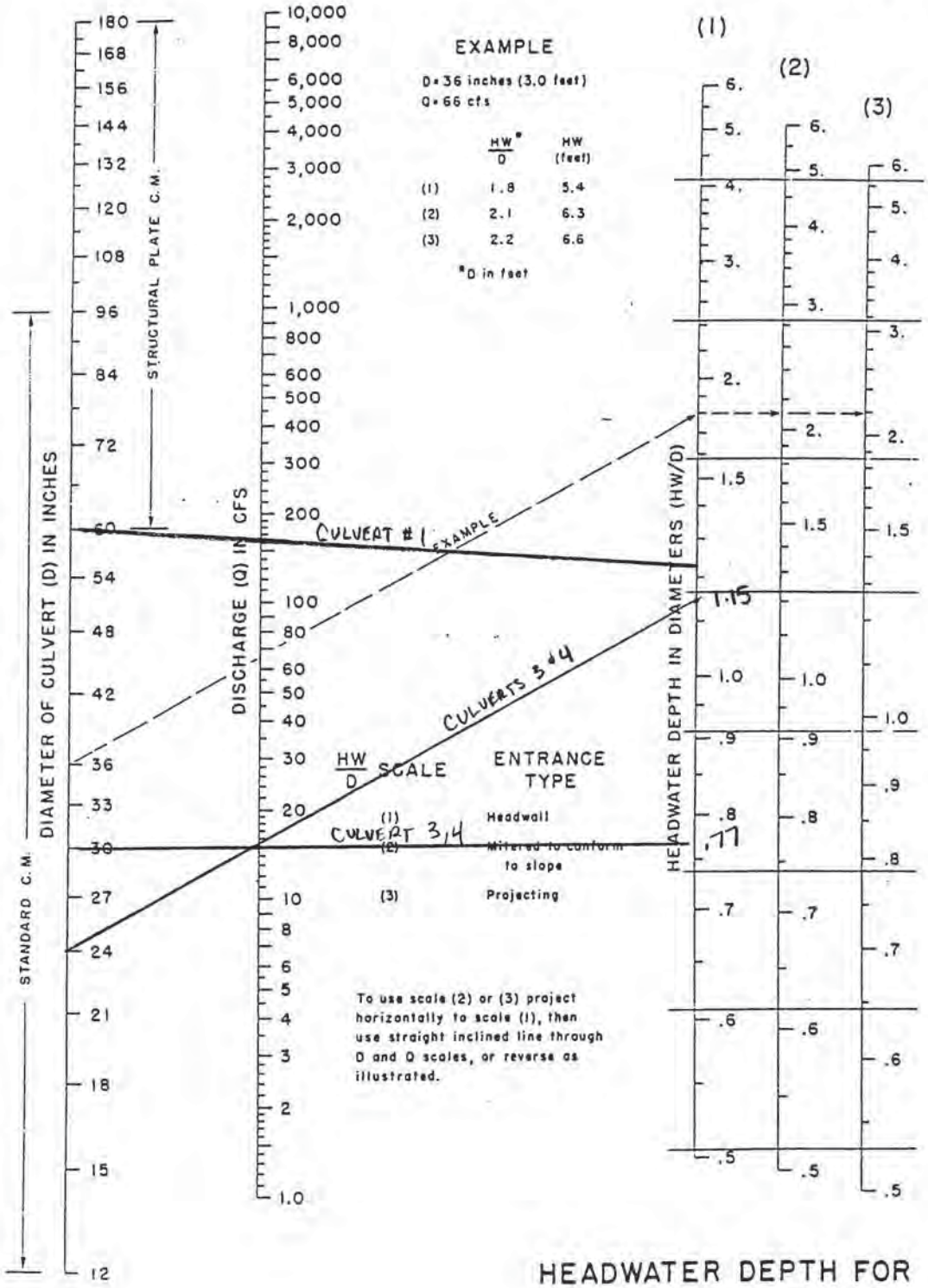
*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be designed using the information given for the beveled inlet, p. 5-13.

CHART I



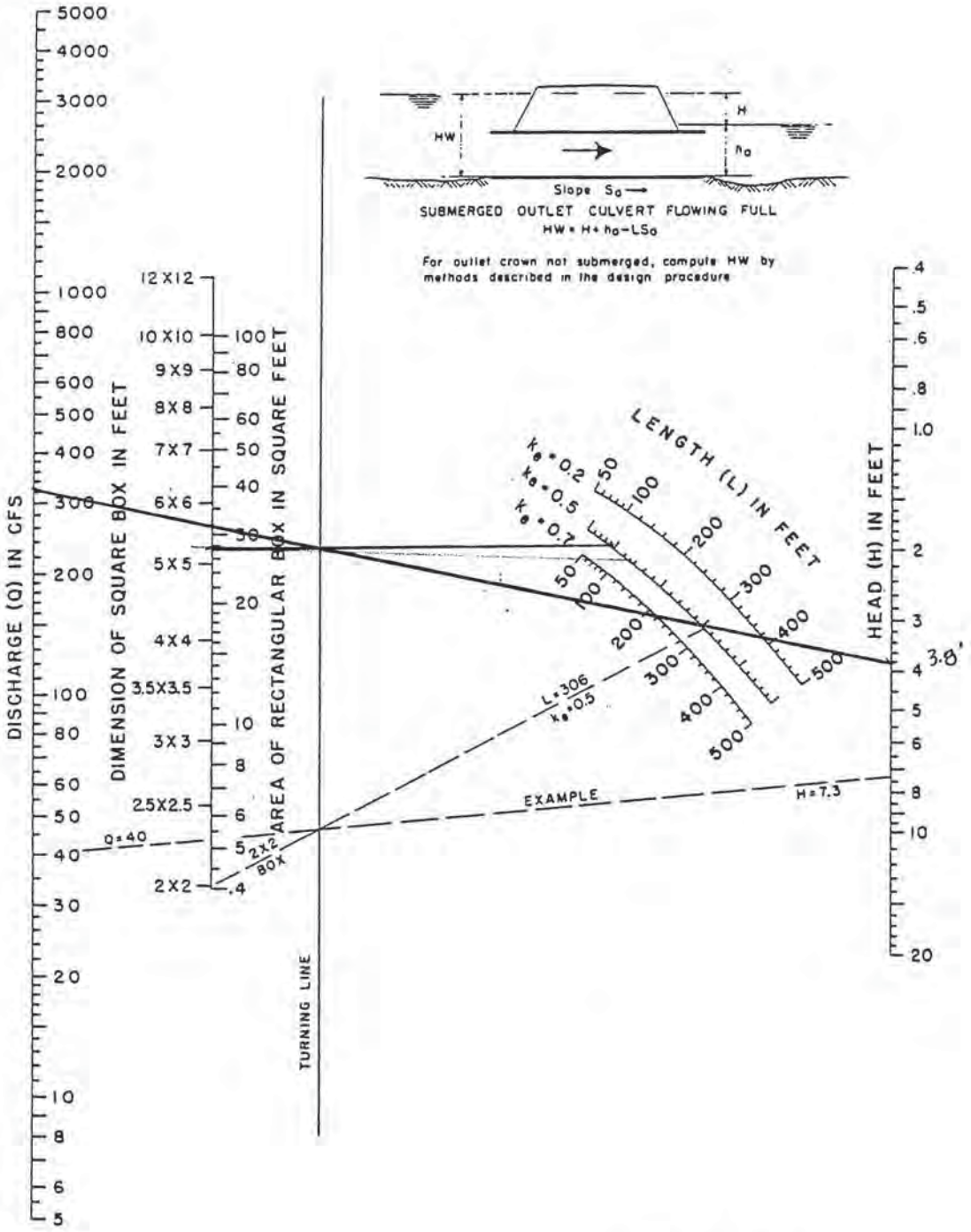
HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

CHART 5



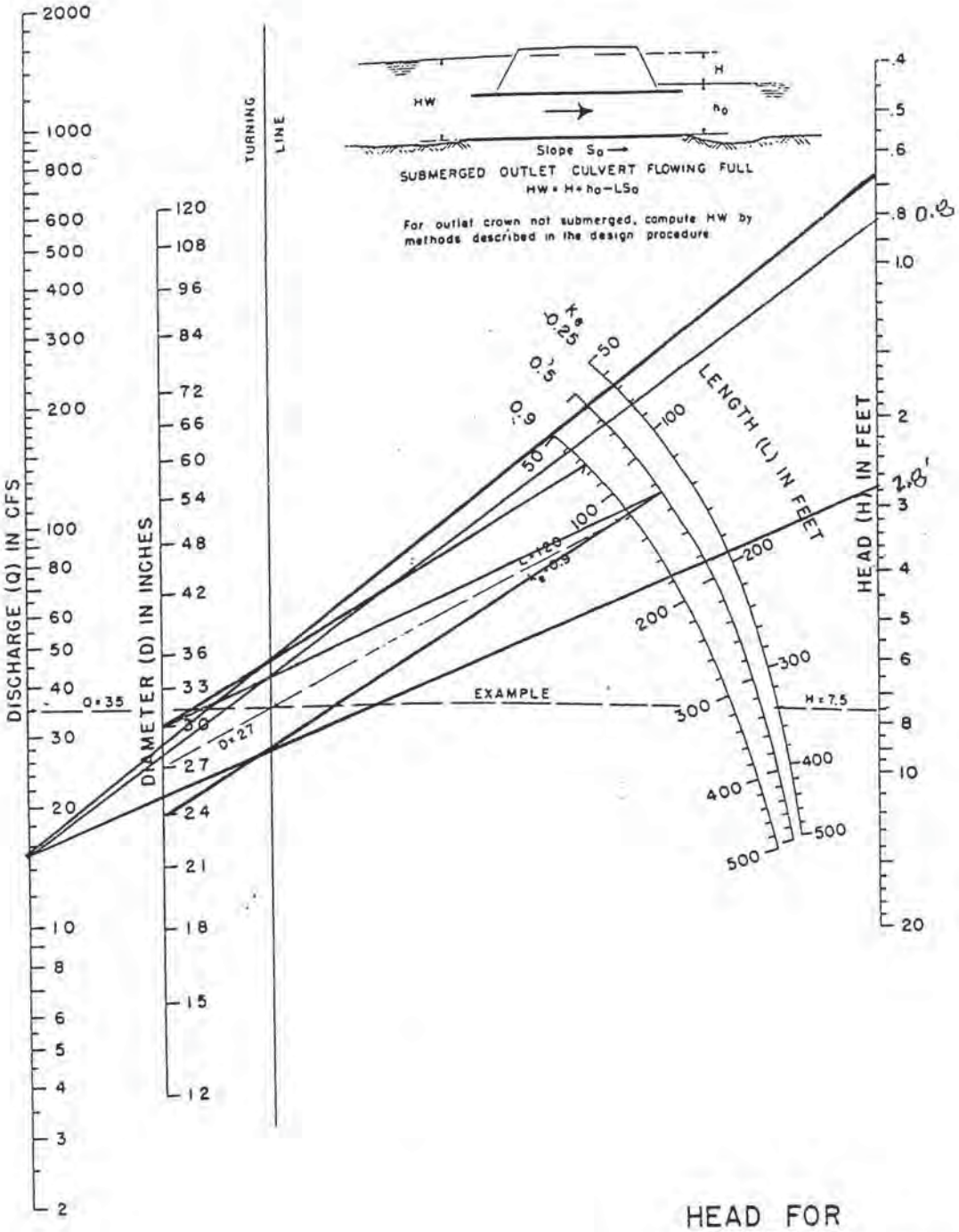
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

CHART 8



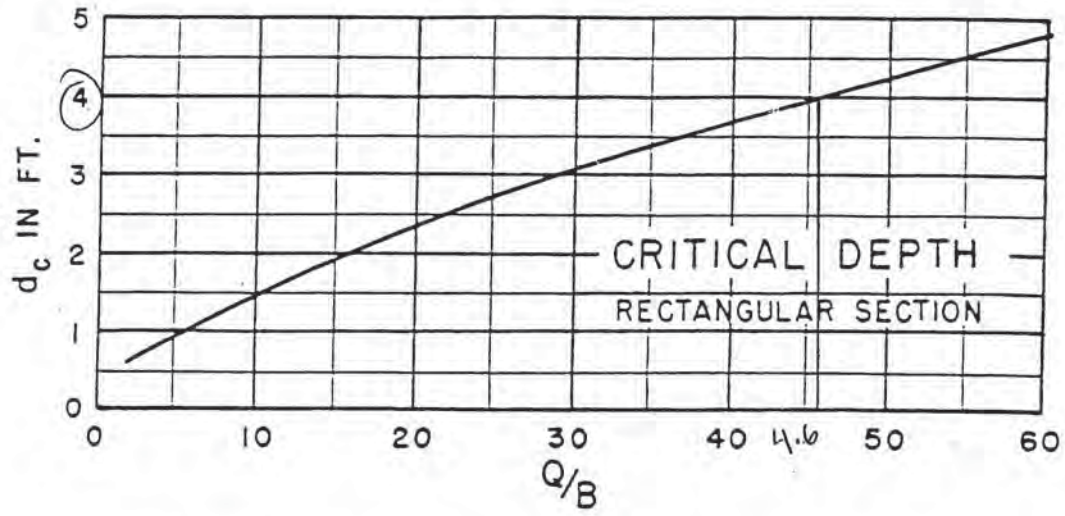
HEAD FOR
CONCRETE BOX CULVERTS
FLOWING FULL
n = 0.012

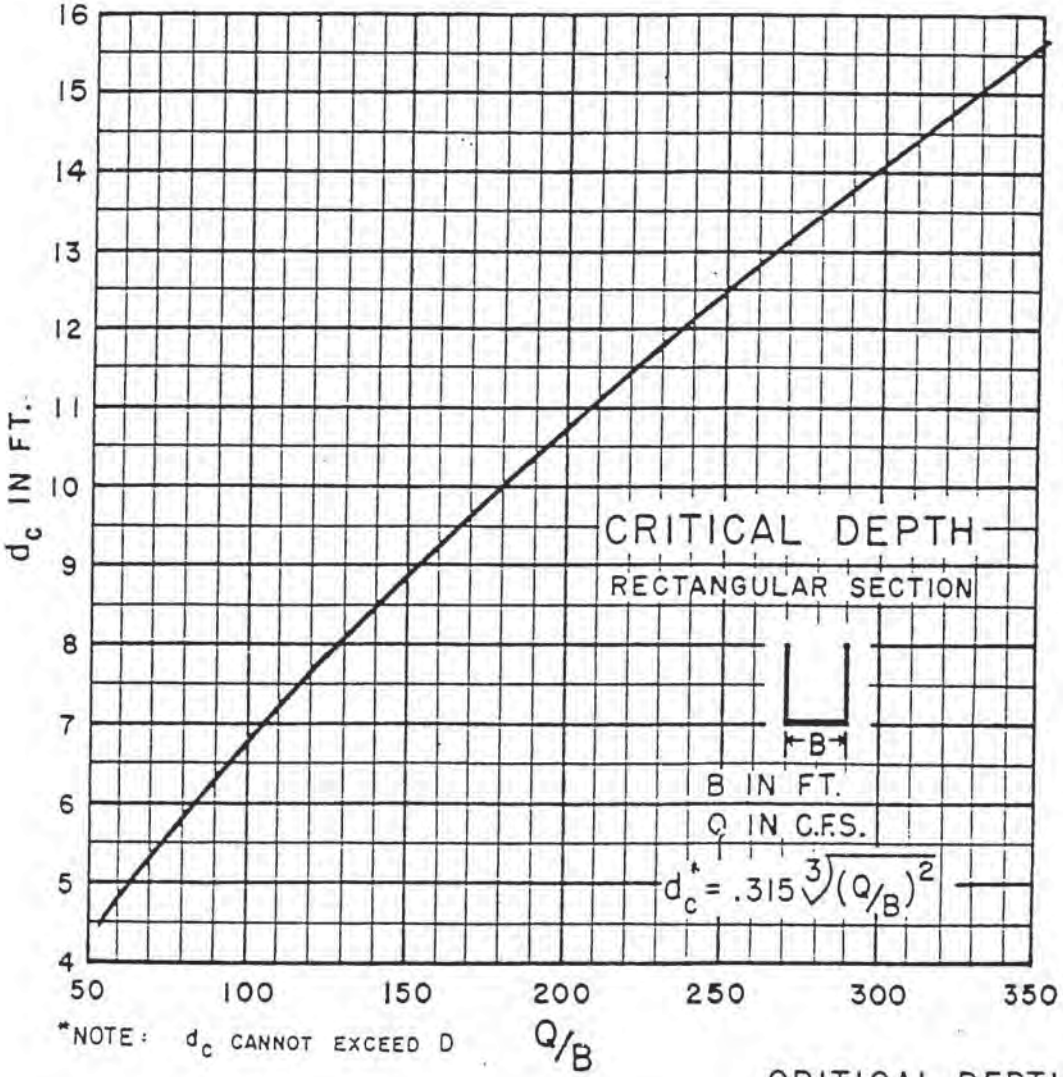
CHART 11



HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

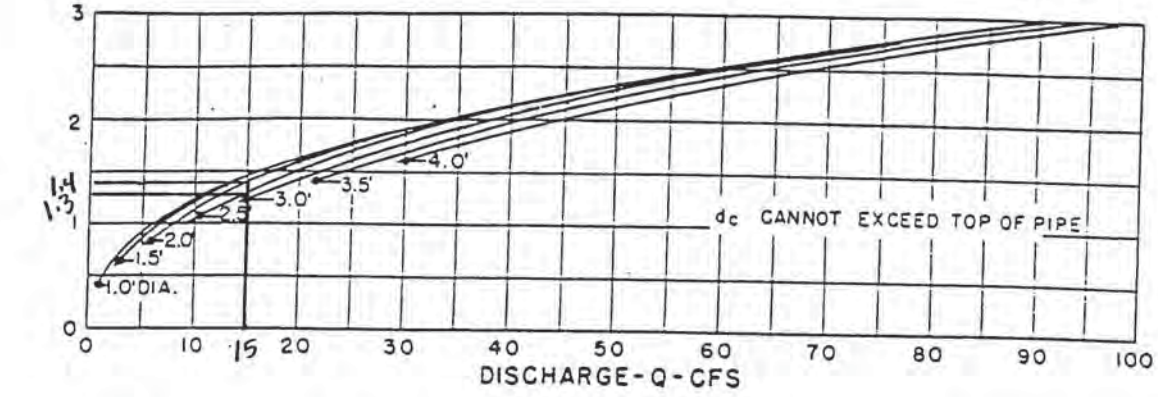
Chart 15

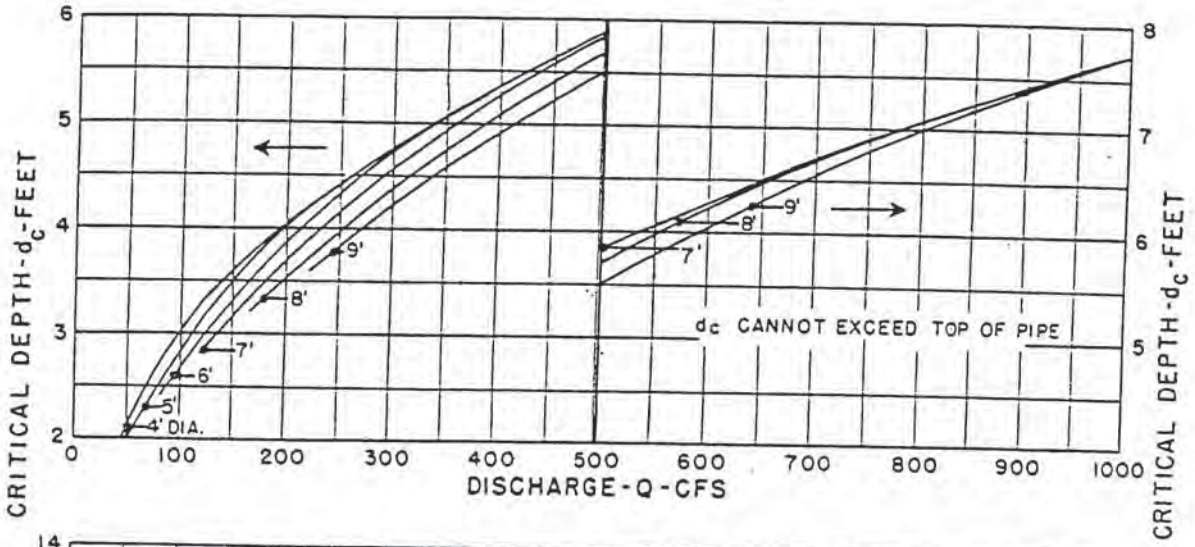


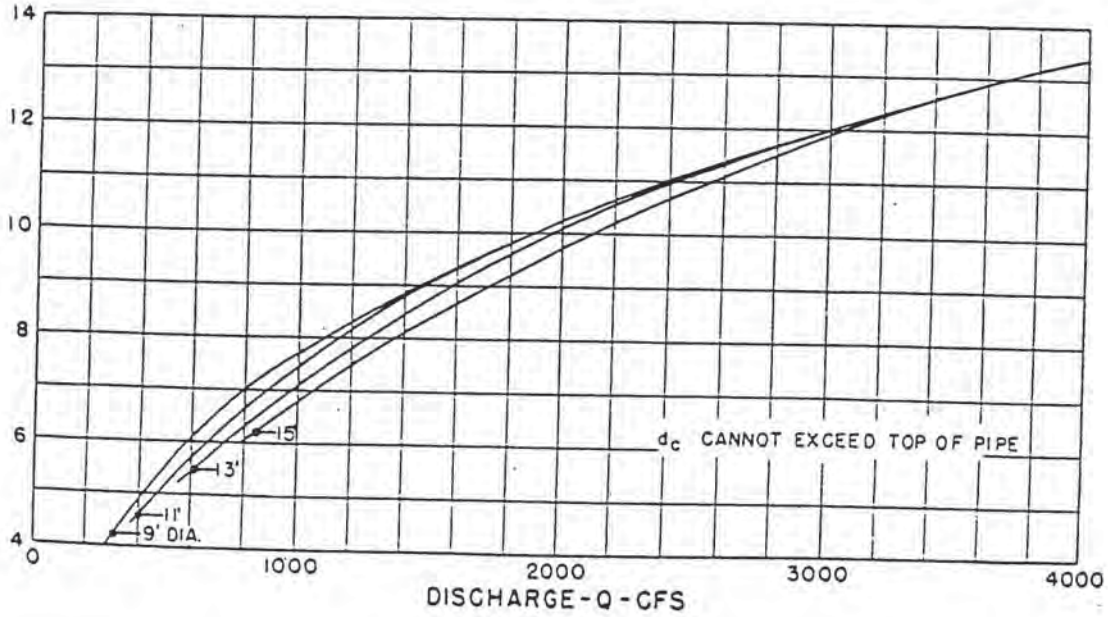


CRITICAL DEPTH
RECTANGULAR SECTION

CHART 16







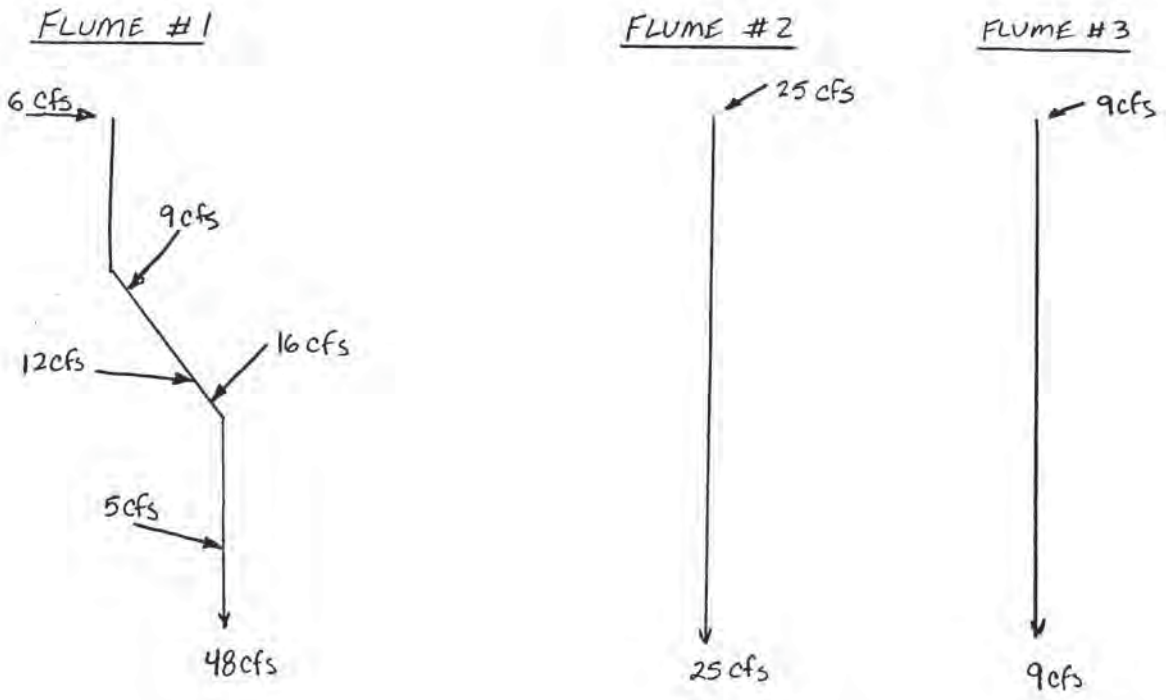
CRITICAL DEPTH
CIRCULAR PIPE

744 Heartland Trail
Madison, WI 53717-1934
Tel. (608) 831-4444 • Fax (608) 831-3334

PROJECT / PROPOSAL NAME / LOCATION: DAIRYLAND POWER - POO		PROJECT / PROPOSAL NO. 3081.40
SUBJECT: FLUME SIZING		
PREPARED BY: B.J.K	DATE: 9/00	FINAL ☐
CHECKED BY:	DATE:	REVISION ☐

DOWNSLOPE FLUME SIZING

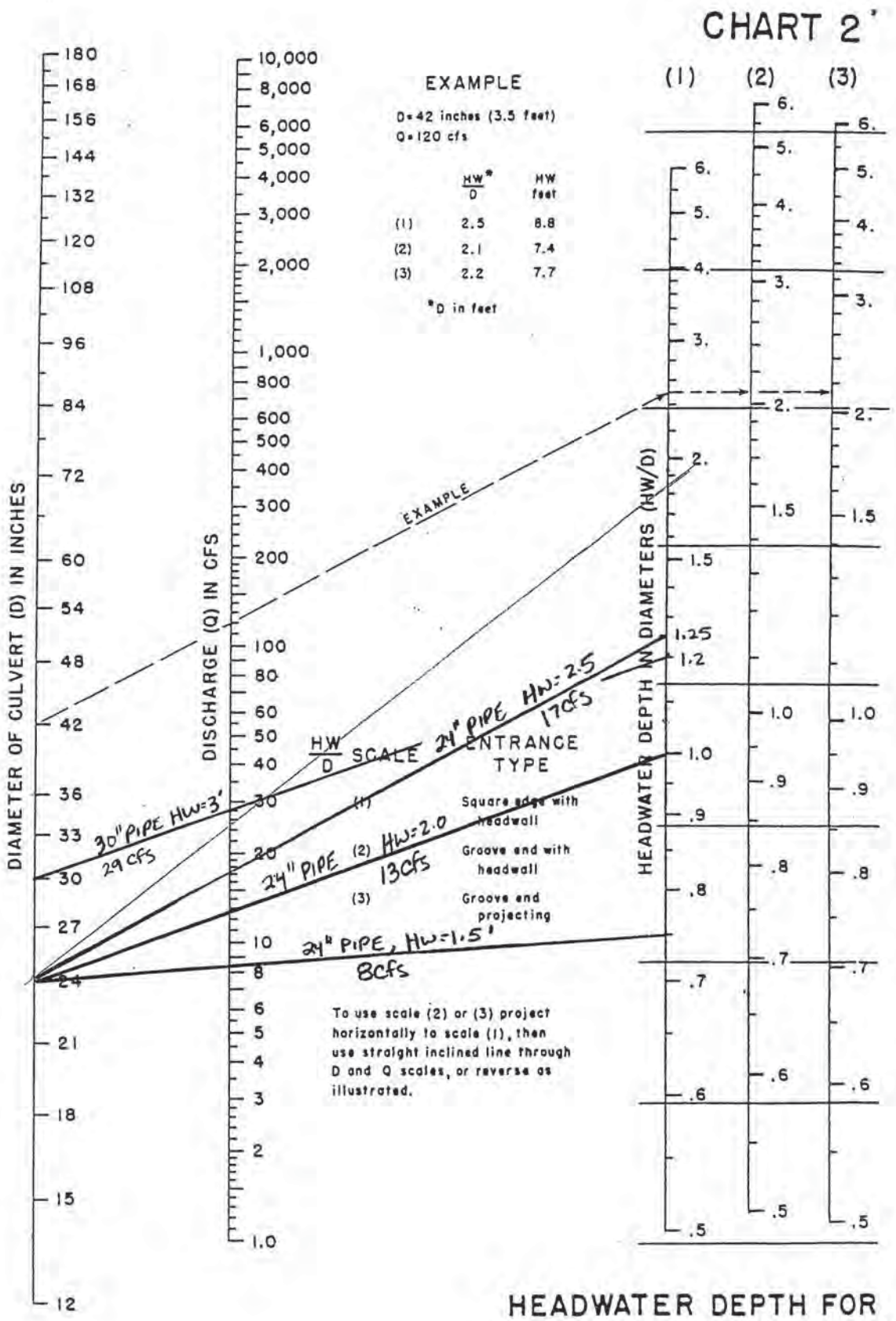
1. SIZE INLET PIPES



NOTE: PEAK FLOWS OBTAINED FROM RUNOFF CALCULATIONS
PEAK FLOWS ADDED TO OBTAIN TOTALS (CONSERVATIVE)

ESTABLISH INLET PIPE SIZES AND BERM HEIGHTS USING INLET CONTROL NOMOGRAPHS!

FLOW RANGE	INLET PIPE SIZE	HW	REQ'D BERM HEIGHT
0-8 cfs	24"	1.5'	2.5'
9-13 cfs	24"	2.0'	2.5'
14-17 cfs	24"	2.5'	3.0'
18-29 cfs	30"	3.0'	3.5'



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

RMT
744 Heartland Trail
Madison, WI 53717-1934
Tel. (608) 831-4444 • Fax (608) 831-3334

SHEET ____ OF ____

PROJECT / PROPOSAL NAME / LOCATION: DAIRYLAND POWER - POO		PROJECT / PROPOSAL NO. 30B140
SUBJECT: FLUME SIZING		
PREPARED BY: BJK	DATE: 9/00	FINAL ☐
CHECKED BY:	DATE:	REVISION ☐

CHECK STRAIGHT PIPE FLUME SIZING

WORST-CASE FLOW - FLUME #1

SLOPE = 20% (AT RIDGE)
PIPE DIA = 1.5'
MAX FLOW = 48 cfs

FULL PIPE FLOW:

$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} A$$

$n = 0.010$ for HDPE PIPE
$R = D/4 = 1.5/4 = 0.375$
$S = 0.20$ ft/ft
$A = \pi D^2/4 = \pi (1.5)^2/4 = 1.77$ ft^2

$$Q_{FULL} = \frac{1.49}{0.01} (0.375)^{2/3} (0.20)^{1/2} (1.77)$$

$= 61$ cfs > 48 cfs ok ✓

A WATER RESOURCES TECHNICAL PUBLICATION

Engineering Monograph No. 25

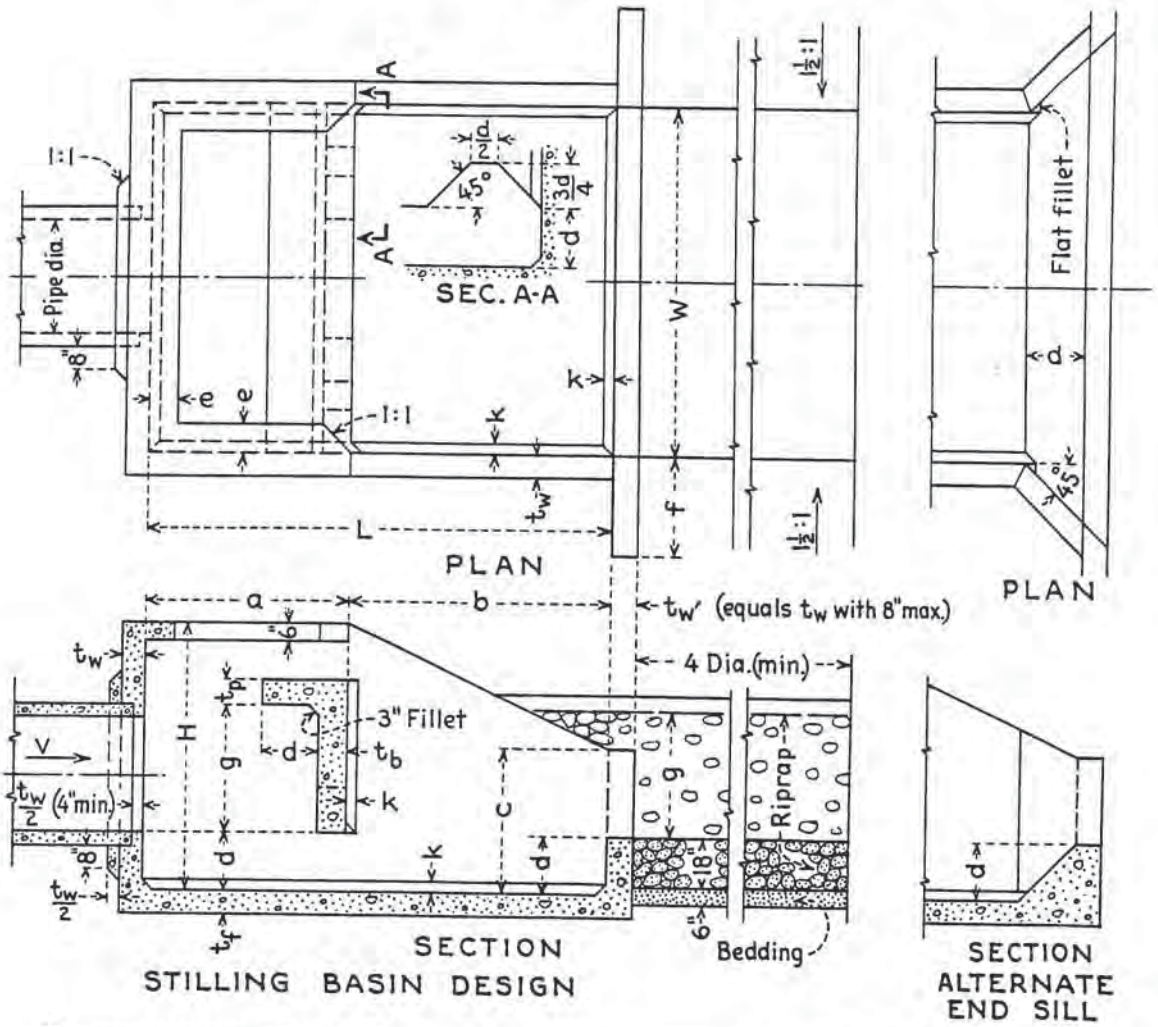
Hydraulic Design of Stilling Basins and Energy Dissipators

By A. J. PETERKA

Denver, Colorado

United States Department of the Interior

BUREAU OF RECLAMATION



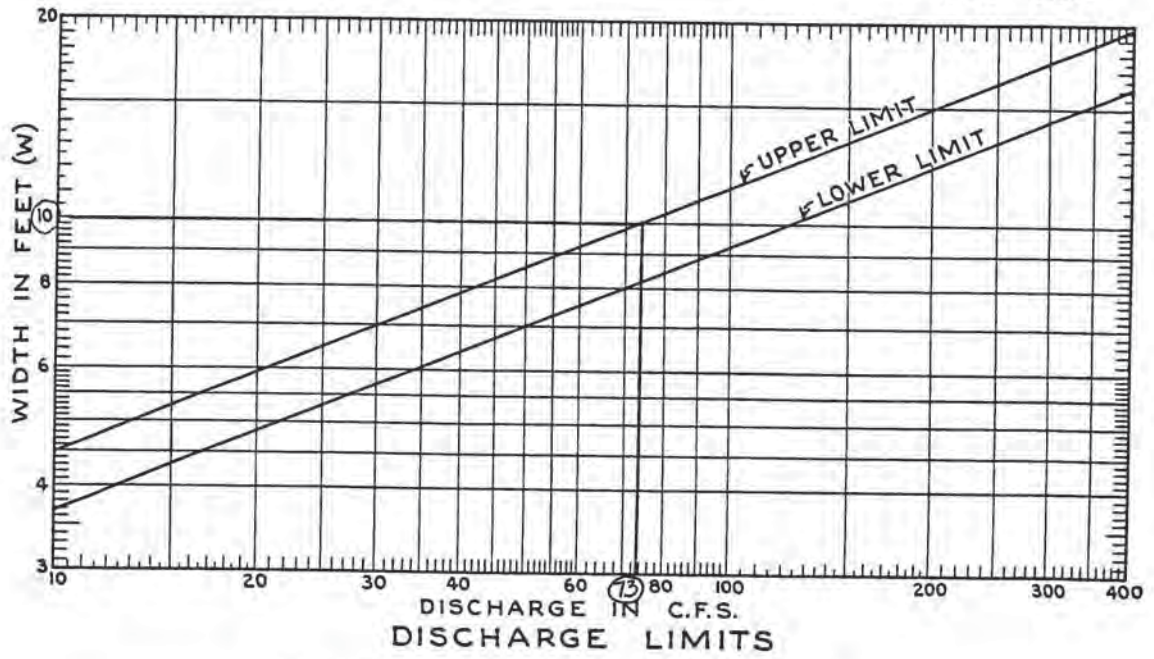


FIGURE 42.—*Impact-type energy dissipator (Basin VI).*

TABLE 11.—*Stilling basin dimensions (Basin VI). Impact-type energy dissipator.*

Suggested pipe size [1]		Max discharge Q	Feet and inches										Inches					
Dia in.	Area (sq ft)		W	H	L	a	b	c	d	e	f	g	t_w	t_f	t_b	t_p	K	Suggested riprap size [3]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19) [3]
18	1. 77	[2] 21	5–6	4–3	7–4	3–3	4–1	2–4	0–11	0–6	1–6	2–1	6	6½	6	6	3	4. 0
24	3. 14	38	6–9	5–3	9–0	3–11	5–1	2–10	1–2	0–6	2–0	2–6	6	6½	6	6	3	7. 0
30	4. 91	59	8–0	6–3	10–8	4–7	6–1	3–4	1–4	0–8	2–6	3–0	6	6½	7	7	3	8. 5
36	7. 07	85	9–3	7–3	12–4	5–3	7–1	3–10	1–7	0–8	3–0	3–6	7	7½	8	8	3	9. 0
42	9. 62	115	10–6	8–0	14–0	6–0	8–0	4–5	1–9	0–10	3–0	3–11	8	8½	9	8	4	9. 5
48	12. 57	151	11–9	9–0	15–8	6–9	8–11	4–11	2–0	0–10	3–0	4–5	9	9½	10	8	4	10. 5
54	15. 90	191	13–0	9–9	17–4	7–4	10–0	5–5	2–2	1–0	3–0	4–11	10	10½	10	8	4	12. 0
60	19. 63	236	14–3	10–9	19–0	8–0	11–0	5–11	2–5	1–0	3–0	5–4	11	11½	11	8	6	13. 0
72	28. 27	339	16–6	12–3	22–0	9–3	12–9	6–11	2–9	1–3	3–0	6–2	12	12½	12	8	6	14. 0

73cfs →

[1] Suggested pipe will run full when velocity is 12 feet per second or half full when velocity is 24 feet per second. Size may be modified for other velocities by $Q=AV$, but relation between Q and basin dimensions shown must be maintained.

[2] For discharges less than 21 second-feet, obtain basin width from curve of Fig. 42. Other dimensions proportional to W; $H=\frac{3W}{4}$, $L=\frac{4W}{3}$, $d=\frac{W}{6}$, etc.

[3] Determination of riprap size explained in Sec. 10.

Calculations – Temporary Culverts, Operational Conditions

COMPUTATION SHEET

RMT INC.

SHEET _____ OF _____

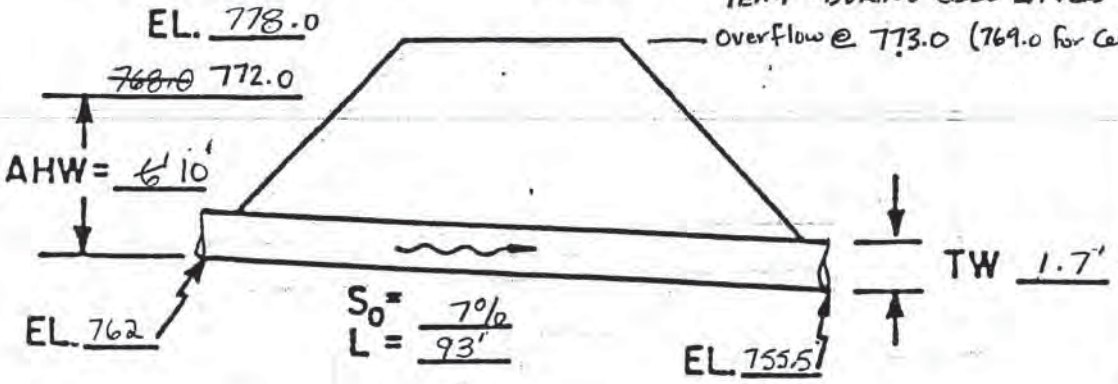
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

PROJECT / PROPOSAL NAME	PREPARED By: BJK Date: 9/00	CHECKED By: Date:	PROJECT/PROPOSAL NO.
DPC - PLAN OF OPERATION			3081.40

REV BJK 7/03

SKETCH

STATION: CULVERT #1
TEMP - DURING CELL 2A & 2B



MAX. STREAM FLOW= ~~323 CFS~~ 355 cfs (25 yr)
561 cfs (100 yr)

Flows for Areas North + West - See Pages 92 & 96 From PCO Apx K

2.)

Culvert Calculator Report
Culvert 1 - Operational (25-Year)

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	773.00 ft	Headwater Depth/ Height	1.94
Computed Headwater Elevation	769.75 ft	Discharge	355.00 cfs
Inlet Control HW Elev	769.18 ft	Tailwater Elevation	757.20 ft
Outlet Control HW Elev	769.75 ft	Control Type	Entrance Control

Grades			
Upstream Invert	762.00 ft	Downstream Invert	755.50 ft
Length	93.00 ft	Constructed Slope	0.069892 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	2.10 ft
Slope Type	Steep	Normal Depth	1.58 ft
Flow Regime	Supercritical	Critical Depth	4.00 ft
Velocity Downstream	24.17 ft/s	Critical Slope	0.008921 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	769.75 ft	Upstream Velocity Head	2.50 ft
Ke	0.50	Entrance Loss	1.25 ft

Inlet Control Properties			
Inlet Control HW Elev	769.18 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft²
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		

RMT, Inc.
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Culvert Calculator Report
Culvert 1 - Operational (100-Year)

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	773.00 ft	Headwater Depth/ Height	3.34
Computed Headwater Elevation	775.36 ft	Discharge	561.00 cfs
Inlet Control HW Elev	775.18 ft	Tailwater Elevation	757.20 ft
Outlet Control HW Elev	775.36 ft	Control Type	Entrance Control

Grades			
Upstream Invert	762.00 ft	Downstream Invert	755.50 ft
Length	93.00 ft	Constructed Slope	0.069892 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	2.93 ft
Slope Type	Steep	Normal Depth	2.18 ft
Flow Regime	Supercritical	Critical Depth	4.00 ft
Velocity Downstream	27.37 ft/s	Critical Slope	0.022277 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	775.36 ft	Upstream Velocity Head	6.24 ft
Ke	0.50	Entrance Loss	3.12 ft

Inlet Control Properties			
Inlet Control HW Elev	775.18 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft²
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		

COMPUTATION SHEET

RMT INC.

SHEET _____ OF _____

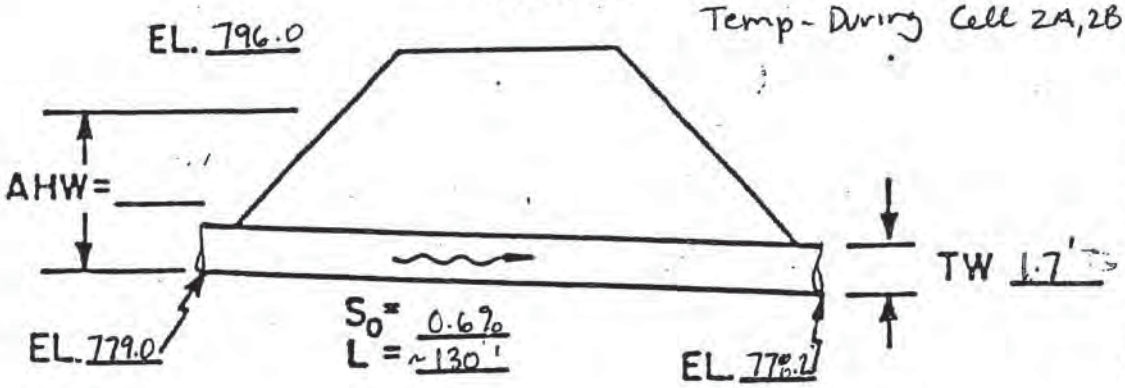
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

PROJECT / PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
Dairyland Power – Phase IV	BJH	7/03			3061.56

SKETCH

STATION: Culvert #2

Temp - During Cell 2A, 2B

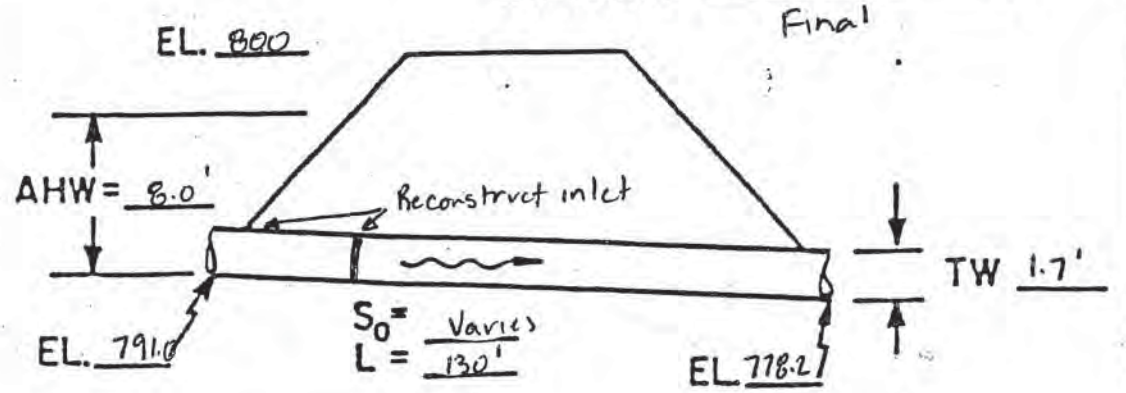


MAX. STREAM FLOW= 561 ~~323~~ cfs

SKETCH

STATION: Culvert #2

Final



MAX. STREAM FLOW= 323 cfs

Culvert Calculator Report
Culvert 2 - Operational

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	796.00 ft	Headwater Depth/ Height	3.86
Computed Headwater Elevation	794.45 ft	Discharge	561.00 cfs
Inlet Control HW Elev	792.30 ft	Tailwater Elevation	779.90 ft
Outlet Control HW Elev	794.45 ft	Control Type	Outlet Control

Grades			
Upstream Invert	779.00 ft	Downstream Invert	778.20 ft
Length	130.00 ft	Constructed Slope	0.006154 ft/ft

Hydraulic Profile			
Profile	Pressure	Depth, Downstream	4.00 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	4.00 ft
Velocity Downstream	20.04 ft/s	Critical Slope	0.022277 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	794.45 ft	Upstream Velocity Head	6.24 ft
Ke	0.50	Entrance Loss	3.12 ft

Inlet Control Properties			
Inlet Control HW Elev	792.30 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft²
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		

Culvert Calculator Report
Culvert 2 - Final

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	799.00 ft	Headwater Depth/ Height	1.78
Computed Headwater Elevation	798.10 ft	Discharge	323.00 cfs
Inlet Control HW Elev	797.44 ft	Tailwater Elevation	779.90 ft
Outlet Control HW Elev	798.10 ft	Control Type	Entrance Control

Grades			
Upstream Invert	791.00 ft	Downstream Invert	778.20 ft
Length	130.00 ft	Constructed Slope	0.098462 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	1.60 ft
Slope Type	Steep	Normal Depth	1.32 ft
Flow Regime	Supercritical	Critical Depth	4.00 ft
Velocity Downstream	28.87 ft/s	Critical Slope	0.007385 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	798.10 ft	Upstream Velocity Head	2.07 ft
Ke	0.50	Entrance Loss	1.03 ft

Inlet Control Properties			
Inlet Control HW Elev	797.44 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft²
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		

COMPUTATION SHEET

RMT INC.

SHEET _____ OF _____

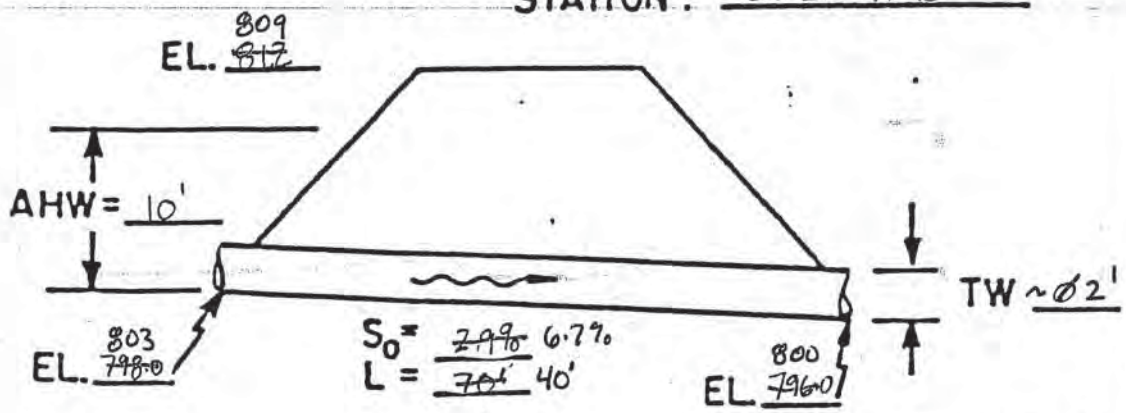
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

PROJECT / PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
DPC - PLAN OF OPERATION	By: KAA	Date: 9/[illegible]/04	By:	Date:	3081.4C

Rev BSK 8/03

SKETCH

STATION: CULVERT D



MAX. STREAM FLOW= ~~583 cfs~~ 228 CFS (25-YR) 360 CFS (100-YR)

Culvert Calculator Report
Culvert D - 25 Year

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	809.00 ft	Headwater Depth/ Height	1.40
Computed Headwater Elevation	808.61 ft	Discharge	228.00 cfs
Inlet Control HW Elev	807.84 ft	Tailwater Elevation	802.00 ft
Outlet Control HW Elev	808.61 ft	Control Type	Entrance Control

Grades			
Upstream Invert	803.00 ft	Downstream Invert	800.00 ft
Length	45.00 ft	Constructed Slope	0.066667 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	1.74 ft
Slope Type	Steep	Normal Depth	1.19 ft
Flow Regime	Supercritical	Critical Depth	3.21 ft
Velocity Downstream	18.70 ft/s	Critical Slope	0.003975 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	808.61 ft	Upstream Velocity Head	1.60 ft
Ke	0.50	Entrance Loss	0.80 ft

Inlet Control Properties			
Inlet Control HW Elev	807.84 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft²
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		

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Culvert Calculator Report
Culvert D - 100 Year

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	809.00 ft	Headwater Depth/ Height	1.96
Computed Headwater Elevation	810.85 ft	Discharge	360.00 cfs
Inlet Control HW Elev	810.30 ft	Tailwater Elevation	802.00 ft
Outlet Control HW Elev	810.85 ft	Control Type	Entrance Control

Grades			
Upstream Invert	803.00 ft	Downstream Invert	800.00 ft
Length	45.00 ft	Constructed Slope	0.066667 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	2.52 ft
Slope Type	Steep	Normal Depth	1.63 ft
Flow Regime	Supercritical	Critical Depth	4.00 ft
Velocity Downstream	20.38 ft/s	Critical Slope	0.009174 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	810.85 ft	Upstream Velocity Head	2.57 ft
Ke	0.50	Entrance Loss	1.28 ft

Inlet Control Properties			
Inlet Control HW Elev	810.30 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft²
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		

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Culvert Calculator Report
Flume MH

Solve For: Headwater Elevation

Culvert Summary					
		→ 827.5, adjacent pipe inlet			
Allowable HW Elevation	8.00	ft	Headwater Depth/ Height	1.98	
Computed Headwater Elevation	825.18	ft	Discharge	73.00	cfs
Inlet Control HW Elev	825.18	ft	Tailwater Elevation	780.67	ft
Outlet Control HW Elev	824.72	ft	Control Type	Inlet Control	

Grades					
Upstream Invert	819.25	ft	Downstream Invert	779.00	ft
Length	185.00	ft	Constructed Slope	0.217568	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.91	ft
Slope Type	Steep		Normal Depth	0.86	ft
Flow Regime	Supercritical		Critical Depth	2.70	ft
Velocity Downstream	40.57	ft/s	Critical Slope	0.006248	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.010	
Section Material	PVC		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev	824.72	ft	Upstream Velocity Head	1.85	ft
Ke	0.50		Entrance Loss	0.92	ft

Inlet Control Properties					
Inlet Control HW Elev	825.18	ft	Flow Control	Submerged	
Inlet Type	Square edge w/headwall		Area Full	7.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

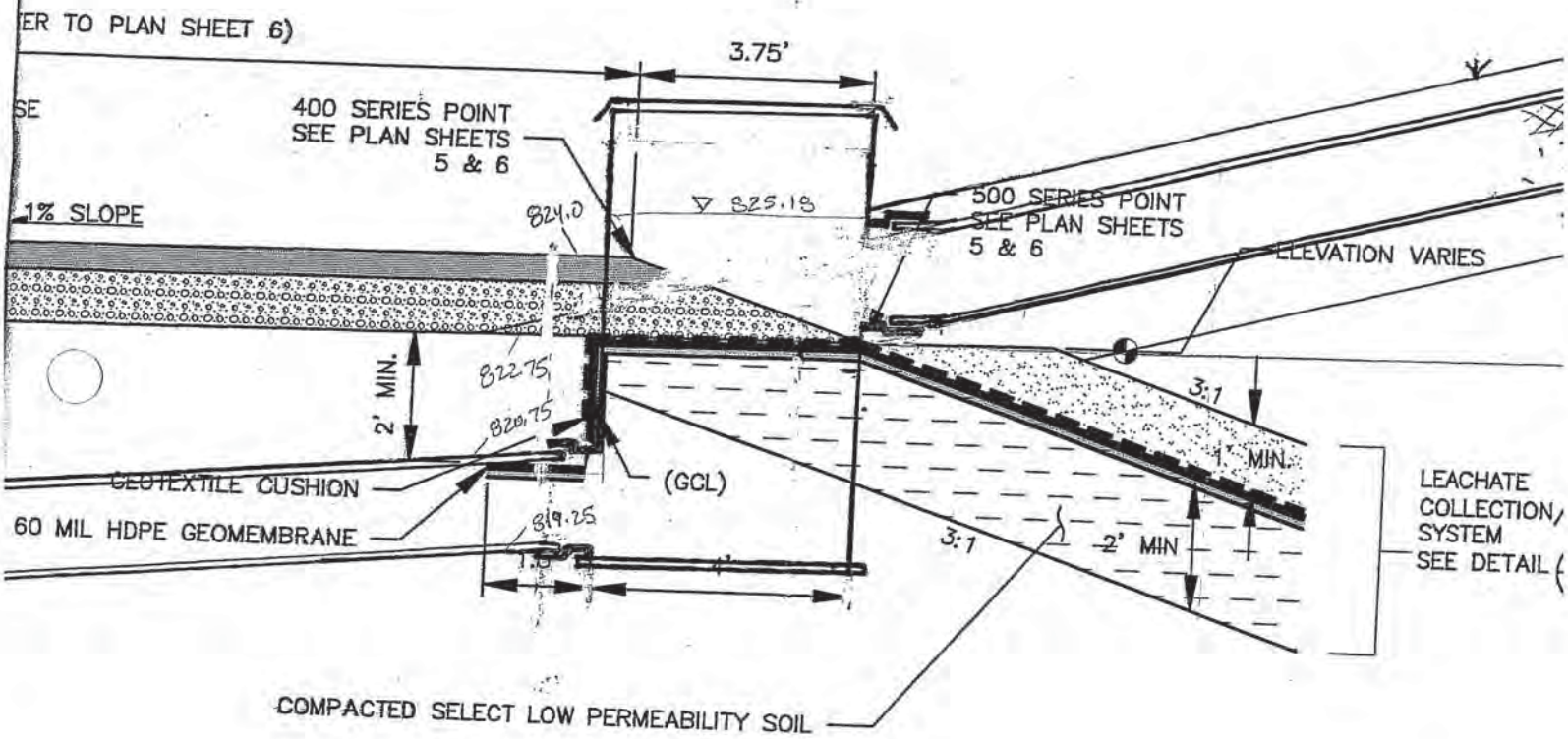
RMT, Inc. 37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

POWER SUPPLY
LARRY WOOD
262-255-3030
5/27/03

$65/VF × 7 VF BARREL
PLATE 1"

2,200 - 2,500 (incl. $500 for lid)

d flange
lid add $500



COMPUTATION SHEET

RMT INC.

SHEET _____ OF _____

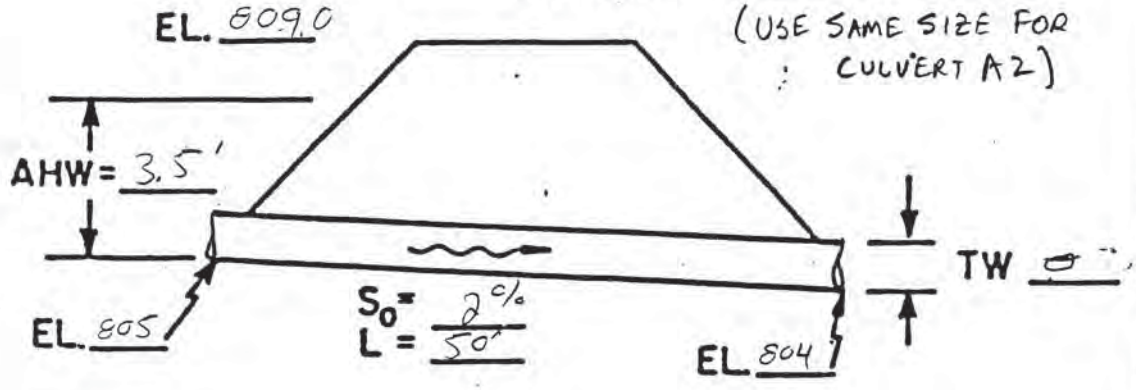
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

PROJECT / PROPOSAL NAME	PREPARED	CHECKED	PROJECT/PROPOSAL NO.
DPC - PLAN OF OPERATION	By: SAA ; Date: 9/8-9/00	By: BJK Date:	3CE1.40

SKETCH

STATION : CULVERT A1/A2

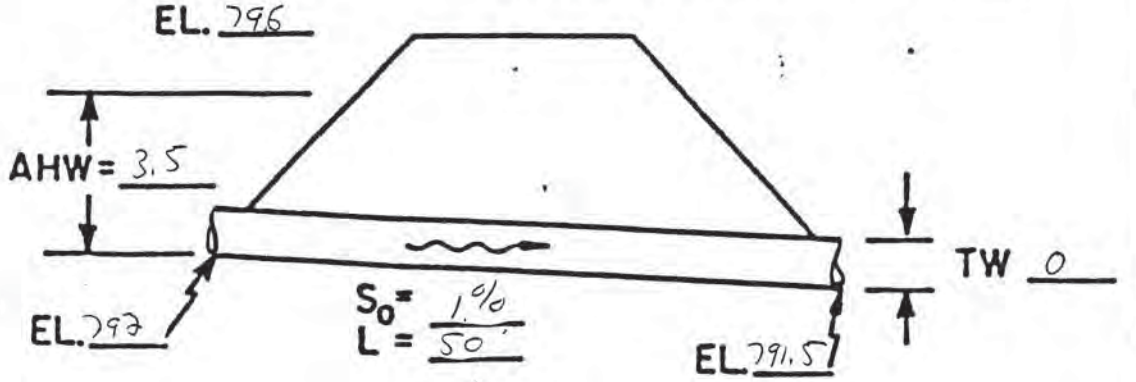
(USE SAME SIZE FOR : CULVERT A2)



MAX. STREAM FLOW= 14 cfs

SKETCH

STATION : CULVERT B



MAX. STREAM FLOW= 11 cfs

COMPUTATION SHEET

RMT INC.

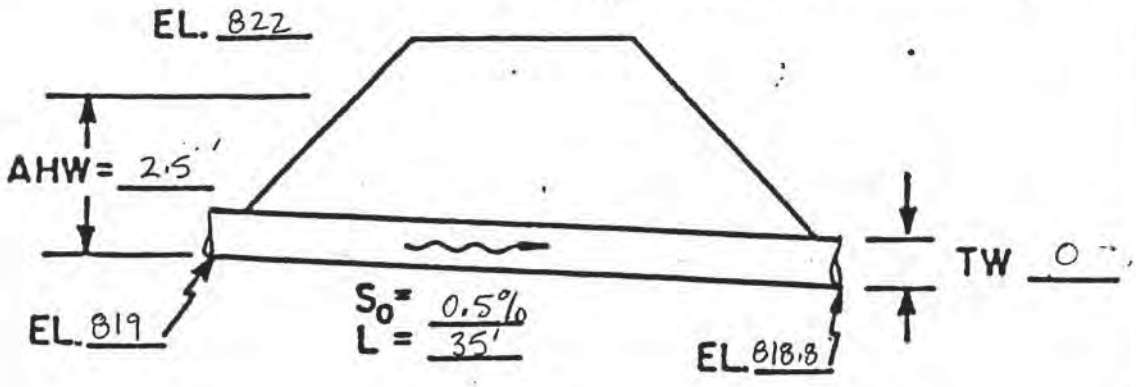
SHEET _____ OF _____

744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

PROJECT / PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
DPC - PLAN OF OPERATION	AA	9/27/06			3081.41C

SKETCH

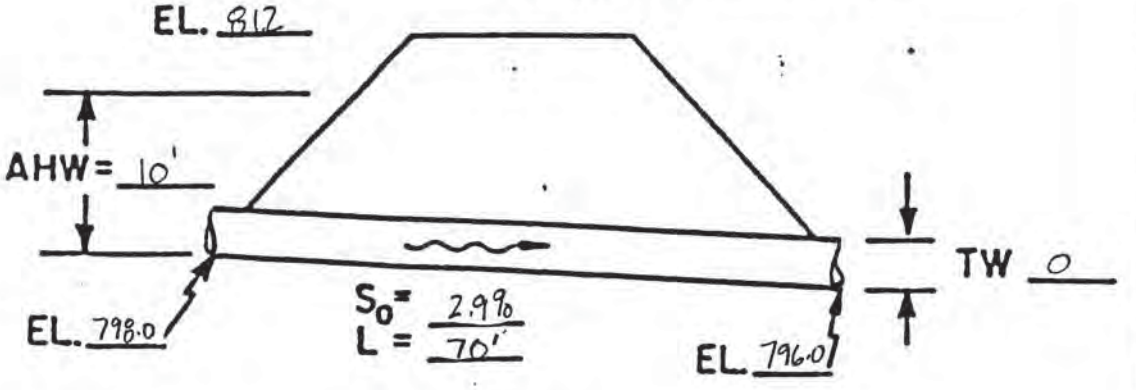
STATION : CULVERT C



MAX. STREAM FLOW= 6 cfs

SKETCH

STATION : CULVERT D



MAX. STREAM FLOW= 583 cfs

COMPUTATION SHEET

RMT INC.

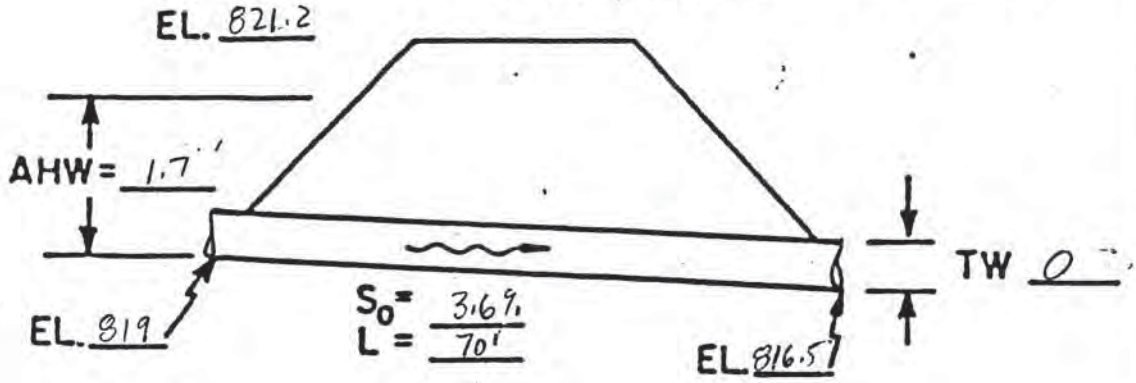
SHEET _____ OF _____

744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

PROJECT / PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
DPC - PLAN OF OPERATION	BAA	9/29/06			3C81.4C

SKETCH

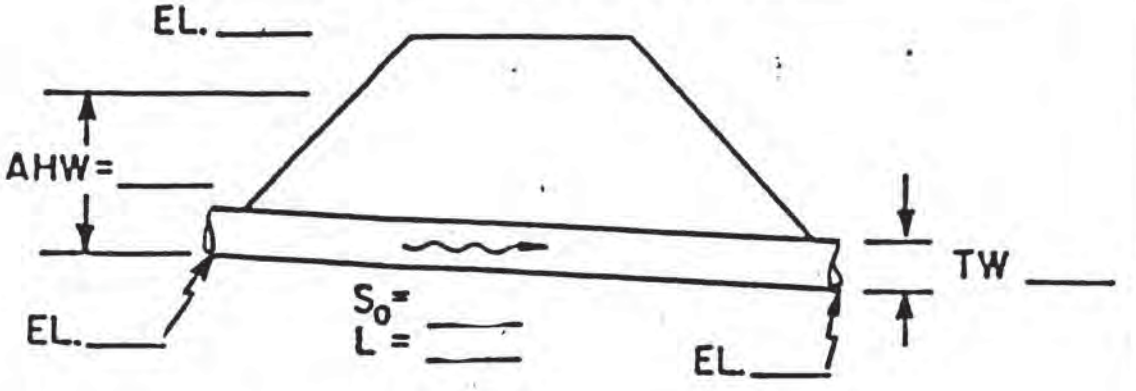
STATION : CULVERT E



MAX. STREAM FLOW= 7 cfs

SKETCH

STATION : _____



MAX. STREAM FLOW= _____

PROJECT: DPC PCO

DESIGNER: BAA

DATE: 9/29/00

HYDROLOGIC AND CHANNEL INFORMATION

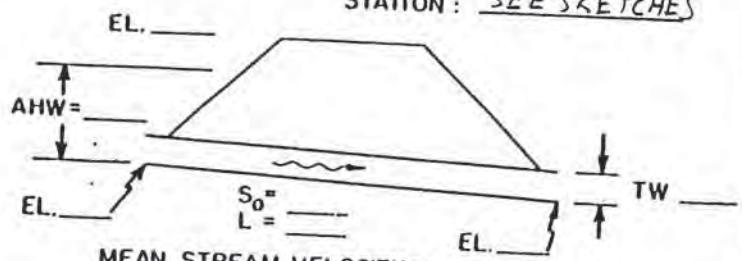
Q_1 = SEE SKETCHES TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: SEE SKETCHES



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION											CONTROLLING H W	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL HW=H + h_o - LS_o												
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW					
CULVERT A CMP-PROJECTING	14	24"	1.15	2.3	0.9	1.3	1.4	1.7		1.7	1	2	2.3			OK	
CULVERT A CONCRETE	14	18"	2	3	0.2	2.1	1.4	1.45		1.45	1	2.55				OK	
CULVERT B CMP	11	24"	1.0	2.0	0.9	0.8	1.2	1.6	0	1.6	1.0	1.4				RECOMMENDED	
CULVERT C	6	24"	.65	1.3	0.9	0.4	0.8	1.4	0	1.4	0.2	1.6				OK	

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: DRC P00

DESIGNER: BAA

DATE: 9/29/00

HYDROLOGIC AND CHANNEL INFORMATION

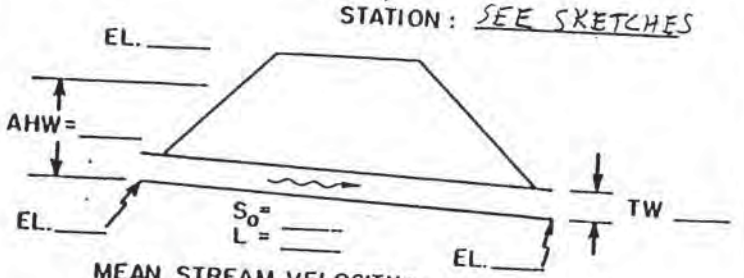
Q_1 = SEE SKETCHES TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: SEE SKETCHES



MEAN STREAM VELOCITY = _____

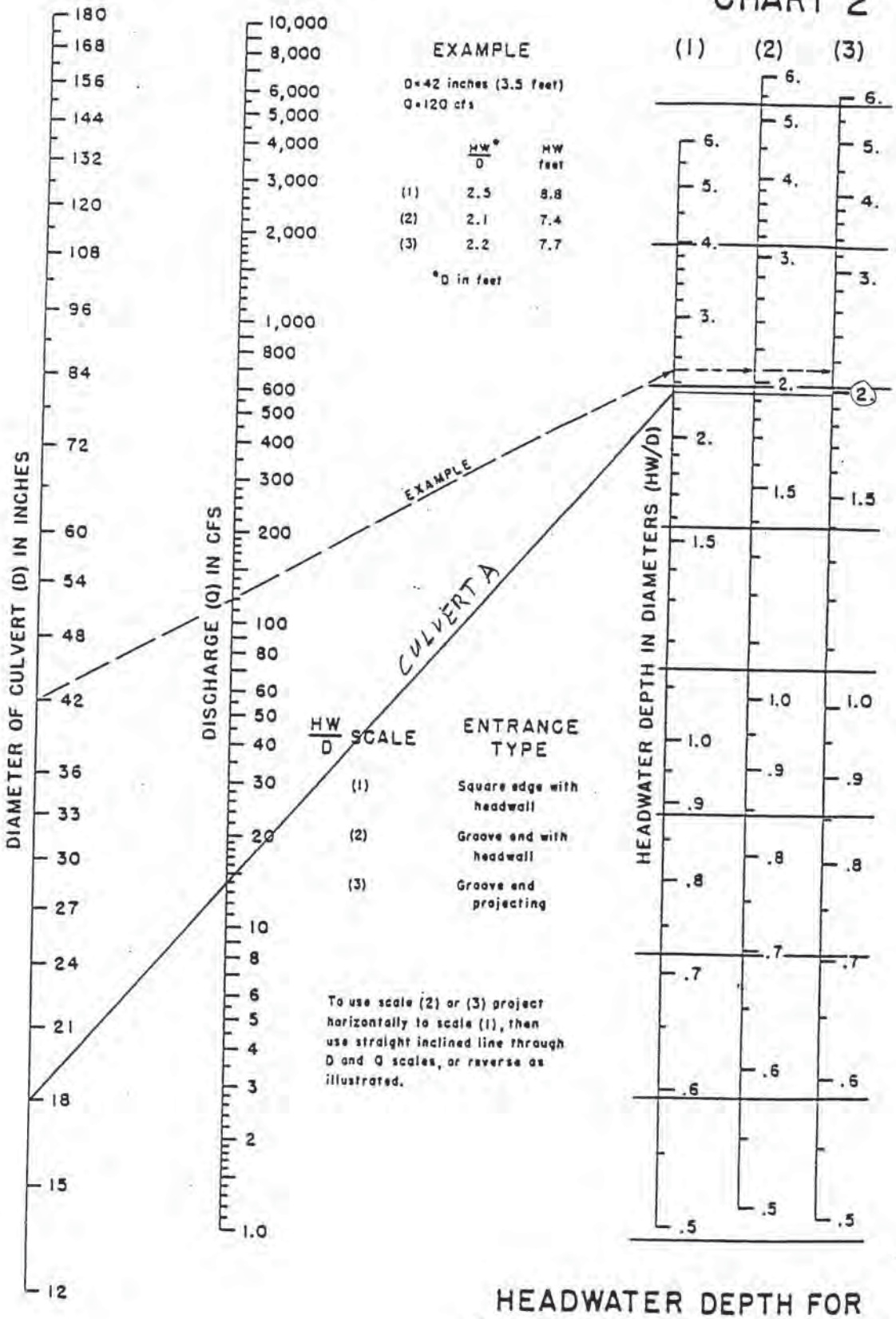
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW = H + h_o - LS_o$											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
CULVERT E CMP-PROJECTING	7	24"	0.7	1.4	0.9	0.4	0.8	1:4	0	1.4	2.5	—	1.4			OK
CULVERT D 7'X4' BOX	583	SAME FLOW AS PERMANENT CULVERTS 1, 2, and 5.														

SUMMARY & RECOMMENDATIONS:

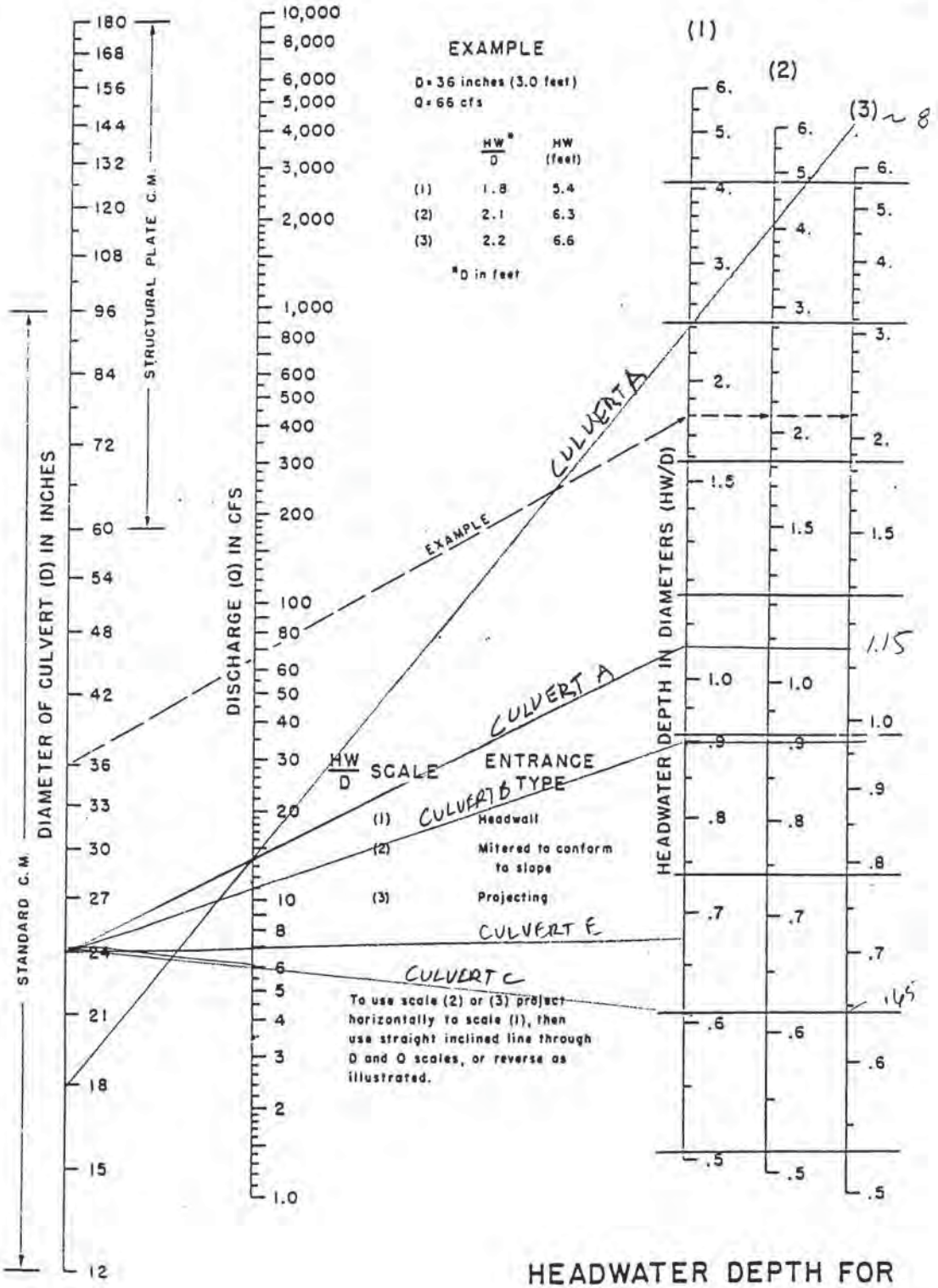
Figure 7

CHART 2



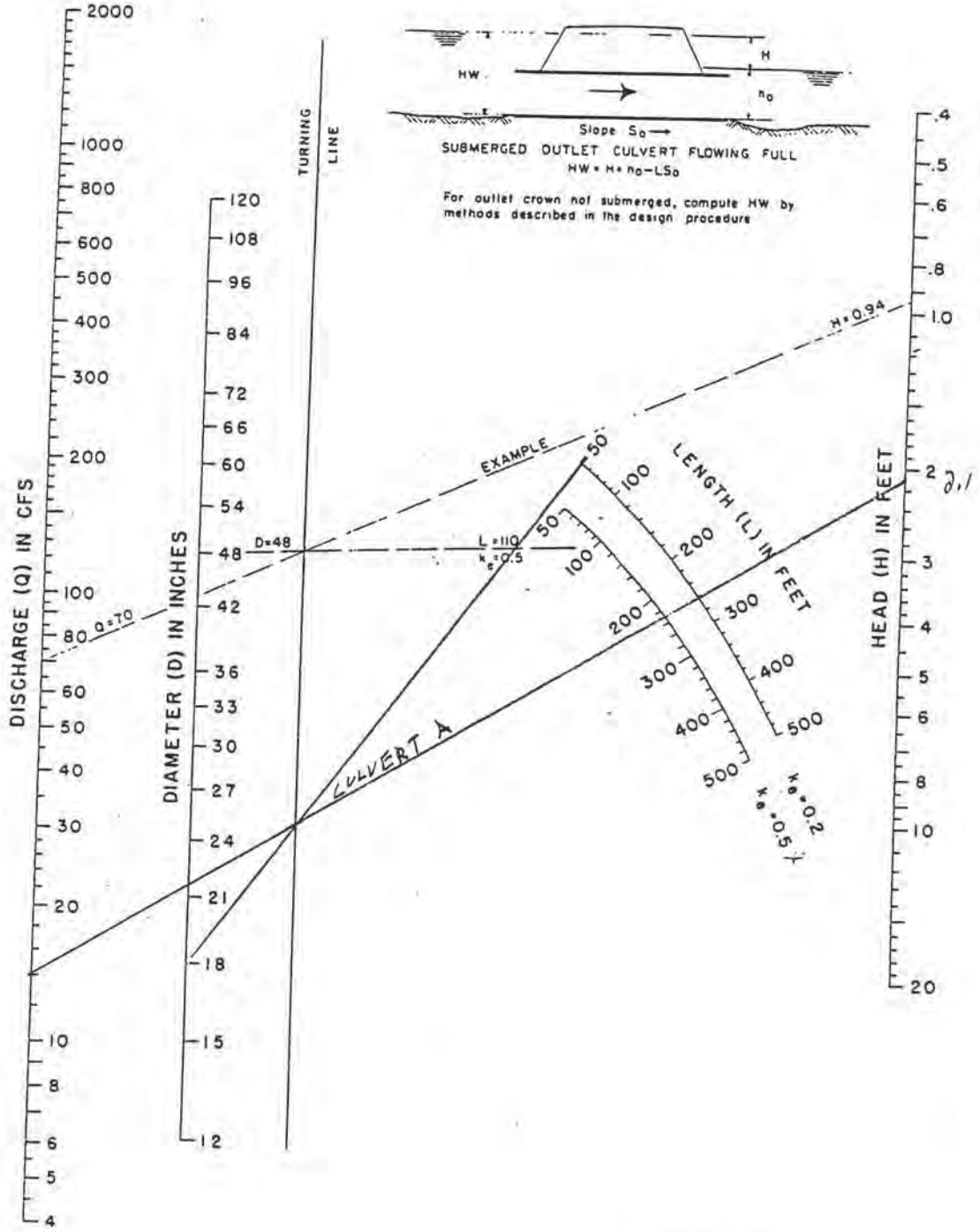
HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

CHART 5



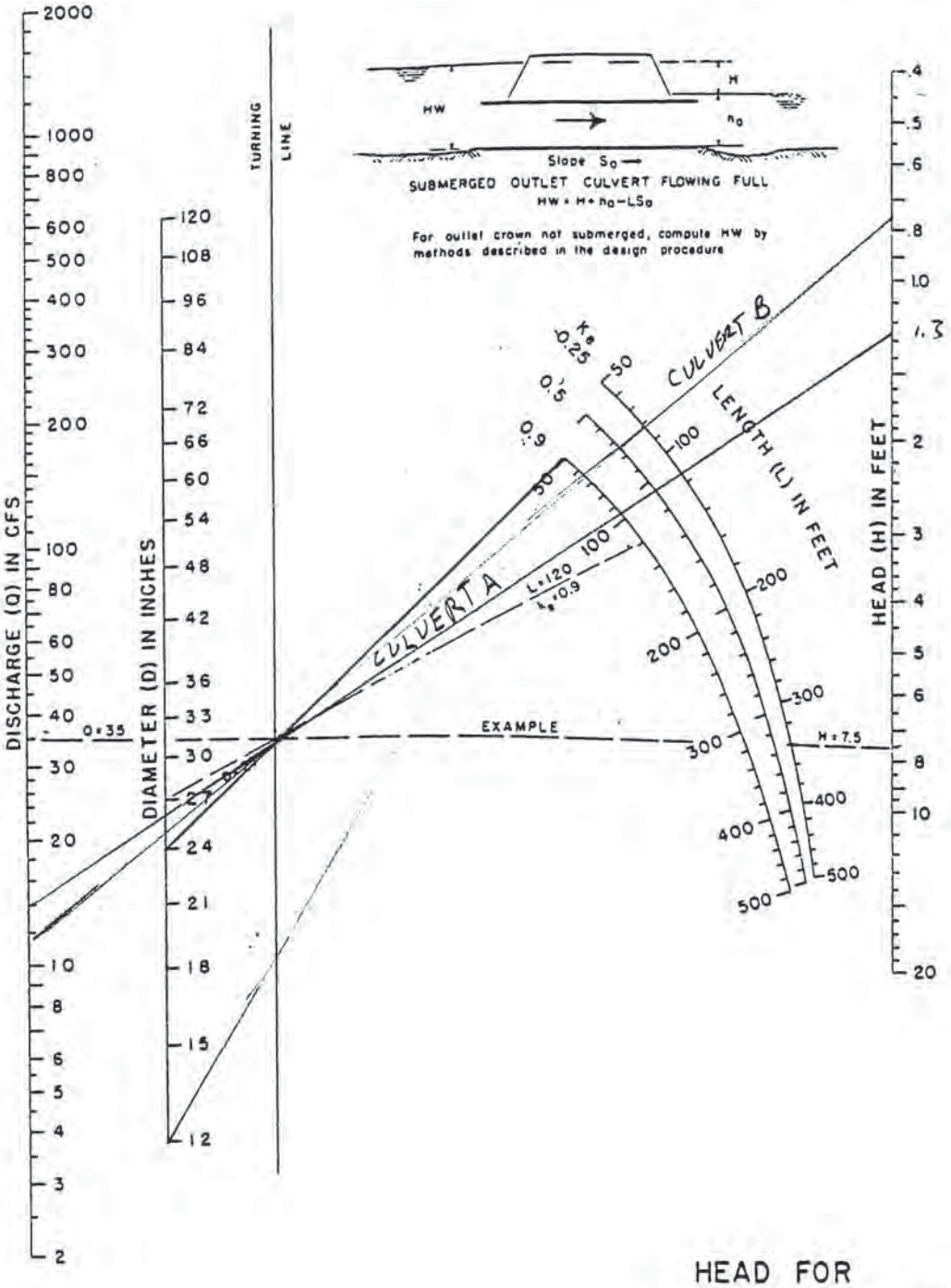
HEADWATER DEPTH FOR
C. M. PIPE CULVERTS
WITH INLET CONTROL

CHART 9



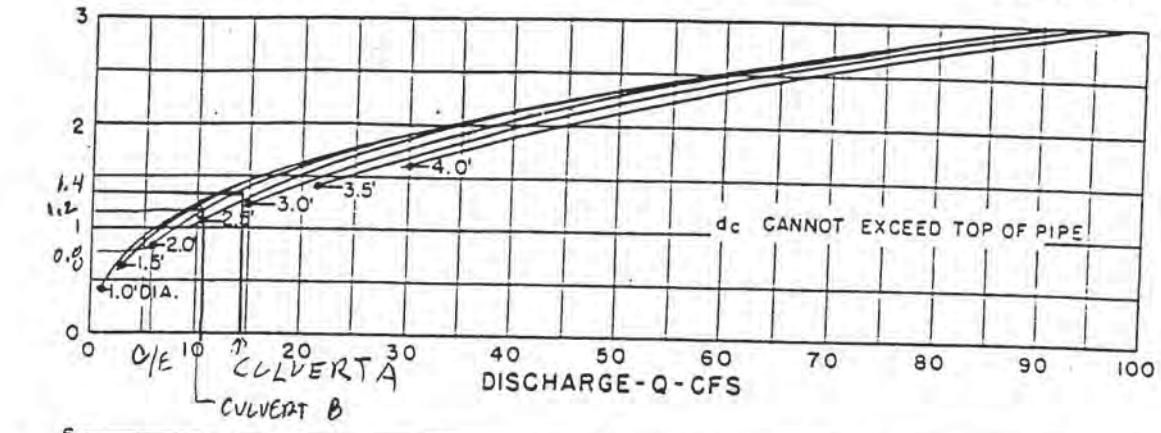
HEAD FOR
CONCRETE PIPE CULVERTS
FLOWING FULL
n = 0.012

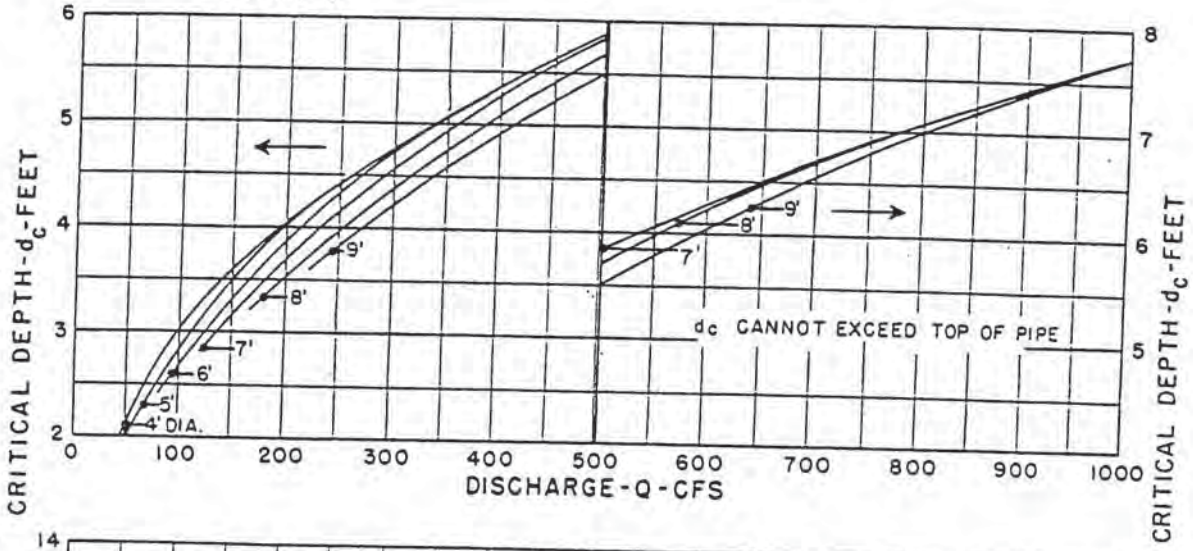
CHART 11

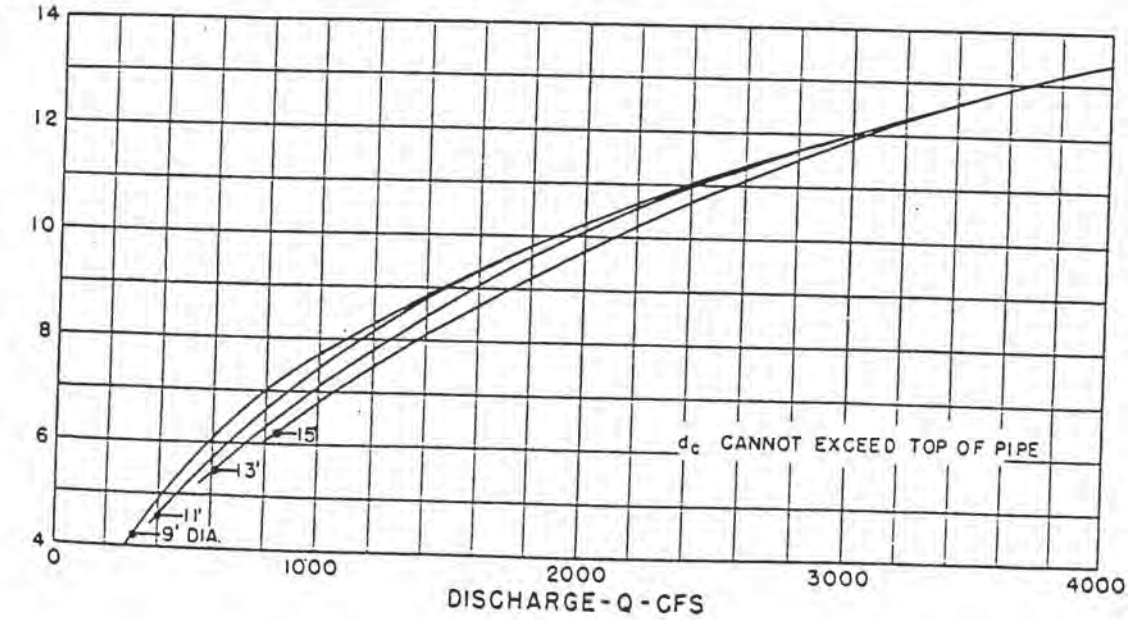


HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

CHART 16







CRITICAL DEPTH
CIRCULAR PIPE

TABLE 1 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full

Entrance head loss $H_e = k_e \frac{V^2}{2g}$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be designed using the information given for the beveled inlet, p. 5-13.

Vegetation Information

✓ BJK 10/6/98

****

NORTH AMERICAN GREEN - ECMDS VER.IV - SLOPE PROTECTION - ENGLISH

USER SPECIFIED - PERMANENT PROTECTION RESULTS

****

PROJECT NAME: Dairyland Power Coop. PROJECT NO.: 3081.33

COMPUTED BY: BJK DATE: 10-06-1998

SLOPE DESCRIPTION: 2:1 Slopes

Slope Gradient: 2.00:1 ✓ Slope Length: 50 feet ✓

Soil Type: Clay Loam (K= 0.21) ✓ Annual R Factor: 125.0 ✓

Slope Reach feet		Material	Type	Density	LS	C
0 -	30	Est. Veg.	Mix	75-95%	4.10	.020
30 -	50	P300	Mix	75-95%	7.35	.002

Slope Reach feet		Material	Type	Density	ASLbare inch	ASLmat inch	SLT inch	Sf	Recommend
0 -	30	Est. Veg.	Mix	75-95%	0.641	0.013	0.03	2.3	STABLE
30 -	50	P300	Mix	75-95%	1.149	0.002	0.03	13.1	STABLE
0 -	50	Composite			0.844	0.009			

Vegetation Density=Percentage of soil coverage provided by vegetation
C=Cover material performance factor (Fraction of soil loss of unprotected)
ASLbare=Average Soil Loss potential of unprotected soil (uniform inches)
ASLmat=Average Soil Loss potential w/material (uniform inches)
SLT=Soil Loss Tolerance for slope segment (uniform inches)
Sf=Safety Factor
Composite=Average soil loss from total slope length (uniform inches)

← For Slope's 0'-30' use Mix No. 20 Vegetation

For slopes >30', use permanant erosion matting on bottom portion of slope (below 30') And No. 20 Vegetation on upper portion

- See Attached For Vegetation Types

Species Common Name	Species Botanical Name	Acceptable Varieties
Kentucky Bluegrass	Poa pratensis	
Red Fescue	Festuca rubra	Creeping
Hard Fescue	Festuca ovina var. duriuscula	Improved
Tall Fescue	Festuca arundinacea	Improved turf type
Salt Grass	Puccinella distans	Fult's
Redtop	Agrostis alba	
Timothy	Phleum pratense	
Little Bluestem*	Andropogon scoparius	
Sideoats Grama*	Bouteloua curtipendula	
Canada Wild Rye*	Elymus canadensis	
Perennial Ryegrass	Lolium perenne	
Perennial Ryegrass	Lolium perenne	Improved Fine
Annual Ryegrass	Lolium multiflorum	
Alsike Clover	Trifolium hybridum	
Red Clover	Trifolium pratense	
White Clover	Trifolium repens	
Birdsfoot Trefoil	Lotus corniculatus	Empire
Japanese Millet	Echinochola crusgalli var. frumentacea	
Annual Oats	Avena sativa	
Alfalfa	Medicago sativa	
Bromegrass	Bromus inermis	
Orchardgrass	Dactylis glomerata	
Ladino Clover	Trifolium repens var. latum	Ladino
Agricultural Rye	Secale cereale	
Winter Wheat	Triticum aestivum	

*Pure Live Seed

Ditches

Slopes

Species	*Purity Min. %*	*Germination min.%*	*Mixture Proportions, Percent* No. 10	No. 20	No. 30	No. 40	No. 50	No. 60	No. 70
Kentucky Bluegrass	85	80	40	6	10	35			
Red Fescue	97	85	25		30	20			
Hard Fescue	97	85		24	25	20			10
Tall Fescue	98	85		40					25
Salt Grass	98	85			10				
Redtop	92	85	5						
Timothy	98	90						12	
Little Bluestem		PLS*							15
Sideoats Grama		PLS*							15
Canada Wild Rye		PLS*						12	5
Perennial Ryegrass	97	90	20	30					30
Improved Fine Perennial Ryegrass	96	85			15	25			
Annual Ryegrass	97	90						35	
Alsike Clover	97	90						4	
Red Clover	98	90						4	
White Clover	95	90	10						
Birdsfoot Trefoil	95	80			10		100		
Japenese Millet	97	85						8	
Annual Oats*	98	90						25	

* Substitute winter wheat for annual oats in fall plantings started after September 1.

630.2.1.5.1.1.2 Mixture to be Used. The selection of the seed mixture or mixtures for use on the project shall meet with the approval of the engineer, and unless otherwise provided in the contract, shall be in accordance with the following:

Seed Mixture No. 10 is intended for use on projects where average loam, heavy clay or moist soils predominate.

Seed Mixture No. 20 is intended for use on projects where light, dry, well-drained, sandy or gravelly soils predominate and shall be used for all high cut and fill slopes (generally exceeding 1.8 to 2.4 m), except where No. 70 is used.

STATE OF WISCONSIN
DEPARTMENT OF TRANSPORTATION

STANDARD SPECIFICATIONS

FOR

HIGHWAY AND STRUCTURE CONSTRUCTION

1996 EDITION

****
***** VEGETATION SELECTION *****
***** North American Green *****
****

Region Number: 1

Predominant Soil Type: Clay - Clay Loam

Moisture Regime Conditions: Normal Moisture

Planned Maintenance: Medium - High Maintenance

	Longevity	Growth Habit	Seed Rate lb/ac	kg/ha	
Grasses					
Tall Fescue (Festuca arundinacea)	P	B	200	224	(No. 20)
Chewings Fescue (Festuca rubra, commutata)	P	B	120	134	(No. 10)
Kentucky Bluegrass (Poa pratensis)	P	S	80	90	(No 10, No. 20)
Perennial Ryegrass (Lolium perenne)	P	B	160	179	(No. 10, No 20)
Annual Ryegrass (Lolium multiflorum)	A	B	160	179	
Orchardgrass (Dactylis glomerata)	P	B	40	45	
Timothy (Phleum pratense)	P	B	80	90	
Creeping Red Fescue (Festuca rubra)	P	S	120	134	
Legumes					
Alsike Clover (Trifolium hybridum)	P		15	17	
White Dutch Clover (Trifolium repens)	P		5	6	
White Sweet Clover (Melilotus alba)	P		15	17	

Appendix B: Surface Water Run-Off Control System Calculations

- Leachate Storage Capacity for the 25-Year 24-Hour Storm Event
- References

Leachate Storage Capacity for the 25-Year 24-Hour Storm Event

PROJECT / LOCATION: DPC: Alma Offsite Disposal Facility, Phase IV Landfill		PROJECT / PROPOSAL NO.
SUBJECT: Active Area Leachate Disposal Capacity		421717.0000
PREPARED BY: B. Kahnk	DATE: 4/27/2021	FINAL X
CHECKED BY: J. Hotstream	DATE: 4/29/2021	REVISION X

Purpose: Determine the leachate storage capacity from a 25 year, 24-hour storm event during the critical leachate generation scenario.

Assumptions:

1. Critical leachate generation scenario occurs during the current condition with approximately 12.7 acres are operational (Portions of Cell 2 and the entirety of Cell 3) and approximately 7.6 acres have final cover. (See Figure 1 for this scenario).

2. The 25 year, 24-hour storm event is 5.40 inches (refer to attached sheet).

3. No portion of the leachate drainage layer within the open area is saturated.

4. The leachate drainage sand has a porosity of 30 percent. The bottom ash has a porosity of 25 percent.

5. The minimum thickness of the drainage layer is 1.0 foot.

6. A minimum of 1 foot of bottom ash was installed above the drainage layer in Cell 2A over an area of approximately 2.3 acres.

7.A minimum of 4 feet of bottom ash was installed above the drainage layer during the Cell 3A construction. Using a maximum elevation of 820 feet, this bottom ash covers an area of approximately 2.75 acres.

Method:

1. Determine the volume of rain collected in the open areas during the critical condition from a 25 year, 24-hour storm event.

2. Calculate the available storage volume for leachate in the drainage layer. Due to the slope of the landfill perimeter berm, the capacity of the drainage layer is based on the area of the drainage layer at or below an elevation of 820 feet. Elevation 820 represents the lowest top of berm base grade elevation documented during construction of Cell 3A (refer to attached base grades sheet).

3. The available storage volume within the pipe trenches, transfer piping, and leachate collection tank is ignored.

4. Calculate the available storage volume for leachate in the 4 feet of bottom ash placed above the drainage layer during Cell 3A construction and 1 foot of bottom ash placed above the drainage layer during Cell 2A construction.

5. Calculate the volume of storage required for the 25 year, 24-hour storm event.

PROJECT / LOCATION: DPC: Alma Offsite Disposal Facility, Phase IV Landfill		PROJECT / PROPOSAL NO.
SUBJECT: Active Area Leachate Disposal Capacity		421717.0000
PREPARED BY: B. Kahnk	DATE: 4/27/2021	FINAL X
CHECKED BY: J. Hotstream	DATE: 4/29/2021	REVISION ☐

Step 1. Determine volume of run-off collected during the 25 year, 24-hour storm event

Area: 12.7 acres - Area open (portions of Cell 2 and the entirety of Cell 3)

Rain Event: 5.43 inches

$$Runoff\ Volume(ft^3): Rain\ Event\ (inches) \times \frac{1ft}{12\ inches} \times Area\ (acres) \times \frac{43{,}560\ ft^2}{1\ acre}$$

Runoff Volume: 250,328 cubic feet

Step 2. Calculate the available storage volume for leachate in the drainage layer.

Area: 9.2 acres - see attached base grades plan
Thickness: 1 foot
Porosity: 0.3

$$Storage\ Capacity(ft^3): Area\ (acres) \times \frac{43{,}560\ ft^2}{1\ acre} \times Thickness\ (foot) \times Porosity$$

Storage Capacity: 120,226 cubic feet

Step 3. Ignore storage in pipe trenches, transfer piping and leachate collection tank

Step 4. Calculate the available storage volume in the bottom ash placed above the drainage layer

Cell 2A:		Cell 3A:	
Area:	2.3 acre(s)	Area:	2.75 acre(s)
Thickness:	1 feet	Thickness:	4 feet
Porosity:	0.25	Porosity:	0.25

$$Storage\ Capacity(ft^3): Area\ (acres) \times \frac{43{,}560\ ft^2}{1\ acre} \times Thickness\ (foot) \times Porosity$$

Cell 2A:		Cell 3A:	
Storage Capacity:	25,047 cubic feet	Storage Capacity:	119,790 cubic feet

Total Storage Capacity (Cell 2A + Cell 3A): 144,837 cubic feet

PROJECT / LOCATION: DPC: Alma Offsite Disposal Facility, Phase IV Landfill		PROJECT / PROPOSAL NO.
SUBJECT: Active Area Leachate Disposal Capacity		421717.0000
PREPARED BY: B. Kahnk	DATE: 4/27/2021	FINAL X
CHECKED BY: J. Hotstream	DATE: 4/29/2021	REVISION

Step 5. Calculate the storage required for the 25 year, 24-hour storm event.

Required Storage:

$$Required\ Storage = Run\ Off\ Volume - Drainage\ Layer\ Capacity\ - Bottom\ Ash\ Capacity$$

Run-Off Volume:	250,328	cubic feet from Step 1
Drainage Layer:	120,226	cubic feet, from Step 2
Bottom Ash:	144,837	cubic feet from Step 4
Required Storage:	-14,734	cubic feet

The negative required storage calculated above indicates that there is sufficient storage capacity in the leachate collection drainage layer and the bottom ash that was placed in the cells above the drainage layer to contain the runoff from a 25 year, 24-hour storm event.

References

NOAA Atlas 14, Volume 8, Version 2
Location name: Alma, Wisconsin, US*
Latitude: 44.3657°, Longitude: -91.9171°
Elevation: 1074 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.366 (0.300-0.455)	0.436 (0.357-0.543)	0.555 (0.453-0.692)	0.657 (0.532-0.822)	0.801 (0.626-1.03)	0.915 (0.697-1.20)	1.03 (0.757-1.38)	1.16 (0.809-1.58)	1.32 (0.887-1.85)	1.45 (0.946-2.06)
10-min	0.536 (0.439-0.666)	0.639 (0.523-0.795)	0.813 (0.663-1.01)	0.962 (0.779-1.20)	1.17 (0.917-1.52)	1.34 (1.02-1.75)	1.51 (1.11-2.02)	1.69 (1.19-2.31)	1.94 (1.30-2.71)	2.13 (1.39-3.02)
15-min	0.653 (0.535-0.812)	0.779 (0.638-0.969)	0.991 (0.809-1.24)	1.17 (0.950-1.47)	1.43 (1.12-1.85)	1.64 (1.25-2.14)	1.84 (1.35-2.46)	2.06 (1.45-2.82)	2.36 (1.58-3.31)	2.59 (1.69-3.68)
30-min	0.908 (0.744-1.13)	1.09 (0.894-1.36)	1.40 (1.14-1.74)	1.66 (1.34-2.08)	2.03 (1.58-2.62)	2.32 (1.76-3.03)	2.62 (1.92-3.49)	2.92 (2.05-4.00)	3.34 (2.24-4.68)	3.66 (2.39-5.19)
60-min	1.19 (0.978-1.48)	1.42 (1.16-1.77)	1.82 (1.48-2.27)	2.17 (1.76-2.72)	2.69 (2.12-3.51)	3.13 (2.39-4.11)	3.58 (2.63-4.81)	4.07 (2.86-5.60)	4.76 (3.20-6.70)	5.31 (3.46-7.53)
2-hr	1.48 (1.22-1.82)	1.75 (1.44-2.15)	2.23 (1.84-2.76)	2.68 (2.19-3.33)	3.36 (2.67-4.37)	3.94 (3.04-5.15)	4.55 (3.38-6.09)	5.22 (3.70-7.15)	6.18 (4.20-8.66)	6.96 (4.57-9.80)
3-hr	1.67 (1.38-2.04)	1.95 (1.62-2.39)	2.48 (2.05-3.05)	2.99 (2.46-3.69)	3.79 (3.04-4.93)	4.48 (3.48-5.86)	5.24 (3.92-7.00)	6.07 (4.33-8.31)	7.28 (4.97-10.2)	8.28 (5.46-11.6)
6-hr	1.96 (1.64-2.38)	2.28 (1.91-2.77)	2.90 (2.41-3.53)	3.50 (2.90-4.28)	4.47 (3.63-5.79)	5.32 (4.18-6.93)	6.27 (4.73-8.33)	7.32 (5.27-9.96)	8.86 (6.11-12.3)	10.1 (6.74-14.1)
12-hr	2.23 (1.88-2.68)	2.59 (2.18-3.12)	3.29 (2.76-3.96)	3.96 (3.30-4.79)	5.02 (4.10-6.43)	5.96 (4.71-7.68)	6.99 (5.31-9.21)	8.13 (5.90-11.0)	9.80 (6.81-13.5)	11.2 (7.49-15.5)
24-hr	2.53 (2.15-3.01)	2.91 (2.47-3.46)	3.63 (3.07-4.33)	4.33 (3.64-5.19)	5.43 (4.47-6.89)	6.40 (5.10-8.17)	7.46 (5.72-9.75)	8.65 (6.33-11.6)	10.4 (7.26-14.2)	11.8 (7.97-16.2)
2-day	2.94 (2.52-3.46)	3.29 (2.81-3.87)	3.97 (3.39-4.69)	4.65 (3.94-5.53)	5.76 (4.79-7.25)	6.75 (5.44-8.56)	7.86 (6.08-10.2)	9.10 (6.72-12.1)	10.9 (7.72-14.9)	12.5 (8.48-17.0)
3-day	3.23 (2.79-3.79)	3.58 (3.08-4.19)	4.26 (3.65-5.01)	4.95 (4.21-5.84)	6.07 (5.07-7.59)	7.07 (5.72-8.91)	8.19 (6.37-10.6)	9.45 (7.01-12.5)	11.3 (8.02-15.3)	12.8 (8.79-17.5)
4-day	3.48 (3.00-4.05)	3.85 (3.32-4.49)	4.57 (3.93-5.35)	5.28 (4.51-6.21)	6.42 (5.37-7.98)	7.43 (6.03-9.31)	8.55 (6.67-11.0)	9.81 (7.30-12.9)	11.6 (8.29-15.7)	13.2 (9.04-17.9)
7-day	4.09 (3.56-4.73)	4.59 (3.99-5.31)	5.48 (4.75-6.37)	6.30 (5.42-7.35)	7.54 (6.31-9.20)	8.58 (6.97-10.6)	9.70 (7.58-12.3)	10.9 (8.15-14.2)	12.6 (9.03-16.9)	14.0 (9.70-19.0)
10-day	4.64 (4.05-5.34)	5.24 (4.57-6.03)	6.27 (5.45-7.24)	7.17 (6.20-8.32)	8.50 (7.11-10.3)	9.58 (7.80-11.7)	10.7 (8.39-13.4)	11.9 (8.91-15.4)	13.6 (9.73-18.1)	14.9 (10.4-20.1)
20-day	6.27 (5.53-7.14)	7.04 (6.19-8.02)	8.32 (7.29-9.51)	9.40 (8.19-10.8)	10.9 (9.19-13.0)	12.1 (9.95-14.7)	13.4 (10.6-16.6)	14.7 (11.0-18.7)	16.4 (11.8-21.6)	17.7 (12.4-23.7)
30-day	7.70 (6.82-8.72)	8.60 (7.61-9.75)	10.1 (8.89-11.5)	11.3 (9.91-12.9)	13.0 (11.0-15.3)	14.3 (11.8-17.2)	15.7 (12.4-19.3)	17.0 (12.9-21.6)	18.8 (13.6-24.6)	20.2 (14.2-26.9)
45-day	9.58 (8.53-10.8)	10.7 (9.51-12.1)	12.5 (11.1-14.1)	13.9 (12.3-15.8)	15.9 (13.4-18.5)	17.3 (14.3-20.6)	18.8 (14.9-22.9)	20.2 (15.3-25.3)	21.9 (15.9-28.5)	23.3 (16.4-30.8)
60-day	11.2 (10.0-12.6)	12.6 (11.2-14.1)	14.7 (13.0-16.5)	16.3 (14.4-18.5)	18.5 (15.7-21.4)	20.1 (16.6-23.7)	21.5 (17.1-26.1)	22.9 (17.4-28.7)	24.7 (18.0-31.8)	25.9 (18.4-34.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PROJECT / LOCATION: DPC: Alma Offsite Disposal Facility, Phase IV Landfill		PROJECT / PROPOSAL NO.
SUBJECT: Active Area Leachate Disposal Capacity		243332.0002
PREPARED BY: J. Hotstream	DATE: 8/31/2016	FINAL ☐
CHECKED BY:	DATE:	REVISION ☐

Volume Relationships of Sand

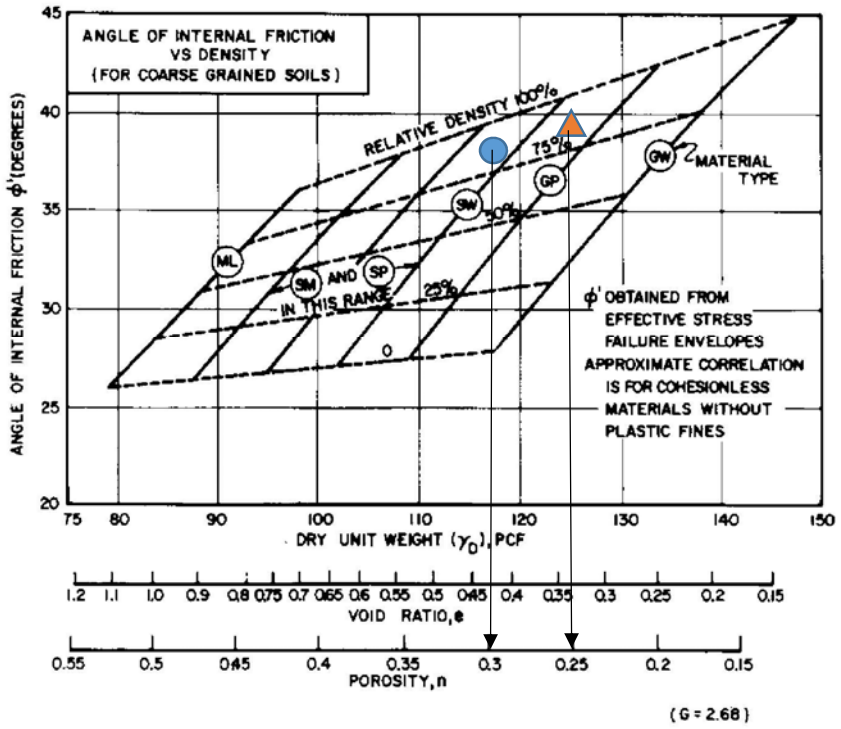
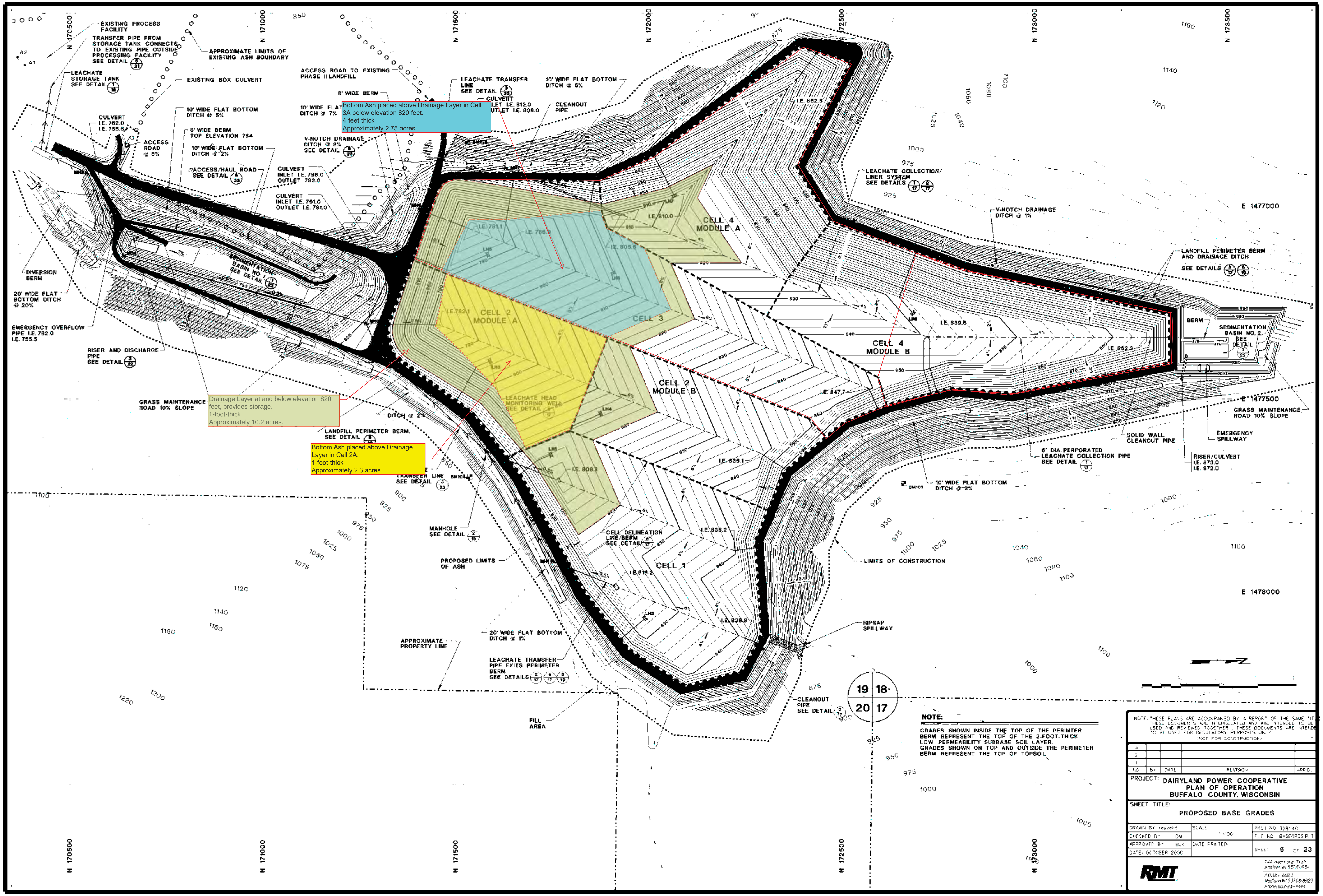


Figure from NavFac DM 7.1 (1986)

Drainage Layer Sand - Poorly Graded Sand (SP)

Bottom Ash - Poorly Graded Sand (SP) to Poorly Graded Gravel (GP)


Bottom Ash placed above Drainage Layer in Cell 3A below elevation 820 feet.
4-feet-thick
Approximately 2.75 acres.
Drainage Layer at and below elevation 820 feet, provides storage.
1-foot-thick
Approximately 10.2 acres.
Bottom Ash placed above Drainage Layer in Cell 2A.
1-foot-thick
Approximately 2.3 acres.
EXISTING PROCESS FACILITY
TRANSFER PIPE FROM STORAGE TANK CONNECTS TO EXISTING PIPE OUTSIDE PROCESSING FACILITY SEE DETAIL
APPROXIMATE LIMITS OF EXISTING ASH BOUNDARY
LEACHATE STORAGE TANK SEE DETAIL
EXISTING BOX CULVERT
ACCESS ROAD TO EXISTING PHASE II LANDFILL
8' WIDE BERM
LEACHATE TRANSFER LINE SEE DETAIL
10' WIDE FLAT BOTTOM DITCH @ 5%
CULVERT I.E. 762.0 I.E. 755.5
10' WIDE FLAT BOTTOM DITCH @ 5%
8' WIDE BERM TOP ELEVATION 784
ACCESS ROAD @ 9%
10' WIDE FLAT BOTTOM DITCH @ 2%
ACCESS/HAUL ROAD SEE DETAIL
CULVERT INLET I.E. 798.0 OUTLET 782.0
CULVERT INLET I.E. 791.0 OUTLET I.E. 781.0
V-NOTCH DRAINAGE DITCH @ 8% SEE DETAIL
CLEANOUT PIPE
LEACHATE COLLECTION/ LINER SYSTEM SEE DETAILS
V-NOTCH DRAINAGE DITCH @ 1%
LANDFILL PERIMETER BERM AND DRAINAGE DITCH SEE DETAILS
SEDIMENTATION BASIN NO. 1 SEE DETAIL
DIVERSION BERM
20' WIDE FLAT BOTTOM DITCH @ 20%
EMERGENCY OVERFLOW PIPE I.E. 782.0 I.E. 755.5
RISER AND DISCHARGE PIPE SEE DETAIL
GRASS MAINTENANCE ROAD 10% SLOPE
CELL 4 MODULE A
CELL 3
CELL 2 MODULE A
CELL 2 MODULE B
CELL 4 MODULE B
CELL 1
LEACHATE HEAD MONITORING WELL SEE DETAIL
BERM
SEDIMENTATION BASIN NO. 2 SEE DETAIL
E 1477000
E 1477500
E 1478000
GRASS MAINTENANCE ROAD 10% SLOPE
EMERGENCY SPILLWAY
SOLID WALL CLEANOUT PIPE
6" DIA PERFORATED LEACHATE COLLECTION PIPE SEE DETAIL
RISER/CULVERT I.E. 873.0 I.E. 872.0
10' WIDE FLAT BOTTOM DITCH @ 2%
LANDFILL PERIMETER BERM SEE DETAIL
MANHOLE SEE DETAIL
CELL DELINEATION LINE/BERM SEE DETAIL
PROPOSED LIMITS OF ASH
LIMITS OF CONSTRUCTION
RIPRAP SPILLWAY
APPROXIMATE PROPERTY LINE
20' WIDE FLAT BOTTOM DITCH @ 1%
LEACHATE TRANSFER PIPE EXITS PERIMETER BERM SEE DETAILS
FILL AREA
CLEANOUT PIPE SEE DETAIL
N 170500
N 171000
N 171500
N 172000
N 172500
N 173000
N 173500
NOTE:
GRADES SHOWN INSIDE THE TOP OF THE PERIMTER BERM REPRESENT THE TOP OF THE 2-FOOT-THICK LOW PERMEABILITY SUBBASE SOIL LAYER.
GRADES SHOWN ON TOP AND OUTSIDE THE PERIMETER BERM REPRESENT THE TOP OF TOPSOIL
NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY.
(NOT FOR CONSTRUCTION)
NO. BY DATE REVISION APP'D.
PROJECT: DAIRYLAND POWER COOPERATIVE
PLAN OF OPERATION
BUFFALO COUNTY, WISCONSIN
SHEET TITLE:
PROPOSED BASE GRADES
DRAWN BY: reyzerd
CHECKED BY: DM
APPROVED BY: BJK
DATE: OCTOBER 2000
SCALE
DATE PRINTED:
PROJ. NO. 3087.40
FILE NO. BASEGRDS.PLT
SHEET 5 OF 23
RMT
744 Heartland Trail Madison, WI 53717-1934
P.O. Box 8923 Madison, WI 53708-8923
Phone: 608-831-4444

EXISTING PHASE II LANDFILL (CLOSED)

W106

P42B

W42

P42A

CELL 4A (FUTURE)

OPEN AREA OF LANDFILL: 12.69 ACRES

EXISTING PHASE IV, CELL 3A AND 3B (ACTIVE)

W100R

W100AR

W107

CELL 4B (FUTURE)

SG-2

EXISTING PHASE IV, CELL 2A

W105

EXISTING PHASE IV, CELL 2B

W104A

W104

W101A

W101

EXISTING PHASE IV, CELL 1

AREA OF PHASE IV LANDFILL THAT HAS RECEIVED FINAL COVER

W102AR

W102R

SG-3

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- GRID LOCATION
- 890 — EXISTING 10' CONTOUR
- x 895.7 — EXISTING SPOT ELEVATION
- LIMITS OF PERMITTED LANDFILL
- LIMITS OF CCR DISPOSAL (ACTIVE LANDFILL)
- PHASE LINE
- W42 — MONITORING WELL (NOT INCLUDED IN FEDERAL GWMP)
- W42B — PIEZOMETER (NOT INCLUDED IN FEDERAL GWMP)
- W101 — MONITORING WELL LOCATION
- W101A — PIEZOMETER LOCATION

NOTES

1. THE BASE MAP WAS COMPILED FROM THE CELL 3B LINER CONSTRUCTION DOCUMENTATION REPORT (OCTOBER, 2016) AND THE NOVEMBER 12, 2020 ANNUAL AIR SPACE SURVEY BY EXETER DESIGN, INC.
2. THE HORIZONTAL DATUM IS REFERENCED TO THE WISCONSIN STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NORTH AMERICAN DATUM 1983, US SURVEY FEET.
3. VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 1988. CONTOUR INTERVAL IS 10 FEET.

N

0 200 400

SCALE IN FEET

PROJECT: DAIRYLAND POWER COOPERATIVE
RUN-ON AND RUN-OFF CONTROL SYSTEMS PLAN
ALMA OFF-SITE PHASE IV LANDFILL
BUFFALO COUNTY, WISCONSIN

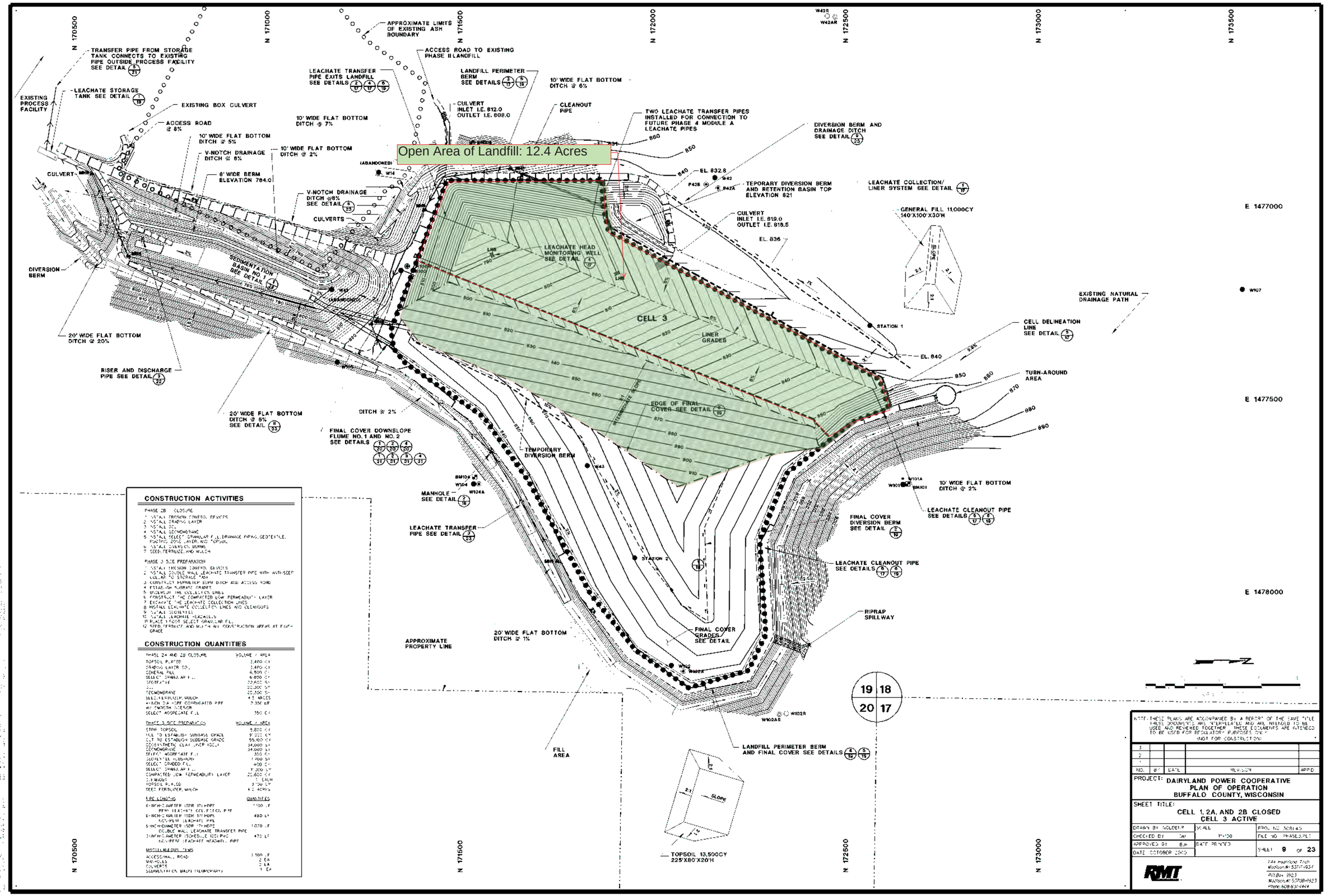
TITLE: EXISTING CONDITIONS

WORKING COPY

DRAWN BY:	S. HAMWAY	PROJ NO.:	421717
CHECKED BY:	B. KAHNK		
APPROVED BY:			FIGURE 1
DATE:	OCTOBER 2021		

TRC
708 Heartland Trail
Suite 3000
Madison, WI 53717
Phone: 608.826.3600

FILE NO.: 421717.01.dwg



CONSTRUCTION ACTIVITIES

PHASE 2B - CLOSURE
1. INSTALL EROSION CONTROL DEVICES
2. INSTALL GRADING LAYER
3. INSTALL GCL
4. INSTALL GEOMEMBRANE
5. INSTALL SELECT GRANULAR F.L. DRAINAGE PIPING, GEOTEXTILE, PROTECTIVE COVER LAYER, AND TOPSOIL
6. INSTALL DIVERSION BERMS
7. SEED, FERTILIZE, AND MULCH

PHASE 3 SITE PREPARATION
1. INSTALL EROSION CONTROL DEVICES
2. INSTALL DOUBLE WALL LEACHATE TRANSFER PIPE WITH ANTI-SEEP COLLAR TO STORAGE TANK
3. CONSTRUCT PERIMETER BERM DITCH AND ACCESS ROAD
4. ESTABLISH SUBBASE GRADES
5. UNDERCUT THE COLLECTION LINES
6. CONSTRUCT THE COMPACTED LOW PERMEABILITY LAYER
7. EXCAVATE THE LEACHATE COLLECTION LINES
8. INSTALL LEACHATE COLLECTION LINES AND CLEANOUTS
9. INSTALL GEOTEXTILE
10. INSTALL LEACHATE HEADWALLS
11. PLACE 1 FOOT SELECT GRANULAR F.L.
12. SEED, FERTILIZE, AND MULCH ALL CONSTRUCTION AREAS AT FINAL GRADE

CONSTRUCTION QUANTITIES

PHASE 2A AND 2B CLOSURE	VOLUME / AREA
TOPSOIL PLACED	3,400 CY
GRADING LAYER SOIL	3,400 CY
GENERAL FILL	6,800 CY
SELECT GRANULAR F.L.	6,800 CY
GEOTEXTILE	22,600 SY
GCL	22,300 SY
GEOMEMBRANE	22,300 SY
SEED, FERTILIZER, MULCH	4.5 ACRES
4-INCH DIA. HDPE CORRUGATED PIPE W/ SMOOTH INTERIOR	2,350 LF
SELECT AGGREGATE F.L.	350 CY

PHASE 3 SITE PREPARATION	VOLUME / AREA
STRIP TOPSOIL	6,800 CY
FILL TO ESTABLISH SUBBASE GRADE	9,300 CY
CUT TO ESTABLISH SUBBASE GRADE	55,100 CY
GEOSYNTHETIC CLAY LINER (GCL)	34,000 SY
GEOMEMBRANE	34,000 SY
SELECT AGGREGATE F.L.	350 CY
SLOPE MESS-NOH	1,700 SY
SELECT GRADED F.L.	400 CY
SELECT GRANULAR F.L.	7,200 CY
COMPACTED LOW PERMEABILITY LAYER	20,600 CY
MANHOLE	1 EACH
TOPSOIL PLACED	3,700 CY
SEED, FERTILIZER, MULCH	4.0 ACRES

PIPE LENGTHS	QUANTITIES
6-INCH-DIAMETER (SDR 17) HDPE PERF. LEACHATE COLLECTION PIPE	1,100 LF
6-INCH-DIAMETER (SDR 17) HDPE NON-PERF. LEACHATE PIPE	480 LF
6-INCH-DIAMETER (SDR 17) HDPE DOUBLE WALL LEACHATE TRANSFER PIPE	1070 LF
3-INCH-DIAMETER (SCHEDULE 80) PVC NON-PERF. LEACHATE HEADWALL PIPE	470 LF

MISCELLANEOUS ITEMS	
ACCESS/HAUL ROAD	1,500 LF
MANHOLES	2 EA
CULVERTS	2 EA
SEDIMENTATION BASIN (TEMPORARY)	1 EA

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NOT FOR CONSTRUCTION

NO.	BY	DATE	REVISION	APPD
3				
2				
1				

PROJECT: DAIRYLAND POWER COOPERATIVE
PLAN OF OPERATION
BUFFALO COUNTY, WISCONSIN

SHEET TITLE:
CELL 1, 2A, AND 2B CLOSED
CELL 3 ACTIVE

DRAWN BY: WOLDER	SCALE:	PROJ. NO: 3081A0
CHECKED BY: DM	1"=100'	FILE NO: PHASE3.PLT
APPROVED BY: BJA	DATE PRINTED:	SHEET 9 OF 23
DATE: OCTOBER 2010		

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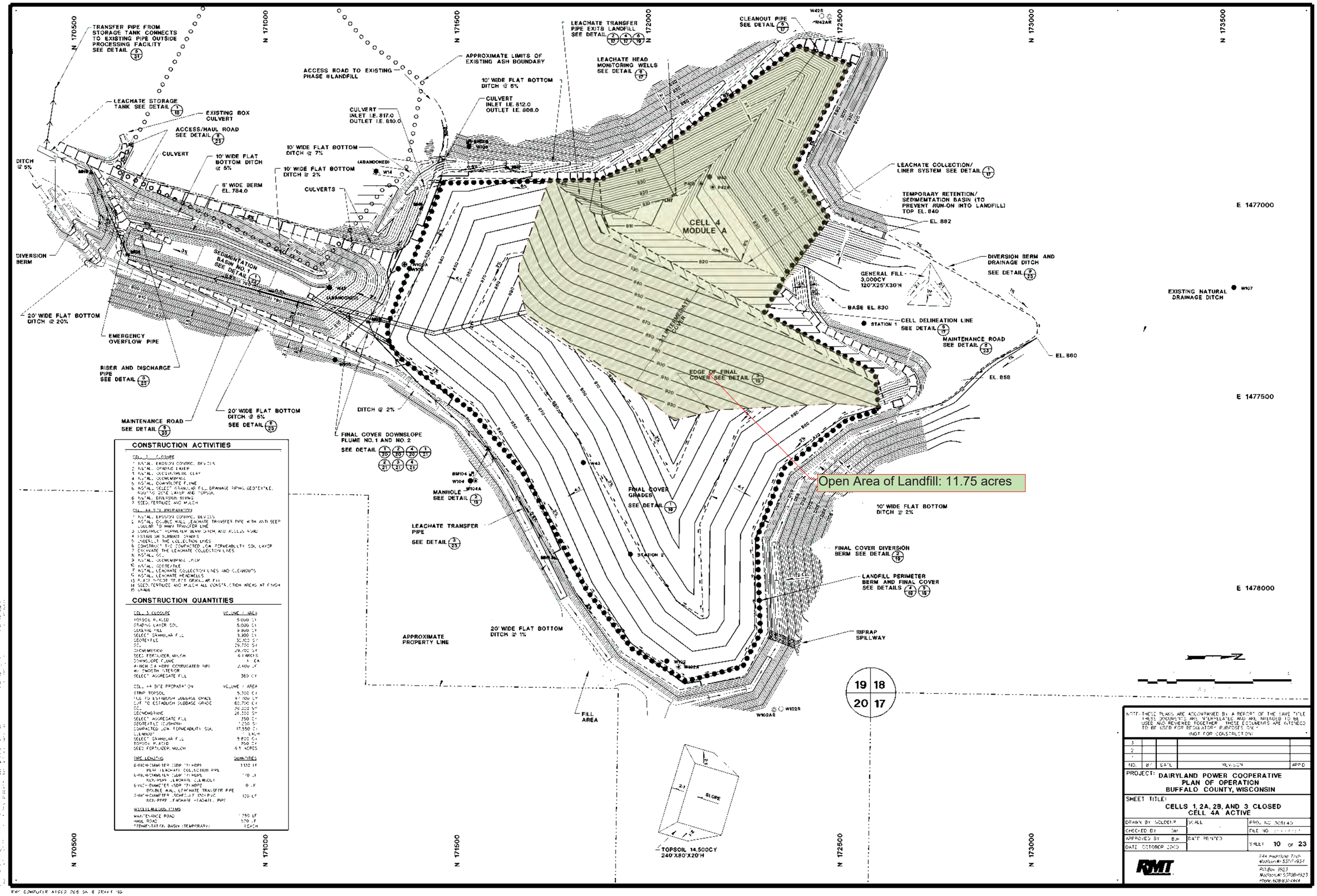
Phone: 608-831-4444

RMT COMPUTER AIDED DESIGN & DRAFTING



CONSTRUCTION ACTIVITIES

CELL 3 CLOSURE
1. INSTAL. EROSION CONTRL. DEVICES
2. INSTAL. GRADING LAYER
3. INSTAL. GEOSYNTHETIC CLAY
4. INSTAL. GEOMEMBRANE
5. INSTAL. DOWNSLOPE FLUME
6. INSTAL. SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE, AGGR'G ZONE LAYER AND TOPSOIL
6. INSTAL. DIVERSION BERMS
7. SEED, FERTILIZE AND MULCH

CELL 4A SITE PREPARATION
1. INSTAL. EROSION CONTRL. DEVICES
2. INSTAL. DOUBLE WALL LEACHATE TRANSFER PIPE WITH ANTI SEEP COLLAR TO MAIN TRANSFER LINE
3. CONSTRUCT TEMPORARY BERM DITCH, AND ACCESS ROAD
4. ESTABLISH SUBBASE GRADES
5. UNDERCUT THE COLLECTION LINES
6. CONSTRUCT THE COMPACTED LOW PERMEABILITY SOIL LAYER
7. EXCAVATE THE LEACHATE COLLECTION LINES
8. INSTAL. GCL
9. INSTAL. GEOMEMBRANE LINER
10. INSTAL. GEOTEXTILE
11. INSTAL. LEACHATE COLLECTION LINES AND CLEANOUTS
12. INSTAL. LEACHATE HEADCELLS
13. PLACE 24"COVER SELECT GRANULAR FILL
14. SEED, FERTILIZE AND MULCH ALL CONSTRUCTION AREAS AT FINISH GRADE

CONSTRUCTION QUANTITIES

CELL 3 CLOSURE	VOLUME / AREA
TOPSOIL PLACED	5,000 CY
GRADING LAYER SOIL	5,000 CY
GENERAL FILL	9,900 CY
SELECT GRANULAR FILL	3,300 CY
GEOTEXTILE	32,100 SY
GCL	29,700 SY
GEOMEMBRANE	29,700 SY
SEED FERTILIZER, MULCH	6.1 ACRES
DOWNSLOPE FLUME	1 EA
4-INCH DIA HDPE CORRUGATED PIPE W/ SMOOTH INTERIOR	2,400 LF
SELECT AGGREGATE FILL	360 CY

CELL 4A SITE PREPARATION	VOLUME / AREA
STRIP TOPSOIL	5,300 CY
FILL TO ESTABLISH GENERAL GRADE	47,700 CY
CUT TO ESTABLISH SUBBASE GRADE	65,700 CY
GCL	26,300 SY
GEOMEMBRANE	26,300 SY
SELECT AGGREGATE FILL	350 CY
GEOTEXTILE CUSHION	1,350 SY
COMPACTED LOW PERMEABILITY SOIL	17,550 CY
CLEANOUT	1 EACH
SELECT GRANULAR FILL	9,800 CY
TOPSOIL PLACED	350 CY
SEED FERTILIZER, MULCH	6.5 ACRES

PIPE LENGTHS	QUANTITIES
8-INCH-DIAMETER SDR 17 HDPE PERF LEACHATE COLLECTION PIPE	1,130 LF
6-INCH-DIAMETER SDR 17 HDPE NON-PERF LEACHATE CLEANOUT	170 LF
8-INCH-DIAMETER SDR 17 HDPE DOUBLE WALL LEACHATE TRANSFER PIPE	0 LF
3-INCH-DIAMETER SCHEDULE 80 PVC NON-PERF LEACHATE HEADER PIPE	120 LF

MISCELLANEOUS ITEMS	
MAINTENANCE ROAD	1,350 LF
HAUL ROAD	570 LF
SEDIMENTATION BASIN (TEMPORARY)	1 EACH

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NOT FOR CONSTRUCTION

NO.	BY	DATE	REVISION	APPD
1				
2				
3				

PROJECT: DAIRYLAND POWER COOPERATIVE
PLAN OF OPERATION
BUFFALO COUNTY, WISCONSIN

SHEET TITLE:
CELLS 1, 2A, 2B, AND 3 CLOSED
CELL 4A ACTIVE

DRAWN BY	WOLDER	SCALE	PROJ. NO. 3081.45
CHECKED BY	SM		FILE NO. [illegible]
APPROVED BY	BJH	DATE PRINTED	SHEET 10 OF 23
DATE	OCTOBER 2010		

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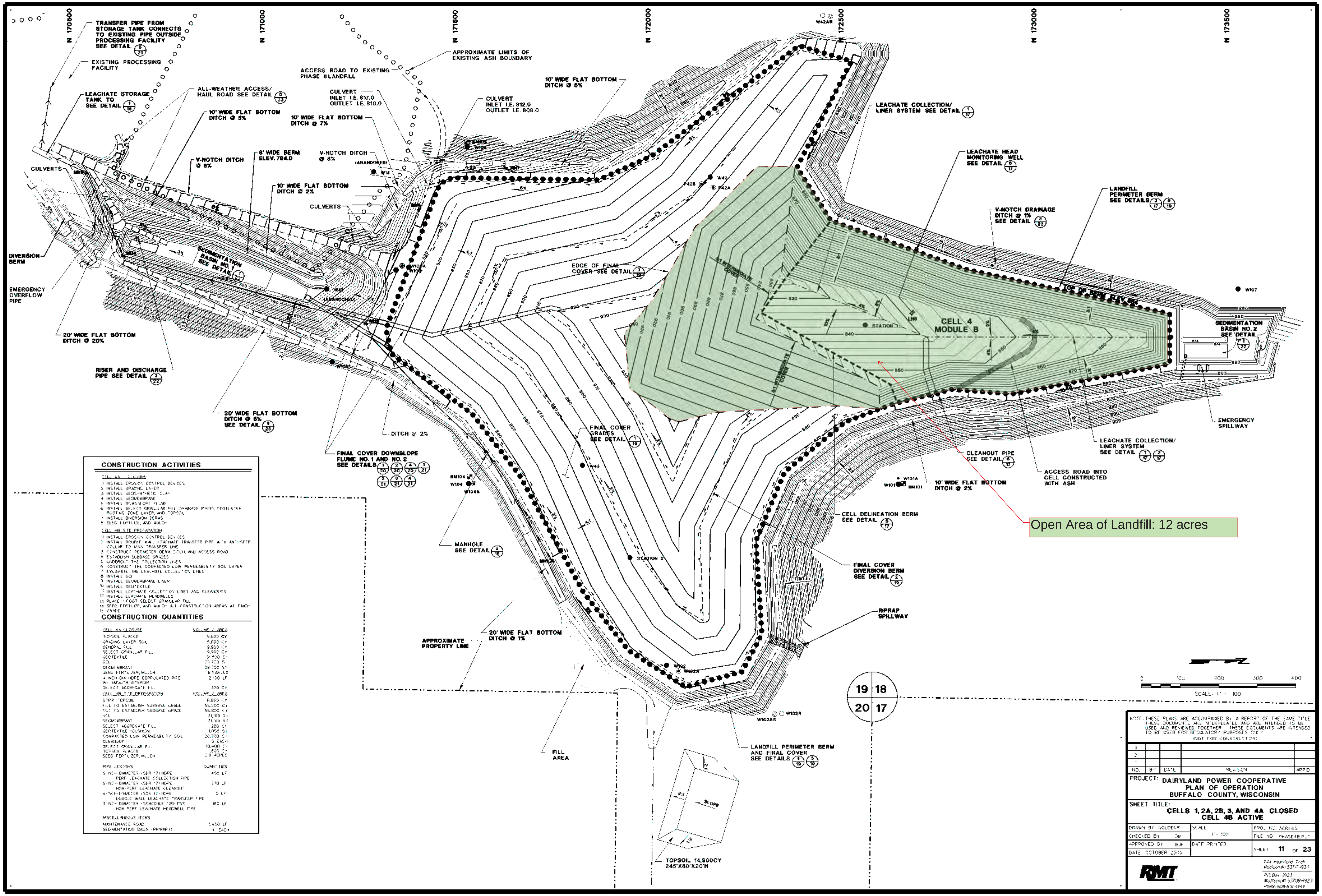
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923
Madison, WI 53708-8923
Phone: 608-831-4444

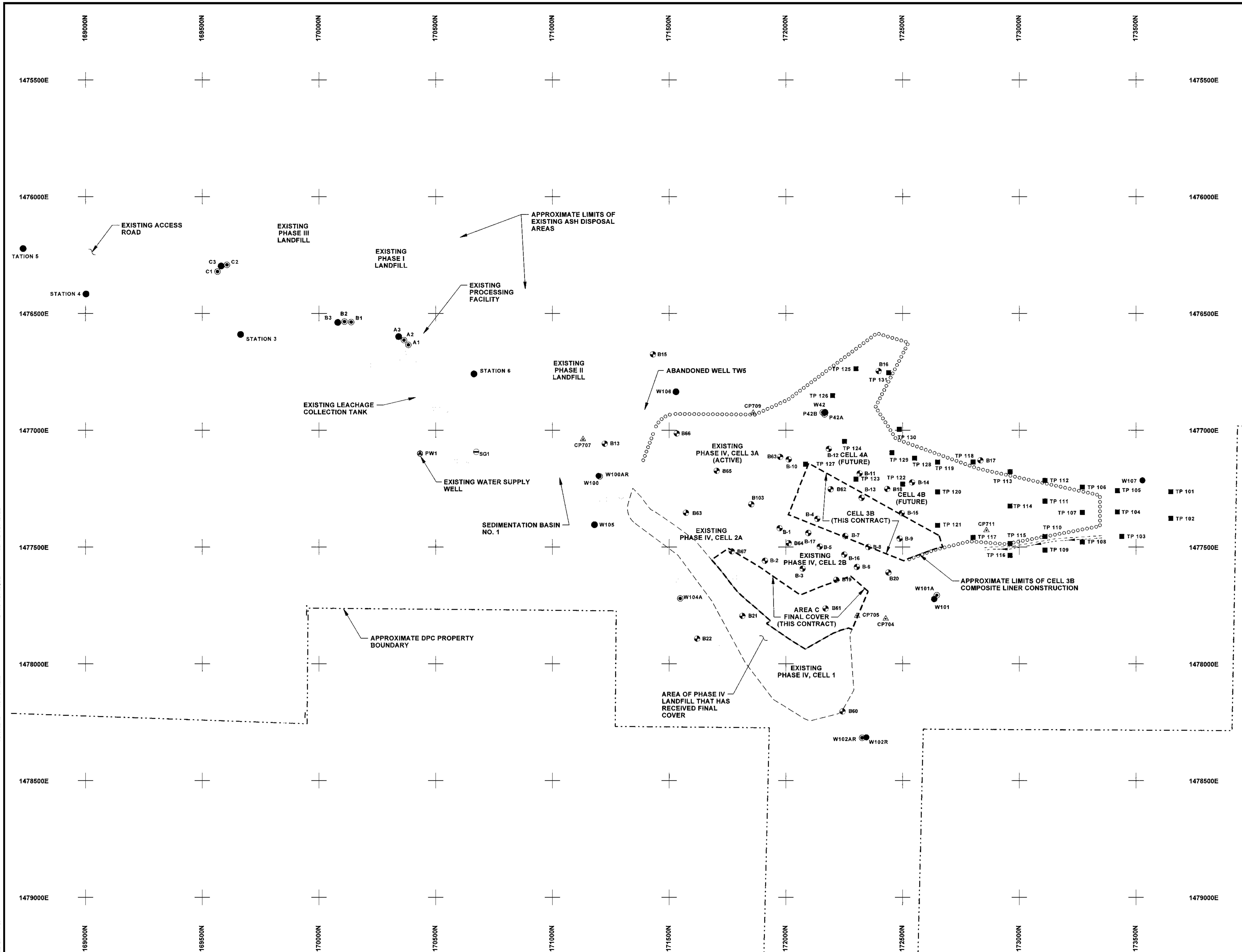
RMT COMPUTER AIDED DESIGN & DRAFTING



Open Area of Landfill: 12 acres
CELL 4 MODULE B
TRANSFER PIPE FROM STORAGE TANK CONNECTS TO EXISTING PIPE OUTSIDE PROCESSING FACILITY SEE DETAIL
EXISTING PROCESSING FACILITY
LEACHATE STORAGE TANK TO SEE DETAIL
ALL-WEATHER ACCESS/ HAUL ROAD SEE DETAIL
10' WIDE FLAT BOTTOM DITCH @ 5%
CULVERTS
V-NOTCH DITCH @ 5%
8' WIDE BERM ELEV. 784.0
V-NOTCH DITCH @ 8%
10' WIDE FLAT BOTTOM DITCH @ 2%
ACCESS ROAD TO EXISTING PHASE II LANDFILL
CULVERT INLET I.E. 817.0 OUTLET I.E. 810.0
10' WIDE FLAT BOTTOM DITCH @ 7%
APPROXIMATE LIMITS OF EXISTING ASH BOUNDARY
CULVERT INLET I.E. 812.0 OUTLET I.E. 808.0
10' WIDE FLAT BOTTOM DITCH @ 6%
LEACHATE COLLECTION/ LINER SYSTEM SEE DETAIL
LEACHATE HEAD MONITORING WELL SEE DETAIL
LANDFILL PERIMETER BERM SEE DETAILS
V-NOTCH DRAINAGE DITCH @ 1% SEE DETAIL
TOP OF BERM ELEV 864
SEDIMENTATION BASIN NO. 2 SEE DETAIL
SEDIMENTATION BASIN NO. 1 SEE DETAIL
DIVERSION BERM
EMERGENCY OVERFLOW PIPE
20' WIDE FLAT BOTTOM DITCH @ 20%
RISER AND DISCHARGE PIPE SEE DETAIL
20' WIDE FLAT BOTTOM DITCH @ 6% SEE DETAIL
EDGE OF FINAL COVER SEE DETAIL
DITCH @ 2%
FINAL COVER DOWNSLOPE FLUME NO. 1 AND NO. 2 SEE DETAILS
FINAL COVER GRADES SEE DETAIL
MANHOLE SEE DETAIL
CLEANOUT PIPE SEE DETAIL
ACCESS ROAD INTO CELL CONSTRUCTED WITH ASH
LEACHATE COLLECTION/ LINER SYSTEM SEE DETAIL
EMERGENCY SPILLWAY
10' WIDE FLAT BOTTOM DITCH @ 2%
CELL DELINEATION BERM SEE DETAIL
FINAL COVER DIVERSION BERM SEE DETAIL
RIPRAP SPILLWAY
APPROXIMATE PROPERTY LINE
20' WIDE FLAT BOTTOM DITCH @ 1%
FILL AREA
LANDFILL PERIMETER BERM AND FINAL COVER SEE DETAILS
TOPSOIL 14,900CY 245'X80'X20'H
STATION 1
STATION 2
N 170500
N 171000
N 171500
N 172000
N 172500
N 173000
N 173500
CONSTRUCTION ACTIVITIES
CELL 4A CLOSURE
1 INSTALL EROSION CONTROL DEVICES
2 INSTALL GRADING LAYER
3 INSTALL GEOSYNTHETIC CLAY
4 INSTALL GEOMEMBRANE
5 INSTALL DOWNSLOPE FLUME
6 INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE ROOTING ZONE LAYER, AND TOPSOIL
7 INSTALL DIVERSION BERMS
8 SEED, FERTILIZE, AND MULCH
CELL 4B SITE PREPARATION
1 INSTALL EROSION CONTROL DEVICES
2 INSTALL DOUBLE WALL LEACHATE TRANSFER PIPE WITH ANTI-SEEP COLLAR TO MAIN TRANSFER LINE
3 CONSTRUCT PERIMETER BERM, DITCH, AND ACCESS ROAD
4 ESTABLISH SUBBASE GRADES
5 UNDERCUT THE COLLECTION LINES
6 CONSTRUCT THE COMPACTED LOW PERMEABILITY SOIL LAYER
7 EXCAVATE THE LEACHATE COLLECTION LINES
8 INSTALL GCL
9 INSTALL GEOMEMBRANE LINER
10 INSTALL GEOTEXTILE
11 INSTALL LEACHATE COLLECTION LINES AND CLEANOUTS
12 INSTALL LEACHATE HEADWELLS
13 PLACE 1 FOOT SELECT GRANULAR FILL
14 SEED, FERTILIZE, AND MULCH ALL CONSTRUCTION AREAS AT FINISH
15 GRADE
CONSTRUCTION QUANTITIES
CELL 4A CLOSURE VOLUME / AREA
TOPSOIL PLACED 5,000 CY
GRADING LAYER SOIL 5,000 CY
GENERAL FILL 9,900 CY
SELECT GRANULAR FILL 9,900 CY
NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY.
(NOT FOR CONSTRUCTION)
NO. BY DATE REVISION APP'D
PROJECT: DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN
SHEET TITLE: CELLS 1, 2A, 2B, 3, AND 4A CLOSED CELL 4B ACTIVE
DATE OCTOBER 2000
SHEET 11 OF 23
RMT
SCALE: 1" = 100'
0 100 200 300 400

Appendix C: Relevant October 2000 POO Plan Sheets

- Sheet 3 Existing Conditions Map – Phase IV, Cell 3B Liner & Area C (Over Cells 1 & 2) Final Cover Construction
- Sheet 5 Proposed Base Grades
- Sheet 9 Phasing Plan – Cell 1, 2A, and 2B Closed; Cell 3 Active
- Sheet 11 Phasing Plan – Cell 1, 2A, 2B, 3, and 4A Closed; Cell 4B Active
- Sheet 12 Proposed Final Grades
- Sheet 17 Details – Liner and Collection Pipes
- Sheet 19 Details – Final Cover
- Sheet 22 Details – Sedimentation Basins
- Sheet 23 Details – Miscellaneous



169000N
169500N
170000N
170500N
171000N
171500N
172000N
172500N
173000N
173500N
1475500E
1476000E
1476500E
1477000E
1477500E
1478000E
1478500E
1479000E
EXISTING ACCESS ROAD
EXISTING PHASE III LANDFILL
EXISTING PHASE I LANDFILL
APPROXIMATE LIMITS OF EXISTING ASH DISPOSAL AREAS
EXISTING PROCESSING FACILITY
EXISTING PHASE II LANDFILL
EXISTING LEACHAGE COLLECTION TANK
ABANDONED WELL TW5
EXISTING WATER SUPPLY WELL
SEDIMENTATION BASIN NO. 1
EXISTING PHASE IV, CELL 3A (ACTIVE)
CELL 4A (FUTURE)
CELL 4B (FUTURE)
CELL 3B (THIS CONTRACT)
EXISTING PHASE IV, CELL 2A
EXISTING PHASE IV, CELL 2B
AREA C FINAL COVER (THIS CONTRACT)
EXISTING PHASE IV, CELL 1
APPROXIMATE LIMITS OF CELL 3B COMPOSITE LINER CONSTRUCTION
APPROXIMATE DPC PROPERTY BOUNDARY
AREA OF PHASE IV LANDFILL THAT HAS RECEIVED FINAL COVER
STATION 3
STATION 4
STATION 5
STATION 6
C1
C2
C3
B1
B2
B3
A1
A2
A3
PW1
SG1
W100
W100AR
W101
W101A
W102AR
W102R
W104A
W105
W106
W107
W42
P42A
P42B
CP704
CP705
CP707
CP709
CP711
B13
B15
B16
B17
B20
B21
B22
B60
B61
B62
B63
B64
B65
B66
B67
B103
B-1
B-2
B-3
B-4
B-5
B-6
B-7
B-8
B-9
B-10
B-11
B-12
B-13
B-14
B-15
B-16
B-17
B18
B19
TP 101
TP 102
TP 103
TP 104
TP 105
TP 106
TP 107
TP 108
TP 109
TP 110
TP 111
TP 112
TP 113
TP 114
TP 115
TP 116
TP 117
TP 118
TP 119
TP 120
TP 121
TP 122
TP 123
TP 124
TP 125
TP 126
TP 127
TP 128
TP 129
TP 130
TP 131
0
200
400
600
800
SCALE IN FEET

NOTES

1. REFER TO PLAN SHEET 2 FOR STANDARD LEGEND, NOTES, AND BENCHMARK LOCATIONS.

NOTE: THE CONTRACTOR SHALL NOTIFY ALL AREA UTILITY COMPANIES PRIOR TO COMMENCING WORK ON THIS CONTRACT, IN ACCORDANCE WITH STATE AND LOCAL REQUIREMENTS.

NOTE: THESE PLANS ARE ACCOMPANIED BY A PROJECT MANUAL OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER.

NO.	BY	DATE	REVISION	APP'D.

PROJECT: DAIRYLAND POWER COOPERATIVE
PHASE IV, CELL 3B LINER & AREA C (OVER CELLS 1 & 2)
FINAL COVER CONSTRUCTION
BUFFALO COUNTY, WISCONSIN

SHEET TITLE:

EXISTING CONDITIONS MAP

DRAWN BY: lstormer	SCALE: AS SHOWN	PROJ. NO.	216851.0004
CHECKED BY: DM		FILE NO.	215851.0004.SHT03-EC.PLT
APPROVED BY: TWM	DATE PRINTED:		
DATE: MARCH 2015		SHEET 3 OF 13	

TRC
708 Heartland Trail
Suite 3000
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Phone: 608.826.3600

NOTE:

GRADES SHOWN INSIDE THE TOP OF THE PERIMETER BERM REPRESENT THE TOP OF THE 2-FOOT-THICK LOW PERMEABILITY SUBBASE SOIL LAYER.
GRADES SHOWN ON TOP AND OUTSIDE THE PERIMETER BERM REPRESENT THE TOP OF TOPSOIL.

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3.				
2.				
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PROJECT: DAIRYLAND POWER COOPERATIVE
PLAN OF OPERATION
BUFFALO COUNTY, WISCONSIN

SHEET TITLE: PROPOSED BASE GRADES

DRAWN BY: reyzekd	SCALE: 1"=100'	PROJ. NO. 3081.40
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APPROVED BY: BJK	DATE PRINTED:	SHEET 5 OF 23
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CONSTRUCTION ACTIVITIES

PHASE 2B CLOSURE

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL GRADING LAYER.
3. INSTALL GCL.
4. INSTALL GEOMEMBRANE.
5. INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE, ROOTING ZONE LAYER, AND TOPSOIL.
6. INSTALL DIVERSION BERMS.
7. SEED, FERTILIZE, AND MULCH.

PHASE 3 SITE PREPARATION

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL DOUBLE WALL LEACHATE TRANSFER PIPE WITH ANTI-SEEP COLLAR TO STORAGE TANK.
3. CONSTRUCT PERIMETER BERM, DITCH, AND ACCESS ROAD.
4. ESTABLISH SUBBASE GRADES.
5. UNDERCUT THE COLLECTION LINES.
6. CONSTRUCT THE COMPACTED LOW PERMEABILITY LAYER.
7. EXCAVATE THE LEACHATE COLLECTION LINES.
8. INSTALL LEACHATE COLLECTION LINES AND CLEANOUTS.
9. INSTALL GEOTEXTILE.
10. INSTALL LEACHATE HEADWELLS.
11. PLACE 1-FOOT SELECT GRANULAR FILL.
12. SEED, FERTILIZE, AND MULCH ALL CONSTRUCTION AREAS AT FINISH GRADE.

CONSTRUCTION QUANTITIES

PHASE 2A AND 2B CLOSURE	VOLUME / AREA
TOPSOIL PLACED	3,400 CY
GRADING LAYER SOIL	3,400 CY
GENERAL FILL	6,800 CY
SELECT GRANULAR FILL	6,800 CY
GEOTEXTILE	22,600 SY
GCL	20,300 SY
GEOMEMBRANE	20,300 SY
SEED, FERTILIZER, MULCH	4.5 ARCES
4-INCH DIA. HDPE CORRUGATED PIPE W/ SMOOTH INTERIOR	2,350 LF
SELECT AGGREGATE FILL	350 CY

PHASE 3 SITE PREPARATION	VOLUME / AREA
STRIP TOPSOIL	8,800 CY
FILL TO ESTABLISH SUBBASE GRADE	91,200 CY
CUT TO ESTABLISH SUBBASE GRADE	55,100 CY
GEOSYNTHETIC CLAY LINER (GCL)	34,000 SY
GEOMEMBRANE	34,000 SY
SELECT AGGREGATE FILL	350 CY
GEOTEXTILE (CUSHION)	1,700 SY
SELECT GRADED FILL	400 CY
SELECT GRANULAR FILL	11,300 CY
COMPACTED LOW PERMEABILITY LAYER	22,600 CY
CLEANOUT	1 EACH
TOPSOIL PLACED	3,100 CY
SEED FERTILIZER, MULCH	4.0 ACRES

PIPE LENGTHS	QUANTITIES
6-INCH-DIAMETER (SDR 17) HDPE PERF. LEACHATE COLLECTION PIPE	1,100 LF
6-INCH-DIAMETER (SDR 17) HDPE NON-PERF. LEACHATE PIPE	480 LF
6-INCH-DIAMETER (SDR 17) HDPE DOUBLE WALL LEACHATE TRANSFER PIPE	1,070 LF
3-INCH-DIAMETER (SCHEDULE 120) PVC NON-PERF. LEACHATE HEADWELL PIPE	470 LF

MISCELLANEOUS ITEMS	
ACCESS/HAUL ROAD	1,300 LF
MANHOLES	2 EA
CULVERTS	2 EA
SEDIMENTATION BASIN (TEMPORARY)	1 EA

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PROJECT: DAIRYLAND POWER COOPERATIVE
PLAN OF OPERATION
BUFFALO COUNTY, WISCONSIN

SHEET TITLE:
CELL 1, 2A, AND 2B CLOSED
CELL 3 ACTIVE

DRAWN BY: NOLDENR	SCALE: 1"=100'	PROJ. NO. 3081.40
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CONSTRUCTION ACTIVITIES

CELL 4A CLOSURE

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL GRADING LAYER
3. INSTALL GEOSYNTHETIC CLAY
4. INSTALL GEOMEMBRANE
5. INSTALL DOWNSLOPE FLUME.
6. INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE, ROOTING ZONE LAYER, AND TOPSOIL.
7. INSTALL DIVERSION BERMS.
8. SEED, FERTILIZE, AND MULCH.

CELL 4B SITE PREPARATION

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL DOUBLE WALL LEACHATE TRANSFER PIPE WITH ANTI-SEEP COLLAR TO MAIN TRANSFER LINE.
3. CONSTRUCT PERIMETER BERM, DITCH, AND ACCESS ROAD.
4. ESTABLISH SUBBASE GRADES.
5. UNDERCUT THE COLLECTION LINES.
6. CONSTRUCT THE COMPACTED LOW PERMEABLILTY SOIL LAYER.
7. EXCAVATE THE LEACHATE COLLECTION LINES.
8. INSTALL GCL
9. INSTALL GEOMEMBRANE LINER
10. INSTALL GEOTEXTILE.
11. INSTALL LEACHATE COLLECTION LINES AND CLEANOUTS.
12. INSTALL LEACHATE HEADWELLS.
13. PLACE 1-FOOT SELECT GRANULAR FILL.
14. SEED, FERTILIZE, AND MULCH ALL CONSTRUCTION AREAS AT FINISH
15. GRADE.

CONSTRUCTION QUANTITIES

CELL 4A CLOSURE	VOLUME / AREA
TOPSOIL PLACED	5,000 CY
GRADING LAYER SOIL	5,000 CY
GENERAL FILL	9,900 CY
SELECT GRANULAR FILL	9,900 CY
GEOTEXTILE	31,800 SY
GCL	29,700 SY
GEOMEMBRANE	29,700 SY
SEED, FERTILIZER, MULCH	6.1 ARCES
4-INCH DIA. HDPE CORRUGATED PIPE W/ SMOOTH INTERIOR	2,100 LF
SELECT AGGREGATE FILL	320 CY
CELL 4B SITE PREPARATION	**VOLUME / AREA**
STRIP TOPSOIL	6,800 CY
FILL TO ESTABLISH SUBBASE GRADE	55,200 CY
CUT TO ESTABLISH SUBBASE GRADE	58,800 CY
GCL	31,100 SY
GEOMEMBRANE	31,100 SY
SELECT AGGREGATE FILL	280 CY
GEOTEXTILE (CUSHION)	1,050 SY
COMPACTED LOW PERMEABILITY SOIL	20,700 CY
CLEANOUT	3 EACH
SELECT GRANULAR FILL	10,400 CY
TOPSOIL PLACED	1,600 CY
SEED FERTILIZER, MULCH	2.0 ACRES

PIPE LENGTHS	QUANTITIES
6-INCH-DIAMETER (SDR 17) HDPE PERF. LEACHATE COLLECTION PIPE	450 LF
6-INCH-DIAMETER (SDR 17) HDPE NON-PERF. LEACHATE CLEANOUT	370 LF
6-INCH-DIAMETER (SDR 17) HDPE DOUBLE WALL LEACHATE TRANSFER PIPE	0 LF
3-INCH-DIAMETER (SCHEDULE 120) PVC NON-PERF. LEACHATE HEADWELL PIPE	180 LF

MISCELLANEOUS ITEMS	
MAINTENANCE ROAD	1,450 LF
SEDIMENTATION BASIN (PRIMARY)	1 EACH

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PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **CELLS 1, 2A, 2B, 3, AND 4A CLOSED CELL 4B ACTIVE**

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CONSTRUCTION ACTIVITIES

PHASE 4B CLOSURE

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL GRADING LAYER.
3. INSTALL GCL.
4. INSTALL GEOMEMBRANE.
5. INSTALL DOWNSLOPE FLUME.
6. INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE, ROOTING ZONE LAYER, AND TOPSOIL.
7. INSTALL DIVERSION BERMS.
8. SEED, FERTILIZE, AND MULCH.

CONSTRUCTION QUANTITIES

PHASE 4B CLOSURE	VOLUME / AREA
TOPSOIL PLACED	
GRADING LAYER SOIL	9,800 CY
GENERAL FILL	9,800 CY
SELECT GRANULAR FILL	19,600 CY
GEOTEXTILE	19,600 CY
GCL	61,700 SY
GEOMEMBRANE	58,600 SY
SEED, FERTILZER, MULCH	58.600 SY
DOWNSLOPE FLUME	12.1 ACRES
4-INCH DIA. HDPE CORRUGATED PIPT	1 EACH
W/ SMOOTH INTERIOR	3,150 LF
SELECT AGGREGATE FILL	470 CY

0 100 200 300 400

SCALE: 1" = 100'

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PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE:

PROPOSED FINAL GRADES

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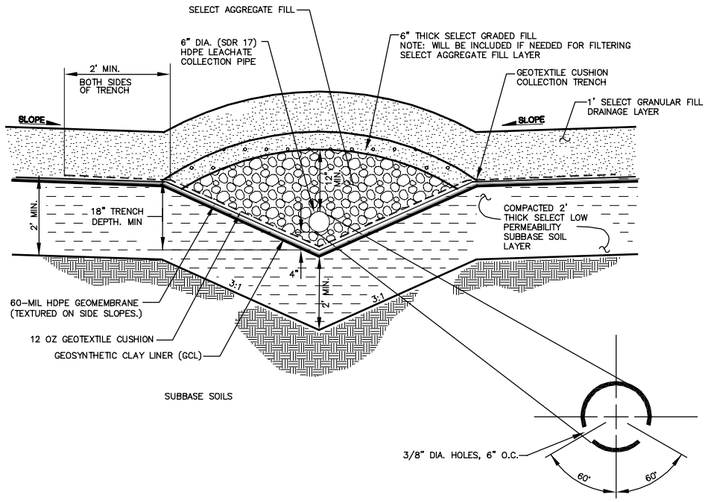
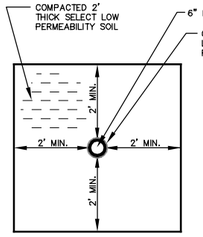
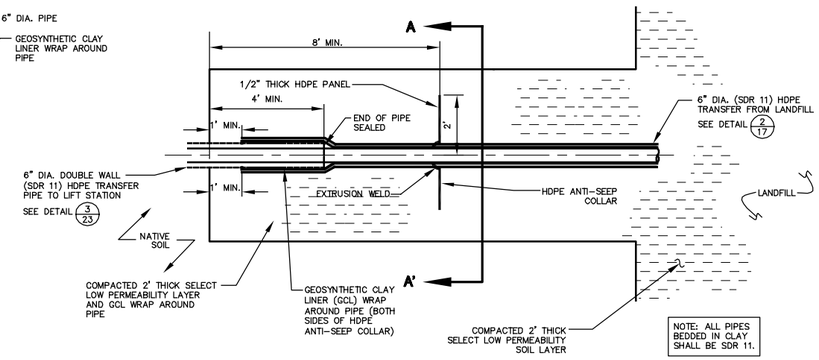


1/17 LEACHATE COLLECTION/LINER SYSTEM

(NOT TO SCALE)

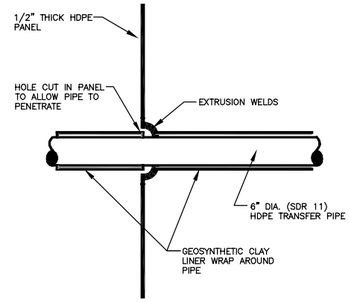


SECTION A-A'

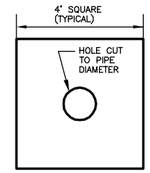


4/17 LEACHATE TRANSFER PIPE CLAY TRENCH CUT-OFF THROUGH PERIMETER BERM (TYPICAL)

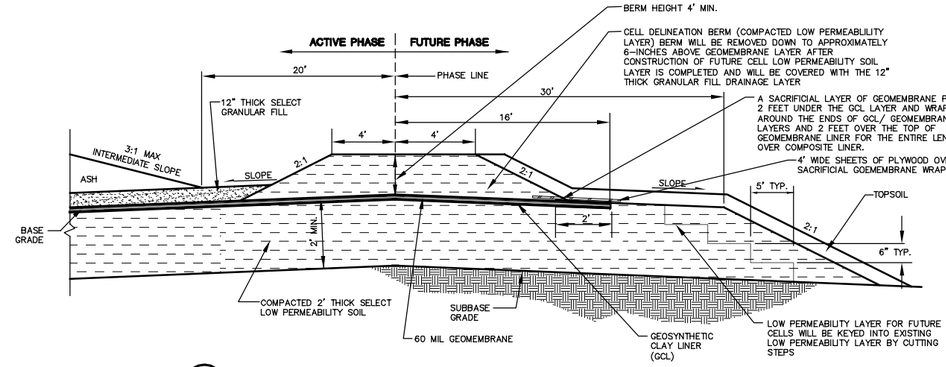
(NOT TO SCALE)



HDPE ANTI-SEEP COLLAR DETAIL (TYPICAL)

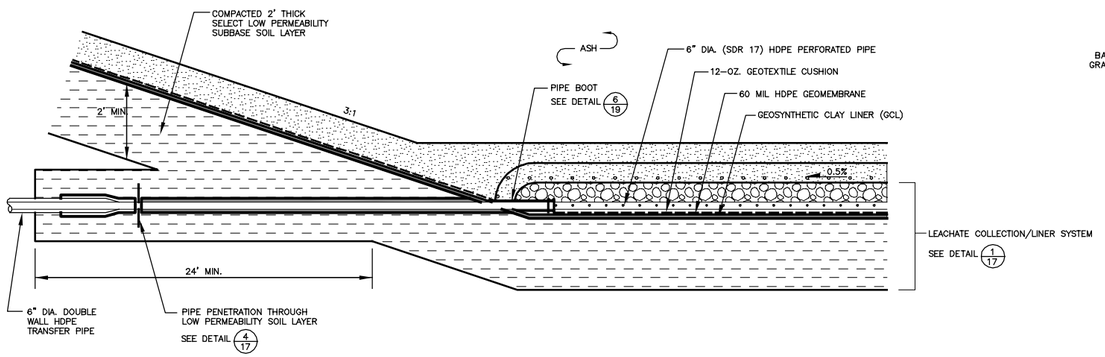


1/2" THICK HDPE PANEL



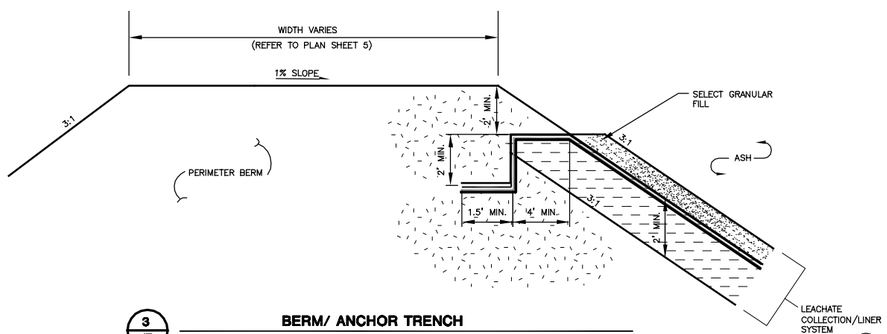
5/17 CELL DELINEATION BERM

(NOT TO SCALE)



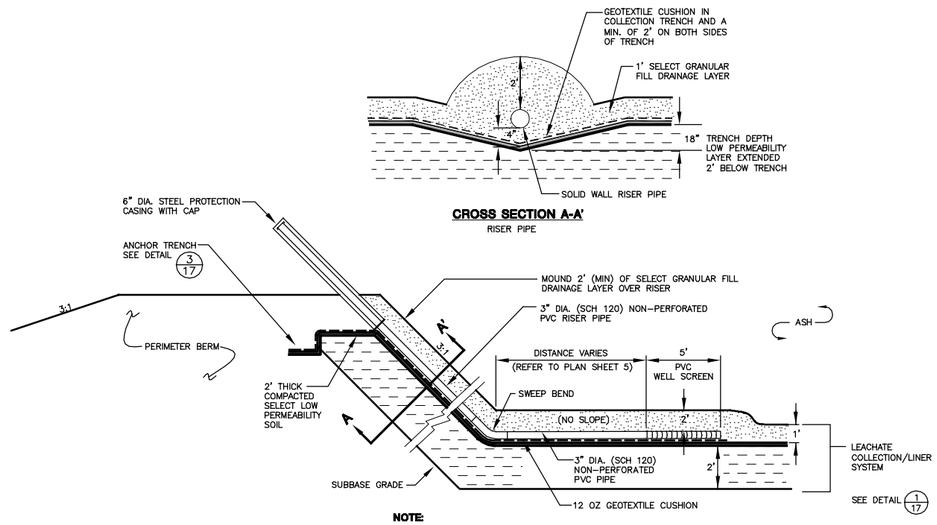
2/17 PIPE PENETRATION THROUGH LANDFILL PERIMETER BERM (TYPICAL)

(NOT TO SCALE)
LOOKING EAST



3/17 BERM/ ANCHOR TRENCH

(NOT TO SCALE)



CROSS SECTION A-A'

RISER PIPE

NOTE:
LEACHATE HEADWELL WILL LIE HORIZONTALLY ON TOP OF LINER AND WITHIN 12" SELECT GRANULAR FILL DRAINAGE LAYER.

PIPE CONSTRUCTION ON BERM SIDE SLOPE IS ALSO TYPICAL FOR LEACHATE CLEANOUT PIPES.

6/17 LEACHATE HEADWELL

(NOT TO SCALE)

LINE AND SHADING LEGEND

GEOTEXTILE	GEOMEMBRANE
GEOCOMPOSITE	GEOSYNTHETIC CLAY LINER (GCL)
TOPSOIL	NATIVE SOIL
SELECT GRANULAR FILL DRAINAGE LAYER	CONCRETE
PIPE BEDDING MATERIAL	RIPRAP
SELECT AGGREGATE FILL	GRAVEL
COMPACTED SELECT LOW PERMEABILITY SOIL	GENERAL FILL

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PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **DETAILS- LINER AND COLLECTION PIPES**

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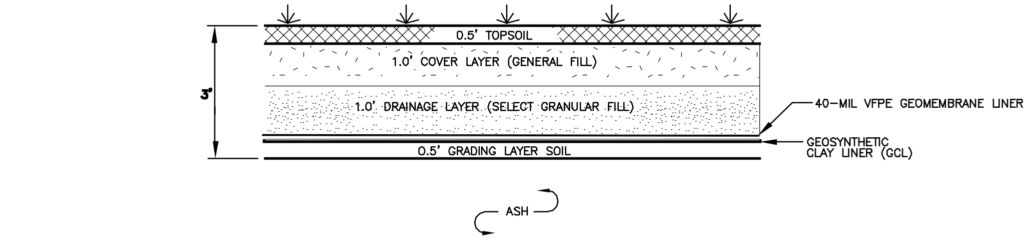
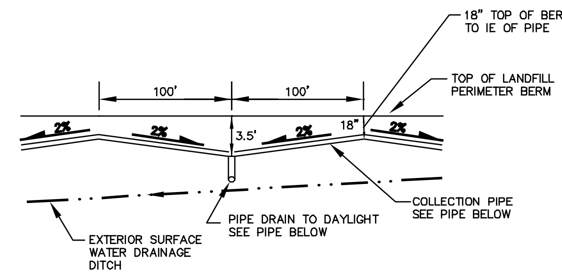


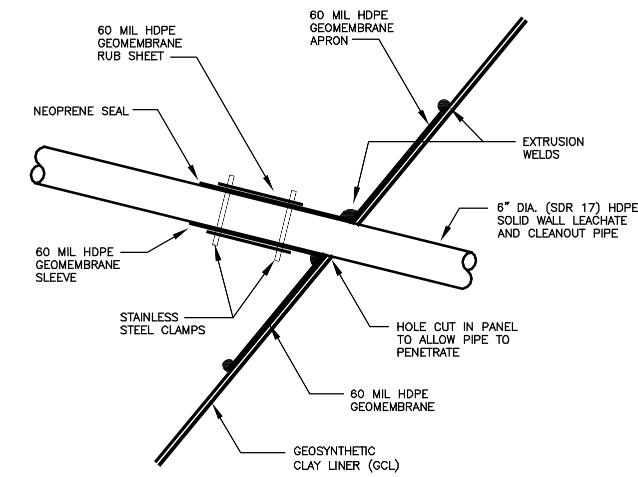
1/19 **FINAL COVER**

(NOT TO SCALE)



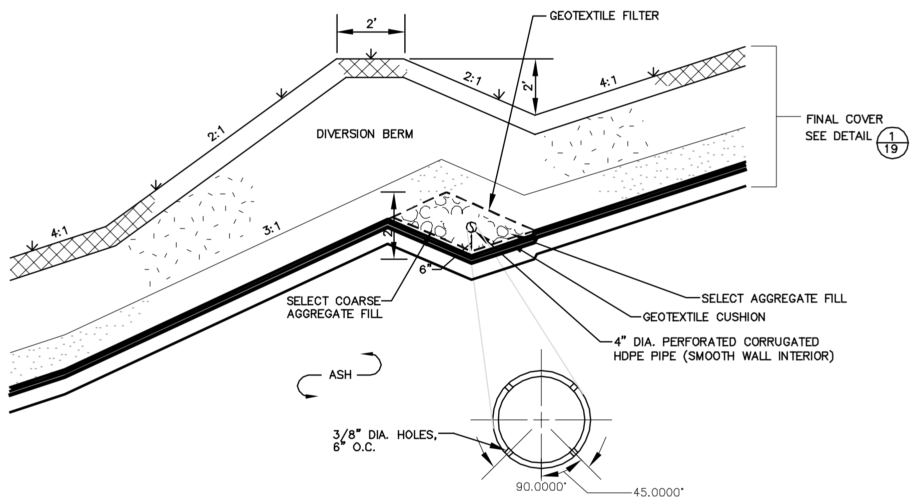
NOTE: IN AREAS WHERE THE TOP OF BERM SLOPES, THE COLLECTION PIPE WILL FOLLOW THE SAME SLOPE AS THE TOP OF BERM AND WILL OUTLET THROUGH DISCHARGE PIPES LOCATED AT SPECIFIED INTERVALS. REFER TO PLAN SHEET 12.

SECTION A-A' OF FINAL COVER DRAINAGE LAYER



6/19 **PIPE BOOT- PIPES PENETRATING THROUGH FINAL COVER AND LOW PERMEABILITY LAYER (TYPICAL)**

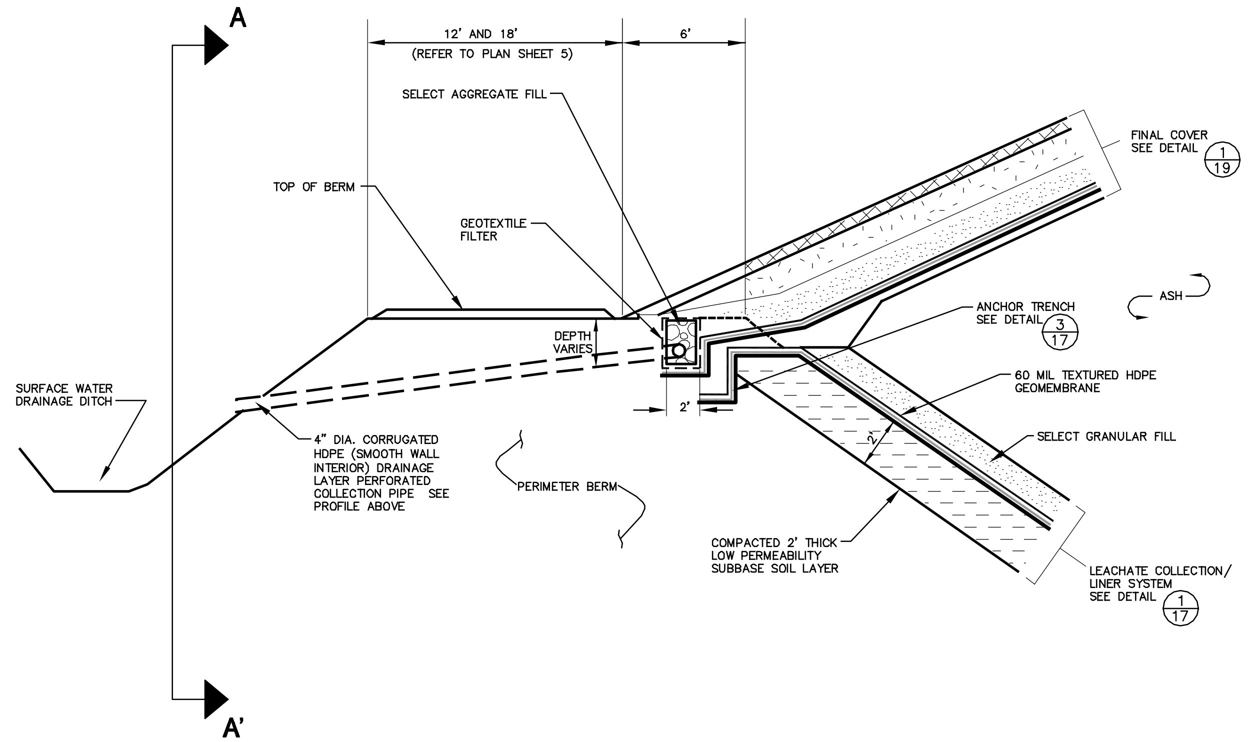
(NOT TO SCALE)



NOTE:
A 4" DIA. PERFORATED CORRUGATED HDPE PIPE WILL BE LOCATED BELOW EVERY DIVERSION BERM ABOVE THE FINAL COVER EXCEPT THE LOWEST BERM LOCATED NEXT TO THE LANDFILL PERIMETER BERM. TO COLLECT WATER IN THE DRAINAGE LAYER ALONG THE PERIMETER BERM PIPES WILL BE CONSTRUCTED IN THE BERM AS SHOWN ON DETAIL 4 OF 19.

2/19 **SURFACE WATER DIVERSION BERM ON FINAL COVER (TYPICAL)**

(NOT TO SCALE)



4/19 **PERIMETER BERM FINAL COVER DRAINAGE LAYER DISCHARGE PIPE (TYPICAL)**

(NOT TO SCALE)

LINE AND SHADING LEGEND

GEOTEXTILE	GEOMEMBRANE
GEOCOMPOSITE	GEOSYNTHETIC CLAY LINER (GCL)
TOPSOIL	NATIVE SOIL
SELECT GRANULAR FILL DRAINAGE LAYER	CONCRETE
PIPE BEDDING MATERIAL	RIPRAP
SELECT AGGREGATE FILL	GRAVEL
COMPACTED SELECT LOW PERMEABILITY SOIL	GENERAL FILL

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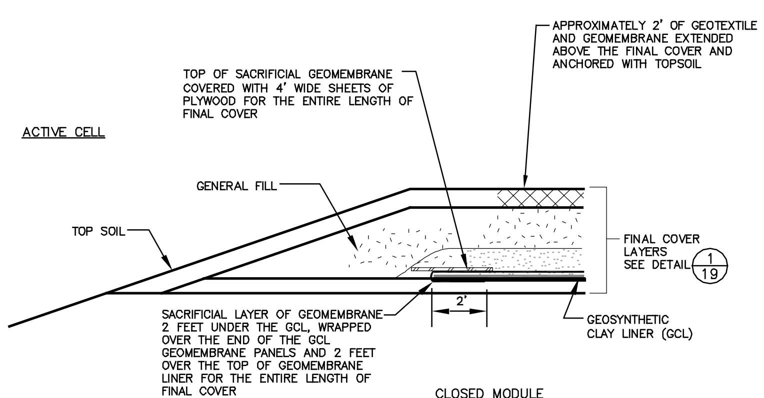
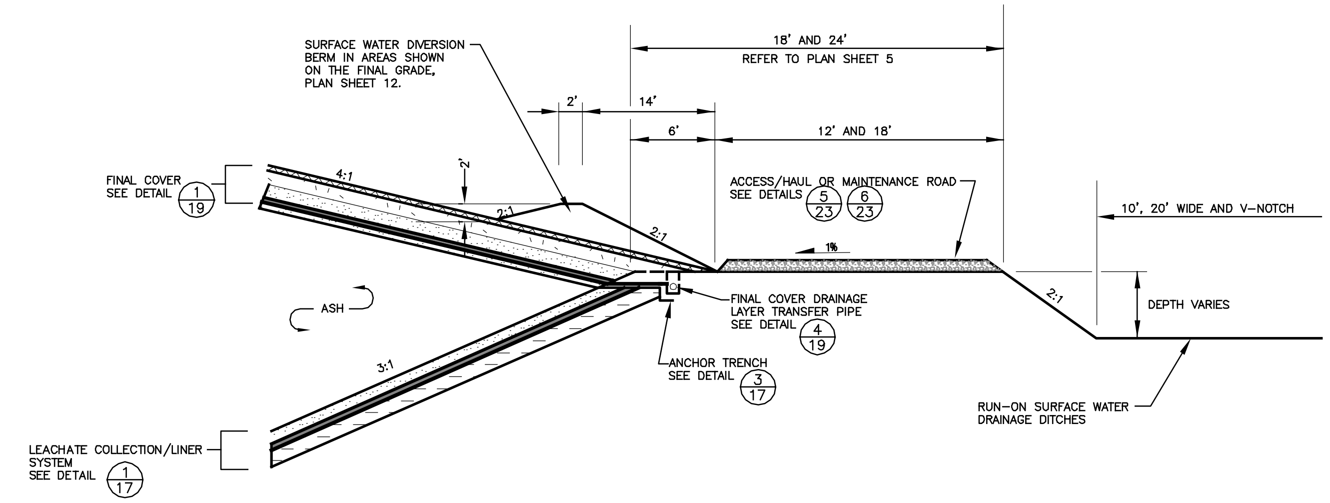


3/19 **CONSTRUCTION OF FINAL COVER FOR SPLICING FUTURE FINAL COVER**

(NOT TO SCALE)



5/19 **LANDFILL PERIMETER BERM AND SURFACE WATER DRAINAGE DITCHES (TYPICAL)**

(NOT TO SCALE)

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PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **DETAILS- FINAL COVER**

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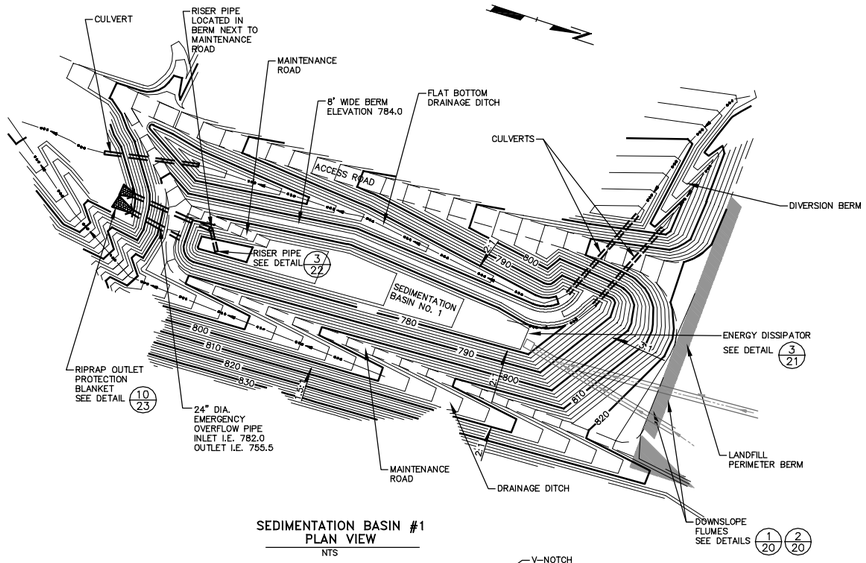
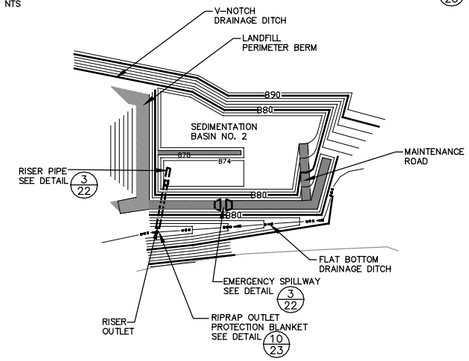


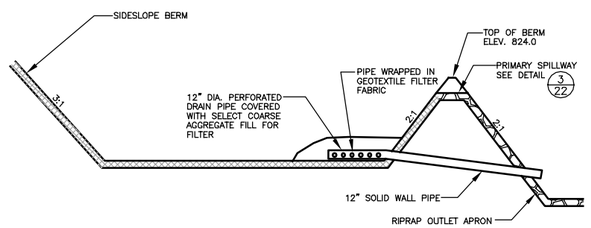
SEDIMENTATION BASIN #1
PLAN VIEW
NTS



SEDIMENTATION BASIN #2
PLAN VIEW
NTS

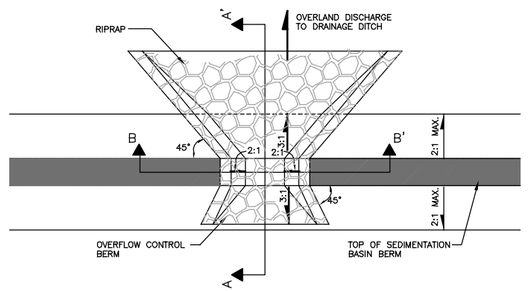
1/22 SEDIMENTATION BASINS NO. 1 AND NO. 2

(NOT TO SCALE)



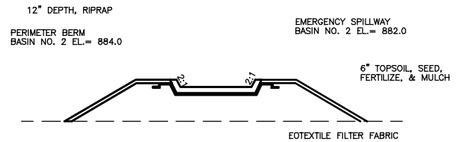
2/22 TEMPORARY SEDIMENTATION BASIN (TYPICAL)

(NOT TO SCALE)

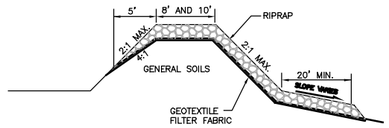


SURFACE WATER PRIMARY OR EMERGENCY SPILLWAY
PLAN VIEW

NOTE:
SEDIMENTATION BASIN NO. 1 WILL HAVE A CULVERT PIPE INSTALLED FOR THE EMERGENCY OVERFLOW. SEE DETAIL 1 OF 22.



CROSSECTION B–B'



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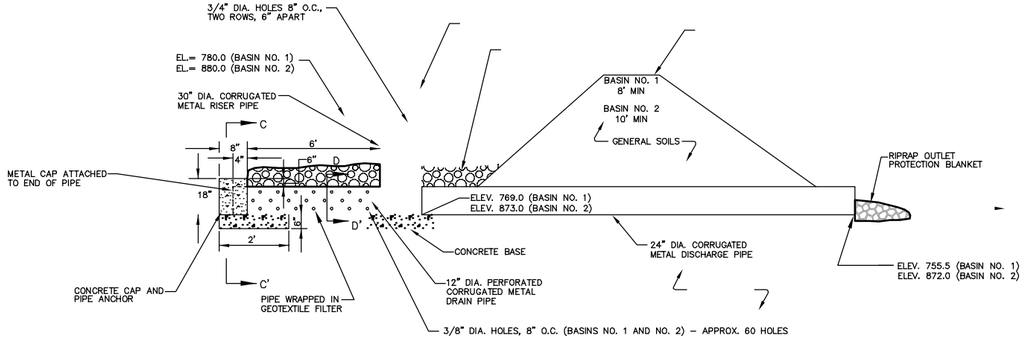
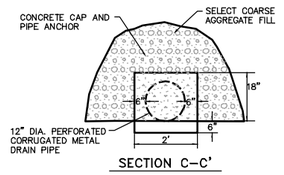


RISER/DISCHARGE PIPE CROSS SECTION (TYPICAL)



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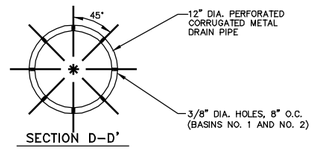

SECTION D–D'

3/22 RISER/DISCHARGE PIPE/EMERGENCY SPILLWAY

(NOT TO SCALE)

LINE AND SHADING LEGEND

GEOTEXTILE	GEOMEMBRANE
GEOCOMPOSITE	GEOSYNTHETIC CLAY LINER (GCL)
TOPSOIL	NATIVE SOIL
SELECT GRANULAR FILL DRAINAGE LAYER	CONCRETE
PIPE BEDDING MATERIAL	RIPRAP
SELECT AGGREGATE FILL	GRAVEL
COMPACTED SELECT LOW PERMEABILITY SOIL	GENERAL FILL

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NOT FOR CONSTRUCTION

NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **DETAILS- SEDIMENTATION BASINS**

DRAWN BY: DEFOEJ	SCALE: NOT TO SCALE	PROJ. NO. 3081.40
CHECKED BY: DM		FILE NO. 30814007.dwg
APPROVED BY: BJK	DATE PRINTED:	SHEET 22 OF 23
DATE: OCTOBER 2000		

RMT
744 Heartland Trail
Madison, WI 53717–1934
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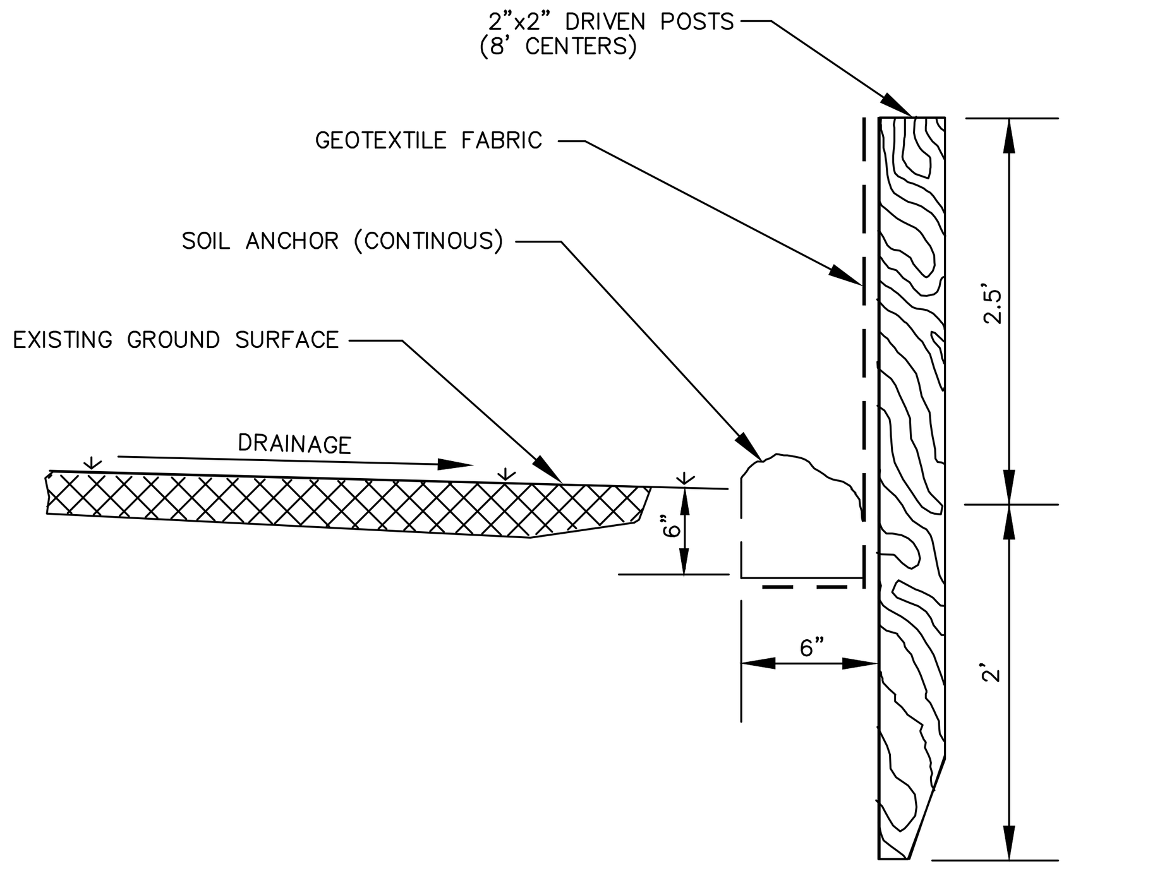
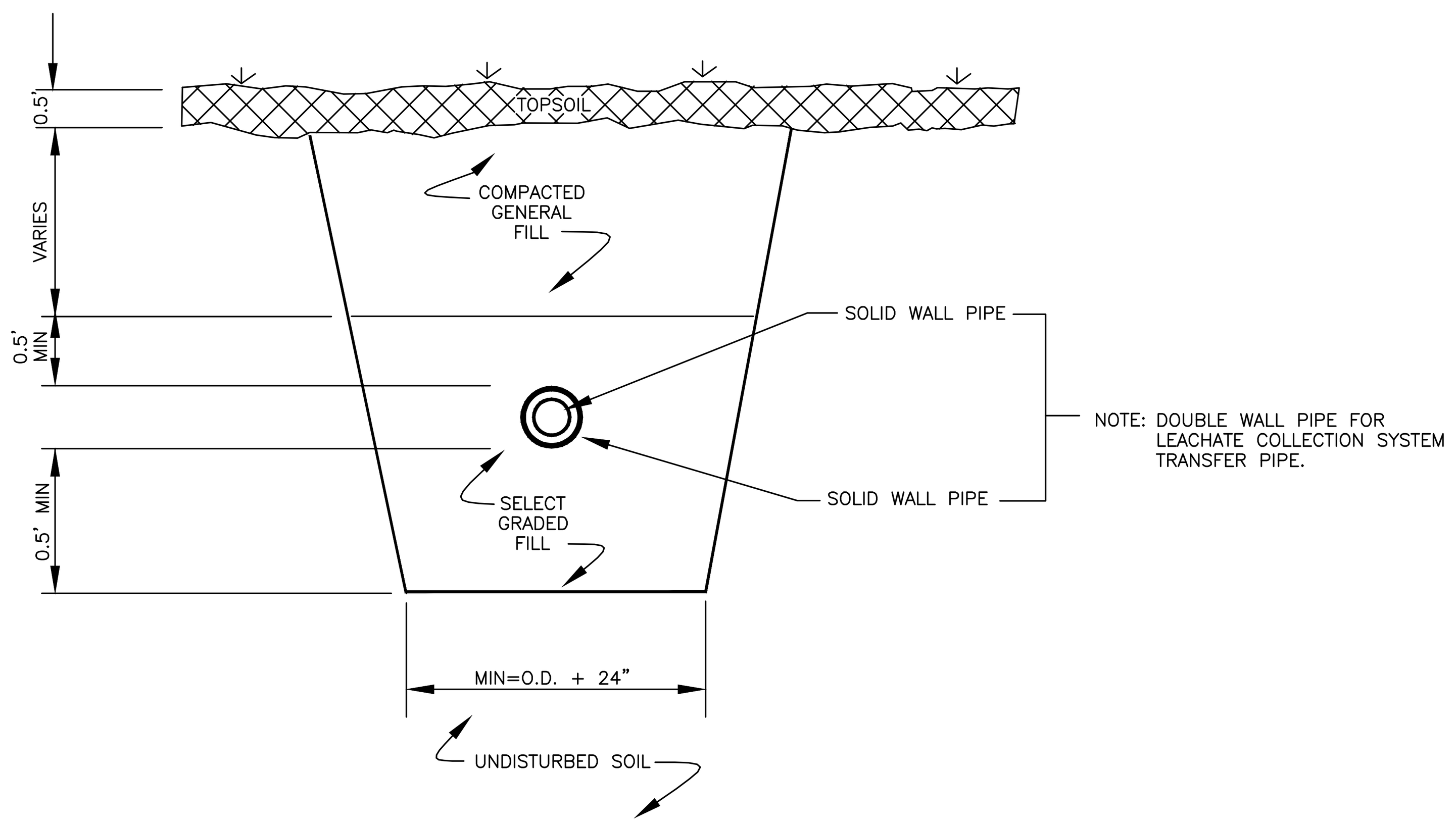
Madison, WI 53708–8923
Phone: 608/831–4444



NOTE:
DETAIL SHOWN FOR PURPOSES OF IDENTIFYING INSTALLATION METHOD. LOCATION OF FENCE WILL BE DETERMINED AT DEVELOPMENT OF ENGINEERING PLANS FOR EACH PHASE OF CONSTRUCTION AND IN THE FIELD DURING ACTUAL CONSTRUCTION OF EACH PHASE.

1 / 23 **SEDIMENT CONTROL FENCE**
(NOT TO SCALE)



3 / 23 **DOUBLE WALL TRANSFER PIPE**
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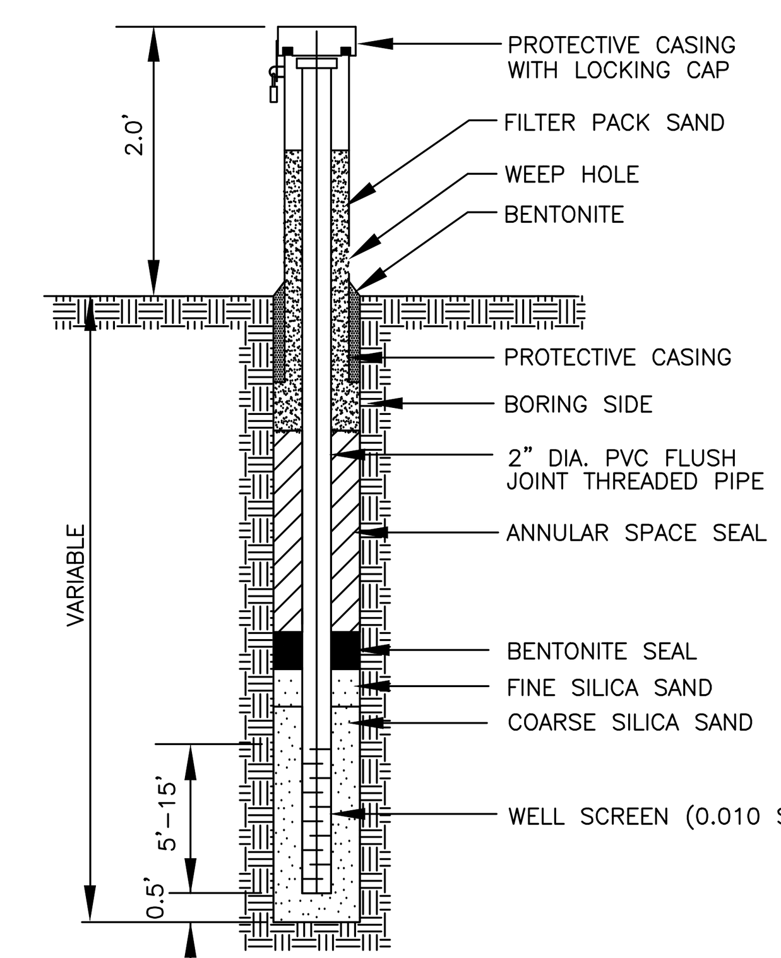

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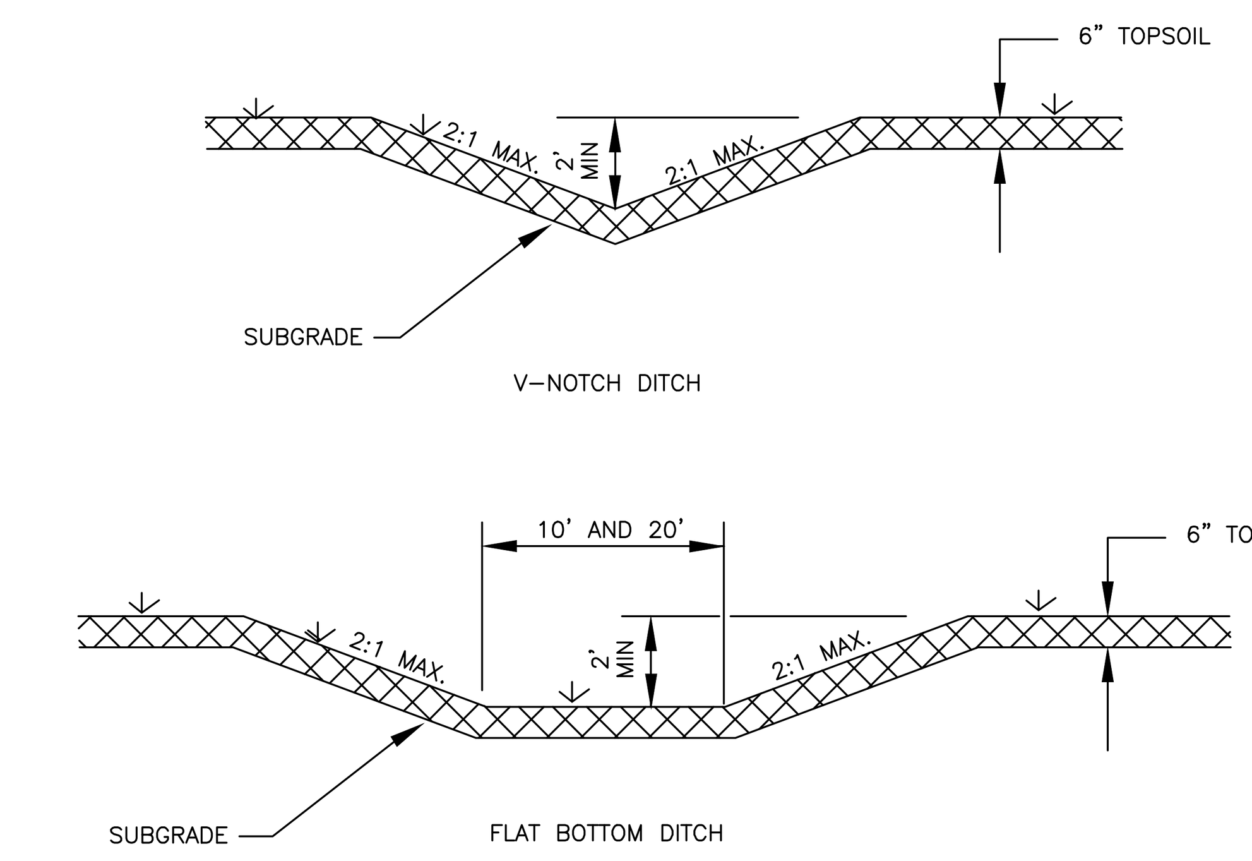
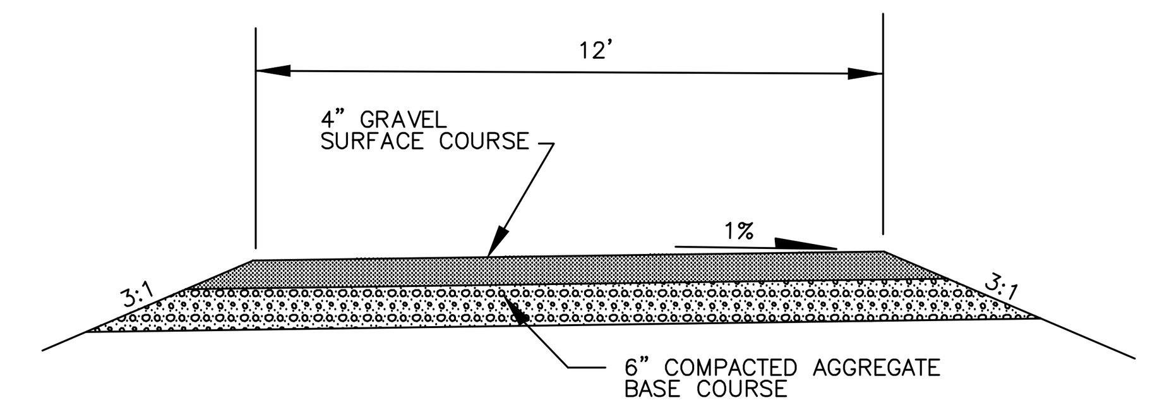
NOT TO SCALE



8 / 23 **DRAINAGE DITCH DETAILS OUTSIDE LANDFILL COVER**
(NOT TO SCALE)



5 / 23 **MAINTENACE ROAD**
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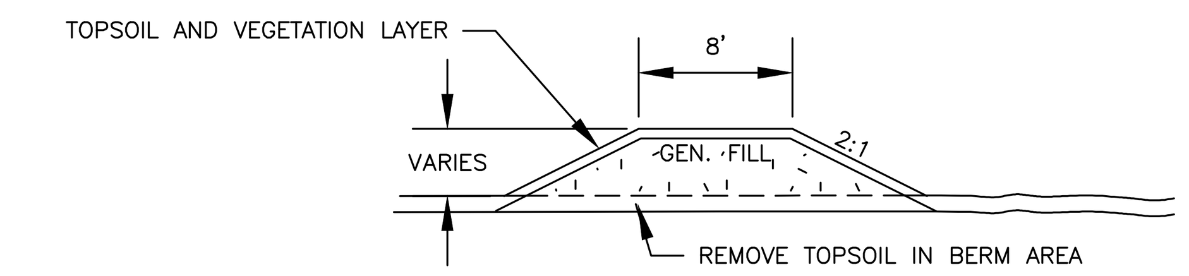

9 / 23 **TEMPORARY BERM FOR CONTROLLING WATER**
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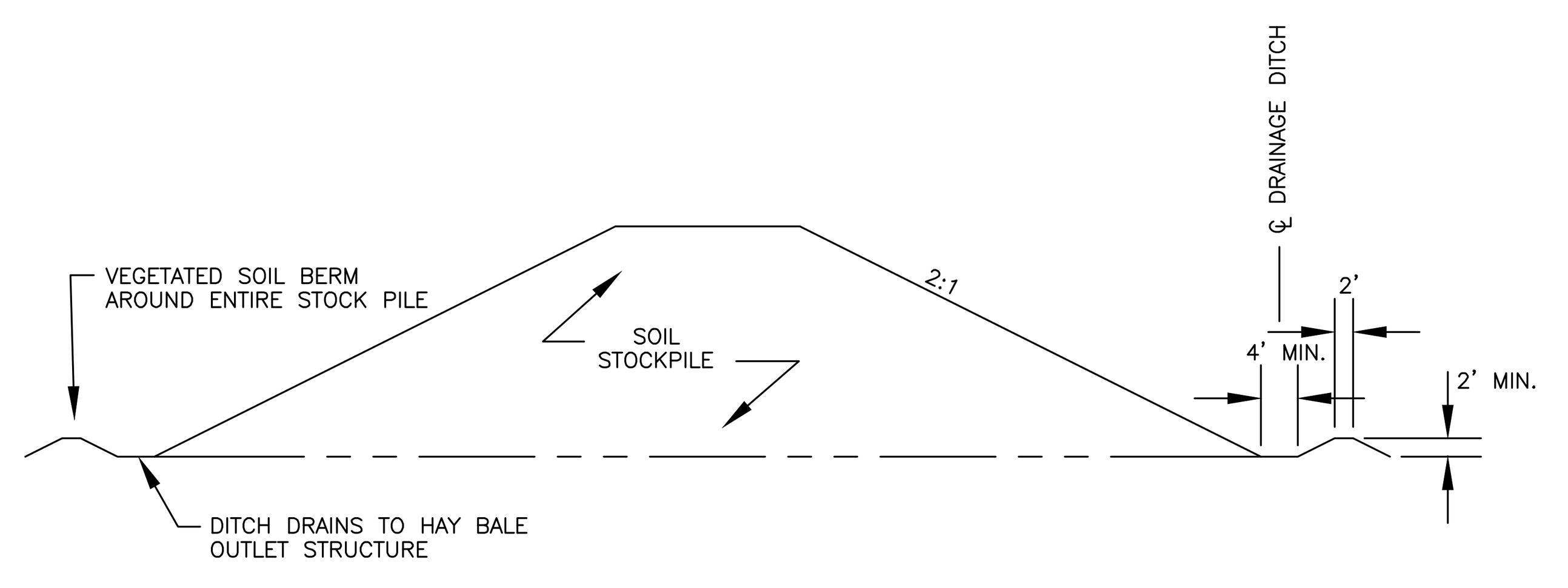
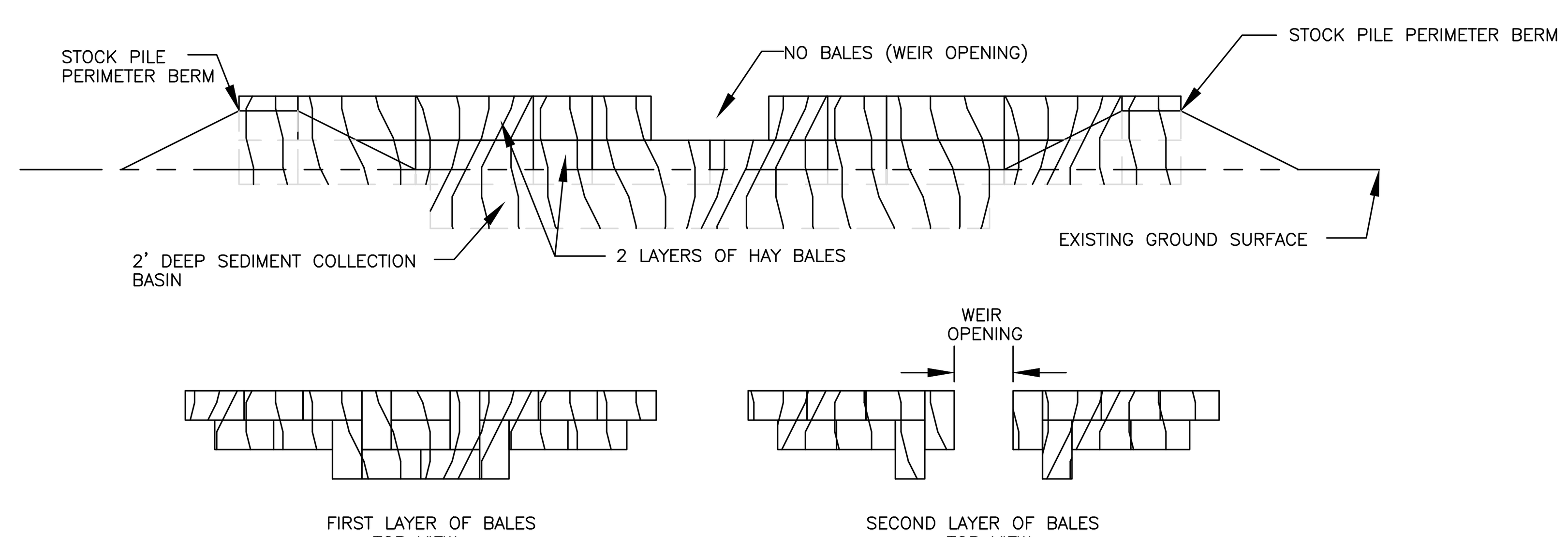
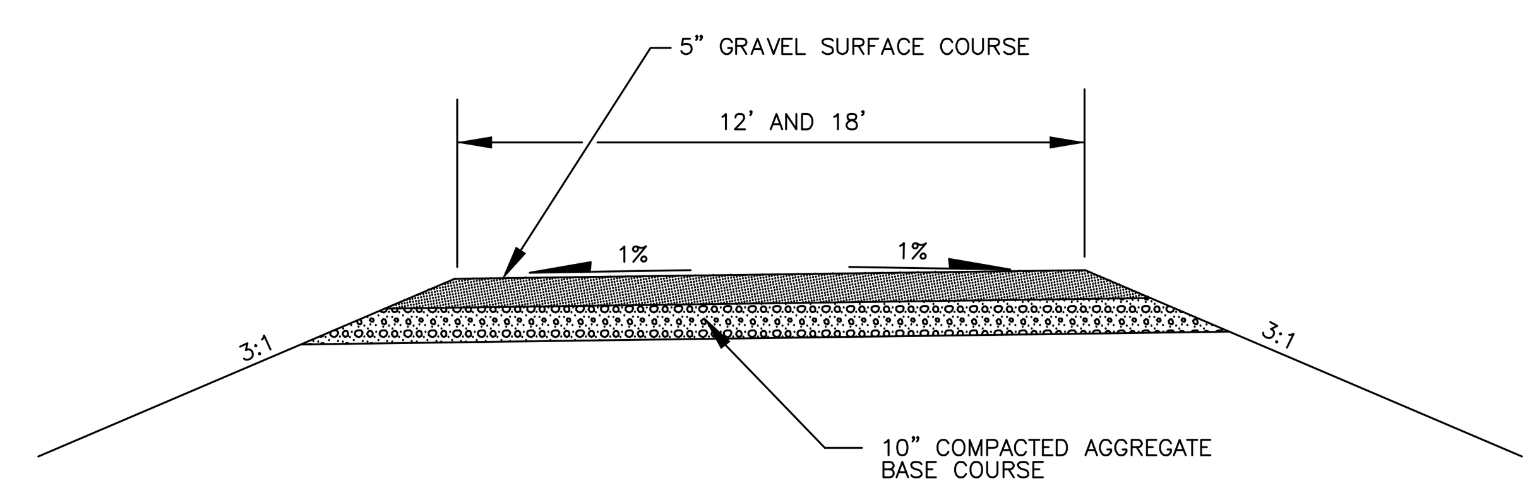


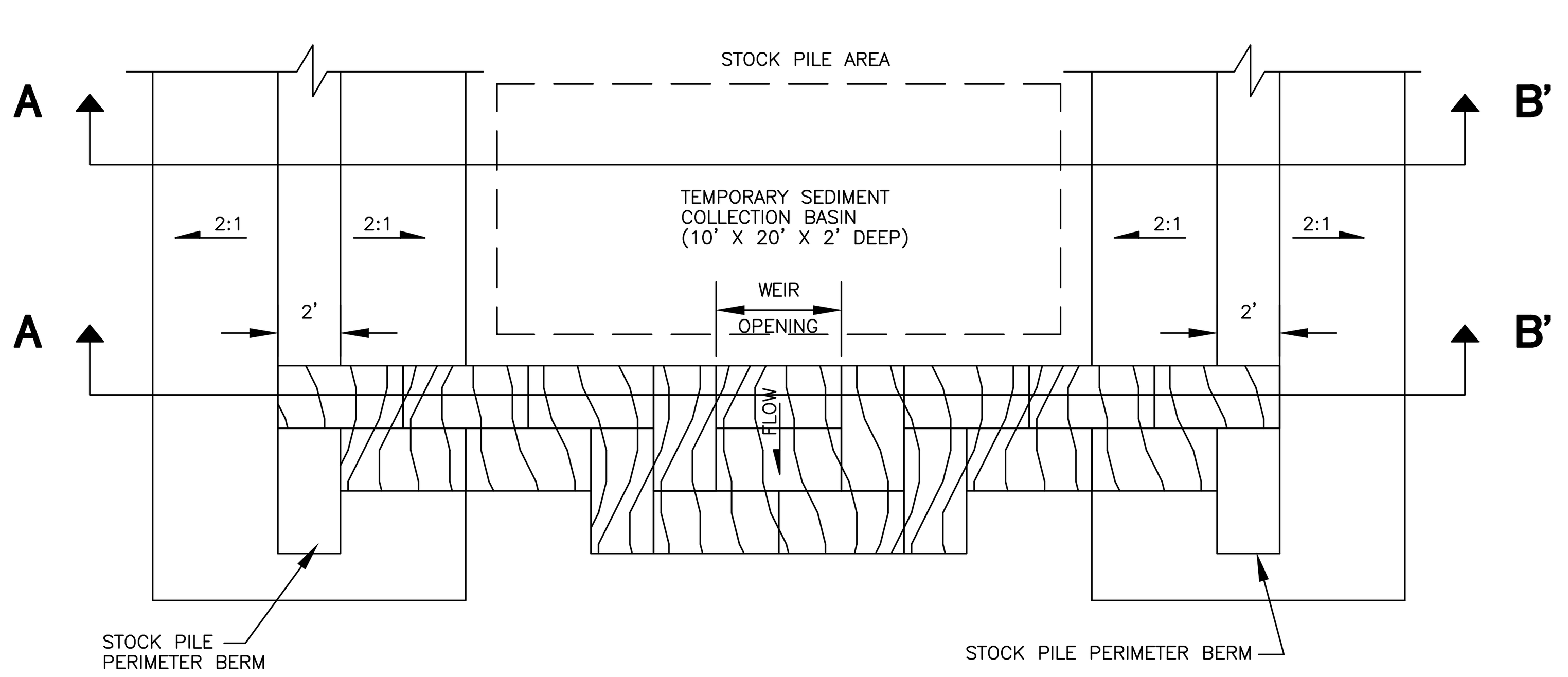
SECTION B-B'



SECTION A-A'



6 / 23 **ALL WEATHER ACCESS/ HAUL ROAD**
(NOT TO SCALE)



2 / 23 **SURFACE WATER OUTLET FOR STOCKPILES**
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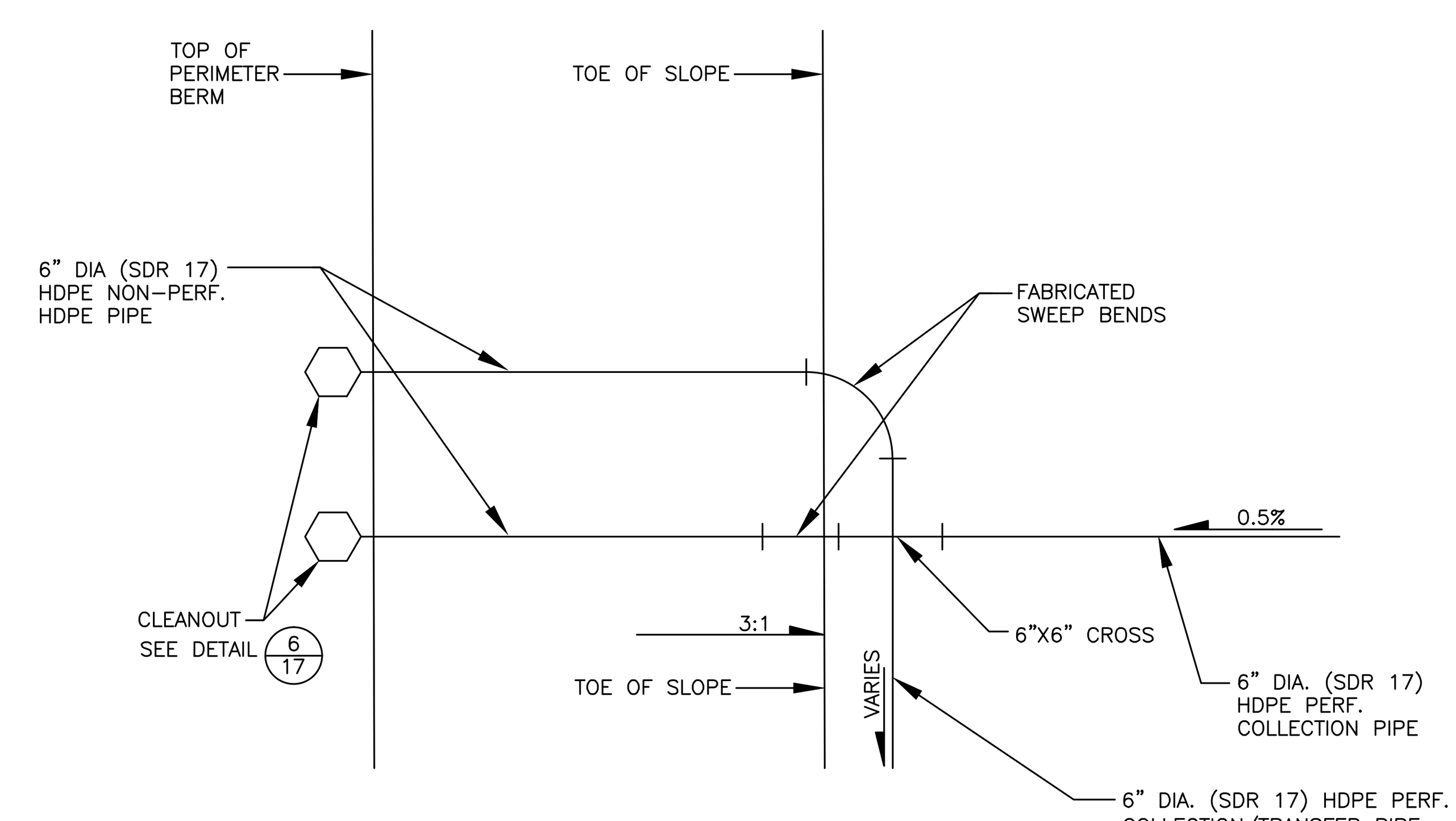
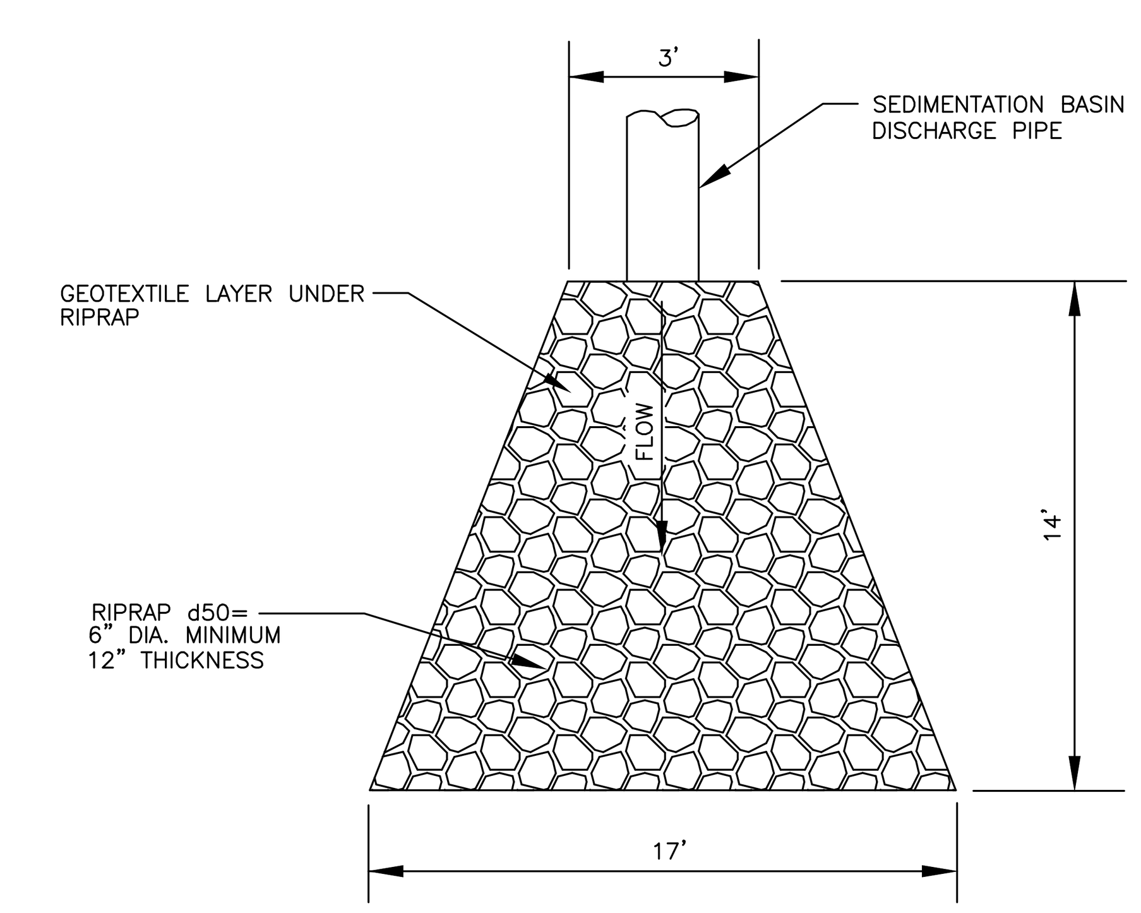


7 / 23 **PIPE CONNECTIONS (TYPICAL)**
(NOT TO SCALE)



10 / 23 **DISCHARGE PIPE RIPRAP OUTLET PROTECTION BLANKET**
(NOT TO SCALE)

LINE AND SHADING LEGEND

GEOTEXTILE	GEOMEMBRANE
GEOCOMPOSITE	GEOSYNTHETIC CLAY LINER (GCL)
TOPSOIL	NATIVE SOIL
SELECT GRANULAR FILL DRAINAGE LAYER	CONCRETE
PIPE BEDDING MATERIAL	RIPRAP
SELECT AGGREGATE FILL	GRAVEL
COMPACTED SELECT LOW PERMEABILITY SOIL	GENERAL FILL

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NO.	BY	DATE	REVISION	APP'D.
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2.				
1.				

PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **DETAILS- MISCELLANEOUS**

DRAWN BY: DEFOEJ	SCALE: NOT TO SCALE	PROJ. NO. 3081.40
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APPROVED BY: BJK	DATE PRINTED:	SHEET 23 OF 23
DATE: OCTOBER 2000		

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Appendix D: Estimated Control System Construction Schedule

Estimated Run-on and Run-off Structures Construction Schedule
Run-on and Run-off Control System Plan
Dairyland Power Cooperative, Alma Off-Site Disposal Facility
Plan Modification- June 2024

Control System	System Components	Construction Event	Anticipated Year of Construction
Run-on Control System	- Sedimentation Basin 1 - Perimeter Drainage Ditches around Cells 1-3 - Temporary diversion berm on the northern boundary of Cell 3 - Temporary retention basin on northern boundary of Cell 3 - Downslope Flume and diversion berms in final cover - Stormwater culverts	Currently Constructed	N/A
Run-off Control System	- Leachate collection and transfer system for Cells 1 through 3		
Run-on Control System	- Perimeter Drainage Ditches around the northern perimeter of Cell 4A - Stormwater culverts beneath access road - Temporary diversion berm and drainage ditch within Cell 4B footprint - Temporary sedimentation basin east of Cell 4A	Cell 4A Liner	2026
Run-off Control System	- Leachate collection system for Cell 4A		
Run-on Control System	- Final Cover Diversion Berms and drainage outlets	Cell 3 Final Cover	2029
Run-on Control System	- Sedimentation Basin 2 construction - Perimeter drainage ditch around remainder of Cell 4	Cell 4B Liner	2036
Run-off Control System	- Leachate collection system for Cell 4B		
Run-on Control System	- Final Cover Diversion Berms and drainage outlets	Cell 4A Final Cover	2038
Run-on Control System	- Final Cover Diversion Berms and drainage outlets	Cell 4B Final Cover	2057

Attachment 5

Updated Closure Plan

Closure Plan

Alma Offsite Disposal Facility, Phase IV Landfill Alma, Wisconsin

July 2024
Revision 2

Prepared For:

Dairyland Power Cooperative
3200 East Avenue South
La Crosse, Wisconsin 54601

Prepared By:

TRC
999 Fourier Drive, Suite 101
Madison, Wisconsin 53717

BreAnne Kahnk, P.E.
Senior Engineer

Todd W. Martin
Principal Project Manager

TABLE OF CONTENTS

TABLES

APPENDICES

Revision History

Revision Number	Revision Date	Section Revised	Summary of Revisions
1	01/12/2023	1-3	Text updates.
2	07/09/2024	1-2, Tables	Text updates and Table 1 and Table 2

1.0 Introduction

This Closure Plan (Plan) was prepared by TRC Environmental Corporation (TRC) on behalf of Dairyland Power Cooperative (DPC) for the Alma Off-Site Disposal Facility, Phase IV Landfill (Landfill) where coal combustion residuals (CCR) are disposed. The approximately 32.1 acres Landfill is located in Sections 18 and 19, T21N, R12W, Town of Belvidere, Buffalo County, Wisconsin. DPC owns and operates the Landfill in compliance with the Plan of Operation (RMT 2000) as permitted by the Wisconsin Department of Natural Resources (WDNR).

This Plan meets the closure requirements of the U.S. Environmental Protection Agency's (USEPA) CCR Rule, Title 40 Code of Federal Regulations (40 CFR) Parts 257 and 261 Subpart D - "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" as well as ch. NR 500-520, Wisconsin Administrative Code. The Landfill is considered an existing CCR landfill according to the CCR rule (40 CFR 257.53).

DPC plans to close the Landfill by leaving the CCR in-place upon completion of CCR placement. The Landfill is operated by moisture conditioning CCR, placing, and compacting the waste in the active area. Final cover will be installed in phases as portions of the Landfill reach the design top of waste grades. The Landfill has a design waste capacity of 3,011,000 cubic yards. Based on the survey conducted on November 13, 2023, 1,322,200 cubic yards of waste has been placed within the landfill. Based on the available capacity (1,688,800 cubic yards as of November 2023) and estimated filling rate (49,000 cubic yards per year), it is anticipated that final closure will be initiated in 2057. This closure date is subject to change based on potential changes in volume of CCR accepted at the Landfill.

Between the Landfill current operations and final closure, several closure events on portions of the Landfill will be conducted. An estimated schedule from current operations (as of June 2024) to the closure of the last portion of the Landfill is provided in Table 1. This schedule includes the estimated acreage and year of when the closure activities for the phased closures would begin. This schedule is subject to changes based both on changes in the volume of CCR accepted at the material and the number of closure phases that would take place.

2.0 Closure Plan

2.1 Initiation of Closure Activities

The owner or operator of the CCR unit shall initiate closure no later than 30 days after the date on which the CCR unit either receives the known final receipt of waste or removes the known final volume of CCR for beneficial use in accordance with 40 CFR 257.102(e) and s. NR 506.083(2). Closure shall also be commenced if the unit has not received waste or is no longer removing CCR for beneficial use within two years of last receipt of waste or last removal for beneficial use. The owner or operator may secure an additional 2 years so long as they are able to demonstrate that there is reasonable likelihood that the unit will accept waste or remove CCR in the foreseeable future. Subsequent 2-year periods may be continued to be requested so long as they are able to continue to demonstrate the reasonable likelihood of CCR waste disposal or removal for beneficial use. Demonstrations must be placed in the operating recorded prior to the end of any two-year period following 40 CFR 257.102(e)(2)(ii and iii). Per s. NR 506.083(2)(b), these delays shall be requested in writing to the WDNR as a modification to the Closure Plan and include the requirements detailed in s. NR 506.083(2)(b)(1-3).

No later than the date of initiating closure, the owner or operator must prepare a notification of intent to close the Landfill including the certification of a qualified professional engineer for the final cover system design as required by 40 CFR 257.102(d)(3)(iii).

Closure activities have been initiated if the owner or operator has ceased placing waste and completes one of the following activities:

- Taken steps necessary to implement the written closure plan,
- Submitted a completed application for required state or agency permit or modification, or
- Taken steps necessary to comply with state or other agency standards that are pre-requisite to initiating or completing closure.

2.2 Closure Performance Standard

The owner or operator of the Landfill will close the CCR unit in a manner that controls post-closure infiltration of liquids into the waste, releases of waste, and leachate or contaminated run-off to groundwater or surface water and preclude the probability of impoundment of water, sediment, or slurry. Measures will be included that provide slope stability which will prevent movement of the final cover system during closure and post-closure. Need for further maintenance of the CCR unit will be minimized. The CCR unit closure should be completed in the shortest amount of time consistent with recognized and generally accepted engineering practices and be done in accordance with 40 CFR 257.102 and s. NR 506.083.

2.3 Final Cover System

Closure of the Landfill will occur by leaving the CCR in-place, which requires the construction of a final cover system compliant with 40 CFR 257.102(d) and s. NR 504.12(4). The final cover system shall meet the following requirements:

- Designed to be compliant with s. NR 504.07, or

- The hydraulic conductivity of the final cover must be less than or equal to 1 x 10^{-5} centimeters per second (cm/s), or less than or equal to the hydraulic conductivity of the bottom liner system or natural subsoils present, whichever is less.
- An infiltration layer of at least 18 inches of earthen material that meets the requirements of s. NR 504.12(4)(b)(2).
- An erosion layer of at least six inches of earthen material that is capable of sustaining native plant growth that meets the requirements of s. NR 504.12(4)(b)(3).
- The final cover system must be designed to minimize impacts due to settling and subsidence.

The Landfill will be closed using a composite final cover system. For all future final cover events, the following design will be used (from bottom to top):

- a 24-inch compacted soil barrier (barrier layer),
- GCL (barrier layer),
- a 40-mil textured linear low density polyethylene (LLDPE) geomembrane (barrier layer),
- a 12-inch–thick select granular fill drainage layer (infiltration layer),
- an 18-inch–thick general fill rooting layer (infiltration layer), and
- a 6-inch–thick topsoil layer (erosion layer).

In a 2004 Plan of Operation Modification, an alternate final cover system was presented, which has been used in the previous three final cover construction events. This system consisted of the following components (from bottom to top):

- 2-foot (24 inches) moisture-conditioned and compacted “select” fly ash (i.e. mixture containing a minimum of 40 percent of the more reactive J.P. Madgett fly ash) (barrier layer),
- 40-mil geomembrane (barrier layer),
- 1-foot-thick (12 inches) sand drainage layer (infiltration layer),
- 1.5-foot-thick (18 inches) general soil cover layer (infiltration layer), and
- 6-inch-thick topsoil layer (erosion layer).

The general function of each component of the final cover system is provided in parentheses above. The barrier layer consists of 2 feet of compacted material/soil and a 40-mil geomembrane which exceeds the hydraulic conductivity criteria of 1x10^{-5} cm/s. The landfill was constructed with a composite liner system; therefore, a composite final cover system provides an equivalent hydraulic conductivity. The granular fill drainage layer removes water that infiltrates through the erosion and infiltration layers. The infiltration layer and erosion layer meet the requirements of the CCR rule and s. NR 504.07(6) and (7). This final cover system meets the requirements of 40 CFR 257.102(d)(3)(i) and s. NR 504.12(4).

Following placement of final cover and the surface water control features, the area will be fertilized, seeded, and mulched in order to establish vegetation.

The final cover system has design slopes of 25 percent, refer to Sheet 12 from the Plan of Operation in Appendix A. Because the waste is placed and compacted with control of the moisture conditions and the stability of CCR, significant settlement is not anticipated. Global stability of the Landfill and interface stability of the final cover system were evaluated in the Plan of Operation (RMT 2000) with resulting factors of safety that meet the CCR rule. Based on these considerations, the Landfill closure has been designed in a manner to minimize or eliminate infiltration into the waste, preclude the probability of future impoundment of water, provide stable slopes, and minimize future maintenance.

2.3.1 Final Cover Construction

The final cover system will be constructed in phases as the top-of-waste grades are achieved to minimize the active area of the Landfill and leachate generation. The estimated closure phases and the year in which the closure of the phases are projected to be completed are detailed in Table 1. After final CCR placement in the Landfill, the remaining portion of the final cover system will be constructed. Surface water control features on this segment of the final cover will be constructed and connected with the existing surface water control features.

Future final cover will be constructed by fine grading the waste subbase, placing the soil barrier layer and GCL, deploying and installing the 40-mil thick textured geomembrane, placing the granular drainage layer, placing the general fill rooting layer, and placing the topsoil layer. A schedule estimate of closure activities for final closure is presented in Table 2. It is anticipated that closure construction can be completed within the 6-month timeframe, as required by s. NR 506.083(3)(a).

2.3.1.1 Fine Grading the Waste Subbase

The waste subbase will be fine graded and leveled using heavy equipment to provide a surface for the placement of the grading layer and GCL.

2.3.1.2 Soil Barrier Layer and GCL (Future Cover Construction)

The soil barrier layer material will meet the requirements specified in Condition 11b of the Plan of Operation Conditional Approval and January 2024 Addendum to the January 2023 Plan Modification for Initial Permitting of CCR Landfills. The soil barrier layer will have a minimum thickness of 24 inches measured vertically from the top of the ash waste.

The GCL will be deployed above the soil barrier layer such that there is a minimum of 6 inches of overlap on longitudinal seams and a minimum of 24 inches overlap on end seams or as recommended by the manufacturer, whichever is greater. The panels will be placed with the overlap on both longitudinal and end seams shingled down-slope. If the GCL requires granular bentonite to be placed along the seam, the overlapping panel edge will be pulled back and granular sodium bentonite will be poured continuously along all seams, at an application rate of ¼ pound per linear foot.

The GCL will be tested during manufacturing, and prior to installation. The results of manufacturer's testing will be submitted to the engineer for review and approval prior to the

acceptance of GCL. Samples from selected rolls delivered to the site will also be collected for conformance testing prior to acceptance and installation.

2.3.1.3 Select CCR Layer (Previously Completed Cover Construction)

The select CCR layer was moisture conditioned and compacted according to the construction specifications. The compaction of the select CCR material was observed by the engineer's representative while documenting construction. The select CCR layer had a minimum thickness of two feet measured vertically from the cover surface.

2.3.1.4 40-mil LLDPE Geomembrane

If GCL is used, the LLDPE geomembrane will be deployed at a rate equivalent to that of the GCL deployment rate such that the GCL panels will be covered daily to prevent against physical damage and/or hydration of the GCL. The geomembrane will be fabricated from a polyethylene resin, which will have a density range of 0.939 g/cc or less for LLDPE. The nominal geomembrane thickness will be 40 mils for LLDPE, with no thickness measurements falling below the minimum industry-accepted manufacturing tolerance.

The geomembrane will be installed with the panels orientated perpendicular to the contours (i.e., running up and down the slope). The geomembrane will be deployed in a manner that does not adversely impact the barrier material below the geomembrane.

Geomembrane panels will be seamed in the field. Production seaming (linear seams) will be performed using the dual hot wedge (fusion type) seam method. Non-production seams (detail work and repairs) will be performed using the extrusion fillet weld process. Corners, butt seams, and long repairs will be fusion-welded where possible. The geomembrane component of the adjacent cell will be welded together for a continuous membrane surface.

The geomembrane will be tested during manufacturing, and prior to and during installation. The results of the manufacturer's testing will be submitted for review and approval prior to the acceptance of geomembrane rolls delivered to the site. Samples from selected rolls delivered to the site will also be collected for conformance testing by a third-party laboratory prior to acceptance and installation. Finally, during placement, both nondestructive and destructive testing of the geomembrane seams will be performed. Nondestructive testing will be performed by the installation contractor and observed by a third party. Destructive testing will consist of both field and third-party laboratory testing of the samples collected.

2.3.1.5 Granular Drainage Layer

After placement and testing of the geomembrane, or portions thereof, a 12-inch–thick select granular fill drainage layer will be placed as soon as practicable to protect the geomembrane and to provide a confining pressure for the underlying GCL, if used. At a minimum, the select granular fill will be placed within 30 days of completing the membrane installation and quality assurance testing.

To minimize the potential for large wrinkles in the geomembrane, the drainage layer will be placed during cooler temperatures when possible. Wrinkles in the geomembrane that are higher than they are wide, will be smoothed or cut out and repaired prior to placing the drainage layer.

The initial lift of select granular fill will be 2 to 3 feet thick, depending on the type of equipment being used, to provide an access ramp. A minimum of 2 feet of material will be placed prior to operating tracked vehicles and flotation tire–equipped vehicles, while a minimum of 3 feet of material will be placed prior to operating trucks and other wheeled hauling equipment. The initial lifts of select granular fill will eventually be graded to the designed 1-foot–thick layer with a low ground pressure (< 5 psi) tracked vehicle. The procedure for deployment of the granular drainage blanket will be established at the preconstruction meeting.

2.3.1.6 General Fill Rooting Layer

An 18-inch–thick uncompacted general fill rooting layer will be placed above the drainage layer in a single lift. The general fill rooting layer will provide a rooting zone for vegetation and will protect the cap from damage due to freeze-thaw and desiccation.

2.3.1.7 Topsoil and Vegetation

The top layer of the final cover system will be a 6-inch–thick layer of topsoil. Topsoil stripped from the landfill and perimeter areas during site preparation will be stockpiled and reused in the final cover. After topsoil is placed, the area will be seeded, mulched, and fertilized. Prior to seeding, the topsoil layer will be prepared for seeding by disking and pulverizing soil within 2 inches of the surface.

DPC has established prairie vegetation on previously constructed phases of final cover with good performance. The prairie vegetation is suitable to soil quality/thickness, and slopes and moisture conditions, with minimal need for continuous maintenance. This prairie vegetation is planned for use in future final cover construction events. Erosion control measures will be installed as needed across the site to limit erosion prior to establishing vegetation.

2.3.2 Storm Water Control Features

Storm water control features will be constructed and/or completed for each phase of final cover construction. Storm water control features consist of diversion berms, a downslope flumes, and energy dissipaters. These storm water control features on the final cover deliver water to perimeter ditches, sedimentation basins, and sediment traps that were constructed during liner construction of the various cells. The storm water control features will be constructed in accordance with the specifications and details presented in the Plan of Operation (RMT 2000), refer to Appendix A for relevant plan sheets from the Plan of Operation. These features are designed to manage runoff from 100-year 24-hour storm events and minimizing scour and erosion of the final cover. Additional details on the storm water control features are provided in the Run-On and Run-Off Control Systems Plan.

2.4 Completion of Closure Activities

Within 30 days of completion of closure activities the owner or operator shall prepare a notification of closure of a CCR unit with a certification from a qualified professional engineer that the closure has been performed in accordance with this Plan.

Per 40 CFR 257.102(i) the owner or operator must record a notation on the deed to the property, or some other instrument that is normally examined during title search, that the land has been used for a CCR unit and that it is restricted under the post-closure care requirements as provided

in 40 CFR 257.104(d)(1)(iii). Per s. NR 506.083(4)(a), the deed notation (affidavit) is to be recorded within 60 days after closure is complete. A copy of the affidavit is required to be submitted to the WDNR and placed in the facility's operating record within 30 days of recordation.

2.5 Amendment of a Written Closure Plan

The owner or operator will amend the written closure plan in accordance with s. NR 514.04(6) whenever:

- There is a change in the operation of the Landfill that would substantially affect the plan in effect, or
- Before or after closure activities have commenced, unanticipated events necessitate a revision.

The closure plan must be amended and submitted in writing to the WDNR at least 60 days prior to a planned change in operation of the Landfill, or no later than 60 days after an unanticipated event occurs that requires the need to revise an existing closure plan. If a written closure plan is revised after closure activities have commenced for the Landfill, the current closure plan must be amended and submitted to the WDNR no later than 30 days following the triggering event.

3.0 Notification

3.1 Operating Record

The following items will be maintained in the operating record for a minimum of five years:

- 40 CFR 257.105(i)(4): the most recent written closure plan or amendment of the Plan must be maintained for the life of the operating record
- 40 CFR 257.105(i)(7): the notification of intent to close a CCR unit
- 40 CFR 257.105(i)(8): the notification of completion of closure of a CCR unit
- 40 CFR 257.105(i)(9): the notification of recording a notation on the deed

3.2 Notification Requirements

The following required notifications will be provided before the close of business on the day the notification is required to be completed:

- 40 CFR 257.106(i)(4)/s. NR 506.17(4)(c): a notification of the available written closure plan or amendment of the Plan
- 40 CFR 257.106(i)(7)/s. NR 506.083(1)(a): the notification of intent to close a CCR unit
- 40 CFR 257.106(i)(8) /s. NR 506.083(1)(b): the notification of completion of closure of a CCR unit
- 40 CFR 257.106(i)(9) /s. NR 506.083(4)(a): the notification of recording a notation on the deed

3.3 Publicly Accessible Internet Site

The following required items will be posted on the publicly accessible internet site within 30 days of placing the information in the operating record:

- 40 CFR 257.105(i)(4): the most recent written closure plan or amendment of the Plan must be maintained for the life of the operating record
- 40 CFR 257.107(i)(7): the notification of intent to close a CCR unit
- 40 CFR 257.107(i)(8): the notification of completion of closure of a CCR unit
- 40 CFR 257.106(i)(9): the notification of recording a notation on the deed

Information should be posted within 30 days of placing the pertinent information required by 40 CFR 257.105/NR 506.17(3)(c) in the operating record. Records will be made available to the public for at least five years following the date on which the information was posted to the internet site.

Additional postings to the operating record, notifications, and postings to the publicly accessible internet site may be needed if extensions under 40 CFR 257.102e(2)(ii) or 40 CFR 257.102(f)(2) are pursued.

4.0 References

RMT, Inc. 2000. Plan of Operation: Phase IV Disposal Area, Alma Off-site Ash Disposal Facility, Town of Belvidere, Buffalo County, Wisconsin. October 2000.

RMT, Inc. 2004. Plan of Operation Modification: Phase IV Disposal Area, Alma Off-site Disposal Facility, Town of Belvidere, Buffalo County, Wisconsin.

TRC Environmental Corporation. 2021. Run-On and Run-Off Control Systems Plan. October 2021.

5.0 Engineer's Certifications

Pursuant to 40 CFR 257.102 and by means of this certification I attest that:

(i) I am familiar with the requirements of the CCR rule (40 CFR 257);

(ii) I am familiar with the requirements of the ch. NR 500-520, Wisconsin Administrative Code;

(iii) this Closure Plan has been prepared in accordance with good engineering practice;

(iv) the design of the final cover system meets the requirements of 40 CFR 257.102(d)(3) and s. NR 504.12(4); and

(v) this Closure Plan meets the requirements of 40 CFR 257.102 and s. NR 514.07(10)(c).

For the purpose of this document, "certify" and "certification" shall be interpreted and construed to be a "statement of professional opinion." The certification is understood and intended to be an expression of my professional opinion as a Wisconsin licensed professional engineer, based upon knowledge, information, and belief. The statement(s) of professional opinion are not and shall not be interpreted or construed to be a guarantee or a warranty of the analysis herein.

Signature of Registered Professional Engineer

Registration No. E-46825 State: Wisconsin

Table 1: Estimated Schedule of Phased Closure
Alma Offsite Disposal Facility, Phase IV Landfill

Closure Phase	Acreage	Estimated Year of Closure[1]
Portion of Cell 1[2]	3.6 acres	2010
Portion of Cell 2A and Cell 1[2]	1.7 acres	2012
Portions of Cell 1/2A/2B[2]	2.8 acres	2017
Cell 3	5.84 acres	2029
Cell 4A	6.11 acres	2038
Cell 4B	12.05 acre	2057

Footnotes:

(1) Closure construction may be shifted to different years based on rate of filling.

(2) Closure phases currently constructed.

Table 2: Schedule Estimate for Completing Closure
Closure Plan – Alma Offsite Disposal Facility, Phase IV Landfill

Closure Area: 12.1 Acres - Final Phase of Final Cover on Plan of Operation Phasing Plans			
Task/Milestone	**Start Date[1]**	**Duration**	**Estimated End Date**
Ash Filling Ceases	2/1/2057	--	2/1/2057
Notification to Initiate Closure	3/2/2057	--	3/2/2057
Fine Grading Waste	3/5/2057	22 days	3/26/2057
Select CCR Placement and Compaction[2]	3/27/2057	31 days	4/26/2057
Geomembrane Deployment and Installation	4/27/2057	21 days	5/17/2057
Granular Drainage Layer Placement	5/18/2057	18 days	6/4/2057
General Fill Rooting Zone Placement	6/5/2057	21 days	6/25/2057
Topsoil Placement and Seeding	6/26/2057	11 days	7/6/2057
Notification of Completion of Closure	7/9/2057	31 days	8/8/2057
Deed Notation and Notification	7/9/2057	61 days	9/7/2057
	Total Duration:	**124 days[3]**	

Footnotes:

(1) Start date based on assumed beginning of 2057 construction season. Closure construction may be shifted to different years based on rate of filling.

(2) Previous final cover construction has utilized the modified final cover design. Timeframes associated for this modified final cover design will be used.

(3) Total duration provided in time to substantial completion of final cover placement. At this point, the CCR has been covered and the vegetation seed and temporary erosion control has been applied. Emergence and establishment of vegetation may require additional time.

Created By: J. Hotstream
Checked By: S. Sellner

Revised by: B. Kahnk
Checked By: Z. Bauman

Appendix A: Engineering Drawings

- Plan of Operation – Title Sheet (Sheet 1)
- Plan of Operation – Final Grades (Sheet 12)
- Plan of Operation – Details – Final Cover (Sheet 19)
- Cell 3B Liner Construction and Area C (Over Cells 1 and 2) Final Cover Construction – Details (Sheets 12 and 13)

DAIRYLAND POWER COOPERATIVE

DAIRYLAND Power
COOPERATIVE – LACROSSE, WISCONSIN

PLAN OF OPERATION
PHASE IV DISPOSAL AREA
ALMA OFF-SITE ASH DISPOSAL FACILITY

WISCONSIN
CRAIG O. BARTHOLOMEW
G-451
MADISON
WI
PROFESSIONAL GEOLOGIST
10/13/00

WISCONSIN
BERNARD J. KRANTZ
E-30174
Madison, WI
PROFESSIONAL ENGINEER
10/13/00

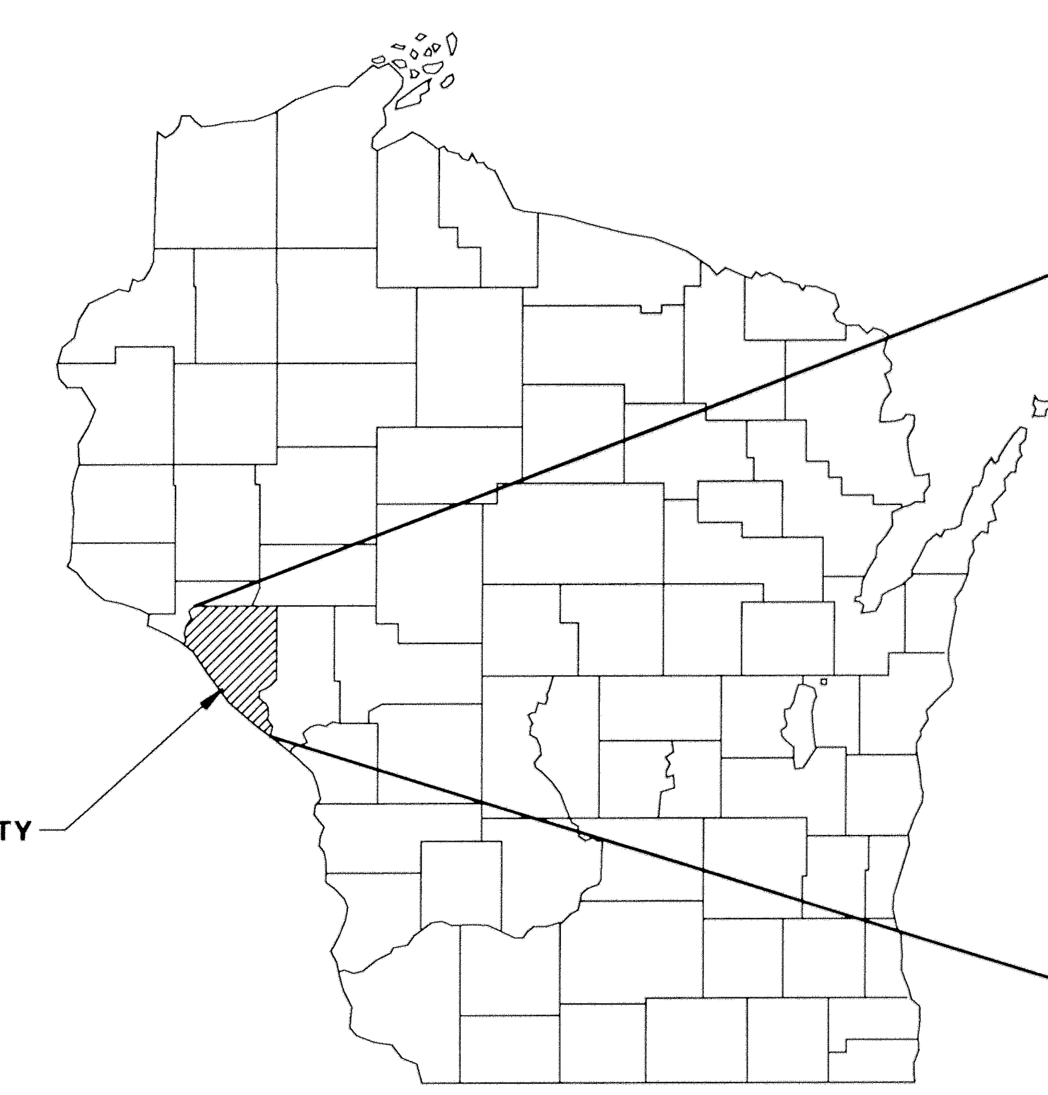
PREPARED FOR: DAIRYLAND POWER COOPERATIVE
LACROSSE, WISCONSIN

PREPARED BY: RMT, INC.
MADISON, WISCONSIN

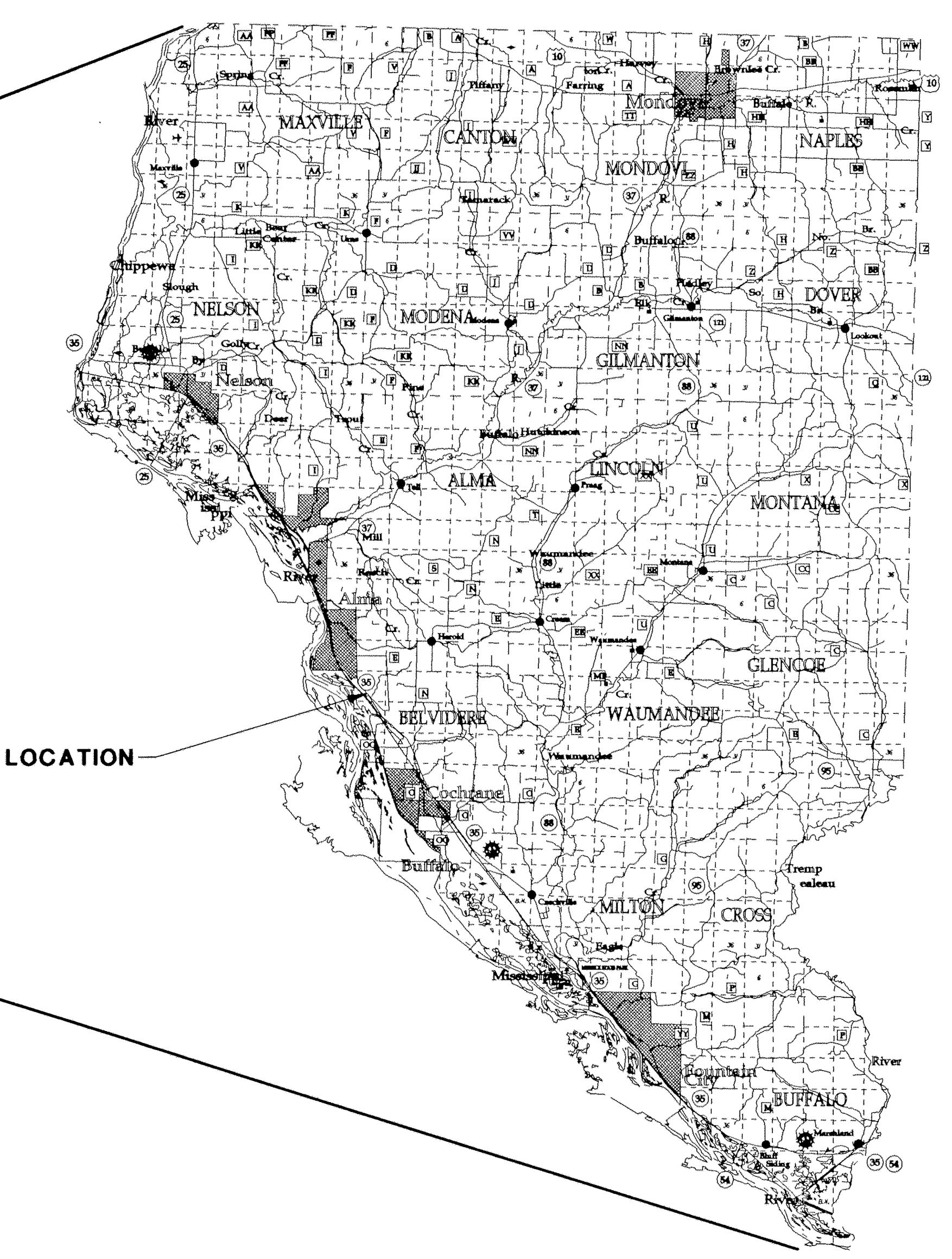
DATE: OCTOBER 2000

INDEX

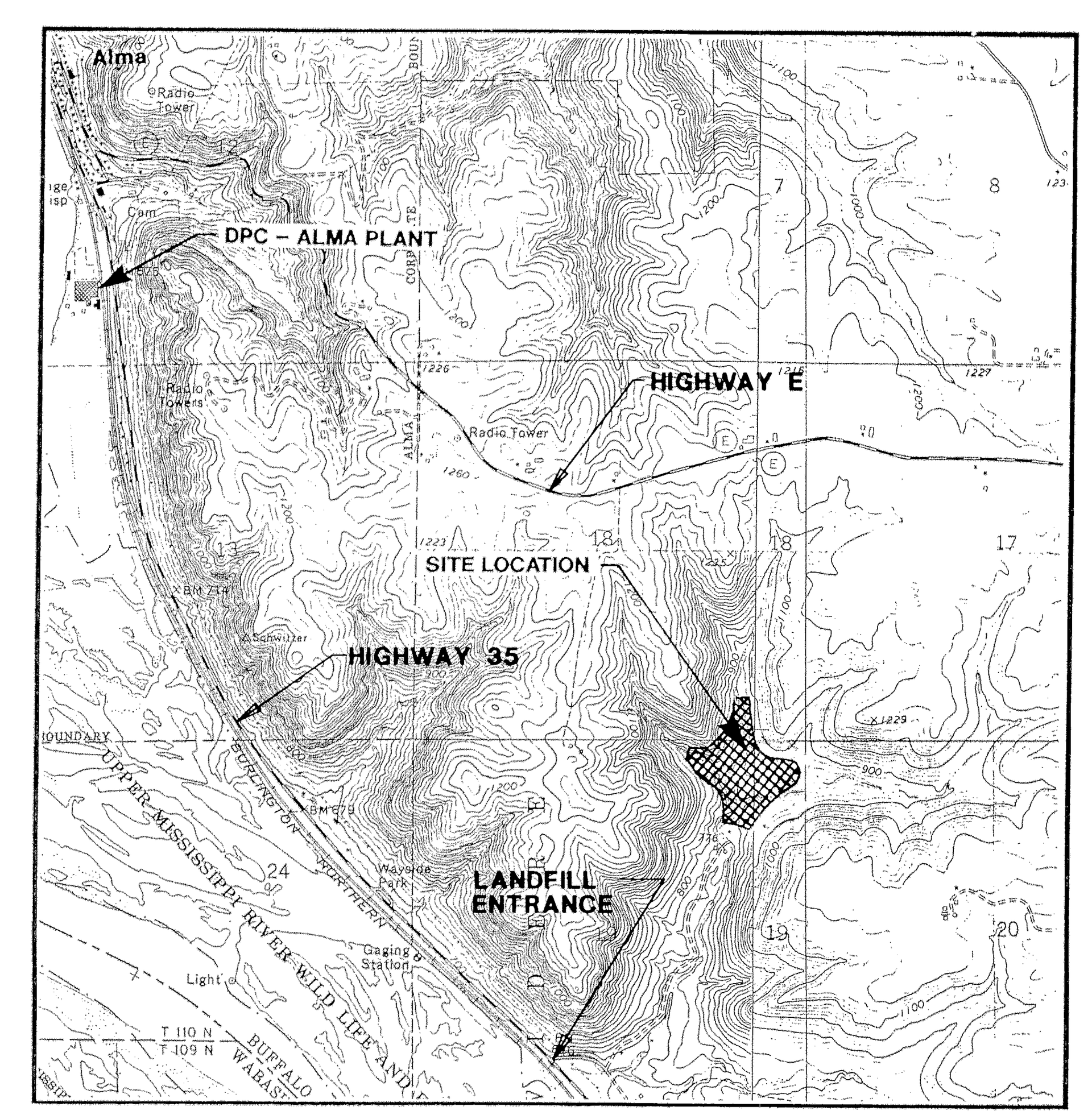
SHEET NUMBER	SHEET TITLE
1	TITLE SHEET/INDEX
2	STANDARD LEGEND AND NOTES
3	EXISTING CONDITIONS MAP
4	PROPOSED SUBBASE GRADES
5	PROPOSED BASE GRADES
6	PHASING PLAN- CELL I ACTIVE
7	PHASING PLAN- CELL I CLOSED CELL 2A ACTIVE
8	PHASING PLAN- CELL 1 AND 2A CLOSED CELL 2B ACTIVE
9	PHASING PLAN- CELL 1, 2A, AND 2B CLOSED CELL 3 ACTIVE
10	PHASING PLAN- CELL 1, 2A, 2B AND 3 CLOSED CELL 4A ACTIVE
11	PHASING PLAN- CELL 1, 2A, 2B, 3 AND 4A CLOSED CELL 4B ACTIVE
12	PROPOSED FINAL GRADES
13	PROPOSED ENVIRONMENTAL MONITORING PLAN
14	LONG TERM CARE PLAN
15	ENGINEERING CROSS SECTIONS 171700N AND 172200N
16	ENGINEERING CROSS SECTIONS 1477340E AND 1477710E
17	DETAILS- LINER AND COLLETION PIPES
18	DETAILS- LEACHATE STORAGE TANK AND MANHOLE
19	DETAILS- FINAL COVER
20	DETAILS- DOWNSLOPE FLUMES
21	DETAILS- DOWNSLOPE FLUMES
22	DETAILS- SEDIMENTATION BASINS
23	DETAILS- MISCELLANEOUS



WISCONSIN



BUFFALO COUNTY



SCALE: 1"=2000'

MAP SOURCE: U.S.G.S. CREAM AND ALMA 7.5' QUADRANGLES, DATE 1974.

SITE LOCATION

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER.
(NOT FOR CONSTRUCTION)

RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923
Madison, WI 53708-8923
Phone: 608-831-4444

RMT COMPUTER AIDED DESIGN & DRAFTING

CONSTRUCTION ACTIVITIES

PHASE 4B CLOSURE

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL GRADING LAYER.
3. INSTALL GCL.
4. INSTALL GEOMEMBRANE.
5. INSTALL DOWNSLOPE FLUME.
6. INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE, ROOTING ZONE LAYER, AND TOPSOIL.
7. INSTALL DIVERSION BERMS.
8. SEED, FERTILIZE, AND MULCH.

CONSTRUCTION QUANTITIES

PHASE 4B CLOSURE	VOLUME / AREA
TOPSOIL PLACED	
GRADING LAYER SOIL	9,800 CY
GENERAL FILL	9,800 CY
SELECT GRANULAR FILL	19,600 CY
GEOTEXTILE	19,600 CY
GCL	61,700 SY
GEOMEMBRANE	58,600 SY
SEED, FERTILZER, MULCH	58.600 SY
DOWNSLOPE FLUME	12.1 ACRES
4-INCH DIA. HDPE CORRUGATED PIPT	1 EACH
W/ SMOOTH INTERIOR	3,150 LF
SELECT AGGREGATE FILL	470 CY

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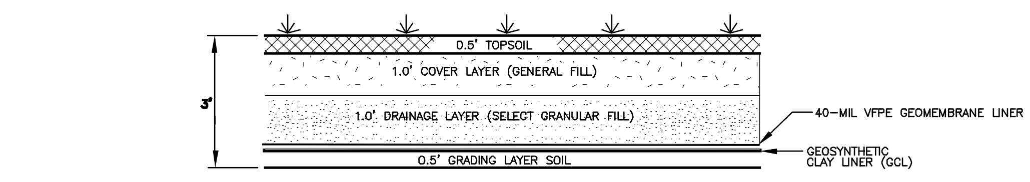
NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **PROPOSED FINAL GRADES**

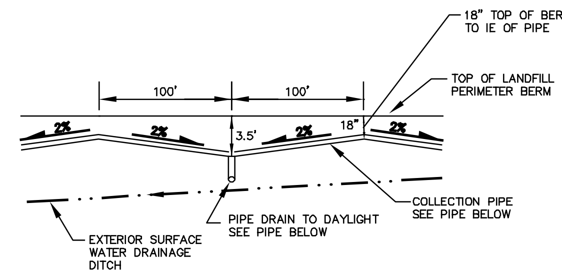
DRAWN BY: NOLDENR	SCALE: 1"=100'	PROJ. NO. 3081.40
CHECKED BY: DM		FILE NO. FGRADES.PLT
APPROVED BY: BJK	DATE PRINTED:	SHEET 12 OF 23
DATE: OCTOBER 2000		

RMT®
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923
Madison, WI 53708-8923
Phone: 608-831-4444



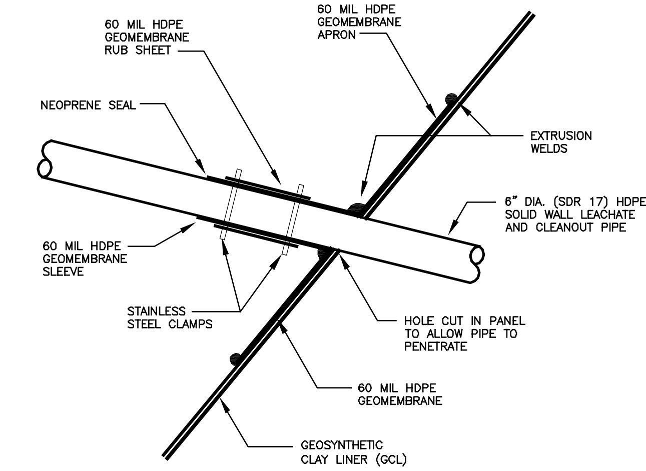
1/19 **FINAL COVER**

(NOT TO SCALE)



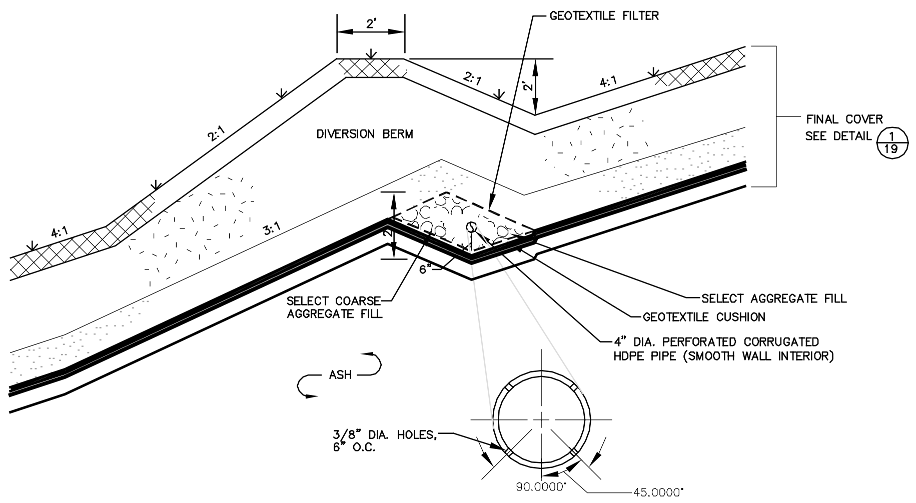
NOTE: IN AREAS WHERE THE TOP OF BERM SLOPES, THE COLLECTION PIPE WILL FOLLOW THE SAME SLOPE AS THE TOP OF BERM AND WILL OUTLET THROUGH DISCHARGE PIPES LOCATED AT SPECIFIED INTERVALS. REFER TO PLAN SHEET 12.

SECTION A-A' OF FINAL COVER DRAINAGE LAYER



6/19 **PIPE BOOT- PIPES PENETRATING THROUGH FINAL COVER AND LOW PERMEABILITY LAYER (TYPICAL)**

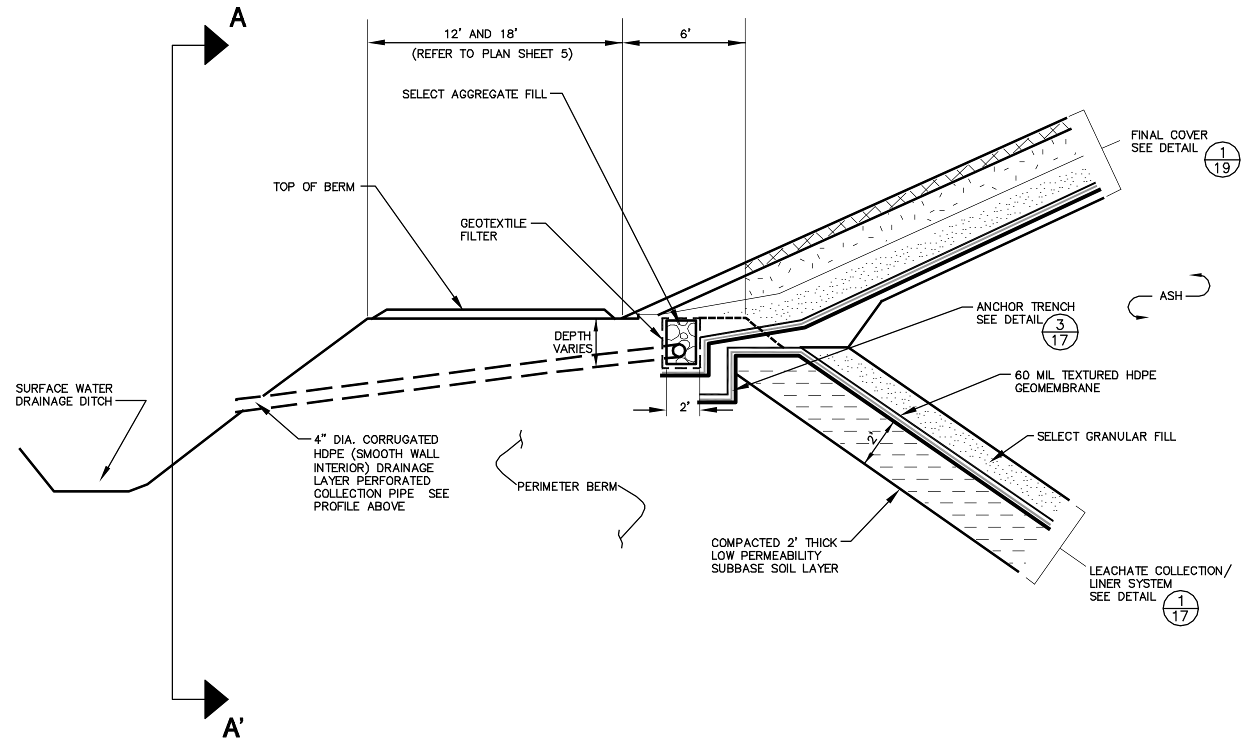
(NOT TO SCALE)



NOTE:
A 4" DIA. PERFORATED CORRUGATED HDPE PIPE WILL BE LOCATED BELOW EVERY DIVERSION BERM ABOVE THE FINAL COVER EXCEPT THE LOWEST BERM LOCATED NEXT TO THE LANDFILL PERIMETER BERM. TO COLLECT WATER IN THE DRAINAGE LAYER ALONG THE PERIMETER BERM PIPES WILL BE CONSTRUCTED IN THE BERM AS SHOWN ON DETAIL 4 OF 19.

2/19 **SURFACE WATER DIVERSION BERM ON FINAL COVER (TYPICAL)**

(NOT TO SCALE)



4/19 **PERIMETER BERM FINAL COVER DRAINAGE LAYER DISCHARGE PIPE (TYPICAL)**

(NOT TO SCALE)

LINE AND SHADING LEGEND

GEOTEXTILE	GEOMEMBRANE
GEOCOMPOSITE	GEOSYNTHETIC CLAY LINER (GCL)
TOPSOIL	NATIVE SOIL
SELECT GRANULAR FILL DRAINAGE LAYER	CONCRETE
PIPE BEDDING MATERIAL	RIPRAP
SELECT AGGREGATE FILL	GRAVEL
COMPACTED SELECT LOW PERMEABILITY SOIL	GENERAL FILL

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY.

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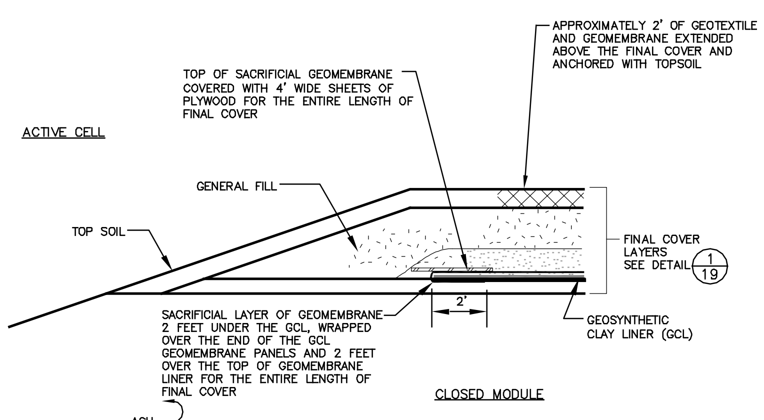
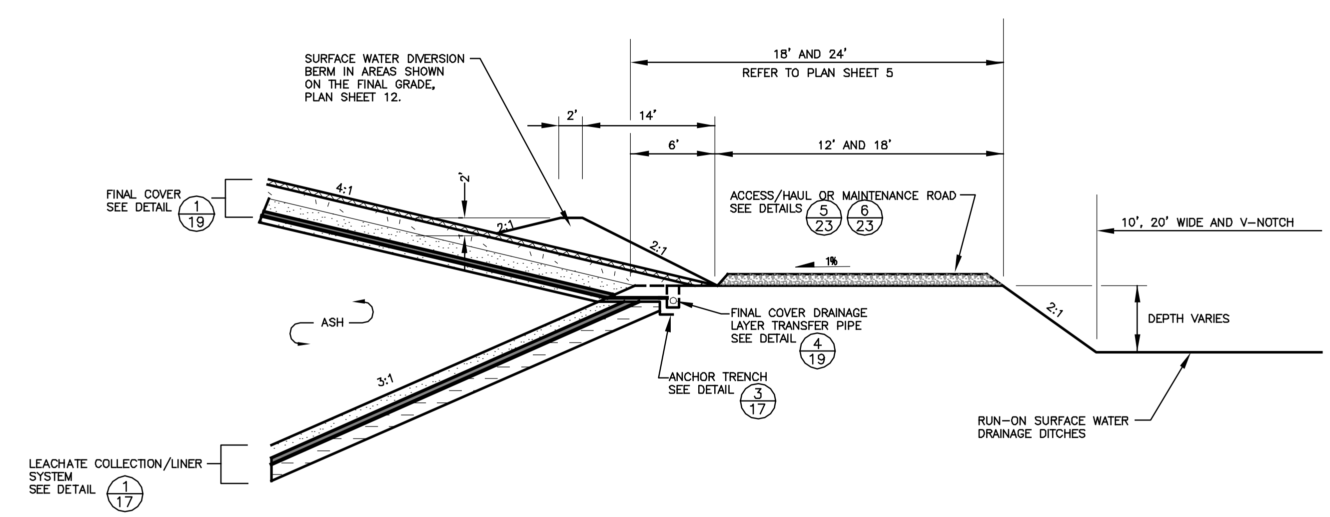


3/19 **CONSTRUCTION OF FINAL COVER FOR SPLICING FUTURE FINAL COVER**

(NOT TO SCALE)



5/19 **LANDFILL PERIMETER BERM AND SURFACE WATER DRAINAGE DITCHES (TYPICAL)**

(NOT TO SCALE)

NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **DETAILS- FINAL COVER**

DRAWN BY: DEFOEJ	SCALE: NOT TO SCALE	PROJ. NO. 3081.40
CHECKED BY: DM		FILE NO.30814004.dwg
APPROVED BY: BJK	DATE PRINTED:	SHEET 19 OF 23
DATE: OCTOBER 2000		

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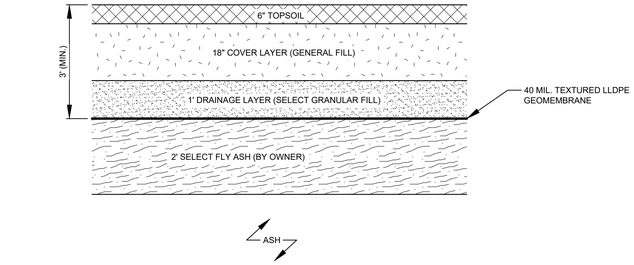
NOT FOR CONSTRUCTION

RMT

744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923
Madison, WI 53708-8923
Phone: 608/831-4444



1/12 FINAL COVER
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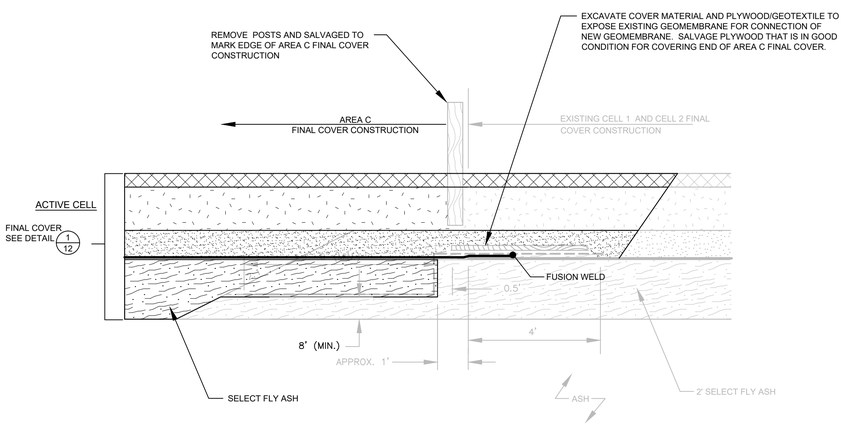

2/12 FINAL COVER CONNECTION
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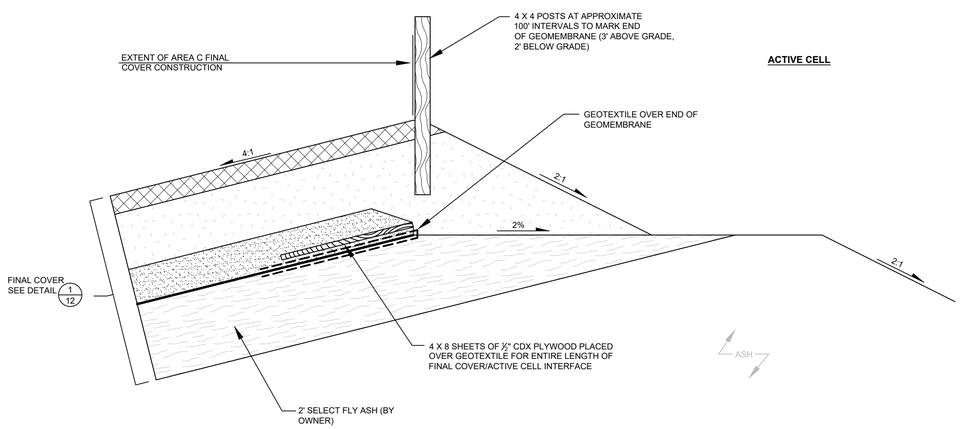

3/12 FINAL COVER TRANSITION
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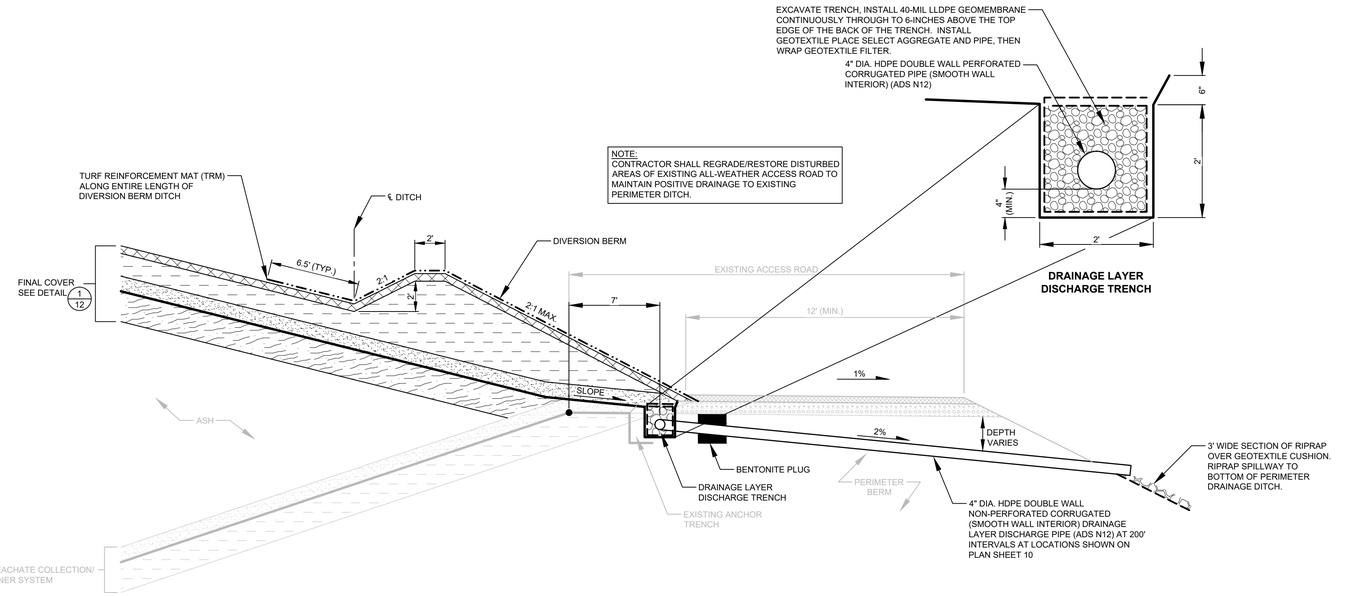

4/12 FINAL COVER TERMINATION WITH TOE DRAIN DISCHARGE PIPE
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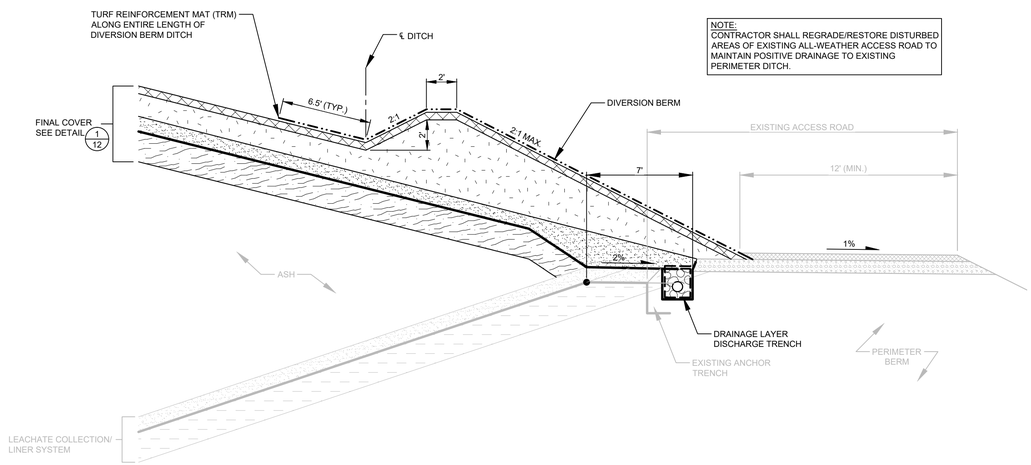

5/12 FINAL COVER TERMINATION (OVER CELL 1 LINER CONSTRUCTION)
(NOT TO SCALE)

NOTE: THE CONTRACTOR SHALL NOTIFY ALL AREA UTILITY COMPANIES PRIOR TO COMMENCING WORK ON THIS CONTRACT, IN ACCORDANCE WITH STATE AND LOCAL REQUIREMENTS.

NOTE: THESE PLANS ARE ACCOMPANIED BY A PROJECT MANUAL OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER.

NO.	BY	DATE	REVISION	APP'D

PROJECT:
DAIRYLAND POWER COOPERATIVE
PHASE IV, CELL 3B LINER CONSTRUCTION & AREA C (OVER CELLS 1 & 2)
FINAL COVER CONSTRUCTION
BUFFALO COUNTY, WISCONSIN

SHEET TITLE:
DETAILS

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CHECKED BY:	DM	AS SHOWN	FILE N:\216851.0004.SHT12-DT.dwg
APPROVED BY:	TWM	DATE PRINTED:	**SHEET 12 OF 13**
DATE:	MARCH 2015		

TRC
708 Heartland Trail
Suite 3000
Madison, WI 53717
Phone: 608.826.3600

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Plot Time: 1:24 PM

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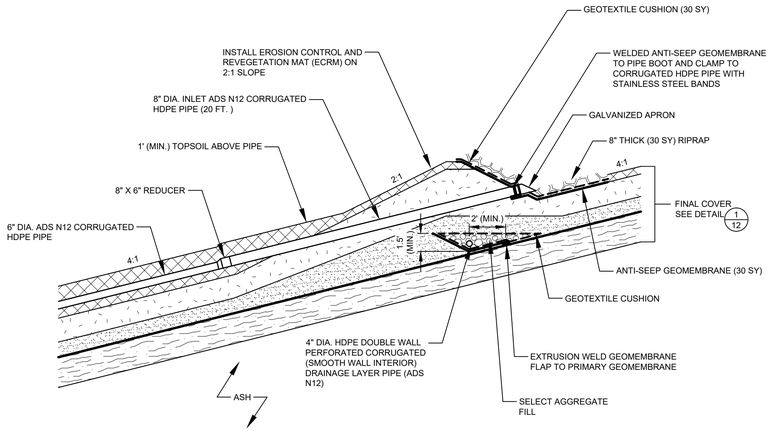
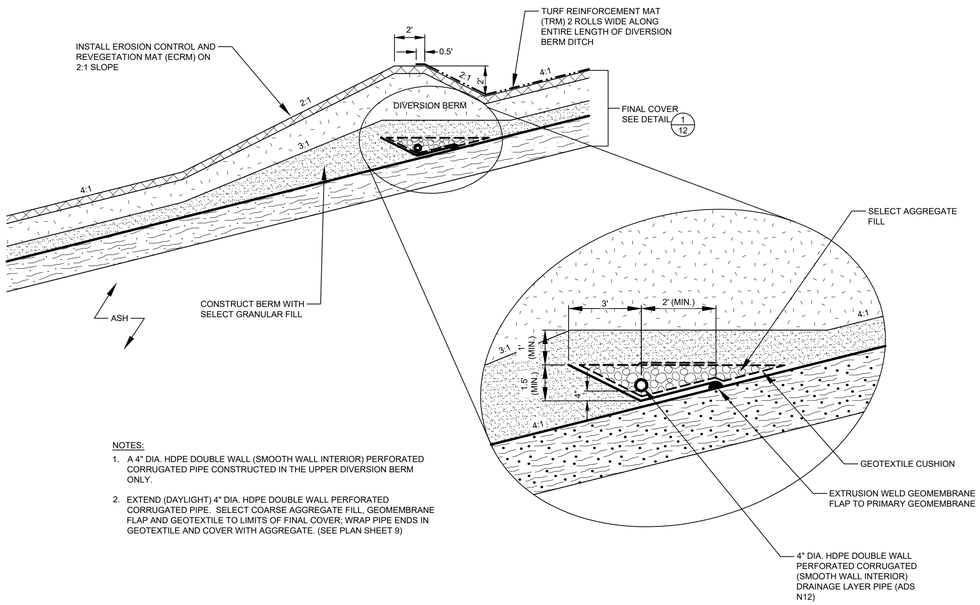


1/13 — 8" DIA. INLET STRUCTURE

(NOT TO SCALE)

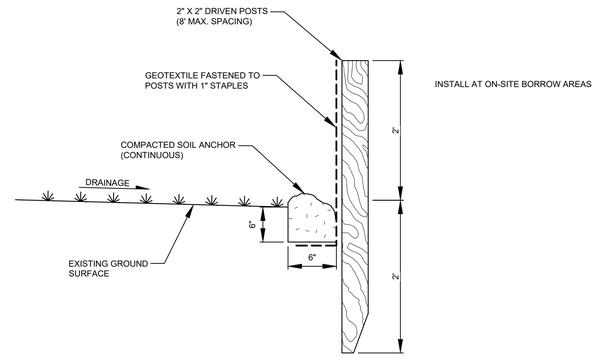


NOTES:

1. A 4" DIA. HDPE DOUBLE WALL (SMOOTH WALL INTERIOR) PERFORATED CORRUGATED PIPE CONSTRUCTED IN THE UPPER DIVERSION BERM ONLY.
2. EXTEND (DAYLIGHT) 4" DIA. HDPE DOUBLE WALL PERFORATED CORRUGATED PIPE. SELECT COARSE AGGREGATE FILL, GEOMEMBRANE FLAP AND GEOTEXTILE TO LIMITS OF FINAL COVER; WRAP PIPE ENDS IN GEOTEXTILE AND COVER WITH AGGREGATE. (SEE PLAN SHEET 9)

2/13 — DIVERSION BERM

(NOT TO SCALE)



3/13 — SEDIMENT CONTROL FENCE

(NOT TO SCALE)

NOTE: THE CONTRACTOR SHALL NOTIFY ALL AREA UTILITY COMPANIES PRIOR TO COMMENCING WORK ON THIS CONTRACT, IN ACCORDANCE WITH STATE AND LOCAL REQUIREMENTS.

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NO.	BY	DATE	REVISION	APP'D

PROJECT:

DAIRYLAND POWER COOPERATIVE
PHASE IV, CELL 3B LINER CONSTRUCTION & AREA C (OVER CELLS 1 & 2) FINAL COVER CONSTRUCTION
BUFFALO COUNTY, WISCONSIN

SHEET TITLE:

DETAILS

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CHECKED BY:	DM	AS SHOWN	FILE N:\216851.0004.SHT13-DT.dwg
APPROVED BY:	TWM	DATE PRINTED:	SHEET 13 OF 13
DATE:	MARCH 2015		

TRC
708 Heartland Trail
Suite 3000
Madison, WI 53717
Phone: 608.826.3600

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Operator Name: STORMER, LARRY
Date/Time: 03/24/2015 1:24 PM
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Attached Xref's:
Attached Images:

Attachment 6

Long-term Care Costs

Opinion of Probable Cost
Long-term Care, Phase IV Landfill
Dairyland Power Cooperative, Alma Off-Site Disposal Facility
Plan Modification - June 2024

Major Cost Item	Unit	Unit Cost [1]	Quantity	Average Cost Per Year
Land Surface Care and Site Maintenance				
Reseed/Erosion Damage	Acre	$ 830.00	32	$ 27,000.00
Lawn Mowing	LS	$ 5,310.00	1	$ 6,000.00
Snow Plowing	LS	$ 3,000.00	1	$ 3,000.00
Road Maintenance	LS	$ 2,000.00	1	$ 2,000.00
Storm Water Control Structures Maintenance	LS	$ 8,300.00	1	$ 9,000.00
Repair Cover from Settlement	Acre	$ 340.00	32	$ 11,000.00
Sedimentation Basin Cleaning	LS	$ 830.00	1	$ 1,000.00
Groundwater Monitoring Maintenance				
Inspections and Maintenance/Purge/Resurvey, Pumps [2]	LS	$ 4,000.00	0.025	$ 1,000.00
Well Replacement/Abandonment [3]	LS	$ 10,000.00	0.375	$ 4,000.00
Leachate Collection System				
Leachate Collection Line Cleaning	LS	$ 3,320.00	1	$ 4,000.00
Leachate Collection Line Televising [4]	LS	$ 1,200.00	0.2	$ 300.00
Operation and Maintenance	LS	$ 4,980.00	1	$ 5,000.00
Leachate Disposal	Gallon	$ 0.0415	876,000	$ 37,000.00
Environmental Monitoring [5]				
Groundwater Monitoring (15 wells)	LS	$ 9,000.00	1	$ 9,000.00
Leachate Monitoring (1 tank)	LS	$ 1,000.00	1	$ 1,000.00
Surface Water Monitoring (2 locations)	LS	$ 1,000.00	1	$ 1,000.00
Data Preparation/Submittal	LS	$ 3,000.00	1	$ 3,000.00
Inspection and Reporting				
Annual Inspections	LS	$ 3,400.00	1	$ 4,000.00
Annual Report	LS	$ 5,000.00	1	$ 5,000.00
			Long-term Care Subtotal:	$ 133,300.00
			Contingency (10%):	$ 13,400.00
			Yearly Grand Total:	$ 146,700.00
			40-year Long-term Care Cost:	**$ 5,868,000.00**

Note:

(1) Costs are in 2023 dollars according to Wisconsin DNR Owner Financial Responsibility Inflation Factor Table. Some totals may not agree due to rounding.

(2) Resurvey/rehabilitation - Assumed to occur once per 40 years.

(3) Replace 15 wells over 40 years.

(4) All lines televised once per five years.

(5) Assumes semiannual monitoring.

Update By: B. Kahnk 6/3/2024
Checked By: T. Martin 7/8/2024