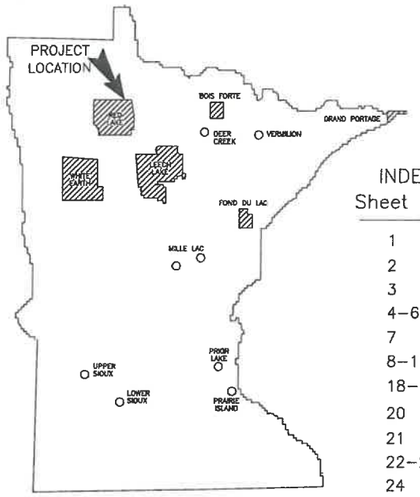
F.H.W.A. REG. NO.	B.I.A. REGION	RESER-VATION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
	MIDWEST	RED LAKE		1	27



State of
MINNESOTA
NTS

INDEX OF SHEETS

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1	TITLE SHEET
2	ESTIMATE SHEET
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18–19	EROSION CONTROL – SWPPP
20	FENCING LAYOUT
21	CLEARING AND GRUBBING PLAN
22–23	GRADING PLAN
24	CONTROL PIPING / STRUCTURE LAYOUT
25	SITE SURFACING LAYOUT
26	CONNECTION TO EXISTING FORCEMAIN
27	GEOMEMBRANE FABRICATION / INSTALLATION SPECS

N W E S

RED LAKE FORCEMAIN
WASTEWATER TREATMENT FACILITY
PLAN AND PROFILE
GRADING PLAN
RED LAKE RESERVATION
BELTRAMI COUNTY, MINNESOTA

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Michael C McFarlane

MICHAEL C. MCFARLANE LIC. NO. 44196

AS-BUILT

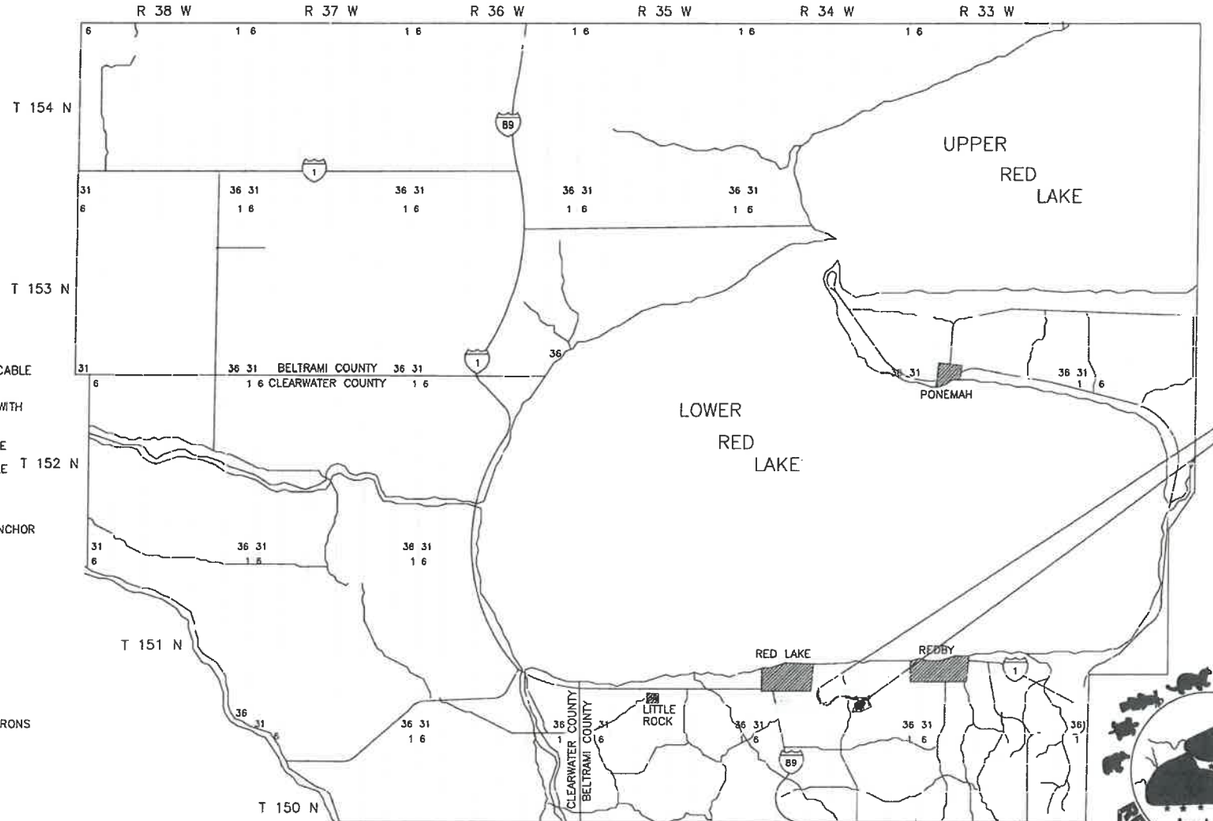
LEGEND

DESCRIPTION
SIGN
LAKE
GAS MAIN
WATER LINE
FORCE MAIN
GRADE TO DRAIN
WATER FLOW
ROAD RIGHT-OF-WAY
PROPERTY LINES
CONSTRUCTION LIMITS
UNDERGROUND TELEPHONE CABLE WITH PED
UNDERGROUND ELECTRICAL WITH TRANSFORMER
OVERHEAD TELEPHONE CABLE
OVERHEAD ELECTRICAL CABLE
TREE LINE
UTILITY POLE/GUY POLE/ANCHOR
LIGHT POLE
WELL
SOIL BORING
BENCH MARK
CONTROL POINT
PROPOSED CULVERT WITH APRONS

FLOW

PROPERTY CORNERS

FOUND MONUMENT
NO MONUMENT FOUND



FORCEMAIN AND WASTEWATER TREATMENT FACILITY

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

WARNING
LOCATION OF UNDERGROUND UTILITIES
TO BE VERIFIED BY CONTRACTOR
GOPHER STATE ONE CALL
CALL BEFORE DIGGING,
1-800-252-1166
REQUIRED BY LAW

Except as provided in the Special Provisions, all work shall be accomplished under the MINNESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION", 2005 Edition, and the latest "SUPPLEMENTAL SPECIFICATIONS" thereto.

Red Lake Band of Chippewa Indians
Tribal Engineering
P.O. Box 274, Red Lake, MN 56671

RED LAKE NATION

APPROVED

TRIBAL CHAIRMAN DATE

S:\NEC\Projects\03-42 rl waste water (lagoon)\03-42 AS-BUILTS\dwg\03-42-TITLE.dwg, Model, 3/29/2011 2:54:38 PM, snrop

STATEMENT OF ESTIMATED QUANTITIES

	ITEM NUMBER	ITEM	UNIT	ESTIMATED QUANTITIES
				EST
	2021.501	MOBILIZATION	L.S.	1
	2105.501	CLEARING	ACRE	27.33
	2101.506	GRUBBING	ACRE	27.33
	2105.523	COMMON EXCAVATION (P)	C.Y.	367530
	2123.509	DOZER HOURS	HOUR	81
	2211.501	AGGREGATE BASE CLASS 5 (MODIFIED)	TON	5360
	2511.501	RIPRAP	C.Y.	40
①	2557.501	WIRE FENCE, DESIGN CHAIN LINK	L.F.	7320
	2573.502	SILT FENCE, MACHINE SLICED AND MAINTAINED	L.F.	7825
	2575.501	SEEDING	ACRE	39.63
	2575.502	SEED, MIXTURE 240	LBS.	3963
	2575.511	MULCH MATERIAL, TYPE 4	TON	74.31
	2575.523	EROSION CONTROL BLANKET (C.O. #1)	S.Y.	25953
②	2722	REHAB EXISTING SECONDARY POND	L.S.	1
③	2722	CONNECT TO EXISTING FORCEMAIN	L.S.	1
	2722	8" PVC FORCEMAIN	L.F.	13150
	2722	PRIMARY INFLUENT STRUCTURE	L.S.	1
	2722	PRIMARY EFFLUENT CONTROL STRUCTURE	L.S.	1
	2722	SECONDARY EFFLUENT CONTROL STRUCTURE A	L.S.	1
	2722	SECONDARY EFFLUENT CONTROL STRUCTURE B	L.S.	1
	2722	PRIMARY CROSSOVER CONTROL STRUCTURE	L.S.	1
	2722	SECONDARY CROSSOVER CONTROL STRUCTURE	L.S.	1
	2722	WATER BALANCE (PRE-FILL)	L.S.	1
④	2722	INTERPOND PIPING (8" DIP)	L.F.	2774
④	2722	INTERPOND PIPING (8" PVC)	L.F.	323
⑤	2722	REINFORCED POLYPROPYLENE LINER	S.F.	1692872
	2722	NEW LIFT STATION	L.S.	1
	2722	AIR RELEASE MANHOLES	EACH	6
⑥	2722	SAFETY LADDER	L.F.	384
⑦	2722	LEVEL INDICATOR	EACH	4

① INCLUDES ALL MATERIALS AND WORK INCLUDING GATES AS CALLED FOR IN THE PLANS. ALSO INCLUDES METAL SIGNS STATING "DANGER WASTEWATER TREATMENT FACILITIES" TO BE INSTALLED ON FENCE AT 20 LOCATIONS AS DETERMINED BY THE ENGINEER.

② REFER TO SHEET 26 FOR DETAILS.

③ INCLUDED ALL SLEEVES, WYE, VALVES, AND OTHER APPURTENANCES NECESSARY FOR MAKING CONNECTION AS SHOWN IN DETAIL ON SHEET 26.

④ INCLUDES ALL MATERIALS AND WORK INVOLVED WITH POND PIPING INCLUDING PIPE, FITTINGS, SPLASH PADS, PIPING DRAINS, AND OTHER APPURTENANCES WITHIN CONTROL STRUCTURES.

⑤ INCLUDES ALL MATERIALS AND WORK INVOLVED WITH LINER PENETRATIONS INCLUDING APPROVED LINER BOOTS OR OTHER TYPES OF SEALS APPROVED BY THE ENGINEER. NO PAYMENT WILL BE MADE FOR OVERLAP AREA FOR SEAMS.

⑥ APPROVED SAFETY LADDERS SHALL BE PERMANENTLY INSTALLED AT 4 LOCATIONS IN EACH PRIMARY CELL AND 2 LOCATIONS IN EACH SECONDARY CELL EXTENDING FROM POND BOTTOM TO TWO FEET BELOW TOP OF BERMS.

⑦ APPROVED POND LEVEL INDICATORS SHALL BE INSTALLED IN EACH PRIMARY AND SECONDARY CELL. INDICATORS SHALL BE HIGHLY VISIBLE FROM CONTROL STRUCTURES.

MANHOLE & CONTROL STRUCTURE SCHEDULE

DESIGNATION	DESIGN	RIM ELEV	BOTTOM ELEV	RIM TO INVERT HEIGHT	FRAME CASTING	COVER CASTING	LOCATION	STATION & OFFSET	SEWER TYPE	SHEET NO.	REMARKS
ARMH-1	4007C	1252.00	1241.30	10.70	700-7	716	FORCEMAIN EASEMENT	5+89	8" PVC FORCEMAIN	8	FURNISH AND INSTALL NEW STRUCTURE
ARMH-2	4007C	1254.60	1243.90	10.70	700-7	716	FORCEMAIN EASEMENT	16+40	8" PVC FORCEMAIN	9	FURNISH AND INSTALL NEW STRUCTURE
VMH-1	4007C	1233.50	1222.80	10.70	700-7	716	FORCEMAIN EASEMENT	23+96, 9' RT	8" PVC FORCEMAIN	9	FURNISH AND INSTALL NEW STRUCTURE
ARMH-3	4007C	1283.30	1272.60	10.70	700-7	716	WA-ZA-WA-NI-KWAY-KUNA-ROAD-B	34+69	8" PVC FORCEMAIN	10	FURNISH AND INSTALL NEW STRUCTURE
ARMH-4	4007C	1266.00	1255.30	10.70	700-7	716	THUNDER LAKE ROAD	50+73	8" PVC FORCEMAIN	11	FURNISH AND INSTALL NEW STRUCTURE
ARMH-5	4007C	1259.30	1248.60	10.70	700-7	716	PROPOSED THUNDER LAKE ROAD	89+72	8" PVC FORCEMAIN	14	FURNISH AND INSTALL NEW STRUCTURE
ARMH-6	4007C	1266.00	1255.30	10.70	700-7	716	PROPOSED THUNDER LAKE ROAD	112+40	8" PVC FORCEMAIN	16	FURNISH AND INSTALL NEW STRUCTURE
CS-1	*	1292.65	1286.15	6.50	*	*	WASTEWATER TREATMENT SITE		8" FORCEMAIN/GRAVITY SEWER	24	PRIMARY INFLUENT STRUCTURE
CS-2	*	1292.65	1279.50	13.15	*	*	WASTEWATER TREATMENT SITE		8" GRAVITY SEWER	24	PRIMARY EFFLUENT CONTROL STRUCTURE
CS-3	*	1292.65	1280.00	12.65	*	*	WASTEWATER TREATMENT SITE		8" GRAVITY SEWER	24	PRIMARY CROSSOVER CONTROL STRUCTURE
CS-4	*	1287.15	1275.00	12.15	*	*	WASTEWATER TREATMENT SITE		8" GRAVITY SEWER	24	SECONDARY CROSSOVER CONTROL STRUCTURE
CS-5	*	1287.15	1274.50	12.65	*	*	WASTEWATER TREATMENT SITE		8" GRAVITY SEWER	24	SECONDARY EFFLUENT CONTROL STRUCTURE A
CS-6	*	1287.15	1273.50	13.65	*	*	WASTEWATER TREATMENT SITE		8" GRAVITY SEWER	24	SECONDARY EFFLUENT CONTROL STRUCTURE B

* SEE DETAIL

STANDARD PLATES

PLATE NO.	DESCRIPTION
0005 A	SPECIFICATION REFERENCE TO STANDARD PLATES (1988) (2 SHEETS)
3000 L	REINFORCED CONCRETE PIPE (5 SHEETS)
4006 L	MANHOLE OR CATCH BASIN (DESIGN G OR DESIGN H)
4007 C	PRECAST MECHANICAL JOINT SEWER MANHOLE
4010 G	CONCRETE SHORT CONE & ADJUSTING RING
4011 D	PRECAST CONCRETE BASE
4101 C	RING CASTING FOR MANHOLE OR CATCH BASIN
410B F	ADJUSTING RINGS FOR CATCH BASINS AND MANHOLES
4110 E	COVER CASTING FOR MANHOLE
4149 C	GRATE CASTING FOR CATCH BASIN
4161 F	CURB BOX CASTING FOR CATCH BASIN
4180 H	MANHOLE OR CATCH BASIN STEP
7035 J	CONCRETE WALK & CURB RETURNS AT ENTRANCES
7036 D	PEDESTRIAN CURB RAMP (FOR THE HANDICAPPED)
7100 G	CONCRETE CURB AND GUTTER (DESIGN B AND DESIGN V)
7111 H	INSTALLATION & REINFORCEMENT OF CATCH BASIN CASTINGS (CONCRETE CURB & CURB AND GUTTER)
8000 I	STANDARD BARRICADES (2 SHEETS)
9102 D	TURF ESTABLISHMENT AREAS (AT PIPE CULVERT ENDS)

BASIS OF ESTIMATED QUANTITES

AGGREGATE BASE, CLASS 5.....140 POUNDS PER CUBIC FOOT
SEED, MIXTURE 240.....100 POUNDS PER ACRE
COMMERCIAL FERTILIZER, ANALYSIS 12-12-12.....500 POUNDS PER ACRE
MULCH, TYPE 4.....3750 POUNDS PER ACRE

CONSTRUCTION NOTES

(1) THE LOCATION OF EXISTING UTILITIES ARE SHOWN FOR INFORMATION ONLY, AND REPRESENT THE BEST KNOWLEDGE OF THE ENGINEER. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO VERIFY THE LOCATION OF THESE UTILITIES PRIOR TO COMMENCING CONSTRUCTION.

(2) CONTRACTOR TO USE FACTORY FABRICATED PIPE SEALS OR ANTI-SEEPAGE COLLARS AT ALL PIPE PENETRATIONS AS APPROVED BY ENGINEER.

(3) ALL POLES TO BE REMOVED AND OR RELOCATED SHALL BE BY OTHERS PRIOR TO COMMENCING CONSTRUCTION.

(4) EXCESS EXCAVATION SHALL BE DISPOSED OF BY THE CONTRACTOR, AS DIRECTED BY THE ENGINEER OR OWNER, WITHIN A DISTANCE OF 1.5 MILES. THIS WORK SHALL BE CONSIDERED INCIDENTAL TO THE CONTRACT AND NO ADDITIONAL COMPENSATION SHALL BE ALLOWED.

(5) ALL DISTURBED AREAS, NOT OTHERWISE SURFACED, SHALL BE SEEDED AND MULCHED.

(6) ALL BACKFILL CONSTRUCTION FOR WATERMAINS, SANITARY SEWERS AND STORM SEWERS SHALL BE IN ACCORDANCE WITH MN/DOT SPEC 2451 AND COMPACTION SHALL BE IN ACCORDANCE WITH 2105.3F1, SPECIFIED DENSITY.

(7) THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PREVENT SILT, SOIL AND OTHER SUSPENDED PARTICLES FROM BEING DISCHARGED TO THE BODIES OF WATER OR DRAINAGE STRUCTURES IN THE CONSTRUCTION VICINITY. THE COST OF THIS WORK SHALL BE CONSIDERED INCIDENTAL, UNLESS PAID FOR SPECIFICALLY IN THE PLANS.

(8) BITUMINOUS MATERIAL FOR MIXTURE SHALL BE PG 58-28.

(9) THE CONTRACTOR SHALL REMOVE MAIL BOXES AS NECESSARY AND REPLACE THEM WHEN THE WORK IS COMPLETE. THE COST OF THIS WORK SHALL BE CONSIDERED INCIDENTAL TO THE CONTRACT AND NO ADDITIONAL COMPENSATION SHALL BE ALLOWED.

(10) EXISTING SOILS SHALL BE SCARIFIED TO A DEPTH OF SIX INCHES AND COMPACTED TO 98% OF MAXIMUM DENSITY PRIOR TO PLACING EMBANKMENT OR BASE COURSE IN ROADWAYS.

REVISIONS:

NO.	DATE	DESCRIPTION	BY
		AS-BUILT	

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME, OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA

Michael C. McFarlane

MICHAEL C. MCFARLANE, P.E. LIC. NO. 44198

NORTHERN ENGINEERING & CONSULTING, INC.
207 4th Street NW, Bemidji, MN, 56601
Phone: 218-444-4860, Fax: 218-444-6042
web: www.nacusa.com

RED LAKE WASTEWATER FACILITIES

ESTIMATE SHEET

RED LAKE RESERVATION, MN

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
2 OF 27

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S:\NECI\Projects\03-42 rl waste water (lagoon)\03-42 AS-BUILTS\dwg\03-42main.dwg, Sheet 3-Overview, 3/29/2011 10:22:25 AM, ssnopl

JOB NO. 03-42
DATE: 03-29-2011
SHEET NO.
03 OF 27

RED LAKE WASTEWATER FACILITIES

OVERVIEW SHEET

RED LAKE RESERVATION, MINNESOTA

NORTHERN ENGINEERING & CONSULTING, INC.
207 4th Street NW, Bemidji, MN, 56601
Phone: 218-444-4860, Fax: 218-444-6042
web: www.neciusa.com

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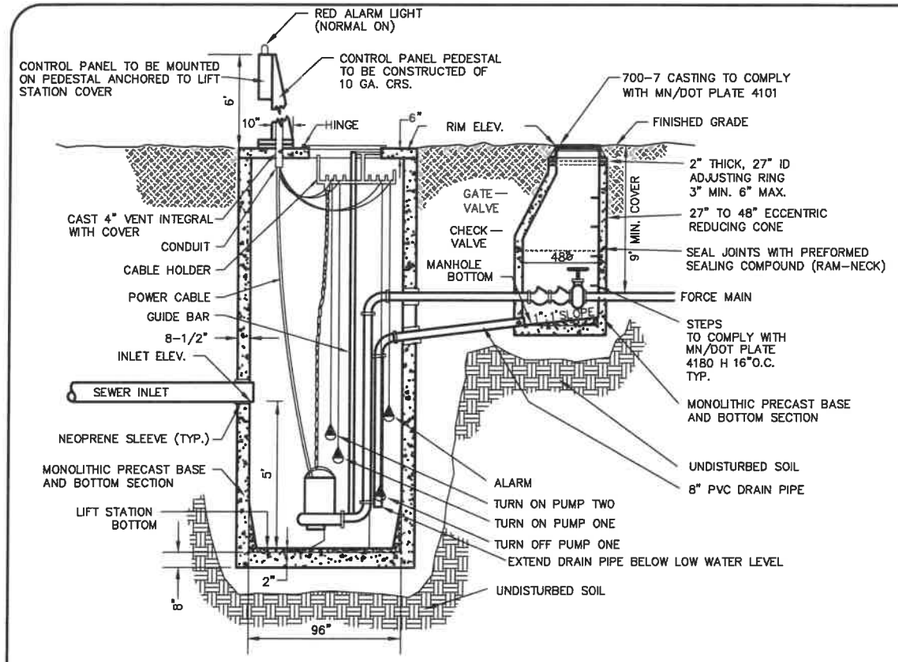
Michael C. McFarlane

MICHAEL C. McFARLANE REG. NO. 44196

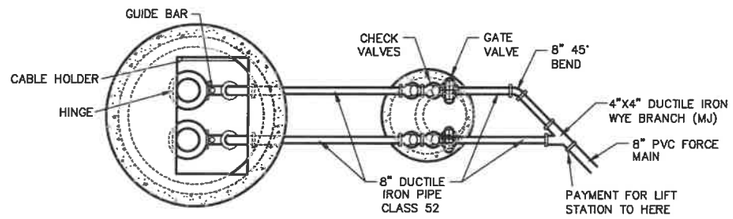
REVISIONS:

AS-BUILT

NO.	DATE	DESCRIPTION	BY



SECTION VIEW



PLAN VIEW

1 SEWAGE LIFT STATION
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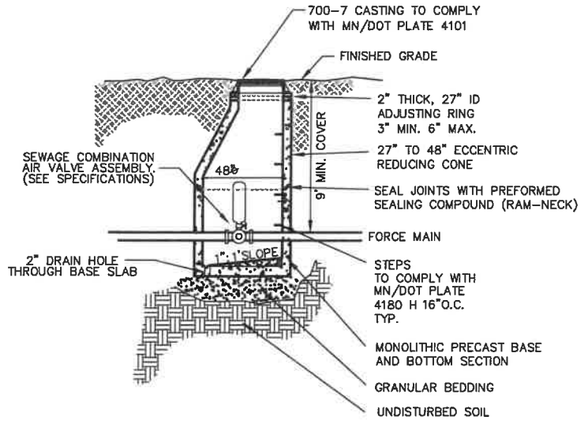

2 AIR RELEASE MANHOLE
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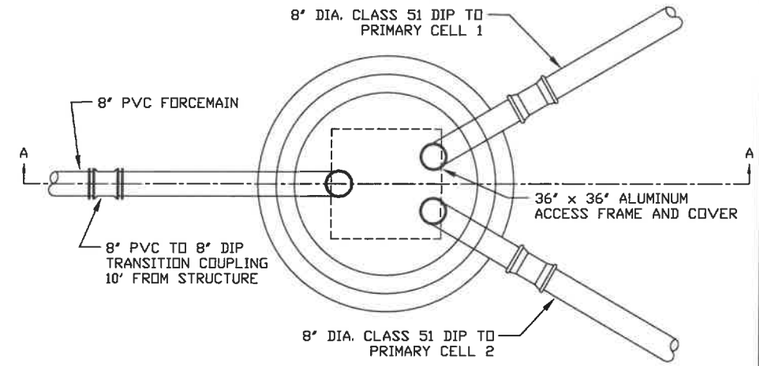

4 PRIMARY INFLUENT STRUCTURE MECHANICAL PLAN
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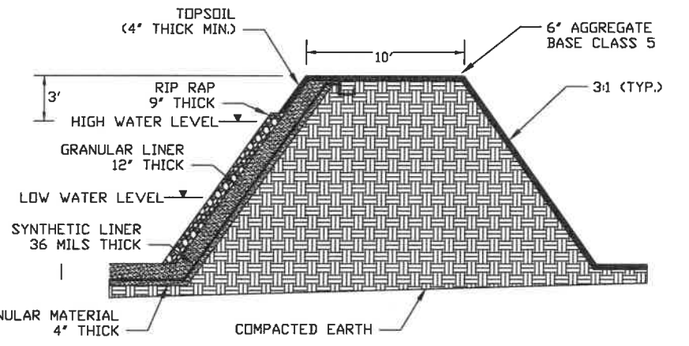
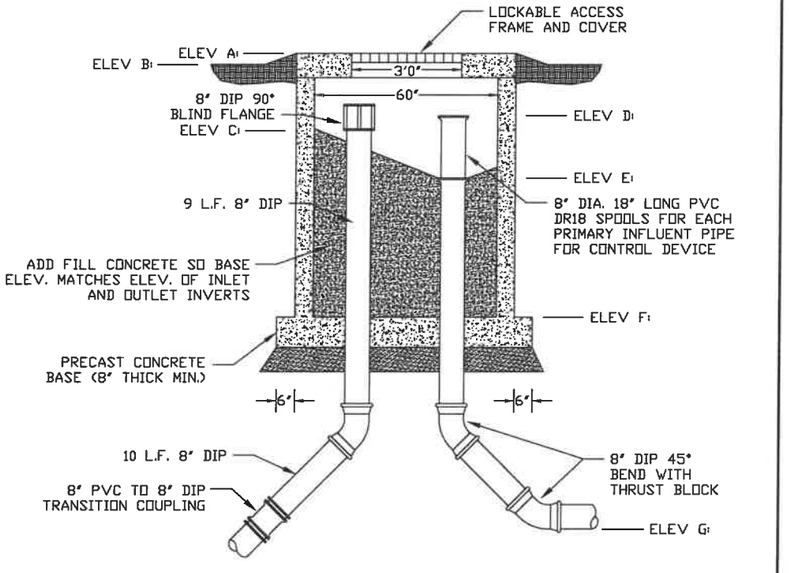


3 TYPICAL BERM CROSS SECTION
NO SCALE



5 PRIMARY INFLUENT STRUCTURE SECTION A-A
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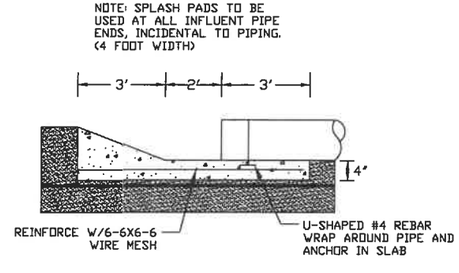

6 SPLASH PAD DETAIL
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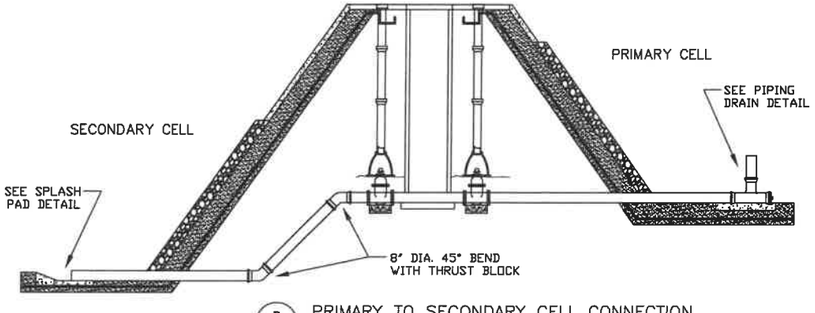

7 PRIMARY TO SECONDARY CELL CONNECTION
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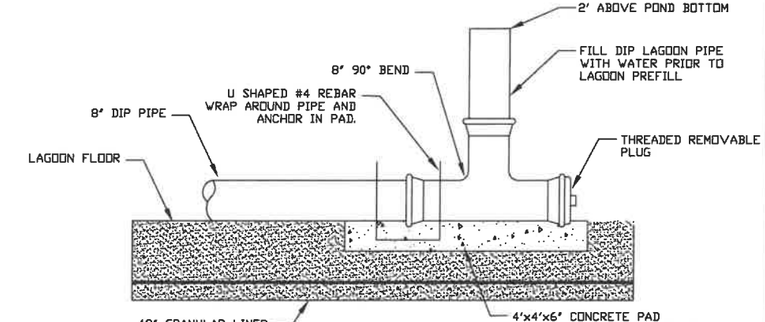

8 PIPING DRAIN DETAIL
NO SCALE

REVISIONS:

NO.	DATE	DESCRIPTION	BY
		AS-BUILT	

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web: www.mckiss.com

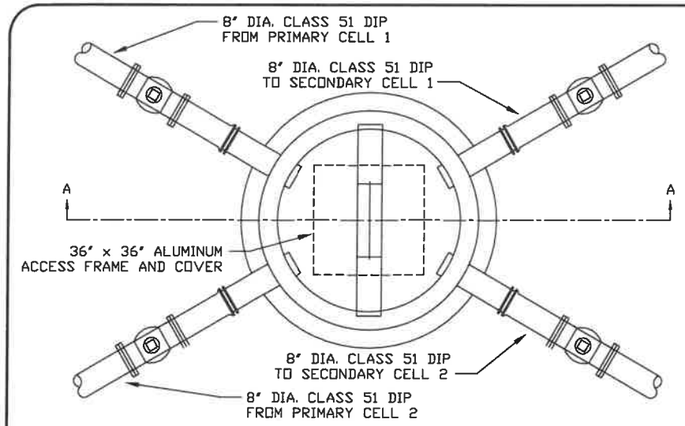
RED LAKE WASTEWATER FACILITIES

DETAILS 1

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
04 OF 27



9 PRIMARY EFFLUENT CONTROL STRUCTURE – MECHANICAL PLAN
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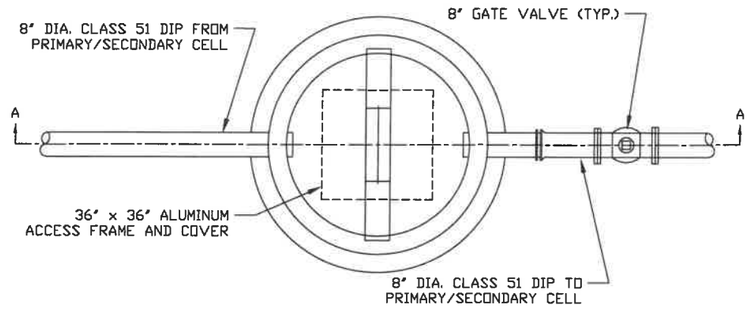

11 PRIMARY/SECONDARY CROSSOVER STRUCTURES – MECHANICAL PLAN
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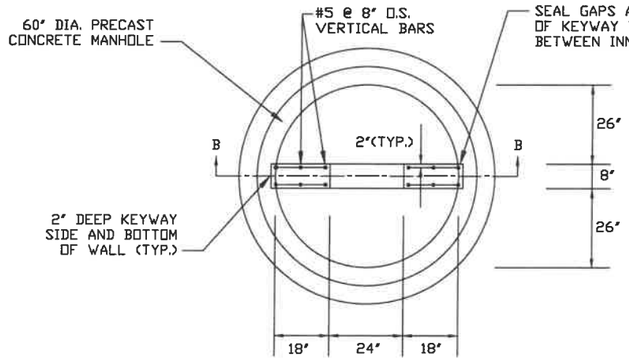

13 PRIMARY EFFLUENT AND PRIMARY/SECONDARY CONTROL STRUCTURES – STRUCTURAL PLAN
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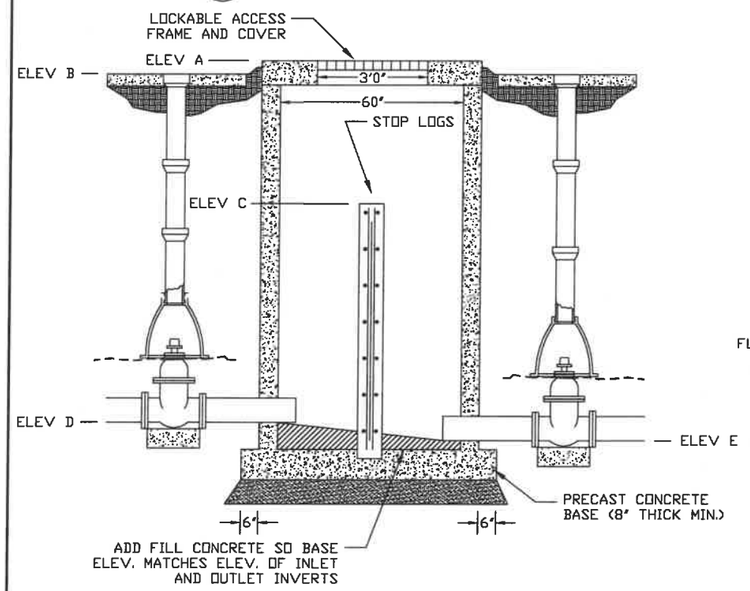

10 PRIMARY EFFLUENT CONTROL STRUCTURE – SECTION A–A
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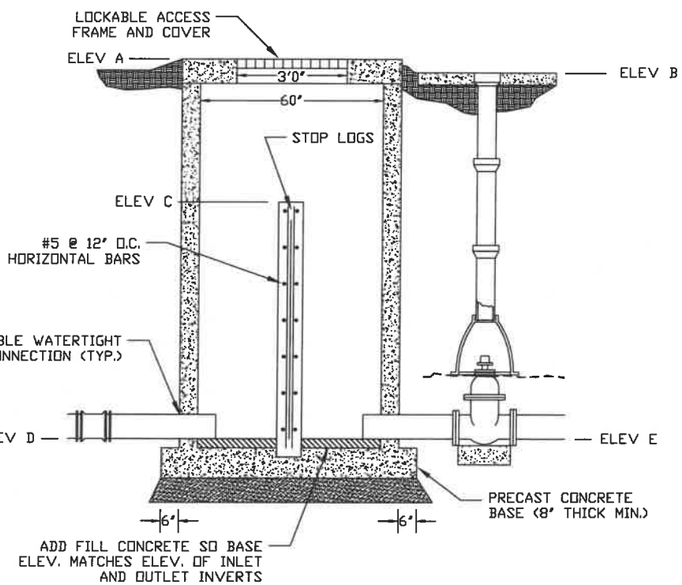
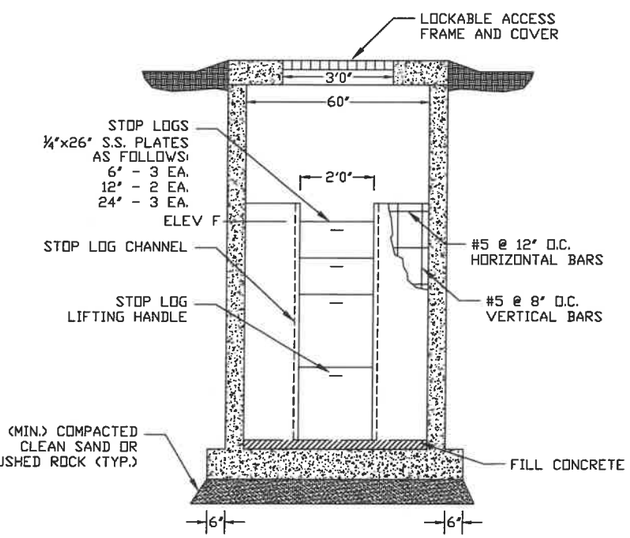


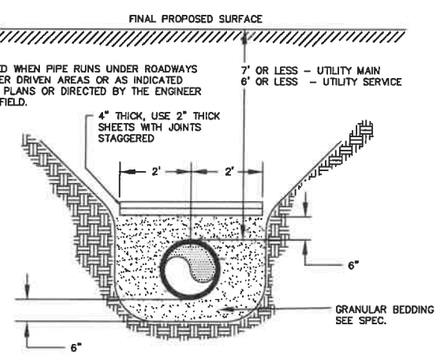
12 PRIMARY/SECONDARY CROSSOVER STRUCTURES – SECTION A–A
NO SCALE



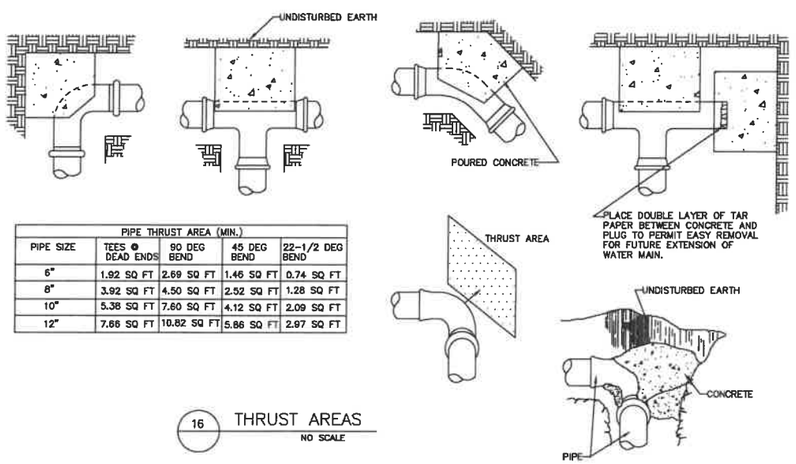
14 PRIMARY EFFLUENT AND PRIMARY/SECONDARY CROSSOVER CONTROL STRUCTURES – SECTION B–B
NO SCALE

CONTROL STRUCTURE ELEVATION DATA:
PRIMARY INFLUENT: (60" DIA.)
A= 1292.65
B= 1292.40
C= 1291.15
D= 1291.65
E= 1290.15
F= 1286.15
G= 1279.00
PRIMARY EFFLUENT: (60" DIA.)
A= 1292.65
B= 1292.40
C= 1290.15
D= 1280.00
E= 1279.50
F= 1289.50
PRIMARY CROSSOVER: (60" DIA.)
A= 1292.65
B= 1292.40
C= 1290.65
D= 1280.00
E= 1280.00
F= 1289.50

CONTROL STRUCTURE ELEVATION DATA:
SECONDARY CROSSOVER: (60" DIA.)
A= 1287.15
B= 1286.90
C= 1284.50
D= 1275.00
E= 1275.00
F= 1284.00
SECONDARY EFFLUENT A: (72" DIA.)
A= 1287.15
B= 1286.90
C= 1284.50
D= 1275.00
E= 1274.50
F= 1284.00
SECONDARY EFFLUENT B: (60" DIA.)
A= 1287.15
B= 1286.90
C= 1284.50
D= 1274.00
E= 1273.50
F= 1284.00



15 INSULATE SEWER PIPE
NO SCALE



PIPE THRUST AREA (MIN.)				
PIPE SIZE	TEES & DEAD ENDS	90 DEG BEND	45 DEG BEND	22-1/2 DEG BEND
6"	1.92 SQ FT	2.69 SQ FT	1.46 SQ FT	0.74 SQ FT
8"	3.92 SQ FT	4.50 SQ FT	2.52 SQ FT	1.28 SQ FT
10"	5.38 SQ FT	7.60 SQ FT	4.12 SQ FT	2.09 SQ FT
12"	7.66 SQ FT	10.82 SQ FT	5.86 SQ FT	2.97 SQ FT

16 THRUST AREAS
NO SCALE

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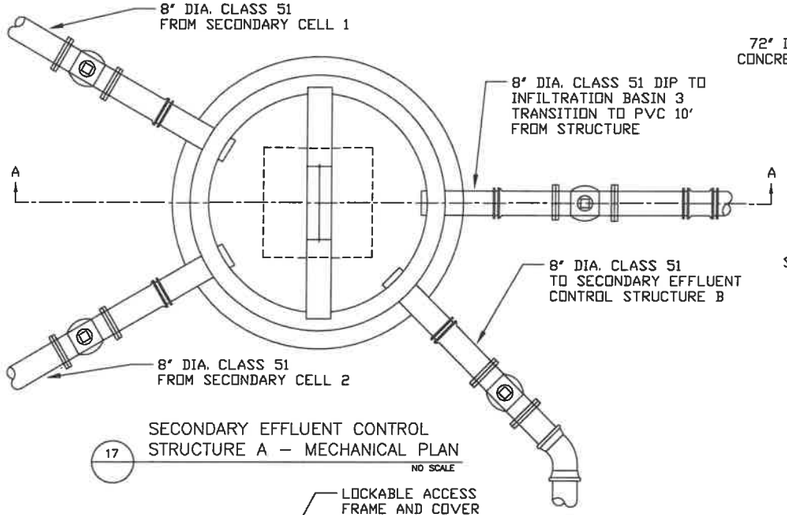
RED LAKE WASTEWATER FACILITIES

DETAILS 2

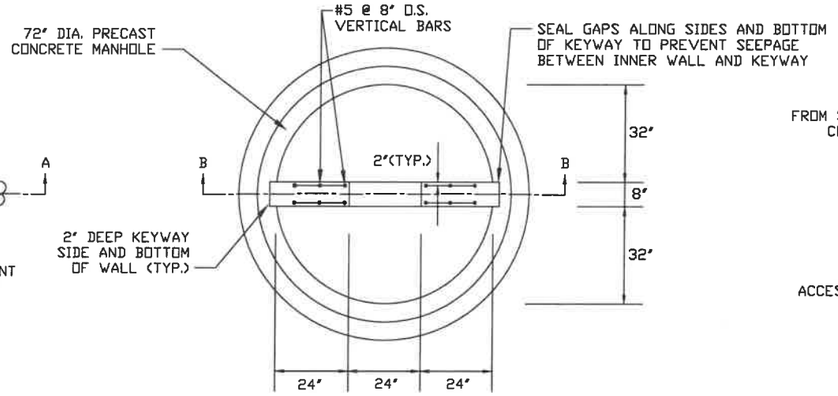
RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2009

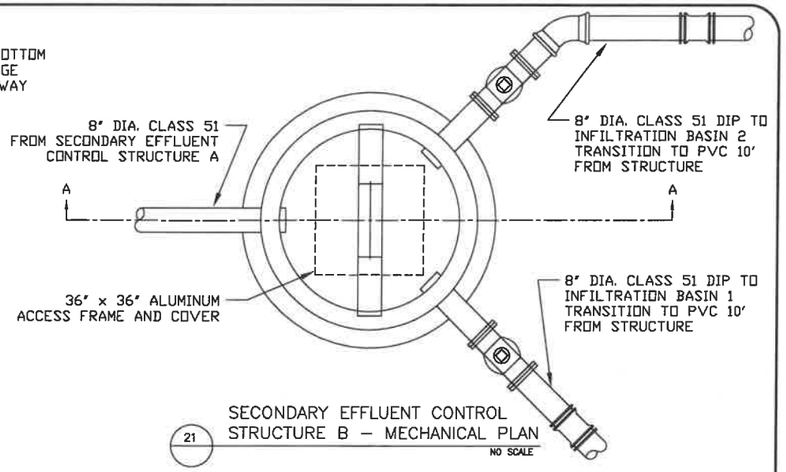
SHEET NO.
05 OF 27



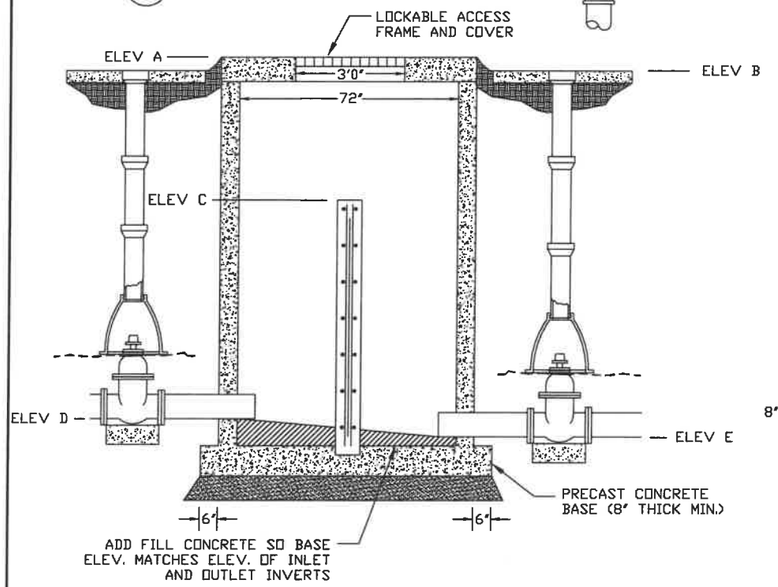
17 SECONDARY EFFLUENT CONTROL STRUCTURE A – MECHANICAL PLAN
NO SCALE



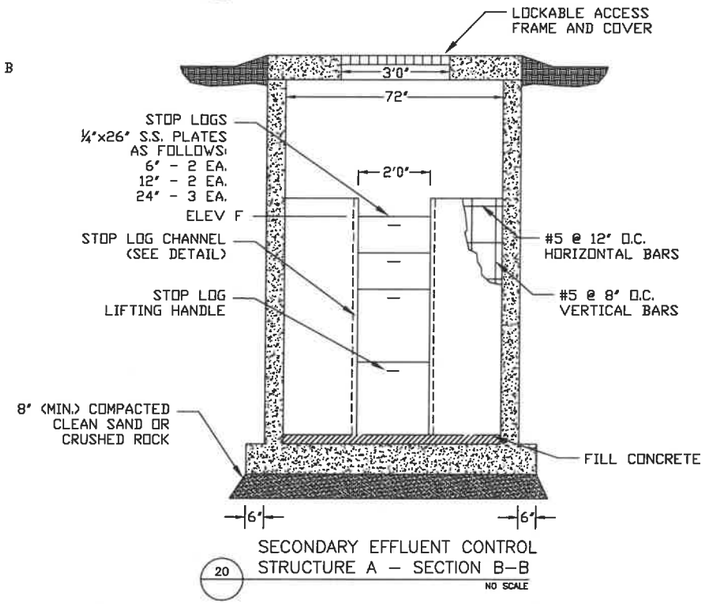
19 SECONDARY EFFLUENT CONTROL STRUCTURE A – STRUCTURAL PLAN
NO SCALE



21 SECONDARY EFFLUENT CONTROL STRUCTURE B – MECHANICAL PLAN
NO SCALE



18 SECONDARY EFFLUENT CONTROL STRUCTURE A – SECTION A–A
NO SCALE



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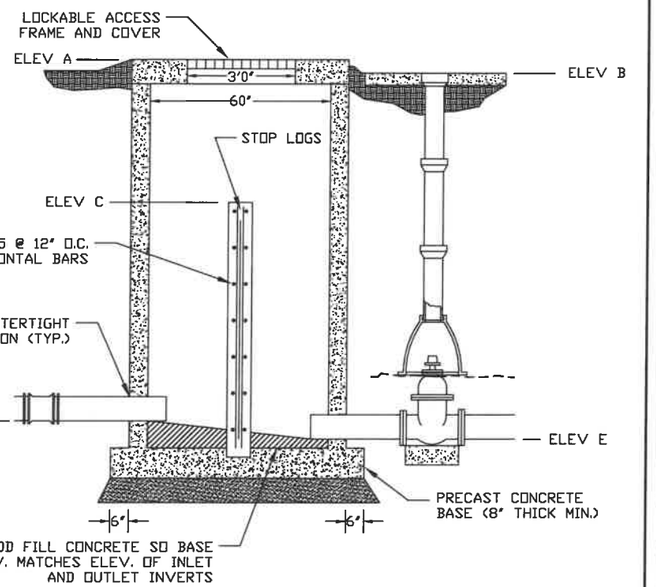

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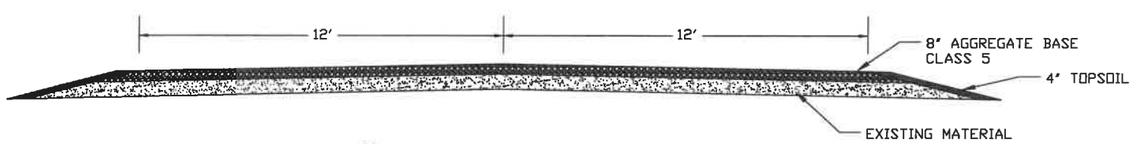
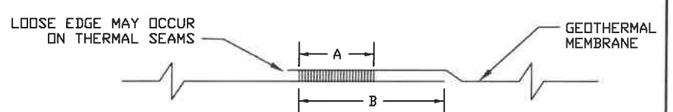
NO SCALE



23 ACCESS ROAD
NO SCALE



24 FIELD SEAM / SPLICE DETAIL
NO SCALE

GEOMEMBRANE CLASSIFICATION	GAUGE (X .001")	DIMENSION "A" (INCHES, MIN.)	DIMENSION "B" (INCHES, MIN.)
CHEMICAL			
REINFORCED	ALL	3	6
NON-REINFORCED	≤ 20	1	4
NON-REINFORCED	30 - 40	1.5	4
NON-REINFORCED	50 +	2	4
THERMAL			
ALL	ALL	1.5	5

NOTE: GEOMEMBRANE INSTALLER SHALL BE APPROVED BY THE MATERIAL SUPPLIER. INSTALLATION SHALL BE IN ACCORDANCE WITH MATERIAL SUPPLIER'S INSTALLATION SPECIFICATION WHICH SHALL BE PROVIDED TO AND APPROVED BY THE ENGINEER PRIOR TO INSTALLATION.

REVISIONS:

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RED LAKE WASTEWATER FACILITIES

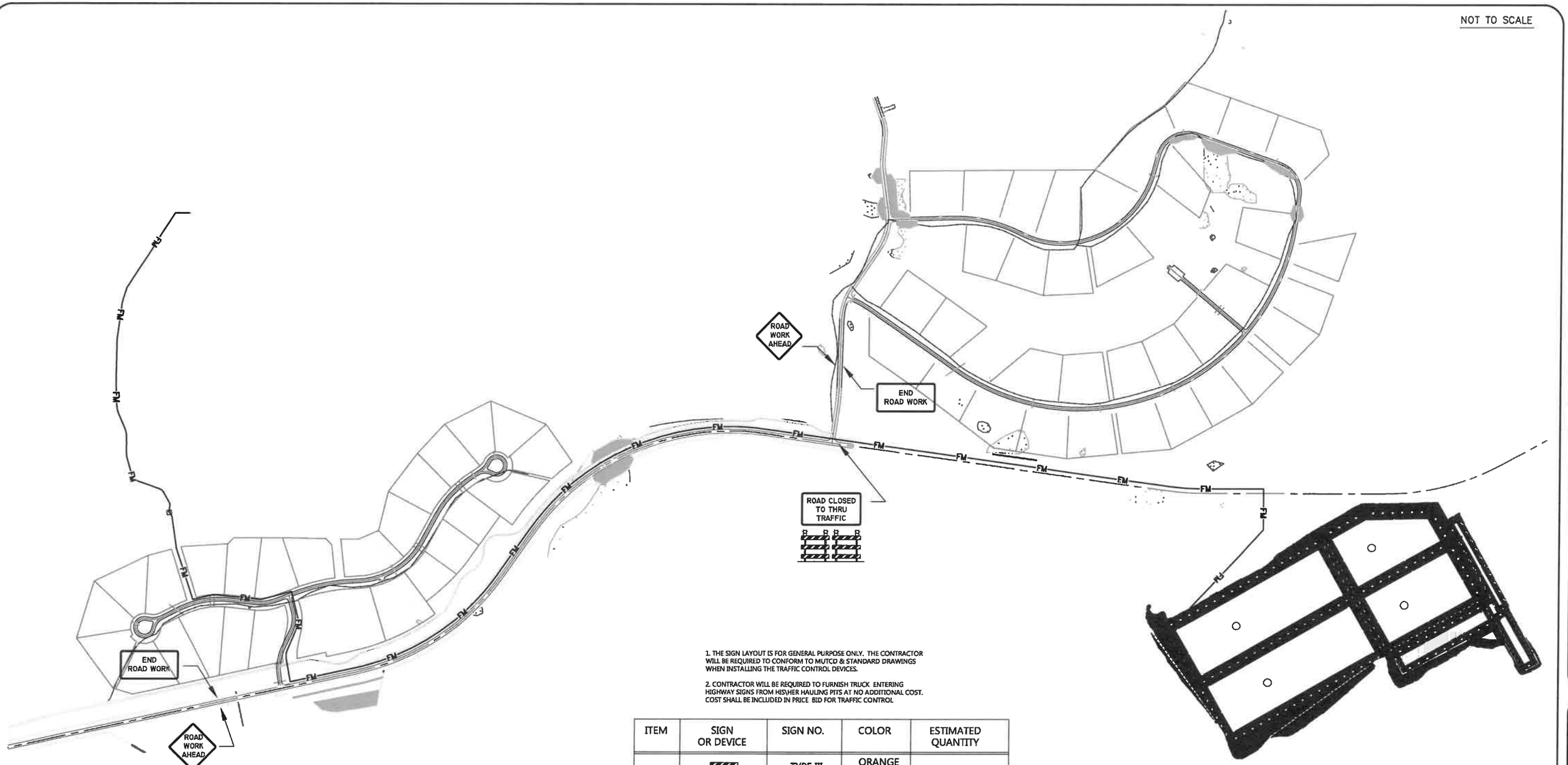
DETAILS 3

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
06 OF 27

NOT TO SCALE



1. THE SIGN LAYOUT IS FOR GENERAL PURPOSE ONLY. THE CONTRACTOR WILL BE REQUIRED TO CONFORM TO MUTCD & STANDARD DRAWINGS WHEN INSTALLING THE TRAFFIC CONTROL DEVICES.

2. CONTRACTOR WILL BE REQUIRED TO FURNISH TRUCK ENTERING HIGHWAY SIGNS FROM HIS\HER HAULING PITS AT NO ADDITIONAL COST. COST SHALL BE INCLUDED IN PRICE BID FOR TRAFFIC CONTROL

ITEM	SIGN OR DEVICE	SIGN NO.	COLOR	ESTIMATED QUANTITY
1		TYPE III BARRICADE	ORANGE ON WHITE	2
2	ROAD CLOSED TO THRU TRAFFIC	R11-4	BLACK ON WHITE	1
3	ROAD WORK AHEAD	W20-1	BLACK ON ORANGE	2
4	END ROAD WORK	G20-2A	BLACK ON ORANGE	2
5		TYPE A	YELLOW	4

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RED LAKE WASTEWATER FACILITIES

TRAFFIC CONTROL SHEET

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
07 OF 27

S:\NECE\Projects\03-42 rl waste water (lagoon)\03-42 AS-BUILTS\dwg\03-42main.dwg, Sheet 7-Traffic Control, 3/29/2011 10:30:29 AM, ssnopl

MATCHLINE STA. 0+00

HORIZONTAL BEND STA 0+95

16.50' ROW

CLEAR AND GRUB

MH 1

GRAPHIC SCALE 0 50 100 150 FEET

MATCHLINE SEE SHEET MH 9 STA. 13+00

PC = 10+44.59
PT = 10+63.46

PC = 7+81.66
PT = 8+11.50

ARMH 1
AIR RELEASE MANHOLE
RIM 1252.00
INV 1242.30
BTM 1241.30

MIN 9' DEPTH

EXISTING GRND./FM PROFILE

PROPOSED 8" PVC FORCEMAIN

VERTICAL SCALE 5 FEET 0

HORIZONTAL SCALE 50 FEET

EXISTING GD. ELEVATION

1241.1 1242.9 1246.2 1246.5 1244.1 1242.8 1249.3 1250.0 1250.5 1250.9 1251.4 1252.0 1252.0 1251.0 1251.0 1251.0 1251.0 1250.2 1247.4 1245.5 1244.7 1243.6 1241.9 1239.3 1236.7 1237.4 1239.9

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00 10+00 11+00 12+00 13+00

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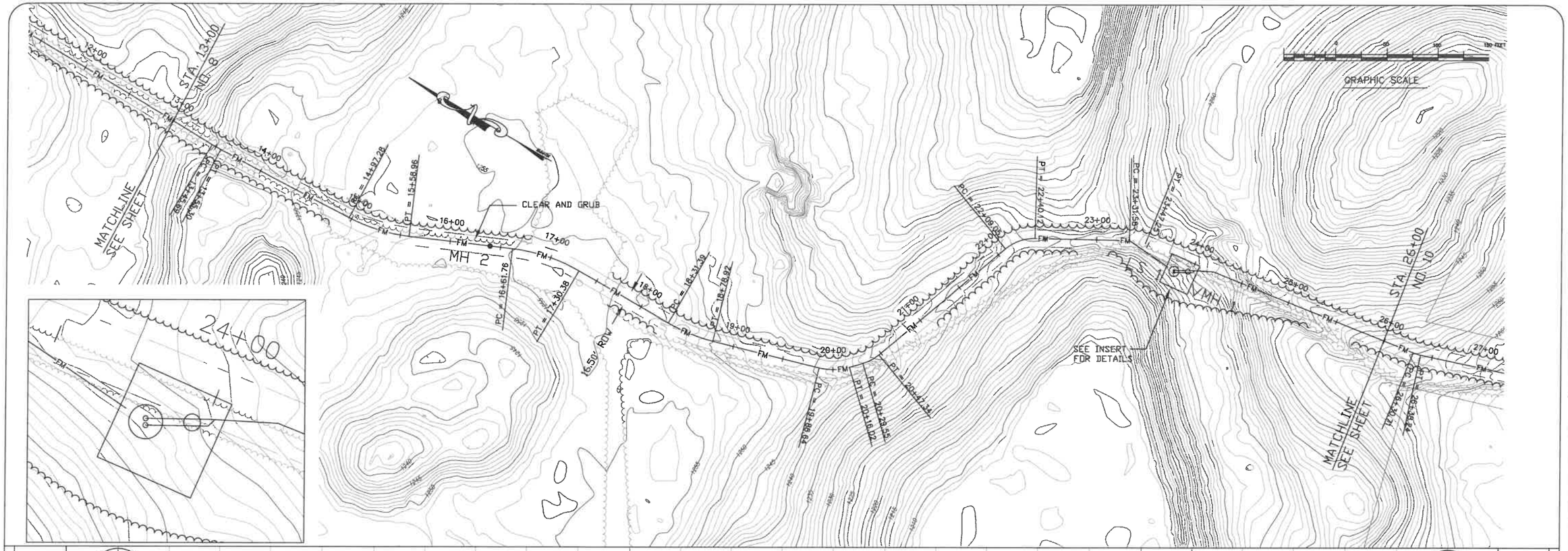
RED LAKE WASTEWATER FACILITIES

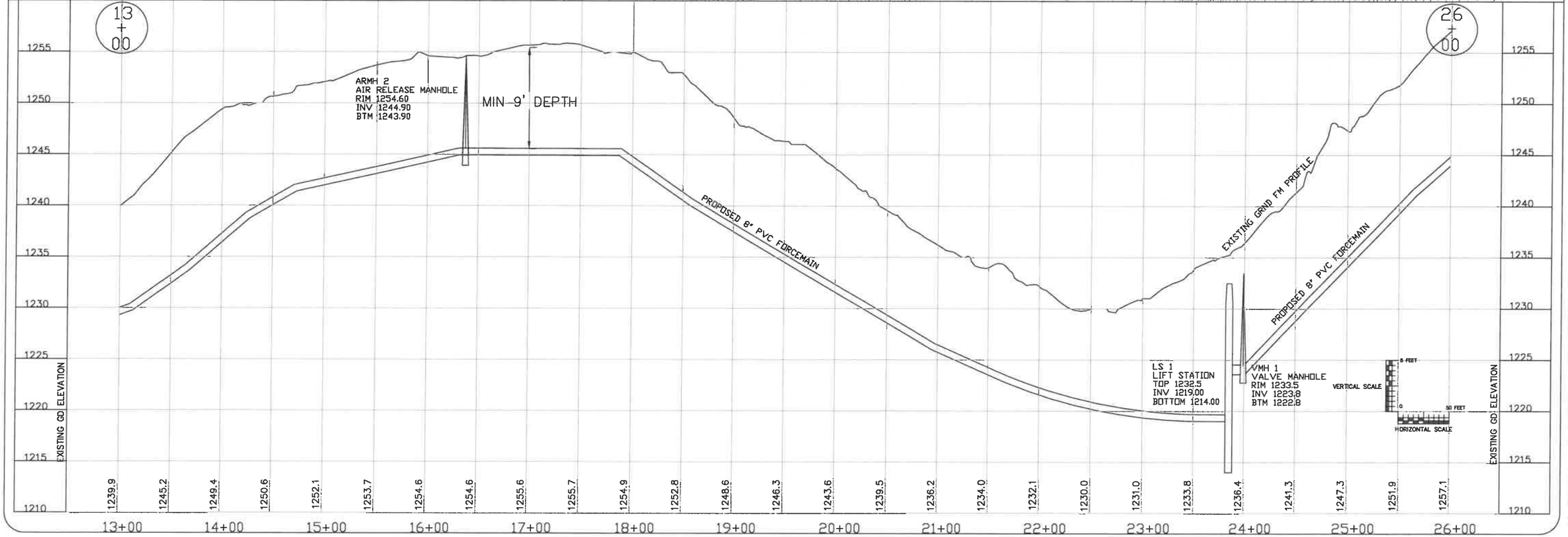
PLAN AND PROFILE

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
08 OF 27





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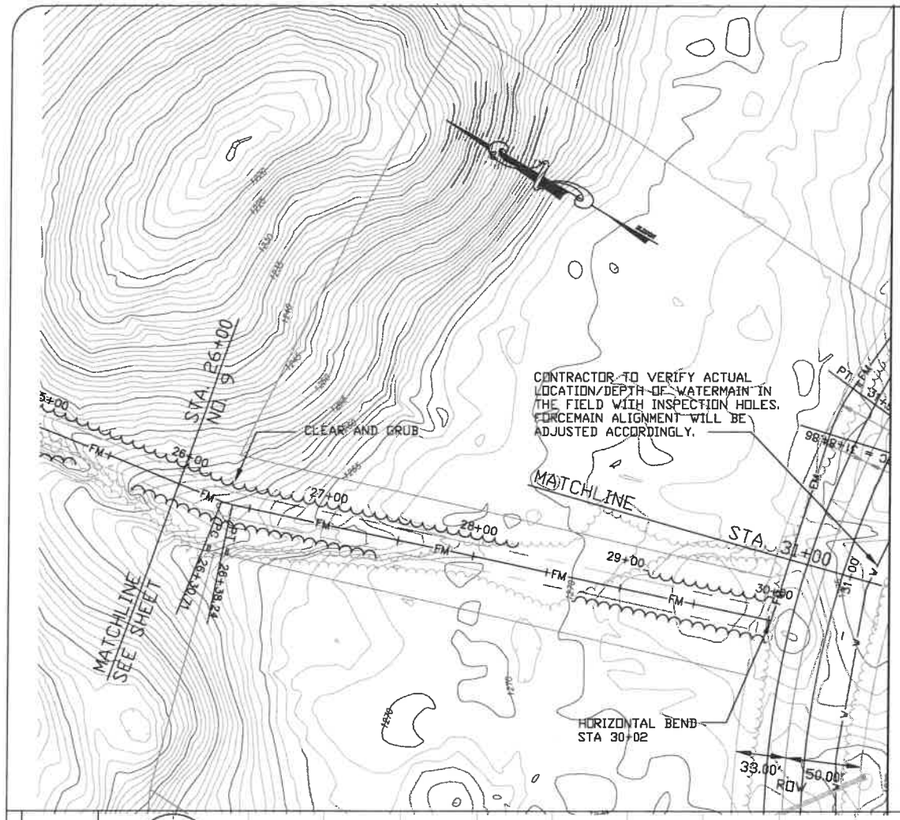
RED LAKE WASTEWATER FACILITIES

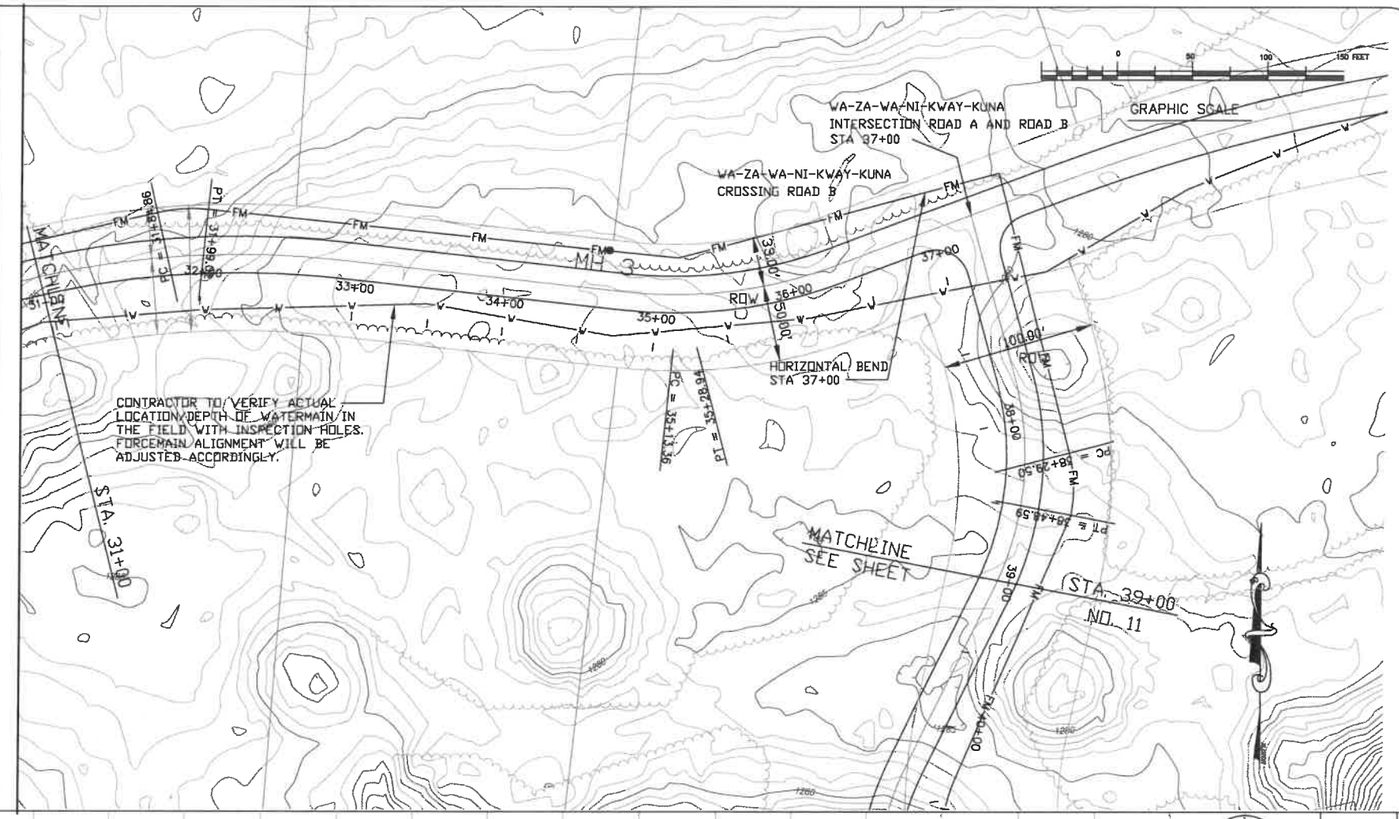
PLAN AND PROFILE

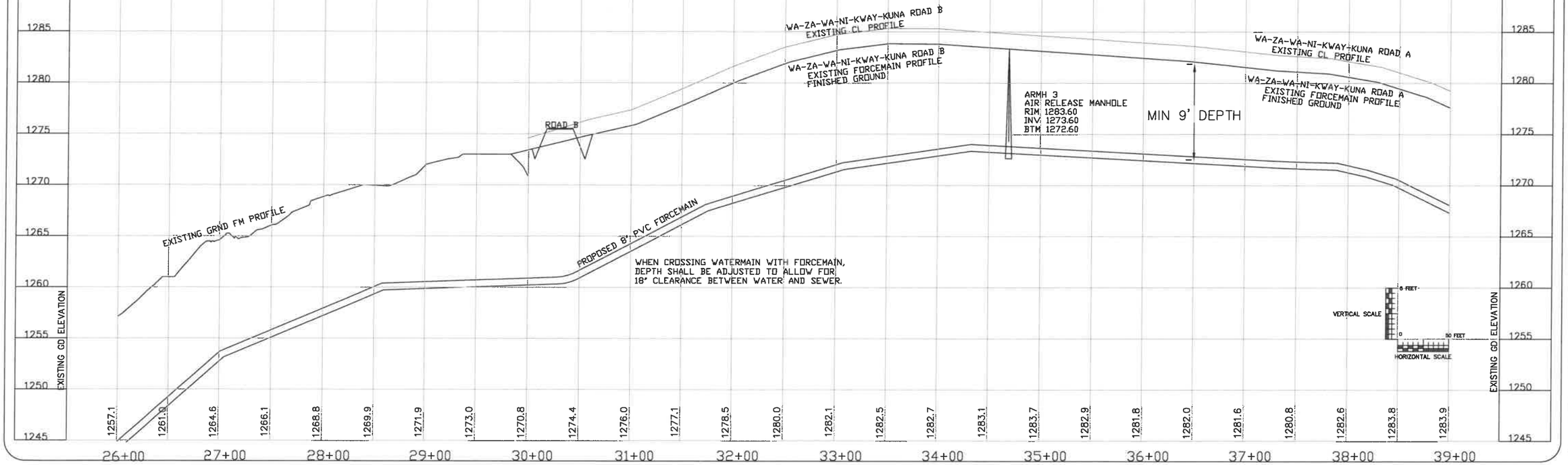
RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
09 OF 27







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RED LAKE WASTEWATER FACILITIES

PLAN AND PROFILE

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
10 OF 27

S:\NECI\Projects\03-42 rl waste water (bgoon)\03-42 AS-BUILTS\dwg\03-42main.dwg, Sheet 11, 3/29/2011 10:36:40 AM, ssnopl

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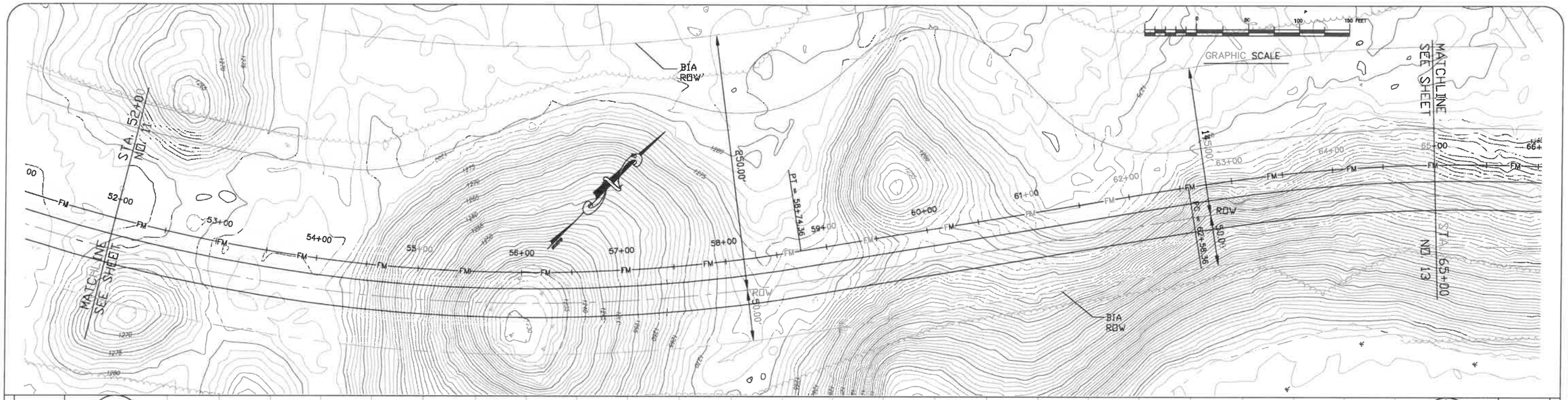
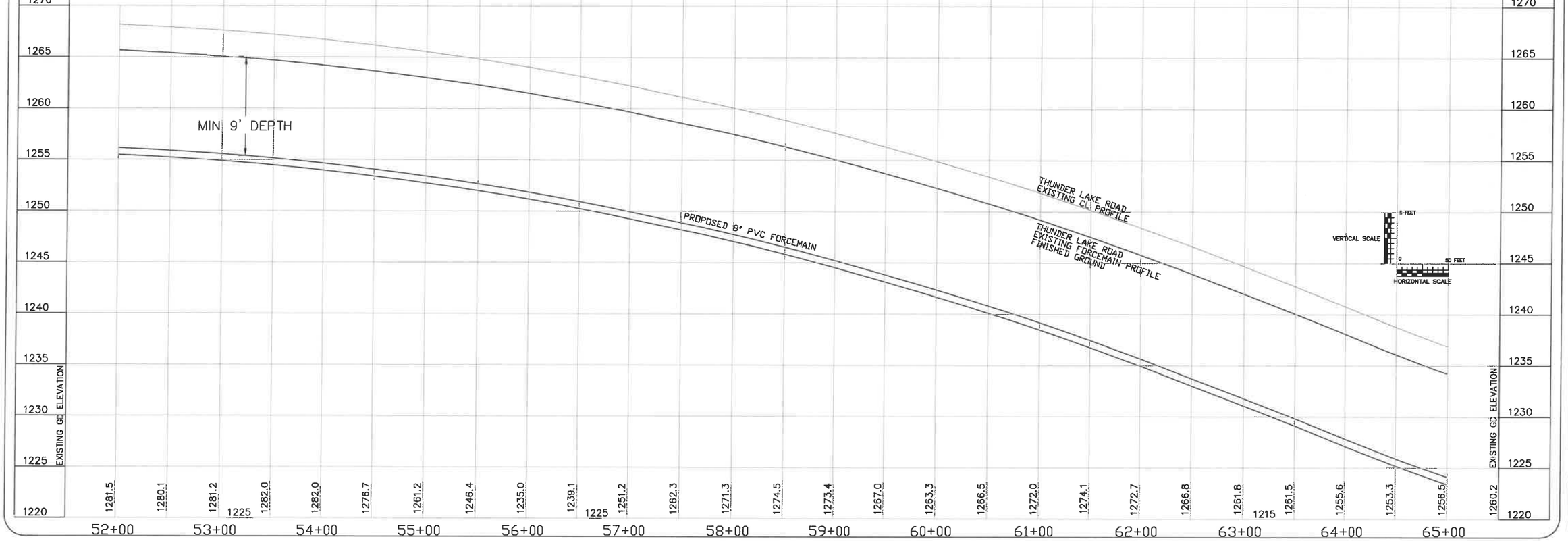
RED LAKE WASTEWATER FACILITIES
PLAN AND PROFILE
RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
11 OF 27





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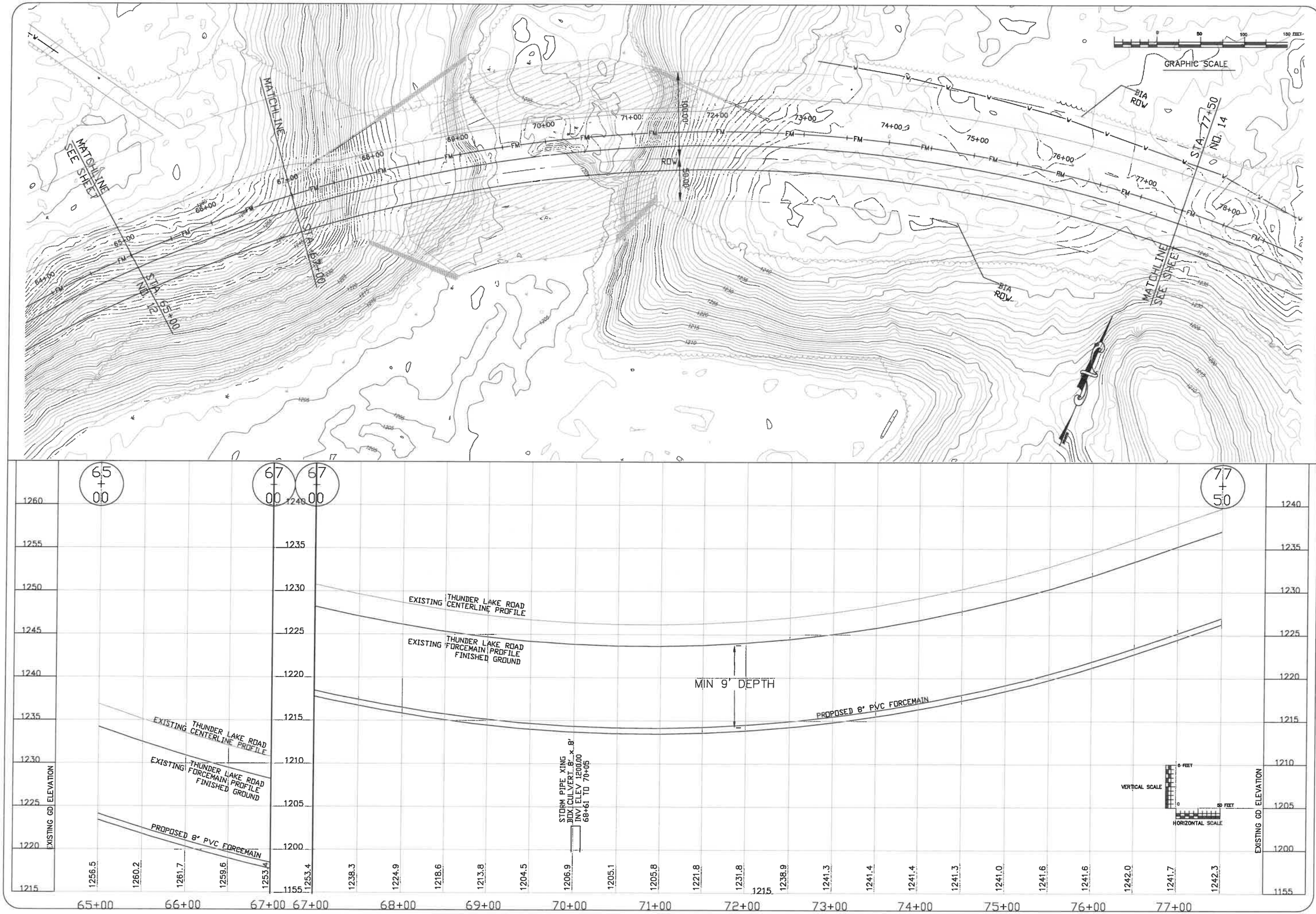
RED LAKE WASTEWATER FACILITIES

PLAN AND PROFILE

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 06-19-2009

SHEET NO.
12 OF 27



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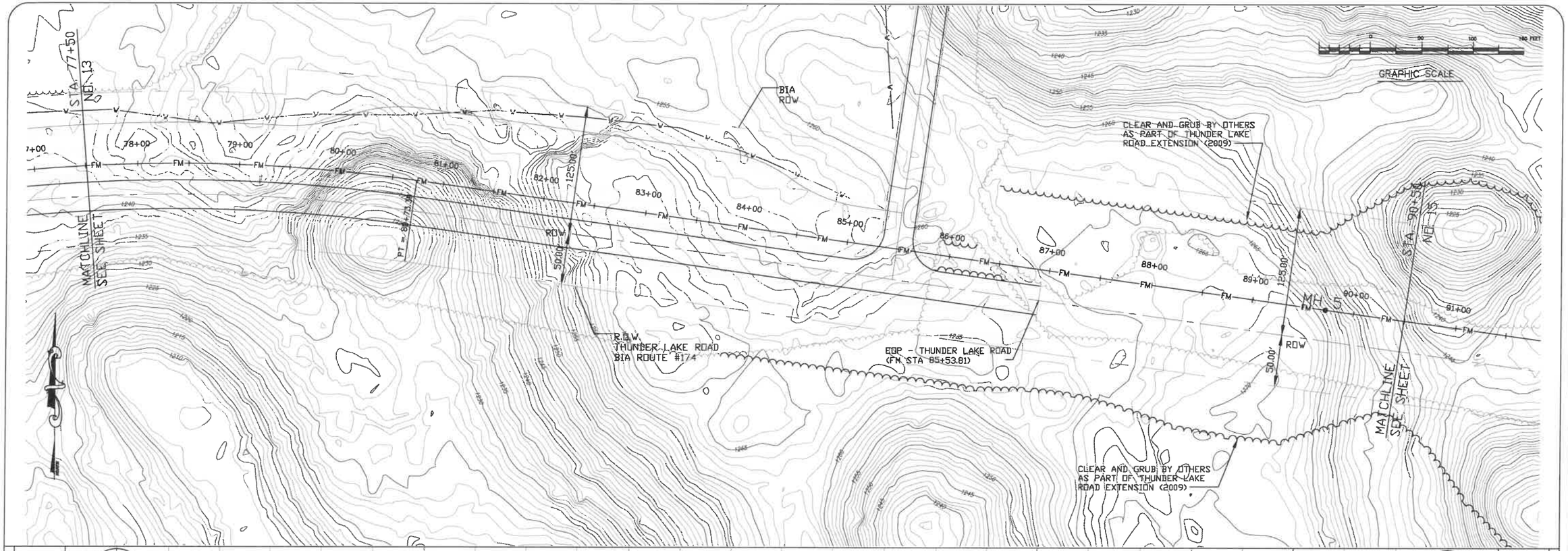
RED LAKE WASTEWATER FACILITIES

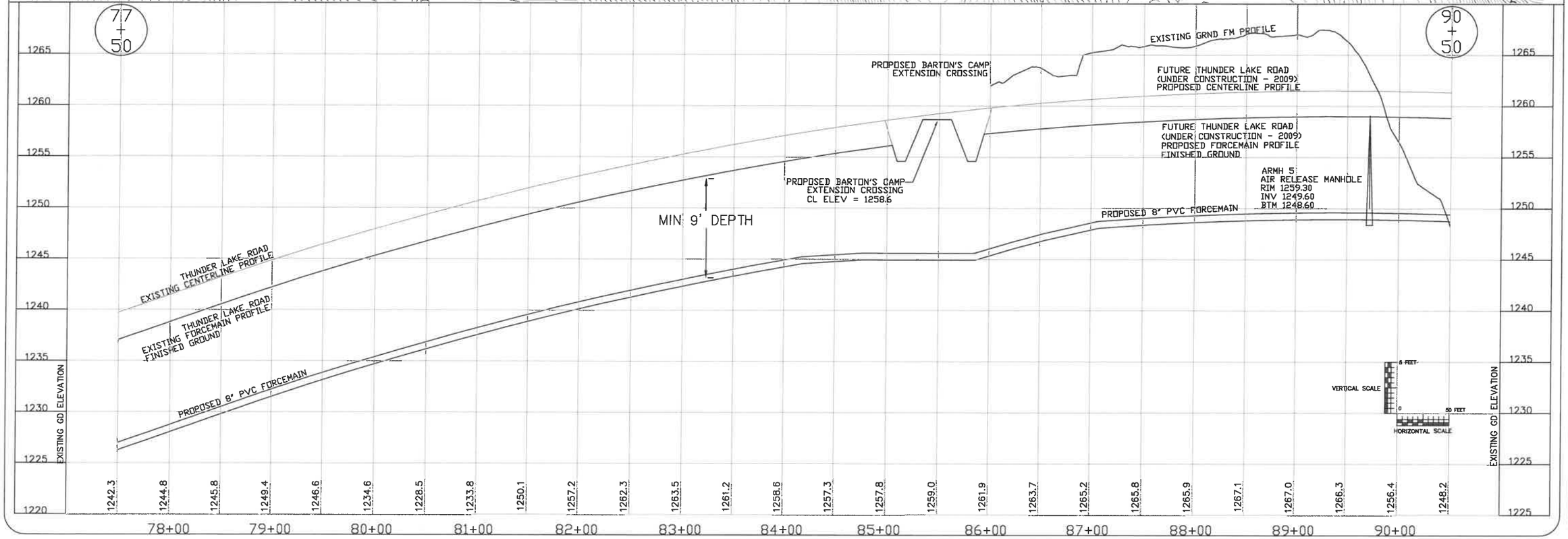
PLAN AND PROFILE

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
13 OF 27





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RED LAKE WASTEWATER FACILITIES

PLAN AND PROFILE

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
14 OF 27

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RED LAKE WASTEWATER FACILITIES
PLAN AND PROFILE
RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
15 OF 27

CLEAR AND GRUB BY OTHERS AS PART OF THUNDER LAKE ROAD EXTENSION (2009)

STA. 103+50 NE 15

MATCHLINE SEE SHEET

103+00 104+00 105+00 106+00 107+00 108+00 109+00 110+00 111+00 112+00 113+00 114+00 115+00 116+00 117+00

PC = 108+48.55

PT = 110+71.86

MH 6

HORIZONTAL BEND STA 114+90

BIA ROW

ROW 50.00'

16.50' ROW

ACCESS ROAD

CLEAR AND GRUB BY OTHERS AS PART OF THUNDER LAKE ROAD EXTENSION (2009)

MATCHLINE SEE SHEET

STA. 116+50 NO. 17

GRAPHIC SCALE 0 50 100 150 FEET

103+50

116+50

FUTURE THUNDER LAKE ROAD (UNDER CONSTRUCTION - 2009) PROPOSED CENTERLINE PROFILE

FUTURE THUNDER LAKE RD

EXISTING GRND FM PROFILE

FUTURE THUNDER LAKE ROAD (UNDER CONSTRUCTION - 2009) PROPOSED FORCEMAIN PROFILE FINISHED GROUND

ARMH 6
AIR RELEASE MANHOLE
RIM 1266.00
INV 1256.30
INV 1255.30

MIN 9' DEPTH

PROPOSED 8" PVC FORCEMAIN

VERTICAL SCALE 5 FEET 0

HORIZONTAL SCALE 0 50 FEET

EXISTING GD ELEVATION

1270 1265 1260 1255 1250 1245 1240 1235 1230 1225

1260.7 1260.9 1261.0 1256.8 1258.6 1262.4 1263.2 1264.0 1264.0 1264.8 1264.0 1264.0 1264.7 1264.2 1263.9 1264.0 1263.8 1264.9 1265.6 1265.1 1265.2 1264.6 1264.3 1264.3 1266.0 1266.7 1268.0

104+00 105+00 106+00 107+00 108+00 109+00 110+00 111+00 112+00 113+00 114+00 115+00 116+00

REVISIONS:

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RED LAKE WASTEWATER FACILITIES

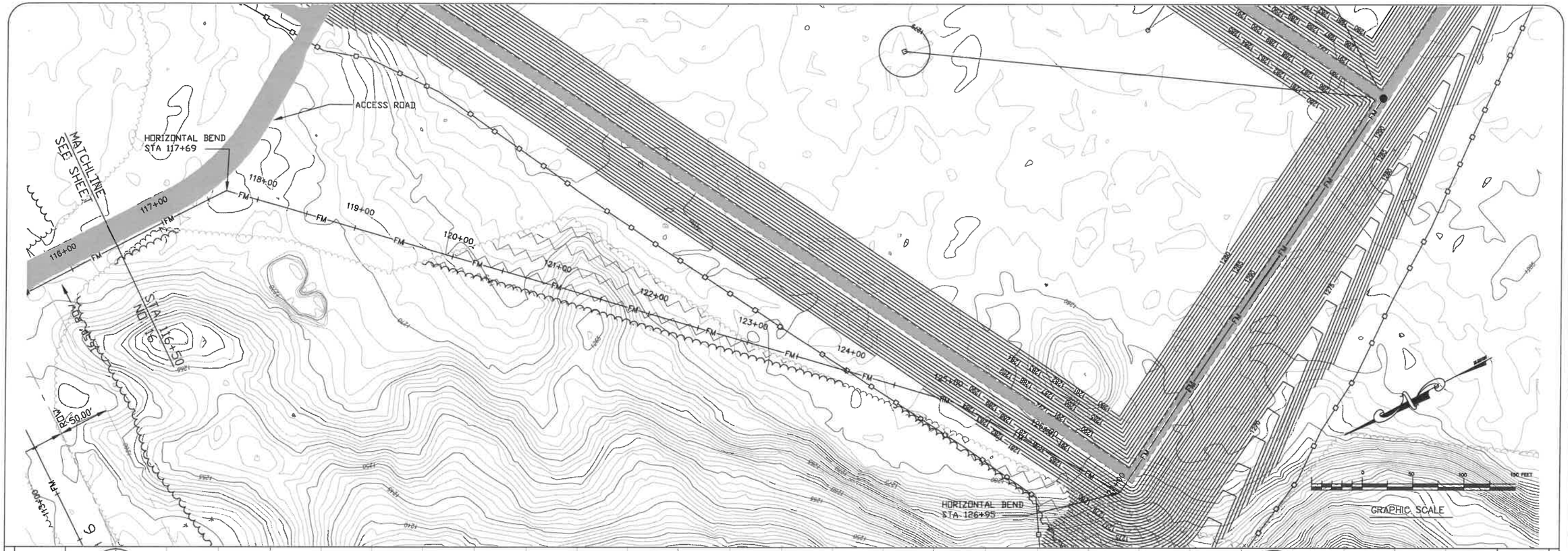
PLAN AND PROFILE

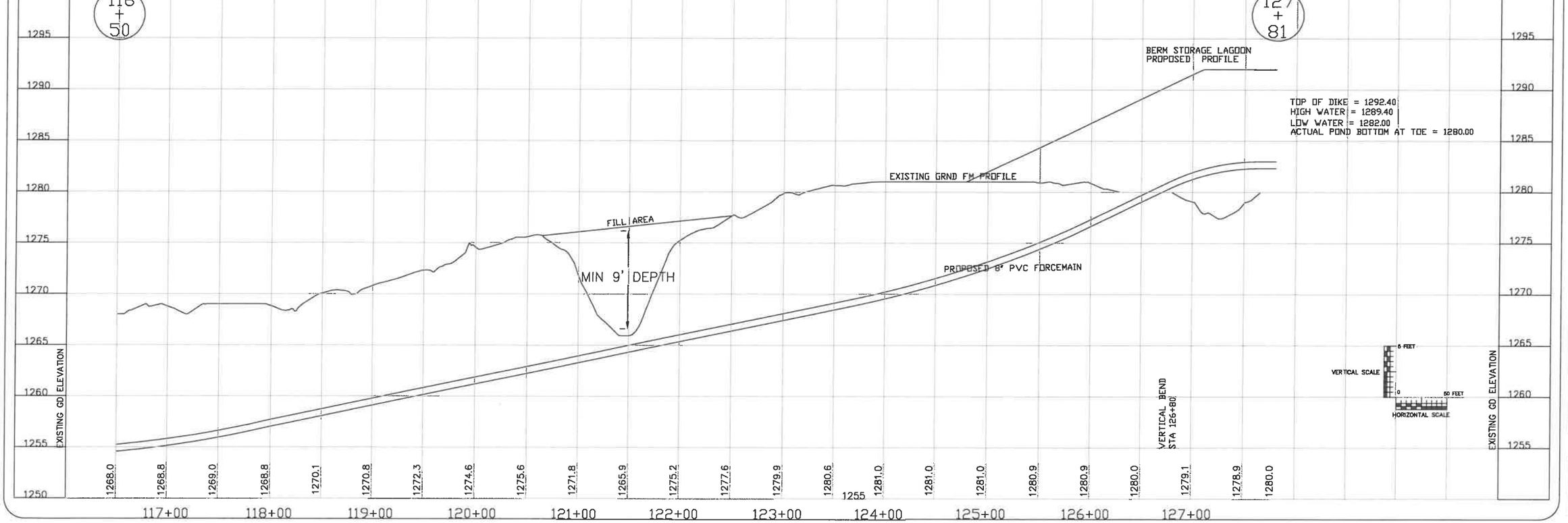
RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
16 OF 27

S:\NEC\Projects\03-42 rl waste water (bigpond)\03-42 AS-BUILTS\dwg\03-42main.dwg, Sheet 16, 3/29/2011 10:37:40 AM, ssropl





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RED LAKE WASTEWATER FACILITIES

PLAN AND PROFILE

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
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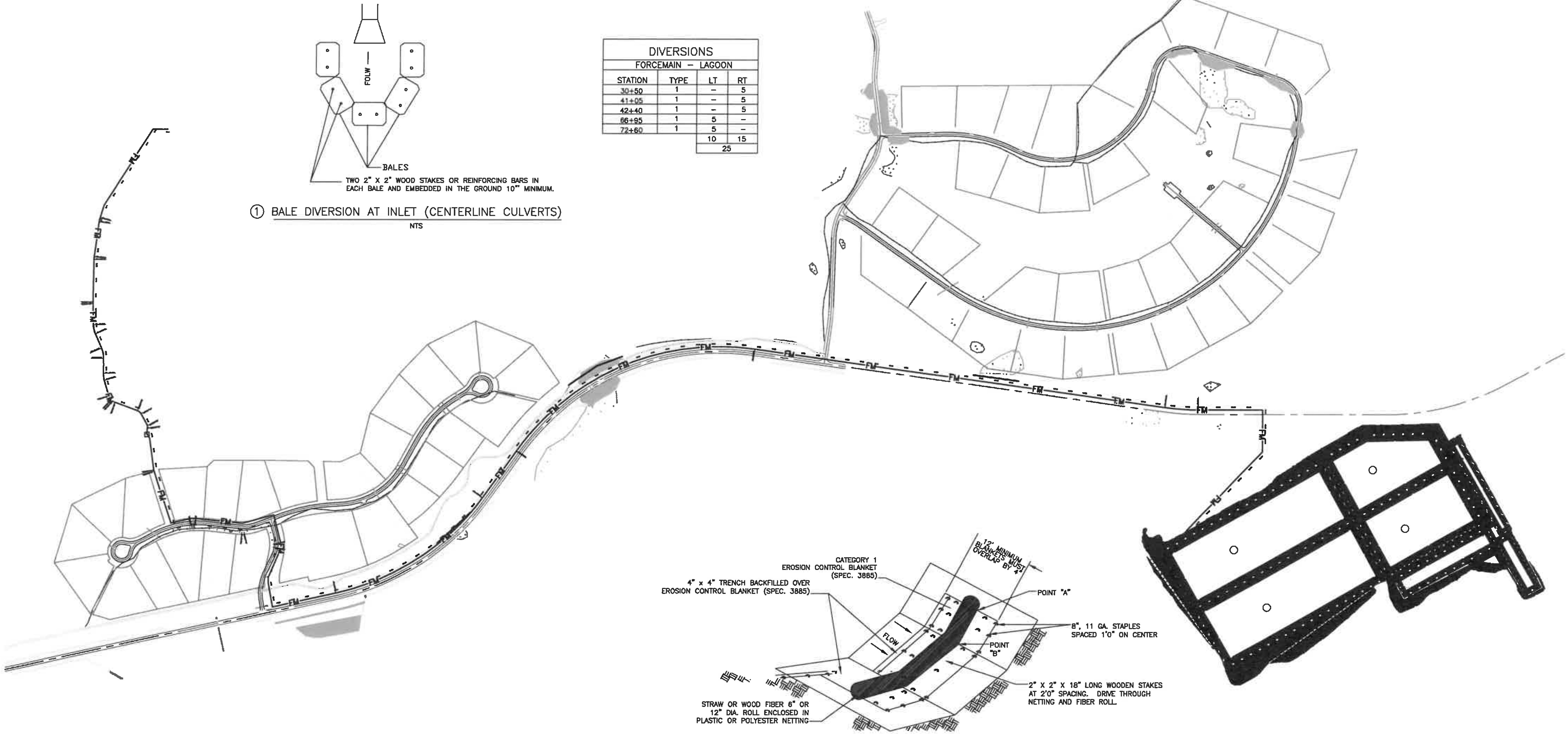
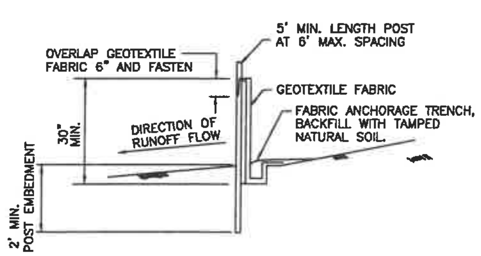
NOT TO SCALE



① BALE DIVERSION AT INLET (CENTERLINE CULVERTS)

NTS

DIVERSIONS			
FORCEMAIN – LAGOON			
STATION	TYPE	LT	RT
30+50	1	–	5
41+05	1	–	5
42+40	1	–	5
66+95	1	5	–
72+60	1	5	–
		10	15
		25	

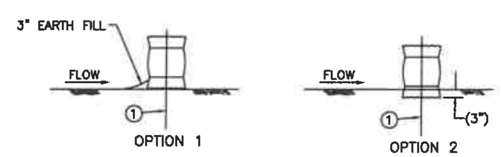


③ SILT FENCE DETAIL

NTS

SILT FENCE TO BE PAID FOR AT CONTRACT PRICE, AS SILT FENCE MACHINE SLICED (MNDOT 2573.502).

SILTFENCE		
FORCEMAIN – LAGOON		
STATION	LT	RT
40+42	–	50
54+50	300	–
68+00	400	–
95+50	300	–
LAGOON	6775	
	7825	



BALE CHECK DETAILS

NTS

① TWO 2" X 2" WOOD STAKES OR REINFORCING BARS IN EACH BALE AND EMBEDDED IN THE GROUND 10" MINIMUM.

BIOROLLS		
FORCEMAIN – LAGOON		
STATION	LT	RT
50+25	10'	–
54+15	10'	–
58+15	10'	–
61+60	10'	–
64+60	10'	–
66+65	10'	–
72+25	10'	–
75+85	10'	–
77+90	10'	–
82+45	10'	–
84+95	10'	–
86+95	10'	–
	120'	
	120'	

POINT "A" MUST BE HIGHER THEN POINT "B" TO ENSURE THAT WATER FLOWS OVER THE DIKE AND NOT AROUND THE ENDS.

② BIOROLL BLANKET SYSTEM
(TYPE 3 SPEC. 3889)

RECOMMENDED SPACING BETWEEN DITCH CHECKS	
DITCH GRADE (%)	SPACING (FT.)
2–4	100
4–6	75
6–8	50
8–10	40
>10	25

S:\NEC\Projects\03-42 rl waste water (lagoon)\03-42 AS-BUILTS\dwg\03-42main.dwg, Sheet 18-Erosion Control 3/29/2011 10:38:56 AM, ssnopl

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RED LAKE WASTEWATER FACILITIES

EROSION CONTROL SHEET

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

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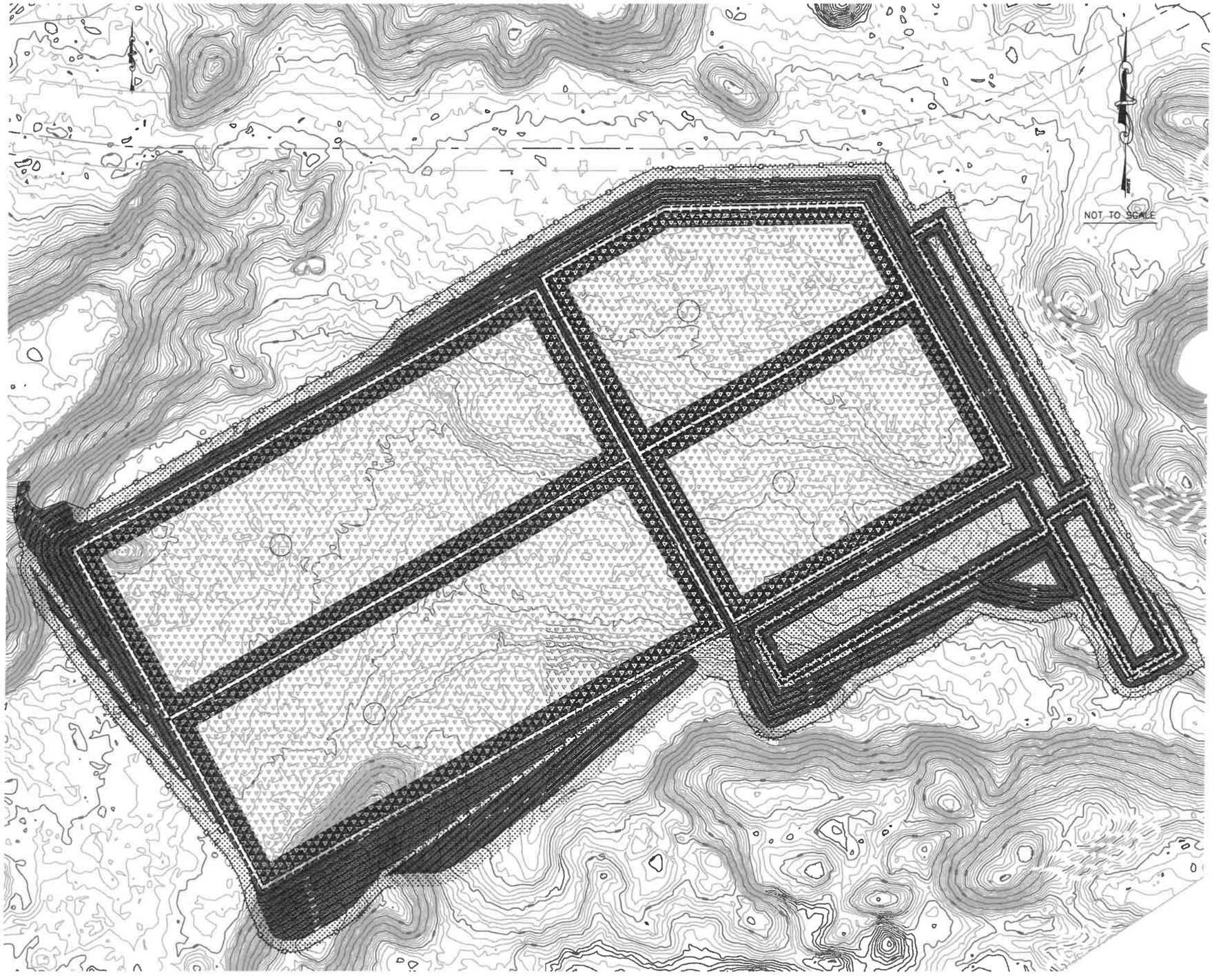

LEGEND

GEOMEMBRANE LINER
(SEE DETAILS AND SPECIFICATIONS)

RIP RAP / GEOMEMBRANE LINER
(SEE DETAILS AND SPECIFICATIONS)

SEEDED GRASS

PERIMETER SILT FENCE

EROSION AND SEDIMENT CONTROL PLAN

1.) The Contractor shall obtain all permits prior to start of construction.

2.) All exposed soil areas must have temporary erosion protection or permanent cover according to the following:

Type of Slope	Time (Maximum time an area can remain open when the area is not actively being worked.)
Slopes steeper than 3:1	within 7 days
Slopes between 10:1 and 3:1	within 14 days
Slopes flatter than 10:1	within 21 days

These areas include constructed storm water management pond side slopes, and any exposed soil areas with a positive slope to a storm water conveyance system, such as a curb and gutter system, storm sewer inlet, temporary or permanent drainage ditch or other natural or man made systems that discharge to a surface water.

3.) Pipe outlets must be provided with energy dissipation with 24 hours of connection to surface water.

4.) All storm sewers discharging into wetlands or water bodies shall outlet at or below the normal water level of the respective wetland or water body or at an elevation where the downstream slope is 1 percent or flatter. The normal water level shall be the invert elevation of the outlet of the wetland or water body.

5.) All grading operations shall be conducted in a manner to minimize the potential for site erosion. Sediment control practices must be established on all down gradient perimeters before any up gradient land disturbing activities begin.

6.) In areas where concentrated flows occur (such as swales and areas in front of storm catch basins and intakes) the erosion control facilities shall be backed by a stabilization structure to protect those facilities form the concentrated flows.

7.) All storm sewer catch basins not needed for site drainage during construction shall be covered to prevent runoff form entering the storm sewer system. Catch basins necessary for site drainage during construction shall be surrounded by silt fence or double ring of staked hay bales backed by snow fence. The fence or bales shall be installed and maintained around all catch basins until the tributary areas are restored.

8.) All construction site entrances shall be surfaced with crushed rock across the entire width of the entrance and from the entrance to a point 50 feet into the construction zone.

9.) The toe of the silt fence shall be trenched in a minimum of 6 inches. The trench backfill shall be compacted with a vibratory plate compactor.

10.) All riprap shall be designed and installed with a filter material and meet the Minnesota Department of Transportation specifications for riprap and filter material.

11.) Inspect the construction site once every seven (7) days during active construction and within 24 hours after a rainfall event greater than 0.5 inches in 24 hours.

12.) All silt fences must be repaired, replaced, or supplemented when they become nonfunctional or the sediment reaches 1/3 of the height of the fence. These repairs must be made within 24 hours of discovery, or as soon as field conditions allow access.

13.) If sediment escapes the construction site, off-site accumulations of sediment must be removed in a manner and at a frequency sufficient to minimize off-site impacts.

14.) All soils tracked onto pavement shall be removed daily.

15.) All permanent sedimentation basins must be restored to their design condition immediately following stabilization of the site.

16.) Upon completion of the project and stabilization of all graded areas, all temporary erosion control facilities (silt fences, hay bales, etc.) shall be removed from the site.

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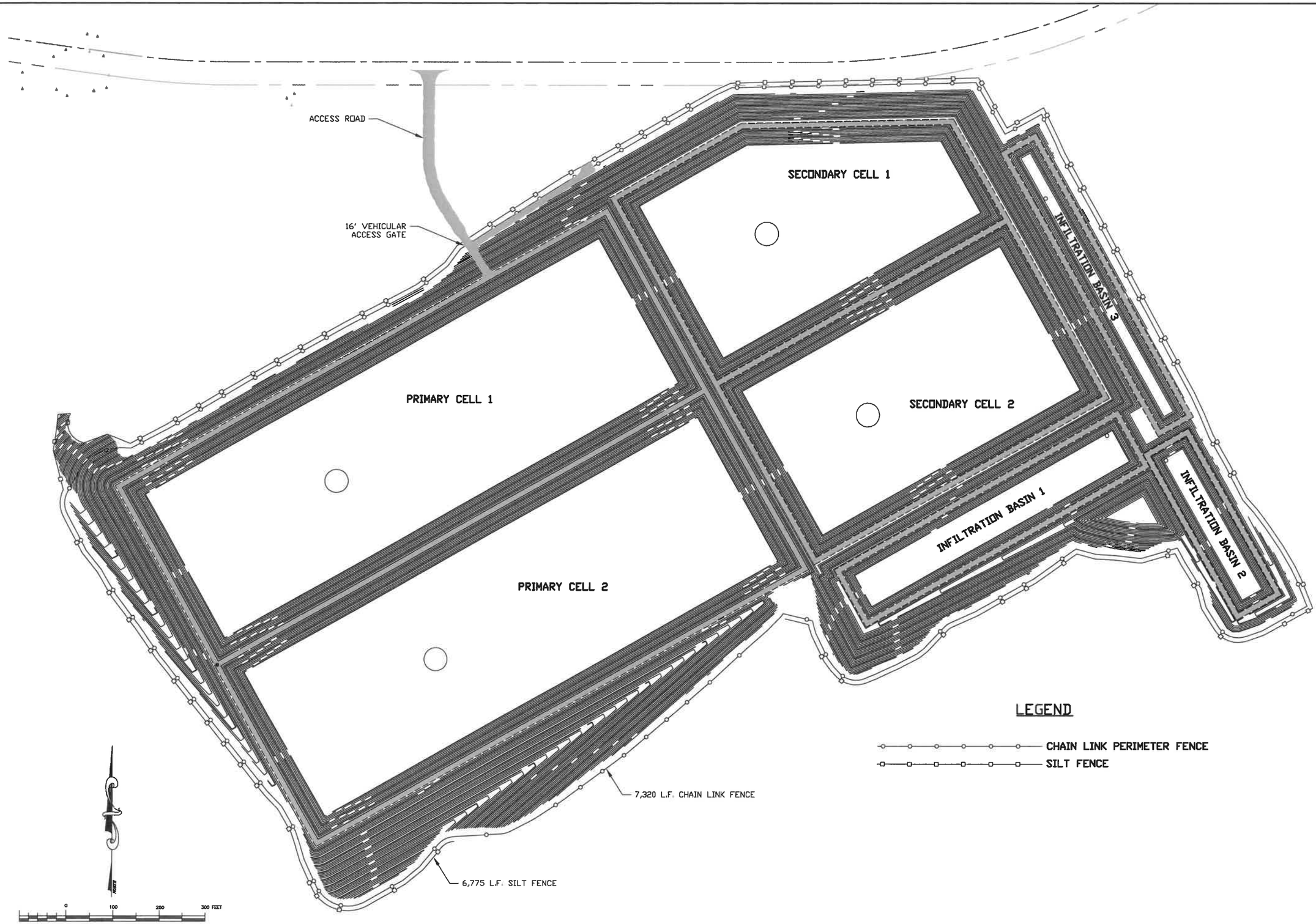
RED LAKE WASTEWATER FACILITIES

SITE EROSION CONTROL SHEET

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
19 OF 27



LEGEND

CHAIN LINK PERIMETER FENCE

SILT FENCE

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RED LAKE WASTEWATER FACILITIES

FENCING LAYOUT

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

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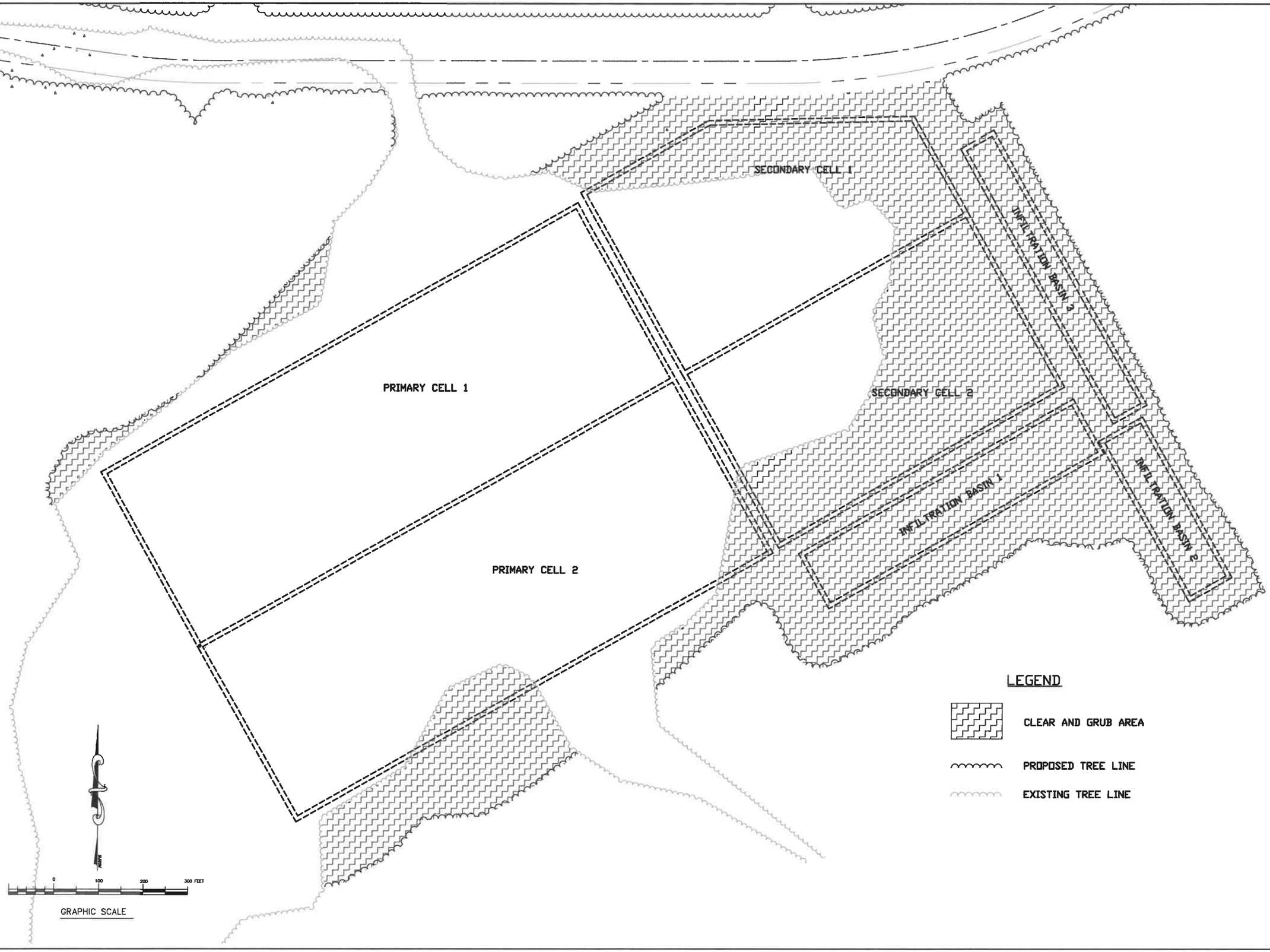

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RED LAKE WASTEWATER FACILITIES

CLEARING AND GRUBBING PLAN

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

SHEET NO.
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TOP OF DIKE = 1292.40
HIGH WATER = 1289.40
LOW WATER = 1282.00
ACTUAL POND BOTTOM AT TOE = 1280.00

TOP OF DIKE = 1292.40
HIGH WATER = 1289.40
LOW WATER = 1282.00
ACTUAL POND BOTTOM AT TOE = 1280.00

10
13
7
11
14
12
16
17
15
18

LEGEND
SOIL BORING

0 60 120 180 FEET
GRAPHIC SCALE

NOTE:
ALL PROPOSED CONTOURS REFLECT FINISH GRADE ELEVATIONS. EARTHWORK IS BASED ON DIFFERENCE BETWEEN EXISTING AND PROPOSED FINISH GRADE ELEVATIONS. CONTRACTOR SHALL NEED TO TAKE INTO ACCOUNT THE NEED FOR OVER-EXCAVATION IN CUT AREAS TO ALLOW FOR TOPSOIL AND SAND LAYERS NEXT TO SYNTHETIC LINER.

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RED LAKE WASTEWATER FACILITIES
GRADING PLAN 1
RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011
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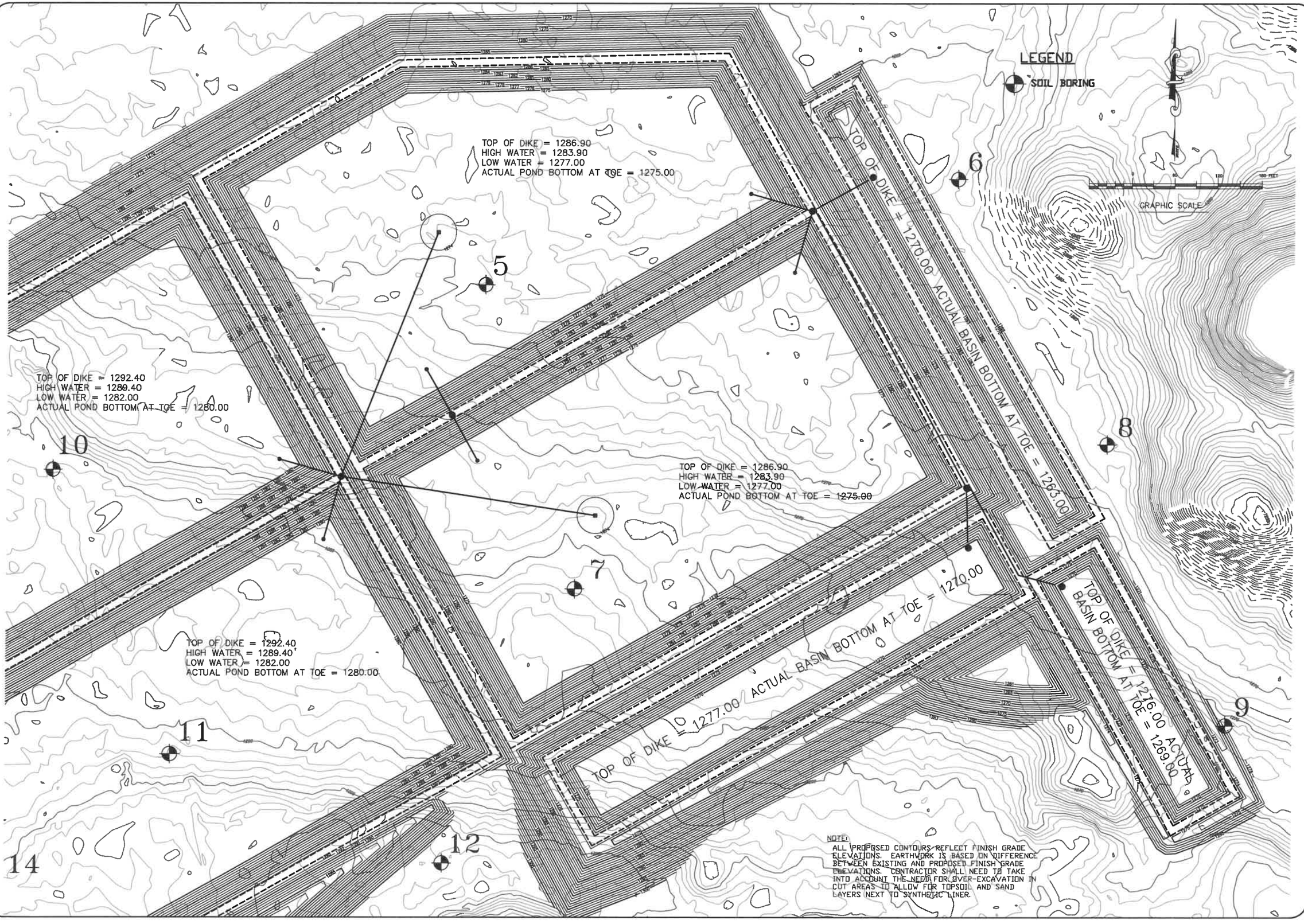
22 OF 27



NOTE:
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RED LAKE WASTEWATER FACILITIES

GRADING PLAN 2

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

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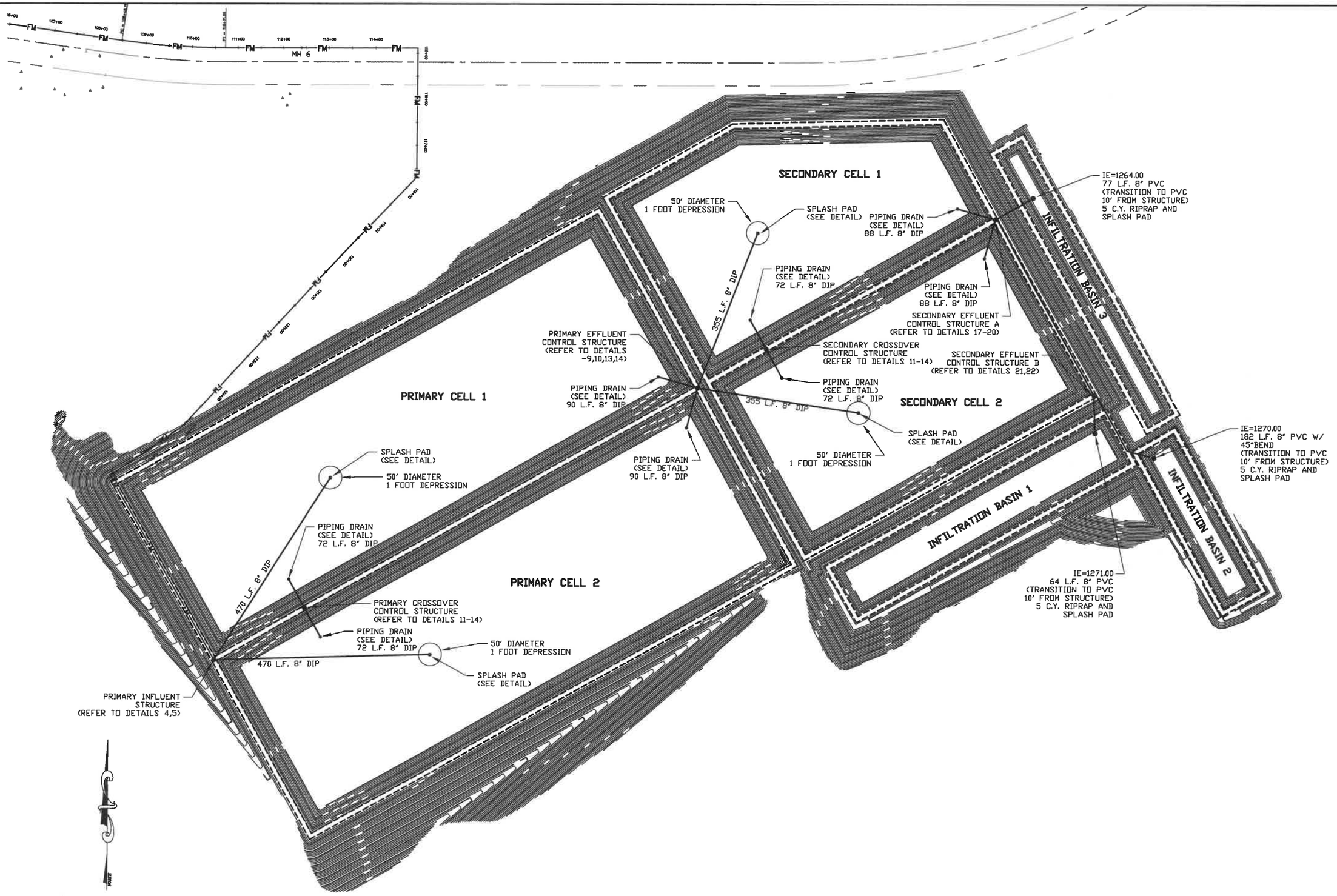

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RED LAKE WASTEWATER FACILITIES

CONTROL PIPING / STRUCTURE LAYOUT

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

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ACCESS ROAD

PRIMARY CELL 1

PRIMARY CELL 2

SECONDARY CELL 1

SECONDARY CELL 2

INFILTRATION BASIN 3

INFILTRATION BASIN 1

INFILTRATION BASIN 2

0 100 200 300 FEET

GRAPHIC SCALE

LEGEND

- GEOMEMBRANE LINER
- RIP RAP / GEOMEMBRANE LINER
- SEEDED GRASS
- AGGREGATE BASE ROAD

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RED LAKE WASTEWATER FACILITIES

SITE SURFACING LAYOUT

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

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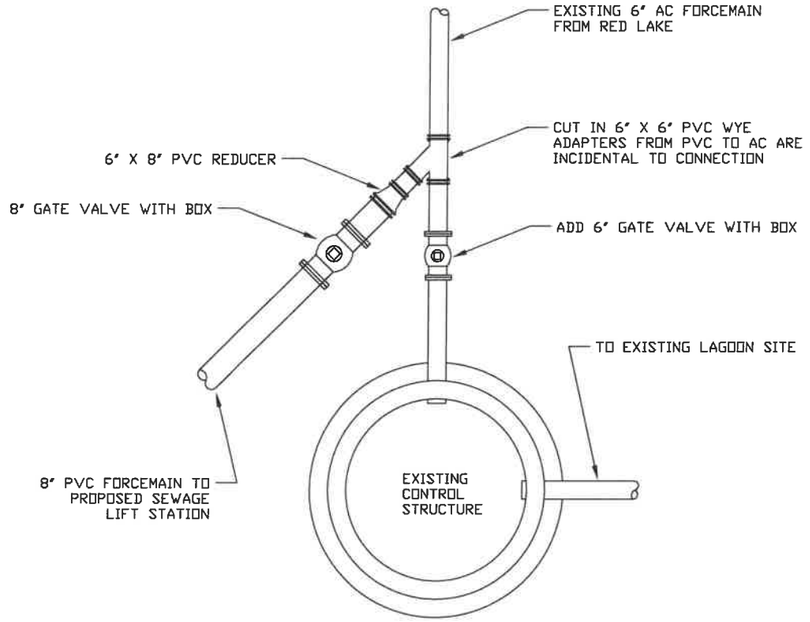

25 CONNECTION TO EXISTING WASTEWATER FACILITIES
NO SCALE

NOTES FOR REHABILITATION OF SECONDARY POND

1. CONTRACTOR SHALL REMOVE ALL TREES, SHRUBS, BRUSH, AND OTHER VEGETATION OR UNSUITABLE MATERIALS FROM THE EXISTING POND
2. CONTRACTOR TO SCARIFY AND RECOMPACT ENTIRE POND BOTTOW AND SIDE SLOPES TO AN ELEVATION 6 FEET ABOVE POND BOTTOM. SCARIFICATION SHALL BE TO A DEPTH OF TH INCHES AND RECOMPACTION SHALL BE A MINIMUM OF 95% STANDARD PROCTOR DENSITY.

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RED LAKE WASTEWATER FACILITIES

CONNECTION TO EXISTING FACILITIES

RED LAKE RESERVATION, MINNESOTA

JOB NO. 03-42
DATE: 03-29-2011

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GEOMEMBRANE FABRICATION

3.1 FACTORY FABRICATION

Individual calendered widths (roll goods) are factory pre-assembled into large panels to minimize field seaming during installation.

Factory seams are produced using chemical, dielectric or thermal method. Each seaming method is tailored for optimum seam strength.

Nominal seam widths, Non-reinforced 1" / Reinforced 1 1/2 " scrim to scrim.

Factory pre-assembly production records identify each panel by panel number, size, date of pre-assembly, material lot number and seam station identification. Each panel is prominently marked with the panel number and panel size to coincide with production records.

3.2 IN-FACTORY SEAM TESTING

Visual and non-destructive inspection shall be performed on 100% of factory pre-assembled seams, including ASTM D4545, through a combined use of sections 7.1.1 (OSHA limits) and 7.1.4. Seam type will determine procedure and ratio. All seams are warranted for two (2) years.

In addition, destructive testing on factory fabricated seams in order to verify quality compliance shall be performed.

Samples of factory seams shall be taken at the beginning and at the end of each production shift. All seams shall be tested for compliance and the results shall be made available to the engineer for materials to be used on the specific job.

3.3 FACTORY SEAM REQUIREMENTS

All factory seams are tested for Bonded Seam and Peel strength in accordance with Industry (ASTM) standards.

4 PACKAGING, HANDLING, AND TRANSPORTATION

4.1 PACKAGING AND HANDLING

After factory pre-assembly, the geomembrane panels are double accordion folded on a pallet or rolled on a cardboard core. Folded panels are shrink wrapped (light reflectant) using a water and UV resistant polymer sheeting with outer cardboard insert banded to a heavy duty wooden pallet. Rolled panels are wrapped in a protective layer and shrink wrapped (light reflectant). All pallets/rolls are identified by panel size, type, and number. Geomembrane panels delivered to the jobsite are unloaded on level ground, stored in their original, unopened containers in a secure, dry area, and protected from weathering. Wherever possible, a six-inch minimum air space between the pallets should be maintained, especially when the geomembrane panels are to be stored over an extended period of time. Pallets must not be stacked. Banding is not to be removed from the pallet until actual deployment, to insure stability.

Material Safety Data Sheets (MSDS) to be provided on all chemicals which include handling and personal protection during usage.

4.2 TRANSPORTATION

Transportation of the geomembrane will be arranged by supplier, and will be shipped via a closed or flat bed trailer. Adequate tarps (flat bed) are recommended during transport. It is the responsibility of the receiver at the time of delivery to indicate condition of shipment on the Bill of Lading. Any visual damage MUST be noted in WRITING and supplier should be contacted within 24 hours or (extreme conditions) before accepting delivery.

5 INSTALLATION

5.1 ANCHORAGE SYSTEM

Unless otherwise specified, the anchor trench should be excavated by the earthwork contractor or others to the lines and grades shown on the design drawings. Store excavated material away from the area to be lined.

Complete trenching process prior to geomembrane placement.

A smooth transition surface from anchor trench to subgrade should be provided.

Following the completion of the seaming operation, the anchor trench shall be backfilled and compacted (as soon as possible) by the earthwork contractor to lock in the geomembrane. During ongoing backfilling operations, backfill should be kept a minimum of 10 feet from un- seamed areas.

5.2 SUBGRADE

5.2.1 Preparation

Surfaces to be lined will be free of all rocks, roots, vegetation, sharp objects, or debris of any kind. The surface shall provide a firm, unyielding foundation for the geomembrane with no sharp or abrupt changes in grade.

If an herbicide is required, it must be suitable for use with geomembranes and shall be applied as per the manufacturer recommendations. Suitability for use with the geomembrane shall be confirmed by the herbicide manufacturer.

5.2.2 Repair and Maintenance

Prior to geomembrane installation, the surfaces to be lined shall be inspected for acceptability by the installers. Any necessary repairs will be made by the owner or earthwork contractor. It is the responsibility of the owner or earthwork contractor to maintain the integrity of the subgrade prior to, and during the geomembrane installation. This includes the control of ground water in the area to be lined.

5.3 GEOMEMBRANE PANEL PLACEMENT

5.3.1 Panel Location

Install the geomembrane as indicated in the approved layout drawing. The installer may modify the proposed layout to best meet the intent of the project specification and/or to accommodate existing site conditions.

5.3.2 Weather Conditions

Consideration must be given to low temperature (<40°F) handling characteristics of the geomembrane before installation, in some cases, before the liner is actually ordered. Please contact supplier if the above condition exists.

5.3.3 Geomembrane Panel Deployment

The number of panels to be deployed in any day shall be limited to the number of panels which can be seamed or secured that day.

The geomembrane shall be installed in a relaxed manner and free of tension and stress. In areas where grade transitions occur, "bridging" or "trampolining" of the geomembrane shall not be allowed. To accommodate grade transition, adequate slack is necessary. Wrinkling of the geomembrane is acceptable and indicates proper slack consideration.

Deploy geomembrane panels to meet a minimum panel overlap of six inches. During cold weather deployment, consideration must be given to residual packaging geometry (ability to lay flat) as it relates to installation quantity. Shingle all panels in the down gradient direction whenever possible.

5.3.4 Preparation for Seaming

Supplier approved installer shall verify the following:

- All personnel walking on the geomembrane liner shall have smooth soled shoes. Personnel working on the geomembrane shall not smoke and shall not engage in activities that could damage the geomembrane.
- Tools used in the installation process shall be properly stored and carried. Knives and other sharp objects shall be carried in protective sheaths.
- The method used to unfold panels will not cause damage to the geomembrane or underlying geosynthetics.
- Any geosynthetic elements directly underlying the geomembrane shall be clean and free of debris.
- Adequate temporary anchoring shall be placed to prevent wind uplift of the geomembrane panels. Typical items are sandbags and ballast tubes. In cases of high wind, continuous loading may be required along the edges of the geomembrane panel.
- High traffic areas may require temporary wear surfaces (i.e. geotextile, additional geomembrane, clean fill, etc.)
- Vehicles shall not be allowed on the geomembrane unless approved by the installer.
- Chemical cleaners, seaming agents and fuels shall be stored separately, away from geomembrane panels. Spill resistant containers shall be used while working directly on the liner and shall be stored upon a sacrificial material such as scrap geomembrane or heavy cardboard.

5.4 FIELD SEAMING

5.4.1 Seam Preparation

Primary and Secondary Field Seaming for Polypropylene-Reinforced shall be by Thermal Method.

The overlapped geomembrane panels must be clean at the surfaces to be joined. Any foreign material (e.g. dirt, moisture) must be removed with clean, dry rags before seaming commences.

If seaming must be conducted over rough substrate, seaming boards are recommended. A one-foot by eight or ten-foot pine shelf board will work well as a seaming platform.

5.4.1.1 Repairs

All fish mouths shall be slit, laid flat, bonded, then patched with a round or oval patch of the same geomembrane material. All patches shall extend a minimum of six inches beyond the repair area in all directions, and seamed along the entire perimeter.

5.4.2 Cold Weather Thermal Fusion Field Seaming

Generally for cold weather seaming, when the geomembrane surface is below 50°F, the surfaces to be joined must be preheated.

If the soil beneath the geomembrane is frozen, the application of heat to the area to be seamed may result in moisture condensing between the surfaces to be joined. This condition may be eliminated by placing a seaming board, or slip-sheet made from the same geomembrane material, between the frozen surface and the geomembrane to be seamed.

See Field Seam Geometry Table in details.

5.4.3 Thermal Fusion Field Seaming (Continuous Width)

The two most common seaming methods are Hot Wedge and Hot Air. Either method is capable of producing a quality seam. These units are equipped with speed and temperature controls with digital (LED) readout along with pressure adjustment.

- Thin gauge materials (<30 Mil) combined with High ambient temperature can affect seam quality.
- Hand Held Leister or equal can be used for pipe boots, details and patching for the majority of non-crystalline geomembranes.
- Each method must be capable of producing sufficient amount of controlled heat and pressure applied to the seam overlap contact zone, resulting in a continuous thermal weld.
- Pressure squeeze out along seam edge to be kept to a minimum in order to maximize overall seam thickness.
- Exercise caution when operating welder in direct contact with subgrade.drive (pressure) rollers must be kept clean at all times.

5.4.5 Pipe Penetrations

Penetrations shall be sealed via the use of factory fabricated pipe seals. Pipe seals are thermally constructed using the same material as the specified geomembrane. For reinforced material, the tube section of the pipe seal shall be constructed using non-reinforced parent material. The method of bonding is as outlined in the field seaming section.

5.5 LINING SYTEM ACCEPTANCE

The supplier authorized installer shall retain responsibility for the geomembrane installation until acceptance by the Engineer and/or Owner.

The geomembrane liner installation will be accepted by the Owner when the following conditions have been met:

1. Installation of the geomembrane is complete.
2. Verification of the integrity of all seams and repairs, as required by the specifications, is complete.
3. All documentation pertaining to the geomembrane installation is completed and submitted to the Owner/Engineer.

6 FIELD QUALITY ASSURANCE

6.1 OVERVIEW

Field seam quality shall be demonstrated by non-destructive (NDT) and destructive (DT) test methods.

The primary purpose of the NDT method is to demonstrate continuity along the entire length and to validate 100% of the field seam. NDT methodology is described in section 6.3 below.

The purpose of the DT method is to determine the quality of a given seam by removing a representative seam sample, and testing the given sample for compliance with accepted applicable industry standards. Testing may be conducted either at the job site, or at a remote testing laboratory. DT methodology is discussed in section 6.4 below.

6.2 TEST STRIP/TRIAL SEAMS

A general requirement of most CQA Documents is that "test seams" or "test strips" be made on a periodic basis. Test strips generally reflect the quality of field seams but should never be used solely for the final field seam acceptance. Final field seam acceptance requirements should be specified in the contract specification and should include a minimum level of destructive testing of the field seams. Test strips are made to minimize the amount of destructive sampling/testing on the finished panels. Typically these test seams, for each seaming crew, are made once per day, or every time equipment is changed, or if significant changes in site conditions are noted, or as required in the contract specification. The purpose of these tests is to establish that proper seaming materials, temperatures, pressures, rates, and techniques along with the necessary geomembrane pre-seaming preparation are being accomplished. Test strips may be used for CQA/CQC evaluation, and must be of sufficient size in order to conduct required testing.

While cursory test seams are evaluated, the seaming crew may begin and continue to work as long as the field seam being constructed is completely traceable and identifiable. If a test seam fails to meet the field seam design specification, then an additional test seam sample is constructed and re-tested by the same seaming crew, equipment, and materials.

Field seams will not be accepted unless CQC seam test result criteria as per the design specification are met.

One of the following procedures shall apply whenever a sample fails a destructive test:

1. The field seam shall be reconstructed between two test locations shown to have acceptable results; one located on either side of the failed sample.
2. The seam shall be traced outward to intermediate points (a maximum of 10 feet from the failed sample in each direction) and sampled for additional testing. If the samples are found to provide acceptable test results, the seam is reconstructed between these two sample locations. If an intermediate sample fails, the process is repeated to establish the zone in which the seam is to be reconstructed. All reconstructed seams shall be defined by two locations from which samples passing other destructive tests have been taken.

Reconstruction of field seams shall be accomplished by removing the suspect seam, repositioning panels and re-seaming, or by installing a cap strip to cover the seam under reconstruction. Cap stripping shall extend a minimum of six inches beyond the reconstructed seam in all directions.

For geomembrane seams that are bonded by the chemical fusion method, the seams must be cured prior to testing. Without the application of heat, the cure times can range from a few hours to a few days. Accelerated curing for on site CQC testing requires the use of an oven or other suitable heat source to condition the seam samples from 1 to 16 hours in a temperature range of 122°F to 158°F. Following the accelerated cure period, a post-cure conditioning period of at least 1/2 hour at ambient conditions prior to testing is required.

During the CQC and CQA test requirement periods, a liner should not be covered, and it cannot be placed into service. This will insure the ease of repairing or reconstructing in the event it is required. During this period, it is imperative that the liner be properly ballasted and otherwise secured so as to prevent wind or unusual weather damage.

6.3 NON-DESTRUCTIVE SEAM TESTING

6.3.1 Test Methods

The following test methods are acceptable for non-destructive testing of field seams:

A. Air Lance
B. Vacuum Chamber

See Appendix II for application of these methods based on seam type or location.

Refer to ASTM D 4437-84, section 7.5 for Mechanical Point Stressing Procedure for close quarters alternate.

6.3.2 Remedial Action

If unbonded areas are located, they can often be repaired by using detail method 5.4 or 5.4.1.1. All patches shall extend a minimum of six inches beyond the area in all directions.

6.4 DESTRUCTIVE SEAM TESTING

6.4.1 Sampling Frequency

Destructive seam testing can be conducted along completed field seams at intervals of 1000 feet (or at intervals indicated in the project specification, and as addressed by addendum to this document). Wherever possible, test strips should be taken out of the anchor trenches so as not to disturb the integrity of the functional lining system.

6.4.2 Sampling Procedure

Samples shall be removed from the completed geomembrane seam by the installer. The sample shall be labeled in a clear and logical manner. The sample location must be identified and recorded.

Any holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired by patching the sampled area with identical geomembrane material. The patch must extend a minimum of six inches beyond the repair area in all directions. The continuity of repaired sampling locations shall be confirmed via NDT methods described above.

6.4.3 Sample Geometry

The *minimum* sample geometry shall be as follows:

Sample width shall be determined as the width of the field seam plus six inches on both sides of the seam.

Sample length can be up to forty-eight (48") inches for non-reinforced material and can be up to one hundred four (104") inches for reinforced material.

6.4.4 Disposition of Samples

The sample described above shall be cut into three equal segments. One segment of the sample shall be submitted for laboratory (or field) testing; one segment to the installer, and the remaining segment to the owner.

6.4.5 Sampling and Testing

6.4.5.1 Conditioning

Conditioning of all samples prior to testing is imperative. Field seams produced using a chemical fusion agent must be allowed to cure until the required strength values can be achieved. Accelerated curing can be accomplished by conditioning the samples at temperature of 122°F-158° F for sixteen hours. Following the accelerated cure period, a post-cure conditioning period of at least 1/2 hour at ambient conditions prior to testing is required. Chemical seam samples shall be considered ready for testing when the chemical fusion agent odor is no longer detectable.

6.4.5.2 Sampling

Test specimens shall be prepared as per Section 6.4.3.

6.4.5.3 Testing

Specimens shall be tested in order to determine bonded seam strength and peel adhesion. Testing Methods per ASTM procedures indicated by Appendix I.

A. Bonded Seam Strength (ASTM D882)

Non-reinforced Material

Specimen dimensions shall be one inch in width and shall extend a distance of four inches (4") on both sides of field seam. Samples must be cut in a manner which eliminates nicks or tears in the specimen which could cause premature failure (refer to ASTM D882 for further information). Specimens must be cut so that the long dimension of the specimen is perpendicular to the length of the seamed sample.

Reinforced Material (ASTM D751)

Specimen dimensions shall be four inches (4") in width and shall extend a distance of four and one-half (4-1/2") on both sides of field seam. Samples must be cut in a manner which eliminates nicks or tears in the specimen which could cause premature failure (refer to ASTM D882 for further information). Specimens must be cut so that the long dimension of the specimen is perpendicular to the length of the seamed sample.

B. Peel Adhesion (ASTM D882)

Non-reinforced and reinforced PP

Prepare specimens as described above for bonded seam strength, non-reinforced PP.

C. Quantity of Specimens

A total of ten specimens shall be cut from the sample. Five specimens will be used to perform bonded seam strength testing with the remaining five specimens to be used for peel adhesion testing. Details of the test procedures are outlined in ASTM D751, Modified (Bonded Seam Strength), and ASTM D413, Modified (Peel Adhesion).

6.4.6 Acceptance of Destructive Test Results

See specifications for minimum specified seam strength values.

6.4.7 Remedial Action - Destructive Test Failure

One of the following procedures shall apply whenever a sample fails a destructive test:

1. The field seam shall be reconstructed between two test locations shown to have acceptable results; one located on either side of the failed sample.
2. The seam shall be traced outward to intermediate points (a maximum of 10 feet from the failed sample in each direction) and sampled for additional testing. If the samples are found to provide acceptable test results, the seam is reconstructed between these two sample locations. If an intermediate sample fails, the process is repeated to establish the zone in which the seam is to be reconstructed. All reconstructed seams shall be defined by two locations from which samples passing other destructive tests have been taken.

Reconstruction of field seams shall be accomplished by either removing the suspect seam, repositioning panels and re-seaming, or by installing a cap strip to cover the seam under reconstruction. Cap stripping shall extend a minimum of six inches beyond the reconstructed seam in all directions.

6.4.8 Verification of Repairs

Any repair requiring a patch or cap strip shall be identified on the as-built drawing. Each repair shall undergo non-destructive testing as described in section 6.3 above. Repairs which pass the NDT shall be taken as an indication of proper repair. Failed NDT's will result in reconstruction and re-testing of the repair area until a passing result is obtained.

NDT METHODS FOR FIELD SEAMS

A. Air Lance Testing for Hot Air Field Welds

For field seams produced using hot air welding, air lancing is the preferred method of testing. This method is applicable for all field seams, including seams around pipe penetrations and accessories. In areas involving 3-way intersections, vacuum box testing may be preferable (see below). A description of the air lance test follows.

All field seams shall be non-destructively tested over their full length. An air lance apparatus shall be used for this testing as described in this Appendix. The air lance shall be capable of supplying 30 psi through a 3/16 inch diameter nozzle. The air stream shall be directed at the edge of the seam no more than two inches from the seam edge. Enough time shall be allowed for the seams to develop adequate strength before commencement of testing. Any defects found during testing shall be marked, repaired, and retested with the air lance. All repairs shall be performed as described in Section 6.3.2 (Remedial Action).

B. Vacuum Box Testing for Hot Air Field Welds

For areas where air lance or pressurized seam testing is inappropriate, vacuum box testing may be used.

This method consists of creating a pressure differential across a seam and observing for bubbles in a film of liquid medium over the low pressure side, within the vacuum chamber. The vacuum chamber has a viewing port that allows observation of the seam area being tested. The sensitivity of the method is dependent on the pressure differential and the liquid used for testing. As long as the pressure differential can be maintained across the area tested, this method can be used. (ASTM E515, 5/90)

The following equipment comprises the vacuum box apparatus:

Vacuum Pump. The vacuum pump shall be fuel or electric powered and capable of sustaining the required vacuum for the duration of the test.

Vacuum Gauge. The vacuum gauge shall be capable of registering, as a minimum to 70kPa (10 psi) in increments of 5 kPa (3/4 psi).

Calibration and adjustment. The calibration of the vacuum gauge shall be checked and adjusted periodically, and routinely at a minimum of once every 12 months.

Foaming Solution. The foaming solution shall be pre-mixed with water at a ratio conducive to the formation of bubbles. It shall be dispensed by spray, brush, or any other convenient means. The foaming solution should not be detrimental to the geomembrane.

NOTE: If the component to be tested has parts made of polyethylene or structural plastics, the test fluid must not promote environmental stress cracking (E.S.C.) (ASTM E515, 5/90)

Vacuum Chamber. The vacuum chamber shall have an open bottom and a clear viewing panel on top. It shall be an appropriate and convenient size and shape, made of rigid materials and equipped with a vacuum gauge, valve, and soft, pliable gasket around the periphery of the open bottom.

Testing of the field seam proceeds as follows:

The area of the seam to be evaluated should be clean and free of soil or foreign objects which might prohibit a good seal from being formed between the vacuum chamber and the geomembrane. Energize the vacuum pump.

Wet an area immediately adjacent to and including the geomembrane seam measuring approximately twice the width and length of the vacuum chamber with a foaming solution.

Place and center the long axis of the vacuum chamber over the long axis of the seam or defect with the gasket in contact with the geomembrane surface over the wet area of geomembrane seam or test area.

For evaluation of geomembrane defects, center the vacuum chamber over the defect.

Apply a normal force to the top of the vacuum chamber to affect a seal and open the vacuum valve.

Ensure that a leak tight seal is created between the vacuum chamber gasket and the geomembrane material. For most cases, minimum vacuum of 28 to 55 kPa (4 to 8 psi) should be registered on the vacuum gauge is appropriate.

With the vacuum applied, maintain the normal force and observe the geomembrane seam through the viewing port for bubbles resulting from the flow of air through defects in the seam. The vacuum should be held over the test site for a duration of not less than 10 seconds. If the vacuum cannot be held for the minimum 10 seconds, the test area shall be marked as untested.

If bubbles appear on the geomembrane seam, turn the three-way vacuum valve to vent the chamber and remove the vacuum chamber from the seam. The defective area should then be marked for later repair.

If bubbles do not appear through the geomembrane seam within the specified dwell time, turn the vacuum valve to vent the chamber and remove the vacuum chamber from the seam. Move the vacuum chamber to the adjoining portion of the seam length overlapping the previously tested area by a distance no less than 10 percent of the minimum chamber length or at least 50mm (2 inches), whichever is the greater and repeat the procedure until the entire seam has been tested.

Any defects found during testing shall be marked, repaired, and retested with the vacuum box. All repairs shall be performed as described in Section 6.3.2 (Remedial Action).

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I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA

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