



Energy Transfer
Dakota Access Pipeline, LP
PO Box 565
Watford City, ND 58854

April 16, 2019

John Hollingsworth – Project Development Director
Allete Clean Energy – Glen Ullin Energy Center
30 W. Superior St.
Duluth, MN 55802
Phone: (218) 590-9514 – Mobile
Phone: (218) 355-3249 - Office
jhollingsworth@alletecleanenergy.com

Sent via Email

Subject: Allete Clean Energy Glen Ullin Energy Center Underground Electric Line Crossing
Morton County, ND
30" 29004 – ND L/R #1 to ND L/R/#2
Tract ID: ND-MO-001.000
GPS Coordinate: 46.980519, -101.785728 (approx.)

Dear Mr. Hollingsworth and Local Field Supervisor,

Reference is made regarding the proposed Allete Clean Energy Glen Ullin Energy Center (ALLETE) Underground Electric Line Project that will take place on those certain parcels of land located in Morton County, North Dakota, (more precisely at GPS Coordinates Latitude: N 46.980519°, Longitude: W -101.785728°). As you are aware, Energy Transfer (ET) operates and maintains a 30-inch high pressure petroleum products pipeline on behalf of Dakota Access Pipeline, LLC (DAPL) in the vicinity of your proposed project.

In accordance with your submitted plans and map on 2/2019, ET has no objection to your proposed work as submitted, subject however, to the following conditions:

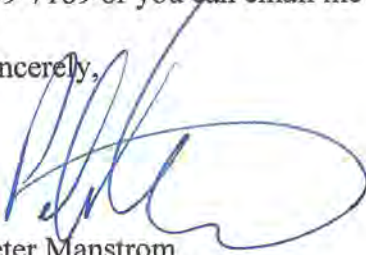
- The contractor shall ensure no loss of depth of cover over DAPL's 50 foot right of way and removing no cover or changing grade within the 50 foot right of way.
- The contractor shall cross underneath the DAPL's 50 foot permanent right of way and maintain minimum 3 (three) feet separation between the top of the ALLETE collection power line(s) and the bottom of the DAPL's 30 inch pipeline throughout the entire DAPL right of way.

- Contractor shall work in a manner that allows a safe environment for all individuals necessary in the excavation of the DAPL pipeline and follow all ET Policies and Procedures at the request of the ET on sight representatives as it impacts the DAPL, DAPL permanent right of way corridor and any on site personnel.
- Contractor shall provide a safe bell hole for the installation of a CP Coupon Test Station at the crossing location. Materials and installation to be provided by DAPL. Contact Michael Luterbach at (701) 334-0436 (michael.luterbach@energytransfer.com) for additional information.
- Contractor shall minimize the length of time the DAPL is exposed after excavation and/or open-cut operations have begun.
- At no time shall the **maximum allowable exposed span of DAPL** exceed 20 feet.
- The contractor shall ensure the ALLETE power line(s) shall be installed at an angle as close to ninety (90) degrees as practical to the DAPL and ensure no crossing shall be installed at an angle less than forty five (45) degrees.
- Contractor shall ensure the ALLETE power line(s) are placed in a non-metallic rigid conduit with pre-mix concrete bags (or poured red-dye concrete) lining the trench immediately above and below the ALLETE power line(s) and conduit throughout the entire length of the DAPL's 50 foot permanent right of way.
- Contractor shall place and bury high visibility red warning tape 18 inches above the ALLETE power line(s) along the entire 50 foot DAPL permanent right of way prior to completion of backfill.
- Permanent ALLETE electric line right of way markers are installed on both sides of the crossing outside of DAPL's 50 foot permanent right of way.
- No above ground appurtenances shall be located within the DAPL's 50 foot right of way.
- Soil backfill shall be compacted and completed to the satisfaction of the ET onsite representative(s).
- Revegetation and reclamation of all impacted areas due to ALLETE, its contractors and the line crossing activities shall be the sole responsibility of ALLETE and its contractors.
- Any proposed material stockpiles and equipment staging area(s) should be located outside of DAPL's 50 foot right of way unless written approval is provided.
- At no time shall any vehicles or equipment cross over the DAPL pipeline without proper protection and approval of an ET representative.
- Contractor shall ensure proper timber matting or use of a 1" (inch) steel plate for approved heavy equipment crossing(s) of any gravel county roads crossing DAPL right of way.
- ET shall be contacted a minimum of 72 hours prior to any work within the easement and an **ET representative must be present during any work** in the vicinity of the DAPL's 50 foot wide right of way boundaries. Please contact Greg St. Onge, DAPL Operations Supervisor at (701) 334-1822 or Kevin Schmidt, Pipeline Technician at (701) 339-0161 for field scheduling arrangements.
- No work may be scheduled outside of normal working hours (7:00am to 4:00pm), on weekends or on holidays. **All scheduling is dependent on the availability of the ET on site representative and subject to restrictions, revocations and limitations at the complete discretion of the ET on site representative and supervisors attached here.**

- Any ALLETE on-site representative and construction contractor(s) shall have at least one (1) printed copy (each) of this paperwork at all times during work.
- All sub-contractors must be aware of ET General Requirements and Restrictions.
- **ET retains the right to stop work within the DAPL permanent right of way at any time at the complete discretion of any ET on site representative.**

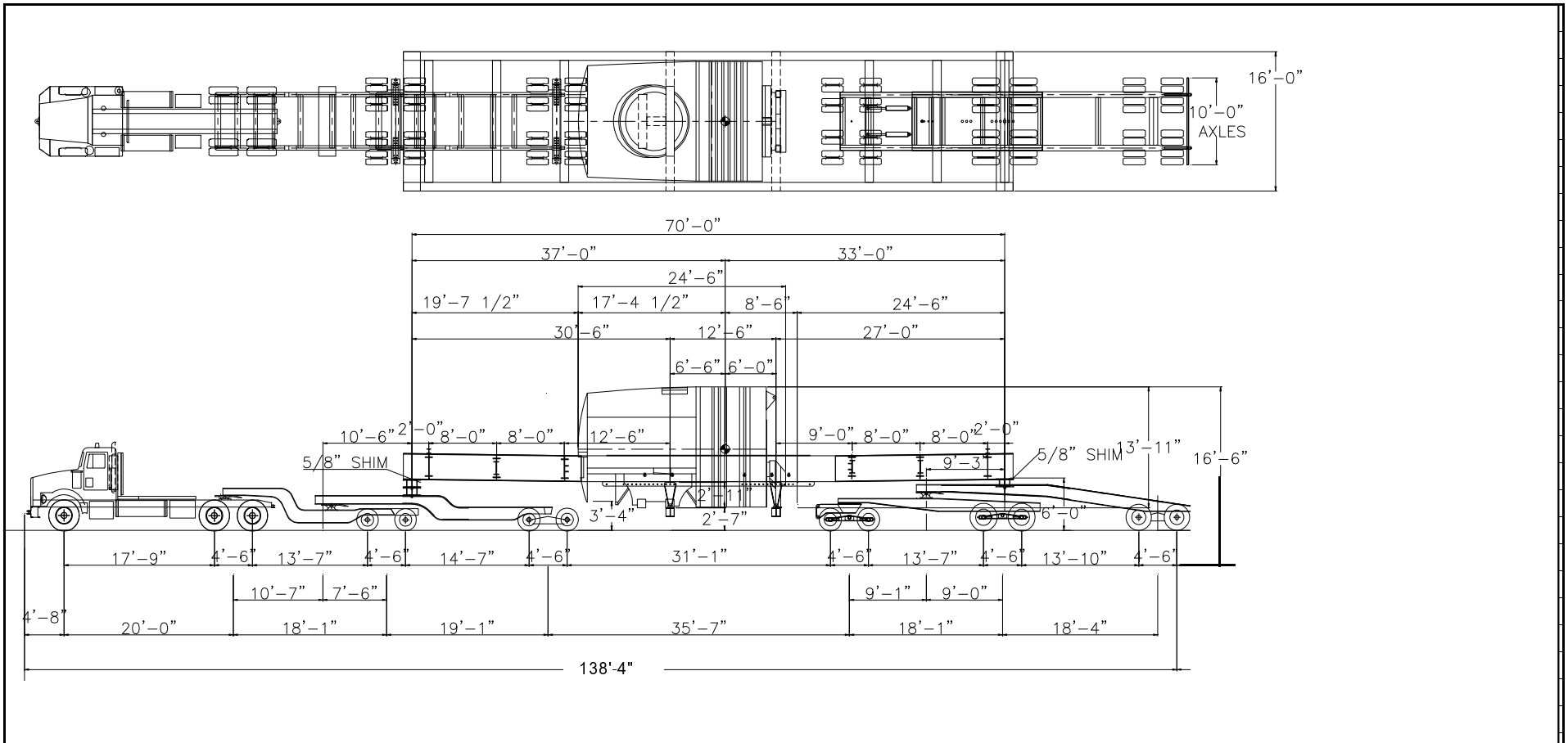
Should you have any questions in the interim, please do not hesitate to contact me directly at (701) 609-7189 or you can email me at peter.manstrom@energytransfer.com.

Sincerely,

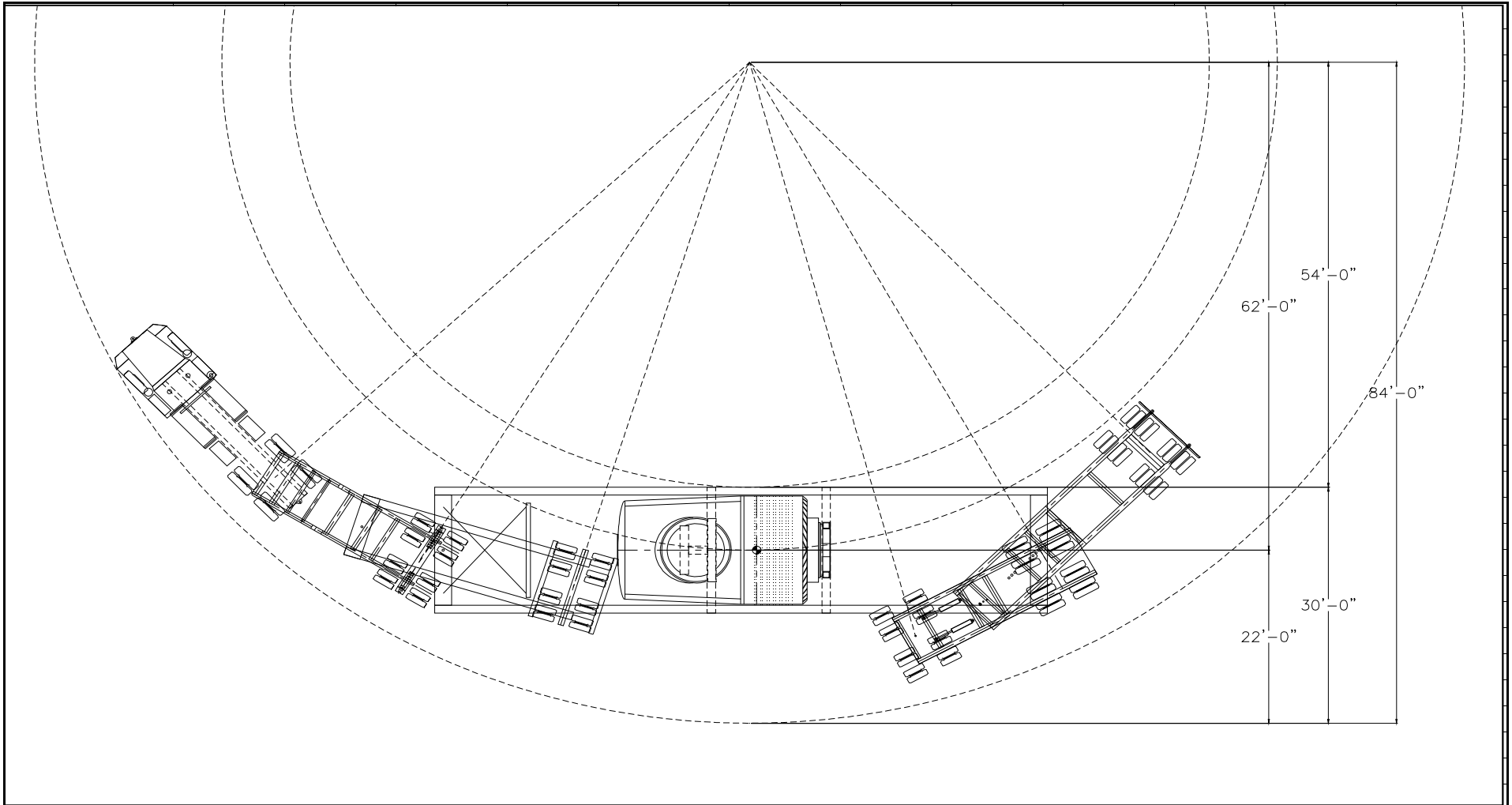


Peter Manstrom
Right of Way Specialist
Energy Transfer Partners
Dakota Access Pipeline, LP
peter.manstrom@energytransfer.com
PO Box 565
Watford City, ND 58854
Cell: 701.609.7189

Cc: C. Arey-ET/Long View
G. St. Onge-ET/Watford City
S. Scotto-ET/Montello
K. Schmidt-ET/Watford City
M. Luterbach-ET/Watford City
J. Mitchell-ET/Watford City



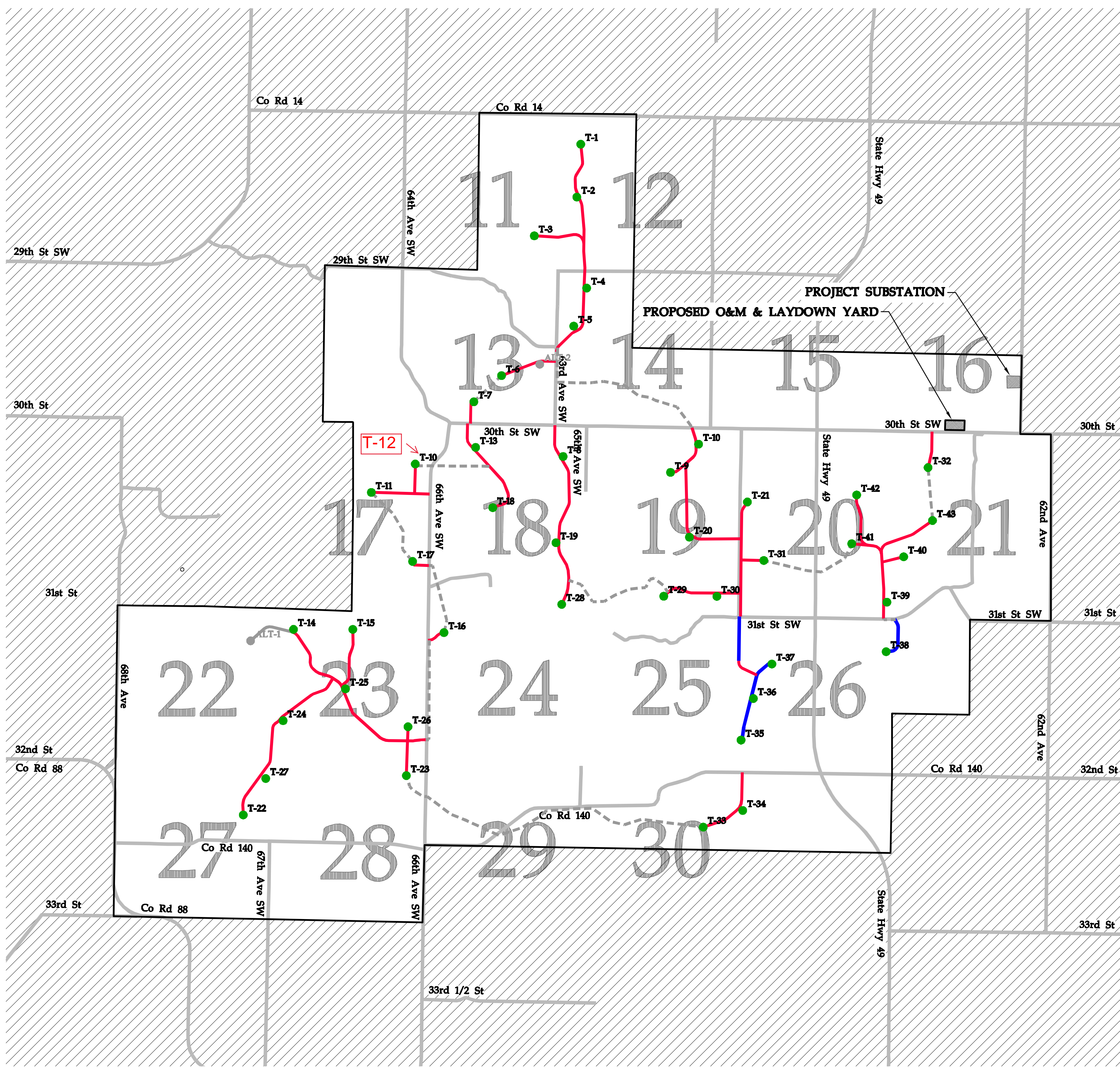
AXLE NO.		1	2-3	4-5	6-7	8-9	10-11	12-13	13 AXLE			
WIDTH (ft)		8	8	10	10	10	10	10	TOTAL			
EST LOAD (lbs)		13500	39100	49000	49500	49350	49250	48900	298600			
REQUESTED LOAD		14500	40000	50000	50000	50000	50000	50000	304500			
NO. OF TIRES		2	8	16	16	16	16	16	90			
EQUIPMENT WEIGHT												
TRACTOR	22000			DESCRIPTION				CONTRACTORS CARGO COMPANY				
JEEP	10000			ITEM				500 S. Alameda St.				
LOWBED	14400			FOR				Compton, CA 90224-5290				
DBL DOLLY	20000			WEIGHT				Phone	(310)609-1957	JOB NO.	C12-01-16	
TRIPLE DOLLY	12800			SIZE				Fax	(310)609-1767			
BEAMS	42340			ORIGIN				SCALE: NTS		REV 2.1	1/19/12	
TOTAL	121540	47000	DESTINAT	CENTER, ND				13 AXLE TRANSPORTER		ND-13AW-J134-1		



TURNING RADIUS OF 13 AXLE WITH REAR TILLERMAN STEERING			DESCRIPTION	CONTRACTORS CARGO COMPANY		
	ITEM		NACELLE NG2 TRAILER AW	500 S. Alameda St.		
	FOR		SIEMENS	Compton, CA 90224-5290		
	WEIGHT	177000 LB		Phone	(310)609-1957	
	SIZE	25'-0"L X 13'-9"W X 13'-10"H		Fax	(310)609-1767	
	ORIGIN	DULUTH, MN		SCALE: NTS		REV 2.1 1/19/12
	DESTINAT	CENTER, ND		13 AXLE TRANSPORTER	DWG NO.	ND-13AW-J134-2

LEGEND:

- TURBINE LOCATION
- XXX** TURBINE NUMBER
- ALTERNATE TURBINE LOCATION
- XXX** ALTERNATE TURBINE NUMBER
- EXISTING PTC ACCESS ROAD
- PROPOSED ACCESS ROAD
- ALTERNATE PROPOSED ACCESS ROAD
- - - - - PROPOSED CRANE PATH
- - - - - EXISTING ROAD
- OUTSIDE OF PROJECT BOUNDARY
- XX** SHEET NUMBER



ITEM	LENGTH
ACCESS ROAD	13.5 mi
CRANE PATH	7.6 mi
PTC ACCESS ROAD	1.1 mi

*ACCESS ROAD LENGTH INCLUDES SPUR ROADS

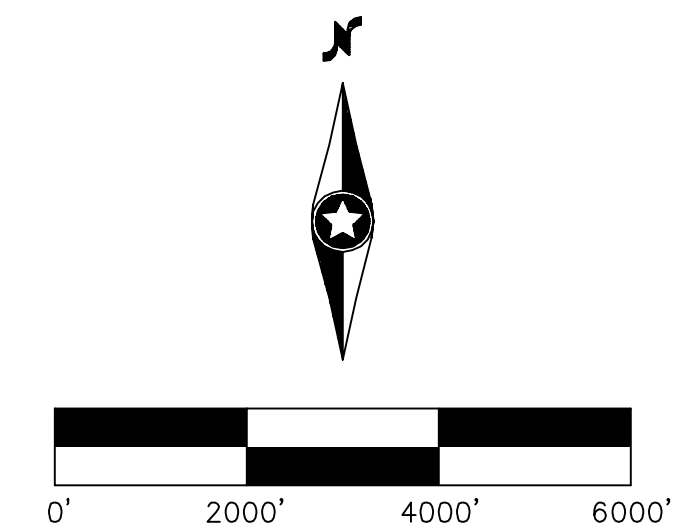
Designed: DJF
 Checked: DJF
 Drawn: SNK
 As-Built Drawing:

Revisions #	DATE	DESCRIPTION
A	08/22/18	30% CIVIL PLANS
B	09/19/18	30% CIVIL PLANS REVISED
C	09/26/18	ISSUED FOR PERMITTING
D	10/01/18	60% CIVIL PLANS

Prepared for:



2028 2nd Avenue NW
 West Fargo, ND 58078



Glen Ullin Energy Center
 Mercer and Morton Counties,
 North Dakota

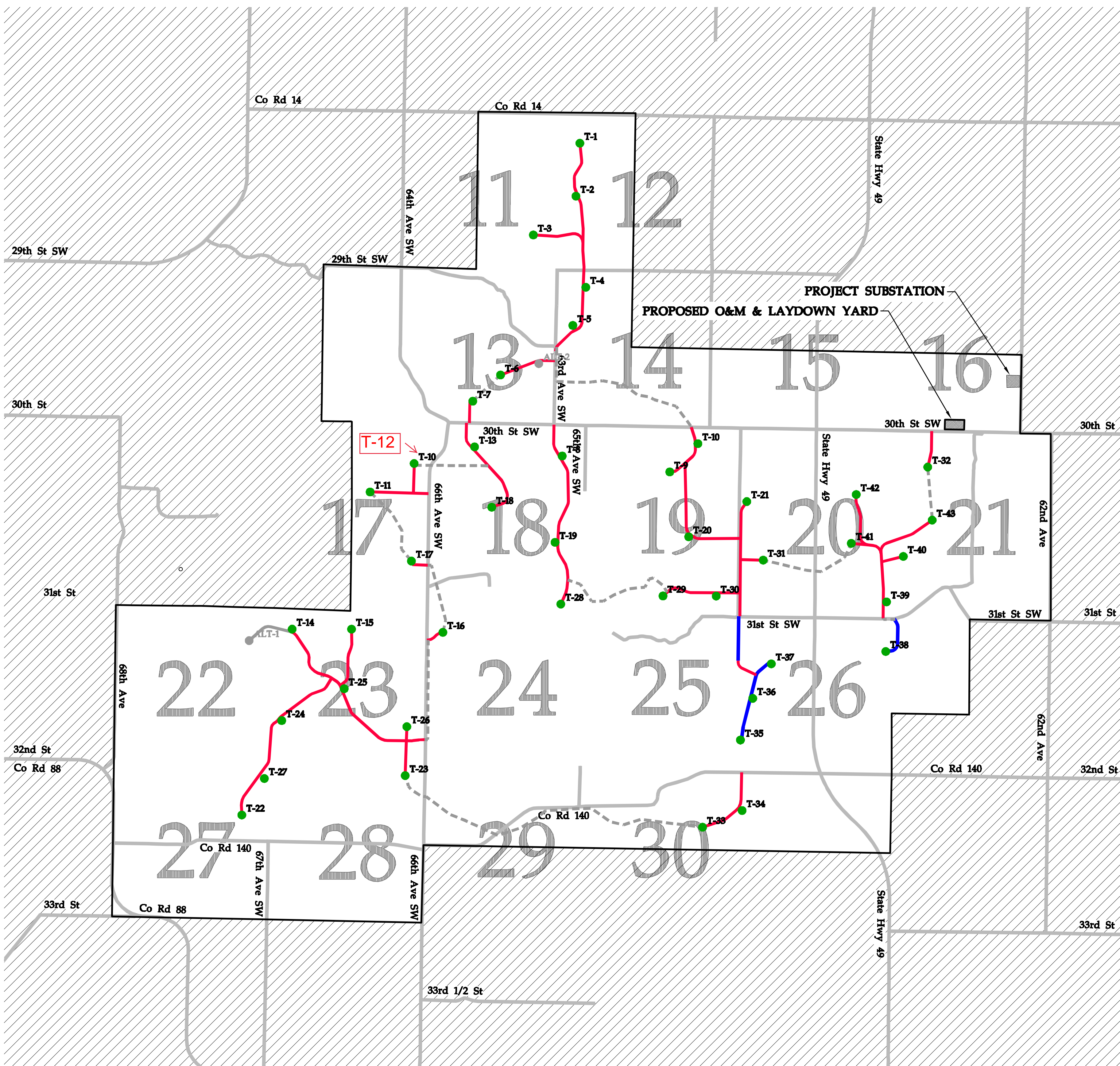
Overall Site Plan

60% Completion
 NOT FOR CONSTRUCTION

Date: 10/01/18
 Sheet: 2 OF 30

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- XXX** TURBINE NUMBER
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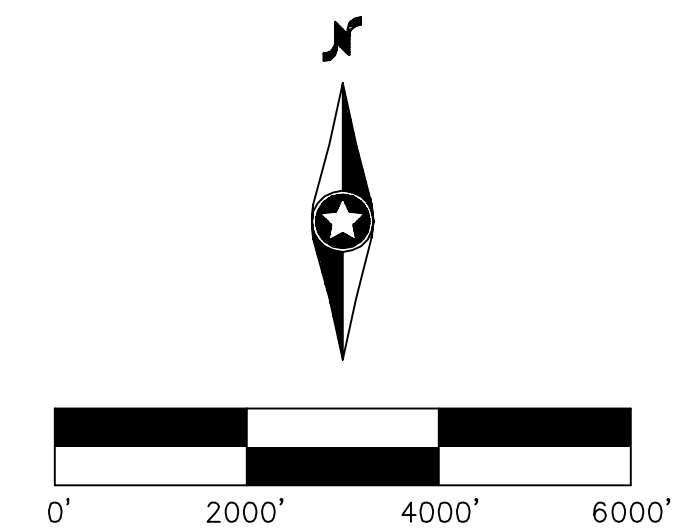
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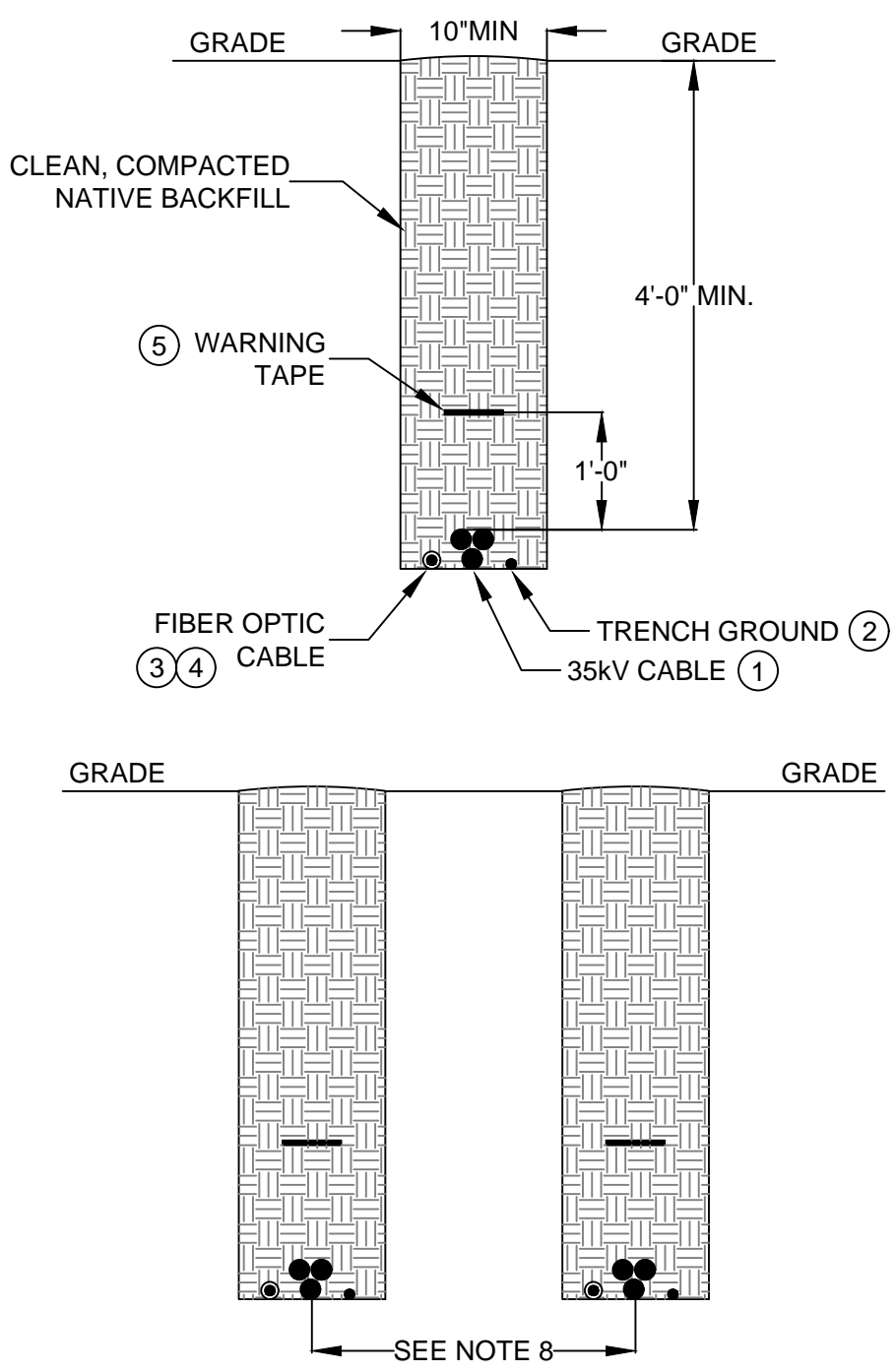


Glen Ullin Energy Center
 Mercer and Morton Counties,
 North Dakota

Overall Site Plan

60% Completion
 NOT FOR CONSTRUCTION

Date: 10/01/18
 Sheet: 2 OF 30



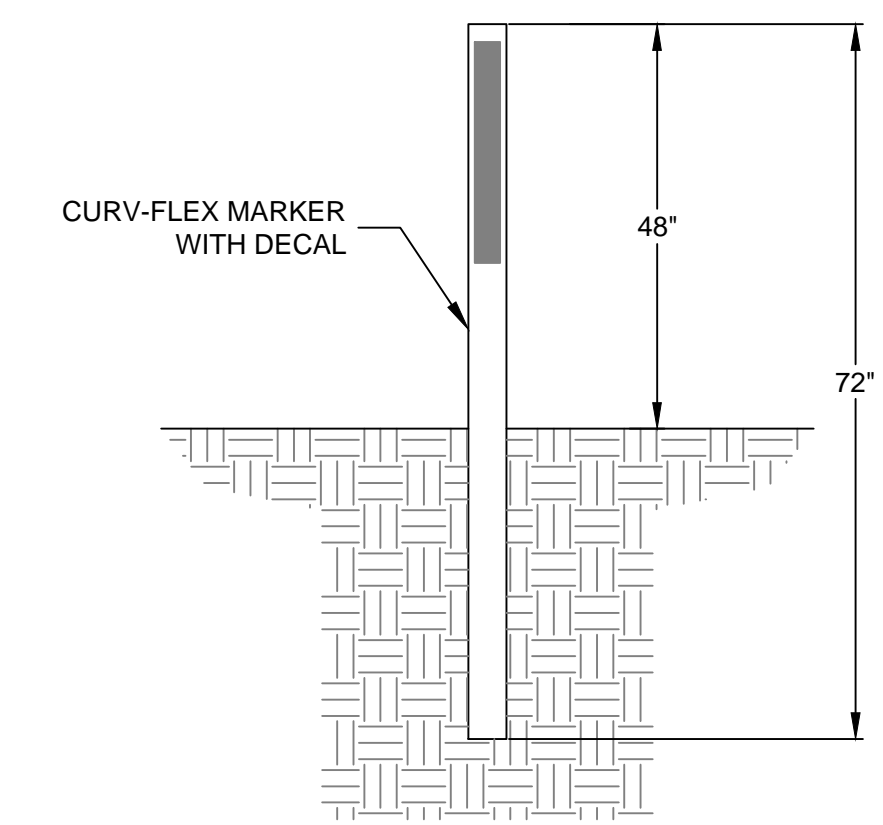
ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION
①	SEE ONE LINE	FT	1/0 AWG AL, 35KV, TRXLPE, 100% INSULATION, 6-#14 ROUND CONCENTRIC, XLPE JACKET
	SEE ONE LINE	FT	4/0 AWG AL, 35KV, TRXLPE, 100% INSULATION, 8-#14 ROUND CONCENTRIC, XLPE JACKET
	SEE ONE LINE	FT	500 MCM AL, 35KV, TRXLPE, 100% INSULATION, 9-#14 ROUND CONCENTRIC, XLPE JACKET
	SEE ONE LINE	FT	750 MCM AL, 35KV, TRXLPE, 100% INSULATION, 12-#14 ROUND CONCENTRIC, XLPE JACKET
	SEE ONE LINE	FT	1000 MCM AL, 35KV, TRXLPE, 100% INSULATION, 9-#14 ROUND CONCENTRIC, XLPE JACKET
②	SEE ONE LINE	FT	1250 MCM AL, 35KV, TRXLPE, 100% INSULATION, 14-#14 ROUND CONCENTRIC, XLPE JACKET
	SEE ONE LINE	FT	7-#8 COPPERCLAD STEEL (40% CONDUCTIVITY)
③	SEE ONE LINE	FT	12-STRAND SINGLE MODE FIBER
④	SEE ONE LINE	FT	FIBER INNERDUCT, 1.25", SDR 13.5
⑤	SEE ONE LINE	FT	6" CABLE WARNING TAPE, RED, DETECTABLE

- NOTES:**
- THE 35KV CABLE SHALL BE INSTALLED AND MAINTAIN A TREFOIL CONFIGURATION. CONTRACTOR SHALL USE CABLE TIES AS NEEDED TO ENSURE TREFOIL FORMATION OF CABLE.
 - FIBER OPTIC CABLE AND/OR DUCT SHALL NOT CONTAIN ANY METAL COMPONENT IF TRENCHED JOINTLY WITH POWER CABLE.
 - IF NOTES 1 & 2 ARE MET, THE FIBER CABLE, TRENCH GROUND, AND 35KV CABLES DO NOT REQUIRE DELIBERATE SEPARATION WHEN FIBER OPTIC CABLE IS IN INNERDUCT.
 - TRENCHING IN OF CABLE IN SOIL CONTAINING ROCK OR OTHER SOLID MATERIAL SHOULD BE DONE IN SUCH A MANNER THAT THE SOLID MATERIAL SHALL NOT DAMAGE THE CABLE, EITHER DURING THE TRENCHING OPERATION, BACKFILLING, OR AFTERWARD.
 - THE DESIGN OF THE CABLE TRENCHING EQUIPMENT AND THE TRENCHING IN OPERATION SHOULD BE SUCH THAT THE CABLE SHALL NOT BE DAMAGED BY BENDING, SIDEWALL PRESSURE, OR EXCESSIVE CABLE TENSION.
 - PROPER CARE SHALL BE TAKEN TO PROTECT THE CABLES FROM DAMAGE DUE TO DEBRIS IN THE TRENCH. INSPECT THE SPOIL PILE AND THE BOTTOM OF TRENCH FOR ROCK AND DEBRIS AND REMOVE ANY LARGE/SHARP ROCKS AND/OR LARGE/SHARP DEBRIS THAT MAY CAUSE DAMAGE TO THE CABLE.
 - ANY DRAIN TILE DAMAGED, DISTURBED, BROKEN, OR CUT BY THE TRENCHING OPERATION SHALL BE REPAIRED AND LOCATED BY GPS.
 - A MINIMUM SEPARATION OF 15 FEET IS REQUIRED BETWEEN PARALLEL TRENCH RUNS EXCEPT WHERE NOTED ELSEWHERE ON THE DRAWINGS. PARALLEL BORES SHALL MAINTAIN A MINIMUM OF 20 FEET OF SEPARATION.
 - STRIP, STOCKPILE, AND REPLACE TOPSOIL IF REQUIRED BY LANDOWNER. DO NOT MIX TOPSOIL WITH SUB SOIL.
 - COMPACT TRENCH SOIL TO 85% STANDARD PROCTOR DENSITY.
 - ONLY ONE FIBER RUN SHOWN, SOME RUNS REQUIRE MULTIPLE FIBER RUNS. SEE FIBER ONE LINE DIAGRAMS.

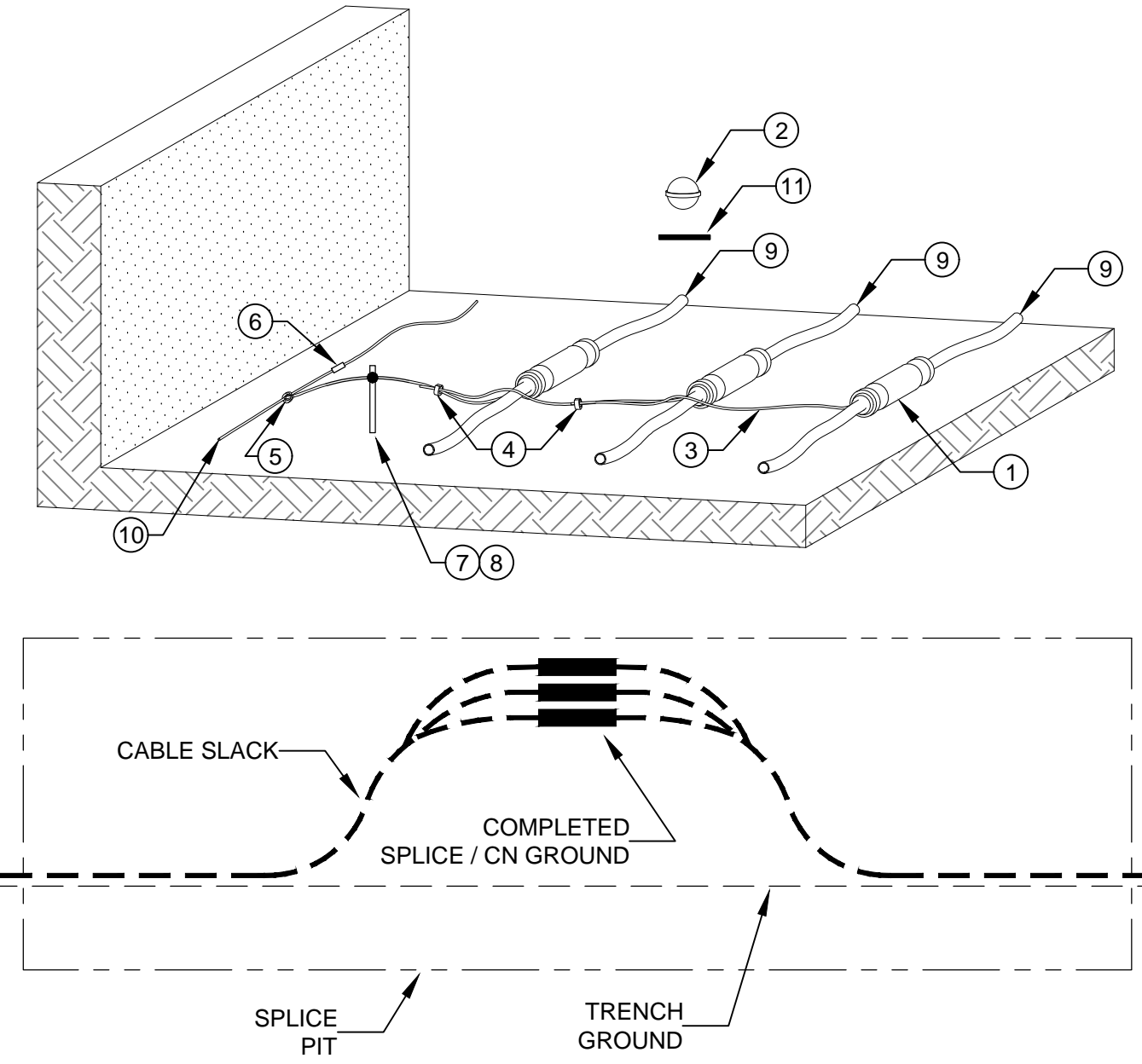
① CABLE TRENCH DETAIL
NOT TO SCALE



- NOTES:**
- INSTALL CABLE ROUTE MARKERS AT ALL ROAD CROSSINGS, WETLAND/STREAM CROSSINGS, PROPERTY LINE CROSSINGS, AND AT CHANGES IN DIRECTION.
 - COORDINATE DECAL INFORMATION WITH THE OWNER.
 - MARKER BALLS SHALL BE REQUIRED AT ALL CROSSING LOCATIONS AND ALL CHANGES IN DIRECTION.



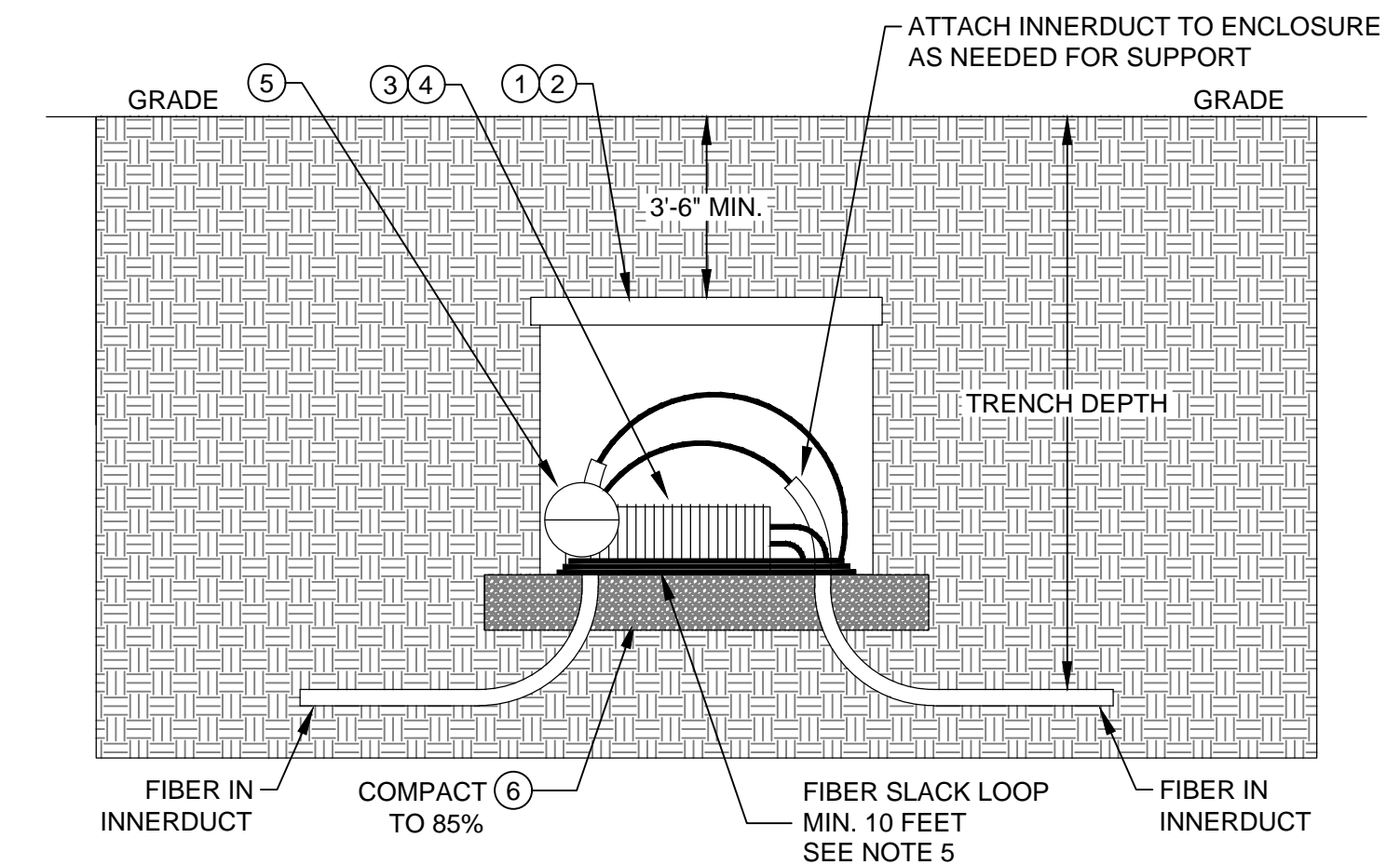
② CABLE MARKER DETAIL
NOT TO SCALE



ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION	MANUFACTURER (OR EQUAL)	PART NUMBER (OR EQUAL)
①	3	EA	CABLE SPLICE KIT, 35KV, 1/0 AWG AL	3M	5467A(S)-9-AL
	3	EA	CABLE SPLICE KIT, 35KV, 4/0 AWG AL	3M	5467A-12-AL
	3	EA	CABLE SPLICE KIT, 35KV, 500 MCM AL	3M	5468A-17-AL
	3	EA	CABLE SPLICE KIT, 35KV, 750 MCM AL	3M	5468A-18-AL
	3	EA	CABLE SPLICE KIT, 35KV, 1000 MCM AL	3M	5468A(L)-19-AL
	3	EA	CABLE SPLICE KIT, 35KV, 1250 MCM AL	3M	5468A(L)-20-AL
②	1	EA	EMS BALL MARKER	3M	80611161144
③	15	FT	#2 SOLID BARE COPPER	SOUTHWIRE	----
④	2	EA	CONNECTOR, #2 CU TO #2 CU	BURNDY	YGHC2C2
⑤	1	EA	CONNECTOR, #2 CU TO TRENCH GROUND	BURNDY	YGHC26C2
⑥	1	EA	TRENCH GROUND TO TRENCH GROUND	BURNDY	YGHC26C26
⑦	1	EA	CONNECTOR, #2 CU TO GROUND ROD	BURNDY	YGHC26C2
⑧	1	EA	5/8" X 10' COPPERBONDED GROUND ROD	ERITECH	615803
⑨	----	----	35KV CABLE	WTEC	----
⑩	----	----	TRENCH GROUND	WTEC	----
⑪	----	----	6" CABLE WARNING TAPE, RED, DETECTABLE	3M	----

- NOTES:**
- CABLES TO BE LAID SLACK IN HORIZONTAL ARRANGEMENT WITH A MINIMUM OF 7.5 INCHES OF SEPARATION.
 - SEAL #2 SOLID BARE COPPER WITHIN SPLICE (IN MASTIC) BEFORE INSTALLING COLD SHRINK COVER.
 - GPS LOCATES SHALL BE TAKEN AT ALL UNDERGROUND CABLE SPLICE LOCATIONS WITH A 3 METER ACCURACY.
 - PLACE MARKER BALL 24-30 INCHES BELOW SURFACE.
 - SPLICE KITS SHALL BE INSTALLED PER THE MANUFACTURER'S INSTRUCTIONS BY QUALIFIED PERSONNEL.
 - WARNING TAPE SHALL BE PLACED ABOVE CABLES.
 - FIBER OPTIC DUCT SHALL BE PLACED NEAR TRENCH GROUND, FIBER DUCT NOT SHOWN FOR CLARITY.
 - SPLICE KIT MANUFACTURER TO INCLUDE CONCENTRIC TO CONCENTRIC CONNECTOR AND CONCENTRIC TO #2 SOLID BARE COPPER CONNECTOR.
 - COMPACT SPLICE PIT TO 85% STANDARD PROCTOR DENSITY OR BETTER WHEN INSTALLATION IS COMPLETE.
 - GROUND ROD MUST GO AT LEAST 8 FEET INTO UNDISTURBED SOIL. IF DENSE SOIL OR ROCK IS ENCOUNTERED DURING VERTICAL GROUND ROD INSTALLATION THEN CONTRACTOR MAY INSTALL GROUND ROD AT 45 DEGREE ANGLE. IF GROUND ROD IS STILL UNABLE TO BE INSTALLED THEN CONTRACTOR MAY INSTALL HORIZONTALLY INTO EXCAVATION WALL OR LAY GROUND ROD WITHIN TRENCH.
 - SUPPLY ENOUGH CABLE SLACK WITHIN THE SPLICE PIT THAT PROVIDES FOR UP TO TWO FUTURE TERMINATIONS.

③ CABLE SPLICE DETAIL
NOT TO SCALE



ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION	MANUFACTURER (OR EQUAL)	PART NUMBER (OR EQUAL)
①	1	EA	HANDHOLE ENCLOSURE	QUAZITE	PG2436BG30
②	1	EA	HANDHOLE ENCLOSURE COVER	QUAZITE	PG2436HG00
③	1	EA	SPLICE CLOSURE	PLP	8006671
④	1	EA	SPLICE TRAY	PLP	80806033
⑤	1	EA	EMS BALL MARKER	3M	80611161144
⑥	AS REQ'D	YD	PEA GRAVEL (6" THICK)	----	----

- NOTES:**
- GPS LOCATES SHALL BE TAKEN AT ALL FIBER SPLICE LOCATIONS.
 - VERIFY HANDHOLE ENCLOSURE LOCATION WITH OWNER PRIOR TO INSTALLATION.
 - INSTALL HANDHOLE ENCLOSURE AND FIBER SPLICES PER MANUFACTURER'S INSTRUCTIONS.
 - FIBER SPLICE HANDHOLE ENCLOSURE SHALL BE BURIED AT TRENCH DEPTH (3-6") IF NOT LOCATED NEAR A WIND TURBINE, ROAD, OR JUNCTION BOX.
 - THE LONG TERM MINIMUM BENDING RADIUS SHALL BE 10X THE OUTER DIAMETER UNLESS OTHERWISE SPECIFIED BY THE MANUFACTURER.
 - MARKER BALL CAN BE PLACED IN OR ABOVE ENCLOSURE. MARKER BALL DEPTH SHALL BE 24 TO 36 INCHES BELOW GRADE.
 - SEAL CONDUITS WITH A CLOSED CELL FOAM AROUND CABLES AFTER INSTALLATION.

④ FIBER SPLICE HANDHOLE ENCLOSURE DETAIL
NOT TO SCALE

Rev.	Date	Description	By
A	12/10/2018	90% SUBMITTAL	CM



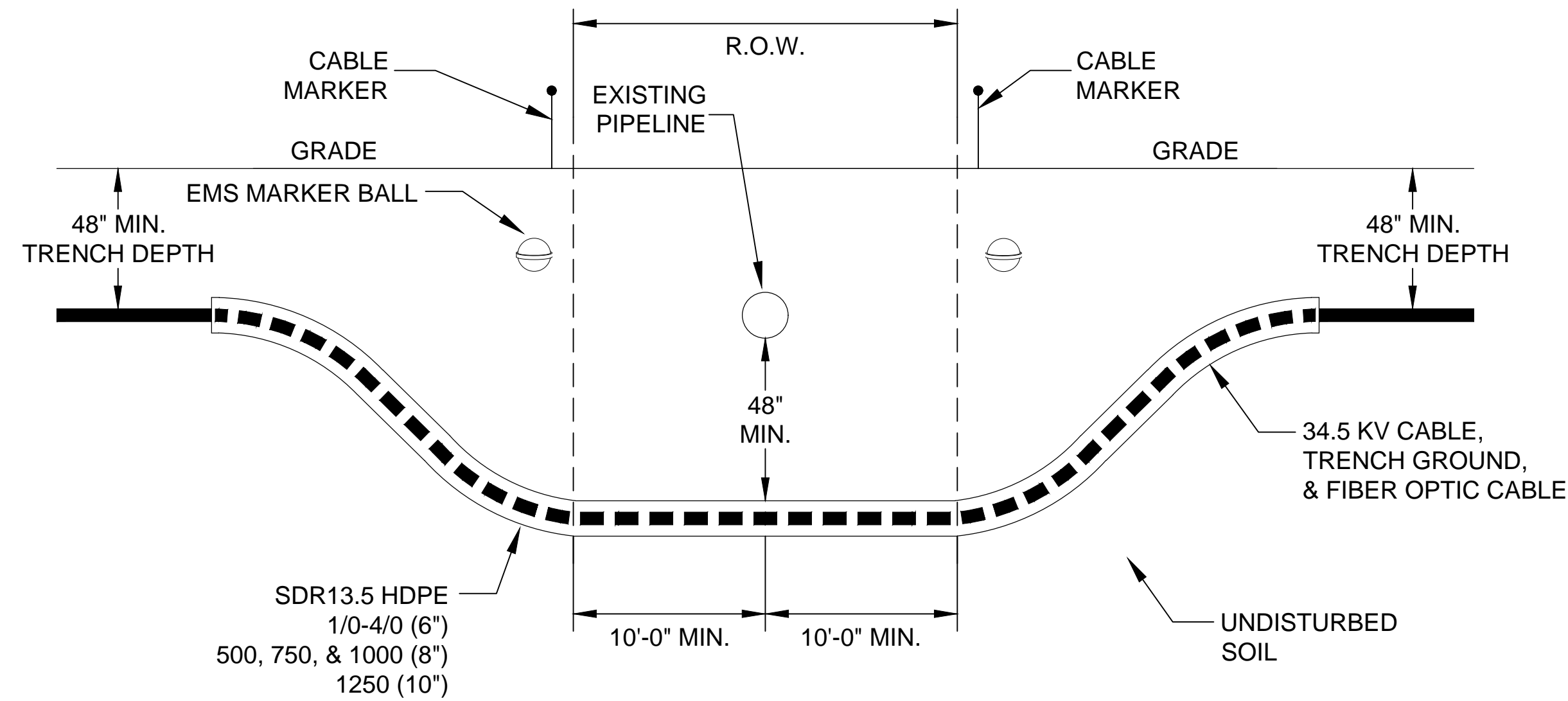
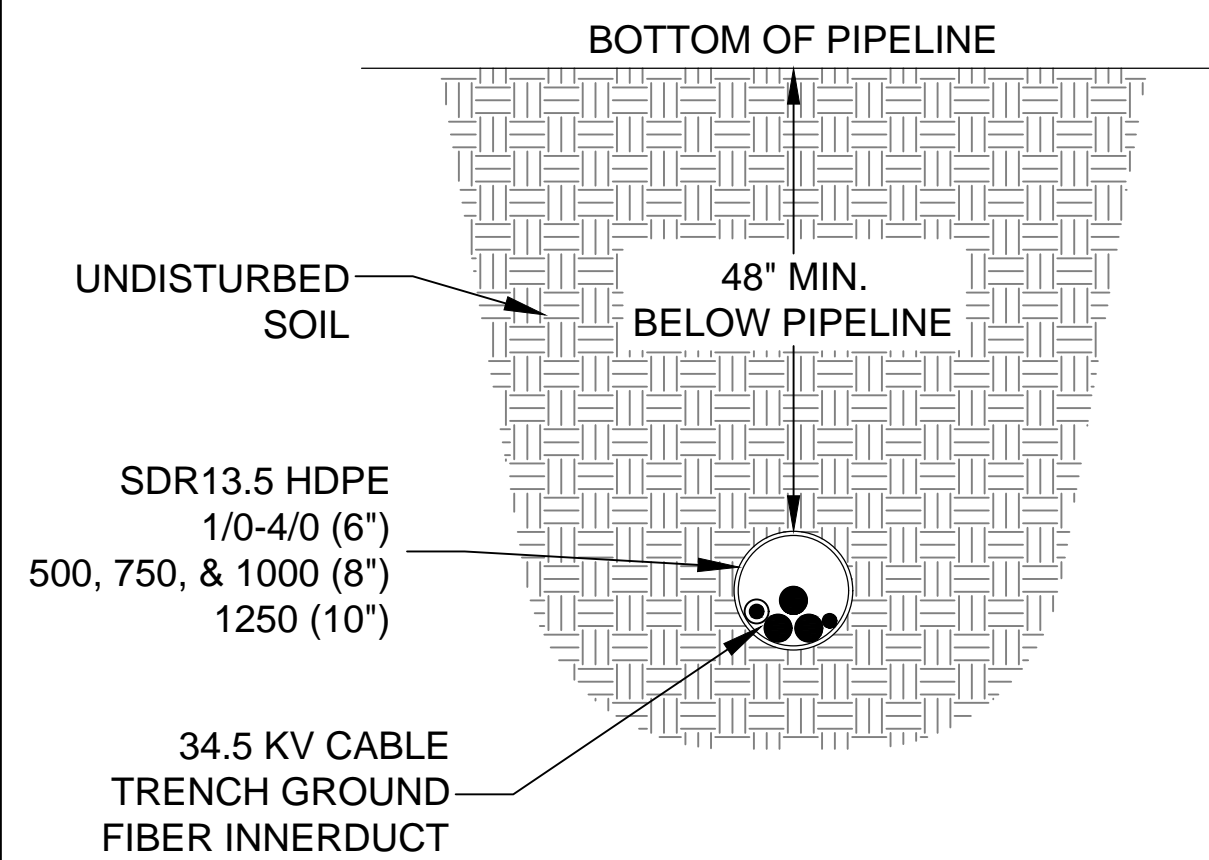
PRELIMINARY
NOT FOR CONSTRUCTION

Ulteig
3350 38th Avenue South
 Fargo, North Dakota 58104
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 Fax: 701.237.3191
 www.ulteig.com

We listen. We solve.[™]
Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul
Design By: J. HERMANSON
Drawn By: M. JENSON
Approved By: C. MATHSON
Project Number: 17.00706

**COLLECTION SYSTEM
CABLE INSTALLATION
DETAILS**

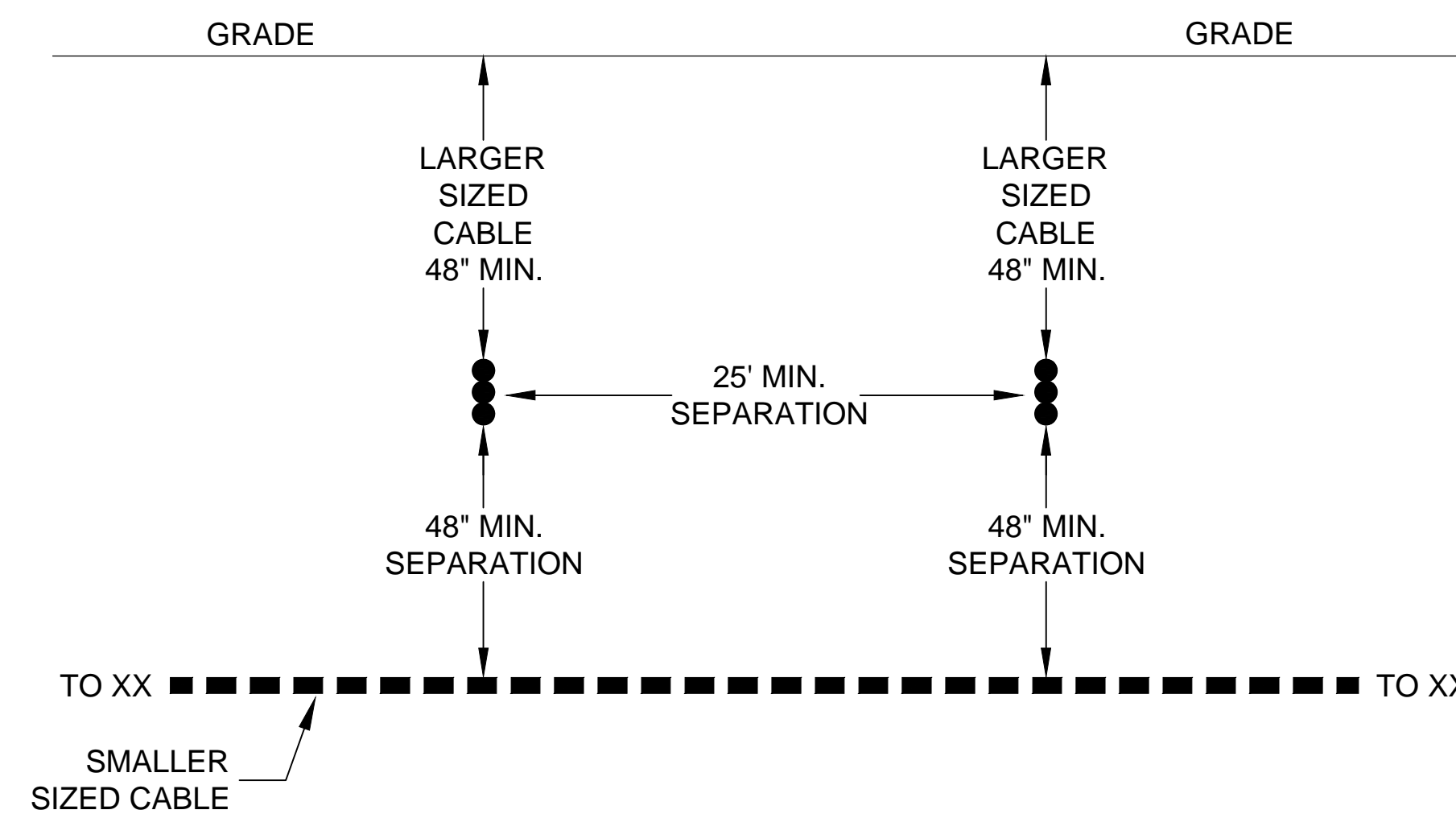
Rev.	Date	Description	By
A	12/10/2018	90% SUBMITTAL	CM



1 PIPELINE CROSSING DETAIL
NOT TO SCALE

NOTES:

- DO NOT EXCEED THE MINIMUM BENDING RADIUS OF THE CABLE.
- TYPICAL PIPELINE CROSSING SHOWN.
- CROSSINGS SHALL BE MADE AS CLOSE TO A 90° ANGLE TO THE PIPELINE AS POSSIBLE.
- ALL CROSSINGS SHALL BE A MINIMUM OF 48 INCHES BELOW BOTTOM OF PIPELINE.
- PARALLEL BORE SEPARATION SHALL BE A MINIMUM OF 20 FEET.
- BORE ENTIRE RIGHT-OF-WAY.
- BORE PITS MUST BE LOCATED OUTSIDE R/W EDGE OR 10 FEET FROM PIPELINE WHICHEVER IS GREATER.
- PLACE CABLE MARKER AT EDGE OF RIGHT-OF-WAY. SEE CABLE MARKER DETAIL.
- REAM OR CHAMFER BORE PIPE ENDS.
- GPS COORDINATES SHALL BE RECORDED.
- PIPELINE REPRESENTATIVE SHALL BE PRESENT WHILE THE EXCAVATION IS TAKING PLACE IF REQUIRED.
- VERIFY CROSSING AGREEMENT REQUIREMENTS OF THE PIPELINE WITH OWNER AND APPROVED PERMIT.
- USE PROPER PULLING LUBRICANT DURING CABLE INSTALLATION.



2 CABLE CROSSING DETAIL
NOT TO SCALE

NOTES:

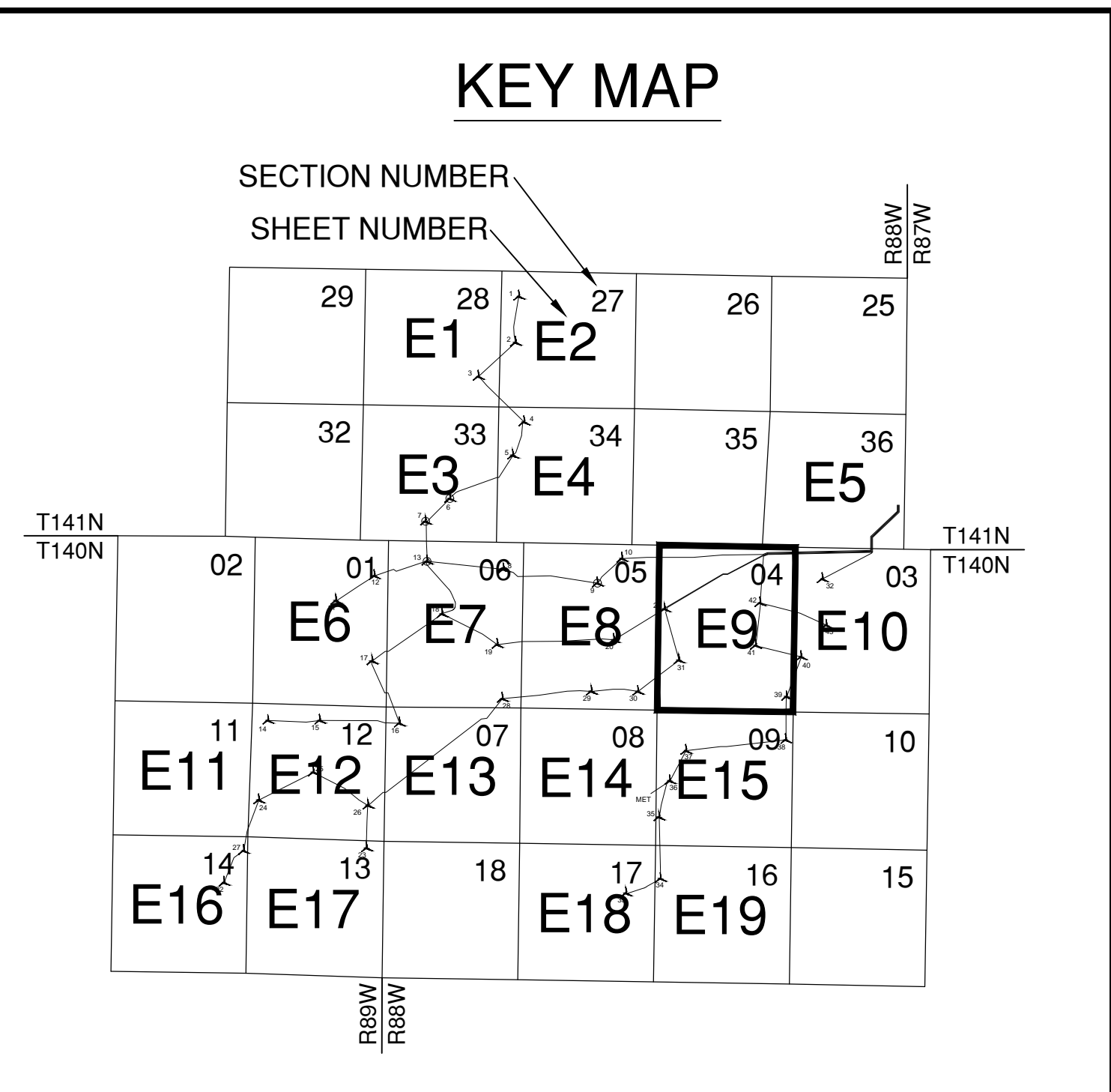
- LARGER SIZED CABLE IS PLACED ABOVE SMALLER SIZED CABLE.
- NOT ALL CABLE RUNS ARE SHOWN FOR CLARITY.
- VERTICAL CABLE INSTALLATION SHOWN. SOME CABLE RUNS REQUIRE TREFOIL FORMATION. SEE ONE LINE FOR MORE DETAILS.

PRELIMINARY
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Bismarck - Denver - Detroit Lakes - Fargo - Sioux Falls - St. Paul
Design By: J. HERMANSON
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COLLECTION SYSTEM
CABLE CROSSING
DETAILS



GLEN ULLIN ENERGY CENTER

GLEN ULLIN, NORTH DAKOTA

Rev.	Date	Description	By
A	12/10/2018	90% SUBMITTAL	CM

a MasTec company

PRELIMINARY

NOT FOR CONSTRUCTION

- GENERAL NOTES:**
- CALL FOR LOCATES PRIOR TO CONSTRUCTION.
 - DO NOT PLACE JUNCTION BOXES IN LOW AREAS THAT MAY FLOOD OR COLLECT WATER. COORDINATE JUNCTION BOX LOCATIONS WITH OWNER.

LEGEND

XX	⚙	WIND TURBINE GE 2.3 MW
XX	⚙	WIND TURBINE GE 2.5 MW
— F1 —		FEEDER 1
— F2 —		FEEDER 2
— F3 —		FEEDER 3
— F4 —		FEEDER 4
— PIPELINE —		PIPELINE
●		MET TOWER
[XJBX]		JUNCTION BOX
— XXX —		BORE WITH ID (XXX)
—		ACCESS ROAD

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COLLECTION SYSTEM FEEDER ROUTING DIAGRAMS SECTION 04, T140N, R88W

CYMCAP Version	7.3 Revision 01
Study:	Glen Ullin Cable Ampacity
Execution:	TRENCH - 1250 MCM

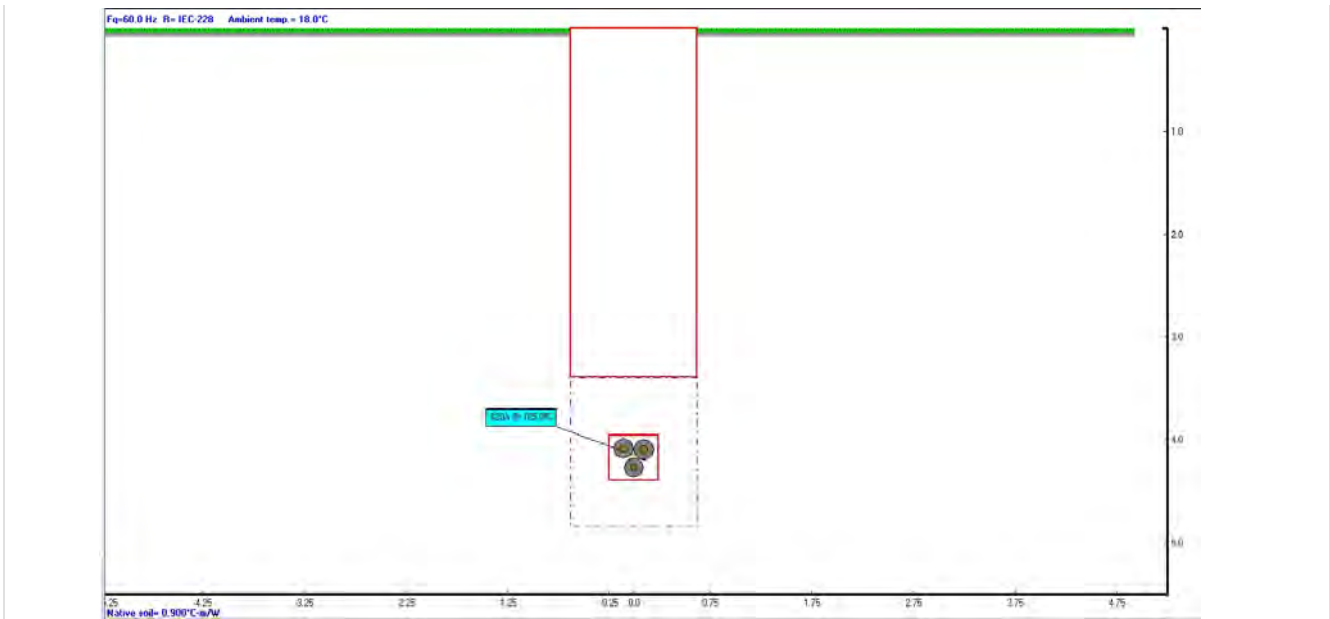
General Simulation Data

Steady State Option	Unequally Loaded
Conductor Resistances Computation Option:	IEC-228

Installation Type: Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	18.0
Native Soil Thermal Resistivity	[K.m/W]	0.9

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	0.0	4.125	1.25	1.45	2.47
Backfill	0.0	1.7	1.25	3.4	2.1



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	GLEN ULLIN 1250	1		A	60.0	1.0	-0.1	4.09	104.9	620.0
2	GLEN ULLIN 1250	1		B	60.0	1.0	0.1	4.09	104.9	620.0
3	GLEN ULLIN 1250	1		C	60.0	1.0	0.0	4.27	105.0	620.0

CYMCAP Version	7.3 Revision 01
Study:	Glen Ullin Cable Ampacity
Execution:	BORE - 1250 MCM

General Simulation Data

Steady State Option	Unequally Loaded
Conductor Resistances Computation Option:	IEC-228

Installation Type: Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	15.0
Native Soil Thermal Resistivity	[K.m/W]	0.9

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	0.0	10.675	1.8	1.75	2.13



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	GLEN ULLIN 1250	1		A	60.0	1.0	-0.1	10.71	105.0	603.5
2	GLEN ULLIN 1250	1		B	60.0	1.0	0.1	10.71	105.0	603.5
3	GLEN ULLIN 1250	1		C	60.0	1.0	0.0	10.53	104.7	603.5

CYMCAP Version	7.3 Revision 01
Study:	Glen Ullin Cable Ampacity
Execution:	PARALLEL TRENCH

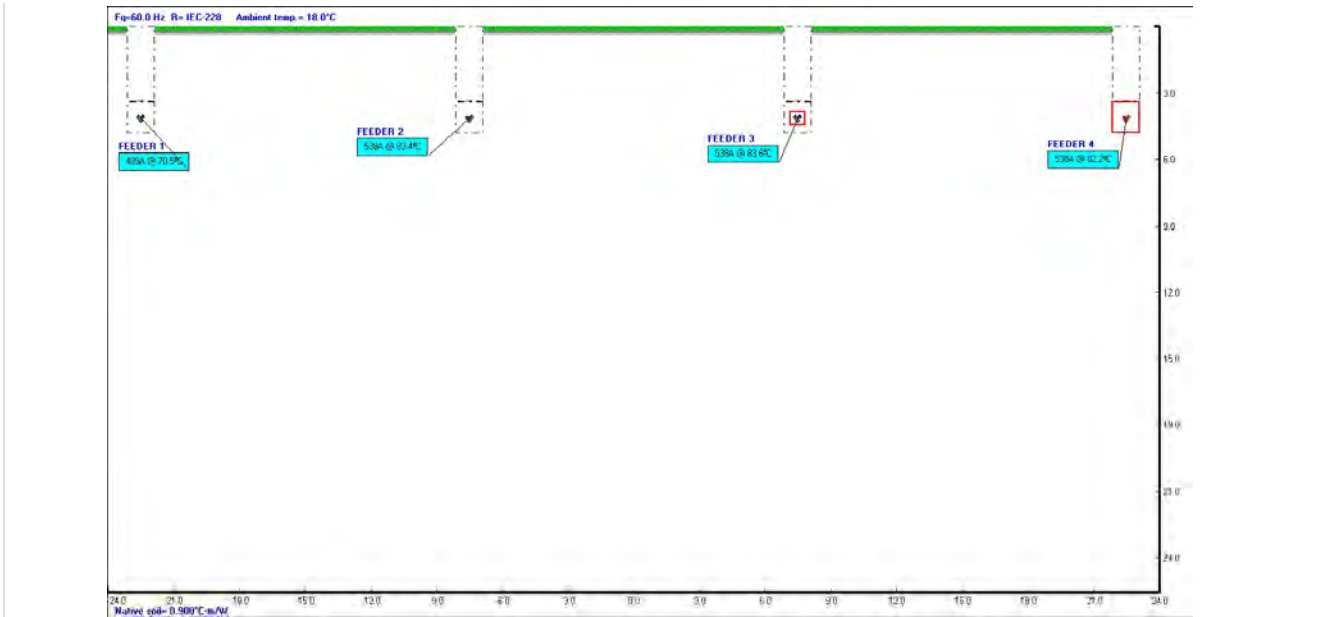
General Simulation Data

Steady State Option	Temperature
Conductor Resistances Computation Option:	IEC-228

Installation Type: Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	18.0
Native Soil Thermal Resistivity	[K.m/W]	0.9

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	-22.5	4.125	1.25	1.45	2.47
Backfill8	22.5	1.7	1.25	3.4	2.1
Backfill7	22.5	4.125	1.25	1.45	2.47
Backfill6	7.5	1.7	1.25	3.4	2.1
Backfill5	7.5	4.125	1.25	1.45	2.47
Backfill4	-7.5	1.7	1.25	3.4	2.1
Backfill3	-7.5	4.125	1.25	1.45	2.47
Backfill	-22.5	1.7	1.25	3.4	2.1



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	GLEN ULLIN 1250	1	FEEDER 1	A	60.0	1.0	-22.6	4.09	70.5	489.3
2	GLEN ULLIN 1250	1	FEEDER 1	B	60.0	1.0	-22.4	4.09	70.5	489.3
3	GLEN ULLIN 1250	1	FEEDER 1	C	60.0	1.0	-22.5	4.27	70.5	489.3
4	GLEN ULLIN 1250	2	FEEDER 2	A	60.0	1.0	-7.6	4.09	83.3	538.2
5	GLEN ULLIN 1250	2	FEEDER 2	B	60.0	1.0	-7.4	4.09	83.3	538.2
6	GLEN ULLIN 1250	2	FEEDER 2	C	60.0	1.0	-7.5	4.27	83.4	538.2

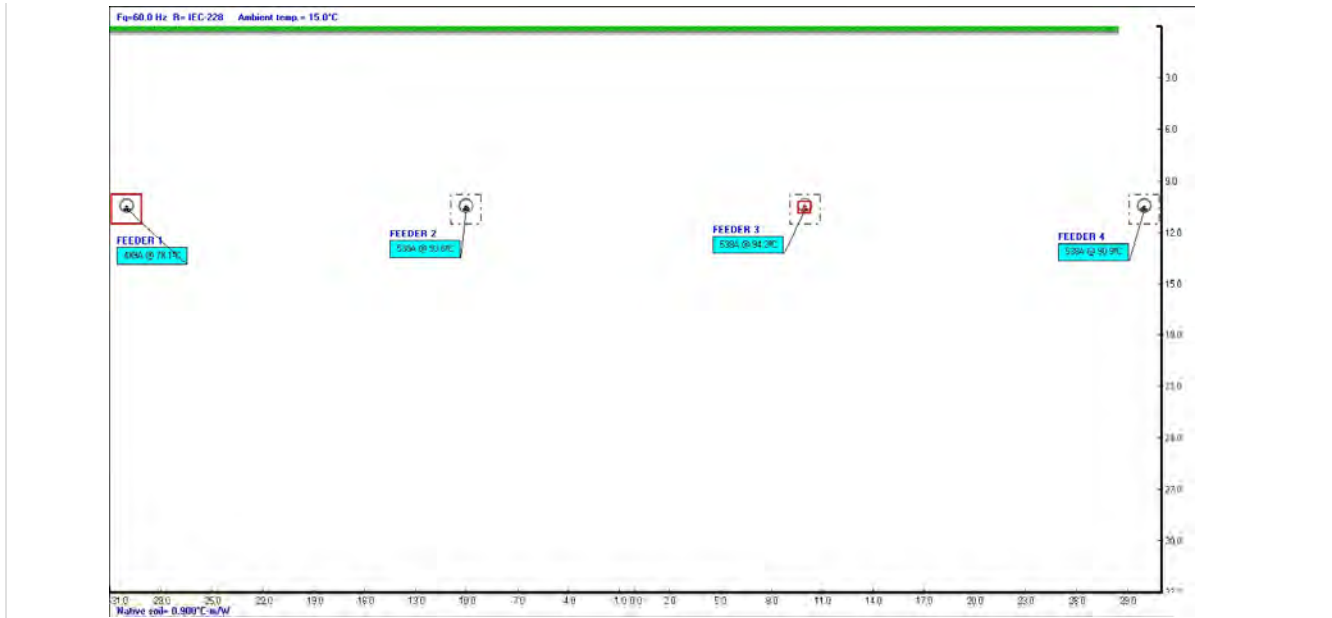
7	GLEN ULLIN 1250	3	FEEDER 3	A	60.0	1.0	7.4	4.09	83.5	538.2
8	GLEN ULLIN 1250	3	FEEDER 3	B	60.0	1.0	7.6	4.09	83.5	538.2
9	GLEN ULLIN 1250	3	FEEDER 3	C	60.0	1.0	7.5	4.27	83.6	538.2
10	GLEN ULLIN 1250	4	FEEDER 4	A	60.0	1.0	22.4	4.09	82.1	538.2
11	GLEN ULLIN 1250	4	FEEDER 4	B	60.0	1.0	22.6	4.09	82.1	538.2
12	GLEN ULLIN 1250	4	FEEDER 4	C	60.0	1.0	22.5	4.27	82.2	538.2

CYMCAP Version	7.3 Revision 01
Study:	Glen Ullin Cable Ampacity
Execution:	PARALLEL BORE

General Simulation Data	
Steady State Option	Temperature
Conductor Resistances Computation Option:	IEC-228

Installation Type: Multiple Ductbanks/Backfills		
Ambient Soil Temperature at Installation Depth	[°C]	15.0
Native Soil Thermal Resistivity	[K.m/W]	0.9

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	-30.0	10.675	1.8	1.75	2.13
Backfill4	30.0	10.675	1.8	1.75	2.13
Backfill3	10.0	10.675	1.8	1.75	2.13
Backfill2	-10.0	10.675	1.8	1.75	2.13



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	GLEN ULLIN 1250	1	FEEDER 1	A	60.0	1.0	-30.1	10.71	78.1	489.3
2	GLEN ULLIN 1250	1	FEEDER 1	B	60.0	1.0	-29.9	10.71	78.1	489.3
3	GLEN ULLIN 1250	1	FEEDER 1	C	60.0	1.0	-30.0	10.53	77.9	489.3
4	GLEN ULLIN 1250	2	FEEDER 2	A	60.0	1.0	-10.1	10.71	93.6	538.2
5	GLEN ULLIN 1250	2	FEEDER 2	B	60.0	1.0	-9.9	10.71	93.6	538.2
6	GLEN ULLIN 1250	2	FEEDER 2	C	60.0	1.0	-10.0	10.53	93.4	538.2
7	GLEN ULLIN 1250	3	FEEDER 3	A	60.0	1.0	9.9	10.71	94.2	538.2
8	GLEN ULLIN 1250	3	FEEDER 3	B	60.0	1.0	10.1	10.71	94.2	538.2
9	GLEN ULLIN 1250	3	FEEDER 3	C	60.0	1.0	10.0	10.53	94.0	538.2

10	GLEN ULLIN 1250	4	FEEDER 4	A	60.0	1.0	29.9	10.71	90.9	538.2
11	GLEN ULLIN 1250	4	FEEDER 4	B	60.0	1.0	30.1	10.71	90.9	538.2
12	GLEN ULLIN 1250	4	FEEDER 4	C	60.0	1.0	30.0	10.53	90.7	538.2

Thermal Resistivity Report ASTM D:5334

Project: **Ace Wind**

Job #: **10198**

Client: **Barr Engineering Company**

Date: **1/28/16**

Boring	Specimen Type	Depth	Type	Classification	Initial Conditions			Dry
					Dry Density (PCF)	WC (%)	Thermal Resistivity (°C-cm/W)	Thermal Resistivity (°C-cm/W)
S114	Reconstituted		Bulk	Lean Clay with sand (CL)	97.9	15.8%	66	140
S131	Reconstituted		Bulk	Silty Sand (SM)	103.8	12.9%	59	152
S141	Reconstituted		Bulk	Lean Clay with sand (CL)	99.1	15.4%	73	153
U162	Reconstituted		Bulk	Silty Sand with gravel (SM)	104.4	13.1%	78	213
	Specimens reconstituted to approximately 90% of maximum standard proctor density near optimum moisture content.							

2401 West 66th Street



Richfield, MN 55423

<http://www.soilengineeringtesting.com>

Grove Manitowoc National Crane Potain



Grove RT9130E

Product Guide



Features

- 120 t (130 USt) capacity
- 12,8 m - 48,8 m (42 ft - 160 ft) five-section, full power boom
- 11 m -18 m (36 ft - 59 ft) offsettable bi-fold swingaway extension
- 8 m (26 ft) extension inserts
- Grove MEGAFORM™ boom
- Cummins 224 kW (300 hp) Tier III, diesel engine
- Grove "E" series cab

Features



Extensions

A 18 m (59 ft) offsettable bi-fold lattice swingaway extension and two 8 m (26 ft) inserts give the RT9130E a maximum tip height of 85 m (279 ft). A hydraulically offsettable bi-fold lattice swingaway is also available, and conveniently offsets from 0° to 40° from the operator's cab.



Cab

The "E" Series cab on the RT9130E tilts up to 20° providing the operator additional comfort when working at long boom and extension lengths.

Removable outrigger boxes

Removable front and rear outrigger boxes provide up to 8788 kg (19,374 lb) of weight reduction for easier transport. Include the removable 18 100 kg (40,000 lb) of counterweight, auxiliary hoist and rope, and the RT9130E can easily self-remove close to 29 000 kg (64,000 lb).



Boom

The 48,8 m (160 ft) five-section Full Power boom incorporates the "U" shaped MEGAFORM™ design, which eliminates stiffeners, thus reducing weight and increasing capacity.

Contents

Specifications	4
Dimensions and weights	7
Working range	8
Load charts	9
Working range with inserts	13
Load chart with inserts	14
Working range - luffing	16
Load charts - luffing extension	18
Load handling	25
Notes	26



Specifications

Superstructure

Boom

12,8 m - 48,8 m (42 ft - 160 ft) five-section, sequenced synchronized full power boom. Maximum tip height: 51,5 m (169 ft)

Lattice extension

11 m - 18 m (36 ft - 59 ft) offsettable bifold lattice swingaway extension. Offsets 0°, 20° and 40°. Stows alongside base boom section. Maximum tip height: 69,2 m (227 ft)

* Optional lattice extension

11 m - 18 m (36 ft - 59 ft) hydraulically offsettable bifold lattice swingaway extension. Offsets from 0° to 40°. Stows alongside base boom section. Maximum tip height: 69,2 m (227 ft)

* Optional lattice extension inserts

Two 8 m (26 ft) lattice extension inserts. Installs between the boom nose and bifold extension, nonstowable. Maximum tip height: 85 m (279 ft)

Boom nose

Seven nylatron sheaves mounted on heavy duty tapered roller bearings with removable pin-type rope guards. Quick reeving type boom nose. Removable auxiliary boom nose with removable pin type rope guard.

Boom elevation

One double acting hydraulic cylinder with integral holding valve provides elevation from -3° to 78°.

Load moment and anti-two block system

Standard "Graphic Display" load moment and anti-two block system with audio-visual warning and control lever lockout. These systems provide electronic display of boom angle, length, radius, tip height, relative load moment, maximum permissible load, load indication and warning of impending two-block condition. The standard Work Area Definition System allows the operator to pre-select and define safe working areas. If the crane approaches the pre-set limits, audio-visual warnings aid the operator in avoiding job-site obstructions.

Cab

20° tilt, full-vision, all-steel fabricated with acoustical lining and tinted safety glass throughout. Deluxe seat incorporates armrest-mounted hydraulic single-axis controllers. Dash panel incorporates gauges for all engine functions. Other standard features include: hot water heater, cab circulating air fan, air conditioning sliding side and rear windows, sliding skylight with electric wiper and sunscreen, electric windshield wash/wipe, fire extinguisher and seat belt.

Swing

Two speed, (2) planetary swing drives with foot applied multi-disc wet brakes. Spring applied, hydraulically released swing brakes. 360° positive swing lock and two-position mechanical house lock, both operated from cab. Maximum speed: 2.5 rpm

Counterweight

18 144 kg (40,000 lb) of total counterweight. Hydraulically installed and removed.

Hydraulic system

Six main pumps with a combined capacity of 776 LPM (205 GPM).

Maximum operating pressure: 331 bar (4800 psi). Two individual post pressure compensated valve banks. Return line type filter with full flow by-pass protection and service indicator. Replaceable cartridge with micron filtration rating of 5/12/16. 1230 L (325 gal) reservoir. Remote mounted oil cooler with thermostatically controlled hydraulic driven motor, fan/air to oil. System pressure test ports.

Hoist Specifications main and auxiliary hoist

Planetary reduction with automatic spring applied multi-disc brake. Grooved drum electronic hoist drum rotation indicator, and hoist drum cable followers.

Maximum single line pull:

- 1st layer - 9083 kg (20,024 lb)
- 3rd layer - 7724 kg (17,028 lb)
- 5th layer - 6718 kg (14,811 lb)

Maximum permissible line pull:

- 7620 kg (16,800 lb) with 6 x 37 class rope
- 7620 kg (16,800 lb) with 35 x 7 class rope

Maximum single line speed: 171 m/min (562 fpm)



Specifications

Superstructure continued

Rope class:

- 6 x 37 EIPS IWRC, Special Flexible
- 35 x 7 EIPS WSC, Rotation Resistant

Rope diameter: 19 mm (3/4 in)

Rope length:

- Main hoist - 290 m (950 ft)
- Auxiliary hoist - 213 m (700 ft)

Maximum rope stowage: 368 m (1206 ft)

Carrier



Chassis

Box section frame fabricated from high-strength, low alloy steel. Removable outrigger housings, front/rear towing and tie down lugs.



Outrigger system

Four hydraulic telescoping single-stage double box beam outriggers with inverted jacks and integral holding valves. Three position settings, 0%, 50% and fully extended. Outrigger boxes removable for ease of transportation. All steel fabricated, quick release type outrigger floats, 775 mm (30.5 in) diameter. Maximum outrigger pad load - 75 298 kg (166,000 lb)



Outrigger controls

Controls and crane level indicator located in cab.



Engine (Tier III)

Cummins QSC8.3L diesel, six cylinders, 224 kW (300 bhp) (Gross) at 2200 rpm. Maximum torque: 1356 Nm (1000 ft lb) at 1600 rpm



Fuel tank capacity

379 L (100 gal)



Transmission

Full powershift with 6 forward and 3 reverse speeds. Front axle disconnect for 4 x 2 travel.



Electrical system

Two 12 V - maintenance free batteries.
12 V starting and lighting, circuit breakers.



Drive

4 x 4



Steering

Fully independent power steering:
Front: Full hydraulic steering wheel controlled.
Rear: Full hydraulic switch controlled.
Provides infinite variations of four main steering modes: front only, rear only, crab and coordinated.
Rear steer centered indicator light.



Axles

Front: Drive/steer with differential and planetary reduction hubs rigid mounted to frame.
Rear: Drive/steer with differential and planetary reduction hubs pivot mounted to frame.



Oscillation lockouts

Automatic full hydraulic lockouts on rear axle permits 254 mm (10 in) oscillation with boom centered over the front.



Brakes

Full hydraulic split circuit, dry disc service brakes operating on all wheels. Spring-applied, hydraulically released parking brake mounted on front axle.



Tires

Standard 33.25 x 29 - 38 bias ply, Titan SL-100



Lights

Full lighting including turn indicators, head, tail, brake and hazard warning lights.



Specifications

Carrier continued

Maximum speed

24 km/h (15 mph)

Gradeability (theoretical)

73% (Based on 81 647 kg [180,000 lb] GVW) 33.25 x 29 tires, pumps engaged, 48,8 m (160 ft) boom, plus 18 m (59 ft) swingaway, 18 144 kg (40,000 lb) counterweight, hookblock and headache ball.

Miscellaneous standard equipment

Full width aluminum fenders, full length aluminum decking, dual rear view mirrors, hook-block tie down, electronic back-up alarm, light package, front stowage well, tachometer/hourmeter, immersion type block heater, rear wheel position indicator, 36,000 BTU hot water cab heater, hoist mirrors, engine distress A/V warning system, front/rear tie down and tow lugs, coolant sight level indicator, hydraulic pump disconnect, LMI light bar. Hydraulically activated boom removal pins, lift cylinder travel support, 80T hookblock, 10T top swivel ball.

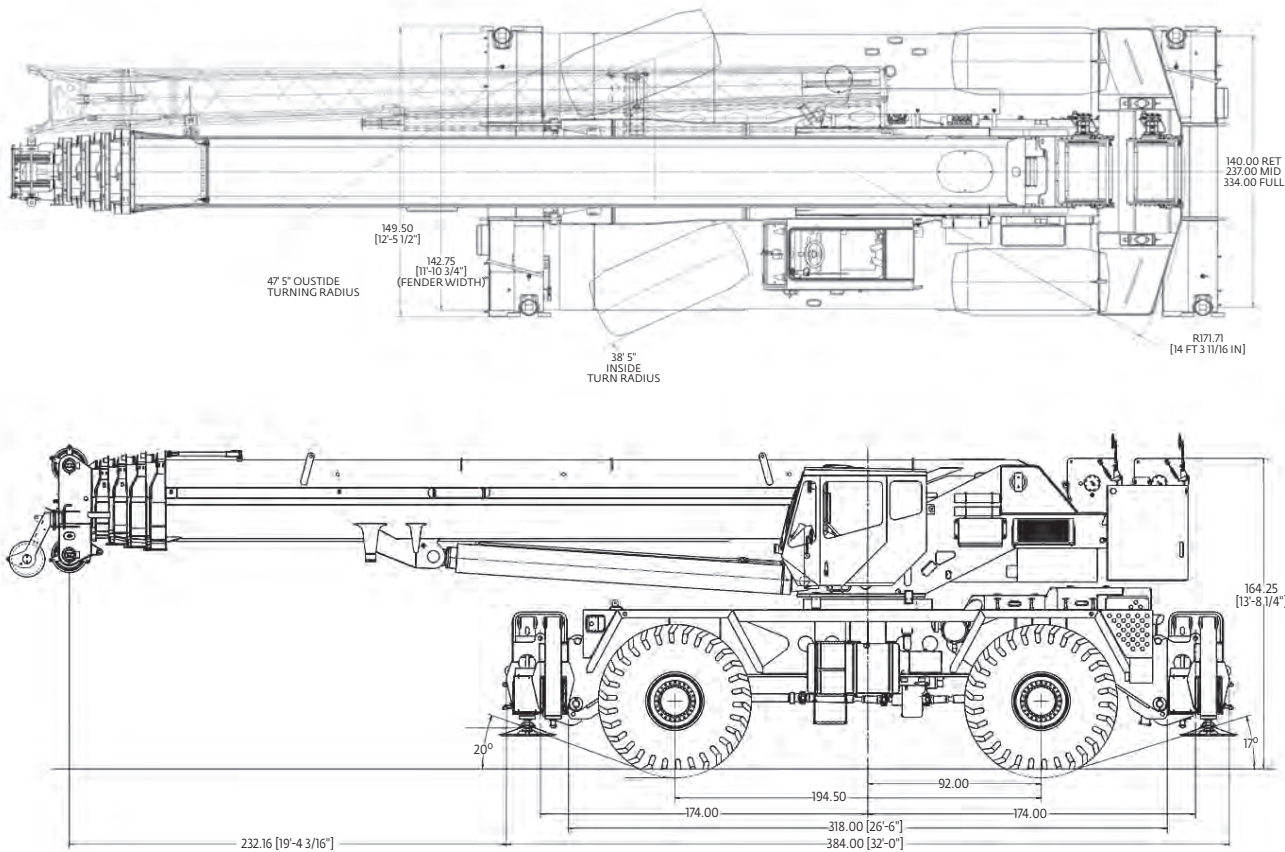
* Optional equipment

- ▶ AUXILIARY LIGHTING AND CONVENIENCE PACKAGE: Includes cab mounted amber flashing light, 360° rotation spotlight and dual base boom mounted floodlights, and rubber mat for stowage trough
- ▶ 130 USt hookblock
- ▶ Rear pintle hook
- ▶ Cab controlled cross axle differential locks, (front and rear)
- ▶ PAT event recorder down load kit
- ▶ Wind speed indicator (wireless)
- ▶ Third wrap indicator with host cut-out (main and auxiliary)



Dimensions and weights

Dimensions



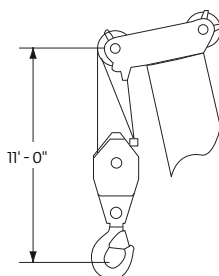
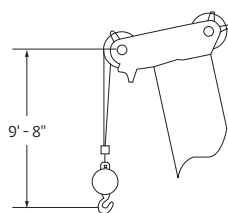
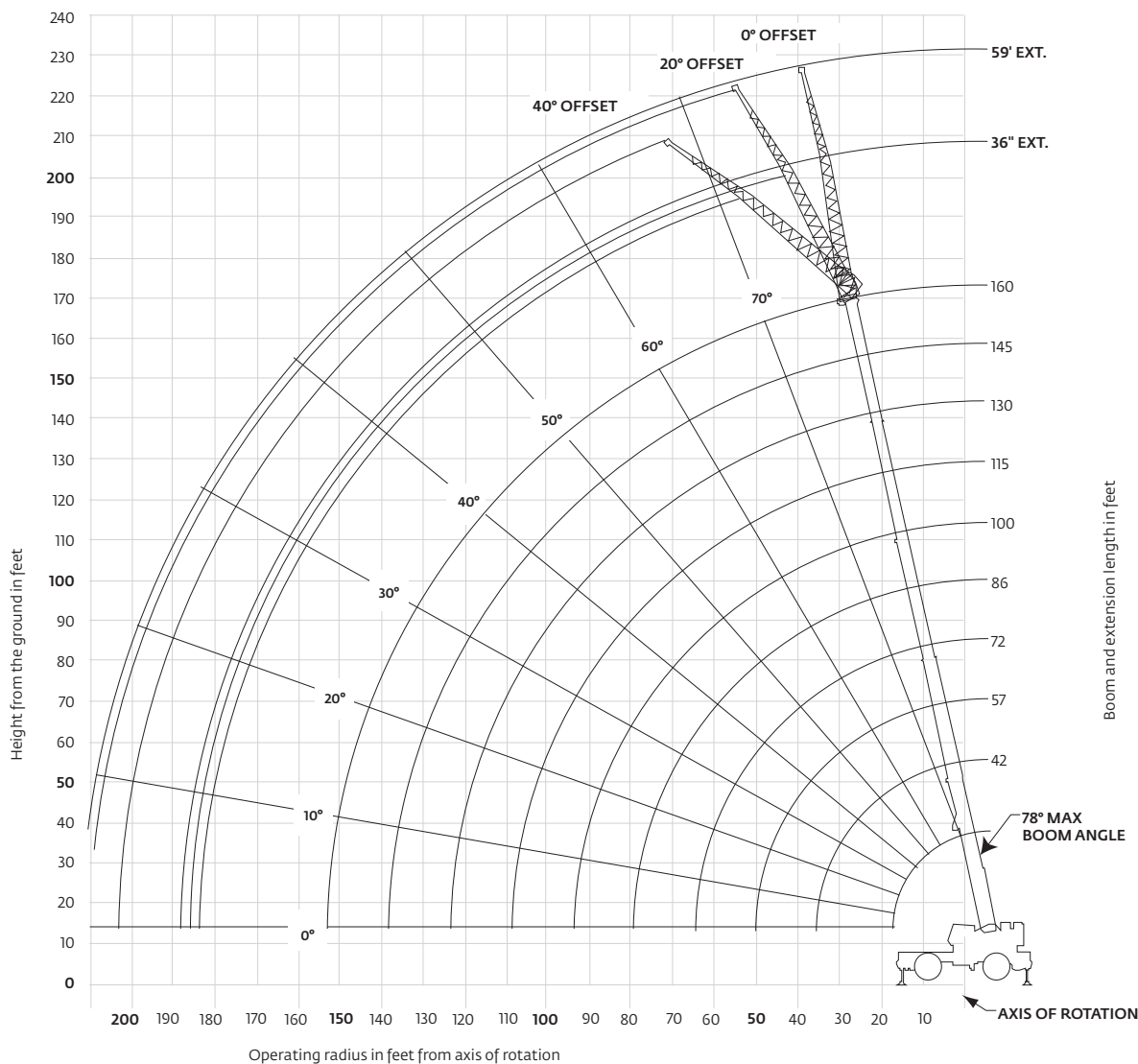
All dimensions are in inches (feet)

Weights

	Gross kg (lb)	Front kg (lb)	Rear kg (lb)	Weight of items removed
Basic Machine: Includes 160 ft main boom, main hoist with 950 ft of wire rope and auxiliary hoist with 700 ft of wire rope, manual offsettable bi-fold swingaway, full counterweight, 10 USt headache ball, and 80 USt hookblock	78 946 (174,043)	36 050 (79,475)	42 896 (94,568)	
Sub: Hydraulic offsettable bi-fold swingaway	79 222 (174,651)	36 682 (80,868)	42 540 (93,783)	
Remove: 40,000 lb counterweight, auxiliary hoist with rope, and manual offsettable swingaway	57 539 (126,849)	39 623 (87,353)	17 915 (39,496)	21 734 (47,194)
Remove: 40,000 lb counterweight, auxiliary hoist with rope, manual offsettable swingaway, 80 USt hookblock, 10 USt headache ball, and both outrigger boxes/beams	47 952 (105,715)	34 396 (75,829)	13 556 (29,886)	30 994 (68,328)
Remove: 40,000 lb counterweight, auxiliary hoist with rope, both outrigger boxes/beams, 80 USt hookblock, 10 USt headache ball, and boom assembly	32 765 (72,233)	14 051 (30,977)	18 714 (41,256)	46 181 (101,810)
Remove: 40,000 lb counterweight, auxiliary hoist with rope, both outrigger boxes/beams, 80 USt hookblock, 10 USt headache ball, boom assembly, and all tire/wheels	28 447 (62,713)	11 892 (26,217)	16 555 (36,496)	50 499 (111,330)

Working range

160 ft main boom + 36 ft - 59 ft fixed offset extension



Dimensions are for largest Grove furnished hookblock and headache ball, with anti-two block activated.

Load chart



Feet	Pounds								
	#0001								
	Main boom length in feet								
	42	57	72	86	100	115	130	145	160
10	+260,000 (71.5)	147,000 (76.5)							
12	224,000 (68.5)	147,000 (74.5)	*127,000 (78)						
15	176,000 (63.5)	147,000 (71.5)	127,000 (76)	*92,600 (78)					
20	127,500 (55.5)	125,500 (65.5)	115,500 (71.5)	86,550 (75.5)	*65,000 (78)				
25	97,300 (46)	95,550 (60)	95,300 (67)	78,900 (72)	62,650 (75)	44,600 (78)			
30	76,900 (34)	75,250 (53.5)	75,050 (62.5)	68,500 (68.5)	56,800 (72)	44,600 (75.5)	43,150 (78)		
35		60,950 (46.5)	60,750 (58)	60,100 (64.5)	50,050 (69)	44,600 (73)	42,200 (76)	32,550 (78)	
40		50,300 (38.5)	50,150 (52.5)	50,550 (60.5)	44,050 (66)	41,400 (70)	38,000 (73.5)	32,550 (76)	25,100 (78)
45		42,050 (28)	41,950 (47)	42,350 (56.5)	38,950 (62.5)	37,450 (67.5)	34,150 (71)	32,550 (74)	24,800 (76.5)
50			35,400 (41)	35,850 (52.5)	34,650 (59)	33,450 (64.5)	31,350 (68.5)	29,550 (71.5)	24,500 (74.5)
55			30,050 (34)	30,550 (47.5)	30,050 (55.5)	30,000 (61.5)	29,200 (66)	26,850 (69.5)	24,000 (72.5)
60			25,600 (24.5)	26,100 (42.5)	25,850 (52)	26,950 (58.5)	26,350 (63.5)	24,700 (67.5)	23,200 (70.5)
65				22,400 (37)	22,150 (48)	23,800 (55.5)	23,850 (61)	22,950 (65)	21,100 (68.5)
70				19,200 (30.5)	18,950 (44)	20,800 (52.5)	21,600 (58.5)	20,850 (62.5)	19,200 (66.5)
75				16,400 (22)	16,200 (39)	18,100 (49)	19,250 (55.5)	19,000 (60.5)	17,500 (64.5)
80					13,800 (34)	15,700 (45.5)	16,900 (52.5)	17,100 (58)	15,750 (62.5)
85					11,650 (28)	13,550 (41.5)	15,000 (49.5)	15,500 (55.5)	14,300 (60)
90					9770 (19.5)	11,700 (37)	13,100 (46.5)	13,900 (53)	13,100 (58)
95						10,000 (32)	11,450 (43)	12,250 (50)	12,150 (55.5)
100						8490 (26.5)	9940 (39.5)	11,000 (47)	11,400 (53)
105						5690 (18.5)	8630 (35.5)	9730 (44)	10,200 (50.5)
110							7320 (30.5)	8460 (41)	9020 (48)
115							6220 (25)	7370 (37.5)	8100 (45.5)
120							5120 (17.5)	6280 (33.5)	7190 (42.5)
125								5350 (29.5)	6270 (39.5)
130								4430 (24)	5350 (36)
135								2560 (16.5)	4560 (32.5)
140									3770 (28)
Minimum boom angle (°) for indicated length (no load)									23
Maximum boom length (ft) at 0° boom angle (no load)									145

#LMI operating code. Refer to LMI manual for instructions.
 *This capacity is based upon maximum obtainable boom angle.
 +16 parts line required to lift this capacity (using aux. boom nose). Refer to Operator's and Safety Handbook for reeving diagram.
 Note: () Boom angles are in degrees.

Lifting capacities at zero degree boom angle									
Boom Angle	Main boom length in feet								
	42	57	72	86	100	115	130	145	160
0°	41,400 (35.3)	24,650 (50)	15,350 (64.6)	9700 (79.3)	5250 (94)	3650 (108.6)	2450 (123.3)	1450 (138)	

Note: () Reference radii in feet

A6-829-103576

Load chart

Pounds						
Feet	36 ft LENGTH			59 ft LENGTH		
	0° OFFSET #0021	20° OFFSET #0022	40° OFFSET #0023	0° OFFSET #0041	20° OFFSET #0042	40° OFFSET #0043
25	[*] 33,600 (78)					
30	33,600 (76.5)			[*] 14,950 (78)		
35	32,950 (74.5)	[*] 23,150 (78)		14,950 (77.5)		
40	31,050 (72)	22,150 (76.5)		14,950 (76)		
45	29,250 (70)	21,250 (74)	17,250 (78)	14,950 (74)		
50	27,600 (67.5)	20,450 (72)	16,850 (75.5)	14,950 (72)	12,350 (78)	
55	26,150 (65)	19,700 (69.5)	16,500 (73)	14,950 (70)	11,900 (77)	
60	24,750 (63)	19,050 (67)	16,150 (70.5)	14,800 (68)	11,500 (75)	
65	23,550 (60.5)	18,450 (65)	15,900 (68)	14,300 (66)	11,100 (73)	9210 (78)
70	22,050 (58)	17,850 (62)	15,650 (65.5)	13,650 (64)	10,700 (71)	9000 (76)
75	20,100 (55.5)	17,350 (59.5)	15,450 (63)	13,100 (62)	10,400 (69)	8820 (73.5)
80	18,100 (52.5)	16,900 (57)	15,250 (60)	12,550 (60)	10,050 (66.5)	8650 (71.5)
85	16,000 (50)	16,500 (54)	15,150 (57)	12,000 (58)	9780 (64.5)	8490 (69)
90	14,150 (47)	15,500 (51.5)	15,050 (54)	11,550 (55.5)	9510 (62.5)	8360 (66.5)
95	12,500 (44)	13,700 (48)	14,000 (50.5)	11,100 (53)	9260 (60)	8240 (64)
100	11,050 (40.5)	12,100 (45)	12,750 (47)	10,650 (51)	9030 (57.5)	8130 (61.5)
105	9770 (37)	10,650 (41.5)		10,250 (48.5)	8820 (55)	8050 (59)
110	8490 (33.5)	9270 (37.5)		9930 (46)	8620 (52.5)	7980 (56)
115	7430 (29)	8060 (33)		9040 (43)	8450 (49.5)	7950 (53)
120	6370 (24)	6850 (28)		8150 (40.5)	8280 (47)	7920 (50)
125				7240 (37)	7830 (43.5)	7900 (46.5)
130				6340 (34)	7380 (40.5)	7890 (42.5)
135				5570 (30.5)	6440 (36.5)	
140				4800 (26)	5510 (32)	
145				4140 (21)		
150				3480 (14)		
Min. boom angle for indicated length (no load)	0°	20°	40°	0°	20°	40°
Max. boom length (ft) at 0° boom angle (no load)	100ft			100ft		

NOTE: () Boom angles are in degrees
 #LMI operating code. Refer to LMI for operating instructions
^{*}This capacity is based on maximum obtainable boom angle.

NOTES:

- All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765.
- 36 ft boom extension may be used for single or double line lifting service. 59 ft boom extension may be used for single line lifting service only.
 WARNING: Lifting with the 36 ft extension base, with the 23 ft extension fly either erected or folded along side of extension base, is strictly prohibited.
- Radii listed are for a fully extended boom with the boom extension erected. For main boom lengths less than fully extended, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is configured. For boom angles not shown, use the rating of the next lower boom angle.
 WARNING: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
- Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
- Capacities listed are with outriggers properly extended and vertical jacks set only.

Load chart



Pounds						
Feet	36 ft LENGTH			59 ft LENGTH		
	0° OFFSET #0021	20° OFFSET #0022	40° OFFSET #0023	0° OFFSET #0041	20° OFFSET #0042	40° OFFSET #0043
35	23,350 (78)					
40	23,350 (77)			12,300 (78)		
45	23,350 (75)	*21,300 (78)		12,300 (77.5)		
50	23,350 (73.5)	20,700 (76.5)		12,300 (76)		
55	23,350 (71.5)	20,100 (75)	16,600 (78)	12,300 (74.5)		
60	23,350 (69.5)	19,500 (73)	16,350 (76)	12,300 (73)	11,600 (78)	
65	22,300 (67.5)	19,000 (71)	16,100 (74)	12,300 (71.5)	11,300 (77)	
70	20,350 (66)	18,500 (69)	15,850 (72)	12,300 (69.5)	10,950 (75)	
75	18,350 (64)	18,050 (67)	15,650 (70)	12,300 (68)	10,700 (73.5)	8940 (78)
80	16,600 (62)	17,100 (65)	15,500 (68)	12,300 (66.5)	10,400 (72)	8790 (76)
85	15,050 (60)	15,550 (63)	15,300 (66)	12,300 (64.5)	10,150 (70)	8650 (74.5)
90	13,700 (57.5)	14,150 (61)	14,500 (63.5)	12,300 (63)	9910 (68.5)	8520 (72.5)
95	12,450 (55.5)	12,900 (58.5)	13,250 (61.5)	11,900 (61)	9680 (66.5)	8410 (70.5)
100	11,300 (53.5)	11,750 (56.5)	12,100 (59)	11,450 (59)	9460 (64.5)	8300 (68.5)
105	10,300 (51)	10,750 (54)	11,050 (56.5)	10,500 (57.5)	9260 (63)	8210 (66.5)
110	9390 (48.5)	9810 (52)	10,050 (54)	9580 (55.5)	9060 (61)	8120 (64.5)
115	8570 (46)	8970 (49.5)	9200 (51.5)	8790 (53.5)	8860 (59)	8050 (62.5)
120	7750 (43.5)	8140 (46.5)	8350 (48.5)	8010 (51.5)	8660 (57)	7990 (60.5)
125	6840 (41)	7360 (44)	7600 (45.5)	7340 (49.5)	7960 (54.5)	7820 (58)
130	5940 (38)	6590 (41)	6850 (42.5)	6680 (47.5)	7270 (52.5)	7660 (55.5)
135	5170 (34.5)	5730 (37.5)		6100 (45)	6660 (50.5)	7010 (53.5)
140	4400 (31)	4880 (34)		5530 (42.5)	6050 (48)	6360 (50.5)
145	3730 (27.5)	4120 (30)		4890 (40)	5510 (45.5)	5770 (48)
150	3070 (22.5)	3360 (25.5)		4260 (37.5)	4970 (42.5)	5190 (45)
155				3670 (35)	4360 (40)	
160				3090 (31.5)	3750 (36.5)	
165				2570 (28.5)	3120 (33)	
170				2060 (24.5)	2490 (29)	
Min. boom angle for indicated length (no load)	20°	20°	40°	20°	20°	40°

Max. boom length (ft) at 0° boom angle (no load)

100 ft

100 ft

A6-829-102127

NOTE: () Boom angles are in degrees

#LMI operating code. Refer to LMI for operating instructions

*This capacity is based on maximum obtainable boom angle.

NOTES:

- All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765.
- 36 ft boom extension may be used for single or double line lifting service. 59 ft boom extension may be used for single line lifting service only. WARNING: Lifting with the 36 ft extension base, with the 23 ft extension fly either erected or folded along side of extension base, is strictly prohibited.
- Radii listed are for a fully extended boom with the boom extension erected. For main boom lengths less than fully extended, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is configured. For boom angles not shown, use the rating of the next lower boom angle. WARNING: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
- Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
- Capacities listed are with outriggers properly extended and vertical jacks set only.

Load chart



Pounds						
Feet	36 ft LENGTH			59 ft LENGTH		
	0°	20°	40°	0°	20°	40°
	OFFSET #0021	OFFSET #0022	OFFSET #0023	OFFSET #0041	OFFSET #0042	OFFSET #0043
45	16,000 (78)					
50	16,000 (77.5)					
55	15,900 (76)			10,100 (78)		
60	15,850 (74)	15,700 (77.5)		10,100 (77)		
65	15,800 (72.5)	15,700 (76)	*15,200 (78)	10,100 (75.5)		
70	15,750 (71)	15,000 (74.5)	14,750 (77)	10,100 (74)	10,050 (78)	
75	14,950 (69.5)	14,300 (73)	14,100 (75.5)	10,100 (73)	10,050 (77.5)	
80	14,200 (68)	13,600 (71)	13,450 (74)	10,100 (71.5)	10,050 (76)	
85	13,450 (66)	12,950 (69.5)	12,850 (72)	10,100 (70)	10,050 (74.5)	8600 (78)
90	12,800 (64.5)	12,350 (68)	12,250 (70.5)	10,100 (68.5)	9870 (73)	8500 (77.5)
95	11,700 (63)	11,750 (66)	11,700 (68.5)	10,100 (67)	9680 (72)	8400 (75.5)
100	10,650 (61)	11,200 (64.5)	11,200 (67)	9710 (65.5)	9450 (70)	8310 (74)
105	9710 (59.5)	10,250 (62.5)	10,400 (65)	9280 (64)	9050 (68.5)	8220 (72.5)
110	8780 (57.5)	9310 (61)	9680 (63)	8850 (62.5)	8650 (67)	8140 (71)
115	7990 (55.5)	8500 (59)	8840 (61)	8110 (61)	8280 (65.5)	7920 (69.5)
120	7210 (53.5)	7690 (57)	8010 (59)	7370 (59.5)	7920 (64)	7700 (67.5)
125	6540 (52)	7000 (55)	7290 (57)	6720 (57.5)	7360 (62.5)	7440 (66)
130	5880 (49.5)	6310 (53)	6580 (55)	6070 (56)	6810 (60.5)	7190 (64)
135	5300 (47.5)	5710 (51)	5950 (53)	5510 (54.5)	6210 (59)	6630 (62.5)
140	4730 (45.5)	5110 (49)	5330 (50.5)	4950 (52.5)	5620 (57)	6080 (60.5)
145	4190 (43)	4580 (46.5)	4770 (48)	4460 (50.5)	5100 (55.5)	5520 (58.5)
150	3650 (41)	4060 (44)	4220 (45.5)	3980 (49)	4580 (53.5)	4970 (56.5)
155	3070 (38.5)	3500 (41.5)	3660 (43)	3550 (47)	4120 (51.5)	4470 (54.5)
160	2490 (35.5)	2940 (38.5)		3130 (45)	3660 (49.5)	3970 (52)
165	1970 (32.5)	2370 (36)		2710 (43)	3240 (47.5)	3510 (50)
170	1460 (29.5)	1800 (32.5)		2300 (40.5)	2830 (45)	3060 (47.5)
175				1840 (38.5)	2420 (43)	2640 (45)
180				1390 (36)	2010 (40)	2220 (42)
185					1530 (37.5)	
Min. boom angle for indicated length (no load)	26	28	40	34	35	40
Max. boom length (ft) at 0° boom angle (no load)		100			100	

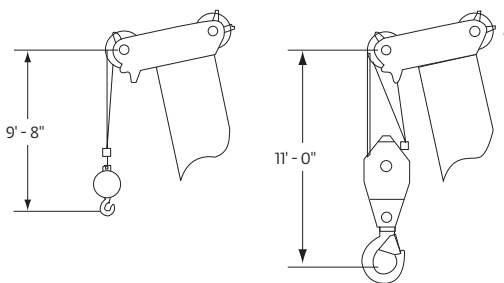
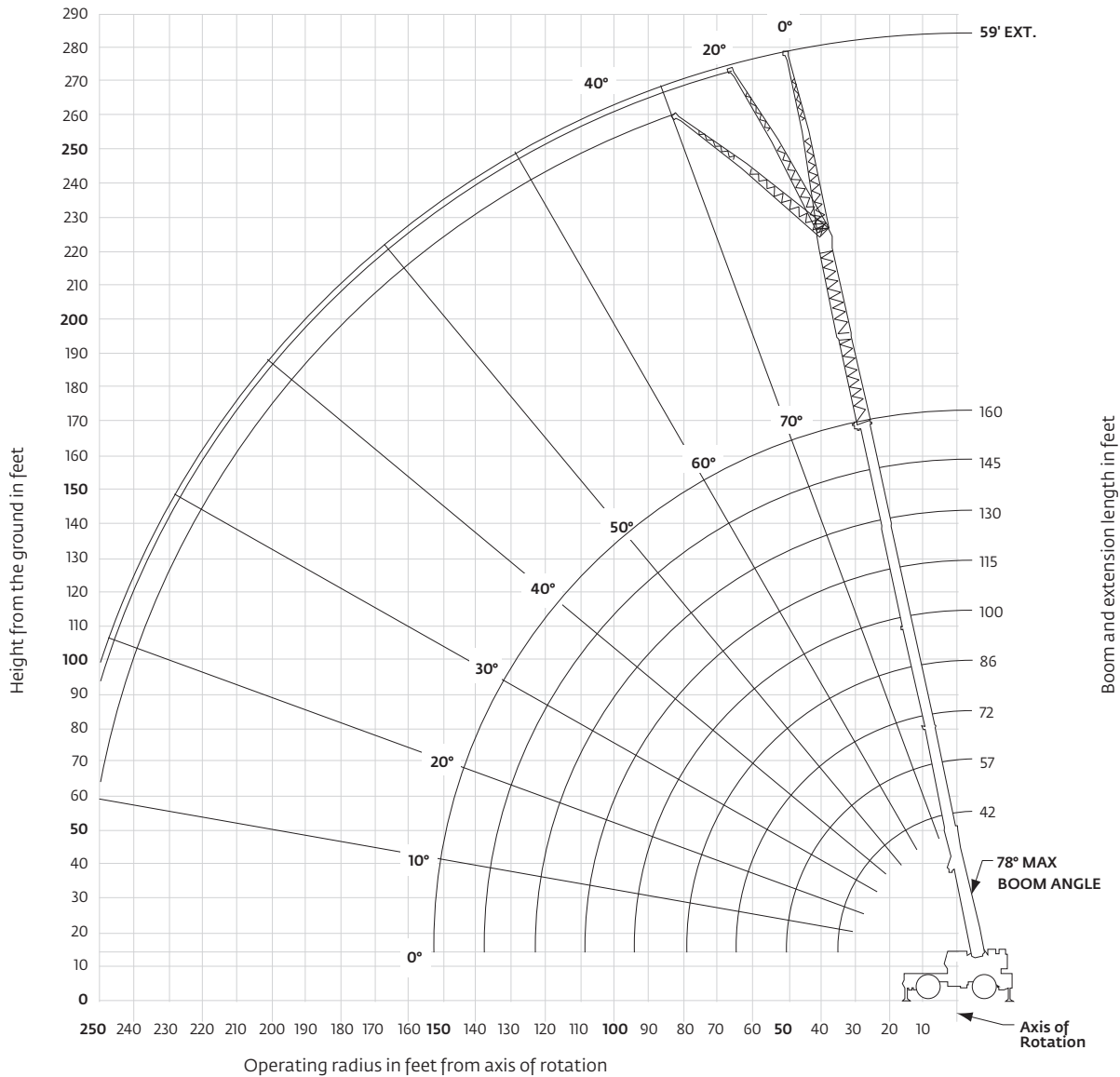
NOTE: () Boom angles are in degrees AG-829-101980A
 #LMI operating code. Refer to LMI for operating instructions
 *This capacity is based on maximum obtainable boom angle.

NOTES:

- All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765.
- 36 ft boom extension may be used for single or double line lifting service. 59 ft boom extension may be used for single line lifting service only.
 WARNING: Lifting with the 36 ft extension base, with the 23 ft extension fly either erected or folded along side of extension base, is strictly prohibited.
- Radii listed are for a fully extended boom with the boom extension erected. For main boom lengths less than fully extended, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is configured. For boom angles not shown, use the rating of the next lower boom angle.
 WARNING: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
- Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
- Capacities listed are with outriggers properly extended and vertical jacks set only.

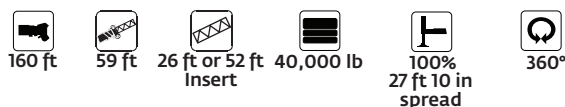
Working range

160 ft main boom + 2 inserts + 36 ft - 59 ft fixed offset extension



Dimensions are for largest Grove furnished hook block and headache ball, with anti-two block activated.

Load chart



Pounds						
Feet	59 ft LENGTH WITH 26 ft INSERT			59 ft LENGTH WITH 52 ft INSERT		
	0° OFFSET #0084	20° OFFSET #0085	40° OFFSET #0086	0° OFFSET #0084	20° OFFSET #0085	40° OFFSET #0086
60	7070 (78)					
65	7070 (77.5)					
70	7070 (76.5)			4400 (78)		
75	7070 (75)			4400 (77.5)		
80	7070 (74)	6610 (78)		4400 (76.5)		
85	7070 (72.5)	6610 (75)		4400 (75.5)		
90	7070 (71.5)	6610 (76)		4400 (74.5)	4230 (78)	
95	7070 (70)	6610 (75)	6400 (78)	4400 (73)	4230 (77.5)	
100	7070 (69)	6610 (73.5)	6400 (77)	4400 (72)	4230 (76.5)	
105	7070 (67.5)	6610 (72.5)	6400 (76)	4400 (71)	4230 (75.5)	4000 (78)
110	7070 (66)	6610 (71)	6400 (74.5)	4400 (69.5)	4230 (74)	4000 (77)
115	6735 (65)	6545 (69.5)	6315 (73)	4400 (68.5)	4230 (73)	4000 (75.5)
120	6400 (63.5)	6480 (68)	6230 (71.5)	4400 (67.5)	4230 (72)	4000 (74.5)
125	5940 (62)	6170 (67)	5955 (70)	4400 (66)	4230 (70.5)	4000 (73)
130	5480 (60.5)	5860 (65.5)	5680 (68.5)	4400 (65)	4230 (69.5)	4000 (72)
135	4930 (59.5)	5510 (64)	5440 (67)	4110 (63.5)	4195 (68)	4000 (70.5)
140	4380 (58)	5160 (62.5)	5200 (65.5)	3820 (62.5)	4160 (67)	4000 (69)
145	3900 (56.5)	4645 (61)	4910 (64)	3350 (61)	3885 (65.5)	3785 (68)
150	3420 (55)	4130 (59.5)	4620 (62.5)	2880 (60)	3610 (64)	3570 (66.5)
155	3000 (53.5)	3680 (58)	4140 (60.5)	2470 (58.5)	3205 (63)	3365 (65)
160	2580 (51.5)	3230 (56.5)	3660 (59)	2060 (57)	2800 (61.5)	3160 (63.5)
165	2210 (50)	2825 (54.5)	3220 (57.5)	1690 (56)	2405 (60)	2810 (62.5)
170	1840 (48.5)	2420 (53)	2780 (55.5)		2010 (59)	2460 (61)
175	1515 (46.5)	2060 (51)	2385 (53.5)		1655 (57.5)	2075 (59.5)
180		1700 (49.5)	1990 (51.5)			1690 (58)
185		1370 (47.5)	1625 (49.5)			
Min. boom angle for indicated length (no load)	45	46	48	54	56	56
Max. boom length (ft) at 0° boom angle (no load)		57		57		

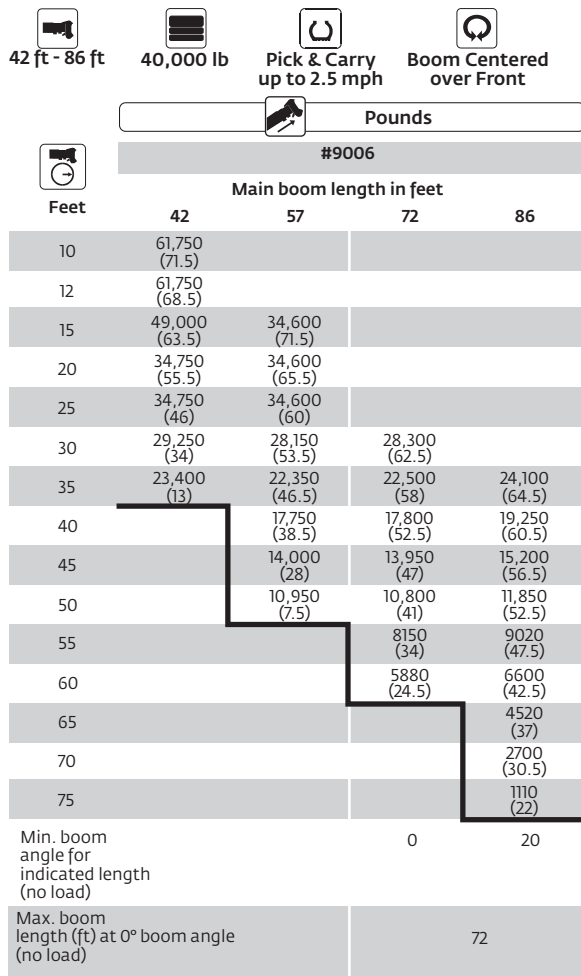
A6-829-101983A

NOTE: () Boom angles are in degrees
 #LMI operating code. Refer to LMI for operating instructions

NOTES:

1. All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765.
2. 59 ft folding boom extension length may be used for single line lifting service only. Note: Lifting with the 36 ft extension base with either one or two 26 ft insert sections installed is not permitted.
3. For main boom lengths less than 160 ft with the boom extension erected, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is set up. For boom angles not shown, use the rating of the next lower boom angle.
4. **WARNING:** Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
5. Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
6. Capacities listed are with outriggers properly extended and vertical jacks set only.

Load chart



NOTE: () Boom angles are in degrees
 #LMI operating code. Refer to LMI for operating instructions

Lifting capacities at zero degree boom angle		
Boom angle	42	57
0°	23,000 (35.3)	10,900 (50)

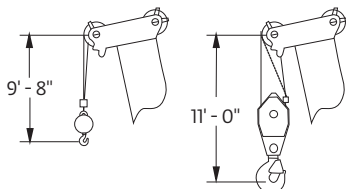
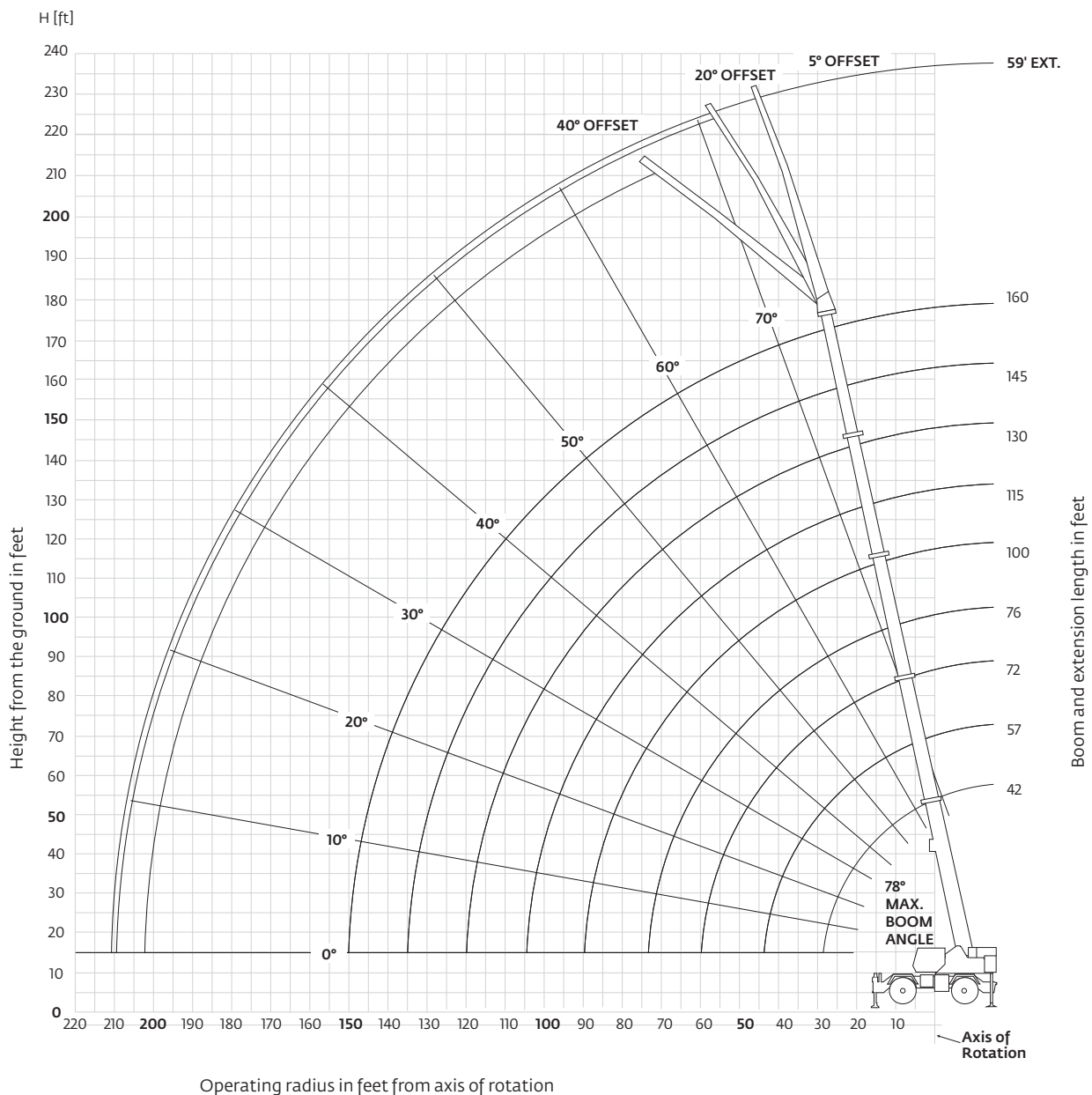
A6-829-102108A

NOTES:

1. Capacities are in pounds and do not exceed 75% of tipping loads as determined by test in accordance with SAE J-765.
2. Capacities are applicable to machines equipped with 33.25x29 (38 ply) bias ply tires, at 85 psi cold inflation pressure.
3. Capacities appearing above the bold line are based on structural strength and tipping should not be relied upon as a capacity limitation.
4. Capacities are applicable only with machine on firm level surface.
5. On rubber lifting with boom extension not permitted.
6. Axle lockouts must be functioning when lifting on rubber.
7. For pick and carry operation, boom must be centered over front of machine, mechanical swing lock engaged and load restrained from swinging. When handling loads in the structural range with capacities close to maximum ratings, travel should be reduced to creep speeds.
8. All lifting depends on proper tire inflation, capacity and condition. Capacities must be reduced for lower tire inflation pressures. See lifting capacity chart for tire used. Damaged tires are hazardous to safe operation of crane.
9. Creep – not over 200 ft of movement in any 30 minute period and not exceeding 1 mph.

Working range

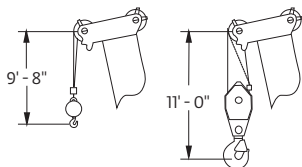
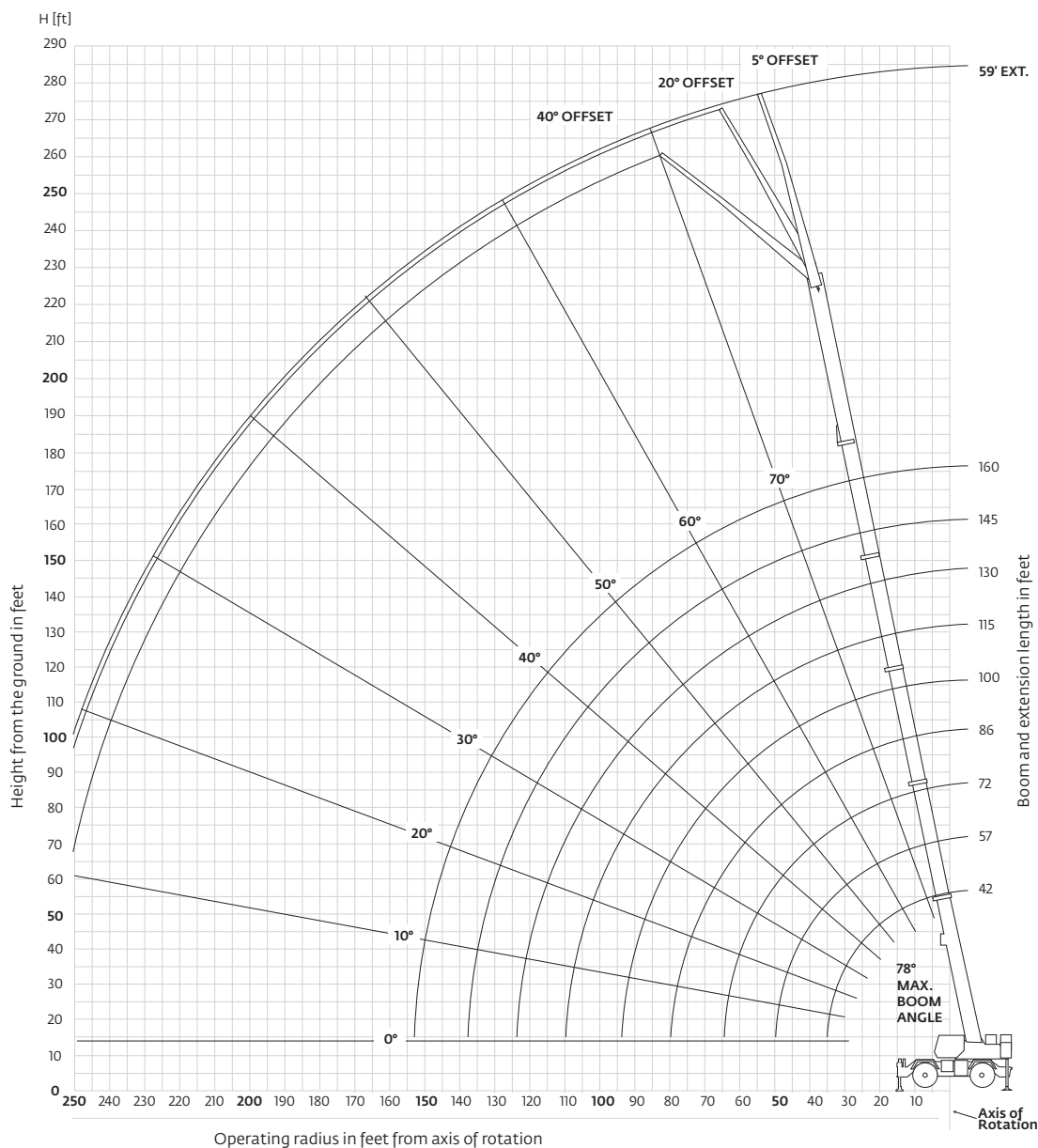
160 ft main boom + 36 ft - 59 ft luffing extension



Dimensions are for largest Grove furnished hook block and headache ball, with anti-two block activated.

Working range

160 ft main boom + 2 inserts + 36 ft - 59 ft luffing extension



Dimensions are for largest Grove furnished hook block and headache ball, with anti-two block activated.

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE.

Grove RT9130E

The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane

Load chart

36 ft - 59 ft luffing folding boom extension (fixed angle) 100 ft boom



Pounds						
Feet	36 ft LENGTH			59 ft LENGTH		
	5° OFFSET	20° OFFSET	40° OFFSET	5° OFFSET	20° OFFSET	40° OFFSET
30	32,600 (78)					
35	30,700 (76)	*23,150 (78)				
40	28,950 (74)	22,150 (76.5)		14,950 (77.5)		
45	27,350 (71.5)	21,250 (74)	15,250 (78)	14,950 (75.5)		
50	25,900 (69.5)	20,450 (72)	14,850 (75.5)	14,950 (73.5)	12,350 (78)	
55	24,600 (67)	19,700 (69.5)	14,500 (73)	14,550 (72)	11,900 (77)	
60	23,400 (64.5)	19,050 (67)	14,200 (70.5)	14,150 (70)	11,500 (75)	
65	22,300 (62)	18,450 (65)	13,900 (68)	13,750 (68)	11,100 (73)	8050 (78)
70	21,300 (59.5)	17,850 (62)	13,650 (65.5)	13,350 (66)	10,700 (71)	7850 (76)
75	20,100 (57)	17,350 (59.5)	13,450 (63)	13,000 (64)	10,400 (69)	7660 (73.5)
80	18,100 (54.5)	16,900 (57)	13,300 (60)	12,550 (61.5)	10,050 (66.5)	7490 (71.5)
85	16,000 (51.5)	16,500 (54)	13,150 (57)	12,000 (59.5)	9,780 (64.5)	7340 (69)
90	14,150 (49)	15,400 (51.5)	13,050 (54)	11,550 (57.5)	9,510 (62.5)	7210 (66.5)
95	12,500 (46)	13,700 (48)	13,000 (50.5)	11,100 (55)	9,260 (60)	7090 (64)
100	11,050 (42.5)	12,100 (45)	12,750 (47)	10,650 (52.5)	9,030 (57.5)	6980 (61.5)
105	9770 (39)	10,650 (41.5)		10,250 (50)	8820 (55)	6900 (59)
110	8490 (35.5)	9270 (37.5)		9930 (47.5)	8620 (52.5)	6830 (56)
115	7400 (31)	8060 (33)		9040 (45)	8440 (49.5)	6790 (53)
120	6320 (26)	6850 (28)		8150 (42)	8260 (47)	6750 (50)
125				7240 (39)	7820 (43.5)	
130				6340 (35.5)	7380 (40.5)	
135				5570 (32)	6440 (36.5)	
140				4800 (28)	5510 (32)	
145				4100 (23)		
150				3410 (16)		

Min. boom angle for indicated length (no load)

5°	20°	40°	5°	20°	40°
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Max. boom length (ft) at 5° boom angle (no load)

100 ft	100 ft
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NOTE: () Boom angles are in degrees. A6-829-102550
 #LMI operating code. Refer to LMI manual for operating instructions.
 *This capacity is based on maximum obtainable boom angle.

NOTES:

- All capacities above the bold line are based on structural strength of boom extension.
- 36 ft boom extension may be used for single or double line lifting service. 59 ft boom extension may be used for single line lifting service only.
 WARNING: Lifting with the 36 ft extension base, with the 23 ft extension fly either erected or folded along side of extension base, is strictly prohibited.
- Radii listed are for a 100 ft boom with the boom extension erected. For main boom lengths less than 100 ft, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is configured. For boom angles not shown, use the rating of the next lower boom angle.
 WARNING: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
- Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
- Capacities listed are with outriggers properly extended and vertical jacks set only.

Load chart

36 ft - 59 ft luffing folding boom extension (fixed angle) 130 ft boom



Feet	Pounds					
	36 ft LENGTH			59 ft LENGTH		
	5° OFFSET	20° OFFSET #0091	40° OFFSET	5° OFFSET	20° OFFSET #0092	40° OFFSET
40	23,350 (78)					
45	23,350 (76)	21,300 (78)		12,300 (78)		
50	23,350 (74)	20,700 (76.5)		12,300 (77.5)		
55	23,350 (72.5)	20,100 (75)	14,850 (78)	12,300 (76)		
60	23,350 (70.5)	19,500 (73)	14,550 (76)	12,300 (74.5)	11,600 (78)	
65	22,300 (68.5)	19,000 (71)	14,300 (74)	12,300 (73)	11,300 (77)	
70	20,350 (66.5)	18,500 (69)	14,050 (72)	12,300 (71)	10,950 (75)	
75	18,350 (64.5)	18,050 (67)	13,850 (70)	12,300 (69.5)	10,700 (73.5)	7850 (78)
80	16,600 (62.5)	17,000 (65)	13,650 (68)	12,300 (68)	10,400 (72)	7690 (76)
85	15,050 (60.5)	15,450 (63)	13,450 (66)	12,300 (66)	10,150 (70)	7550 (74.5)
90	13,650 (58.5)	14,050 (61)	13,300 (63.5)	12,250 (64.5)	9910 (68.5)	7420 (72.5)
95	12,400 (56.5)	12,800 (58.5)	13,150 (61.5)	11,900 (62.5)	9680 (66.5)	7300 (70.5)
100	11,300 (54)	11,650 (56.5)	11,950 (59)	11,450 (61)	9460 (64.5)	7190 (68.5)
105	10,300 (52)	10,650 (54)	10,950 (56.5)	10,500 (59)	9,260 (63)	7090 (66.5)
110	9340 (49.5)	9660 (52)	9950 (54)	9580 (57)	9060 (61)	7000 (64.5)
115	8480 (47)	8810 (49.5)	9070 (51.5)	8790 (55)	8800 (59)	6930 (62.5)
120	7630 (44.5)	7970 (46.5)	8200 (48.5)	8010 (53)	8550 (57)	6860 (60.5)
125	6700 (41.5)	7240 (44)	7430 (45.5)	7340 (51)	7840 (54.5)	6810 (58)
130	5780 (39)	6510 (41)	6670 (42.5)	6680 (49)	7140 (52.5)	6770 (55.5)
135	4980 (35.5)	5690 (37.5)		6100 (46.5)	6520 (50.5)	6500 (53.5)
140	4190 (32)	4880 (34)		5520 (44)	5910 (48)	6240 (50.5)
145	3500 (28)	4120 (30)		4860 (42)	5360 (45.5)	5640 (48)
150	2820 (23.5)	3360 (25.5)		4200 (39)	4820 (42.5)	5050 (45)
155				3580 (36.5)	4280 (40)	
160				2970 (33.5)	3750 (36.5)	
165				2430 (30)	3120 (33)	
170				1890 (26)	2490 (29)	

Min. boom angle for indicated length (no load)

20°	20°	40°	20°	20°	40°
-----	-----	-----	-----	-----	-----

Max. boom length (ft) at 5° boom angle (no load)

100 ft	100 ft
--------	--------

NOTE: () Boom angles are in degrees. #LMI operating code. Refer to LMI manual for operating instructions. A6-829-102554
 *This capacity is based on maximum obtainable boom angle.

NOTES:

- All capacities above the bold line are based on structural strength of boom extension.
- 36 ft boom extension may be used for single or double line lifting service. 59 ft boom extension may be used for single line lifting service only. WARNING: Lifting with the 36 ft extension base, with the 23 ft extension fly either erected or folded along side of extension base, is strictly prohibited.
- Radii listed are for a 130 ft boom with the boom extension erected. For main boom lengths less than 130 ft, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is configured. For boom angles not shown, use the rating of the next lower boom angle. WARNING: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
- Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
- Capacities listed are with outriggers properly extended and vertical jacks set only.

Load chart

36 ft - 59 ft luffing folding boom extension (fixed angle) 160 ft boom



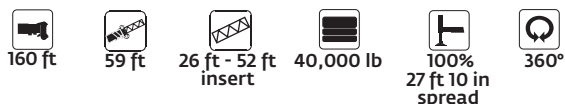
Pounds						
Feet	36 ft LENGTH			59 ft LENGTH		
	5° OFFSET	20° OFFSET #0091	40° OFFSET	5° OFFSET	20° OFFSET #0092	40° OFFSET
50	15,550 (77.5)					
55	15,550 (76)					
60	15,550 (74.5)	14,950 (77.5)		9650 (78)		
65	15,550 (73)	14,950 (76)	*14,400 (78)	9650 (77)		
70	15,550 (71.5)	14,950 (74.5)	14,150 (77)	9650 (75.5)	9650 (78)	
75	14,900 (70)	14,250 (73)	13,950 (75.5)	9650 (74)	9650 (77.5)	
80	14,100 (68)	13,550 (71)	13,400 (74)	9650 (72.5)	9650 (76)	
85	13,400 (66.5)	12,900 (69.5)	12,800 (72)	9650 (71)	9650 (74.5)	7630 (78)
90	12,700 (65)	12,250 (68)	12,200 (70.5)	9650 (69.5)	9650 (73)	7510 (77.5)
95	11,500 (63)	11,700 (66)	11,650 (68.5)	9650 (68.5)	9650 (72)	7390 (75.5)
100	10,400 (61.5)	10,850 (64.5)	11,100 (67)	9570 (67)	9420 (70)	7290 (74)
105	9480 (59.5)	9910 (62.5)	10,200 (65)	9150 (65)	9010 (68.5)	7200 (72.5)
110	8570 (58)	8970 (61)	9360 (63)	8730 (63.5)	8610 (67)	7110 (71)
115	7780 (56)	8160 (59)	8530 (61)	8000 (62)	8220 (65.5)	7030 (69.5)
120	6990 (54)	7360 (57)	7700 (59)	7280 (60.5)	7840 (64)	6950 (67.5)
125	6320 (52)	6670 (55)	6980 (57)	6620 (59)	7180 (62.5)	6890 (66)
130	5650 (50)	5980 (53)	6260 (55)	5970 (57.5)	6530 (60.5)	6830 (64)
135	5070 (48)	5380 (51)	5630 (53)	5400 (55.5)	5930 (59)	6320 (62.5)
140	4500 (46)	4780 (49)	5010 (50.5)	4830 (54)	5340 (57)	5820 (60.5)
145	3990 (43.5)	4250 (46.5)	4450 (48)	4340 (52)	4820 (55.5)	5260 (58.5)
150	3490 (41.5)	3730 (44)	3900 (45.5)	3850 (50)	4300 (53.5)	4710 (56.5)
155	2990 (38.5)	3260 (41.5)		3410 (48)	3840 (51.5)	4210 (54.5)
160	2490 (36)	2800 (38.5)		2980 (46)	3380 (49.5)	3710 (52)
165	1970 (33)	2300 (36)		2590 (44)	2960 (47.5)	3250 (50)
170	1450 (30)	1800 (32.5)		2210 (42)	2550 (45)	2790 (47.5)
175				1800 (39.5)	2170 (43)	
180				1390 (37.5)	1800 (40)	
185					1420 (37.5)	
Min. boom angle for indicated length (no load)	26°	29°	40°	34°	36°	40°
Max. boom length (ft) at 5° boom angle (no load)		100 ft			100 ft	

NOTE: () Boom angles are in degrees. A6-829-102558
 #LMI operating code. Refer to LMI manual for operating instructions.
 *This capacity is based on maximum obtainable boom angle.

- NOTES:**
- All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J765.
 - 36 ft. boom extension may be used for single or double line lifting service. 59 ft boom extension may be used for single line lifting service only. **WARNING:** Lifting with the 36 ft extension base, with the 23 ft extension fly either erected or folded along side of extension base, is strictly prohibited.
 - Radii listed are for a 160 ft boom with the boom extension erected. For main boom lengths less than 160 ft., the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is configured. For boom angles not shown, use the rating of the next lower boom angle. **WARNING:** Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
 - Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
 - Capacities listed are with outriggers properly extended and vertical jacks set only.

Load chart

59 ft luffing folding boom extension with 1 or 2 inserts (fixed angle) 160 ft boom



Pounds						
Feet	59 ft LENGTH WITH 26 ft INSERT			59 ft LENGTH WITH 52 ft INSERT		
	5° OFFSET	20° OFFSET #0095	40° OFFSET	5° OFFSET	20° OFFSET #1095	40° OFFSET
70	6830 (78)					
75	6830 (77)			4400 (78)		
80	6830 (75.5)	6610 (78)		4400 (77.5)		
85	6830 (74.5)	6610 (77.5)		4400 (76.5)		
90	6830 (73)	6610 (76)		4400 (75.5)	4230 (78)	
95	6830 (72)	6610 (75)	6400 (78)	4400 (74.5)	4230 (77.5)	
100	6830 (70.5)	6610 (73.5)	6400 (77)	4400 (73)	4230 (76.5)	
105	6830 (69.5)	6610 (72.5)	6400 (76)	4400 (72)	4230 (75.5)	4000 (78)
110	6830 (68)	6610 (71)	6400 (74.5)	4400 (71)	4230 (74)	4000 (77)
115	6590 (66.5)	6520 (69.5)	6310 (73)	4400 (69.5)	4230 (73)	4000 (75.5)
120	6350 (65)	6430 (68)	6230 (71.5)	4400 (68.5)	4230 (72)	4000 (74.5)
125	5910 (64)	6120 (67)	5950 (70)	4400 (67.5)	4230 (70.5)	4000 (73)
130	5480 (62.5)	5810 (65.5)	5680 (68.5)	4400 (66)	4,230 (69.5)	4000 (72)
135	4930 (61)	5480 (64)	5430 (67)	4110 (65)	4170 (68)	4000 (70.5)
140	4380 (59.5)	5160 (62.5)	5190 (65.5)	3820 (63.5)	4120 (67)	4000 (69)
145	3900 (58)	4640 (61)	4900 (64)	3350 (62.5)	3860 (65.5)	3780 (68)
150	3420 (56.5)	4130 (59.5)	4620 (62.5)	2880 (61)	3610 (64)	3570 (66.5)
155	3000 (55)	3680 (58)	4140 (60.5)	2470 (59.5)	3200 (63)	3360 (65)
160	2580 (53.5)	3230 (56.5)	3660 (59)	2060 (58.5)	2800 (61.5)	3160 (63.5)
165	2210 (52)	2820 (54.5)	3220 (57.5)	1690 (57)	2400 (60)	2810 (62.5)
170	1840 (50)	2420 (53)	2780 (55.5)		2010 (59)	2460 (61)
175	1510 (48.5)	2060 (51)	2380 (53.5)		1650 (57.5)	2070 (59.5)
180		1700 (49.5)	1990 (51.5)			1690 (58)
Min. boom angle for indicated length (no load)	46°	46°	48°	55°	56°	56°
Max. boom length (ft) at 5° boom angle (no load)	57 ft			57 ft		

NOTES:

- All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765.
- 59 ft. folding boom extension length may be used for single line lifting service only.
NOTE: Lifting with the 36 ft extension base with either one or two 26 ft insert sections installed is not permitted.
- For main boom lengths less than 160 ft with the boom extension erected, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is set up. For boom angles not shown, use the rating of the next lower boom angle.
- WARNING:** Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
- Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
- Capacities listed are with outriggers properly extended and vertical jacks set only.

NOTE: () Boom angles are in degrees. A6-829-102562
#LMI operating code. Refer to LMI manual for operating instructions.

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE.

Load chart

36 ft - 59 ft luffing folding boom extension 160 ft boom (load luffing)



Feet	Pounds			
	36 ft LENGTH		59 ft LENGTH	
	5° - 20° OFFSET #0091	20° - 40° OFFSET	5° - 20° OFFSET #0092	20° - 40° OFFSET
60	14,950			
65	14,950	10,250		
70	14,950	10,050	9650	
75	14,250	9840	9320	
80	13,550	9640	8950	
85	12,900	9460	8600	5100
90	12,250	9280	8290	4980
95	11,500	9130	7990	4880
100	10,400	8980	7720	4780
105	9480	8850	7470	4690
110	8570	8720	7220	4600
115	7780	8160	7010	4520
120	6990	7360	6790	4440
125	6320	6670	6600	4370
130	5650	5980	5970	4310
135	5070	5380	5400	4250
140	4500	4780	4830	4200
145	3990	4250	4340	4160
150	3490	3730	3850	4120
155	2990		3410	3840
160	2490		2980	3380
165	1970		2590	2960
170	1450		2210	2550
175			1800	
180			1390	
Min. boom angle for indicated length (no load)	29°	40°	36°	40°
Max. boom length (ft) at 5° boom angle (no load)	100 ft		100 ft	

A6-829-102575







#LMI operating code. Refer to LMI for operating instructions

NOTES:

1. All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765.
2. 36 ft boom extension length may be used for single or double line lifting service. 59 ft boom extension may be used for single line lifting service only.
WARNING: Lifting with the 36 ft extension base, with the 23 ft. extension fly either erected or folded along side of extension base, is strictly prohibited.
3. Capacities are applicable for a 160 ft main boom length only.
WARNING: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
4. The loads for luffing depend on the angle of the main boom, angle of the boom extension and dynamic working pressure of the luffing cylinder for the boom extension.
5. Capacities listed are with outriggers properly extended and vertical jacks set only.

Load chart

59 ft luffing folding boom extension with 1 or 2 inserts 160 ft boom (load luffing)

 160 ft  59 ft  26 ft - 52 ft Insert  40,000 lb  100% 27 ft 10 in spread  360°				
Pounds				
Feet	59 ft LENGTH with 26 ft INSERT		59 ft LENGTH with 52 ft INSERT	
	5° - 20° OFFSET	20° - 40° OFFSET	5° - 20° OFFSET	20° - 40° OFFSET
	#0095		#1095	
80	6610			
85	6610			
90	6610		4230	
95	6610	4420	4230	
100	6610	4330	4230	
105	6610	4250	4230	4000
110	6430	4180	4230	4000
115	6250	4100	4230	4000
120	6070	4020	4230	4000
125	5900	3970	4230	4000
130	5480	3920	4230	4000
135	4930	3870	4110	4000
140	4380	3810	3820	3960
145	3900	3770	3350	3780
150	3420	3730	2880	3570
155	3000	3680	2470	3200
160	2580	3230	2060	2800
165	2210	2820	1690	2400
170	1840	2420		2010
175	1510	2060		1650
180		1700		
Min. boom angle for indicated length (no load)	46°	48°	56°	56°
Max. boom length (ft) at 5° boom angle (no load)	57 ft		57 ft	

#LMI operating code. Refer to LMI manual for operating instructions. A6-829-102579

NOTES:

- All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765.
- 59 ft. boom extension may be used for single line lifting service only.
WARNING: Lifting with the 36 ft extension base, with either one or two 26 ft insert sections installed is not permitted.
- Capacities are applicable for a 160 ft main boom length only.
WARNING: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
- The loads for luffing depend on the angle of the main boom, angle of the boom extension and dynamic working pressure of the luffing cylinder for the boom extension.
- Capacities listed are with outriggers properly extended and vertical jacks set only.

Load chart

Installation and removal of counterweight and auxiliary hoist rated lifting capacities in pounds

On outriggers fully extended- 360°	
Radius in feet	#0801 Main boom length 42 ft*
10	48,000
12	48,000
15	48,000
20	48,000
25	48,000
30	48,000

Installation and removal of front and rear outrigger boxes rated lifting capacities in pounds without counterweight

On rubber (stationary) - 360°	
Radius in feet	#9810 Main boom length 42 ft*
10	11,600
12	11,600
15	11,600
20	11,600

* The boom must be fully retracted.

Notes for on rubber

- Capacities are applicable to machines equipped with Titan 33.25 x 29 (38 ply) tires at 85 psi cold inflation pressure. Capacities do not exceed 75% of tipping loads as determined by test in accordance with SAE J765.
- With no load, the boom angle must not be less than 35° when over sides of machine since loss of stability will occur causing a tipping condition. To lower boom below 35° boom angle, boom must be swung over front or rear and LMI bypass activated.
- Once one outrigger box is installed, do not swing load over that end of the machine while installing the other outrigger box.
- Each outrigger box assembly weighs 9373 lb including the outrigger beams and pads.
- May be used for single or double line lifting service.

Load handling

Weight reductions for load handling devices

36 ft - 59 ft luffing folding boom extension	Pounds
*36 ft extension (erected)	5260
*59 ft extension (erected)	9860
Luffing extension with 26 ft insert	Pounds
*59 ft extension (erected)	14,100
Luffing extension with 52 ft insert	Pounds
*59 ft extension (erected)	19,400

When lifting over boom nose with 36 ft or 59 ft extension erected, the outriggers must be fully extended or 50% extended (19 ft 9 in) spread.

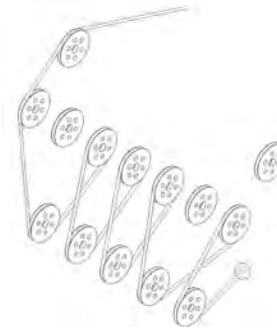
When lifting over main boom nose with 36 ft or 52 ft insert erected, the outriggers must be fully extended.

Auxiliary boom nose	Pounds
	120
Hookblocks and headache balls	Pounds
80 USt, 5-sheave	1600+
130 USt, 8-sheave	2400+
100 USt overhaul ball	690+
+Refer to rating plate for actual weight.	

When lifting over swingaway and/or jib combinations, deduct total weight of all load handling devices reeved over main boom nose directly from swingaway or jib capacity.

NOTE: All load handling devices and boom attachments are considered part of the load and suitable allowances **MUST BE MADE** for their combined weights. Weights are for Grove furnished equipment.

Reeving diagram



Line pulls and reeving information

Hoists	Cable specs	Permissible line pulls	Nominal cable length
Main Model 35	19 mm (3/4 in) 6 x 37 class, EIPS, IWRC Special Flexible Min. Breaking Str. 58,800 lb	16,800 lb	950 ft
Main Model 35	19 mm (3/4 in) Flex-X 35 Rotation resistant (non-rotating) Min. breaking Str. 85,500 lb	16,800 lb	950 ft
Auxiliary Model 35	19 mm (3/4 in) Flex-X 35 Rotation resistant (non-rotating) Min. breaking Str. 85,500 lb	16,800 lb	700 ft

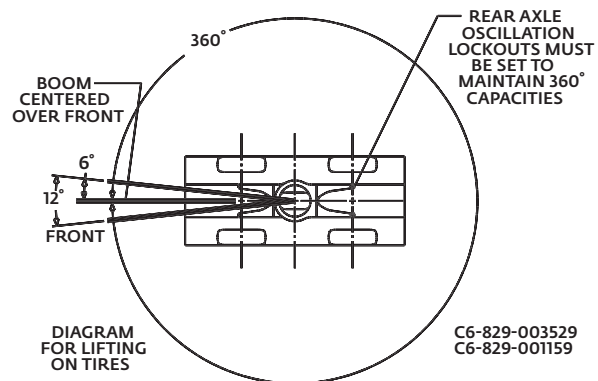
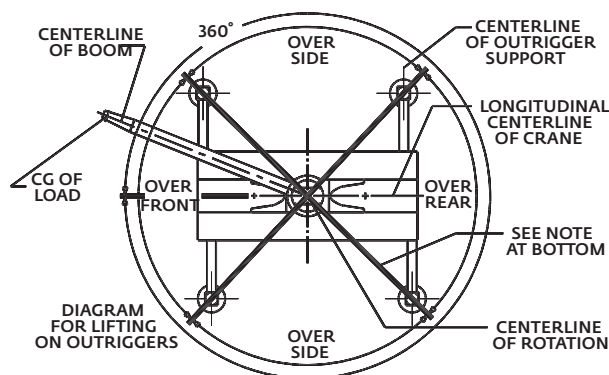
The approximate weight of 3/4 in wire rope is 1.5 lb/ft

Hoist performance

Wire rope layer	Hoist line pulls two-speed hoist		Drum rope capacity (ft)	
	Low available lb*	High available lb*	Layer	Total
1	20,024	12,496	140	140
2	18,405	11,485	152	293
3	17,028	10,626	165	458
4	15,842	9886	177	636
5	14,811	9243	190	826
6	13,906	8678	202	1028

* Max lifting capacity:
6 x 37 class or 35 x 7 class = 16,800 lb

Working area diagram



Bold lines determine the limiting position of any load for operation within working areas indicated.

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE.

Notes



Notes

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE.

Grove RT9130E

The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane

27

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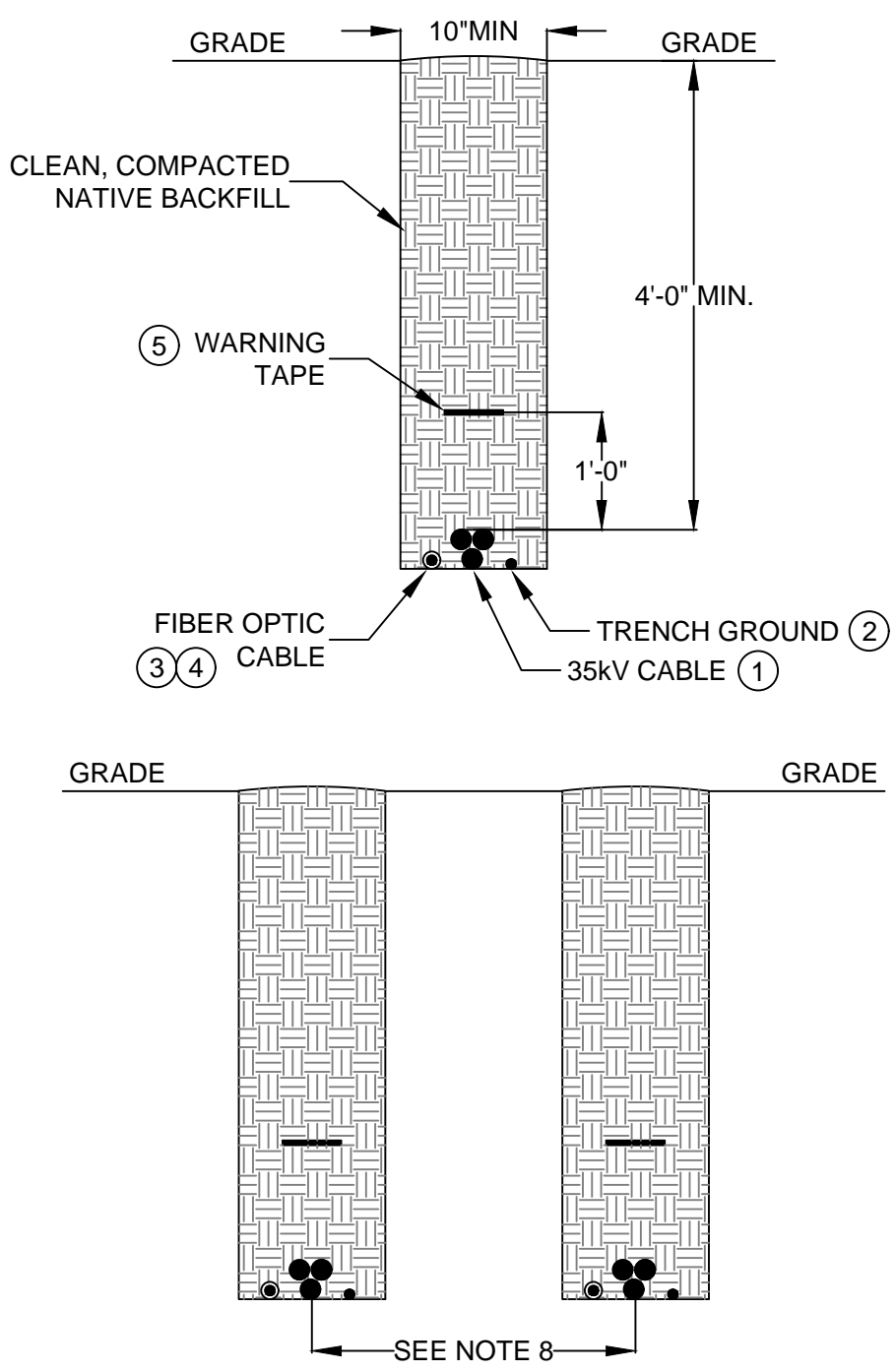
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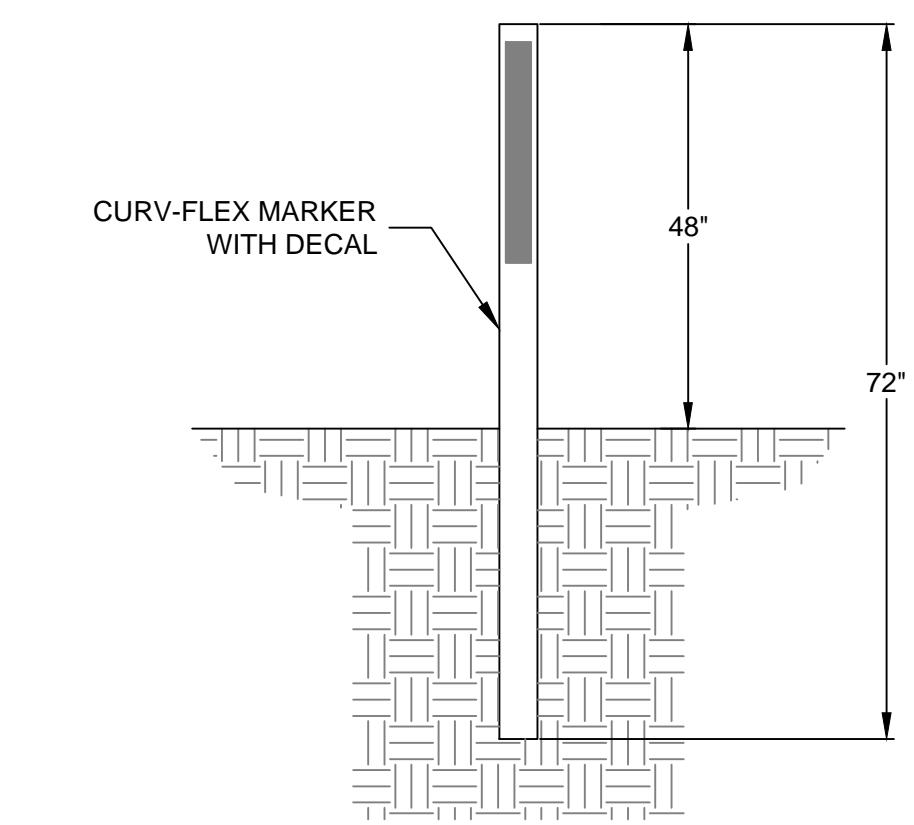
ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION
SEE ONE LINE	FT	1/0 AWG AL, 35KV, TRXLPE, 100% INSULATION, 6-#14 ROUND CONCENTRIC, XLPE JACKET	
SEE ONE LINE	FT	4/0 AWG AL, 35KV, TRXLPE, 100% INSULATION, 8-#14 ROUND CONCENTRIC, XLPE JACKET	
①	SEE ONE LINE	FT	500 MCM AL, 35KV, TRXLPE, 100% INSULATION, 9-#14 ROUND CONCENTRIC, XLPE JACKET
SEE ONE LINE	FT	750 MCM AL, 35KV, TRXLPE, 100% INSULATION, 12-#14 ROUND CONCENTRIC, XLPE JACKET	
SEE ONE LINE	FT	1000 MCM AL, 35KV, TRXLPE, 100% INSULATION, 9-#14 ROUND CONCENTRIC, XLPE JACKET	
SEE ONE LINE	FT	1250 MCM AL, 35KV, TRXLPE, 100% INSULATION, 14-#14 ROUND CONCENTRIC, XLPE JACKET	
②	SEE ONE LINE	FT	7-#8 COPPERCLAD STEEL (40% CONDUCTIVITY)
③	SEE ONE LINE	FT	12-STRAND SINGLE MODE FIBER
④	SEE ONE LINE	FT	FIBER INNERDUCT, 1.25", SDR 13.5
⑤	SEE ONE LINE	FT	6" CABLE WARNING TAPE, RED, DETECTABLE

- NOTES:
- THE 35KV CABLE SHALL BE INSTALLED AND MAINTAIN A TREFOIL CONFIGURATION. CONTRACTOR SHALL USE CABLE TIES AS NEEDED TO ENSURE TREFOIL FORMATION OF CABLE.
 - FIBER OPTIC CABLE AND/OR DUCT SHALL NOT CONTAIN ANY METAL COMPONENT IF TRENCHED JOINTLY WITH POWER CABLE.
 - IF NOTES 1 & 2 ARE MET, THE FIBER CABLE, TRENCH GROUND, AND 35KV CABLES DO NOT REQUIRE DELIBERATE SEPARATION WHEN FIBER OPTIC CABLE IS IN INNERDUCT.
 - TRENCHING IN OF CABLE IN SOIL CONTAINING ROCK OR OTHER SOLID MATERIAL SHOULD BE DONE IN SUCH A MANNER THAT THE SOLID MATERIAL SHALL NOT DAMAGE THE CABLE, EITHER DURING THE TRENCHING OPERATION, BACKFILLING, OR AFTERWARD.
 - THE DESIGN OF THE CABLE TRENCHING EQUIPMENT AND THE TRENCHING IN OPERATION SHOULD BE SUCH THAT THE CABLE SHALL NOT BE DAMAGED BY BENDING, SIDEWALL PRESSURE, OR EXCESSIVE CABLE TENSION.
 - PROPER CARE SHALL BE TAKEN TO PROTECT THE CABLES FROM DAMAGE DUE TO DEBRIS IN THE TRENCH. INSPECT THE SPOIL PILE AND THE BOTTOM OF TRENCH FOR ROCK AND DEBRIS AND REMOVE ANY LARGE/SHARP ROCKS AND/OR LARGE/SHARP DEBRIS THAT MAY CAUSE DAMAGE TO THE CABLE.
 - ANY DRAIN TILE DAMAGED, DISTURBED, BROKEN, OR CUT BY THE TRENCHING OPERATION SHALL BE REPAIRED AND LOCATED BY GPS.
 - A MINIMUM SEPARATION OF 15 FEET IS REQUIRED BETWEEN PARALLEL TRENCH RUNS EXCEPT WHERE NOTED ELSEWHERE ON THE DRAWINGS. PARALLEL BORES SHALL MAINTAIN A MINIMUM OF 20 FEET OF SEPARATION.
 - STRIP, STOCKPILE, AND REPLACE TOPSOIL IF REQUIRED BY LANDOWNER. DO NOT MIX TOPSOIL WITH SUB SOIL.
 - COMPACT TRENCH SOIL TO 85% STANDARD PROCTOR DENSITY.
 - ONLY ONE FIBER RUN SHOWN, SOME RUNS REQUIRE MULTIPLE FIBER RUNS. SEE FIBER ONE LINE DIAGRAMS.

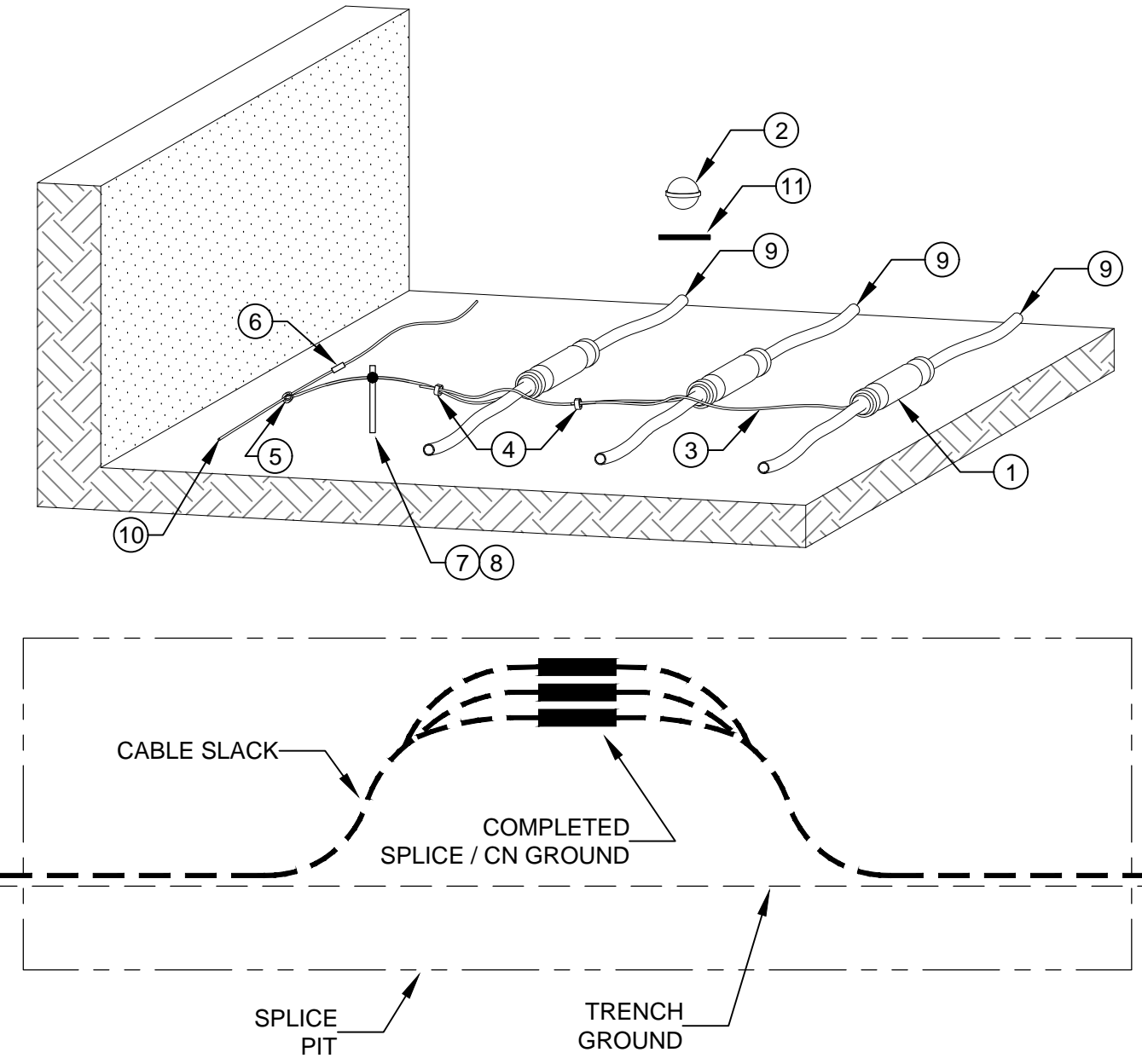
① CABLE TRENCH DETAIL
NOT TO SCALE



- NOTES:
- INSTALL CABLE ROUTE MARKERS AT ALL ROAD CROSSINGS, WETLAND/STREAM CROSSINGS, PROPERTY LINE CROSSINGS, AND AT CHANGES IN DIRECTION.
 - COORDINATE DECAL INFORMATION WITH THE OWNER.
 - MARKER BALLS SHALL BE REQUIRED AT ALL CROSSING LOCATIONS AND ALL CHANGES IN DIRECTION.



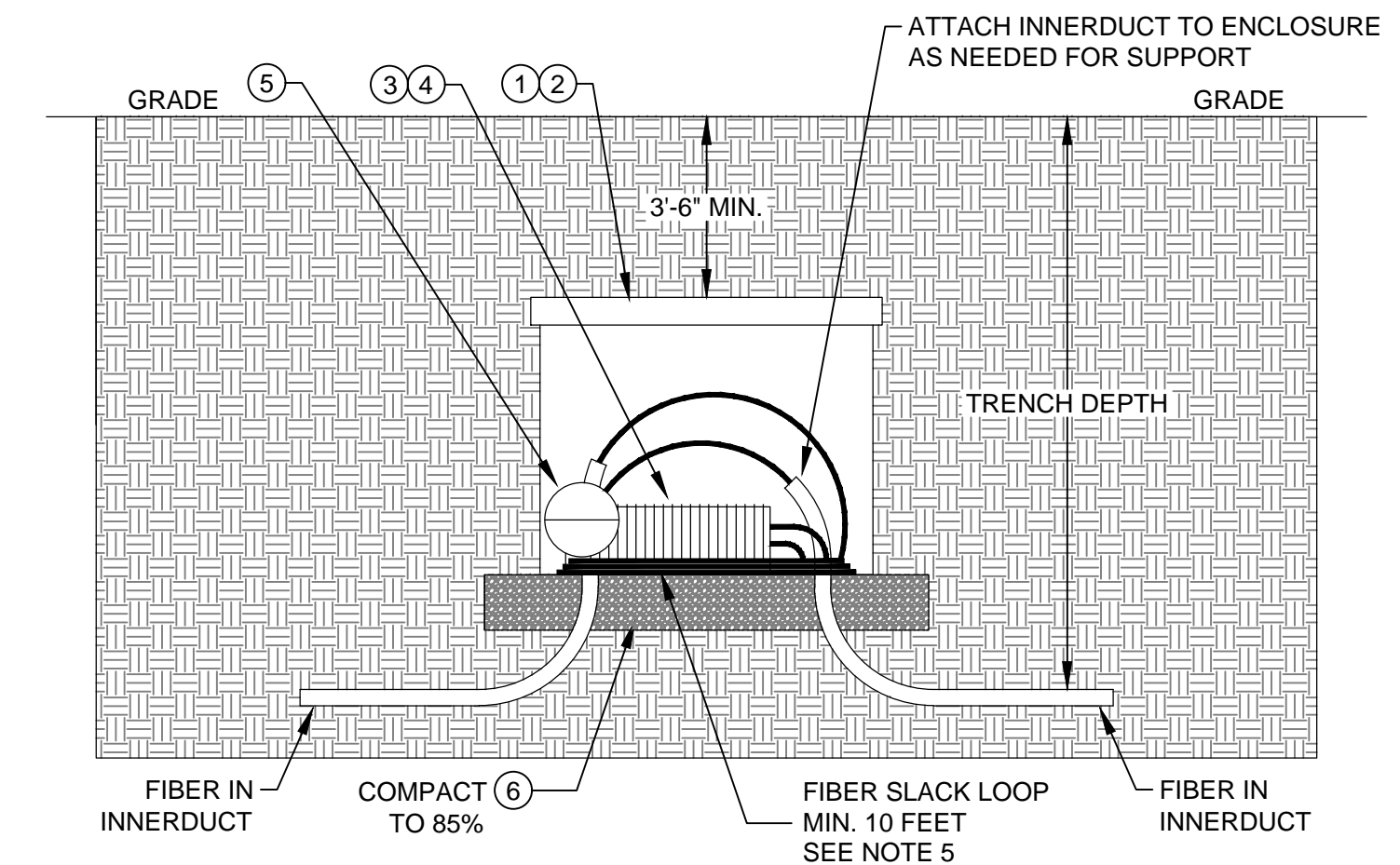
② CABLE MARKER DETAIL
NOT TO SCALE



ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION	MANUFACTURER (OR EQUAL)	PART NUMBER (OR EQUAL)
①	3	EA	CABLE SPLICE KIT, 35KV, 1/0 AWG AL	3M	5467A(S)-9-AL
	3	EA	CABLE SPLICE KIT, 35KV, 4/0 AWG AL	3M	5467A-12-AL
	3	EA	CABLE SPLICE KIT, 35KV, 500 MCM AL	3M	5468A-17-AL
	3	EA	CABLE SPLICE KIT, 35KV, 750 MCM AL	3M	5468A-18-AL
	3	EA	CABLE SPLICE KIT, 35KV, 1000 MCM AL	3M	5468A(L)-19-AL
	3	EA	CABLE SPLICE KIT, 35KV, 1250 MCM AL	3M	5468A(L)-20-AL
②	1	EA	EMS BALL MARKER	3M	80611161144
③	15	FT	#2 SOLID BARE COPPER	SOUTHWIRE	----
④	2	EA	CONNECTOR, #2 CU TO #2 CU	BURNDY	YGHC2C2
⑤	1	EA	CONNECTOR, #2 CU TO TRENCH GROUND	BURNDY	YGHC26C2
⑥	1	EA	TRENCH GROUND TO TRENCH GROUND	BURNDY	YGHC26C26
⑦	1	EA	CONNECTOR, #2 CU TO GROUND ROD	BURNDY	YGHC26C2
⑧	1	EA	5/8" X 10' COPPERBONDED GROUND ROD	ERITECH	615803
⑨	----	----	35KV CABLE	WTEC	----
⑩	----	----	TRENCH GROUND	WTEC	----
⑪	----	----	6" CABLE WARNING TAPE, RED, DETECTABLE	3M	----

- NOTES:
- CABLES TO BE LAID SLACK IN HORIZONTAL ARRANGEMENT WITH A MINIMUM OF 7.5 INCHES OF SEPARATION.
 - SEAL #2 SOLID BARE COPPER WITHIN SPLICE (IN MASTIC) BEFORE INSTALLING COLD SHRINK COVER.
 - GPS LOCATES SHALL BE TAKEN AT ALL UNDERGROUND CABLE SPLICE LOCATIONS WITH A 3 METER ACCURACY.
 - PLACE MARKER BALL 24-30 INCHES BELOW SURFACE.
 - SPLICE KITS SHALL BE INSTALLED PER THE MANUFACTURER'S INSTRUCTIONS BY QUALIFIED PERSONNEL.
 - WARNING TAPE SHALL BE PLACED ABOVE CABLES.
 - FIBER OPTIC DUCT SHALL BE PLACED NEAR TRENCH GROUND, FIBER DUCT NOT SHOWN FOR CLARITY.
 - SPLICE KIT MANUFACTURER TO INCLUDE CONCENTRIC TO CONCENTRIC CONNECTOR AND CONCENTRIC TO #2 SOLID BARE COPPER CONNECTOR.
 - COMPACT SPLICE PIT TO 85% STANDARD PROCTOR DENSITY OR BETTER WHEN INSTALLATION IS COMPLETE.
 - GROUND ROD MUST GO AT LEAST 8 FEET INTO UNDISTURBED SOIL. IF DENSE SOIL OR ROCK IS ENCOUNTERED DURING VERTICAL GROUND ROD INSTALLATION THEN CONTRACTOR MAY INSTALL GROUND ROD AT 45 DEGREE ANGLE. IF GROUND ROD IS STILL UNABLE TO BE INSTALLED THEN CONTRACTOR MAY INSTALL HORIZONTALLY INTO EXCAVATION WALL OR LAY GROUND ROD WITHIN TRENCH.
 - SUPPLY ENOUGH CABLE SLACK WITHIN THE SPLICE PIT THAT PROVIDES FOR UP TO TWO FUTURE TERMINATIONS.

③ CABLE SPLICE DETAIL
NOT TO SCALE



ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION	MANUFACTURER (OR EQUAL)	PART NUMBER (OR EQUAL)
①	1	EA	HANDHOLE ENCLOSURE	QUAZITE	PG2436BG30
②	1	EA	HANDHOLE ENCLOSURE COVER	QUAZITE	PG2436HG00
③	1	EA	SPLICE CLOSURE	PLP	8006671
④	1	EA	SPLICE TRAY	PLP	80806033
⑤	1	EA	EMS BALL MARKER	3M	80611161144
⑥	AS REQ'D	YD	PEA GRAVEL (6" THICK)	----	----

- NOTES:
- GPS LOCATES SHALL BE TAKEN AT ALL FIBER SPLICE LOCATIONS.
 - VERIFY HANDHOLE ENCLOSURE LOCATION WITH OWNER PRIOR TO INSTALLATION.
 - INSTALL HANDHOLE ENCLOSURE AND FIBER SPLICES PER MANUFACTURER'S INSTRUCTIONS.
 - FIBER SPLICE HANDHOLE ENCLOSURE SHALL BE BURIED AT TRENCH DEPTH (3'-6") IF NOT LOCATED NEAR A WIND TURBINE, ROAD, OR JUNCTION BOX.
 - THE LONG TERM MINIMUM BENDING RADIUS SHALL BE 10X THE OUTER DIAMETER UNLESS OTHERWISE SPECIFIED BY THE MANUFACTURER.
 - MARKER BALL CAN BE PLACED IN OR ABOVE ENCLOSURE. MARKER BALL DEPTH SHALL BE 24 TO 36 INCHES BELOW GRADE.
 - SEAL CONDUITS WITH A CLOSED CELL FOAM AROUND CABLES AFTER INSTALLATION.

④ FIBER SPLICE HANDHOLE ENCLOSURE DETAIL
NOT TO SCALE

Rev.	Date	Description	By
A	12/10/2018	90% SUBMITTAL	CM



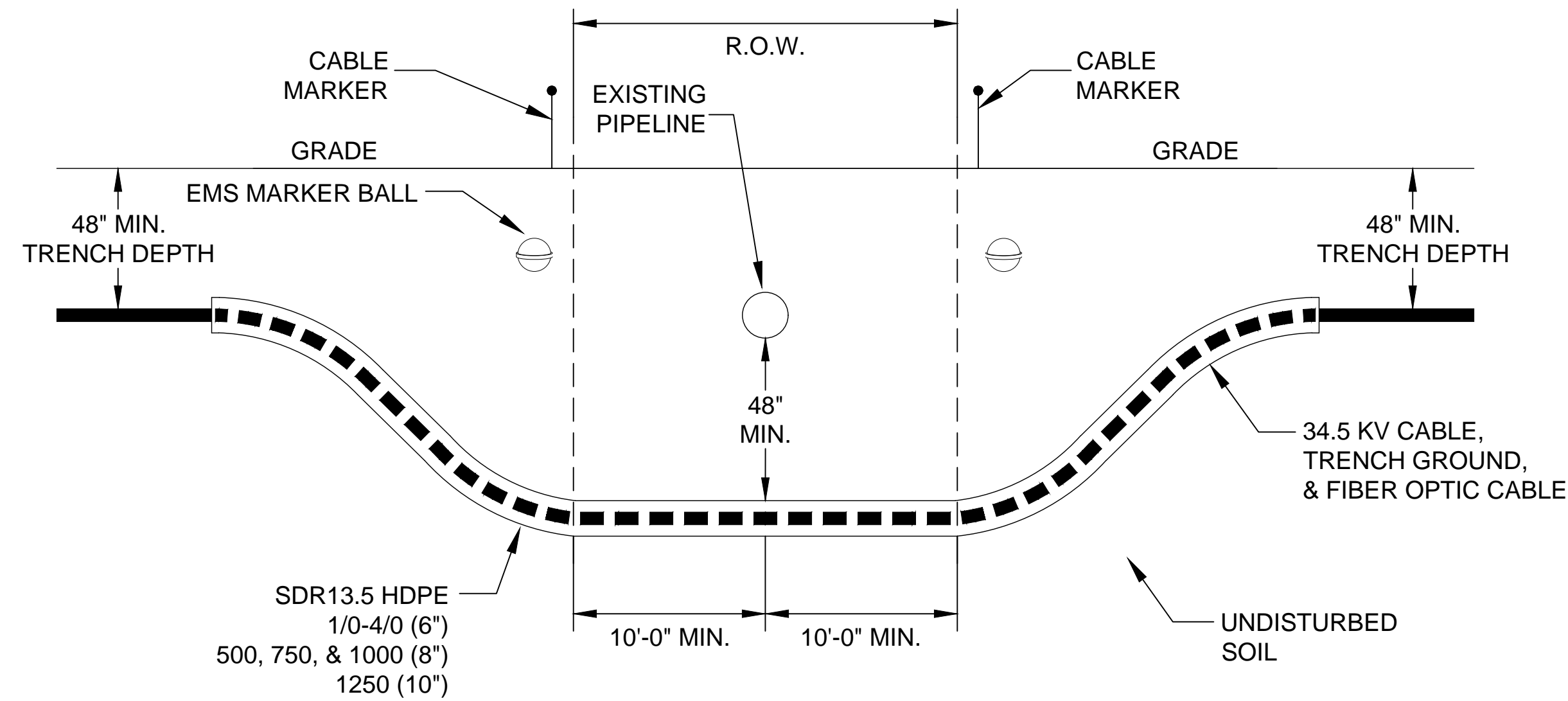
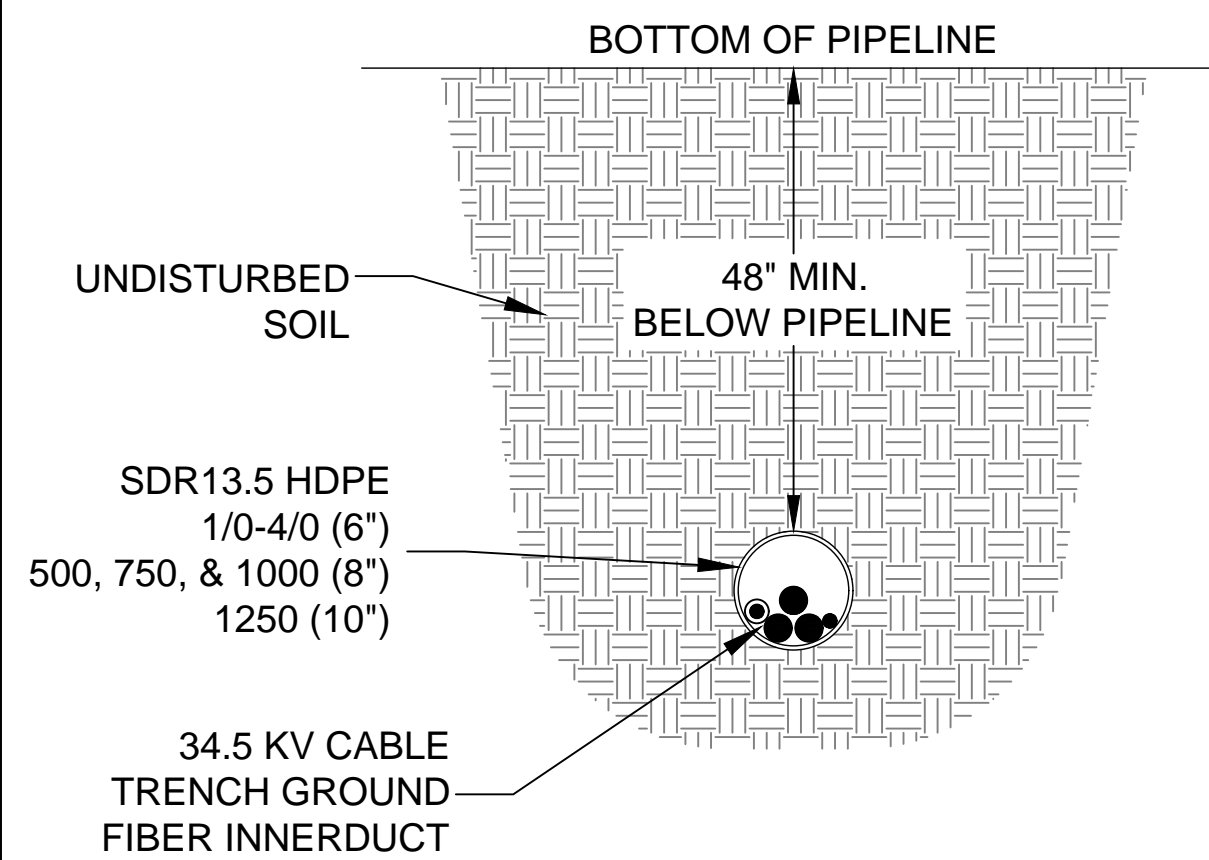
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Design By: J. HERMANSON
Drawn By: M. JENSON
Approved By: C. MATHSON
Project Number: 17.00706

**COLLECTION SYSTEM
CABLE INSTALLATION
DETAILS**

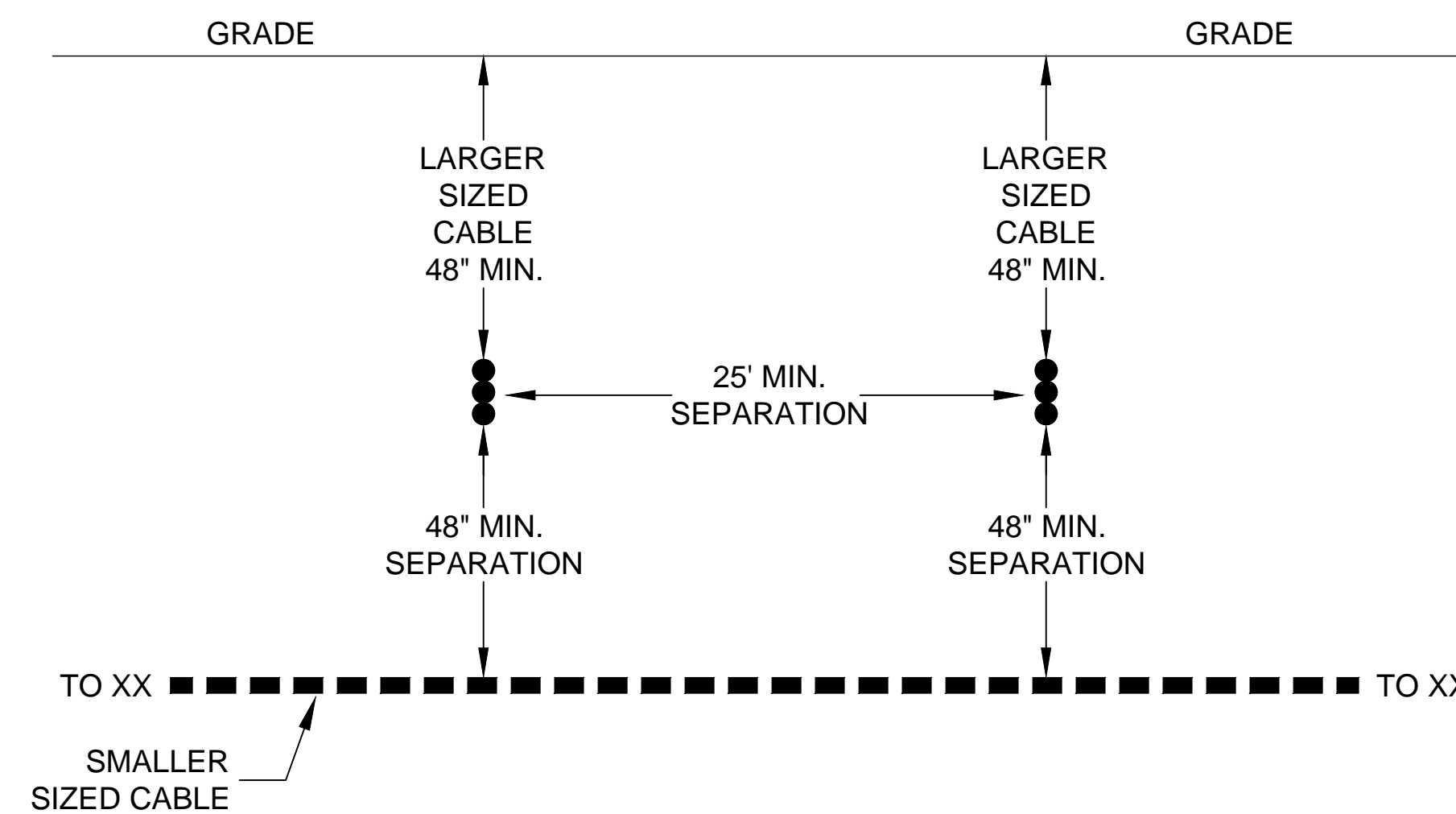
Rev.	Date	Description	By
A	12/10/2018	90% SUBMITTAL	CM
0	01/18/2019	ISSUED FOR CONSTRUCTION	CM



1 PIPELINE CROSSING DETAIL
NOT TO SCALE

NOTES:

- DO NOT EXCEED THE MINIMUM BENDING RADIUS OF THE CABLE.
- TYPICAL PIPELINE CROSSING SHOWN.
- CROSSINGS SHALL BE MADE AS CLOSE TO A 90° ANGLE TO THE PIPELINE AS POSSIBLE.
- ALL CROSSINGS SHALL BE A MINIMUM OF 48 INCHES BELOW BOTTOM OF PIPELINE.
- PARALLEL BORE SEPARATION SHALL BE A MINIMUM OF 20 FEET.
- BORE ENTIRE RIGHT-OF-WAY.
- BORE PITS MUST BE LOCATED OUTSIDE R/W EDGE OR 10 FEET FROM PIPELINE WHICHEVER IS GREATER.
- PLACE CABLE MARKER AT EDGE OF RIGHT-OF-WAY. SEE CABLE MARKER DETAIL.
- REAM OR CHAMFER BORE PIPE ENDS.
- GPS COORDINATES SHALL BE RECORDED.
- PIPELINE REPRESENTATIVE SHALL BE PRESENT WHILE THE EXCAVATION IS TAKING PLACE IF REQUIRED.
- VERIFY CROSSING AGREEMENT REQUIREMENTS OF THE PIPELINE WITH OWNER AND APPROVED PERMIT.
- USE PROPER PULLING LUBRICANT DURING CABLE INSTALLATION.



2 CABLE CROSSING DETAIL
NOT TO SCALE

NOTES:

- LARGER SIZED CABLE IS PLACED ABOVE SMALLER SIZED CABLE.
- NOT ALL CABLE RUNS ARE SHOWN FOR CLARITY.
- VERTICAL CABLE INSTALLATION SHOWN. SOME CABLE RUNS REQUIRE TREFOIL FORMATION. SEE ONE LINE FOR MORE DETAILS.

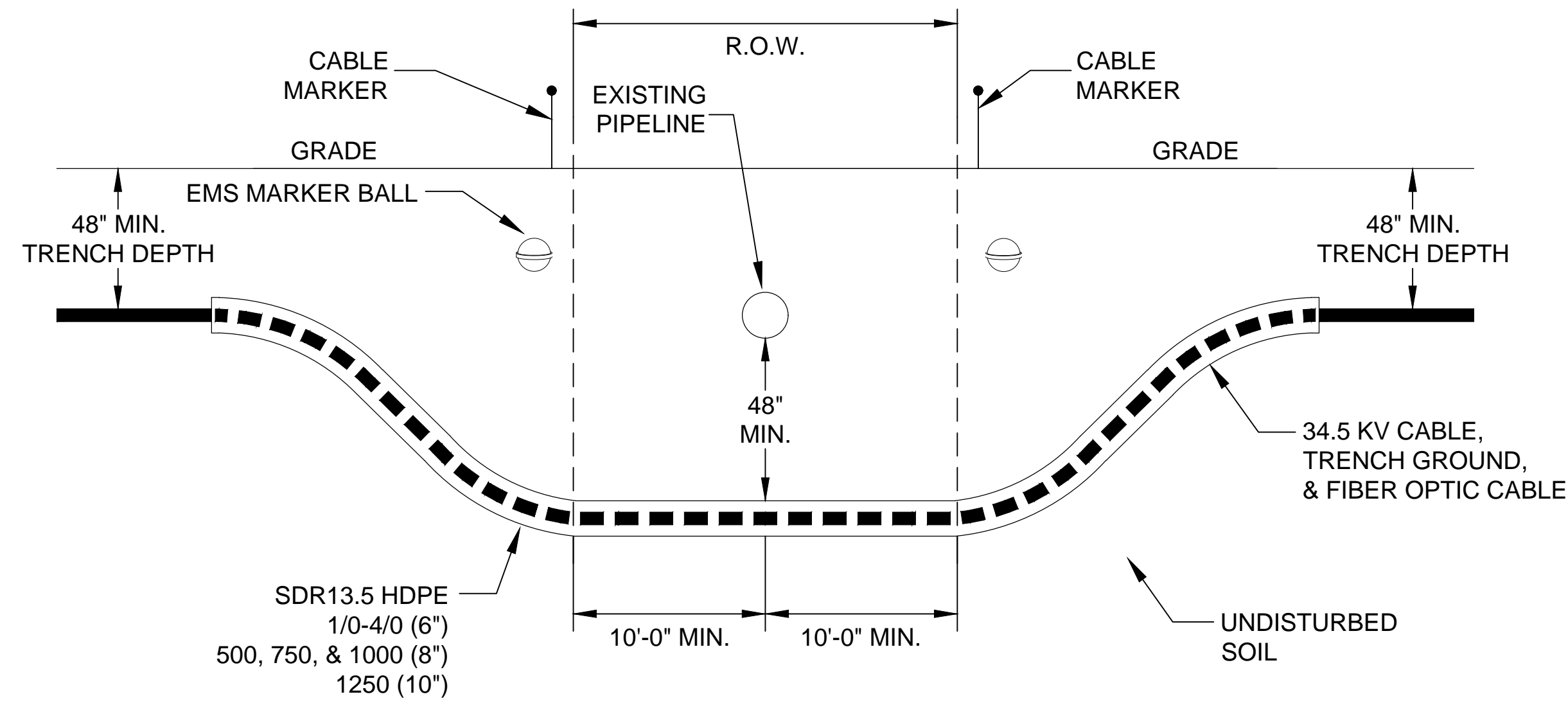
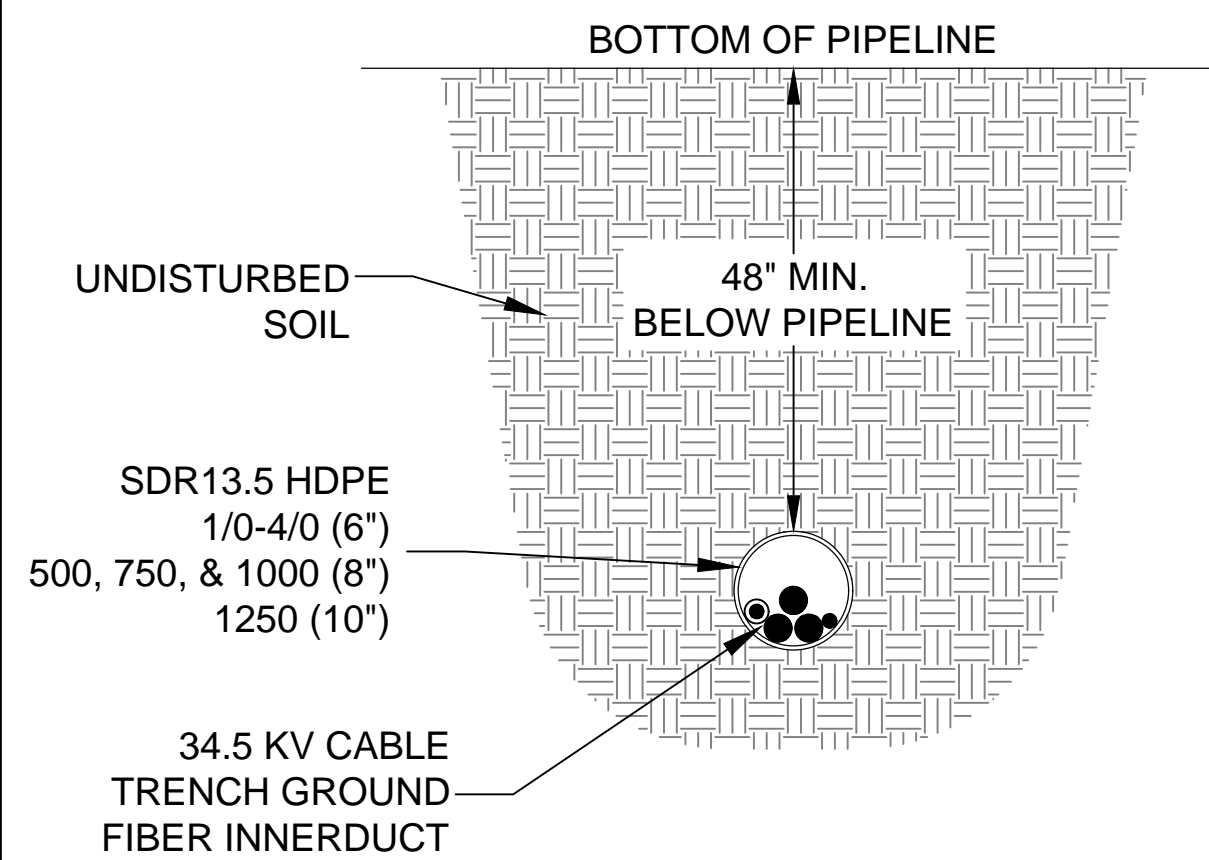
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Design By: J. HERMANSON
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Approved By: C. MATHSON
Project Number: 17.00706

COLLECTION SYSTEM
CABLE CROSSING
DETAILS

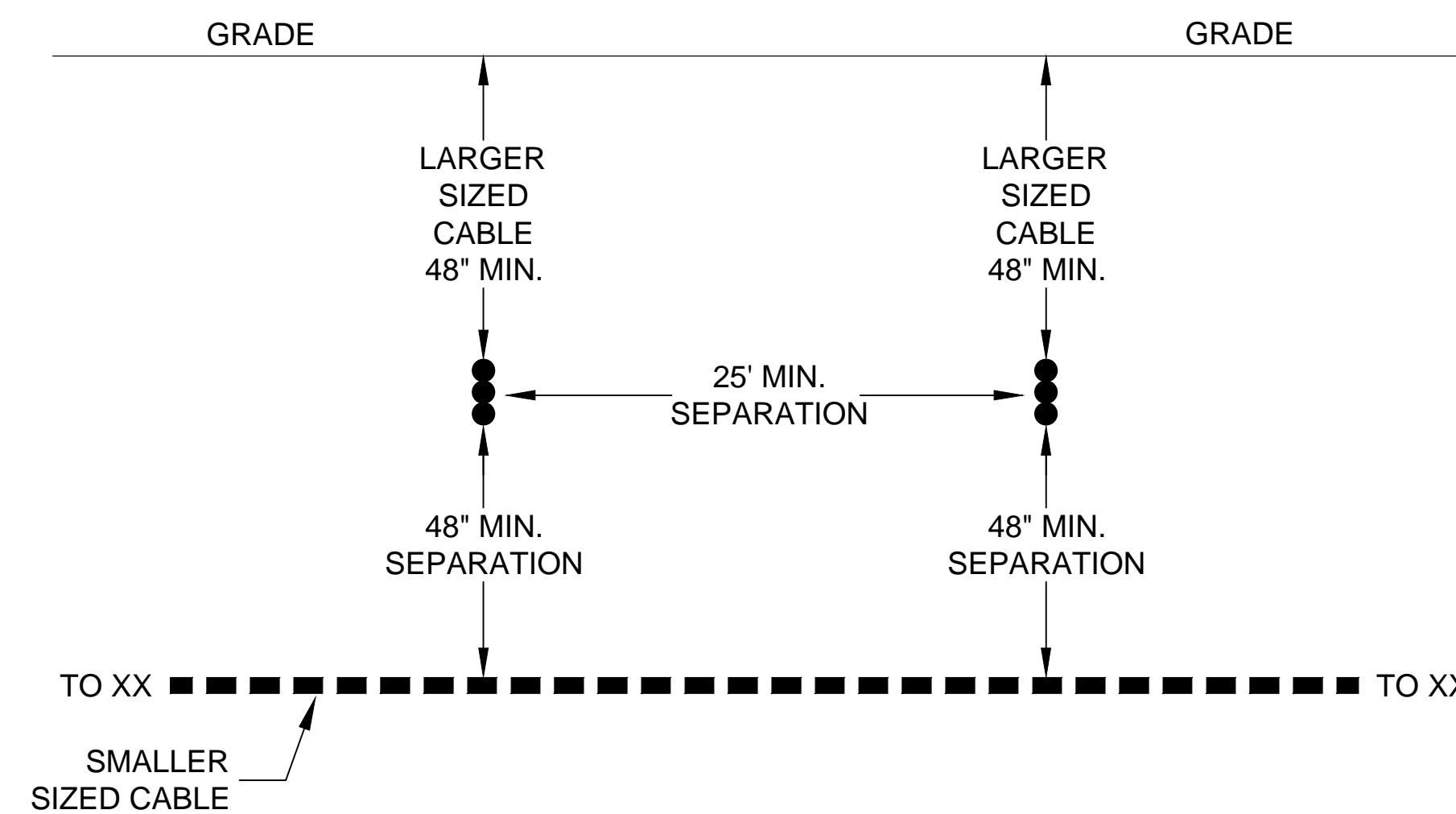
Rev.	Date	Description	By
A	12/10/2018	90% SUBMITTAL	CM



1 PIPELINE CROSSING DETAIL
NOT TO SCALE

NOTES:

- DO NOT EXCEED THE MINIMUM BENDING RADIUS OF THE CABLE.
- TYPICAL PIPELINE CROSSING SHOWN.
- CROSSINGS SHALL BE MADE AS CLOSE TO A 90° ANGLE TO THE PIPELINE AS POSSIBLE.
- ALL CROSSINGS SHALL BE A MINIMUM OF 48 INCHES BELOW BOTTOM OF PIPELINE.
- PARALLEL BORE SEPARATION SHALL BE A MINIMUM OF 20 FEET.
- BORE ENTIRE RIGHT-OF-WAY.
- BORE PITS MUST BE LOCATED OUTSIDE R/W EDGE OR 10 FEET FROM PIPELINE WHICHEVER IS GREATER.
- PLACE CABLE MARKER AT EDGE OF RIGHT-OF-WAY. SEE CABLE MARKER DETAIL.
- REAM OR CHAMFER BORE PIPE ENDS.
- GPS COORDINATES SHALL BE RECORDED.
- PIPELINE REPRESENTATIVE SHALL BE PRESENT WHILE THE EXCAVATION IS TAKING PLACE IF REQUIRED.
- VERIFY CROSSING AGREEMENT REQUIREMENTS OF THE PIPELINE WITH OWNER AND APPROVED PERMIT.
- USE PROPER PULLING LUBRICANT DURING CABLE INSTALLATION.



2 CABLE CROSSING DETAIL
NOT TO SCALE

NOTES:

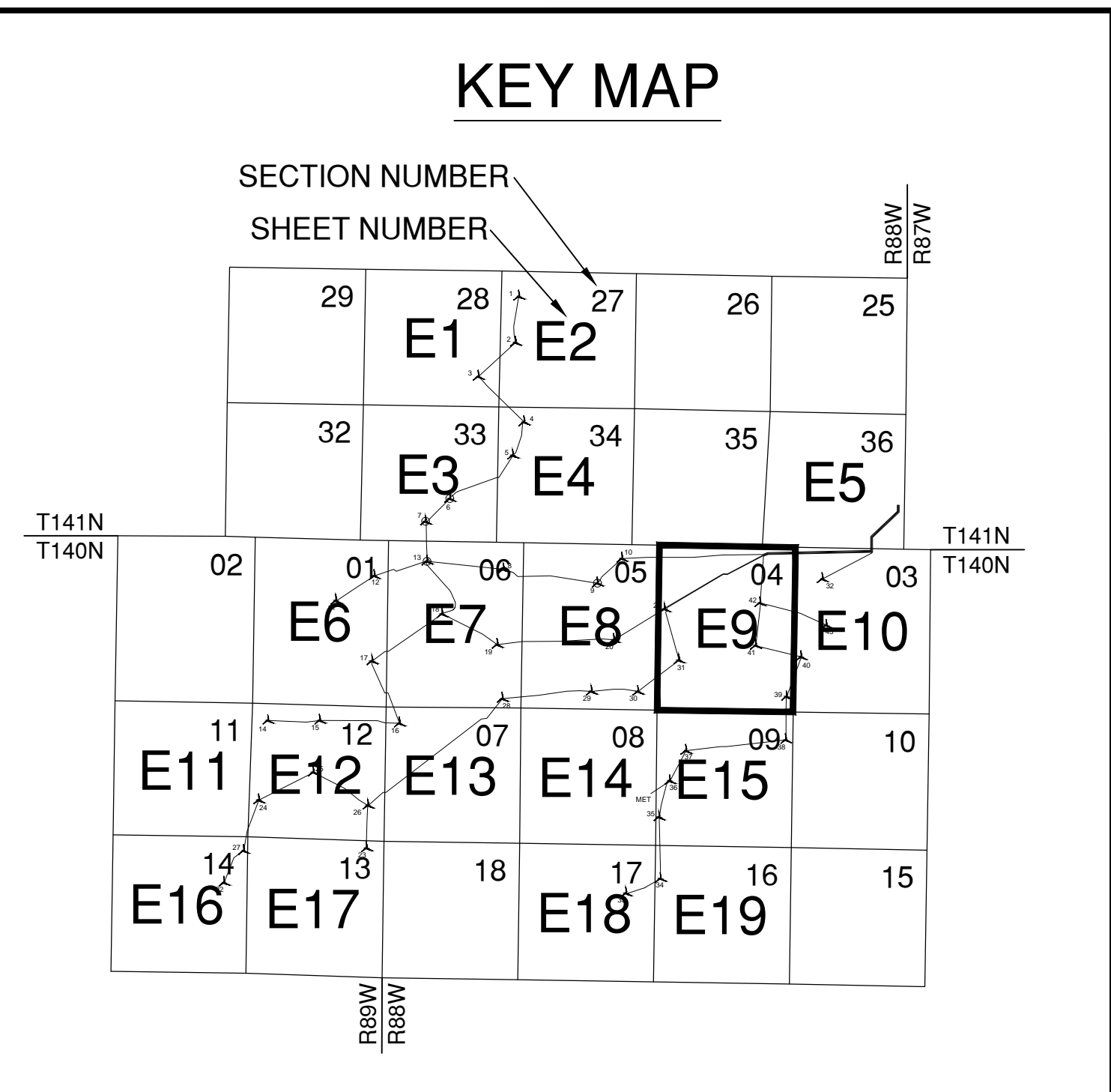
- LARGER SIZED CABLE IS PLACED ABOVE SMALLER SIZED CABLE.
- NOT ALL CABLE RUNS ARE SHOWN FOR CLARITY.
- VERTICAL CABLE INSTALLATION SHOWN. SOME CABLE RUNS REQUIRE TREFOIL FORMATION. SEE ONE LINE FOR MORE DETAILS.

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COLLECTION SYSTEM
CABLE CROSSING
DETAILS



GLEN ULLIN ENERGY CENTER
GLEN ULLIN, NORTH DAKOTA

Rev.	Date	Description	By
A	12/10/2018	90% SUBMITTAL	CM

a MasTec company

PRELIMINARY

NOT FOR CONSTRUCTION

- GENERAL NOTES:**
1. CALL FOR LOCATES PRIOR TO CONSTRUCTION.
 2. DO NOT PLACE JUNCTION BOXES IN LOW AREAS THAT MAY FLOOD OR COLLECT WATER. COORDINATE JUNCTION BOX LOCATIONS WITH OWNER.

LEGEND	
XX	WIND TURBINE GE 2.3 MW
XX	WIND TURBINE GE 2.5 MW
— F1 —	FEEDER 1
— F2 —	FEEDER 2
— F3 —	FEEDER 3
— F4 —	FEEDER 4
— PIPELINE —	PIPELINE
●	MET TOWER
[XJBX]	JUNCTION BOX
XXX	BORE WITH ID (XXX)
—	ACCESS ROAD

N
W E
S

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COLLECTION SYSTEM
FEEDER ROUTING
DIAGRAMS
SECTION 04, T140N, R88W

DWG #: **GUEC-COL-E9** REVISION: **A**

CYMCAP Version	7.3 Revision 01
Study:	Glen Ullin Cable Ampacity
Execution:	TRENCH - 1250 MCM

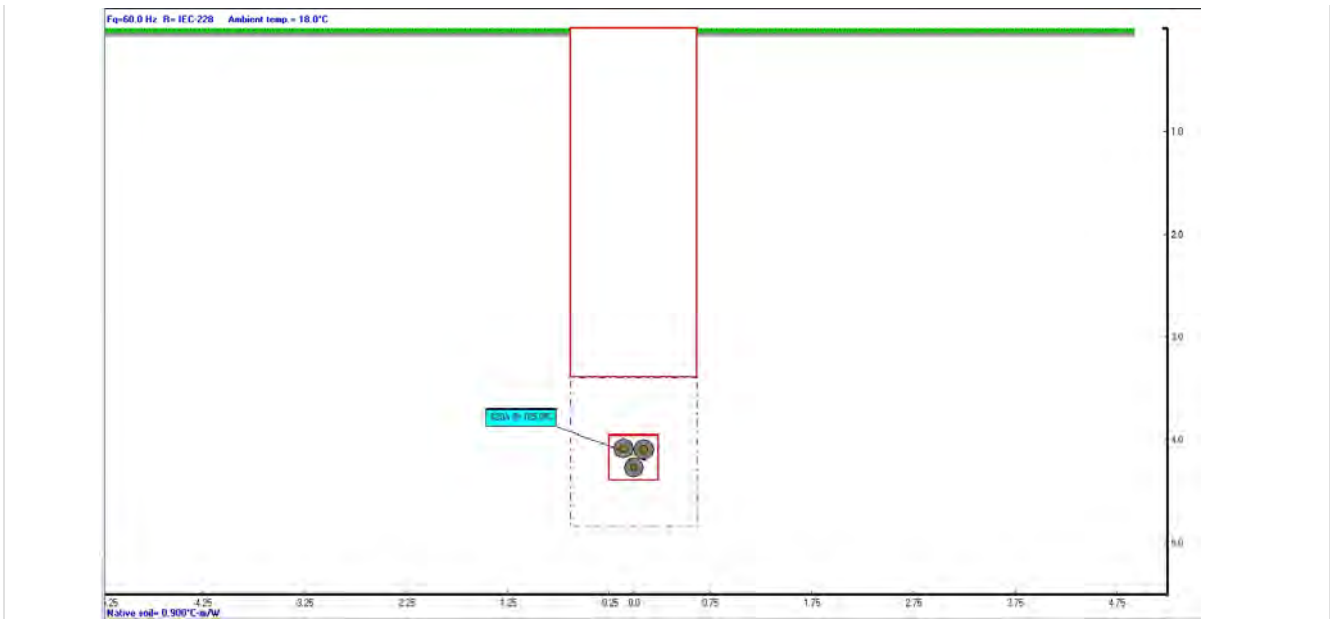
General Simulation Data

Steady State Option	Unequally Loaded
Conductor Resistances Computation Option:	IEC-228

Installation Type: Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	18.0
Native Soil Thermal Resistivity	[K.m/W]	0.9

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	0.0	4.125	1.25	1.45	2.47
Backfill	0.0	1.7	1.25	3.4	2.1



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	GLEN ULLIN 1250	1		A	60.0	1.0	-0.1	4.09	104.9	620.0
2	GLEN ULLIN 1250	1		B	60.0	1.0	0.1	4.09	104.9	620.0
3	GLEN ULLIN 1250	1		C	60.0	1.0	0.0	4.27	105.0	620.0

CYMCAP Version	7.3 Revision 01
Study:	Glen Ullin Cable Ampacity
Execution:	BORE - 1250 MCM

General Simulation Data	
Steady State Option	Unequally Loaded
Conductor Resistances Computation Option:	IEC-228

Installation Type: Multiple Ductbanks/Backfills		
Ambient Soil Temperature at Installation Depth	[°C]	15.0
Native Soil Thermal Resistivity	[K.m/W]	0.9

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	0.0	10.675	1.8	1.75	2.13



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	GLEN ULLIN 1250	1		A	60.0	1.0	-0.1	10.71	105.0	603.5
2	GLEN ULLIN 1250	1		B	60.0	1.0	0.1	10.71	105.0	603.5
3	GLEN ULLIN 1250	1		C	60.0	1.0	0.0	10.53	104.7	603.5

CYMCAP Version	7.3 Revision 01
Study:	Glen Ullin Cable Ampacity
Execution:	PARALLEL TRENCH

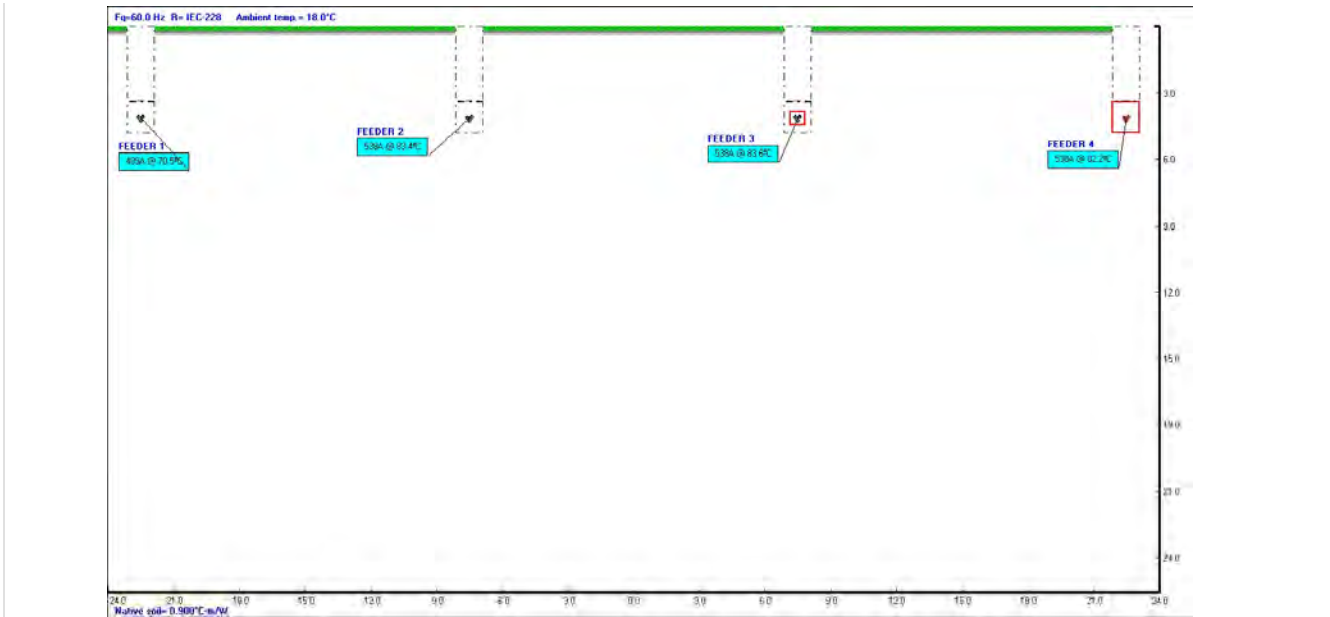
General Simulation Data

Steady State Option	Temperature
Conductor Resistances Computation Option:	IEC-228

Installation Type: Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	18.0
Native Soil Thermal Resistivity	[K.m/W]	0.9

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	-22.5	4.125	1.25	1.45	2.47
Backfill8	22.5	1.7	1.25	3.4	2.1
Backfill7	22.5	4.125	1.25	1.45	2.47
Backfill6	7.5	1.7	1.25	3.4	2.1
Backfill5	7.5	4.125	1.25	1.45	2.47
Backfill4	-7.5	1.7	1.25	3.4	2.1
Backfill3	-7.5	4.125	1.25	1.45	2.47
Backfill	-22.5	1.7	1.25	3.4	2.1



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	GLEN ULLIN 1250	1	FEEDER 1	A	60.0	1.0	-22.6	4.09	70.5	489.3
2	GLEN ULLIN 1250	1	FEEDER 1	B	60.0	1.0	-22.4	4.09	70.5	489.3
3	GLEN ULLIN 1250	1	FEEDER 1	C	60.0	1.0	-22.5	4.27	70.5	489.3
4	GLEN ULLIN 1250	2	FEEDER 2	A	60.0	1.0	-7.6	4.09	83.3	538.2
5	GLEN ULLIN 1250	2	FEEDER 2	B	60.0	1.0	-7.4	4.09	83.3	538.2
6	GLEN ULLIN 1250	2	FEEDER 2	C	60.0	1.0	-7.5	4.27	83.4	538.2

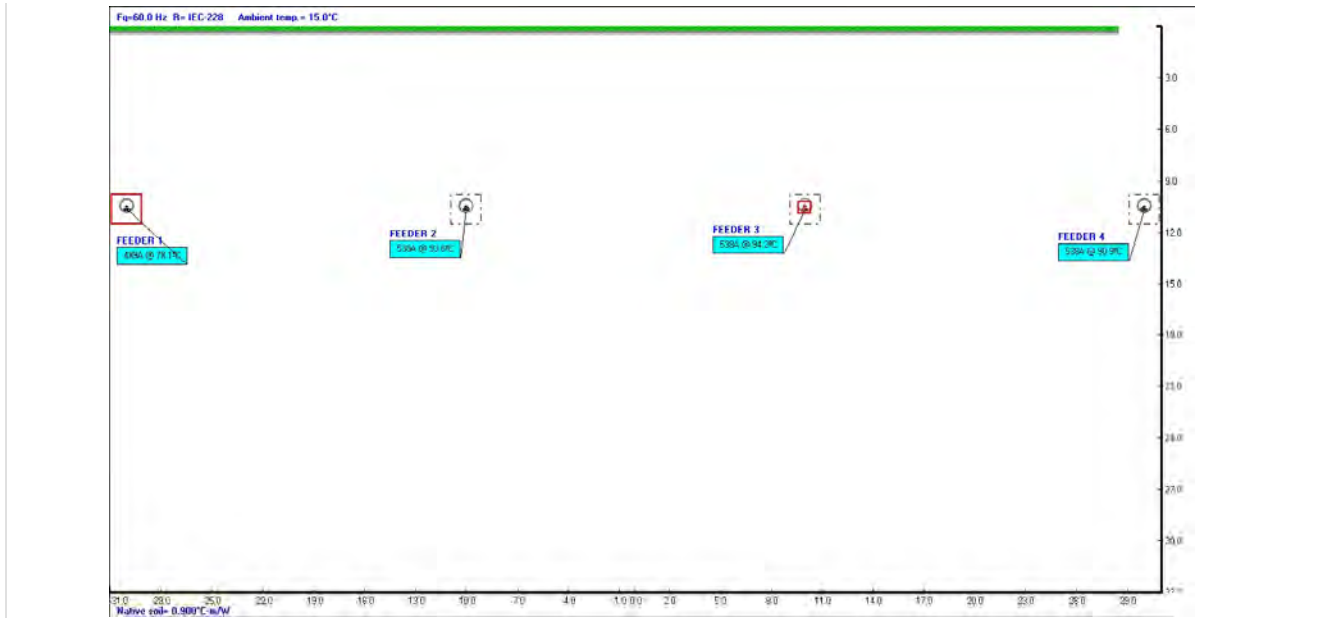
7	GLEN ULLIN 1250	3	FEEDER 3	A	60.0	1.0	7.4	4.09	83.5	538.2
8	GLEN ULLIN 1250	3	FEEDER 3	B	60.0	1.0	7.6	4.09	83.5	538.2
9	GLEN ULLIN 1250	3	FEEDER 3	C	60.0	1.0	7.5	4.27	83.6	538.2
10	GLEN ULLIN 1250	4	FEEDER 4	A	60.0	1.0	22.4	4.09	82.1	538.2
11	GLEN ULLIN 1250	4	FEEDER 4	B	60.0	1.0	22.6	4.09	82.1	538.2
12	GLEN ULLIN 1250	4	FEEDER 4	C	60.0	1.0	22.5	4.27	82.2	538.2

CYMCAP Version	7.3 Revision 01
Study:	Glen Ullin Cable Ampacity
Execution:	PARALLEL BORE

General Simulation Data	
Steady State Option	Temperature
Conductor Resistances Computation Option:	IEC-228

Installation Type: Multiple Ductbanks/Backfills		
Ambient Soil Temperature at Installation Depth	[°C]	15.0
Native Soil Thermal Resistivity	[K.m/W]	0.9

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	-30.0	10.675	1.8	1.75	2.13
Backfill4	30.0	10.675	1.8	1.75	2.13
Backfill3	10.0	10.675	1.8	1.75	2.13
Backfill2	-10.0	10.675	1.8	1.75	2.13



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	GLEN ULLIN 1250	1	FEEDER 1	A	60.0	1.0	-30.1	10.71	78.1	489.3
2	GLEN ULLIN 1250	1	FEEDER 1	B	60.0	1.0	-29.9	10.71	78.1	489.3
3	GLEN ULLIN 1250	1	FEEDER 1	C	60.0	1.0	-30.0	10.53	77.9	489.3
4	GLEN ULLIN 1250	2	FEEDER 2	A	60.0	1.0	-10.1	10.71	93.6	538.2
5	GLEN ULLIN 1250	2	FEEDER 2	B	60.0	1.0	-9.9	10.71	93.6	538.2
6	GLEN ULLIN 1250	2	FEEDER 2	C	60.0	1.0	-10.0	10.53	93.4	538.2
7	GLEN ULLIN 1250	3	FEEDER 3	A	60.0	1.0	9.9	10.71	94.2	538.2
8	GLEN ULLIN 1250	3	FEEDER 3	B	60.0	1.0	10.1	10.71	94.2	538.2
9	GLEN ULLIN 1250	3	FEEDER 3	C	60.0	1.0	10.0	10.53	94.0	538.2

10	GLEN ULLIN 1250	4	FEEDER 4	A	60.0	1.0	29.9	10.71	90.9	538.2
11	GLEN ULLIN 1250	4	FEEDER 4	B	60.0	1.0	30.1	10.71	90.9	538.2
12	GLEN ULLIN 1250	4	FEEDER 4	C	60.0	1.0	30.0	10.53	90.7	538.2

Thermal Resistivity Report ASTM D:5334

Project: **Ace Wind**

Job #: **10198**

Client: **Barr Engineering Company**

Date: **1/28/16**

Boring	Specimen Type	Depth	Type	Classification	Initial Conditions			Dry
					Dry Density (PCF)	WC (%)	Thermal Resistivity (°C-cm/W)	Thermal Resistivity (°C-cm/W)
S114	Reconstituted		Bulk	Lean Clay with sand (CL)	97.9	15.8%	66	140
S131	Reconstituted		Bulk	Silty Sand (SM)	103.8	12.9%	59	152
S141	Reconstituted		Bulk	Lean Clay with sand (CL)	99.1	15.4%	73	153
U162	Reconstituted		Bulk	Silty Sand with gravel (SM)	104.4	13.1%	78	213
	Specimens reconstituted to approximately 90% of maximum standard proctor density near optimum moisture content.							

2401 West 66th Street



Richfield, MN 55423

<http://www.soilengineeringtesting.com>

Thermal Resistivity Report ASTM D:5334

Project: Ace Wind
Client: Barr Engineering Company

Job: 10198
Date: 1/28/16

	Boring	Specimen Type
Specimen A:	S114	Reconstituted
Specimen B:	S131	Reconstituted
Specimen C:	S141	Reconstituted
Specimen D:	U162	Reconstituted

Thermal Dryout Curves (Resistivity vs. Water Content)

