



Electric Service Requirements

69kV Underground Structure

Engineering Specification T008

January 2020

Powering forward.
Together.



 SMUD®	ENGINEERING SPECIFICATION	No. T008 Page 1 of 13	
		REV. 2	DATE: 1/2020
Category: ELECTRIC SERVICE REQUIREMENT			
SUBJECT: 69kV Underground Structure			

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1 PURPOSE

In general, 69kV underground structures will be constructed using underground conduit systems and 8' x 14' subsurface pulling manholes. This Electric Service Requirement (ESR) booklet is used to set forth the Sacramento Municipal Utility District (SMUD) requirements pertaining to material and installation of the 69kV underground structures for new circuits and for changes to existing facilities. These requirements are necessary for SMUD to supply uniform and safe installations throughout the service area. It is important that the customer and their representatives, including contractors, read and understand this specification in its entirety because infrastructure will not be deemed complete until all the requirements are satisfied and approved by all of the appropriate inspection authorities including SMUD.

2 SCOPE

This specification applies to the material, construction, and installation requirements for 69kV underground substructures throughout SMUD's service area.

3 REFERENCES

All equipment shall be designed, manufactured, supplied, and installed in accordance with the latest applicable standards including but limited to:

- 3.1 American Society for Testing and Materials (ASTM) F512, Standard Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation
- 3.2 National Electric Manufacturers Association (NEMA) TC-2, Electrical Polyvinyl Chloride (PVC) Conduit
- 3.3 National Electric Manufacturers Association (NEMA) TC-3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
- 3.4 National Electric Manufacturers Association (NEMA) TC-6 & 8, Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
- 3.5 California Public Utilities Commission (CPUC), General Order 128, Rules for Construction of Underground Electrical Supply and Communication Systems.
- 3.6 Underwriters Laboratories (UL) 651, UL Standard for Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
- 3.7 ASTM C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
- 3.8 SMUD Document SS0801 Engineering Specification for PVC Conduit
- 3.9 SMUD Document SS4001 Engineering Specification for Structural Concrete
- 3.10 Code of Federal Regulations, Title 29, Section 1926.704(d)
- 3.11 American Concrete Institute (ACI) 318-19, Building Code Requirements for Structural Concrete

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- 3.12 AASHTO HB Standard Specification for Highway Bridges
- 3.13 ASTM D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
- 3.14 SMUD Engineering Specification DS0604: 8x14 Splicing Manhole
- 3.15 SMUD Electric Service Requirement T007: Distribution Underground Structures

4 REQUIREMENTS FOR 69kV UG CONSTRUCTION

- 4.1 All manhole installations must be located at a maximum of 15' back of curb, within an exclusive SMUD easement (preferred) or public utility easement that parallel the street, except as may be directed by the SMUD Engineering Designer. Manholes shall be located a minimum 25' clearance from other improvements.
- 4.2 All conduit and manholes located in the SMUD exclusive easement or Public Utility Easement are to be installed by the customer at the customer's expense and will be deeded to SMUD. All manholes to be deeded to SMUD will have the covers engraved with the words "SMUD ELECTRIC". This wording meets the requirements of State Safety Order G.O. No. 128 for identification of ownership.
- 4.3 Unless noted elsewhere, all permits and licenses necessary to the prosecution of the work shall be secured by the Customer, at the customer's own expense, and the customer shall give all notices necessary and incidental to the due and lawful prosecution of the work - excepting that right of way encroachment permits will be obtained by SMUD for all off-site work.
- 4.4 Portions of the work may be near existing utility facilities. These facilities may remain energized throughout the course of the work. The customer and their personnel shall use extreme care while performing work near energized facilities. It shall be the responsibility of the Customer to ascertain the location of both existing overhead and underground facilities and to be fully aware of the proximity of their work to the energized electrical facilities or other hazards. The customer shall be responsible for any damage to existing electrical facilities caused by the customer. The Underground Service Alert (USA) organization shall be used to help locate existing facilities. Their number is 1 800 642 2444.

**USE CAUTION WHEN
DIGGING TO AVOID
BURIED ELECTRICAL CABLES
BEFORE DIGGING CALL
U.S.A. (Underground Service Alert)
800-227-2600**

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- 4.5 The Customer shall indemnify, defend, and hold harmless SMUD, its directors, officers, representatives, agents, and employees against all claims, loss, damage, expense and liability asserted or incurred by other parties, including, but not limited to, SMUD's employees and Customers' employees, arising out of or in any way connected with the performance of work described by this specification and caused by the acts, omissions, intent or negligence, whether active or passive, of the Customer, its agents, employees and suppliers, and excepting only loss, damage or liability as may be caused by the intentional acts or the active negligence of SMUD. It is the intent of parties hereto that, where negligence is determined to have been contributory, principles of comparative negligence will be followed, and each party shall bear the proportionate cost of any loss, damage, expense and liability attributable to that party's negligence.
- 4.6 **Material Furnished and Installed by SMUD**
- 4.6.1 The SMUD Engineering Designer shall determine the quantity, size, and type of facilities to be furnished and installed by SMUD.
- 4.7 **Material Furnished and Installed by Customer**
- 4.7.1 The customer is required to furnish and install all materials, labor, equipment, and incidentals necessary to provide a complete conduit system. The complete conduit system also includes any future facility needs. The materials include but are not limited to the trench (excavation and appropriate installation of backfill), conduit, ducts, manholes, vaults, enclosures, and all measures required to protect these facilities (concrete encasements, retaining walls, barricades, etc.). The material and installation shall be per this specification, which includes the design and construction drawings located in Appendix B.
- 4.7.2 The customer shall comply with all applicable SMUD procedures and specifications in order to assure SMUD of the acceptable installation of customer installed manholes and duct lines intended for attachment to SMUD's system.
- 4.7.3 SMUD equipment and material are to be installed and maintained in or on facilities furnished by the customer. The customer will grant the SMUD Representative a right of access to the site for construction inspection and maintenance purposes.
- 4.7.4 SMUD equipment shall be accessible to a 26,000-pound SMUD service vehicle in all weather. SMUD equipment shall be no further than 15 feet from a drivable surface. The drivable surface shall have a minimum width of 20 feet.
- 4.7.5 The customer and/or their representatives or contractors shall not enter any vault, manhole, or other SMUD facility that contains energized equipment except in the presence of a SMUD Representative. SMUD personnel are available for this purpose upon 48-work hours notice to SMUD's Inspection Division.

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4.8 Inspections

- 4.8.1 SMUD will provide an Inspector. Two full working days are required to schedule an inspector. The hours of work for the Inspector are from 8:00 a.m. to 3:00 p.m., Monday through Friday. All work requiring the presence of the Inspector shall be scheduled during these hours. For scheduling of Inspectors call (916) 732-5990.
- 4.8.2 All material and work shall be subject to inspection, examination, and testing by SMUD, at any time during manufacture, installation, or construction. The Customer shall provide and maintain proper facilities and safe access for such inspections or testing. The Customer shall pay the cost of all tests required under this specification. SMUD will pay the costs of any additional testing required by its Inspector to ensure the adequacy of the work.
- 4.8.3 The Customer shall, unless otherwise specified, give 48 hours advance notice to the SMUD Inspector prior to placing concrete, installing ground rods, backfilling trench, and mandrelling conduit. Conducting such work without the presence of the SMUD Inspector is grounds for rejection of the work.
- 4.8.4 SMUD shall have the right to reject defective material and work. Rejected work shall be corrected and rejected material shall be replaced with proper material. The Customer shall promptly segregate and remove rejected material from the job site.
- 4.8.5 Failure of the Customer to adhere to the above provisions may result in the Customer being required, at the customers expense, to remove, uncover or otherwise enable inspection of such work by the Inspector.
- 4.8.6 Rejected work will result in delaying electric service until the inadequacies are corrected. The customer shall pay the cost of correcting rejected work.

4.9 Excavations and Backfill (See also Reference 3.8)

- 4.9.1 Backfilling shall not be done until the work to be covered has been approved by the Inspector.
- 4.9.2 Excavation, backfill, and compaction shall be in accordance this specification, which includes the latest revision of SMUD drawings as shown in Appendix B, and SMUD Specification DS0604, unless otherwise specified in the plans and/or the requirements of the local jurisdiction.
- 4.9.3 Trenches for conduit installations shall be graded true with no rocks or soft spots in the bottom. Trench bottoms that have been disturbed shall be compacted to a relative density of at least 90 percent (Reference 3.13). Conduits shall have a firm-bearing surface along the full length of the run.

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- 4.9.4 For backfilling trenches, native fine earth, compacted aggregate base, and/or 2-sack cement sand slurry shall be used for backfill unless specified or shown otherwise on the plans. Fine earth shall mean earth free of rocks or clods larger than 3/4 inches and deleterious matter. The method of compaction used shall be as approved by the Inspector. Jetting shall not be allowed.
- 4.9.5 The customer will install manhole covers at final grade. Facilities that have been installed, which by SMUD's judgment require raising, lowering, or relocation as a result of customer development changes, shall be done in total at customer expense.
- 4.9.6 Where mounded landscaping is planned or added at a later date, the customer is responsible to provide permanent retaining walls or appropriate grade changes to insure manholes are not covered and proper operating clearances are maintained. Wood is not considered permanent and is not an acceptable material. Contact SMUD's Inspector for further information.

4.10 **SMUD Approved Material**

4.10.1 Request for Material Approval

Materials to be incorporated in the work may be designated under a trade name or the name of the manufacturer, for convenience in designation on the plans or in the specifications. Where materials are specified by a particular designation, the Customer may use an alternative material which is of equal quality and of the required characteristics for the purpose intended, subject to the following requirements:

- 4.10.1.1 The Customer shall request approval of a proposed substitution in writing accompanied by complete data as to the characteristics and quality of the material proposed. Such request shall be made in ample time to permit due consideration for approval without delaying the work. At least ten (10) working days are required to review submittal.
- 4.10.1.2 The burden of proof as to the equality or suitability of alternatives shall be upon the Customer. Samples may be required to determine equality. SMUD shall be the sole judge as to the equality and suitability of alternative materials. Materials incorporated in the work prior to approval of their use by SMUD shall be at the Customer's risk and subject to subsequent rejection.

Submittals shall be sent to:

Sacramento Municipal Utility District
PO Box 15830
Standards Engineer, Mail Stop EA305
Sacramento, California 95852-1830

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4.10.2 Conduit (Also see Reference 3.8)

- 4.10.2.1 Unless otherwise specified, all conduit systems shall be entirely non-metallic.
- 4.10.2.2 Conduits for pole risers shall be Schedule 80 PVC.
- 4.10.2.3 All conduits shall be placed in accordance with SMUD design and installed per the associated drawings that are a part of this specification.
- 4.10.2.4 The Customer shall furnish and install conduit systems in accordance with the plan and specifications. A conduit system shall consist of one or more conduits in the same trench.
- 4.10.2.5 All conduits terminating at manholes shall be supplied with terminators. The terminators shall be flush with the inside wall and grouted in place.
- 4.10.2.6 Sweeps and elbows shall have a uniform curvature over their entire length. The customer shall use factory made sweeps and elbows whenever possible. Factory sweeps shall not be cut or modified. The Customer shall not kink or offset the joints in order to curve the line. Maximum allowable degrees of factory fittings or field manufactured bends shall not exceed a total of 270 degrees in a single run between manholes. The customer must notify the SMUD Engineering Designer in writing of any discrepancy between the drawings and the conditions at the jobsite, which may be discovered in the course of the work. Any work done after such discovery, until authorized by the SMUD Design Engineer or Inspector shall be done at the Customers risk.
- 4.10.2.7 All conduit bends made by the Customer shall be made with suitable equipment while maintaining a round cross-section of the conduit. The bending method shall be in accordance with the equipment manufacturer's recommendations. Kinking and flattening of the conduit will not be permitted.
- 4.10.2.8 The minimum cover of the conduit systems shall be as shown on the drawings. Cover shall be measured from finished grade to top of encasement for concrete encased system and top of upper most conduits for direct buried system. Conduits may need to be installed at a greater depth due to existing facilities or alignment changes.
- 4.10.2.9 The conduit shall be placed such that there is firm bearing for the full length. Conduit shall be laid on as uniform a slope as possible.
- 4.10.2.10 Concrete encasement shall be required on all conduit and shall be a mix consisting of 3/8-inch maximum size, washed pea gravel aggregate, five sacks of cement per cubic yard and have a slump of six (6) to eight (8) inches.

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- 4.10.2.11 Concrete shall be placed to form a conduit encasement of at least three (3) inches on all sides between the outer surfaces of the envelope and the surface of the nearest conduit. Continuous underground warning tape shall be installed 12"-18" above all conduit duct banks. The tape shall be red, 6" wide, non-metallic marked "DANGER, ELECTRICAL LINES BELOW". Red Oxide Dye (5 lbs. red oxide dye per cubic yd.) is required as an ad-mix to the concrete encasement.
- 4.10.2.12 Surfaces upon which concrete is to be placed shall be free of standing water, mud, and debris. Absorptive surfaces against which concrete is to be placed shall be moistened.
- 4.10.2.13 The conduits shall be thoroughly cleaned and tested after installation. A manufactured foam sponge (PIG) with a cross sectional area equal to the inside diameter area of the conduit must be used to clean/swab the conduit if required by the SMUD Inspector. The test shall involve drawing a mandrel through each conduit. The SMUD Inspector will furnish mandrels. The mandrel test shall be pulled only in the presence of the Inspector.
- 4.10.2.14 Conduits that do not pass the mandrel test shall be repaired and re-tested. Steel brushes shall not be used in any plastic conduit.
- 4.10.2.15 A flat tape pull line shall be left in each conduit as a "sleeper".

4.10.3 **DB-120 type conduit**

- 4.10.3.1 All type DB-120 shall be polyvinyl chloride (PVC), Gray color, 20-feet in length with an integral belled end, and in accordance with the latest revisions of ASTM F512 and NEMA TC-8. Conduit shall be any manufacturer meeting this specification. Additional couplings required for installation shall be manufactured, rated, and designed for use with this conduit.

4.10.4 **Schedule 40 and 80 Conduit (Also see Reference 3.8)**

- 4.10.4.1 All Schedule 40 and 80 conduit shall be polyvinyl chloride (PVC), gray color, 10-feet in length with an integral belled end, and in accordance with the latest revisions of UL651 and NEMA TC-2. Conduit shall be from any manufacturer meeting this specification. Additional couplings required for installation shall be manufactured, rated, and designed for use with this conduit.

4.10.5 **Elbow (Rigid Non-metallic)**

All elbows shall be polyvinyl chloride (PVC), Schedule 40 except as noted on the drawings. Elbows shall conform to NEMA TC-3, Type III application. Horizontal sweeps for 6" conduit sizes shall have a minimum radius of 12-feet.

The minimum radius for riser elbows shall be as follows:

Conduit Size	Minimum Radius
4"	30"
6"	48"

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4.10.6 Duct Bank Spacers

Interlocking plastic base and intermediate spacers manufactured for use with conduit shall be used to support and separate all conduit to be encased with concrete. Spacer assemblies shall provide a minimum conduit separation of 1.5 inches and a 3-inch space above the trench floor.

4.10.7 End Bell

The end bells shall be solid one-piece type, polyvinyl chloride (PVC), Schedule 40, gray color. End bells shall conform to NEMA Publication No. TC 3-2004 and ASTM Publication F-512-06.

End bells shall be the following or SMUD approved equal:

	4" Conduit	6" Conduit
Prime Conduit	EB400	EB600
Cantex	5144012	5144014
JM Eagle	61500400	61500600

4.10.8 Conduit Plug

The conduit plugs shall be plastic tapered for appropriate conduit size. Plugs shall be the following or SMUD approved equal:

	4" Conduit	6" Conduit
Prime Conduit	PEPT400	PEPT600
Cantex	5315262	5315264
JM Eagle	61800400	61800600

4.10.9 Conduit Cap

Where spare conduit is installed, the open end shall be capped. The conduit cap shall be the following or other SMUD-approved equal:

	4" Conduit	6" Conduit
Prime Conduit	CAP400	CAP600
Cantex	5140040	5140042
JM Eagle	60460400	60460600

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4.10.10 PVC Cement

All non-metallic conduits shall be cemented at all joints with suitable cement per ASTM 2564, ASTM 2855, and Underwriters Laboratory (UL).

4.10.10.1 The cement shall have a VOC of 510 Grams/Liter or less and contain no Cyclohexane.

4.10.10.2 The PVC Cement shall be the following or other SMUD-approved equal:

Gorilla Brand "Gorilla PVC Cement"

4.10.11 Ground rods

Ground rods shall be 5/8" x 8'-0" copper clad steel. The copper cladding shall be a 13-mil thick minimum. The cladding shall be bonded to a carbon steel rod 0.562" to 0.565" in diameter (nominal 5/8") and eight feet (8') in length. The maximum tolerances of ground rod length are plus one inch (1") and minus zero inches (0"). The ground rod shall be a sectional type with one end having a true conical machined driving point and non-thread end. The opposite end shall be flat with a non-thread end. The quantity of ground rods shall be per the associated drawings and/or per SMUD's Line Design Department.

Ground rod shall be the following or SMUD approved equal:

Eritech	615883
Thompson Lightning Protection	TL588
ATI Tectoniks	GRC-10-15-8
Galvan	6258G13

4.10.12 Pull Tape (Sleeper)

The tape shall be made from Polyester, be lubricated, printed with footage markings and have a minimum strength of 2500 lb. The tape shall be one continuous length with no splices. The tape shall be the following or SMUD approved equal:

ARNCO	DLWP25S-3000
NEPTCO	WP 2500P
Pacific Strapping	FMT-P2500
Fibertek	WP2500
Advance Fiber Technologies	WPP 2500 PL
Wellington Slick-Tape	N303M10-9083
Red Buck	PW2500
Milliken	MT2500-3000

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4.10.13 69kV Manhole

The Customer shall furnish and install the 8'x14' manhole. Fabrication and installation of this manhole shall be per SMUD Engineering Specification DS0604, latest revision.

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5 APPENDIX A - LIST OF MATERIAL SUPPLIERS

The table below lists material suppliers with whom SMUD is familiar. It is not intended to be an exhaustive list of all possible suppliers in the area.

CONSOLIDATED ELECTRICAL DIST. 1800 24th Street Sacramento, CA 95816 (916) 452-3111 Fax (916) 452-3155	GRAYBAR ELECTRIC COMPANY P.O. Box G 1211 Fee Drive Sacramento, CA 95813 (916) 561-1900
ELECTROREP, INC. 2015 Bridgeway, Suite 201 Sausalito, CA 94965 (415) 332-4100 Fax (415) 332-4150	JENSEN PRECAST 5400 Raley Boulevard Sacramento, CA 95830 (916) 991-8800/800-843-9569 Fax (916) 991-8810
WESCO DISTRIBUTION, INC. 1045 W National Drive, #19 Sacramento, CA 95834 (916) 928-1001	OLDCASTLE PRECAST, INC. 3786 Valley Ave. Pleasanton, CA 94566-8183 (925) 846-8183 Fax (925) 846-4904

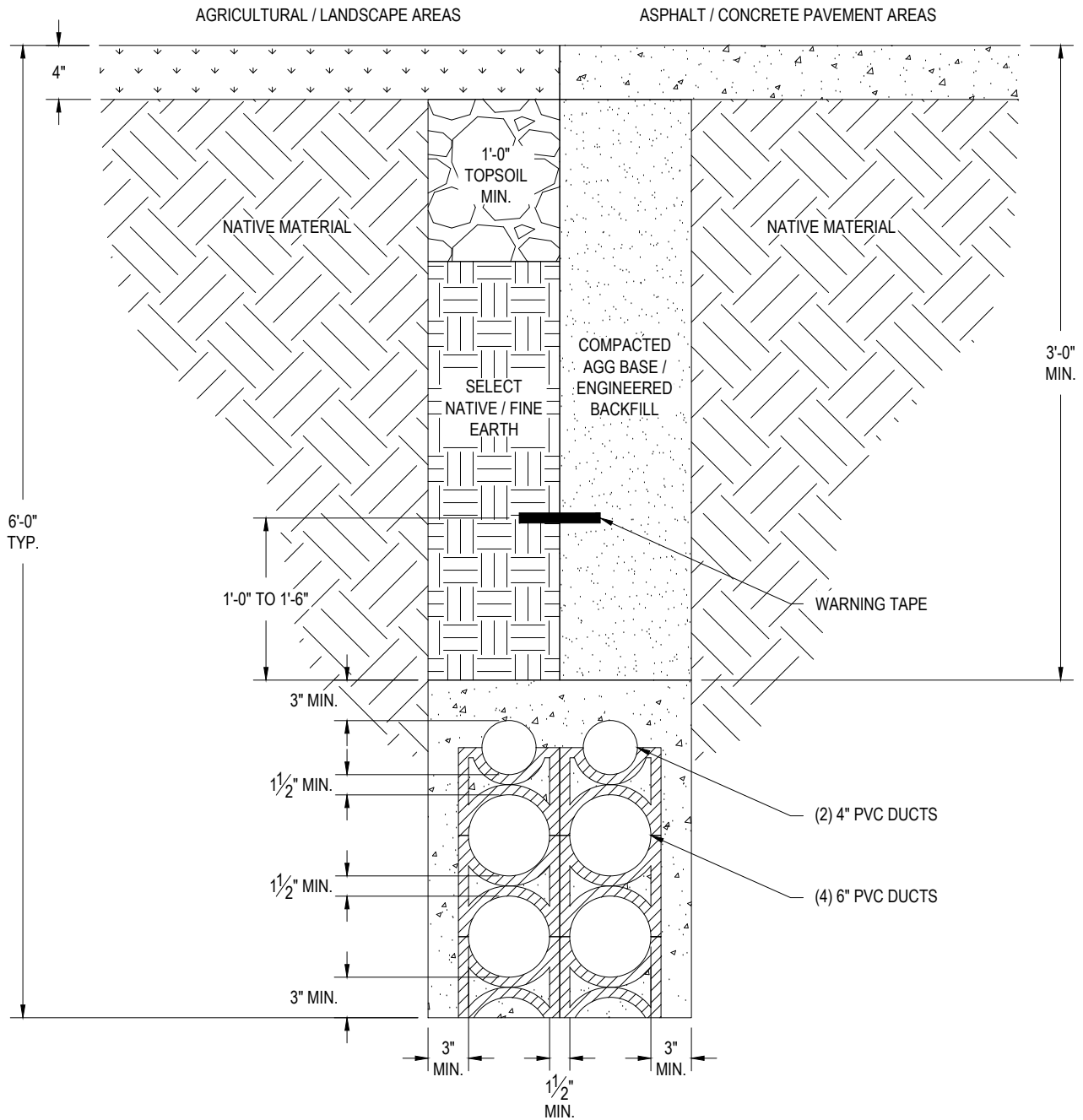
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6 APPENDIX B - DESIGN & CONSTRUCTION DRAWINGS

The customer and/or their representatives or contractors shall adhere to the design and construction drawings listed in the table below, unless otherwise specified in writing by a SMUD Inspector or Engineering Designer. The Customer shall review all drawings. Any questions, comments, or requests for additional drawings shall be brought to Sacramento Municipal Utility District's (SMUD) attention for clarification or resolution.

Drawing Title	Drawing Identification Code
Single Circuit Trench	6.1
Double Circuit Trench – Rural Area	6.2
Double Circuit Trench – Landscaped Area	6.3
Grounding Details	6.4
Manhole Grounding Details	6.5

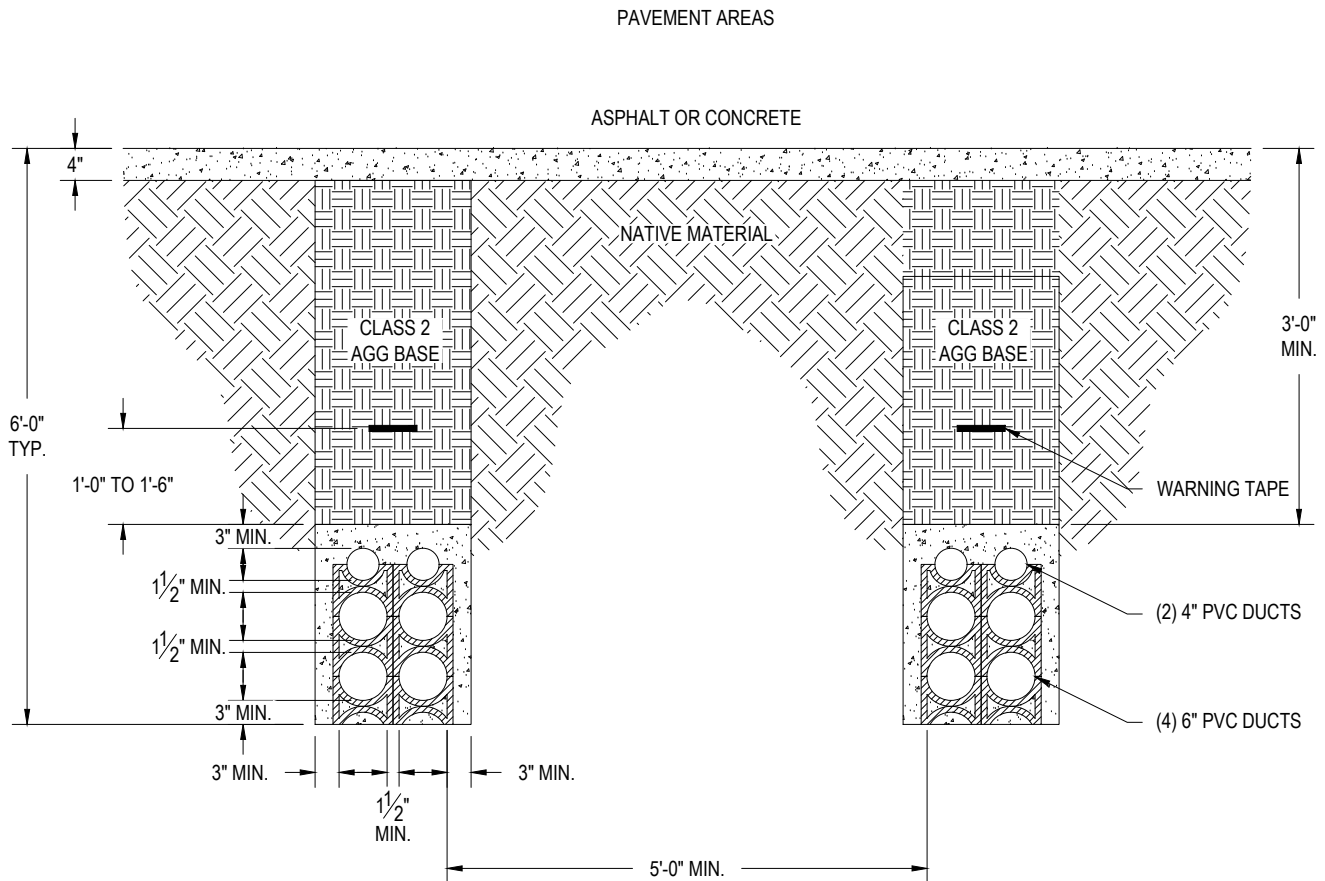
SINGLE CIRCUIT TRENCH



NOTES:

- A. 1 1/2" MINIMUM SPACING BETWEEN DUCTS.
- B. 3" MINIMUM PROTECTIVE CONCRETE ENCASEMENT ENVELOPE AROUND DUCTS.
- C. NOMINAL OUTSIDE DIMENSIONS OF CONCRETE ENCASEMENT ENVELOPE IS 1'-8" X 2'-6".
- D. 5-SACK, 3/8" PEA GRAVEL CONCRETE ENCASEMENT MIX.
- E. ALL DUCT USED SHALL BE DB-120 PVC MATERIAL.
- F. SEE SMUD ENGINEERING SPECIFICATION SS0801 FOR ADDITIONAL INFORMATION.
- G. MINIMUM RADIUS FOR HORIZONTAL DUCT SWEEPS IS 12'-0".

DOUBLE CIRCUIT - RURAL AREA



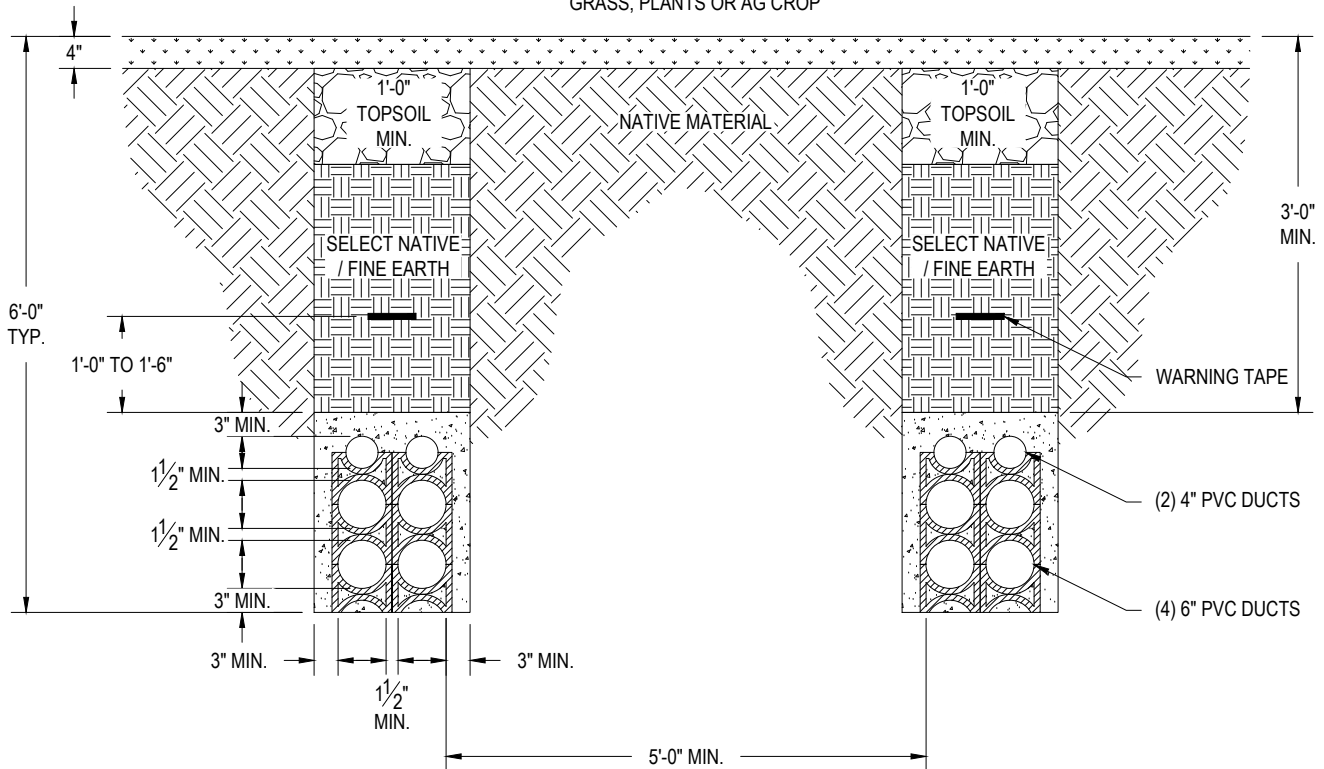
NOTES:

- A. 1 1/2" MINIMUM SPACING BETWEEN DUCTS.
- B. 3" MINIMUM PROTECTIVE CONCRETE ENCASMENT ENVELOPE AROUND DUCTS.
- C. NOMINAL OUTSIDE DIMENSIONS OF CONCRETE ENCASMENT ENVELOPE IS 1'-8" X 2'-6".
- D. 5-SACK, 3/8" PEA GRAVEL CONCRETE ENCASMENT MIX.
- E. ALL DUCT USED SHALL BE DB-120 PVC MATERIAL.
- F. SEE SMUD ENGINEERING SPECIFICATION SS0801 FOR ADDITIONAL INFORMATION.
- G. MINIMUM RADIUS FOR HORIZONTAL DUCT SWEEPS IS 12'-0".

DOUBLE CIRCUIT - LANDSCAPE AREA

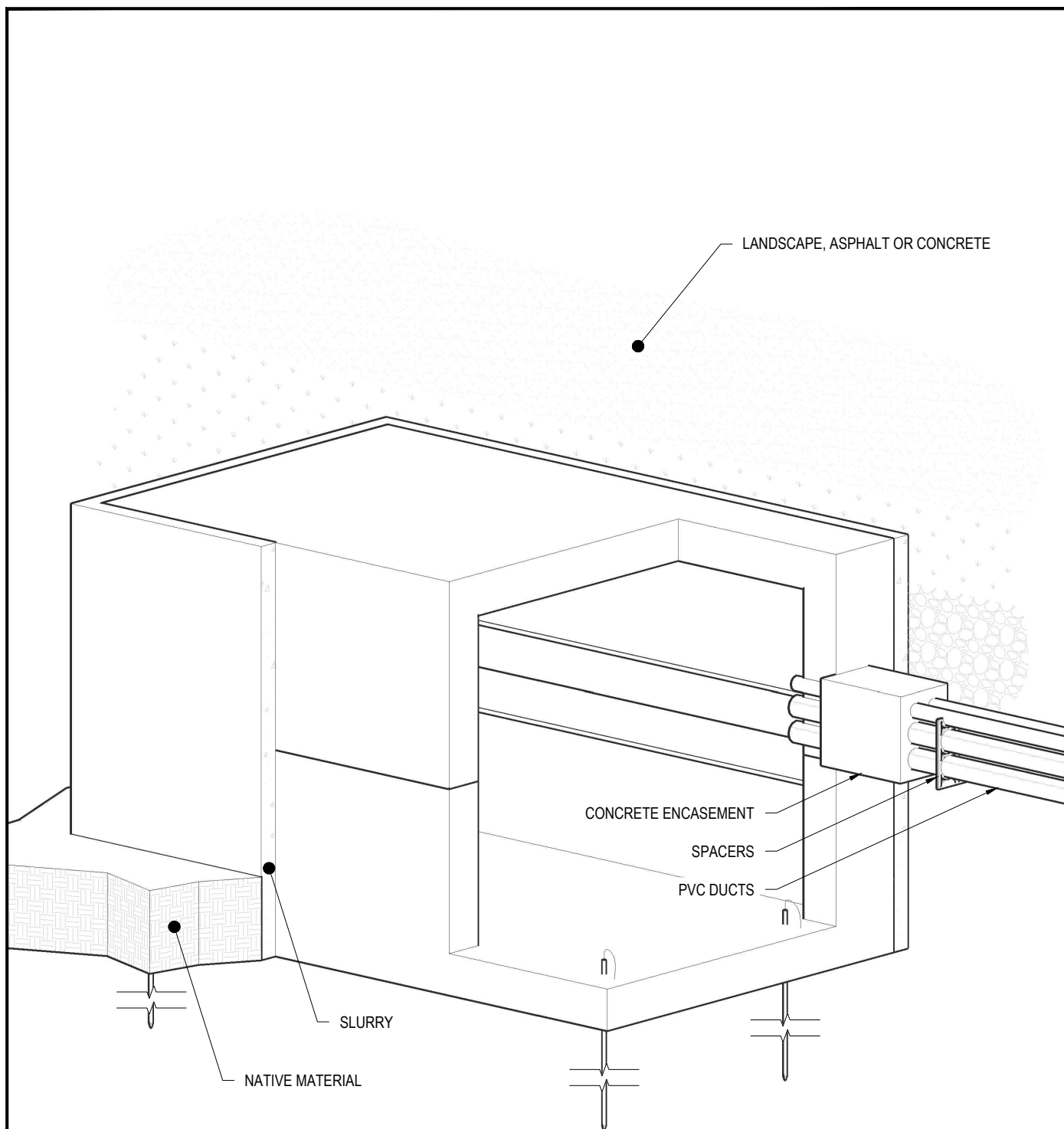
AGRICULTURAL / LANDSCAPE AREAS

GRASS, PLANTS OR AG CROP



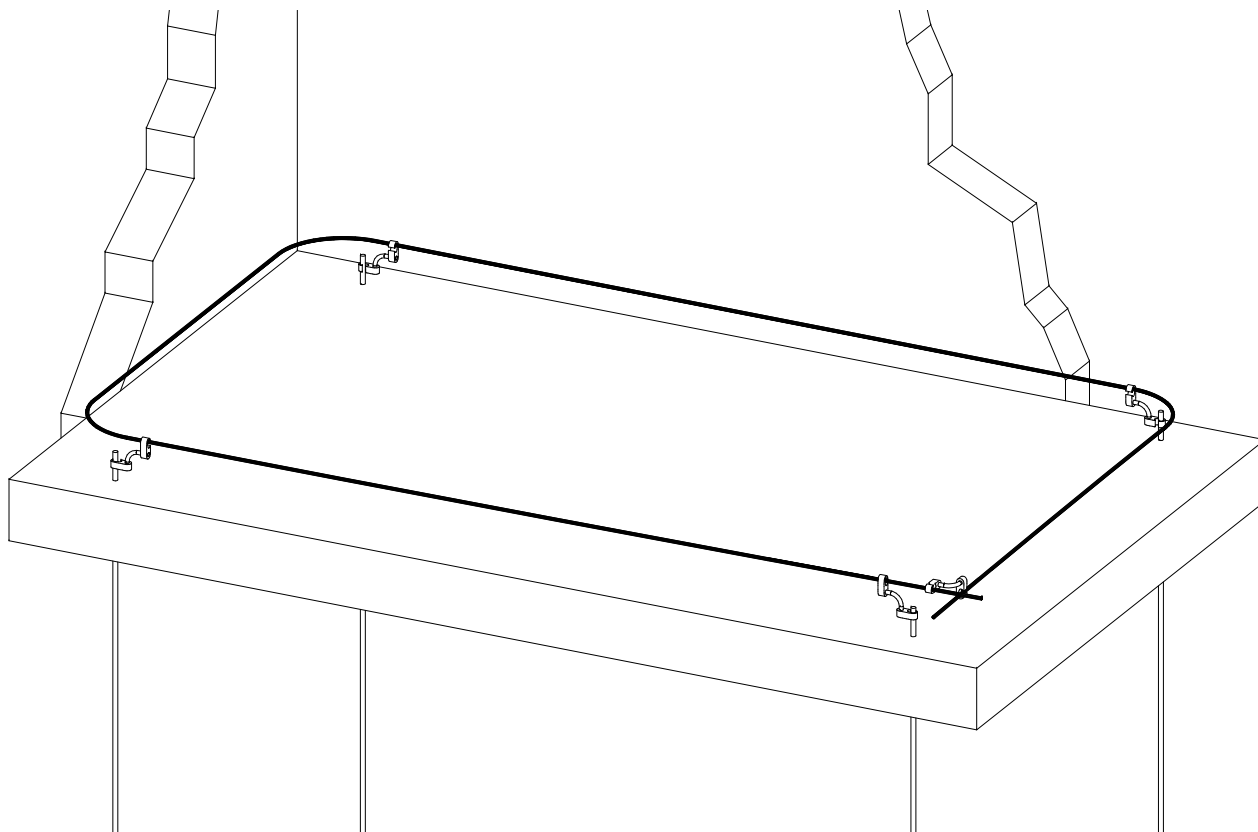
NOTES:

- A. 1 1/2" MINIMUM SPACING BETWEEN DUCTS.
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- F. SEE SMUD ENGINEERING SPECIFICATION SS0801 FOR ADDITIONAL INFORMATION.
- G. MINIMUM RADIUS FOR HORIZONTAL DUCT SWEEPS IS 12'-0".



NOTES:

- A. THERE SHALL BE FOUR (4) GROUND RODS INSTALLED INSIDE THE MANHOLE.
- B. AFTER SLURRY IS APPLIED AROUND THE CIRCUMFERENCE OF THE MANHOLE, THE REMAINING BACKFILL SHALL BE AS DESCRIBED IN PARAGRAPH 4.9.



NOTES:

- A. THERE SHALL BE TOTAL OF FOUR (4) GROUND RODS INSTALLED INSIDE THE MANHOLE.
- B. 4/0 STRANDED COPPER WIRE SHALL BE CONFIGURED AS ABOVE. ALL CONNECTION SHALL BE COMPRESSED OR EXOTHERMALLY WELDED.
- C. FOR COVER INSTALLATION DETAILS, SEE DRAWING (UVC1.8.3)

PART#	QTY	DESCRIPTION	SAP NO.
1	1 PT	COMPOUND CORR INHIBT F/CU GRND GRID CONN	10003146
2	60'-0"	CABLE BARE CU SD 4/0 AWG 19 STRAND	10000204
3	4	CONN GROUND 4/0 TO 5/8 GROUND ROD	10022812
4	4	ROD GROUND COPPER CLAD 5/8 DIA 8 FT	10000573
5	*	CONN COMP CROSS TYPE #4/0CU - 4/0CU GRND	10009732
6	*	CONN COMP C TYPE #4/0 CU TO 4/0 CU GRND	10009733

* - AS NECESSARY

