CITY OF WORCESTER, MASSACHUSETTS

Administration & Finance
Purchasing Division
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November 19, 2021

To All Bidders:

Subject: **Bid No. 7682-W2, Hospital Drive Construction – Phase II (M21-10) / DPWP**

ADDENDUM NO. 2

To Whom It May Concern:

With reference to our bid request relative to the above subject, please refer to the changes/modifications/clarifications to the original proposal request.

- ***PLEASE SEE ATTACHED GENERAL BID CLARIFICATIONS INCLUDING QUESTIONS RECEIVED AND RESPONSES FROM CITY.***

BID PRICING SHEETS HAVE BEEN UPDATED.
BIDDERS ARE INSTRUCTED TO USE THE REVISED BID PRICING SHEETS WITH BID SUBMISSION.

Bidders are requested to acknowledge and/or include this addendum with bid. All other terms, conditions and specifications remain unchanged.

Very truly yours,

Christopher J. Gagliastro
Purchasing Director

ADDENDUM NUMBER TWO

Date: November 18, 2021

Project: Creation of Hospital Drive (M21-10) – Bid No. 7682-W2
City of Worcester Department of Public Works and Parks
DPW&P – Engineering Division

Bid Question Responses Submitted as of End of Day 11/12/2021

Some of the Responses to These Questions are Pending. Responses are in *Italics*. Those Pending Questions Have the Agency in Question Highlighted in RED

Questions Submitted After 11/12/2021, Which Are not Addressed Here, Will Be Responeded to Under a Subsequent Addendum.

1- ITEM # 301.08 " 8" CLDI PIPE" 270 FT, PLANS ARE ONLY SHOWING ABOUT 90 FT, PLEASE CLARIFY.
The quantity has been corrected to 90 linear feet.

2- ITEM # 301.10 " 10" CLDI PIPE" 2110 FT PLANS ARE ONLY SHOWING ABOUT 1050 FT, PLEASE CLARIFY.
The quantity has been corrected to 1,020 linear feet.

3- ITEM # 305.08 " 8" GATE VALVE" 4 EACH, PLANS SHOWS 2 EACH, PLEASE CLARIFY.
The quantity has been corrected to 2 valves.

4- ITEM # 305.12 " 12" GATE VALVE" 2 EACH, WHERE ARE THEY LOCATED, PLEASE CLARIFY.
This item has been removed from the bid.

5- ITEM # 171 " INSTALLATION AND MAINTENANCE OF EROSION CONTROLS" 3000 LF, YOU ALREADY HAVE TWO OTHER ITEMS (931.2021 " SILT FENCE" AND 932.2021 " COMPOST SOCK") THAT TAKES CARE OF THE EROSION CONTROLS, PLEASE CLARIFY.
Item 171 has been removed from the bid.

6- ITEM # 222.12 " FURNISH AND INSTALL 12" RCP" 780 FT, DRAWINGS ARE ONLY SHOWING 122 FT, PLEASE CLARIFY.
The quantity has been corrected to 138 linear feet.

7- ITEM # 230.40, 230.50, 231.40 & 231.50 " 4' AND 5' MANHOLE BASE AND SECTION", FIRST QUESTION IS WHICH MANHOLE ARE 4' DIA AND WHICH ONES ARE 5' DIA., ALSO YOU HAVE A TOTAL OF 9 EA SMH AND 13 EA DMH, AND A TOTAL BID OF 27 EA, PLEASE CLARIFY.
The 5' manhole base and section items have been removed. The 4' manhole base item has been corrected to 22.

8- THERE ARE SEVERAL TREES ON THIS PROJECT TO BE REMOVED, HOW ARE YOU COMPENSATING FOR THAT, PLEASE CLARIFY.
Items 104 and 106 have been added to the bid with appropriate quantities. Due to ongoing construction and demolition operations for this site, the number of trees remaining may not be the same as what is included in this bid. The intent of this project is to retain as many trees as possible.

9- ITEM # 928.2021 " TELECOM TRUNK LINE 4" CONDUIT" 1750 FT, QUANTITY SHOWN ON THE PLANS IS AROUND 1350 FT, ALSO IS THIS ITEM CONCRETE ENCASED, PLEASE CLARIFY.
The quantity has been corrected to 1,300 linear feet. This is concrete encased.

10- ITEM # 929.2021 " TELECOM 3'X3' MANHOLE" 8 EACH, PLANS ONLY SHOW 3 EACH, PLEASE CLARIFY.
The quantity has been corrected to 3.

11- ITEM # 932.2020 " TEMPORARY PEDESTRIAN BARRICADE" 2550 FT, DO YOU HAVE SPECIFICATIONS OR DETAIL FOR THIS AND WHERE IS IT BEING USED, PLEASE CLARIFY.
This item has been removed from the bid.

12- ITEM # 305.06, 310.10 & 310.60 " ALL HYDRANT RELATED ITEMS", IT CALLS FOR 7 EACH, PLANS ARE SHOWING **ONLY 4 EACH, PLEASE CLARIFY** BOHLER
The quantity has been corrected to 4 hydrants.

13- On page 252 of 581, Liquidated Damages, Section B states "*The Contractor acknowledges that delay in Substantial Completion of the Project will cause disruption of the DPW&P's schedule for completing the surrounding infrastructure of the City's proposed baseball complex. Such disruptions include without limitation, absence of access to proposed facilities due to uncompleted/unimproved roadways and unmet timetables of other projects associated with the baseball complex in which the City has a vested interest."* Please clarify how this project relates to a baseball complex and will these liquidated damages be assessed even though there does not seem to be any work affecting a baseball complex.
This language has been removed from the Liquidated Damages section of the contract.

14- Page 256 of 581 states *"The Contractor will schedule all resurfacing related work only after all infrastructure, City controlled and non-City controlled infrastructure, work is completed on the street, and accepted by the City of Worcester or overseeing agency."* What work is considered non-City controlled infrastructure? Can activities and durations be identified and called out so that all contractors can incorporate these activities into a project schedule?
Non-City controlled infrastructure includes those utilities which the City does not control or maintain. The City oversees and maintains the Street Lights and Sanitary, Drain, and Water mains. Other utilities such as gas, electric, telecommunications, etc. The installation and approval of these non-City utilities will verified by the respective utility agency.

15- If the work considered "non-City controlled infrastructure" delays the project, will the contractor be allowed a time extension and therefore, not be assessed liquidated damages, due to work that is non-City controlled?
Consideration for extra time will be made where it can be shown that any delays were outside of the contractor's control.

16- Should a time extension be granted, would the bonus apply if the contractor completes work prior to the extended completion date?
If an extension of time is granted to the contractor for delays outside of their control, the bonus would be applied if work is complete by that new extension date.

17- Page 261 of 581 states that as-builts shall be submitted and are to include work completed under contract S20-5, Bid No. 7478-W1. Can the plans be provided for that contract showing all the work that was done and requires as-built information?
The Phase I plans will be provided to the awarded contractor.

18- Was any extra work performed under that contract that is not reflected on the plans but will have to be included on the As-Builts?
No extra work was added to the Phase I contract that would affect the preparation of as-built plans.

19- Can the final pay estimate for Contract S20-5 be provided to bidders and act as a reference to what needs to be part of the As-Builts?
The final payment estimate from the Phase I work can be given to the awarded contractor.

20- Does the City of Worcester expect the contractor to test pit to be able to verify and identify work installed by Contract S20-5? If so, please add a pay item for test pits.
No test pits will be necessary for the Phase I contract for the preparation of the as-built.

21- For any water work that was installed under contract S20-5, does the City expect this contractor to find and make ties to water line bends? If so, can these be shown on the plans and will test pits be required and paid for?
DPW has ties to the water installation for Phase I and can be provided to the awarded contractor.

22- Note 1 on Plan Sheet 2 General Grading and Utility Plan Notes states existing underground utilities shall be field verified by Test Pit prior to commencement of construction. Under what item will the contractor be paid to perform said test pits?
The item for test pits, ITEM 112.20, has been added with a quantity of 8.

23- On page 262 of 581, Item 930.2021-Gas Main-6" the specification states that the 6" main shall be purchased and installed by Eversource. Given the historical performance challenges that come with working with a third party utility, will the City consider having Eversource perform their own excavation and backfill?
This project is specifically set up for the City's contractor to excavate for, and backfill and pave (if necessary), for the installation of the Eversource gas main. Eversource will purchase, lay, and connect the pipe. The City's contractor will perform all other activities necessary to facilitate this.

Questions 24 through 32 and 34 through 35 were answered by Eversource.

24- If the answer to question 12 is no, then please provide an expected sequence of construction for the gas main installation in conjunction with this contractor. How long of a trench will the gas company be able to install in a given day?
The crew should be able to install 400' a day

25- Is there a minimum amount of trench that needs to be excavated to schedule Eversource to arrive and install the pipe?
No.

26- Is there a maximum amount of trench that should not be exceeded in any given day that Eversource can not keep up in laying pipe?
No more than 500'

27- Will Eversource be on site continuously once trenching is started to work in conjunction with site contractor and work right behind the excavation and backfill operation?
Once this job starts the crew will be on site until this job is complete, weather permitting.

28- How long does Eversource require for advance notification for scheduling an Eversource crew for the installation so this can be incorporated into a project schedule.
Depending on the time of year.

29- Does the entire run of gas line pipe need to be open for inspection by Eversource prior to backfill or can backfilling be performed as the pipe is installed?
No, the trench will be inspected every day prior to installing the main. The main is 6" and the trench will have to be dug at a depth of 47" deep. This will account for 4" of sand under the main and we need a minimum of 1' of clearance in-between other utilities.

30- Will the contractor be able to backfill any installed piping immediately or is it expected to steel plate the trench and not backfill until all pipe is installed?
After the pipe is installed the sand will be supplied by the contractor that is digging the trench. We need a minimum of 6" of sand laid on the top of the main. The trench will then be able to be backfilled with suitable material the day the main is installed.

31- Plan Sheet 9 shows the gas line connection in Belmont St. but a note states "Eversource to make connection to Prop. 6" gas main to exist. 8" IP Gas main excluded from Phase 2 Bid Work." However, an adjacent note states "Provide Pavement Patch for gas connection in accordance with City of Worc. Specifications." Where does the gas trenching to be done under this contract end at the Belmont St. end?
This question should be answered by sales fulfillment.

32- Will the contractor be required to sawcut, excavate the Eversource temporary patch, install a new full depth patch at the gas line tie-in? Or, will this contract just mill 2" and pave 2" over the Gas company trench in Belmont St.?
The Eversource supplied contractor will be digging over the existing main and backfilling and paving to City spec.

33- The concrete sidewalk and wheelchair ramp will be removed at the gas line tie in at Belmont St. and the plans do not show this as being reconstructed. Confirm that this restoration will be paid under other contract items such as sidewalks and loam and seed and that it is not considered incidental to the gas line trenching item.
The reconstruction of surface structures (curb, sidewalk, HC ramp, etc.) will be paid with contract unit prices for those items.

34- If gas line testing does not pass and re-excavation is required, confirm that this is not incidental and confirm the site contractor will be paid under a change order for any re-excavation, if necessary, to get the gas line passed.
If the Gas main does not pass the required air test then the Eversource supplied contractor will be excavating to find issues.

35- Does the City expect the contractor to plate and maintain the gas line trench if any delays or scheduling issues arise?
Eversource does not anticipate any delays during installation. The main is to be continuously installed and immediately gassed up.

36- Can firms with a designated SDO certification of PBE, VBE, SDVOBE, LGBTBE & DOBE be considered as a component to meet the goals of 10% MBE and 5 % WBE?
Per the Purchasing Department, the % goals are based on the EDA funding requirement.

37- If the answer to question 2 is no, please consider the following statement taken from https://www.mass.gov/certification-program-for-sdo *"The Supplier Diversity Office (SDO) has a long tradition of service to minority and women owned businesses in the Commonwealth of Massachusetts. The SDO is responsible for conducting investigations of certification applications from businesses that meet certain criteria. The SDO currently certifies certain diverse business categories (Minority (MBE), Women (WBE), Portuguese (PBE) and Veteran (VBE) businesses) inhouse and has agreements with third-party organizations that certify these same categories and others that certify other business categories (Service-Disabled Veteran (SDVOBE), Lesbian, Gay, Bisexual and Transgender (LGBTBE) and Disability-Owned (DOBE) businesses), all of which must meet certain certification criteria."*
Please provide the reasoning as to only requiring MBE and WBE entities for participation in this contract and not advocating for other equally classified groups of businesses?
Refer to question #36

38- Has the City of Worc. ever established a participation goal for PBE certified firms?
No.

39- Has the City of Worc. ever established a participation goal for VBE certified firms?
No.

40- Has the City of Worc. ever established a participation goal for SDVOBE certified firms?
No.

41- Has the City of Worc. ever established a participation goal for LGBTBE certified firms?
No.

42- Has the City of Worc. ever established a participation goal for DOBE certified firms?
No.

43- Is it the City of Worc.'s policy to discriminate against PBE, VBE, SDVOBE, LGBTBE & DOBE firms by not setting participation goals for these certified groups?
No, see question36.

44- Plans reference plans by Wozny Barbar in several locations for lighting info-please provide these plans.
The requested plans have been included with this addendum.

45- On plan sheet 9, a note calls for 2 each-2" lighting conduits and handholes at Station 0+75 left (the same note is on plan sheet 10 around station 6+25, Left). The line then seems to split with conduit going to a handhole and branching to another handhole. Will both handholes have 2 each-2" conduits into and out of them? If so, the main run should have 4 Each-2" conduits for them to branch out. Please clarify. (perhaps the Wozny Barbar plans will clear this up).
Please refer to the provided Wozny Barbar plans.

46- On plan sheet 10, Station 4+50, Left, the plan calls for one 3" conduit to feed the new load center (similar to Sta. 14+10, Left). Do we break into an existing conduit in the existing duct bank or do we run the 3" conduit all the way to the existing 3-way manhole at Sta. 3+75.?
ADDITIONAL INFORMATION IS BEING SOUGHT FROM WOZNY BARBER ON THIS.

47- Please detail the work required at the new load center and transformer, Station 4+50, Left and Station 14+10 Left. Does the new single 3" conduit go into the load center from the existing duct bank and then 2-2" (or 4-2"?) conduits leave the load center and go to the adjacent handhole?
ADDITIONAL INFORMATION IS BEING SOUGHT FROM WOZNY BARBER ON THIS

48- Plan sheets 9, 10 & 11 have a Note stating "All electric conduit and services shall be concrete encased. Contractor to refer to NGRID plans and specifications for additional details and information." Does this apply to site lighting and telecom or just NGRID ductbanks? This seems to contradict the "Telecom Trench Installation detail" on plan sheet 29.
Applies to NGRID duct banks and does not apply to telecom duct banks. Refer to plans by Wozny Barbar for information on lighting duct banks.

49- Confirm that site lighting electrical conduit is not concrete encased.
Refer to plans by Wozny Barbar for information on lighting duct banks.

50- Confirm that the 1 each 4" telecom is not concrete encased.
WORKING TO CLARIFY THIS WITH CHARTER AND WILL RESPOND WITH INFORMATION

51- What kind of PVC pipe is required for the telecom conduit in Item 928.2021—Type EB, DB, Sch. 40, Sch. 80 etc.?
Refer to Telecom Trench Installation Detail on Sheet 29 which notes Sch. 40 PVC.

52- The note on plan sheet 10 states "Proposed 3'x3' Telecom Manhole in conformance with telecom provider requirements." Confirm that the detail on sheet 29-"Telecom Manhole" is in conformance with the telecom provider and there are not any special requirements other than those shown on the plans. Does the casting need any special or custom wording on the manhole cover?
WORKING TO CLARIFY THIS WITH CHARTER AND WILL RESPOND WITH INFORMATION

53- The description of Item 804.21 in the City of Worc. Standards is "Additional 2 Inch Electrical Conduit (foot) Type NM-Plastic-(NEMA) for street Lighting within the Same Trench". This is not the description provided on the bid form. Confirm that this item will be used for an additional 2" street lighting conduit in a trench already paid for under Item 804.2.
Item 804.21 is the item to be paid for the additional run of conduit to be placed within the same trench as the conduit for Item 804.20.

54- Item 804.2, 804.21(2200 Feet & 2200 feet respectively) seem to cover all conduits for street lighting. What work is covered by Item 813.8000-Electrical Service (Linear Foot)-4,400 Feet?
ADDITIONAL INFORMATION IS BEING SOUGHT FROM WOZNY BARBER ON THIS

55- Under Item 812.2000-Light Standard foundations found in the City of Worc. Standards, it states that the light pole foundation shall be as shown on the plans and per the structural engineer's recommendations. Please provide a concrete light pole foundation detail or confirm which detail (page 8-15 or 8-16 or 8-26) from the City of Worc. Standards shall be used. (Perhaps they are on the Wozny Barbar plans?)
Please refer to the provided plans by Wozny Barbar for light pole base detail.

56- Sewer Manhole "Prop. SMH-119" shown on sheet 11 is calling for a proposed sewer manhole but the other note just states to core and connect to the SMH installed previously. Sheet 19 lists it as existing. Is SMH-119 existing or proposed?
SMH 119 is exiting and was installed during the Phase I contract.

57- 10" PVC Sewer pipe as well as 12" PVC sewer pipe is on the plans but there is no bid item for 10" sewer pipe. Please clarify and review quantities for bid item 220.1200 and bid item 222.1200.
The quantity for Item 220.1200 has been corrected to 375 linear feet, the Item 220.10 has been added with a quantity of 405 linear feet. As noted in #6 above Item 222.12 - 12" RCP is noted as 138 LF on the bid forms.

58- On sheet 17, DMH A and DMH B are proposed as well as 131' of 15" RCP connecting the 2 structures. On sheet 12, this pipe run is not shown. Please clarify and can sheet 12 be updated to show this work?
The plans have been updated to clarify this pipe location on Sheet 12.

59- On sheet 17, 8" RCP is called out between DMH-C to CB-A. There is no bid item for 8" RCP – please clarify. City of Worcester spec is typically C900 PVC pipe between CB's and DMH's.
This connection should be C900 and was Included in Item 225.08 - 8" catch basin connection.

60- On sheet 17, 18" HDPE is called out between existing DMH9 and Proposed DMH8. There is no bid item for 18" HDPE-please clarify.
This pipe length shall be RCP and is reflected in Item # 222.1800. The plans have been revised to reflect this correction.

61- On sheet 6 a note calls to "Exist Pavement (TBR-Typ) (Full Depth Pavement Removal)" and on sheet 11 a note states to "Approx. Limits of Exist. Pave to be Removed and Replaced with Loam and Seed (Typ.)". The arrow leaders clearly go beyond the limit of work calling for pavement removal. This area is also beyond the erosion control barriers shown on sheet 23. Is the contractor supposed to remove pavement and loam/seed beyond the limit of work? Can plans be updated to clarify what work outside limit of work and erosion and sediment controls is required?
As noted on the plans site features outside the limit of work are to be removed by others and are not part of the phase 2 bid. Pavement removal is only required within the limits of work. The leader arrow on the plan has been adjusted accordingly.

62- As discussed at the pre-bid conference, Mike D. from the Water Dept. stated that Worcester water specs are for sand bedding and sand on top of water pipe as well as poly wrapping water pipe. The detail "Typical Water Trench" on sheet 28 does not show sand or poly wrapping. The other trench detail "City of Worcester Typical Trench Detail" just shows gravel. Please clarify the detail desired for the water line trench.
The typical water trench detail on Sheet 28 has been updated to be consistent with the City of Worcester DPW&P Water Operations Detail W-5 listed in the City Standard Specifications and Details.

63- Plan Sheet 28 has 3 separate and different trench details for Sewer, Drain and Water. Sheet 29 has a detail for Telecom trench. Given these 4 separate and unique detailed trench cross sections, my question is what type of utility does the detail "City of Worcester Typical Trench Detail" on the middle of sheet 29 pertain to?
The City of Worcester Typical Trench Detail on Sheet 29 has been removed from the plans.

64- Plan & Profile "B" Sheet 19, DMH-100 in the profile is missing inverts in and out and only shows a rim grade. Can the inverts be provided?
The plans have been revised to provide this information.

65- Plan & Profile "C" Sheet 20, CB-1 and CB-2 seem to be cut off in the profile. Can the rim and invert out for CB's 1 & 2 be provided?
The plans have been revised to provide this information.

66- Plan & Profile "A", Sheet 18, CB-104 and CB-105 seem to be cut off in the profile. Can the rim and invert for CB-104 and CB-105?
The plans have been revised to provide this information.

67- As discussed at the pre-bid conference, confirm that NGRID specifications will be made available and are part of the bid documents.
The National Grid Specifications are included with this Addendum.

68- As discussed, confirm that the traffic loops on Hospital Drive and Belmont St. intersection will be re-installed at no cost to this contract and will be done by others.
Any traffic loops damaged during resurfacing of the roadway or utility installations will be replaced by a different City contractor.

69- As discussed, confirm that decorative crosswalks that are to be pulvi-milled and milled, will be replaced with thermoplastic striping and decorative crosswalks shall not be replaced.
Decorative crosswalks removed during this project are not planned to be replaced. Standard high visibility thermoplastic crosswalks will be placed as the finished product.

70- Confirm the decorative crosswalk on the East side of the Belmont St./Hospital Drive is treated as existing to remain and that this crosswalk will not be milled out. It seems odd to leave one decorative crosswalk and mill out the other 2.
Any surface treatment that does not get removed, either partially or fully needs to be reconstructed.

71- As discussed, will cross sections of the roadway be provided by Bohler to be used to verify cuts/fills?
Bohler will not be providing cross sections for the bid process but can provide them to the awarded contract, in addition to the CAD plans, if so requested by the awarded contractor.

72- As discussed, there is a driveway opening to the Abbvie parking lot around Station 1+00 to Sta. 2+00, Right that exists but is not shown on the plans. Confirm this driveway is to remain and the pulvi-mill limits of work will be the gutter line of Hospital Drive.
For clarification I believe they are referring to the driveway opening for WuXi that was just installed as there are no driveway cuts for Abbvie. The driveway is newly constructed for that user and shall remain. The pulvi-mill limits of work will be the gutter line for Hospital Drive. Work adjacent to the new driveway should be coordinated with the abutting developer's contractor.

73- As discussed, there is a settling patch of the water line tie-in performed under Contract S20-5 in Belmont St. Confirm that full depth restoration of this trench is not required and only the milling and paving are required over the water line tie-in patch.
This will be repaired by the contractor who did the work prior to this bid opening.

74- If further settlement of the water line patch continues after milling and paving, confirm it will NOT be the responsibility of this contractor to repair any further settlement.
Once the contract begins, the date of the Notice to Proceed, the awarded contractor will be responsible for what is within the limits of work for this contract.

75- The existing steam tunnel that calls for demolition was discussed as being 3'x5'. Please confirm this and provide a wall thickness that all bidders shall assume when bidding.
This is the most up to date information according to the design engineer.

76- As discussed, confirm no borings have been done as part of the project, or, provide them if they have been done.
Attached are two geotechnical reports from Whitestone showing the borings that were done for the buildings and the rock probes that were done along the existing roads.

77- Was any rock encountered and paid for under Contract S20-5 “Rock Excavation” under the Phase 1 project?
No bedrock was encountered as part of the Phase I contract work.

78- As discussed, confirm that the steam tunnel was abated and if hazardous materials are encountered, this will be dealt with as a changed condition.
There is no provision for hazardous material removal for this contract as none is expected to be encountered.

79- As discussed, confirm that no AC pipe removal is expected.
No AC pipe removal is expected.

80- As discussed, confirm that no hazardous materials are included in the project.
There is no provision for hazardous material removal for this contract as none is expected to be encountered.

81- Confirm that soil testing and LSP services are not required for this project as all soils are to remain on site.
Do not believe an LSP and/or soil testing is necessary. Should the contractor elect to remove soils from the site (ie: unsuitable material), soils should be tested and managed appropriately by the contractor. All soil should be able to stay on site.

Attachments: Revised Unit Quantities, Wozny Barbar Electrical Plan, Eversource Gas Trench Guidelines, Geotechnical Report, Rock Probes Report, Pre-Bid Sign In, National Grid Specifications, Telecom Specification.

THE BIDDER MUST FILL IN THESE UNIT PRICES. Also carry out all extensions and fill in "Computed Totals."
In case of error or discrepancies, UNIT PRICES govern and written works take precedence over figures.

ITEM NUMBER AND DESCRIPTION		ESTIMATED QUANTITY	COMPUTED TOTALS
104.0000	TREE REMOVAL (LESS THAN 24 INCHES) INCLUDING STUMP		
	_____ Dollars	12.00	$ _____
	($ _____) EA		
106.0000	TREE REMOVAL (24 INCHES & OVER) INCLUDING STUMP		
	_____ Dollars	7.00	$ _____
	($ _____) EA		
107.0000	STREET TREE REPLACEMENT		
	_____ Dollars	31.00	$ _____
	($ _____) EA		
112.2000	TEST PITS		
	_____ Dollars	8.00	$ _____
	($ _____) EA		
113.0000	TREE PROTECTION		
	_____ Dollars	6.00	$ _____
	($ _____) EA		
116.0000	EXCAVATION		
	_____ Dollars	4,000.00	$ _____
	($ _____) CY		
118.0000	CLASS "A" ROCK EXCAVATION AND DISPOSAL		
	_____ Dollars	250.00	$ _____
	($ _____) CY		
120.0000	CLASS "B" ROCK EXCAVATION AND DISPOSAL		
	_____ Dollars	120.00	$ _____
	($ _____) CY		

ITEM NUMBER AND DESCRIPTION		ESTIMATED QUANTITY	COMPUTED TOTALS
124.0000	ORDINARY BORROW/SELECTED COMMON FILL		
	Dollars	18,890.00	$
	($) CY		
125.0000	SAND BORROW		
	Dollars	300.00	$
	($) CY		
126.0000	GRAVEL BORROW		
	Dollars	1,500.00	$
	($) CY		
128.0000	SCREENED LOAM BORROW		
	Dollars	2,000.00	$
	($) CY		
156.0000	SEEDING		
	Dollars	22,500.00	$
	($) SY		
170.0000	COMPLY WITH THE CONSERVATION COMMISSION ORDER OF CONDITIONS		
	Dollars	1.00	$
	($) LS		
220.0800	TRENCH EXCAVATION AND BACKFILL, FURNISH AND INSTALL 8" PVC		
	Dollars	80.00	$
	($) LF		
220.1000	TRENCH EXCAVATION AND BACKFILL FURNISH AND INSTALL 10" PVC		
	Dollars	405.00	$
	($) LF		
220.1200	TRENCH EXCAVATION AND BACKFILL, FURNISH AND INSTALL 12" PVC		
	Dollars	375.00	$
	($) LF		

ITEM NUMBER AND DESCRIPTION		ESTIMATED QUANTITY	COMPUTED TOTALS
222.1200	TRENCH EXCAVATION AND BACKFILL, FURNISH AND INSTALL 12" RCP		
	_____ Dollars	138.00	$ _____
	($ _____) LF		
222.1500	TRENCH EXCAVATION AND BACKFILL, FURNISH AND INSTALL 15" RCP		
	_____ Dollars	1,160.00	$ _____
	($ _____) LF		
222.1800	TRENCH EXCAVATION AND BACKFILL, FURNISH AND INSTALL 18" RCP		
	_____ Dollars	110.00	$ _____
	($ _____) LF		
225.0800	8 INCH CATCH BASIN CONNECTION		
	_____ Dollars	256.00	$ _____
	($ _____) LF		
230.4000	4' MANHOLE BASE		
	_____ Dollars	22.00	$ _____
	($ _____) EA		
231.4000	4' MANHOLE SECTION		
	_____ Dollars	100.00	$ _____
	($ _____) VF		
235.0000	CATCH BASIN FRAME & GRATE		
	_____ Dollars	14.00	$ _____
	($ _____) EA		
236.0000	MANHOLE FRAME & COVER		
	_____ Dollars	22.00	$ _____
	($ _____) EA		
240.0000	WORCESTER STANDARD CATCH BASIN (5 foot diameter)		
	_____ Dollars	14.00	$ _____
	($ _____) EA		

ITEM NUMBER AND DESCRIPTION		ESTIMATED QUANTITY	COMPUTED TOTALS
245.0000 GRANITE INLET STONE			
	Dollars	14.00	$
	($) EA		
246.0000 8 INCH GREEN TRAPS			
	Dollars	14.00	$
	($) EA		
249.0000 CATCH BASIN CLEANING			
	Dollars	22.00	$
	($) EA		
250.0000 MANHOLE FRAMES, REMOVE, PLATE & RETAIN			
	Dollars	15.00	$
	($) EA		
252.1000 MANHOLE ADJUSTMENT 12 INCH OR LESS GRAVEL			
	Dollars	15.00	$
	($) EA		
254.1000 CATCH BASIN ADJUST TO LINE AND/OR GRADE 12 INCH OR LESS, GRAVEL			
	Dollars	7.00	$
	($) EA		
265.0000 REMOVE AND DISPOSE OF EXISTING MANHOLE			
	Dollars	11.00	$
	($) EA		
301.0600 6” CLDI Pipe			
	Dollars	40.00	$
	($) LF		
301.0800 8” CLDI Pipe			
	Dollars	90.00	$
	($) LF		

ITEM NUMBER AND DESCRIPTION		ESTIMATED QUANTITY	COMPUTED TOTALS
301.1000 10” CLDI Pipe			
	Dollars	1,020.00	$
	($) LF		
301.5000 Polyethylene Wrap for Ductile Iron Pipe			
	Dollars	2,500.00	$
	($) LF		
302.1000 Cast or Ductile Fittings			
	Dollars	2,500.00	$
	($) LB		
304.0100 VALVE BOX			
	Dollars	20.00	$
	($) EA		
305.0600 6” Gate Valve			
	Dollars	7.00	$
	($) EA		
305.0800 8” Gate Valve			
	Dollars	2.00	$
	($) EA		
305.1000 10” Gate Valve			
	Dollars	7.00	$
	($) EA		
310.1000 New Hydrant			
	Dollars	7.00	$
	($) EA		
310.6000 HYDRANT PAINTING			
	Dollars	7.00	$
	($) EA		
312.1000 10” Tie-in			
	Dollars	1.00	$
	($) EA		

ITEM NUMBER AND DESCRIPTION		ESTIMATED QUANTITY	COMPUTED TOTALS
313.1000 Thrust Block			
	Dollars	60.00	$
	($) CY		
402.0000 FINE GRADING, ROLLING AND FINISHING			
	Dollars	18,240.00	$
	($) SY		
403.2000 GRINDING AND MILLING 2 INCH			
	Dollars	750.00	$
	($) SY		
404.0000 PULVI-MILLING			
	Dollars	3,200.00	$
	($) SY		
405.0000 STRAIGHT CURB (VA-4)			
	Dollars	1,790.00	$
	($) LF		
408.0000 CIRCULAR CURB (10' RADIUS & OVER) (VA-4)			
	Dollars	1,060.00	$
	($) LF		
418.0000 CURB REMOVAL & STACK			
	Dollars	1,925.00	$
	($) LF		
422.1000 SUPERPAVE 9.5 MM LEVEL 2 (TOP COURSE)			
	Dollars	950.00	$
	($) TN		
422.2000 SUPERPAVE 12.5 MM LEVEL 2 (BINDER COURSE)			
	Dollars	1,350.00	$
	($) TN		
428.0000 BITUMINOUS CONCRETE ROADWAY REPAIR			
	Dollars	80.00	$
	($) SY		

ITEM NUMBER AND DESCRIPTION		ESTIMATED QUANTITY	COMPUTED TOTALS
434.0000 SAWING PAVEMENT			
	Dollars	1,100.00	$
	($) LF		
435.0000 HOT POURED RUBBERIZED ASPHALT SEALER			
	Dollars	1,136.00	$
	($) LF		
436.0000 RESURFACE TRENCHES TEMPORARY			
	Dollars	620.00	$
	($) LF		
436.0100 RESURFACE TRENCHES PERMANENT			
	Dollars	420.00	$
	($) LF		
440.0000 NEW CONCRETE SIDEWALK 4 INCH			
	Dollars	1,100.00	$
	($) SY		
446.3000 EXCAVATABLE CONTROL DENSITY FILL (CDF)			
	Dollars	25.00	$
	($) CY		
448.0000 WORCESTER HIGHWAY MONUMENT			
	Dollars	22.00	$
	($) EA		
454.0000 WHEELCHAIR RAMP CEMENT CONCRETE - 6" THICK WITH DETECTABLE WARNING PANELS			
	Dollars	30.00	$
	($) SY		
501.0000 4 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)			
	Dollars	975.00	$
	($) LF		

ITEM NUMBER AND DESCRIPTION		ESTIMATED QUANTITY	COMPUTED TOTALS
502.0000	4 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)		
	_____ Dollars	3,768.00	$ _____
	($ _____) LF		
504.0000	PAVEMENT ARROW/LEGEND REFLECTORIZED WHITE (THERMOPLASTIC)		
	_____ Dollars	62.00	$ _____
	($ _____) EA		
506.0000	4 INCH REFLECTORIZED YELLOW LINE (WATERBORNE)		
	_____ Dollars	116.00	$ _____
	($ _____) LF		
520.0000	WARNING AND REGULATORY SIGNS		
	_____ Dollars	5.00	$ _____
	($ _____) EA		
522.0000	TYPE "B" STREET NAME SIGNS		
	_____ Dollars	4.00	$ _____
	($ _____) EA		
523.0000	TRAFFIC SIGN POLES		
	_____ Dollars	5.00	$ _____
	($ _____) EA		
804.2000	2-INCH ELECTRICAL CONDUIT (FOOT) TYPE NM PLASTIC (UL)		
	_____ Dollars	2,200.00	$ _____
	($ _____) LF		
804.2100	ADDITIONAL 2 INCH ELECTRICAL CONDUIT (FOOT) TYPE NM PLASTIC (UL)		
	_____ Dollars	2,200.00	$ _____
	($ _____) LF		
804.3000	3-INCH ELECTRICAL CONDUIT (FOOT) TYPE NM PLASTIC (UL)		
	_____ Dollars	200.00	$ _____
	($ _____) LF		

ITEM NUMBER AND DESCRIPTION		ESTIMATED QUANTITY	COMPUTED TOTALS
810.2000	ELECTRIC HANDHOLE PRECAST CONCRETE (EACH)		
	Dollars	40.00	$
	($) EA		
811.2000	ELECTRIC LOAD CENTER BASE CONCRETE (EACH)		
	Dollars	2.00	$
	($) EA		
812.2000	LIGHT STANDARD FOUNDATION CONCRETE (EACH		
	Dollars	19.00	$
	($) EA		
813.8000	ELECTRICAL SERVICE (LINEAR FOOT)		
	Dollars	4,400.00	$
	($) LF		
821.0000	STREET LIGHT		
	Dollars	19.00	$
	($) EA		
821.2000	STREET LIGHTING CONTROL LOAD CENTER (EACH)		
	Dollars	2.00	$
	($) EA		
900.0000	Lump Sum Reserve		
	four hundred seventy thousand and xx / 100 Dollars		$ 470,000.00
924.2020	CONDUCTOR #10 AWG (FOOT)		
	Dollars	2,500.00	$
	($) LF		
927.2021	AS-BUILT PLAN		
	Dollars	1.00	$
	($) LS		

ITEM NUMBER AND DESCRIPTION		ESTIMATED QUANTITY	COMPUTED TOTALS
928.2021 TELECOM TRUNK LINE 4" CONDUIT			
	Dollars	1,300.00	$
	($) LF		
929.2021 3'X3' TELECOM MANHOLE			
	Dollars	3.00	$
	($) EA		
930.2021 GAS MAIN - 6"			
	Dollars	1,950.00	$
	($) LF		
931.2021 SILT FENCE			
	Dollars	2,400.00	$
	($) LF		
932.2021 COMPOST SOCK			
	Dollars	2,500.00	$
	($) LF		
933.2021 SEDIMENT BASINS			
	Dollars	3.00	$
	($) EA		
934.2021 CHECK DAMS			
	Dollars	20.00	$
	($) EA		
935.2021 REMOVE AND DISPOSE OF WATER LINES AND STRUCTURES			
	Dollars	1.00	$
	($) LS		
936.2021 REMOVE AND DISPOSE GAS LINES AND STRUCTURES			
	Dollars	1.00	$
	($) LS		

ITEM NUMBER AND DESCRIPTION		ESTIMATED QUANTITY	COMPUTED TOTALS
937.2021	REMOVE AND DISPOSE SANITARY LINE AND STRUCTURES		
	Dollars	1.00	$
	($) LS		
938.2021	REMOVE AND DISPOSE DRAINAGE LINES AND STRUCTURES		
	Dollars	1.00	$
	($) LS		
939.2021	REMOVE AND DISPOSE OF ELECTRIC LINES AND STRUCTURES		
	Dollars	1.00	$
	($) LS		
940.2021	REMOVE AND DISPOSE OF EXISTING STREET LIGHTS		
	Dollars	19.00	$
	($) EA		
941.2021	REMOVE AND DISOPSE OF UTILITY TUNNEL		
	Dollars	1.00	$
	($) LS		
942.2021	DIVERSION SWALES AND BERMS		
	Dollars	1.00	$
	($) EA		
943.2021	EDA FUNDING ADVERTISEMENT SIGN		
	Dollars	2.00	$
	($) EA		
944.2021	ROADWAY LAYOUT		
	Dollars	1.00	$
	($) LS		
953.2020	SILT SACK		
	Dollars	35.00	$
	($) EA		

ITEM NUMBER AND DESCRIPTION		ESTIMATED QUANTITY	COMPUTED TOTALS
955.2020	NPDES STORM WATER POLLUTION PREVENTION PLAN		
	_____ Dollars	1.00	$ _____
	($ _____) LS		
966.2020	12"X10" Cut-in Tee		
	_____ Dollars	1.00	$ _____
	($ _____) EA		
969.2020	ELECTRICAL TRUNK LINE 9-5" CONDUIT		
	_____ Dollars	75.00	$ _____
	($ _____) LF		
971.2020	ELECTRIC MANHOLE 2-WAY		
	_____ Dollars	1.00	$ _____
	($ _____) EA		
972.2020	ELECTRIC MANHOLE 3-WAY		
	_____ Dollars	1.00	$ _____
	($ _____) EA		
973.2020	ELECTRICAL TRUNK LINE 15-5" CONDUIT		
	_____ Dollars	950.00	$ _____
	($ _____) LF		
974.2021	ELECTRIC MANHOLE 4-WAY		
	_____ Dollars	1.00	$ _____
	($ _____) EA		

TOTAL BID PRICE INCLUDING CONTINGENCY

_____Dollars and _____Cents
(amount in words)

$_____
(amount in figures)

This proposal is based on provisions of the following addenda:

No. _____ No. _____

No. _____ No. _____

All amounts and totals given above will be subject to verification by the City. In case of variation between Unit Bid Price and Totals shown by the Bidder, the Unit Price written in words will be considered to be the bid.

The City reserves the right to reject any and all bids, wholly or in part, and to make awards in a manner deemed in the best interests of the City.

The above estimated quantities form an approximate statement of the extent of the work to be done, based upon the estimate of the Contracting Officer. The City does not expressly or by implication agree that the actual quantity of work will correspond therewith, but reserves the right to increase or decrease the quantity of any class or portion of the work, as may be deemed necessary by the Contracting Officer.

LIGHTING FIXTURES

SYMBOL	DESCRIPTION	NOTES
FP 1a	WALL OR CEILING MOUNTED LIGHTING FIXTURE	UPPER CASE LETTERS INDICATE FIXTURE TYPE. REFER TO FIXTURE SCHEDULE FOR MANUFACTURER. SUBSCRIPT LOWER CASE LETTERS INDICATE SWITCH CONTROL ASSOCIATIONS. SHADING OF FIXTURES THUS: INDICATES FIXTURE ON NIGHT/EMERGENCY CIRCUIT OR EMERGENCY BATTERY BACK UP BALLAST WHERE APPLICABLE, CONTRACTOR SHALL CONFIRM LOCATION OF REMOTE EMERGENCY BALLAST WITH ARCHITECT PRIOR TO PURCHASE AND INSTALLATION. EMERGENCY BALLAST SHALL BE SIMILAR TO BODINE B30ST OR B30 WITH INTEGRAL INDICATOR LIGHT TEST SWITCH. PROVIDE 2 LAMP APPLICATION WHERE APPLICABLE. CONTRACTOR SHALL PROVIDE ALL MOUNTING HARDWARE APPLICABLE TO CEILING, WALL, AND FLOOR TYPE INTO WHICH FIXTURE IS INSTALLED. CONTRACTOR SHALL COORDINATE MOUNTING HEIGHT WITH ARCHITECTURAL INTERIOR/EXTERIOR ELEVATIONS. CONTRACTOR SHALL COORDINATE AND CONFIRM K RATING OF LAMPS TO ACHIVE COLOR AS PER ARCHITECT
	EXTERIOR POLE MOUNTED FIXTURE	CONTRACTOR SHALL FURNISH AND SUPPLY ANY STEP DOWN TRANSFORMERS FOR ANY LOW VOLTAGE LIGHTING

EMERGENCY LIGHTING

SYMBOL	DESCRIPTION	NOTES
EB	EMERGENCY LIGHTING WITH BATTERY UNIT	ALL EMERGENCY BATTERY PACKS SHALL HAVE REMOTE HEAD CAPABILITY UNLESS NOTED OTHERWISE
	DUAL REMOTE EMERGENCY LIGHTING HEAD	
	SINGLE REMOTE EMERGENCY LIGHTING HEAD	

EXIT SIGNS

SYMBOL	DESCRIPTION	NOTES
WP 1	CEILING MOUNTED EXIT SIGN	ALL EXIT SIGNS SHALL BE FURNISHED WITH INTERNAL, 90 MINUTE BATTERY UNLESS NOTED OTHERWISE. APPLICATION OF SHADED QUADRANTS AND ARROWS THUS:
WP 1	WALL MOUNTED EXIT SIGN	INDICATE LETTERED FACE AND DIRECTIONAL CHEVERONS AS REQUIRED. UPPER CASE LETTERS INDICATE REFERENCE TO LIGHTING FIXTURE SCHEDULE

WIRING DEVICES—SWITCHES

SYMBOL	DESCRIPTION	NOTES	
S WP	SINGLE POLE SWITCH	20A 120–277V AC "WP" – INDICATES WEATHER PROOF	SUBSCRIPT LOWER CASE LETTERS INDICATE SWITCH CONTROL ASSOCIATIONS. SUBSCRIPT UPPER CASE LETTERS DENOTE SWITCH TYPE AS LISTED IN NON-STANDARD SWITCHES. UNLESS NOTED OTHERWISE SWITCHES SHALL BE MOUNTED 48" TO CENTER LINE AFF
SP	SINGLE POLE SWITCH WITH PILOT LIGHT		
S2	DOUBLE POLE SWITCH		
S3	THREE–WAY SWITCH		
S4	FOUR–WAY SWITCH		
ST	SPRING WOUND INTERVAL TIME SWITCH	TORK OR EQUAL 30 MINUTE MAX	
D	LINEAR SLIDE BAR DIMMER SWITCH	1500W–120 VOLT RATING UNLESS NOTED OTHERWISE	0–10V DIMMER FOR ALL DIMMED LED FIXTURES
OS 1	CEILING MOUNTED CORRIDOR OCCUPANCY SENSOR (80' oc)	WATT STOPPER: W–2000H	CONTRACTOR SHALL FURNISH AND INSTALL ALL NECESSARY POWER PACKS, RELAYS, CABLES, AND CONTROL MODULES TO COMPLETE SYSTEM. SUBSCRIPT LOWER CASE LETTERS INDICATE SWITCH LEG CONTROL. CONTRACTOR SHALL CONFIRM AND COORDINATE TIME DELAY SETTINGS WITH OWNER/TENANTS REPRESENTATIVE
OS 2	CEILING MOUNTED DUAL TECHNOLOGY SENSOR (1,600 sf)	WATT STOPPER: DT–300	
OS	WALL MOUNTED DUAL TECHNOLOGY OCCUPANCY SENSOR	WATT STOPPER: DW–100	
OS ab	WALL MOUNTED DUAL TECHNOLOGY DUAL RELAY SENSOR	WATT STOPPER: DW–200	
OS 3	CEILING MOUNTED HVAC SENSOR	WATT STOPPER: CI–24	
DS 1	CEILING MOUNTED DAYLIGHT SENSOR	LUTRON	
OS D	WALL MOUNTED DIMMABLE WALL SENSOR	WATT STOPPER: WD–170 (120V) WD–180 (277V)	

LIGHTING CONTROL SYSTEM

SYMBOL	DESCRIPTION	NOTES
TC	7 DAY ASTRONOMICAL TIME CLOCK	TORK OR EQUAL
PC	WALL MOUNTED PHOTOCELL	
LC	LIGHTING CONTACTOR	
K	KEY SWITCH	
MS	MASTER CONTROL SWITCH	

TELECOMMUNICATION SYSTEMS

SYMBOL	DESCRIPTION	NOTES
MHNC	MODULAR HOME NETWORK CENTER PROVIDE (1) DEDICATED 120V CIRCUIT & DOUBLE DUPLEX RECEPTACLE	MODULAR HOME NETWORKING PANEL SHALL BE LEVITON 47606–AHT IN 47605–140 ENCLOSURE OR EQUAL WITH 120V. RECEPTACLE
	WALL MOUNTED DATA OUTLET	4"x4" SQUARE OUTLET BOX WITH 1"C BACK TO DEMARK CLOSET. REFER TO BRYANT UNIVERSITY TEL/DATA CONSULTANT FOR ADDITIONAL INFORMATION
	CEILING MOUNTED DATA OUTLET	
T	FIRE RATED FURNITURE FEED POKE THROUGH DEVICE FOR TEL/DATA CONNECTIONS TO ELECTRIFIED FURNITURE	
T	4" SQUARE OUTLET BOX WITH 1 1/2" GROMMETTED HOLE COVERPLATE FOR TEL/DATA CONNECTION TO ELECTRIFIED FURNITURE PARTITIONS, MOUNTED 8" AFF	
TV	WALL MOUNTED CABLE TV OUTLET	4"x4" SQUARE OUTLET BOX WITH 1" CONDUIT STUBBED 6" ABOVE ACCESSIBLE CEILING SEE ARCH PLAN FOR MOUNTING HEIGHT
—CT—	CABLE TRAY	12" WIDE, 4" DEEP, CENTER SPLINE EQUAL TO WIREMOLD SPECMATE. PROVIDE ALL CONNECTORS AND HARDWARE FOR INSTALLATION OF LAYOUT SHOWN

WIRING DEVICES – RECEPTACLES

SYMBOL	DESCRIPTION	NOTES
1	WALL DUPLEX CONVENIENCE OUTLET MTD 18" AFF	20A/125V, 2P, 3W, GNDG., NEMA 5–20R. SHADING OF SYMBOL THUS: INDICATES RECEPTACLE WITH EACH HALF SEPARATELY WIRED. (HALF CONSTANT HALF SWITCH CONTROLLED.) "1"– INDICATES CIRCUIT NUMBER. SUBSCRIPT LOWER CASE LETTERS INDICATE SWITCH CONTROL ASSOCIATIONS. SHADING OF SYMBOL THUS: INDICATES RECEPTACLE MTD 6" ABOVE COUNTER TO CENTER LINE OR 48" AFF UNLESS NOTED OTHERWISE. 'WP' – INDICATES WEATHER PROOF. 'GFI' DENOTES GROUND FAULT INTERRUPTING TYPE RECEPTACLE. ALL POWER OUTLET FACEPLATES SHALL BE LABELED WITH CIRCUIT NUMBER AND PANEL DESIGNATION FEEDING OUTLET
	CEILING MOUNTED DUPLEX CONVENIENCE OUTLET	
IG	ISOLATED GROUND DUPLEX CONVENIENCE OUTLET	
	WALL DOUBLE DUPLEX CONVENIENCE OUTLET	
H	HOSPITAL GRADE DUPLEX CONVENIENCE OUTLET	
	WALL MTD SINGLE CONVENIENCE OUTLET	
USB	DUPLEX RECEPTACLE WITH (2) USB PORTS	HUBBELL: USB20X2. CONFIRM DEVICE AND FACEPLATE COLOR WITH ARCHITECT
9	WALL MOUNTED SPECIAL PURPOSE POWER RECEPTACLE	NUMERAL WITHIN SQUARE DENOTES RECEPTACLE TYPE AS LISTED IN SCHEDULE OF NON–STANDARD RECEPTACLES
P	FIRE RATED FURNITURE FEED POKE THRIUGH DEVICE FOR POWER CONNECTIONS TO ELECTRIFIED FURNITURE	
P	4" SQUARE OUTLET BOX TO OUTLETS LOCATED IN FURNITURE PARTITIONS (SEE FLOOR PLANS)	

WIRING DEVICES – MISCELLANEOUS

SYMBOL	DESCRIPTION	NOTES
PP	2 CHANNEL PWR/DATA POWER POLE WITH ELEC DEVICES AND PLATES	WIREMOLD AMDPT SERIES OR EQUAL
	2 PIECE SURFACE MTD RACEWAY WITH 20A DUPLEX RECEPTACLES SPACING AS SHOWN ON ELECTRICAL PLANS	WIREMOLD OR EQUAL
	2 PIECE MULTI–CHANNEL RACEWAY WITH 20A DUPLEX RECEPTACLES AND DATA OUTLETS SPACING AS SHOWN ON ELECTRICAL PLANS	WIREMOLD OR EQUAL
	FLUSH FLOOR MOUNTED POWER/DATA CONVIENCE RECEPTACLES	POKE THRU APPLICATION: 2 HOUR RATED. WIREMOLD RC SERIES OR EQUAL. COORDINATE FINAL POWER AND TEL/DATA TERMAINTIONS WITH TENANT. FLOOR TRENCH APPLICATION: DEEP RECTANGULAR CAST IRON BOX WIREMOLD OR EQUAL. PROVIDE 1"C FROM TEL/DATA TO 6" AFF. CONTRACTOR SHALL SUPPLY ALL COVERS AND FACE PLATES SPECIFIC TO SERIES

JUNCTION BOXES

SYMBOL	DESCRIPTION	NOTES
J	CEILING MOUNTED JUNCTION BOX	
J	WALL MOUNTED JUNCTION BOX	
J	SURFACE MOUNTED JUNCTION BOX	
J	FLUSH FLOOR MOUNTED JUNCTION BOX	
PB	PULL BOX	
J	JUNCTION BOX WITH FLEXIBLE CONNECTION TO EQUIPMENT	P – DENOTES POWER FEED C – DENOTES COMMUNICATIONS FEED

MOTORS AND CONTROLS

SYMBOL	DESCRIPTION	NOTES	
	MOTOR	COMPLETE INFO. FOR MOTOR IS INDICATED BY APPLICATION OF INDEXING SYMBOLS REFERENCE TO SCHEDULE OF MECHANICAL EQUIPMENT	
	MAGNETIC MOTOR STARTER COMPLETE W/ THERMAL OVERLOAD PROTECTION	SUBSCRIPT INDICATES NEMA SIZE	COMPLETE INFORMATION FOR CONTROL ITEMS IS INDICATED BY THE APPLICATION OF INDEXING SYMBOL REFERENCE APPLIED TO ASSOCIATED EQUIP.
	MANUAL MOTOR STARTER (THERMAL OVERLOAD SWITCH)		
VFD	VARIABLE FREQUECY DRIVE	REFER TO HVAC SCHEDULE FOR MOTOR LOAD HORSEPOWER SIZE	
CP	CONTROL PANEL (MECHANICAL EQUIP)	FURNISHED AND INSTALLED BY OTHERS. WIRED BY THE ELECTRICAL CONTRACTOR	

DISTRIBUTION EQUIPMENT

SYMBOL	DESCRIPTION	NOTES
	SURFACE MOUNTED PANEL	
	FLUSH MOUNTED PANEL	
TVSS	SURGE SUPPRESSION	PROVIDE PER SPECIFICATIONS
T	TRANSFORMER	SEE ELECTRICAL PLANS FOR KVA RATING
	GROUNDING PER SPECIFICATION	
M	METER SOCKET AND METER	METER SOCKET PROVIDED BY CONTRACTOR PROVIDED BY LOCAL UTILITY CO.
	OVERCURRENT AND/OR SWITCHING DEVICE "WP" – INDICATES WEATHER PROOF	COMPLETE INFORMATION FOR DEVICES IS INDICATED BY APPLICATION OF TAG SYMBOLS. 30 – INDICATES UNFUSED SWITCH 30 – FRAME SIZE. 30/15 – INDICATES FUSED SWITCH 30 – FRAME SIZE 15 – FUSE SIZE. CB – INDICATES ENCLOSED CIRCUIT BREAKER. 30/15 – INDICATES COMBINATION FUSED SWITCH AND STARTER 30 – FRAME SIZE 15 – FUSE SIZE. CB – INDICATES COMBINATION ENCLOSED CIRCUIT BREAKER AND STARTER. INDICATES BY OTHERS
	WALL MOUNTED EMERGENCY POWER OFF BUTTON	

BRANCH CIRCUITRY

SYMBOL	DESCRIPTION	NOTES
	LIGHTING AND APPLIANCE BRANCH CIRCUITRY CONCEALED ABOVE	ARROW HEAD INDICATES HOME RUN CIRCUITRY TO 20A–1P CIRCUIT BREAKER (UNLESS NOTED OTHERWISE) NUMBER OF ARROW HEADS INDICATE NUMBER OF BRANCH POLES REQUIRED IN PANEL. CROSS MARKS INDICATE NUMBER OR NO. 12 WIRES IN 3/4" CONDUIT PLUS GROUND. ABSENCE OF CROSSMARKS INDICATES 2#12, 1#12 GROUND. HOME RUNS ARE INDICATED THUS: LL2 – 1, 3, 5. "LL2" DENOTES PANEL DESIGNATION. "1,3,5" DENOTES CIRCUIT NO'S 1,3,5 CONTAINING 20A. 1P. CB'S IN PANELBOARD. CONDUIT RUNS REQUIRING CIRCUIT BREAKER GREATER THAN 20A–1P WIRE SIZE GREATER THAN NO. 12 AND CONDUIT SIZE GREATER THAN 3/4" ARE NOTED NOTED THUS: LL2–1, 3, 5 50A 3P 4 #4, 1 #8 GROUND 1–1/4" CONDUIT
	LIGHTING AND APPLIANCE BRANCH CIRCUITRY CONCEALED BELOW	
	LIGHTING AND APPLIANCE BRANCH RUN EXPOSED	
	INDIVIDUAL RUN TURNING UP	
	INDIVIDUAL RUN TURNING DOWN	
	INDIVIDUAL RUN TURNING UP&DOWN	

GENERAL CIRCUITRY

SYMBOL	DESCRIPTION	NOTES
	BUSWAY	
	CIRCUIT BREAKER BUS PLUG, BREAKERS AS INDICATED	
	BUSWAY FEED/ LUG CONNECTION	
—PE—	IDENTIFICATION OF INDIVIDUAL RUN OTHER THAN BRANCH CIRCUITRY OR SECONDARY FEEDERS	PE – PRIMARY ELECTRIC SE – SECONDARY ELECTRIC TEL – TELEPHONE TV – TELEVISION CATV – CABLE TELEVISION E – EMERGENCY

SECONDARY FEEDERS

SYMBOL	DESCRIPTION	NOTES
	FEEDER RUN CONCEALED ABOVE	ARROW HEAD INDICATES HOME RUN TO PANEL BOARD
	FEEDER RUN CONCEALED BELOW	FEEDER SIZING SHOWN ON POWER RISER DIAGRAM
	FEEDER RUN AS PER SPECIFIC NOTATION	

TAG SYMBOLS

SYMBOL	DESCRIPTION	NOTES
	INDEX SYMBOL	HEXAGONAL SYMBOLS CONTAINING TWO UPPER CASE LETTERS INDICATE REFERENCE TO A SCHEDULE OF SPECIAL EQUIPMENT. HEXAGONAL SYMBOLS CONTAINING UPPER CASE LETTERS AND NUMERICALS INDICATE REFERENCE TO SCHEDULE OF MECHANICAL EQUIPMENT. HEXAGONAL SYMBOLS CONTAINING NUMERICALS ONLY INDICATE REFERENCE TO AN EXPLANATION OF ELECTRICAL WORK REQUIREMENT
	GANGING CROSS REFERENCE	THE NOTED INDICATION ADJACENT TO A DEVICE DENOTES THAT THE DEVICE IS TO BE GANGED IN A BOX WITH ANOTHER DEVICE SIMILARLY NOTED AT THE SAME LOCATION ON ANOTHER DRAWING
( )	SPECIAL MOUNTING HEIGHT INDICATIONS	DIMENSION NOTED IN PARENTHESIS ADJACENT TO ANY ITEM OF THE DRAWINGS INDICATES THE HEIGHT OF IT'S HORIZONTAL CENTERLINE ABOVE FINISHED FLOOR
*	MOUNTING HEIGHT REFERENCE TO ARCHITECTURAL DRAWINGS	
	LINE INDICATING PHYSICAL SIZE OF ELECTRICAL ITEMS	INDICATION USED CIRCUMSCRIBING OTHER SYMBOLS TO DELINEATE PHYSICAL SIZE
	DETAIL TITLE ANNOTATION INDICATING DETAIL NUMBER	
	WIRING DEVICE GANGING SYMBOL	GANGING SYMBOL SHOWN IN CIRCUITRY RUN IN COMBINATION WITH ANY WIRING DEVICE SYMBOL THUS: DENOTES WIRING DEVICES WHICH ARE TO BE GANGED IN A COMMON PLATE OUTLET

NURSE / EMERGENCY CALL SYSTEMS

SYMBOL	DESCRIPTION	NOTES
NC	NURSE CALL PATIENT PULL CHORD	
NC	NURSE CALL PATIENT DOME LIGHT	
NC	NURSE CALL DUTY STAFF STATION	
NCAP	NURSE CALL ANNUNCIATOR PANEL	
EC	EMERGENCY CALL PULL CHORD	
EC	EMERGENCY CALL DOME LIGHT	
EC	EMERGENCY CALL REMOTE STATION	
ECCP	EMERGENCY CALL COMMUNICATION PANEL	

FIRE ALARM SYSTEM

SYMBOL	DESCRIPTION	NOTES
F	MANUAL FIRE ALARM PULL STATION	
	FIRE FIGHTER FIRE EMERG PHONE	
	VISUAL ONLY FIRE ALARM DEVICE	
F	COMBINATION AUDIO AND VISUAL FIRE ALARM DEVICE	
F C	CEILING MOUNTED AUDIO AND VISUAL FIRE ALARM DEVICE	
S	WALL MOUNTED FIRE ALARM SPEAKER	
S	WALL MOUNTED FIRE ALARM SPEAKER AND STROBE	
M	WALL MOUNTED MINI–HORN	
M	WALL MOUNTED FIRE ALARM MINI–HORN & STROBE	
F	FIRE ALARM MASTER BOX	
K	KNOX BOX	
B	ROTATING FIRE ALARM BEACON LIGHT	
EB	ELECTRIC BELL PROVIDE (1) DEDICATED 120V CIRCUIT	
FACP	FIRE ALARM CONTROL PANEL	S – COMBINATION SMOKE DETECTOR/ VISUAL ALARM FOR HEARING IMPAIRED.
FAA	FIRE ALARM ANNUNCIATOR PANEL	H – COMBINATION HEAT DETECTOR/ VISUAL ALARM FOR HEARING IMPAIRED.
RTS	REMOTE TEST STATION	CO – CEILING MOUNTED CARBON MONOXIDE DETECTOR
RI	REMOTE INDICATOR ALARM DEVICE	CO – WALL MOUNTED CARBON MONOXIDE DETECTOR
S	SMOKE DETECTOR	DETECTOR TYPE SUBSCRIPT: L LOCAL 120V DETECTOR; R RECEIVER UNIT; T TRANSMITTER UNIT; D IN DUCT DETECTOR; E ELEVATOR RECALL; B BEAM TYPE PHOTOELECTRIC; SA SUPPLY AIR DUCT DETECTOR; RA RETURN AIR DUCT DETECTOR; CO COMBINATION SMOKE/CARBON MONOXIDE DETECTOR
H	HEAT DETECTOR	
S / H	WALL MOUNTED SMOKE OR HEAT DETECTOR	
FS / TS / PS	SPRINKLER SYSTEM MONITOR: FS WATER FLOW; TS TAMPER SWITCH; PS DRY ALARM PRESSURE SWITCH	MONITOR TYPE: MM MONITORING MODULE; CM CONTROL MODULE
DH	MAGNETIC DOOR HOLDER	PROVIDE CONNECTION TO DOOR HARDWARE INTEGRAL HOLDERS
SK	SMOKE EXHAUST FAN KEY SWITCH	
I	ADDRESSABLE CONTROL OR MONITOR MODULE	MODULE SUBSCRIPT TYPE: C CONTROL MODULE; M MONITOR MODULE

EXISTING ELECTRICAL EQUIPMENT

SYMBOL	DESCRIPTION	NOTES
ETR	EXISTING TO REMAIN	ALL EXISTING TO REMAIN LIGHTING SHALL BE CLEANED AND RELAMPED. CONTRACTOR SHALL VERIFY THAT ALL EXISTING TO REMAIN ELECTRICAL DEVICES ARE OPERATIONAL & FUNCTIONAL. IF ETR DEVICES ARE NOT OPERATIONAL, IT SHALL BE REPLACED WITH A NEW DEVICE OF THAT TYPE. ALL REPLACED DEVICES SHALL MATCH EXISTING. CONTRACTOR SHALL EXTEND AND CONNECT EXISTING WIRING TO NEW LOCATION OF RELOCATED EQUIPMENT. CONTRACTOR SHALL REPLACE EXISTING WIRING BACK TO SOURCE IF NECESSARY IF EXISTING WIRING DOES NOT REACH RELOCATED EQUIPMENT. CONTRACTOR SHALL EVALUATE CONDITION OF EXISTING WIRING AND REPLACE IF NECESSARY.
X	EXISTING EQUIPMENT TO BE REMOVED	
XR	EXISTING EQUIPMENT TO BE REMOVED AND RELOCATED	
RX	NEW LOCATION OF RELOCATED EXISTING EQUIPMENT	
RR	REMOVE EXISTING DEVICE AND REINSTALL NEW DEVICE IN SAME LOCATION	
	DOTTED DENOTES EXISTING ELECTRICAL EQUIPMENT	

SECURITY/INTERCOM/ACCESS SYSTEMS

SYMBOL	DESCRIPTION	NOTES
DB PB	DOOR BELL PUSH BUTTON	EXTERIOR APPLICATION: EDWARDS OR EQUAL
DB C	DOOR BELL CHIME/BELL	
CR	CARD READER	
KP	KEY PAD	
DC	DOOR CONTACT	
ES	ELECTRIC DOOR STRIKE	
LA	LOCAL DOOR ALARM	
VC	INTERCOM SPEAKER VOLUME CONTROL	
IS	VIDEO INTERCOM STATION TALK/ACCESS	
INTP	MAIN VIDEO INTERCOM PANEL	
MD	WALL MOUNTED MOTION DETECTOR	
MD	CEILING MOUNTED MOTION DETECTOR	
SP	CEILING MOUNTED PUBLIC ADDRESS SPEAKER	
CCTV	CLOSED CIRCUIT TELEVISION CAMERA	
SCP	SECURITY CONTROL PANEL	
IAP	INTRUSION ALARM PANEL	ARA – AREA OF RESCUE ASSISTANCE INDICATOR LIGHT W/ BATTERY BACKUP SIMILAR TO HOUSING DEVICES
HC	HANDICAP ACCESS PUSH BUTTON	RB – AREA OF RESCUE SYSTEM SIMILAR TO HOUSING DEVICES ADA 1000 PHONE LINE.

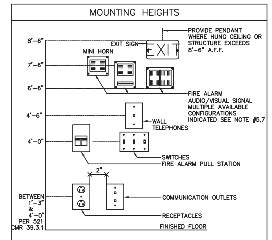
GENERAL NOTES

1. ALL CONDUITS AND EQUIPMENT SHALL BE INSTALLED AND GROUND IN ACCORDANCE WITH THE LATEST RULES AND REGULATIONS OF THE APPLICABLE LOCAL AND NATIONAL CODES.
2. CONDUIT RUNS ARE SHOWN DIAGRAMATICALLY ONLY AND SHALL BE INSTALLED IN A MANNER TO PREVENT CONFLICTS WITH EQUIPMENT AND STRUCTURAL CONDITIONS. EXPOSED CONDUITS SHALL BE INSTALLED PARRALEL TO BEAMS AND WALLS. EMPTY CONDUITS SHALL HAVE NYLON PULL LINE
3. CONDUITS SHALL BE TERMINATED SO AS TO PERMIT NEAT CONNECTIONS TO MOTORS AND OTHER EQUIPMENT.
4. NO CONDUIT SMALLER THAN 3/4", NOR WIRE SIZE SMALLER THAN NO. 12 A.W.G. FOR POWER SHALL BE USED UNLESS OTHERWISE NOTED.
5. THE WIRING DIAGRAMS, QUANTITY AND SIZE OF THE WIRES AND CONDUIT REPRESENT A SUGGESTED ARRANGEMENT BASED UPON SELECTED STANDARD COMPONENTS OF ELECTRICAL EQUIPMENT. MODIFICATIONS ACCEPTABLE TO THE CONSTRUCTION MANAGER MAY BE MADE BY THE CONTRACTOR TO ACCOMMODATE EQUIPMENT ACTUALLY PURCHASED. THE BASIC SEQUENCE AND METHOD OF CONTROL MUST BE MAINTAINED AS INDICATED ON THE DRAWINGS AND/OR SPECIFICATIONS.
6. SWITCHES SHALL BE MOUNTED 4'–0" ABOVE FINISHED FLOOR UNLESS OTHERWISE NOTED. RECEPTACLES SHALL BE MOUNTED 18" AFF
7. ALL SURFACE MOUNTED PANELS AND PANELBOARDS ON THE INSIDE OF EXTERIOR WALLS ABOVE GRADE OR IN OTHER LOCATIONS CONSIDERED AS DAMP, SHALL BE MOUNTED SO AS TO MAINTAIN A 1/4" AIR SPACE BETWEEN THE ENCLOSURE AND THE WALL.
8. ALL PANELBOARDS SHALL BE MOUNTED SO THAT THE DISTANCE FROM THE TOP CIRCUIT BREAKER OPERATING HANDLE TO THE FLOOR SHALL NOT EXCEED 6'–6"
9. LIGHTING FIXTURES SHALL BE MOUNTED ACCORDING TO THE MOUNTING HEIGHT GIVEN ON THE DRAWINGS, WITH THE DISTANCE BEING MEASURED FROM THE BOTTOM OF THE LIGHTING FIXTURE TO THE FINISHED FLOOR.
10. FOR LOCATION OF HVAC, PLUMBING, FIRE PROTECTION, AND MISCELLANEOUS EQUIPMENT SEE RESPECTIVE TRADE DRAWINGS.
11. ALL CONDUIT RUNS CROSSING EXPANSION JOINTS SHALL HAVE EXPANSION OR EXPANSION AND DEFLECTION TYPE FITTINGS AS REQUIRED. FOR EXACT LOCATIONS OF EXPANSION JOINTS SEE STRUCTURAL DRAWINGS.
12. ALL MOTOR STARTER CONTROL TRANSFORMERS SHALL BE SIZED TO PROVIDE SUFFICIENT VOLT–AMPERE CAPACITY FOR OPERATING ALL ELECTRICAL DEVICES ASSOCIATED WITH CONTROL OF THE MOTOR, IN ADDITION TO THE STARTER COIL. IT SHALL INCLUDE RELAYS, TIMERS, MOTOR HEATERS, INDICATING LIGHTS, ETC.
13. CONDUIT AND WIRE (NOT SHOWN) FOR FIXTURES, SWITCHES AND/OR RECEPTACLES SHALL BE FURNISHED AND INSTALLED BY THE ELECTRICAL CONTRACTOR AND SHALL BE:
    a. 3/4" (MIN.) CONDUIT RUN
    1. EXPOSED IN UNFINISHED AREAS.
    2. CONCEALED ABOVE HUNG CEILINGS AND IN WALLS IN FINISHED AREAS.
    b. NO.12 (MIN.) Cu WIRE (MIN.) TYPE "THWN/THNN" NO. OF WIRES AS REQUIRED.
14. FOR EQUIPMENT PAD CONSTRUCTION DETAILS SEE STRUCTURAL DRAWINGS.
15. ALL 120V BRANCH CIRCUITS GREATER THAN 100 LINEAR FEET SHALL BE #10AWG MIN.
16. THE ELECTRICAL CONTRACTOR SHALL PROVIDE LAYOUTS FOR ALL ELECTRICAL ROOMS BASED ON ACTUAL EQUIPMENT OF MANUFACTURER SELECTED, SUBMIT FOR REVIEW PRIOR TO INSTALLATION.
17. PROVIDE ELECTRICAL OUTLET PLATE GASKET SEALS AT RECEPTACLES, SWITCHES AND OTHER ELECTRICAL BOXES ON EXTERIOR WALLS AND ON INTERIOR WALLS BETWEEN CONDITIONED AND NON–CONDITIONED SPACES.
18. THE ELECTRICAL CONTRACTOR SHALL SUBMIT A PLAN FOR APPROVAL SHOWING ALL ELECTRICAL TELEPHONE, SECURITY, FIRE ALARM, COMMUNICATION AND OTHER SYSTEMS CONDUITS IN SLAB AND ABOVE CEILING ETC.. COORDINATE WITH OTHER TRADES AND BUILDING'S STRUCTURE TO AVOID ANY CONFLICT.
19. ALL TERMINATION LUGS SHALL BE SIZED ACCORDINGLY TO ACCOMMODATE INDICATED CONDUCTORS.
20. THE ELECTRICAL CONTRACTOR SHALL SUBMIT PLANS FOR APPROVAL SHOWING ALL COMMUNICATIONS EQUIPMENT AND DEVICES THROUGHOUT THE BUILDING. THE ELECTRICAL CONTRACTOR SHALL ALSO LABEL AND IDENTIFY ALL CONDUITS THAT SERVE DIFFERNT SYSTEMS.
21. REFER TO THE ARCHITECTURAL REFLECTED CEILING PLANS AND ELEVATIONS FOR EXACT LOCATIONS OF ALL LIGHT FIXTURES.
22. COORDINATE LOCATIONS OF ALL LIGHT FIXTURES IN MECHANICAL AND ELECTRICAL ROOMS WITH LAYOUT OF EQUIPMENT, PIPING AND DUCTWORK.
23. ALL EXIT SIGNS SHALL BE UNSWITCHED.
24. ALL SWITCHED LIGHT FIXTURES CIRCUITED TO A NORMAL/EMERGENCY CIRCUIT ARE TO BE WIRED WITH AN EMERGENCY BY–PASS RELAY.
25. ALL 20 AMPERE, SINGLE POLE CIRCUITS SHALL BE PROVIDED WITH A SEPARATE FULL SIZE NEUTRAL CONDUCTOR.
26. CONFIRM EXACT POWER REQUIREMENTS AND CONNECTION LOCATIONS FOR ALL EQUIPMENT WITH THE PLUMBING, FIRE PROTECTION, HVAC AND GENERAL CONTRACTOR
27. PROVIDE AN SOU KIT FOR ALL MECH EQUIPMENT RATED LESS THAN 1/2HP (TYP)
28. CERTAIN SYMBOLS IN THE SYMBOL LIST DO NOT APPEAR ELSEWHERE IN THE DRAWINGS. SUCH SYMBOLS ARE INCLUDED TO PERMIT INTERPRETATIONS TO BE MADE IN THE EVENT OF DESIGN CHANGES.
29. ELECTRICAL CONTRACTOR SHALL MAINTAIN RATING OF ANY CEILING, WALL, FLOOR OR ANY BUILDING STRUCTURE THAT ANY ELECTRICAL SYSTEM PENETRATES. SEE ARCHITECTURAL PLAN FOR RATINGS.
30. REFER TO PROJECT WIDE ABBREVIATIONS, GENERAL NOTES, AND SYMBOLS ON G0.01

ABBREVIATIONS

ABBR	ABBREVIATIONS
A/AMP	AMPERE
AC	ALTERNATING CURRENT
A/C	AIR CONDITIONING
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
ARCH	ARCHITECTURAL
ATC	AUTOMATIC TEMPERATURE CONTROL
ATS	AUTOMATIC TRANSFER SWITCH
AUTO	AUTOMATIC
BAT	BATTERY
BIS	BYPASS ISOLATOR SWITCH
C	CONDUIT
CATV	CABLE TELEVISION
CAB	CABINET
CB	CIRCUIT BREAKER
CCTV	CLOSED CIRCUIT TELEVISION
CKT	CIRCUIT
CL	CENTERLINE
CM	CENTIMETER
CLG	CEILING
CO	COMPANY
COL	COLUMN
C/T	CURRENT TRANSFORMER
CW	COOL WHITE
DET	DETAIL
DIA	DIAMETER
DISC	DISCONNECT
DN	DOWN
DP	DISTRIBUTION PANEL
DPDT	DOUBLE POLE DOUBLE THROW
DPST	DOUBLE POLE SINGLE THROW
DT	DUST TIGHT
DWG	DRAWING
EA	EACH
EC	ELECTRICAL CONTRACTOR
EL	ELEVATION
ELEC	ELECTRIC
ELEV	ELEVATOR
ES	ENERGY SAVING
EX	EXISTING
FDR	FEEDER
FLR	FLOOR
FLUO	FLUORESCENT
GEN	GENERATOR
GFI	GROUND FAULT INTERRUPTER
GFP	GROUND FAULT PROTECTOR
GND	GROUND
HC	HUNG CEILING
HGT	HEIGHT
HID	HIGH INTENSITY DISCHARGE LAMP
HO	HIGH OUTPUT
HP	HORSE POWER
HPS	HIGH PRESSURE SODIUM
HVAC	HEATING, VENTILATION AND AIR CONDITIONING
HZ	HERTZ
HV	HIGH VOLTAGE
IN	INCHES
INCAND	INCANDESCENT
JB	JUNCTION BOX
KV	KILOVOLT
KVA	KILOVOLT–AMPERES
KW	KILOWATT
L	LENGTH
LA	LIGHTNING ARRESTOR
LP	LIGHTING PANEL
LTG	LIGHTING
LV	LOW VOLTAGE
M	METER
MM	MILLIMETER
MCB	MAIN CIRCUIT BREAKER
MEC	MASS ELECTRIC COMPANY
MECH	MECHANICAL
MFR	MANUFACTURER
MLO	MAIN LUG ONLY
MISC	MISCELLANEOUS
MTD	MOUNTED
N	NEUTRAL
N/C	NORMALLY CLOSED
NEC	NATIONAL ELECTRIC CODE
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NIC	NOT IN CONTRACT
NL	NIGHT LIGHTING CKT
N/O	NORMALLY OPEN
NO	NUMBER
OC	ON CENTER
O/C	OVERCURRENT
OL	OVERLOAD
PB	PULL BOX
PH	PHASE
PNL	PANEL
PP	PUMP
PRI	PRIMARY
P/T	POTENTIAL TRANSFORMER
PVC	POLYVINYL CHLORIDE
PWR	POWER
RECEPT	RECEPTACLE
REC	RECESSED
RPA	RELAY PANEL
SEC	SECONDARY
SP	SPARE
SPECS	SPECIFICATIONS
SPKLR	SPRINKLER
SW	SWITCH
TB	TERMINAL BOARD
TEL	TELEPHONE
TV	TELEVISION
TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSION
TYP	TYPICAL
U.N.O.	UNLESS NOTED OTHERWISE
V	VOLTS
VA	VOLT AMPERAGE
VAC	VACUUM
VENT	VENTILATING
VFD	VARIABLE FREQUENCY DRIVE
VT	VAPOR TIGHT
W	WATT ON WIRE
W/	WITH
WP	WEATHERPROOF

MOUNTING HEIGHTS



NOTES

1.) ALL MOUNTING HEIGHTS SHALL BE MEASURED FROM FINISHED FLOOR TO CENTERLINE OF DEVICE EXCEPT EXIT SIGNS
2.) DEVICES SHALL BE INSTALLED ON A COMMON VERTICAL CENTERLINE WHEREVER POSSIBLE.
3.) ALL DEVICES SHALL BE INSTALLED AT MOUNTING HEIGHTS AS INDICATED ON THIS DETAIL UNLESS OTHERWISE NOTED. COORDINATE ALIGNMENT OF DEVICES TO ADJASCENT WORK WITH ARCHITECT.
4.) REFER TO THE ARCHITECTS ELEVATION DETAILS FOR EXACT HEIGHT AND LENGTH OF SURFACE RACEWAYS.
5.) WALL MOUNTED VISUAL APPLIANCE THE ENTIRE LENS OF A/V SIGNAL OR VISUAL–ONLY SIGNAL IS NOT LESS THAN 80" AND NOT GREATER THAN 96" A.F.F. CONTRACTOR SHALL CONTACT ENGINEER IF PERFORMANCE BASED ALTERNATIVE (NFPA 72 7.5.4.5) IS REQUIRED DUE TO CEILING HEIGHTS.
6.) ALL LOAD CENTERS LOCATED WITHIN GROUP I & GROUP II UNITS SHALL BE MOUNTED WITH BREAKER A MAXIMUM OF 54" A.F.F. AND 18" FROM INTERIOR CORNER.
7.) ALL WALL MOUNTED AUDIBLE NOTIFICATION APPLIANCES SHALL HAVE THEIR TOPS ABOVE THE FINISHED FLOORS AT HEIGHTS OF NOT LESS THAN 90" (7'6") AND BELOW THE FINISHED CEILINGS AT DISTANCES NOT LESS THAN 6".

1"= 20'

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REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY
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WB&A
Wozny/Barbar & Associates, Inc.
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BID DRAWING

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PROJECT No.:	W161181
DRAWN BY:	PMG
CHECKED BY:	SA
DATE:	01/28/21
CAD I.D.:	

PROJECT:

PHASE 1 BID DOCUMENTS

— FOR —

HOSPITAL DRIVE SUBDIVISION

LOCATION OF SITE
305 BELMONT STREET
WORCESTER COUNTY, CITY OF WORCESTER, MASSACHUSETTS
MAP #57, BLOCK #4, LOT B1-01, LOT B1-02, AND LOT B1-04

BOHLER
352 TURNPIKE ROAD
SOUTHBOROUGH, MA 01772
Phone: (508) 480-9900
Fax: (508) 480-9080
www.BohlerEngineering.com

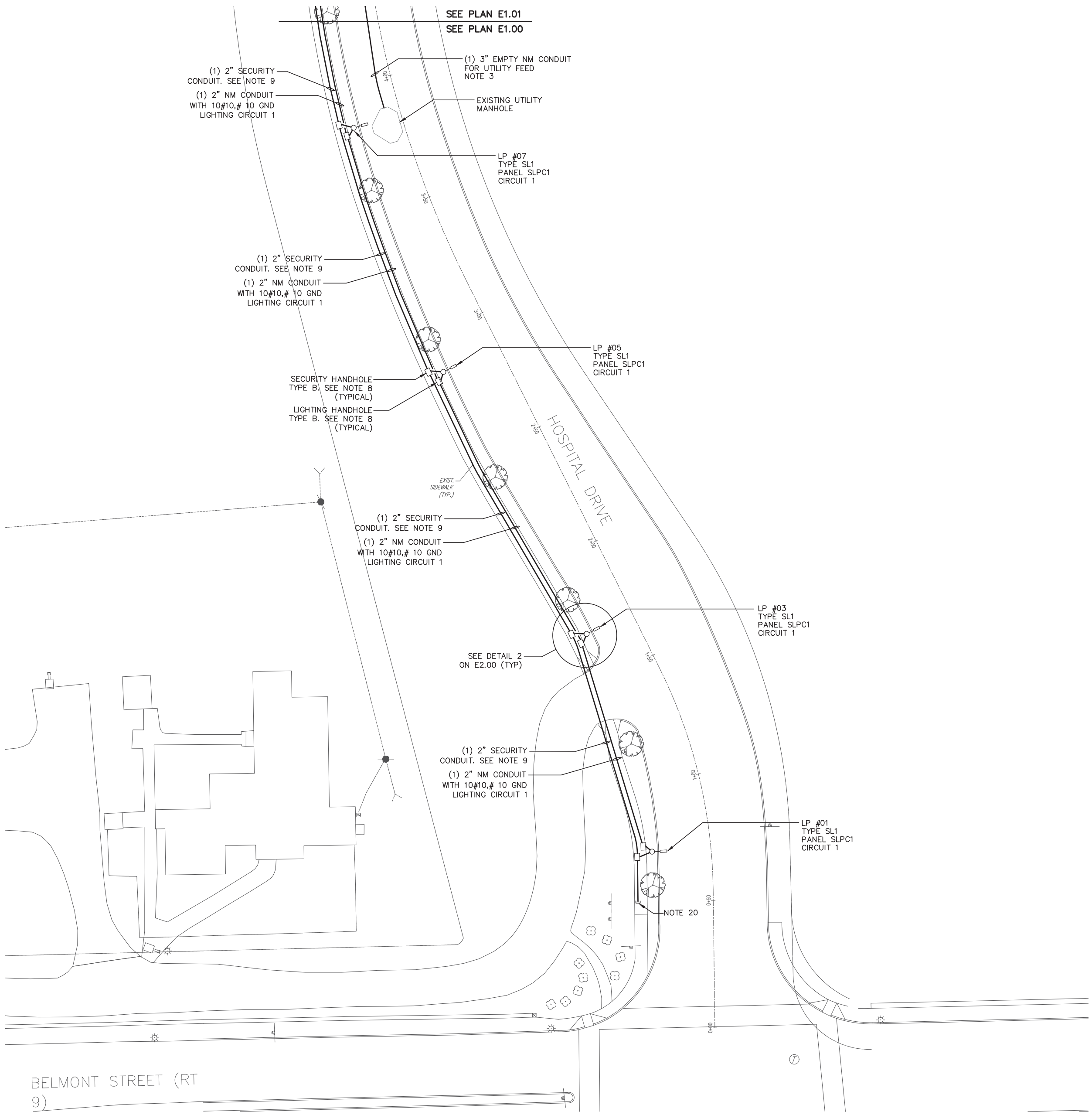
SHEET TITLE:

ELECTRICAL LEGEND & NOTES

SHEET NUMBER:

E0.00

PROGRESS - 02/19/2021



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3. SPECIFICATION FOR STREET LIGHTING RACEWAY IS TO BE CITY OF WORCESTER STANDARD ITEM 804.202 2" ELECTRICAL CONDUIT (FOOT) TYPE NM PLASTIC (NEMA) FOR STREET LTG. RACEWAY FROM EXISTING MANHOLE TO ENCLOSURE SHALL BE 3" NM, ENCASED IN CONCRETE. CONFIRM LOCATION OF EXISTING MANHOLE WITH LOCAL UTILITY COMAPNY. ALL RACEWAY SHALL BE PROVIDED WITH NYLON PULL STRING INSTALLED..
4. ALL RACEWAY SHALL BE INSTALLED AT A MIN DEPTH OF 30", UNLESS DIRECTED BY THE ENGINEER. WHEN MULTIPLE CONDUITS ARE INSTALLED IN THE SAME TRENCH THE CONTRACTOR SHALL INSTALL RACEWAY SPACES AS INCIDENTAL TO THE WORK.
5. CONTRACTOR SHALL COORDINATE AND CONFIRM WITH UTILITY FOR COLD/HOT SEQUENCE METERING REQUIREMENTS.
6. CONTRACTOR SHALL PROVIDE ENOUGH SLACK (CABLE) AT THE HANDHOLES AND PULLBOXES TO ALLOW FOR SPLICING AND REPAIRS TO BE MADE.
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9. SECURITY RACEWAYS TO BE 2" SOLID WALL PE, SDR 13.5, COILABLE CONDUIT WITH 1250# TAPE MANUFACTURED BY BLUE DIAMOND INDUSTRIES, LLC MEETING ASTM SPECIFICATIONS F2160 & D3350. ALL RACEWAY SHALL BE PROVIDED WITH NYLON PULL STRING INSTALLED.
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11. COORDINATE EXACT FIXTURE LOCATIONS AND QUANTITIES WITH SITE CIVIL ENGINEER.
12. CIRCUIT NUMBER DESIGNATIONS ARE INTENDED TO ILLUSTRATE BRANCH WIRING CONFIGURATION ONLY.
13. ELECTRICAL CONTRACTOR SHALL COORDINATE AND CONFIRM K RATING (TEMPERATURE) OF FIXTURE LAMPS TO ACHIEVE COLOR AS PER CONSULTANT AND CITY OF WORCESTER DPW.
14. ELECTRICAL CONTRACTOR SHALL PROVIDE WITHIN HANDHOLES, BETWEEN THE #2 CONDUCTORS, AND THE #10 FEEDS TO THE FIXTURES, IN-LINE, FUSED, SPLICE KITS. QUICK CONNECT TYPE WITH 1/2 AMP FUSES IN BOTH THE HOT AND NEUTRAL CONDUCTORS.
15. ALL WIRING ASSOCIATED WITH SITE LIGHTING BETWEEN THE HANDHOLE AND LIGHTING FIXTURE SHALL BE 2#10+1#10G, 2"C
16. ALL LIGHTING FIXTURES SHALL BE PROPERLY GROUNDED AS PER MANUFACTURERS RECOMMENDATIONS. AND AS REQUIRED BY THE NATIONAL ELECTRICAL CODE.
17. NEW STAINLESS STEEL NEMA 4X UTILITY ENCLOURE WITH 120/240, 1ø, PANEL BOARD, TIME CLOCK AND UTILITY METER FOR ROADWAY LIGHTING AND POWER. ENCLOSURE SHALL ALSO INCLUDE (1) LED, WEATHERPROOF FIXTURE AND (1) GFI, WEATHERPROOF DUPLEX RECEPTACLE. CONTRACTOR SHALL CONFIRM EXACT LOCATION WITH SITE/CIVIL ENGINEER.
18. PROVIDE BURNDY LUG REDUCERS ON ALL OVERSIZED CONDUCTORS TO COMPENSATE FOR VOLTAGE DROP.
19. DESIGN INTENT IS TO HAVE LIGHTING FIXTURES CONTROLLED VIA CIMCON WIRELESS CONTROLLER INSTALLED AT FIXTURE. IF FIXTURE WILL BE CONTROLLED WIRELESSLY, CONTRACTOR SHALL BY PASS TIME-CLOCK AS SPECIFIED AND WIRE DIRECTLY TO PANEL WITHIN ENCLOSURE. CONFIRM CONTROL METHOD WITH CITY OF WORCESTER DEPARTMET OF PUBLIC WORKS AND SITE/CIVIL ENGINEER.
20. CONTRACTOR SHALL CONFIRM RACEWAY LENGTH AND MEANS OF TERMINATION FOR FINAL LENGTH OF 2" SECURITY RACEWAY WITH CITY OF WORCESTER DEPARTMENT OF PUBLIC WORKS.
21. ALL CONDUCTORS FOR POWERING SITE LIGHTING AND DEVICES WITHIN ENCLOSURE SHALL BE COPPER

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REV	DATE	COMMENT	DRAWN BY / CHECKED BY
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PROJECT:

PHASE 1 BID DOCUMENTS

FOR

HOSPITAL DRIVE SUBDIVISION

LOCATION OF SITE
305 BELMONT STREET
WORCESTER COUNTY,
CITY OF WORCESTER,
MASSACHUSETTS
MAP #57, BLOCK #4, LOT B1-01,
LOT B1-02, AND LOT B1-04

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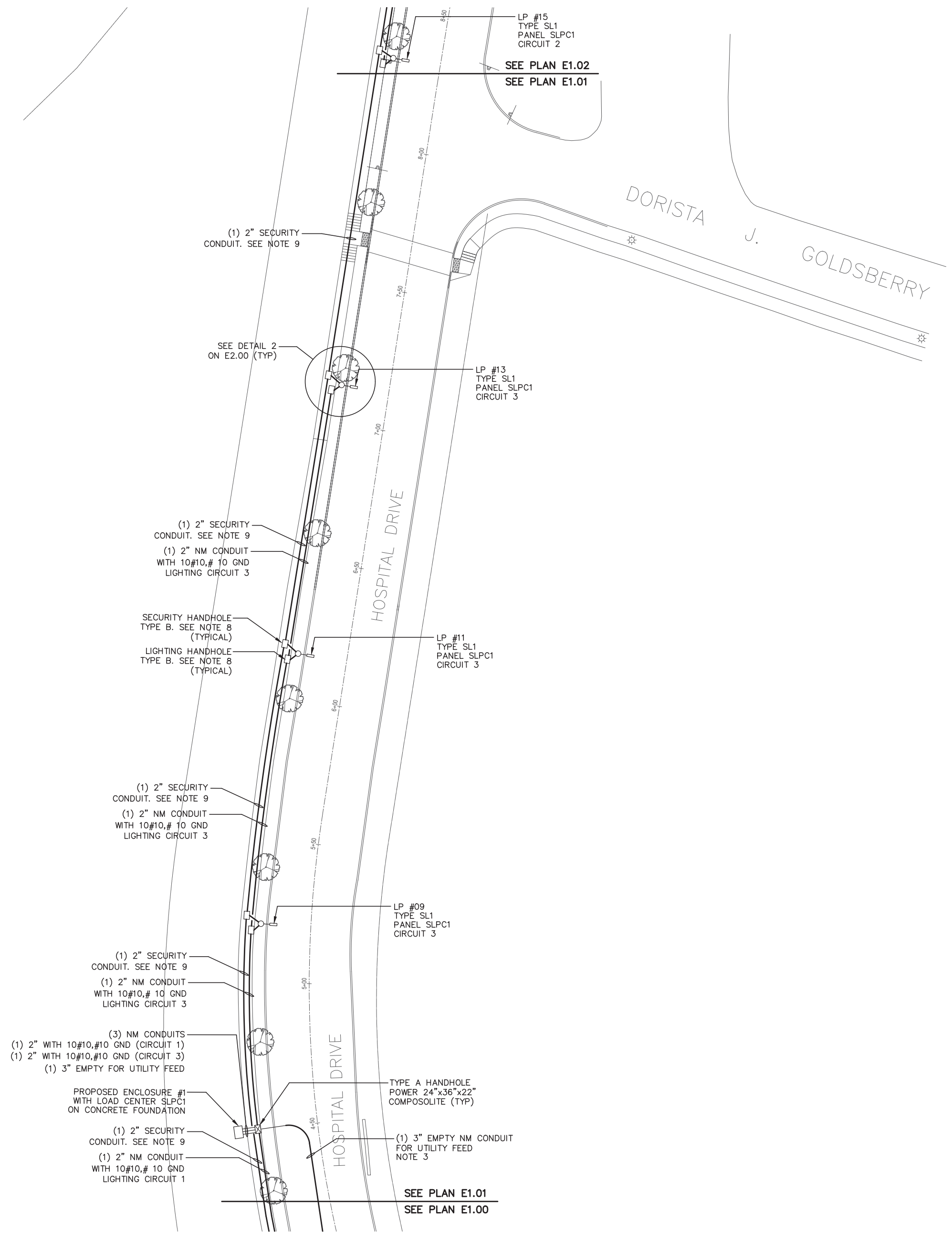
www.BohlerEngineering.com

SHEET TITLE:
ELECTRICAL SITE LIGHTING PLAN 1

SHEET NUMBER:
E1.00

PROGRESS - 02/19/2021



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17. NEW STAINLESS STEEL NEMA 4X UTILITY ENCLOURE WITH 120/240, 1ø, PANEL BOARD, TIME CLOCK AND UTILITY METER FOR ROADWAY LIGHTING AND POWER. ENCLOSURE SHALL ALSO INCLUDE (1) LED, WEATHERPROOF FIXTURE AND (1) GFI, WEATHERPROOF DUPLEX RECEPTACLE. CONTRACTOR SHALL CONFIRM EXACT LOCATION WITH SITE/CIVIL ENGINEER.
18. PROVIDE BURNDY LUG REDUCERS ON ALL OVERSIZED CONDUCTORS TO COMPENSATE FOR VOLTAGE DROP.
19. DESIGN INTENT IS TO HAVE LIGHTING FIXTURES CONTROLLED VIA CIMCON WIRELESS CONTROLLER INSTALLED AT FIXTURE. IF FIXTURE WILL BE CONTROLLED WIRELESSLY, CONTRACTOR SHALL BY PASS TIME-CLOCK AS SPECIFIED AND WIRE DIRECTLY TO PANEL WITHIN ENCLOSURE. CONFIRM CONTROL METHOD WITH CITY OF WORCESTER DEPARTMET OF PUBLIC WORKS AND SITE/CIVIL ENGINEER.
20. CONTRACTOR SHALL CONFIRM RACEWAY LENGTH AND MEANS OF TERMINATION FOR FINAL LENGTH OF 2" SECURITY RACEWAY WITH CITY OF WORCESTER DEPARTMENT OF PUBLIC WORKS.
21. ALL CONDUCTORS FOR POWERING SITE LIGHTING AND DEVICES WITHIN ENCLOSURE SHALL BE COPPER

1"= 20'

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BID DRAWING

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PROJECT No.: W161181
DRAWN BY: PMG
CHECKED BY: SA
DATE: 01/28/21
CAD I.D.: -

PROJECT:

PHASE 1 BID DOCUMENTS

FOR

HOSPITAL DRIVE SUBDIVISION

LOCATION OF SITE
305 BELMONT STREET
WORCESTER COUNTY,
CITY OF WORCESTER,
MASSACHUSETTS
MAP #57, BLOCK #4, LOT B1-01,
LOT B1-02, AND LOT B1-04

BOHLER
352 TURNPIKE ROAD
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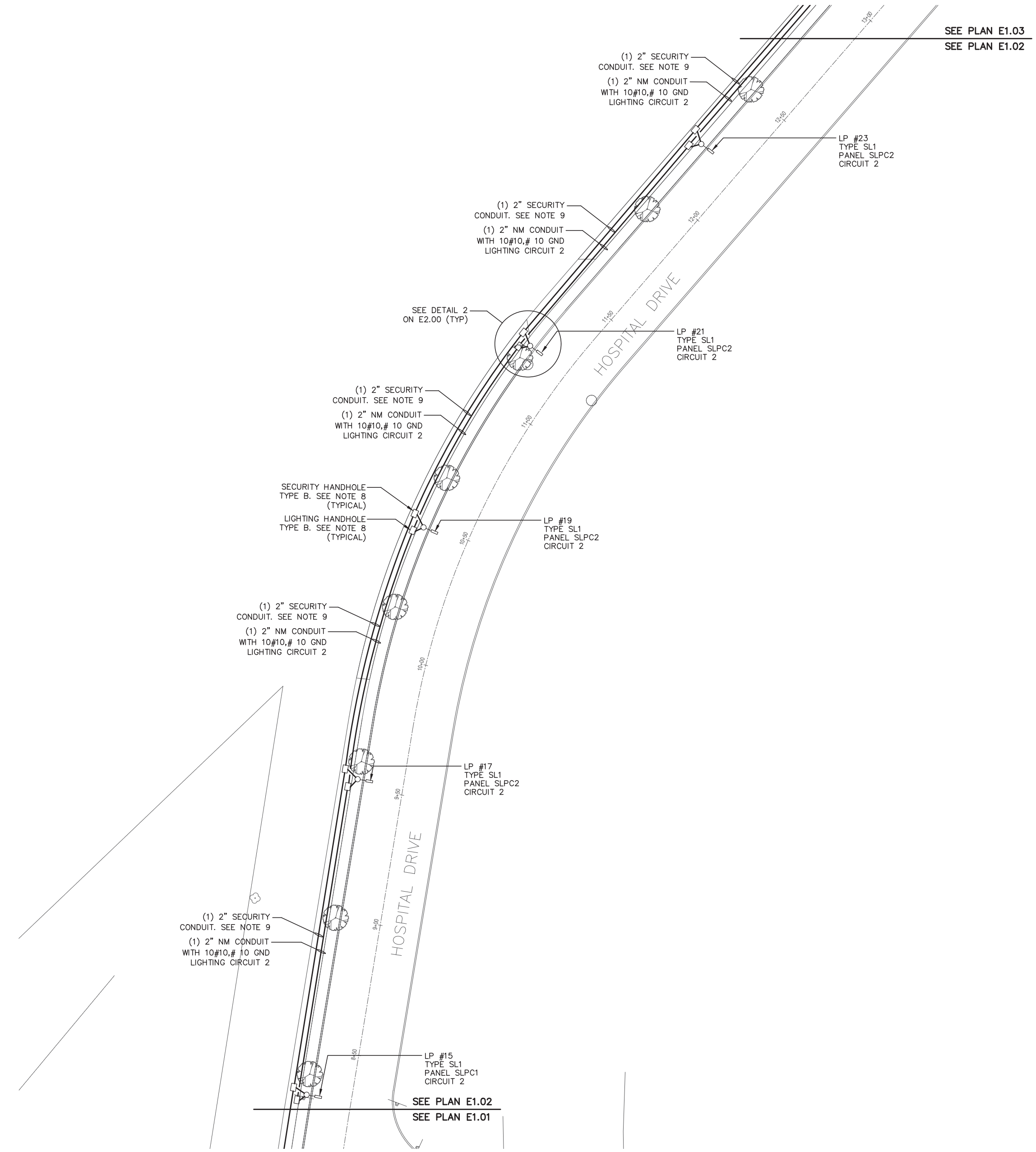
SHEET TITLE:
ELECTRICAL SITE LIGHTING PLAN 2

SHEET NUMBER:
E1.01

PROGRESS - 02/19/2021



NOTES:

1. ALL WORK SHALL CONFORM TO THE LATEST REVISIONS OF THE NATIONAL ELECTRICAL CODE, THE COMMONWEALTH OF MASSACHUSETTS ROADWAY STANDARDS AND SPECIFICATIONS AND THE REQUIREMENTS FOR THE TOWN OF WORCESTER.
2. ALL WORK SHALL BE COORDINATED WITH LOCAL PUBLIC UTILITIES. NO WORK SHALL COMMENCE UNTIL THE CONTRACTOR HAS NOTIFIED DIG-SAFE AND ALL EXISTING UTILITIES HAVE BEEN PROPERLY NOTIFIED. CONTRTACTOR SHALL CONFIRM AND VERIFY LOCATION OF ALL EXISTING UTILITIES BEFORE INSTALLATION OF RACEWAY, HANDHOLES, LIGHTING FIXTURES AND POLE BASES. ANY DAMAGE TO THE UTILITIES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
3. SPECIFICATION FOR STREET LIGHTING RACEWAY IS TO BE CITY OF WORCESTER STANDARD ITEM 804.202 2" ELECTRICAL CONDUIT (FOOT) TYPE NM PLASTIC (NEMA) FOR STREET LTG. RACEWAY FROM EXISTING MANHOLE TO ENCLOSURE SHALL BE 3" NM, ENCASED IN CONCRETE. CONFIRM LOCATION OF EXISTING MANHOLE WITH LOCAL UTILITY COMAPNY. ALL RACEWAY SHALL BE PROVIDED WITH NYLON PULL STRING INSTALLED..
4. ALL RACEWAY SHALL BE INSTALLED AT A MIN DEPTH OF 30", UNLESS DIRECTED BY THE ENGINEER. WHEN MULTIPLE CONDUITS ARE INSTALLED IN THE SAME TRENCH THE CONTRACTOR SHALL INSTALL RACEWAY SPACES AS INCIDENTAL TO THE WORK.
5. CONTRACTOR SHALL COORDINATE AND CONFIRM WITH UTILITY FOR COLD/HOT SEQUENCE METERING REQUIREMENTS.
6. CONTRACTOR SHALL PROVIDE ENOUGH SLACK (CABLE) AT THE HANDHOLES AND PULLBOXES TO ALLOW FOR SPLICING AND REPAIRS TO BE MADE.
7. CONTRACTOR SHALL FURNISH AND INSTALL INDUSTRUCTIBLE, NUMBERING, PLASTIC TAGS ON ALL CIRCUITS AT ALL HANDHOLES AS PER CIRCUITS NOTED ON PLANS.
8. TYPE B HANDHOLES SHALL CONFIRM TO THE RELEVANT PROVISIONS OF THE CITY OF WORCESTER DPW AND PARKS STANDARD SPECIFICATIONS EXCEPT COVERS SHALL READ "ELECTRIC" AND "SECURITY". REFER TO SPECIFICATION FOR CITY OF WORCESTER HAND HOLES. TO BE FURNISHED AND INSTALLED BY CONTRACTOR WITH RACEWAYS. EACH LIGHT BASE SHALL HAVE (2) ACCOMPANYING HAND HOLES, CITY SPECIFICATION ITEM 513.00 PULL BOX 12"X24" (SD2.031), IN-LINE WITH TWIN 2" CONDUIT LINES. HAND HOLES SHOULD ALSO BE INSTALLED WHERE THE TWIN CONDUIT LINE MAKES A 90° TURN.
9. SECURITY RACEWAYS TO BE 2" SOLID WALL PE, SDR 13.5, COILABLE CONDUIT WITH 1250# TAPE MANUFACTURED BY BLUE DIAMOND INDUSTRIES, LLC MEETING ASTM SPECIFICATIONS F2160 & D3350. ALL RACEWAY SHALL BE PROVIDED WITH NYLON PULL STRING INSTALLED.
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1" = 20'

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PROJECT No.: W161161
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CHECKED BY: SA
DATE: 01/28/21
CAD I.D.: -

PROJECT:

PHASE 1 BID DOCUMENTS

FOR

HOSPITAL DRIVE SUBDIVISION

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MAP #57, BLOCK #4, LOT B1-01,
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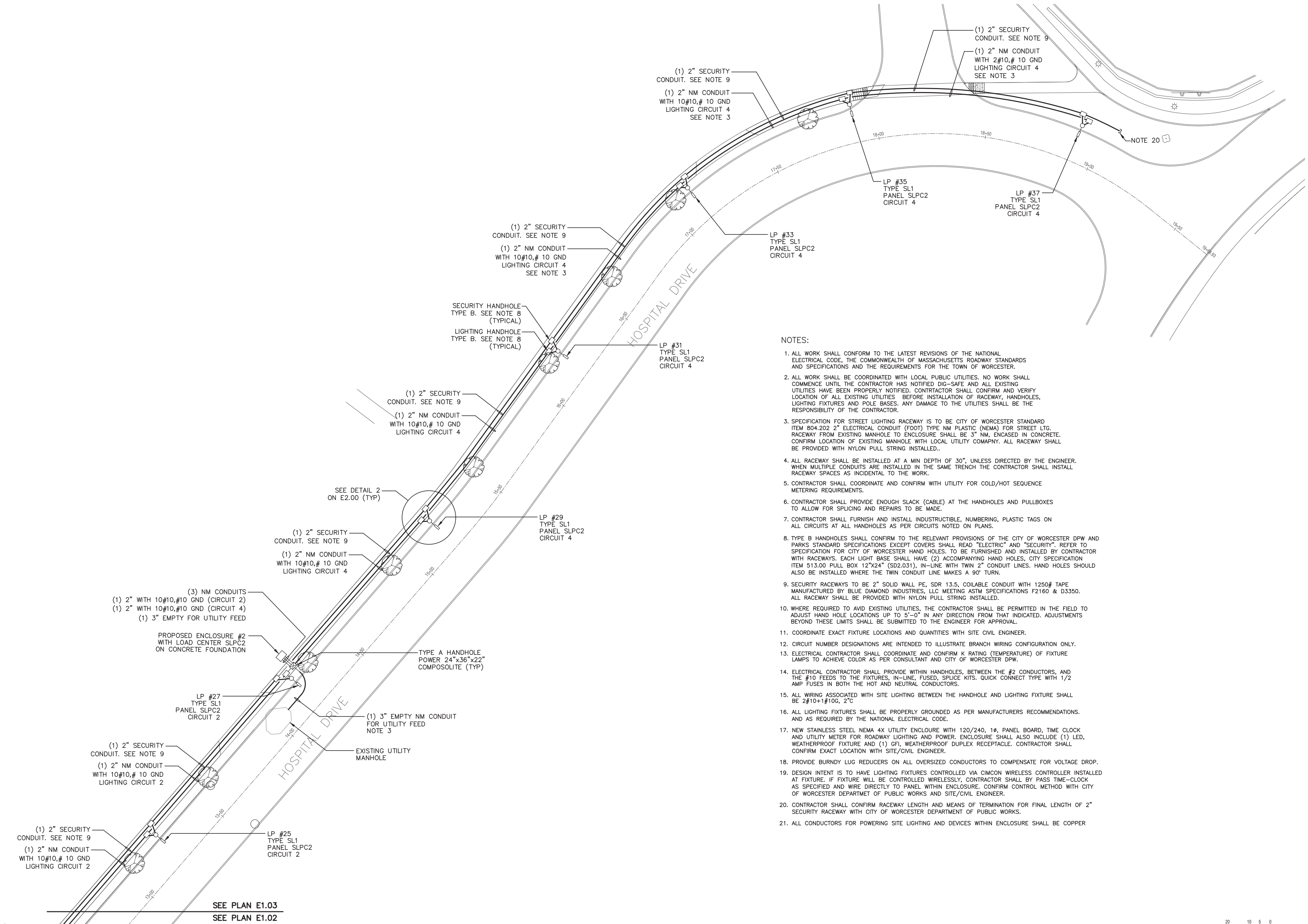
SHEET TITLE:
ELECTRICAL SITE LIGHTING PLAN 3

SHEET NUMBER:
E1.02

PROGRESS - 02/19/2021



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PROJECT No.: W161181
DRAWN BY: PMG
CHECKED BY: SA
DATE: 01/28/21
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PROJECT:

PHASE 1 BID DOCUMENTS

FOR

HOSPITAL DRIVE SUBDIVISION

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SHEET TITLE:
ELECTRICAL SITE LIGHTING PLAN 4

SHEET NUMBER:
E1.03

PROGRESS - 02/19/2021

BRANCH CIRCUITS SCHEDULE

CIRCUIT BREAKER	CONDUCTOR
120 OR 277 VOLT 1ø, 2W. CIRCUITS	
20A–1P	2#12+1#12 GND – 3/4"C
30A–1P	2#10+1#10 GND – 3/4"C
40A–1P	2#8+1#10 GND. – 3/4"C
50A–1P	2#6+1#10 GND. – 3/4"C
60A–1P	2#6+1#10 GND. – 3/4"C
208 VOLT 1ø, 2W. CIRCUITS	
CIRCUIT BREAKER	CONDUCTOR
20A–2P	2#12+1#12 GND. – 3/4"C
30A–2P	2#10+1#10 GND. – 3/4"C
40A–2P	2#8+1#10 GND. – 3/4"C
50A–2P	2#6+1#10 GND. – 3/4"C
60A–2P	2#6+1#10 GND. – 3/4"C
208/120 VOLT, 1ø, 3W CIRCUITS	
CIRCUIT BREAKER	CONDUCTOR
20A–2P	3#12+1#12 GND. – 3/4"C
30A–2P	3#10+1#10 GND. – 3/4"C
40A–2P	3#8+1#10 GND. – 3/4"C
50A–2P	3#6+1#10 GND. – 3/4"C
60A–2P	3#6+1#10 GND. – 3/4"C
208 OR 480 VOLTS, 3ø, 3W CIRCUITS	
CIRCUIT BREAKER	CONDUCTOR
20A–3P	3#12+1#12 GND. – 3/4"C
30A–3P	3#10+1#10 GND. – 3/4"C
40A–3P	3#8+1#10 GND. – 3/4"C
50A–3P	3#6+1#10 GND. – 3/4"C
60A–3P	3#6+1#10 GND. – 3/4"C
208Y/120 & 480Y/277 VOLT, 3ø,4W CIRCUITS	
CIRCUIT BREAKER	CONDUCTOR
20A–3P	4#12+1#12 GND. – 3/4"C
30A–3P	4#10+1#10 GND. – 3/4"C
40A–3P	4#8+1#10 GND. – 3/4"C
50A–3P	4#6+1#10 GND. – 1"C
60A–3P	4#6+1#10 GND. – 1"C

LEGEND OF FEEDER SIZES– COPPER CONDUCTORS

TAG	CONDUCTORS (3 PHASE, 3 WIRE) WITH GROUND	RACEWAY SIZE	TAG	CONDUCTORS (3 PHASE, 4 WIRE) WITH GROUND	RACEWAY SIZE	NOMINAL AMPACITY RATING
30–3G	3#10 & 1#10 GND.	3/4"	30–4G	4#10 & 1#10 GND.	3/4"C.	30
50–3G	3#8 & 1#10 GND.	3/4"	50–4G	4#8 & 1#10 GND.	3/4"C.	50
60–3G	3#6 & 1#10 GND.	3/4"	60–4G	4#6 & 1#10 GND.	1"	60
100–3G	3#3 & 1#8 GND.	1 1/4"	100–4G	4#2 & 1#8 GND.	1 1/4"	100
125–3G	3#1 & 1#6 GND.	1 1/4"	125–4G	4#1 & 1#6 GND.	1 1/2"	125
150–3G	3#1/0 & 1#6 GND.	1 1/2"	150–4G	4#1/0 & 1#6 GND.	2"	150
175–3G	3#2/0 & 1#6 GND.	2"	175–4G	4#2/0 & 1#6 GND.	2"	175
200–3G	3#3/0 & 1#6 GND.	2"	200–4G	4#3/0 & 1#6 GND.	2"	200
225–3G	3#4/0 & 1#4 GND.	2"	225–4G	4#4/0 & 1#4 GND.	2 1/2"	225
250–3G	3#250 KCMIL & 1#4 GND.	2 1/2"	250–4G	4#250 KCMIL & 1#4 GND.	2 1/2"	250
300–3G	3#350 KCMIL & 1#4 GND.	2 1/2"	300–4G	4#350 KCMIL & 1#4 GND.	3"	300
350–3G	3#500 KCMIL & 1#3 GND.	3"	350–4G	4#500 KCMIL & 1#3 GND.	4"	350
400–3G	3#500 KCMIL & 1#3 GND.	3"	400–4G	4#500 KCMIL & 1#3 GND.	4"	400
600–3G	6#350 KCMIL & 2#1 GND.	2–3"	600–4G	8#350 KCMIL & 2#1 GND.	2–3"	600
800–3G	6#600 KCMIL & 3#1/0 GND.	2–3"	800–4G	8#600 KCMIL & 3#1/0 GND.	2–3 1/2"	800
1000–3G	9#400 KCMIL & 3#2/0 GND.	3–3"	1000–4G	12#400 KCMIL & 3#2/0 GND.	3–3"	1000
1200–3G	9#600 KCMIL & 3#3/0 GND.	3–3"	1200–4G	12#600 KCMIL & 3#3/0 GND.	3–3 1/2"	1200
1600–3G	12#600 KCMIL & 4#4/0 GND.	4–3"	1600–4G	16#600 KCMIL & 4#4/0 GND.	4–3 1/2"	1600

LIGHTING FIXTURE SCHEDULE

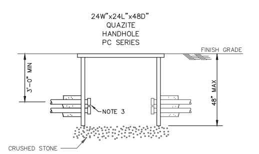
TYPE	DESCRIPTION	MANUFACTURER & CATALOG NUMBER	LAMPS		INPUT		REMARKS
			NUMBER	TYPE	VOLTS	WATTS	
LP	LED LIGHTING FIXTURE WITH WIRELESS CONTROL	REFER TO CITY OF WORCESTER STANDARDS SEE NOTE 1 BELOW	LED	LED	240V	100	SEE NOTES BELOW – –

FIXTURE SCHEDULE NOTES:

1. ELECTRICAL CONTRACTOR SHALL CONFIRM ROADWAY LIGHTING POLE HEIGHT, ARM, LUMINARE, WATTAGE, OPTICAL DISTRIBUTION, AND WIRELESS CONTROLLER WITH CITY OF WORCESTER AND SITE/CIVIL ENGINEER.
2. CONTRACTOR SHALL FURNISH AND INSTALL WIRELESS CIMCON CONTROLLER IN EACH FIXTURE. CONFIRM AND COORDINATE PROGRAMMING OF CONTROLLER WITH CITY OF WORCESTER DEPARTMENT OF PUBLIC WORKS AND SITE CIVIL ENGINEER.

PANELBOARD SCHEDULE

PANEL DESIGNATION	VOLTS	PHASE	WIRES	MAINS (MLO = MAIN LUGS ONLY) BUS SIZE	OVERCURRENT DEVICE TRIP	OVERCURRENT DEVICE FRAME	BKR POLES	BRANCH DEVICES BREAKER AMPS 15	20	25	30	40	50	60	70	TOTAL POLES	MOUNTING: S=SURFACE F=FLUSH	ADDITIONAL CIRCUIT BREAKERS
SLPC1	120/240	1	3	100	100 MCB	100	1P		12							24	S	–
							2P		6									
							3P											
SLPC2	120/240	1	3	100	100 MCB	100	1P		12							42	S	–
							2P		6									
							3P											

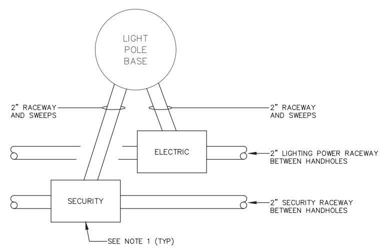


NOTES:

1. CONTRACTOR SHALL CONFIRM LOCATION AND INSTALLATION OF NEW HANDHOLE WITH SITE/CIVIL ENGINEER.

1 Typical Type A Handhole Detail

Scale: None



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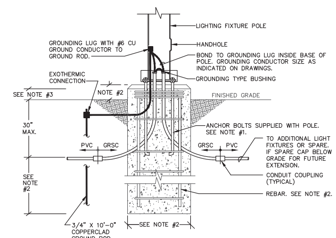
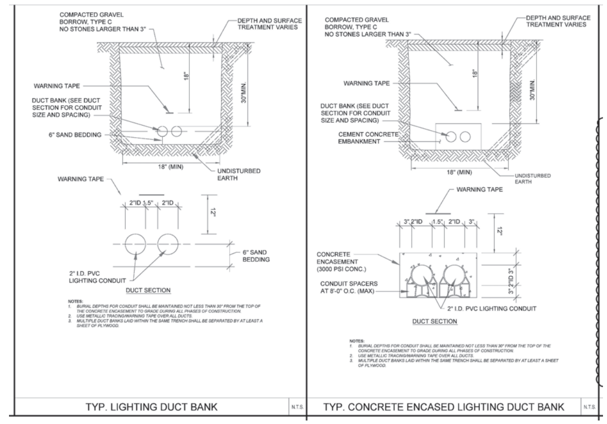


NOTES:

1. FURNISH GENERAL CONTRACTOR WITH POLE BASE BOLT TEMPLATE PRIOR TO CONCRETE POUR.
2. REFER TO SITE CIVIL ENGINEER FOR POLE BASE HEIGHT, SIZE AND REBAR REQUIREMENTS.
3. COORDINATE EXACT ANCHOR BOLT REQUIREMENTS WITH SITE CIVIL ENGINEER e.g. BREAK-AWAY TYPE.

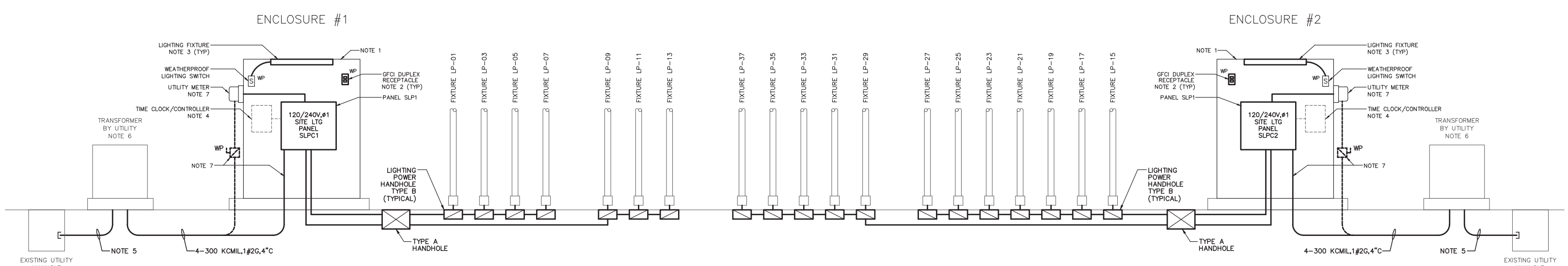
3 Site Lighting Pole Base Detail

Scale: None



3 Site Raceway Burial Details

Scale: None



5 Site Lighting Power Riser

Scale: None

RISER NOTES:

1. NEW STAINLESS STEEL NEMA 4X, 2 DOOR, SINGLE ACCESS ENCLOSURE WITH PADLOCK HANDLE KIT – HOFFMAN:A726018SSFSDN4 PROVIDE ALL ACCESSORIES AND PANELS TO MOUNT NEW ELECTRICAL EQUIPMENT AND MAKE ENCLOSURE SECURE AND LOCKABLE. CONTRACTOR SHALL FURNISH AND INSTALL (1) 400W, SMALL HOFFMAN ELECTRIC HEATER. CATALOG: DAH4001B
2. NEW DUPLEX GFI RCEPTACLE FURNISHED & WIRED TO PANEL SLP1 VIA NEW, 20A, DEDICATED CIRCUIT
3. 24" SURFACE MOUNTED LED FIXTURE – PHILIPS: FSS230L840UDIM FURNISHED AND INSTALLED TO PANEL WITHIN ENCLOSURE.
4. 365 DAY, PROGRAMMABLE, ASTRONIMICAL TIME CLOCK CONTROLLER/RELAY (TORK OR EQUAL) WITH MOMENTARY OVERRIDE SWITCH. PROVIDE REMOTE PHOTOCELL. CONFIRM MOUNTING AND LOCATION OF PHOTOCELL WITH CITE/CIVIL AND LANDSCAPE ENGINEERS. CONTRACTOR SHALL CONFIRM AND COORDINATE PROGRAMMING OF TIME CLOCK/CONTROLLER WITH SITE/CIVIL ENGINEER. LIGHTING DESIGN INTENT IS TO INCLUDE WIRELESS CIMCON CONTROL FOR FIXTURES. IF APPROVED BY SITE/CIVIL ENGINEERS, TIMECLOCK WILL NOT BE REQUIRED. CONFIRM INCLUSION OF WIRELESS CONTROL WITH SITE/CIVIL ENGINEER AND CITY OF WORCESTER STANDARDS.
5. NEW 3" NON-METALLIC RACEWAY FROM EXISTING MANHOLE TO NEW ENCLOSURE PAD LOCATION. CONFIRM LOCATION AND RACEWAY LENGTHS WITH SITE/CIVIL ENGINEER. UTILITY COMPANY SHALL FURNISH AND INSTALL ALL CONDUCTORS BETWEEN EXISTING MANHOLE AND ENCLOSURE PAD. UTILITY COMPANY SHALL FURNISH AND INSTALL METER, TRANSFOMER, PRIMARY SWITCH, AND ANY NECESSARY FUSES WITHIN EXISTING HANDHOLE.
6. EXTERIOR RATED TRANSFORMER FURNISHED & INSTALLED BY UTILITY COMPANY, 120/240, 1ø, 3 WIRE, SECONDARY. CONTRACTOR SHALL CONFIRM PRIMARY VOLTAGE WITH UTILITY COMPANY. LOCATION WITH SITE/CIVIL ENGINEER.
7. CONFIRM AND COORDINATE WITH UTILITY COMAPNY FOR HOT OR COLD SEQUENCING. CONFIRM MEANS OF DISCONNECT WITH UTILITY COMAPNY AND CITY OF WORCESTER. FURNISH AND INSTALL ANY AND ALL ELECTRICAL BREAKERS, DEVICES, WIRE, AND RACEWAY TO COMPLETE INSTALLATION.
8. ALL RACEAY, JUNCTION BOXES AND ELECTRICAL CONNECTIONS SHALL BE SEALED & WEATHERPROOF
9. CONTRACTOR SHALL FURNISH AND INSTALL LUGS WITHIN NEW PANEL TO ACCOMMODATE OVERSIZED CONDUCTORS.

1"= 20'

BOHLER

SITE CIVIL AND CONSULTING ENGINEERING
LAND SURVEYING
PROGRAM MANAGEMENT
LANDSCAPE ARCHITECTURE
SUSTAINABLE DESIGN
PERMITTING SERVICES
TRANSPORTATION SERVICES

REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY
-	-	-	-

WB&A
Wozny/Barbar & Associates, Inc.
CONSULTING ENGINEERS
1076 Washington Street, Hanover, MA 02339, Tel: (781) 824-4144, Fax: (781) 924-5792, www.wbaengineers.com
161 Exchange Street, 3rd Floor, Pawtucket, RI 02860

BID DRAWING

THIS DRAWING IS INTENDED FOR MUNICIPAL AND/OR AGENCY REVIEW AND APPROVAL. IT IS NOT INTENDED AS A CONSTRUCTION DOCUMENT UNLESS INDICATED OTHERWISE.

PROJECT No.: W161181
DRAWN BY: PMG
CHECKED BY: SA
DATE: 01/28/21
CAD I.D.: -

PROJECT:

PHASE 1 BID DOCUMENTS

FOR

HOSPITAL DRIVE SUBDIVISION

LOCATION OF SITE
305 BELMONT STREET
WORCESTER COUNTY,
CITY OF WORCESTER,
MASSACHUSETTS
MAP #57, BLOCK #4, LOT B1-01,
LOT B1-02, AND LOT B1-04

BOHLER
352 TURNPIKE ROAD
SOUTHBOROUGH, MA 01772
Phone: (508) 480-9900
Fax: (508) 480-9080
www.BohlerEngineering.com

SHEET TITLE:

ELECTRICAL SCHEDULES AMD DETAILS

SHEET NUMBER:

E2.00

PROGRESS - 02/19/2021

Open Trench Guidelines
Massachusetts

EVERSOURCE

At Eversource, delivering safe, reliable energy is a top priority. The information below provides guidance to assist you in your planning regarding open trenches, backfilling and certain builder's requirements. These guidelines are primarily for developers and builders as they prepare to incorporate and install natural gas infrastructure during the construction of their commercial properties, land development and residential subdivisions.

Should you have any questions regarding the guidelines or certain specifications, please contact the Eversource Construction Supervisor or Area Planning Supervisor. We look forward to working with you!

Main Trench

Pre-Installation Requirements for Builders, Developers & Contractors

1.) All other underground utilities must be installed prior to gas line installation (e.g. water, sewer, electric).

2.) Contractor will provide an adequate supply of quality sand on site near the main or service location. The sand is placed at a depth of 4 inches below and 6 inches above the pipe as measured after compaction. If the width is greater than 24 inches, the contractor shall provide enough loose sand to pad the bottom of the trench and cover the entire length of pipe to a depth of 1 foot. Sand is to be in accordance with the Massachusetts Highway specification M1.04.1, Sand Borrow for Sub-drains.

3.) **Specifications for the main trench**:

a) **Table 1 provides the trench width and depth requirements for gas pipeline installations.**

Table 1 - Gas Pipeline Trench Depth Requirements

Pipe Size	Trench Depth to Achieve 36" Cover (inches)
< 6"	47
8" & 12"	53
14" & 16"	56
18" - 24"	64
Trench depths are based on 4" (compacted) sand padding below the pipe.	

b) **For mains, the depth of cover shall be a minimum of 36 inches with a maximum of 60 inches.**

c) **Distance between utility trenches varies by town**. Check with your municipality (usually minimum of 3 feet, but can be as much as 10 feet).

If the municipality and/or utility inspector decides the gas trench is too close to other trenches, per safety requirements and to prevent cave-ins, the main trench will need to be moved.

4.) The Developer's contractor must maintain access to trench by keeping all removed spoil at least 2 feet away from the edge of one side of the trench, thereby leaving adequate accessibility for proper installation of sand.

5.) All installations are weather permitting (fusing cannot occur under wet conditions).

6.) If trench fills with snow or other debris prior to main installation, it will be the Contractor's responsibility to clear or redig the trench.

7.) Any rescheduling of an open trench should be done through the Eversource Planning and Scheduling Department.

Please note: If the grade inside the development is altered after Eversource installs its facilities and results in our main to be shallow than the standard requirement, you will be responsible for Eversource's cost to remediate its facilities.

WHITESTONE
ASSOCIATES, INC.
Environmental & Geotechnical Engineers & Consultants

352 TURNPIKE ROAD
SUITE 320
SOUTHBOROUGH, MA 01772
508.485.0755
www.whitestoneassoc.com

REPORT OF PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED BIOMANUFACTURING CAMPUS
305 BELMONT STREET
WORCESTER, WORCESTER COUNTY, MASSACHUSETTS

Prepared for:

WORCESTER BUSINESS DEVELOPMENT CORPORATION
89 Shrewsbury Street
Suite 300
Worcester, Massachusetts 01604

Prepared by:

WHITESTONE ASSOCIATES, INC.
352 Turnpike Road
Suite 320
Southborough, Massachusetts 01772

Richard W.M. McLaren, P.E.
Senior Consultant

Ryan R. Roy, P.E.
New England Regional Manager

Whitestone Project No.: GM1714433.000
May 19, 2017

WHITESTONE
ASSOCIATES, INC.
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May 19, 2017

via email

WORCESTER BUSINESS DEVELOPMENT CORPORATION
89 Shrewsbury Street
Suite 300
Worcester, Massachusetts 01604

Attention: Ms. Julie A. Hostrom
Senior Project Manager

Regarding: REPORT OF PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED BIOMANUFACTURING CAMPUS
305 BELMONT STREET
WORCESTER, WORCESTER COUNTY, MASSACHUSETTS
WHITESTONE PROJECT NO.: GM1714433.000

Dear Ms. Hostrom:

Whitestone Associates, Inc. (Whitestone) is pleased to submit the attached *Report of Preliminary Geotechnical Investigation* for the above-referenced project. The report presents the results of Whitestone's site visit and subsurface exploration, and includes preliminary design recommendations for the proposed foundations, pavements, and related earthwork associated with the proposed biomanufacturing campus.

Whitestone appreciates the opportunity to be of service to Worcester Business Development Corporation. Should you have questions regarding the attached report, contact us at (508) 485-0755.

Sincerely,

WHITESTONE ASSOCIATES, INC.

Richard W.M. McLaren, P.E.
Senior Consultant

Ryan R. Roy, P.E.
New England Regional Manager

RWM/hz N:\Job Folders\2017\1714433GM\Reports and Submittals\1714333 ROGI Worcester MA.docx
Enclosures
Copy: Laurence W. Keller, P.E., Whitestone Associates, Inc.

REPORT OF PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED BIOMANUFACTURING CAMPUS
305 Belmont Street
Worcester, Worcester County, Massachusetts

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REPORT OF PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED BIOMANUFACTURING CAMPUS
305 Belmont Street
Worcester, Worcester County, Massachusetts

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SECTION 1.0
Summary of Findings

Whitestone Associates, Inc. (Whitestone) has performed a preliminary exploration and evaluation of the subsurface conditions on the site of the proposed biomanufacturing campus to be located at 305 Belmont Street in Worcester, Worcester County, Massachusetts. Based on a March 24, 2017 *Concept Master Plan* prepared by Bohler Engineering MA, LLC of Southborough, Massachusetts (Bohler), the proposed redevelopment will include demolition of existing structures and construction of five new buildings labeled A, B, D, E, and F, with footprints ranging from approximately 6,300 square feet to 122,000 square feet, and will include new pavements and utilities.

The preliminary geotechnical investigation included performing a reconnaissance of the project site, advancing 14 soil borings, and collecting soil samples for laboratory testing and characterization. Site subsurface conditions consisted of existing fill over natural glacial till, underlain by bedrock. The existing fill appears to be reworked natural glacial till. Groundwater was encountered in the explorations at depths ranging from about eight feet below ground surface (fbgs) to 19 fbgs.

The results of the preliminary investigation indicate that, except for Building B, the site is suitable for conventional shallow foundations that may bear on the natural glacial till and ground-supported floor or basement slabs that may derive support from the existing fill or natural glacial till. Deep fill was encountered in the single boring advanced for Building B, indicating that an intermediate foundation, rammed aggregate piers or controlled modulus columns, may be required to support the footings and slab. Additionally, the site conditions support the use of typical pavement sections using standard Commonwealth of Massachusetts Department of Transportation (MassDOT) specified materials.

The above summary is intended to provide an overview of the preliminary geotechnical findings and recommendations and is not fully developed. Greater detail is presented in the following sections. The entire report must be read for comprehensive understanding of the information contained herein.

SECTION 2.0
Introduction

2.1 AUTHORIZATION

Ms. Julia A. Hostrom, Senior Project Manager at Worcester Business Development Corporation, issued authorization to Whitestone to perform a preliminary geotechnical investigation on the site relevant to the proposed biomanufacturing campus at 305 Belmont Street in Belmont, Worcester County, Massachusetts. The preliminary geotechnical investigation was performed in general accordance with Whitestone's February 21, 2017 proposal.

2.2 PURPOSE

The purpose of the preliminary subsurface soils investigation was to assess anticipated geologic features, shallow groundwater, existing fill, and the potential feasibility of shallow foundations and/or expected earthwork requirements. While the scope of this preliminary investigation will not be sufficient to formulate detailed design recommendations and a more comprehensive geotechnical investigation ultimately will be required, this preliminary investigation may be used to assess potentially development impactive geotechnical issues to support preliminary studies regarding the feasibility of developing the property.

2.3 SCOPE

The scope of the exploration and analysis included limited subsurface exploration, field testing and sampling, laboratory testing, and a preliminary geotechnical engineering analysis and evaluation of the subsurface materials. This *Report of Preliminary Geotechnical Investigation* is restricted to addressing the site conditions related to the physical support of the proposed construction. An environmental assessment was not part of Whitestone's scope of services.

2.3.1 Field Exploration

Field exploration of the project site was conducted by means of 14 borings, identified as B-1 through B-14. The borings were advanced with a truck-mounted Mobile B-57 drill rig equipped with hollow stem augers to termination depths that ranged from approximately eight fbgs to 22.0 fbgs. Borings B-6 and B-13 were converted to groundwater monitoring wells. The other borings were backfilled with excavated soils generated from the investigation and, where appropriate, the surface patched with asphalt "cold patch". Test locations are shown on the *Boring Location Plan* included as Figure 1 and summarized in the table below.

BUILDING DESIGNATION AND BORING LOCATIONS	
Building	**Borings**
A	B-6, B-7, & B-9
B	B-8
D	B-4, B-5, B-10, B-11, & B-12
E & F	B-1, B-2, B-3, B-13, & B-14

Test locations were based on project information provided to Whitestone at the time of the investigation, including the March 24, 2017 *Concept Master Plan* prepared by Bohler. The subsurface testing was conducted in the presence of a Whitestone representative, who performed field tests, recorded visual classifications, and collected samples of the various strata encountered. Test locations were established in the field using normal taping procedures and estimated right angles. These locations are presumed to be approximate.

Soil borings and Standard Penetration Tests (SPTs) were conducted in general accordance with American Society for Testing and Materials (ASTM) designation D 1586. The SPT resistance value (N) can be used as an indicator of the consistency of fine-grained soils and the relative density of coarse-grained soils. The N-value for various soil types can be correlated with the engineering behavior of earthworks and foundations. Rock was sampled using a NQ2-sized diamond bit. The rock core description, recovery, RQD, and other pertinent information were recorded on the boring logs and are included in Appendix A on the *Records of Subsurface Exploration*. The RQD values reflect the quality and fracture spacing of the rock and are calculated by summing all unbroken samples that are four inches or longer divided by the total length of the run. The percentage of core recovery and RQD values provide an understanding of the physical and engineering properties of the rock.

Groundwater level observations were recorded during and immediately following the completion of the field operations prior to backfilling the borings. Seasonal variations, temperature effects, and recent rainfall conditions may influence the levels of the groundwater, and observed levels will depend on the permeability of the soils. Groundwater elevations derived from sources other than seasonally observed groundwater monitoring wells may not be representative of true groundwater levels.

2.3.2 Laboratory Testing Program

In addition to the field investigation, a laboratory testing program was conducted to determine additional, pertinent engineering characteristics of representative samples of on-site soils. The laboratory testing program was performed in general accordance with applicable ASTM standard test methods and included physical testing of the proposed building foundation bearing stratum.

Physical/Textural Analysis: Two representative samples of the site soils were subjected to a laboratory testing program that included moisture content determination (ASTM D-2216) and washed gradation

analysis (ASTM D-422) in order to perform supplementary engineering soil classifications in general accordance with ASTM D-2487 and to assess its suitability for reuse as structural fill/backfill. The soil stratum tested was classified by the Unified Soil Classification System (USCS). The results of the laboratory testing program are summarized in the following table:

LABORATORY TESTING SUMMARY					
Boring	**Sample Number**	**Depth (fbgs)**	**Moisture Content (%)**	**Passing No. 200 Sieve (%)**	**USCS Classification**
B-8	S-3	5.0 - 7.0	5.5	10.7	GM
B-13	S-4	7.0 - 9.0	9.2	46.9	SM

The engineering classifications are useful when considered in conjunction with the additional site data to estimate properties of the soil types encountered and to predict the soil's behavior under construction and service loads. Laboratory test results are provided in Appendix B.

SECTION 3.0
Site Description

3.1 LOCATION AND DESCRIPTION

The subject property is located at 305 Belmont Street in Worcester, Worcester County, Massachusetts, Latitude 42.2767 North, and Longitude 71.7723 West. The property currently is developed with the former Worcester State Hospital complex, portions of which have been demolished.

The proposed site is irregularly shaped. The site is bounded to the south by Belmont Street, to the east by Plantation Street, to the north by Worcester Recovery Center and Hospital, and to the west by undeveloped wooded land. Access to the site is from Belmont Street. The site of the proposed construction is shown on the *Boring Location Plan* included as Figure 1.

3.2 EXISTING CONDITIONS

Existing Development: At the time of Whitestone's investigation, the subject site was occupied by parts of the Worcester State Hospital complex.

Topography: Based on a review of the *USGS 7.5 Minute Series Worcester North Quadrangle, Massachusetts* (2015) and Whitestone's visual observations, the site varies in elevation from approximately 635 feet above National American Vertical Datum of 1988 (NAVD88) to about 570 feet above NAVD88, generally sloping down to the south and east.

Utilities: The site was serviced by utilities, including water, sewer, telecommunications, gas, and electric. The utility information contained in this report is presented for general discussion only and is not intended for construction purposes.

Site Drainage: Surface run-off generally consists of flow to the south and east, intercepted by paved roadways and directed to existing catch basins. Catch basins are presumed to drain to the local storm stormwater system.

3.3 SITE GEOLOGY

From a review of surficial geology on *OLIVER: MassGIS Online Mapping*, the natural site soils consist of thin glacial till. The *Geologic Map of Massachusetts (1983)*, prepared by U.S. Geological Survey, indicates that the subject property is underlain by Devonian Middlefield Granite, a moderately foliated, biotite-muscovite granite, which is part of the Connecticut Valley Belt.

3.4 PROPOSED CONSTRUCTION

Based on the aforementioned *Concept Master Plan* prepared by Bohler, the proposed development will include demolition of existing Worcester State Hospital structures and construction of five new buildings labeled A, B, D, E, and F, with footprints ranging from approximately 6,300 square feet to 122,000 square feet. Building C, an existing four-story structure, will remain. The proposed construction will also include new pavements and utilities. Whitestone's scope of services was based on the assumption that the proposed buildings will be constructed relatively close to existing site grade, to match existing roadways.

Whitestone understands the proposed buildings will be one story, except Building B, which will be three stories, and will be concrete and steel-framed structures with ground-supported concrete floor slabs. Some of the buildings will have a basement level. Maximum column and wall loads are expected to be on the order of:

- interior column loads - 200.0 kips;
- load bearing walls - 4.0 kips per linear foot; and
- floor slab loads - 200 pounds per square foot.

The scope of Whitestone's investigation and the preliminary professional advice contained in this report were generated based on the project details and loading noted herein. Revisions or additions to the design details enumerated in this report should be brought to the attention of Whitestone for additional evaluation as warranted.

SECTION 4.0
Subsurface Conditions

Details of the subsurface materials encountered in the borings are presented on the *Records of Subsurface Exploration* in Appendix A of this report. The subsurface soil conditions encountered in the test locations consisted of the following generalized strata in order of increasing depth.

4.1 SUBSURFACE SOIL CONDITIONS

Building A

The following descriptions are based on three borings, B-6, B-7, and B-9, which were advanced within the Building A area to depths ranging from 14.5 fbgs to 15.5 fbgs. The borings were drilled on either side of the existing building that will be demolished. Boring B-6 was converted into a groundwater monitoring well.

Surface Cover Materials: Surface material at borings B-6 and B-9 consisted of approximately four inches of topsoil and at boring B-7 consisted of asphaltic concrete, around four inches thick, with no apparent granular base.

Existing Fill: Beneath the surface cover materials, borings B-6 and B-9 encountered existing fill, consisting of brown, loose to medium dense sand, some silt, some to trace gravel, occasional cobbles and boulders. SPT N-values recorded within the existing fill ranged from four blows per foot (bpf) to 15 bpf. The existing fill extended to depths ranging from four fbgs to seven fbgs.

Glacial Till: Beneath the existing fill or surface cover materials, the borings encountered glacial till, consisting of brown, medium dense to very dense sand, some silt, little to trace gravel, occasional cobbles and boulders (USCS: SM). SPT N-values recorded within the glacial till ranged from 12 bpf to 82 bpf.

Bedrock: Beneath the glacial till in boring B-7, the encountered bedrock was cored from 10 fbgs to 15 fbgs. The medium hard granite bedrock had a Rock Quality Designation (RQD) of 88 percent, indicating good rock mass quality. Bedrock was also inferred by refusal of the hollow stem augers at depths of 14.5 fbgs and 15.5 fbgs in borings B-6 and B-9, respectively.

Building B

The following descriptions are based on one boring, B-8, which was advanced within the Building B area to a depth of 22 fbgs.

Surface Cover Materials: Surface material consisted of approximately four inches of topsoil.

Existing Fill: Beneath the surface cover materials, the boring encountered existing fill, consisting of brown, very loose to medium dense (occasionally dense) sand, some to little silt, some to little gravel, occasional brick pieces. SPT N-values recorded within the existing fill ranged from two bpf to 42 bpf. The existing fill extended to a depth of about 12 fbgs. Indications of a former subsoil layer were noted at the bottom of the existing fill layer.

Glacial Till: Beneath the existing fill, the boring encountered glacial till, consisting of brown, medium dense to very dense sand, some gravel, some silt (USCS: SM). SPT N-values recorded within the glacial till ranged from 22 bpf to 79 bpf. The boring terminated in the glacial till at a depth of 22 fbgs.

Building D

The following descriptions are based on five borings, B-4, B-5, B-10, B-11, and B-12, which were advanced within the Building D area to depths ranging from 15 fbgs to 22 fbgs.

Surface Cover Materials: Surface material at borings B-4, B-5, and B-10 consisted of approximately five inches to eight inches of topsoil. Surface material at borings B-11 and B-12 consisted of asphaltic concrete, around three inches thick, with no apparent granular base.

Existing Fill: Beneath the surface cover materials, the borings encountered existing fill, consisting of brown, loose sand, some silt, some to trace gravel. SPT N-values recorded within the existing fill ranged from two bpf to 10 bpf. The existing fill extended to depths ranging from three fbgs to six fbgs.

Glacial Till: Beneath the existing fill or surface cover materials, the borings encountered glacial till, consisting of brown, medium dense to very dense sand, some silt, some to little silt, occasional cobbles and boulders (USCS: SM). SPT N-values recorded within the glacial till ranged from 12 bpf to 84 bpf. Borings B-5 and B-10 terminated in this stratum at a depth of 22 fbgs.

Bedrock: Bedrock was not sampled through rock coring efforts, but was inferred by refusal of the hollow stem augers at depths of 20.9 fbgs and 15 fbgs in borings B-4 and B-11, respectively. The sampler encountered refusal in boring B-12 at a depth of 20.8 fbgs; this also may represent bedrock. Rock coring techniques would be required to further characterize the nature and extent of the refusal materials.

Buildings E and F

The following descriptions are based on five borings, B-1, B-2, B-3, B-13, and B-14, which were advanced within the area of Buildings E and F to depths ranging from eight fbgs to 22 fbgs. Boring B-13 was converted into a groundwater monitoring well.

Surface Cover Materials: Surface material at the borings consisted of approximately six inches of topsoil.

Existing Fill: Beneath the surface cover materials, the borings encountered existing fill, consisting of brown, loose to medium dense (occasionally very loose) sand, some silt, little gravel. SPT N-values recorded within the existing fill ranged from three bpf to 13 bpf. The existing fill generally extended to depths ranging from two fbgs to eight fbgs. However, boring B-1 encountered refusal, possibly on bedrock, at a depth of 8.1 fbgs within this stratum.

Glacial Till: Beneath the existing fill, the borings, except B-1, encountered glacial till, consisting of brown, medium dense to very dense sand, some silt, little to trace gravel, occasional cobbles and boulders (USCS: SM). SPT N-values recorded within the glacial till ranged from 20 bpf to 60 bpf. Boring B-13 terminated in this stratum at a depth of 22 fbgs.

Bedrock: Bedrock was not sampled through rock coring efforts, but was inferred by refusal of the hollow stem augers at depths of 14 fbgs, 20.4 fbgs, and 14 fbgs in borings B-2, B-3, and B-14, respectively. The auger refusal in boring B-1 at a depth of 8.1 fbgs may also represent bedrock. Rock coring techniques would be required to further characterize the nature and extent of the refusal materials.

4.2 GROUNDWATER

Groundwater was encountered during Whitestone's subsurface exploration activities at the depths shown below for each of the proposed building areas.

Building A: Groundwater was encountered in two of the three borings at depths ranging from eight fbgs to 14 fbgs.

Building B: Groundwater was encountered in the boring at a depth of 17 fbgs.

Building D: Groundwater was encountered in two of the five borings at a depth of 19 fbgs.

Buildings E and F: Groundwater was encountered in one of the five borings at a depth of 15 fbgs.

Additionally, static and perched/trapped water conditions generally will fluctuate seasonally and following periods of precipitation.

SECTION 5.0
Conclusions and Recommendations

5.1 GENERAL

The following discussion, which is based on the subsurface conditions encountered during Whitestone's subsurface investigation based on the preliminary development concepts, is intended to provide general characteristics of the subsurface conditions for preliminary planning purposes. The preliminary recommendations should not be utilized for final design of structural foundations, floor slabs, or pavements until final site layout and proposed grading are reviewed by Whitestone and additional explorations are performed.

The results of the preliminary investigation indicate that, except for Building B, the site is suitable for conventional shallow foundations that may bear on the natural glacial till and ground-supported basement slab that may derive support from the natural glacial till, compacted and approved existing fill, and/or compacted structural fill, as specified in this report. Deep fill was encountered in the single boring advanced for Building B, indicating that an intermediate foundation system, such as rammed aggregate piers or controlled modulus columns, may be required to support the footings and slab. Additionally, the site conditions support the use of typical pavement sections using standard MassDOT specified materials.

5.2 SITE PREPARATION AND EARTHWORK

Surface Cover Stripping: Asphaltic concrete, vegetation, trees, shrubs, and other organic matter should be removed from within and at least five feet beyond the limits of the proposed building footprints as well as any other area that will require controlled structural fill placement. Tree/shrub removal should include the removal of stumps and root material. Fill or backfill placed within the proposed addition area should be placed as structural fill.

Demolition: Demolition of the existing structures should include complete removal of all existing utilities, footings, foundation walls, and slabs in structural areas. Partial removal may be considered in areas that will not impact future construction. The resultant demolition excavations should be backfilled with approved materials and compacted in controlled lifts in accordance with geotechnical recommendations.

Weather Performance Criteria: The site soils are moderately moisture sensitive and may soften when exposed to water. Every effort should be made to maintain drainage of surface water runoff away from construction areas by grading and limiting the exposure of excavations and prepared subgrades to rainfall. Accordingly, excavation and fill placement procedures should be performed during favorable weather conditions. Overexcavation of wet or disturbed soils and replacement with controlled structural fill may be required prior to resuming work on subgrade soils.

5.3 STRUCTURAL FILL AND BACKFILL

Imported Fill Material: Imported material placed as structural fill or backfill to raise elevations or restore design grades should consist of clean, relatively well graded sand or gravel with a maximum particle size of three inches and up to 15 percent, by weight, of material finer than a #200 sieve. Imported material should be free of silt, clay, organics, and deleterious material.

On-Site Material Re-Use: Whitestone anticipates that the existing fill will be suitable for selective reuse as structural fill/backfill material, provided that soil moisture contents are controlled within three percent of optimum moisture level and particles larger than three inches in diameter are either removed or crushed.

5.4 GROUNDWATER CONTROL

Static groundwater was encountered within soil borings during this investigation at depths that are unlikely to significantly impact foundation construction. However, perched/trapped water may be encountered above non-permeable strata. As such, construction phase dewatering may consist of removing surface water runoff, infiltrating water, or trapped water at this site. Whitestone anticipates that construction phase dewatering, if required, would include installing temporary sump pits and pumps within trenches and excavations.

Proper grading and drainage should be incorporated into the site design and construction phase grading to discourage ponding of surface runoff. Every effort should be made to maintain drainage of surface run-off away from construction areas by grading. The contractor should limit exposure of excavations and prepared subgrades to rainfall. A permanent perimeter foundation drain should be installed at underside of footing level around any basements.

5.5 PRELIMINARY FOUNDATION DESIGN CRITERIA

5.5.1 Shallow Foundations

Preliminary Foundation Design: Whitestone preliminarily recommends supporting the proposed structures, with the exception of Building B, on conventional spread and continuous wall footings designed to bear on the natural glacial till or structural fill placed over the glacial till, provided the subgrade is properly evaluated and compacted. Overexcavation will likely be required in some areas where the existing fill is deeper. Following in-trench compaction of foundation subgrades, foundations bearing within these materials may be preliminarily designed to impart a maximum net allowable bearing pressure of 5,000 pounds per square foot. This value should be confirmed following building-specific geotechnical investigations once column and wall loading, settlement tolerances, and column spacing is developed.

Foundation subgrades should be compacted in the presence of the geotechnical engineer to densify the subgrade and structural fill. Regardless of loading conditions, new foundations should be sized no less than minimum dimensions of 24 inches for continuous wall footings and 36 inches for isolated column footings.

Footings should be designed such that the maximum toe pressure due to the combined effect of vertical loads (including soil weight) and overturning moment does not exceed the recommended maximum allowable bearing pressure. In addition, positive contact pressure should be maintained throughout the base of the footings such that no uplift or tension exists between the base of the footings and the supporting soil. Uplift loads should be resisted by the weight of the concrete footing. Side friction should be neglected when proportioning the footings, and lateral resistance should be provided by friction resistance at the base of the footings. A coefficient of friction (ultimate) against sliding of 0.40 is recommended for use in the design of concrete foundations bearing within the glacial till or imported structural fill.

Frost Coverage: Footings subject to frost action should be placed at least 48 inches below adjacent exterior grades or the depth required by local building codes to provide protection from frost penetration. Interior footings not subject to frost action may be placed at a minimum depth of 18 inches below the slab subgrade.

5.5.2 Intermediate Foundations & Ground Improvement

Because of the deep, very loose to loose existing fill in the vicinity of Building B, which is a three-story structure, Whitestone recommends that consideration should be given to supporting the proposed building foundations on an intermediate foundation system consisting of rammed aggregate piers (RAP) or controlled modulus columns (CMC) with a ground-supported floor or basement slab. Only one boring was advanced for Building B. Several more borings should be drilled within and adjacent to the proposed building footprint to further define the depth and extent of the existing fill and determine if an intermediate foundation system is appropriate or excavation of the existing fill and replacement with compacted structural fill is a feasible and more economical approach.

Whitestone recommends that the RAPs/CMCs extend through the existing fill materials into the underlying dense natural glacial till. Cobbles and boulders are likely in the existing fill, which is generally reworked natural glacial till. Pre-augering should be expected to facilitate installation of the RAPs/CMCs. The recommended propriety RAP/CMC system should be designed and installed by a licensed RAP/CMC foundation contractor, and the final design should be reviewed by the owner's engineers.

Following ground improvement through installation of RAP or CMC elements as discussed below, Whitestone recommends supporting the proposed structure on conventional shallow foundations bearing

within the improved subsurface materials and/or on controlled structural fill soils that are properly placed and compacted in accordance with the recommendations herein. Foundations bearing on suitably prepared and improved subgrades may be preliminarily designed to impart a maximum allowable net bearing pressure of 5,000 psf for foundations bearing soil stiffened with RAPS or CMCs subject to final design investigations. Regardless of loading conditions, proposed foundations should be sized no less than minimum dimensions of 24 inches for continuous wall footings and 36 inches for isolated column footings.

Ground Improvement – Rammed Aggregate Pier Criteria: In order to reduce the risk of excessive differential settlement and avoid extensive overexcavation, the proposed structure may be supported on conventional shallow foundations as detailed above provided the subsurface materials are improved by installing RAPs.

A RAP is a stiff and highly densified inclusion of rammed crushed aggregate that is installed by drilling a hole and ramming thin lifts of well-graded aggregate within the hole. The first lift of aggregate forms a bulb below the bottoms of the piers, thereby pre-stressing and pre-straining the soils to a depth equal to at least one pier diameter below drill depths. Subsequent lifts are typically about 12 inches in thickness. Ramming takes place with a high-energy beveled tamper that both densifies the aggregate and forces the aggregate laterally into the sidewalls of the hole. This action increases the lateral stress in surrounding soil, thereby further stiffening the stabilized composite soil mass. The combination of the installation of the stiff aggregate pier and lateral stress increase in the matrix soil improves the composite soil strength and controls settlement to within tolerable limits.

Because of likelihood of encountering cobbles and boulders in the existing fill, pre-excavation or pre-drilling should be anticipated to facilitate RAP installation.

For this project, Whitestone preliminarily anticipates that RAP elements will be 24 inches to 36 inches in diameter and extend to typical depths of around 15 feet below the existing site grades. This depth estimate, which is based on a single boring, will have to be reviewed following the advancement of additional borings.

Ground Improvement – Controlled Modulus Column Criteria: Ground modification through CMCs is an alternative to the RAPs. CMCs are similarly used to improve the soil characteristics of subsurface materials by increasing the stiffness of the soil mass and reducing compressibility by use of semi-rigid soil reinforcement columns where the load of the structure is distributed between the soil and the CMCs.

CMCs are semi-rigid inclusions that reinforce the soil by advancing a hollow auger into the subsurface materials and installing a low-pressure grout column through the auger. The combined effect of densification and reinforcement improves characteristics of the ground due to composite action. The CMC system uses a displacement auger powered by equipment with very large torque capacity and downward thrust and displaces the soil laterally with virtually no spoil or vibration. When the required

depth or preset drilling criteria (typically rotational torque) is achieved, a grout-cement mixture is pumped through the center of the hollow auger. The grout mixture then flows under low pressure out of the auger base as it is retracted to obtain a high capacity column that can be used in close vicinity to sensitive structures. The grout is injected under low pressure, typically less than 145 pounds per square inch (psi) with no soil mixing taking place during the grouting procedures. To ensure that the soil above the auger remains compacted, the top of the auger is equipped with reverse direction flights. The result is a composite system with column reinforcements bonded to the surrounding soils.

For this project, Whitestone preliminarily anticipates that CMC elements will range between approximately 12 inches and 20 inches in diameter and extend to typical depths of around 15 feet below the existing site grades. This depth estimate, which is based on a single boring, will have to be reviewed following the advancement of additional borings.

5.6 PRELIMINARY FLOOR AND BASEMENT SLAB RECOMMEDNATIONS

For the buildings, except Building B, Whitestone anticipates that the natural glacial till, compacted and approved existing fill, and/or compacted structural fill, as specified in this report will be suitable for support of proposed floor or basement slabs provided these materials are properly evaluated, compacted, and proofrolled. Areas that are, or become, softened or disturbed as a result of wetting and/or repeated exposure to construction traffic should be removed and replaced with compacted structural fill.

For Building B, Whitestone anticipates that the existing fill materials improved with RAPs or CMCs, and/or compacted structural fill, and/or backfill placed to raise or restore design elevations are expected to be suitable for support of the proposed floor or basement slab provided these materials are properly compacted and proofrolled. The suitability of the improved existing fill materials for re-use of floor slab support will be contingent upon careful inspection and evaluation during construction phase. Any areas that become softened or disturbed as a result of wetting and/or repeated exposure to construction traffic should be removed and replaced with compacted structural fill.

Whitestone preliminarily estimates that properly prepared on-site soils and the existing fill improved with RAPs or CMCs will yield a minimum subgrade modulus (k) of 150 psi/in. However, for Building B, Whitestone recommends that the floor/basement slab concrete be suitably reinforced to span between RAPs/CMCs.

A minimum six-inch layer of MassDOT M1.03.01 Processed Gravel for Subbase (or approved equivalent) should be installed below the floor slab to provide a capillary break. A minimum 12-inch thick layer of MassDOT M1.03.01 Processed Gravel for Subbase (or approved equivalent) should be placed below any basement slabs to provide a uniform subbase and drainage layer. The requirement for underfloor drains under basement slabs within the drainage layer should be reviewed during the design process. An impervious membrane also should be provided as a moisture vapor barrier beneath all floor/basement slabs. Post-construction settlements of floor/basement slabs installed in accordance with

the preliminary recommendations outlined in this report are estimated to be on the order of one quarter inch.

5.7 PRELIMINARY PAVEMENT DESIGN CRITERIA

General: Whitestone anticipates that the natural glacial till, properly inspected and approved existing fill, compacted structural fill, and/or backfill placed to raise or restore design elevations will be suitable for support of the proposed pavements.

Preliminary Design Criteria: Whitestone preliminarily recommends a California Bearing Ratio value of 8.0 for the properly prepared subgrade soils for pavement design purposes. This value was correlated with pertinent soil support values and should be used along with applicable traffic loads to prepare flexible and rigid pavement designs per the AASHTO *Guide for the Design of Pavement Structures*. However, the thicknesses of the various pavement section layers should not be less than the minimums tabulated below.

Pavement Sections: Pavement components should meet material specifications from MassDOT *Division III Materials Specifications* specified below. The recommended flexible pavement materials and minimum thicknesses are tabulated below:

FLEXIBLE PAVEMENT		
Layer	**Material**	**Minimum Thickness (Inches)**
Asphalt Surface Course	MassDOT M3.11.03 Table A "Top Course"	1.5
Asphalt Binder Course	MassDOT M3.11.03 Table A "Binder Course"	1.5
Granular Subbase	MassDOT M2.01.7 Dense-graded Crushed Stone for Sub-base	12.0

A rigid concrete pavement should be used to provide suitable support at areas of high traffic or severe turns, such as at trash enclosures and ingress/egress locations. The recommended rigid pavement materials and minimum thicknesses are tabulated below:

RIGID PAVEMENT		
Layer	**Material**	**Minimum Thickness (Inches)**
Surface	4,000 psi Air-Entrained Concrete	6.0[1]
Granular Subbase	MassDOT M2.01.07 Dense-graded Crushed Stone for Sub-base	12.0

[1] The outer edges of concrete pavements are susceptible to damage as trucks move from rigid pavement to adjacent flexible pavement. Therefore, the thickness at the outer two feet of the rigid concrete pavement should be 12 inches.

5.8 SEISMIC AND LIQUEFACTION CONSIDERATIONS

The subsurface conditions are most consistent with a Site Class C, as defined by the *Massachusetts State Building Code (Eighth Edition)*. Based on the seismic zone and soil/bedrock profile, liquefaction considerations are not expected to have a substantial impact on design.

5.9 SUPPLEMENTAL POST INVESTIGATION SERVICES

Supplemental Investigation: Because the proposed building locations were not fully explored during this preliminary study, supplemental investigative efforts are recommended for each building prior to final foundation design in order to further evaluate the composition and relative densities or consistencies of existing fill materials, the presence and thickness of organic layers, and the depths to bedrock. Additional coring of the bedrock also is warranted. Whitestone anticipates performing supplemental soil borings upon the finalization of the proposed site layout, grading, and loading conditions in order to provide final recommendations for foundation, floor slab earthworks, and pavement designs.

Inaccessible Areas: Portions of the proposed building footprints were inaccessible during Whitestone's preliminary subsurface investigation because of the presence of the existing structures. Bedrock and probable bedrock were encountered at relatively shallow depths. As such, Whitestone also recommends further review of subsurface conditions for foundation, floor/basement slab, and pavement support and/or re-use as structural fill by means of supplemental evaluation following demolition, as discussed further herein, to identify areas requiring removal and possible uncontrolled conditions, deleterious materials, or bedrock not disclosed by the soil borings conducted during this exploration.

SECTION 6.0
General Comments

Additional explorations and supplemental recommendations will be required before finalization of construction plans and/or if significant changes are made in the characteristics or location of the proposed structures. Soil bearing conditions should be checked at the appropriate time for consistency with those conditions encountered during Whitestone's geotechnical investigations.

The preliminary recommendations presented herein should be utilized by a qualified engineer in preparing only project conceptual plans. The engineer should consider these preliminary recommendations as minimum physical standards, which may be superseded by local and regional building codes and structural considerations. These preliminary recommendations are prepared for the sole use of Worcester Business Development Corporation for the specific project detailed and should not be used by any third party. These preliminary recommendations are relevant to the conceptual design phase and should not be used for final design or substituted for construction specifications.

The possibility exists that conditions between borings may differ from those at specific test locations, and conditions may not be as anticipated by the designers or contractors. In addition, the construction process may alter soil and rock conditions.

The exploration and preliminary analysis of the foundation conditions reported herein are considered sufficient in detail and scope to form a reasonable basis only for conceptual foundation design. The preliminary recommendations submitted for the proposed construction are based on the available soil information and the design details furnished by Worcester Business Development Corporation and Bohler Engineering MA, LLC. Deviations from the noted subsurface conditions (and from subsurface conditions in subsequent borings) that are encountered during construction should be brought to the attention of the geotechnical engineer.

The geotechnical engineer warrants that the findings, preliminary recommendations, or professional advice contained herein have been promulgated after being prepared in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics, and engineering geology. No other warranties, express or implied, are made.

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FIGURE 1
Boring Location Plan

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LEGEND

B-1 — BORING LOCATION (APPROX.)

B-6 — BORING/WELL LOCATION (APPROX.)

REFERENCE

THIS PLAN IS BASED UPON A MARCH 24, 2017 CONCEPT MASTER PLAN BY BOHLER ENGINEERING.

PROJECT #:	GM1714433.000
DESIGNED BY:	GR
DRAWN BY:	JL
DATE:	4/20/17
SCALE:	1" = 200'
FIG. SHEET:	1

DRAWING TITLE:
BORING LOCATION PLAN

CLIENT:
WORCESTER BUSINESS DEVELOPMENT CORPORATION

PROJECT:
PROPOSED BIOMANUFACTURING CAMPUS
305 BELMONT STREET
CITY & COUNTY OF WORCESTER, MA

WHITESTONE ASSOCIATES, INC.
Environmental & Geotechnical Engineers & Consultants
352 TURNPIKE ROAD, SUITE 320, SOUTHBOROUGH, MA 01772
508.485.0755 WHITESTONEASSOC.COM

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APPENDIX A
Records of Subsurface Exploration

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-1

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.

Surface Elevation:	± NS feet above msl	**Date Started:**	4/13/2017	**Water Depth (feet bgs) | Elevation (feet msl)**		**Cave-In Depth (feet bgs) | Elevation (feet msl)**	
Termination Depth:	8.1 feet bgs	**Date Completed:**	4/13/2017				
Proposed Location:	Building E + F	**Logged By:**	JL	**During:**	-- | --		
Drill / Test Method:	HSA / SPT	**Contractor:**	GQ	**At Completion:**	-- | --	**At Completion:**	-- | --
		Equipment:	Mobile B-57	**24 Hours:**	-- | --	**24 Hours:**	-- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0	TS		6" Topsoil	
0 - 2	S-1		2 - 5 - 8 - 10	10	13		FILL		Brown, Medium Dense, Medium to Fine Sand, some Silt, little Gravel (FILL)	
2 - 4	S-2		9 - 9 - 4 - 2	8	13				As Above (FILL)	
						5.0				
5 - 7	S-3		2 - 2 - 3 - 4	0	5				No Recovery, Loose	
7 - 8.1	S-4		2 - 5 - 50/1"	3	10				As Above, Loose to Medium Dense, Trace Organics (FILL)	
						10.0			Boring Log B-1 Auger Refusal Encountered, Exploration Terminated at a Depth of 8.1 Feet Below Ground Surface.	
						15.0				
						20.0				
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-2

Page 1 of 1

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.

Surface Elevation:	± NS feet above msl	**Date Started:**	4/13/2017	**Water Depth | Elevation (feet bgs) | (feet msl)**	**Cave-In Depth | Elevation (feet bgs) | (feet msl)**
Termination Depth:	14.0 feet bgs	**Date Completed:**	4/13/2017		
Proposed Location:	Building E + F	**Logged By:**	JL	**During:** -- | --	
Drill / Test Method:	HSA / SPT	**Contractor:**	GQ	**At Completion:** -- | --	**At Completion:** -- | --
		Equipment:	Mobile B-57	**24 Hours:** -- | --	**24 Hours:** -- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0	TS		6" Topsoil	
0 - 2	S-1		2 - 7 - 3 - 3	12	10		FILL		Brown, Medium Dense to Dense, Medium to Fine Sand, Some Silt, Pieces of Slate (FILL)	
2 - 4	S-2		4 - 10 - 10 - 10	6	20		GLACIAL TILL		Brown, Medium Dense, Coarse to Fine Sand, Some Silt, Some Gravel (SM)	
						5.0				
5 - 7	S-3		9 - 15 - 11 - 14	22	26				As Above (SM)	
7 - 7.8	S-4		30 - 50/3"	4	-				As Above, Dense (SM)	
						10.0				
10 - 10.9	S-5		24 - 50/5"	8	-				As Above, Dense (SM)	
						15.0			Boring Log B-2 Auger Refusal on Probable Bedrock, Exploration Terminated at a Depth of 14.0 Feet Below Ground Surface.	
						20.0				
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-3

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.
Surface Elevation:	± NS feet above msl	**Date Started:**	4/13/2017
Termination Depth:	20.4 feet bgs	**Date Completed:**	4/13/2017
Proposed Location:	Building E + F	**Logged By:**	JL
Drill / Test Method:	HSA / SPT	**Contractor:**	GQ
		Equipment:	Mobile B-57

Water Depth | Elevation (feet bgs) | (feet msl)		Cave-In Depth | Elevation (feet bgs) | (feet msl)	
During:	-- | --		
At Completion:	-- | --	**At Completion:**	-- | --
24 Hours:	-- | --	**24 Hours:**	-- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0	TS		6" Topsoil	
0 - 2	S-1		1 - 2 - 5 - 9	21	7		FILL		Brown, Loose, Medium to Fine Sand, Some Silt, Trace Fine Gravel (FILL)	
2 - 4	S-2		4 - 9 - 12 - 12	10	21	2.5			Brown, Medium Dense, Coarse to Fine Sand, Some Silt, Trace Gravel (SM)	
						5.0				
5 - 7	S-3		10 - 17 - 10 - 12	17	27				As Above (SM)	
7 - 7.9	S-4		14 - 50/5"	9	-				As Above (SM)	
						10.0				
10 - 10.9	S-5		34 - 50/4"	6	-				As Above, Dense, Some Gravel (SM)	
							GLACIAL TILL			
						15.0				
15 - 15.8	S-6		21 - 50/3"	12	-				As Above, Little Gravel (SM)	
						20.0				
20 - 20.4	S-7		50/5"	4					As Above (SM)	
									Boring Log B-3 Auger Refusal on Probable Bedrock, Exploration Terminated at a Depth of 20.4 Feet Below Ground Surface.	
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-4

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.

Surface Elevation:	± NS feet above msl	**Date Started:**	4/13/2017	**Water Depth (feet bgs) | Elevation (feet msl)**		**Cave-In Depth (feet bgs) | Elevation (feet msl)**	
Termination Depth:	20.9 feet bgs	**Date Completed:**	4/13/2017				
Proposed Location:	Building D	**Logged By:**	JL	**During:**	19.0 | --		
Drill / Test Method:	HSA / SPT	**Contractor:**	GQ	**At Completion:**	-- | --	**At Completion:**	-- | --
		Equipment:	Mobile B-57	**24 Hours:**	-- | --	**24 Hours:**	-- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0	TS		8" Topsoil	
0 - 2	S-1		2 - 3 - 3 - 3	15	6				Brown, Loose, Medium to Fine Sand, Some Silt, Trace Gravel (FILL)	
2 - 4	S-2		5 - 4 - 5 - 4	4	9		FILL		As Above (FILL)	
						5.0				
5 - 7	S-3		2 - 7 - 12 - 18	10	19				As Above (FILL)	
									Brown, Medium Dense to Dense, Coarse to Fine Sand, Some Silt, Little Gravel (SM)	
7 - 9	S-4		40 - 18 - 17 - 18	16	35				Brown, Dense, Medium to Fine Sand, little Silt, Trace Gravel (SM)	
						10.0				
10 - 12	S-5		10 - 15 - 17 - 20	12	32				Brown, Dense, Fine Sand, Some Silt (SM)	
							GLACIAL TILL			
						15.0				
15 - 17	S-6		15 - 15 - 16 - 19	10	31				As Above (SM)	
						20.0				
20 - 20.9	S-7		10 - 50/4"	12					As Above, Trace Gravel (SM)	
									Boring Log B-4 Auger Refusal on Probable Bedrock, Exploration Terminated at a Depth of 20.9 Feet Below Ground Surface.	
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-5

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.

Surface Elevation:	± NS feet above msl	**Date Started:**	4/13/2017		**Water Depth (feet bgs) | Elevation (feet msl)**		**Cave-In Depth (feet bgs) | Elevation (feet msl)**
Termination Depth:	22.0 feet bgs	**Date Completed:**	4/13/2017				
Proposed Location:	Building D	**Logged By:**	JL	**During:**	19.0 | --		
Drill / Test Method:	HSA / SPT	**Contractor:**	GQ	**At Completion:**	-- | --	**At Completion:**	-- | --
		Equipment:	Mobile B-57	**24 Hours:**	-- | --	**24 Hours:**	-- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0	TS		6" Topsoil	
0 - 2	S-1		1 - 2 - 3 - 3	11	5		FILL		Brown, Loose, Medium to Fine Sand, Some Silt, Trace Gravel (FILL)	
2 - 4	S-2		1 - 2 - 1 - 2	1	3				As Above (FILL)	
						5.0				
5 - 7	S-3		4 - 5 - 8 - 11	10	13				Brown, Medium Dense, Medium to Fine Sand, Some Silt, Trace Gravel (SM)	
7 - 9	S-4		11 - 12 - 18 - 24	5	30				Brown, Medium Dense to Dense, Coarse to Fine Sand, Little Silt, Little Gravel (SM)	
						10.0				
10 - 12	S-5		10 - 15 - 20 - 22	14	35				As Above, Dense, Some Silt (SM)	
							GLACIAL TILL			
						15.0				
15 - 16.3	S-6		12 - 25 - 50/4"	10	50				Brown, Dense to Very Dense, Medium to Fine Sand, Some Silt, Trace Gravel (SM)	
						20.0				
20 - 22	S-7		14 - 14 - 20 - 26	10	34				As Above, Dense (SM)	
						25.0			Boring Log B-5 Terminated at a Depth of 22.0 Feet Below Ground Surface.	

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-6

Page 1 of 1

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.

Surface Elevation:	± NS feet above msl	**Date Started:**	4/18/2017		**Water Depth (feet bgs) | Elevation (feet msl)**		**Cave-In Depth (feet bgs) | Elevation (feet msl)**
Termination Depth:	14.5 feet bgs	**Date Completed:**	4/18/2017				
Proposed Location:	Building A	**Logged By:**	JL	**During:**	8.0 | --		
Drill / Test Method:	HSA / SPT	**Contractor:**	GQ	**At Completion:**	-- | --	**At Completion:**	-- | --
		Equipment:	Mobile B-57	**24 Hours:**	-- | --	**24 Hours:**	-- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0	TS		4" Topsoil	
0 - 2	S-1		6 - 7 - 8 - 4	12	15		FILL		Brown, Medium Dense, Medium to Fine Sand, Some Silt, Little Gravel (FILL)	
2 - 4	S-2		8 - 5 - 4 - 4	8	9				As Above, Loose, Cobbles (FILL)	
						5.0				
5 - 7	S-3		6 - 6 - 6 - 20	14	12				Brown, Medium Dense, Medium to Fine Sand, Some Silt, Little Gravel (SM)	
7 - 7.9	S-4		38 - 50/5"	5	-				As Above, Dense (SM)	
							GLACIAL TILL			
						10.0				
10 - 12	S-5		17 - 40 - 19 - 28	14	59				Brown, Very Dense, Coarse to Fine Sand, Some Gravel, Little Silt (SM)	
									Cobbles at 13 Feet	
						15.0			Boring Log B-6 Auger Refusal on Probable Bedrock, Exploration Terminated at a Depth of 14.5 Feet Below Ground Surface.	
						20.0				
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

35 Technology Drive, Warren, NJ 07059

Phone: (908) 668-7777, Fax: (908) 754-5936

Well Number	MW-6
Start Date:	4/18/2017
Completion Date:	04/18/17

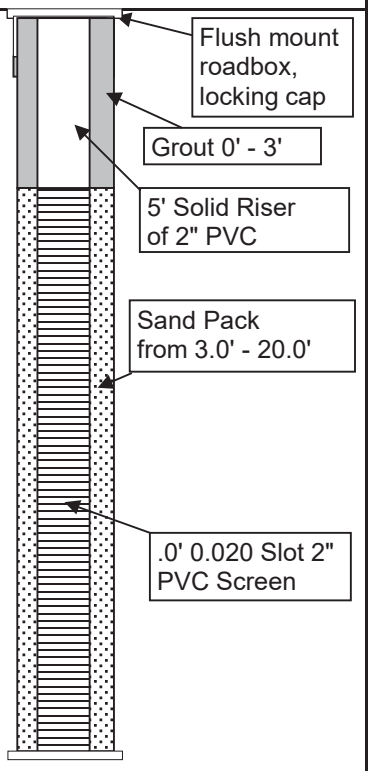
WELL LOCATION SKETCH (N.T.S)

Project:	Proposed Biomanufacturing Campus	**Whitestone Job #:**	GM1714433.000
Location:	305 Belmont Street, Worcester,	**Well Permit #:**	01/00/00
Geologist:	JL	**Drilling Co.:**	Soil Ex
Driller/Helper:	JL	**Drill Rig:**	Mobile B-57
Drilling Method:	HSA / SPT	**Type of Bit:**	Hollow Stem
Sampler Type:	0		

G.W. Encountered:	8'	**G.W. Stabilized:**	0	**Well Depth:**	14.5'	**Solid Riser/Casing:**	0.0' - 3.5'
Depth to Rim:	NA	**Borehole Diameter:**	0"	**Well Diameter:**	2"	**Screen Interval/Screen Type:**	3.0' - 15.5' / 0.020 Slot
						Grout: N/A	**Sand Pack/Open Borehole:** 3.5 - 14.5'

DEPTH (FT.)	SAMPLE ID AND DEPTH	PID/FID/OUA (METER UNITS)	BLOWS/6.0	RECOVERY (INCHES)	SOIL TYPE	SOIL/GEOLOGICAL DESCRIPTION
1–14						Brown, Medium to Fine Sand, Some Silt, Little Gravel
15–25						Monitor Well MW-1 Completed to 14.5 fbgs

WELL CONSTRUCTION DIAGRAM (N.T.S)



WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-7

Page 1 of 1

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.
Surface Elevation:	± NS feet above msl	**Date Started:**	4/18/2017
Termination Depth:	15.0 feet bgs	**Date Completed:**	4/18/2017
Proposed Location:	Building A	**Logged By:**	JL
Drill / Test Method:	HSA / SPT / NQ2	**Contractor:**	GQ
		Equipment:	Mobile B-57

Water Depth | Elevation (feet bgs) | (feet msl)		Cave-In Depth | Elevation (feet bgs) | (feet msl)	
During:	-- | --		
At Completion:	-- | --	**At Completion:**	-- | --
24 Hours:	-- | --	**24 Hours:**	-- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0				
							PAVEMENT		4" Asphalt	
0.5 - 2.5	S-1		6 - 13 - 14 - 20	12	27				Brown, Medium Dense, Medium to Fine Sand, Some Silt, Little Gravel, Cobbles (SM)	
									Cobbles at 2.5 Feet	
2.5 - 4.5	S-2		31 - 42 - 40 - 40	10	82				As Above, Very Dense (SM)	
						5.0				
5 - 6	S-3		26 - 55	0	-		GLACIAL TILL		No Recovery	
									Cobbles at 6 Feet	
	Total Elapsed Cut Time/Cut Time Per Ft.			REC	RQD	10.0			Light-Gray, Slightly Weathered, Fine Grained, Medium Jointed, Medium Hard, Biotite-Muscovite Granite	
			3.0 / 3.0							
			6.0 / 3.0							
10 - 15	C-1	NQ2	10.0 / 4.0	59" 98%	53" 88%		GRANITE BEDROCK			
			15.0 / 5.0							
			20.0 / 5.0			15.0				
						20.0			Boring Log B-7 Terminated at a Depth of 15.0 Feet Below Ground Surface.	
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-8

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.

Surface Elevation:	± NS feet above msl	**Date Started:**	4/18/2017		**Water Depth | Elevation (feet bgs) | (feet msl)**		**Cave-In Depth | Elevation (feet bgs) | (feet msl)**
Termination Depth:	22.0 feet bgs	**Date Completed:**	4/18/2017				
Proposed Location:	Building B	**Logged By:**	DC	**During:**	17.0 | --		
Drill / Test Method:	HSA / SPT	**Contractor:**	GQ	**At Completion:**	-- | --	**At Completion:**	-- | --
		Equipment:	Mobile B-57	**24 Hours:**	-- | --	**24 Hours:**	-- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0	TS		4" Topsoil	
0 - 2	S-1		2 - 27 - 15 - 7	17	42				Brown, Dense, Medium to Fine Sand, Some Silt, Little Gravel (FILL)	
2 - 4	S-2		3 - 2 - 2 - 2	4.5	4				As Above, Coarse to Fine Sand (FILL)	
						5.0				
5 - 7	S-3		6 - 15 - 5 - 6	6	20		FILL		Brown, Medium Dense, Coarse to Fine Sand, Some Gravel, Little Silt, Brick Pieces (FILL)	
7 - 9	S-4		2 - 2 - 2 - 2	5	4				As Above (FILL)	
						10.0				
10 - 12	S-5		1 - 1 - 1 - 1	15	2				Brown, Very Loose, Fine Sand and Silt, Trace Organics (FILL AND FORMER SUBSOIL)	
						15.0				
15 - 17	S-6		4 - 11 - 11 - 13	13	22		GLACIAL TILL		Brown, Medium Dense, Medium to Fine Sand, Some Silt, Little Gravel (SM)	
						20.0				
20 - 22	S-7		15 - 39 - 40 - 34	14	79				Brown, Very Dense, Coarse to Fine Sand, Some Gravel, Little Silt (SM)	
									Boring Log B-8 Terminated at a Depth of 22.0 Feet Below Ground Surface.	
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-9

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.

Surface Elevation:	± NS feet above msl	**Date Started:**	4/18/2017		**Water Depth (feet bgs) | Elevation (feet msl)**		**Cave-In Depth (feet bgs) | Elevation (feet msl)**
Termination Depth:	15.5 feet bgs	**Date Completed:**	4/18/2017				
Proposed Location:	Building A	**Logged By:**	DC	**During:**	14.0 | --		
Drill / Test Method:	HSA / SPT	**Contractor:**	GQ	**At Completion:**	-- | --	**At Completion:**	-- | --
		Equipment:	Mobile B-57	**24 Hours:**	-- | --	**24 Hours:**	-- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0	TS		4" Topsoil	
0 - 2	S-1		1 - 5 - 5 - 4	15.5	10		FILL		Brown, Loose to Medium Dense, Medium to Fine Sand, Some Silt, Some Gravel (FILL)	
2 - 4	S-2		5 - 5 - 3 - 3	5	8				As Above, Loose (FILL)	
						5.0				
5 - 7	S-3		4 - 3 - 1 - 1	11	4				As Above, Very Loose to Loose, Trace Gravel (FILL)	
7 - 9	S-4		6 - 9 - 11 - 10	19	20		GLACIAL TILL		Brown, Medium Dense, Medium to Fine Sand, Some Silt, Trace Gravel (SM)	
						10.0				
10 - 12	S-5		10 - 13 - 18 - 24	22	31				Brown, Dense, Coarse to Fine Sand, Some Silt, Little Gravel (SM)	
						15.0				
15 - 15.4	S-6		61/5"	4					As Above (SM)	
									Boring Log B-9 Auger Refusal on Probable Bedrock, Exploration Terminated at a Depth of 15.5 Feet Below Ground Surface.	
						20.0				
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-10

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.
Surface Elevation:	± NS feet above msl	**Date Started:**	4/18/2017
Termination Depth:	22.0 feet bgs	**Date Completed:**	4/18/2017
Proposed Location:	Building D	**Logged By:**	DC
Drill / Test Method:	HSA / SPT	**Contractor:**	GQ
		Equipment:	Mobile B-57

Water Depth | Elevation (feet bgs) | (feet msl)		Cave-In Depth | Elevation (feet bgs) | (feet msl)	
During:	-- | --		
At Completion:	-- | --	**At Completion:**	-- | --
24 Hours:	-- | --	**24 Hours:**	-- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0	TS		5" Topsoil	
0 - 2	S-1		1 - 2 - 5 - 4	12	7		FILL		Brown, Loose, Medium to Fine Sand, Some Silt, Some Gravel (FILL)	
2 - 4	S-2		2 - 1 - 1 - 2	12	2				As Above, Very Loose, Little Gravel (FILL)	
						5.0				
5 - 7	S-3		4 - 6 - 11 - 13	22	17				As Above, Loose to Medium Dense (FILL)	
7 - 9	S-4		21 - 24 - 24 - 26	18	48				Brown, Medium Dense, Medium to Fine Sand, Some Silt, Little Gravel (SM)	
						10.0			As Above (SM)	
10 - 12	S-5		11 - 18 - 27 - 50	-	45				No Recovery	
						15.0	GLACIAL TILL			
15 - 16.4	S-6		27 - 42 - 62/5"	16	84				As Above, Very Dense (SM)	
						20.0				
20 - 22	S-7		16 - 32 - 29 - 33	21	61				As Above (SM)	
						25.0			Boring Log B-10 Terminated at a Depth of 22.0 Feet Below Ground Surface.	

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-11

Page 1 of 1

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.
Surface Elevation:	± NS feet above msl	**Date Started:**	4/19/2017
Termination Depth:	15.0 feet bgs	**Date Completed:**	4/19/2017
Proposed Location:	Building D	**Logged By:**	JL
Drill / Test Method:	HSA / SPT	**Contractor:**	GQ
		Equipment:	Mobile B-57

Water Depth | Elevation (feet bgs) | (feet msl)		Cave-In Depth | Elevation (feet bgs) | (feet msl)	
During:	-- | --		
At Completion:	-- | --	**At Completion:**	-- | --
24 Hours:	-- | --	**24 Hours:**	-- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0				
							PAVEMENT		3" Asphalt	
0.5 - 2.5	S-1	X	6 - 5 - 3 - 3	3	8		FILL		Brown, Loose, Medium to Fine Sand, Some Silt, Little Gravel, Cobbles (FILL)	
2.5 - 4.5	S-2	X	2 - 3 - 6 - 23	3	9				As Above (FILL)	
						5.0				
5 - 7	S-3	X	8 - 12 - 20 - 22	17	32				Brown, Dense, Coarse to Fine Sand, Some Silt, and Gravel (SM)	
7 - 9	S-4	X	15 - 20 - 40 - 40	12	60				Brown, Very Dense, Medium to Fine Sand, Some Silt, Little Gravel (SM)	
						10.0	GLACIAL TILL			
10 - 12	S-5	X	7 - 9 - 13 - 14	10	22				As Above, Medium Dense (SM)	
									Cobbles at 14.5 Feet	
15 - 15	S-6	X	50/0"	0	-	15.0				
									Boring Log B-11 Auger Refusal on Probable Bedrock, Exploration Terminated at a Depth of 15.0 Feet Below Ground Surface.	
						20.0				
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-12

Page 1 of 1

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.
Surface Elevation:	± NS feet above msl	**Date Started:**	4/19/2017
Termination Depth:	20.8 feet bgs	**Date Completed:**	4/19/2017
Proposed Location:	Building D	**Logged By:**	JL
Drill / Test Method:	HSA / SPT	**Contractor:**	GQ
		Equipment:	Mobile B-57

Water Depth | Elevation (feet bgs) | (feet msl)		Cave-In Depth | Elevation (feet bgs) | (feet msl)	
During:	-- | --		
At Completion:	-- | --	**At Completion:**	-- | --
24 Hours:	-- | --	**24 Hours:**	-- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0				
							PAVEMENT		3" Asphalt	
0.5 - 2.5	S-1	X	6 - 6 - 4 - 4	10	10		FILL		Brown, Loose to Medium Dense, Medium to Fine Sand, Some Silt, Little Gravel (FILL)	
2.5 - 4.5	S-2	X	7 - 10 - 10 - 20	14	20				Gray/Brown, Medium Dense, Medium to Fine Sand, Some Silt, Trace Gravel (SM)	
						5.0				
5 - 7	S-3	X	3 - 4 - 8 - 8	20	12				As Above (SM)	
7 - 9	S-4	X	28 - 15 - 17 - 17	16	32				As Above (SM)	
						10.0				
10 - 12	S-5	X	10 - 12 - 25 - 35	18	37				As Above (SM)	
							GLACIAL TILL			
						15.0			Cobbles Below 15 Feet	
15 - 16	S-6	X	13 - 50	8	-				As Above (SM)	
						20.0				
20 - 20.8	S-7	X	37 - 50/4"	6	-				As Above (SM)	
									Boring Log B-12 Terminated at a Depth of 20.8 Feet Below Ground Surface.	
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-13

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.

Surface Elevation:	± NS feet above msl	**Date Started:**	4/19/2017		**Water Depth (feet bgs) | Elevation (feet msl)**		**Cave-In Depth (feet bgs) | Elevation (feet msl)**
Termination Depth:	22.0 feet bgs	**Date Completed:**	4/19/2017				
Proposed Location:	Building E + F	**Logged By:**	JL	**During:**	15.0 | --		
Drill / Test Method:	HSA / SPT	**Contractor:**	GQ	**At Completion:**	-- | --	**At Completion:**	-- | --
		Equipment:	Acker ADII	**24 Hours:**	-- | --	**24 Hours:**	-- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0	TS		6" Topsoil	
0 - 2	S-1		1 - 1 - 2 - 2	12	3		FILL		Brown, Very Loose, Medium to Fine Sand, Some Silt, Trace Gravel (FILL)	
2 - 4	S-2		4 - 5 - 6 - 9	20	11				As Above, Medium Dense (FILL)	
						5.0				
5 - 7	S-3		6 - 7 - 8 - 11	18	15				As Above (FILL)	
7 - 9	S-4		15 - 15 - 25 - 26	24	40		GLACIAL TILL		Brown, Dense, Medium to Fine Sand, Some Silt, Trace Gravel (SM)	
						10.0				
10 - 12	S-5		11 - 13 - 19 - 16	20	32				As Above (SM)	
						15.0 ▽				
15 - 17	S-6		9 - 13 - 16 - 20	18	29				As Above, Medium Dense (SM)	
									Cobbles at 18.5 Feet	
						20.0				
20 - 22	S-7		8 - 10 - 15 - 20	24	25				As Above (SM)	
						25.0			Boring Log B-13 Terminated at a Depth of 22.0 Feet Below Ground Surface.	

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

35 Technology Drive, Warren, NJ 07059

Phone: (908) 668-7777, Fax: (908) 754-5936

Well Number	MW-13
Start Date:	4/19/2017
Completion Date:	04/19/17

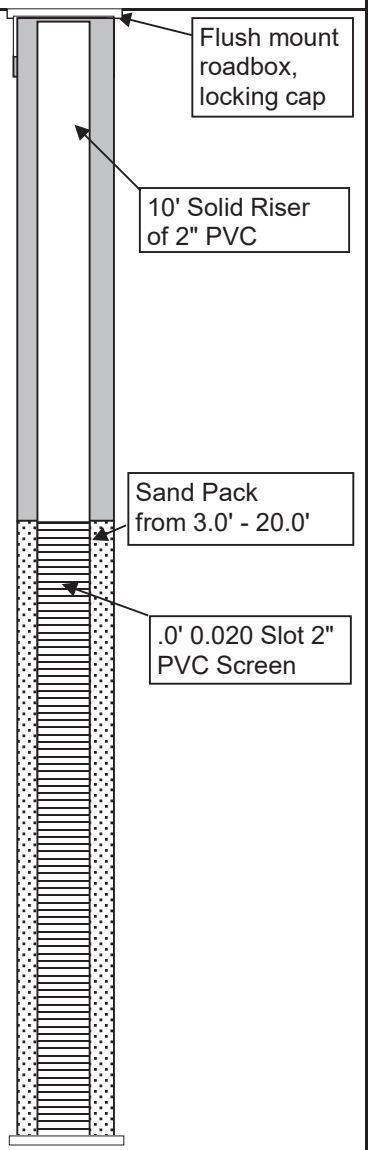
WELL LOCATION SKETCH (N.T.S)

Project:	Proposed Biomanufacturing Campus	**Whitestone Job #:**	GM1714433.000
Location:	305 Belmont Street, Worcester,	**Well Permit #:**	01/00/00
Geologist:	0	**Drilling Co.:**	Soil Ex
Driller/Helper:	JL	**Drill Rig:**	Mobile B-57
Drilling Method:	HSA / SPT	**Type of Bit:**	Hollow Stem
Sampler Type:	0		

G.W. Encountered:	15.0	**G.W. Stabilized:**	0	**Well Depth:**	22'	**Solid Riser/Casing:**	0.0' - 10.0'
Depth to Rim:	NA	**Borehole Diameter:**	0"	**Well Diameter:**	2"	**Screen Interval/Screen Type:**	10.0' - 22.0' / 0.020 Slot
						Grout: N/A	**Sand Pack/Open Borehole:** 3.0 - 20.0'

DEPTH (FT.)	SAMPLE ID AND DEPTH	PID/FID/OUA (METER UNITS)	BLOWS/6.0	RECOVERY (INCHES)	SOIL TYPE	SOIL/GEOLOGICAL DESCRIPTION
1–25						Brown, Medium to Fine Sand, Some Silt, Trace Gravel
						Monitor Well MW-2 Completed to 22.0 fbgs

WELL CONSTRUCTION DIAGRAM (N.T.S)



WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-14

Page 1 of 1

Project:	Proposed Biomanufacturing Campus	**WAI Project No.:**	GM1714433.000
Location:	305 Belmont Street, Worcester, Worcester County, Massachussetts	**Client:**	Worcester Business Develop. Corp.

Surface Elevation:	± NS feet above msl	**Date Started:**	4/19/2017	**Water Depth (feet bgs) | Elevation (feet msl)**	**Cave-In Depth (feet bgs) | Elevation (feet msl)**
Termination Depth:	14.0 feet bgs	**Date Completed:**	4/19/2017		
Proposed Location:	Building E + F	**Logged By:**	JL	**During:** -- | --	
Drill / Test Method:	HSA / SPT	**Contractor:**	GQ	**At Completion:** -- | --	**At Completion:** -- | --
		Equipment:	Acker ADII	**24 Hours:** -- | --	**24 Hours:** -- | --

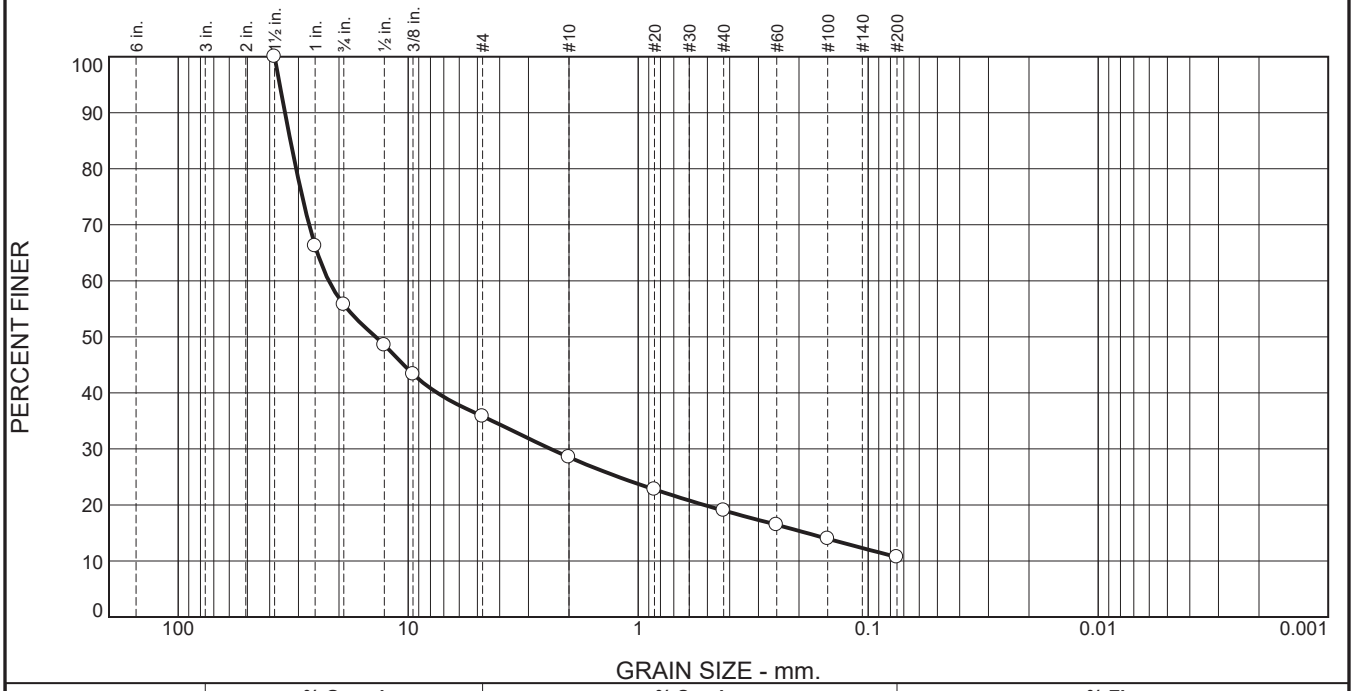
SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0	TS		6" Topsoil	
0 - 2	S-1		1 - 2 - 6 - 8	20	8		FILL		Brown, Loose, Medium to Fine Sand, Some Silt, Trace Gravel (FILL)	
2 - 4	S-2		14 - 14 - 19 - 21	24	33				Brown, Dense, Medium to Fine Sand, Some Silt, Trace Gravel (SM)	
						5.0				
5 - 7	S-3		60 - 17 - 30 - 30	20	47				As Above (SM)	
7 - 9	S-4		21 - 30 - 30 - 30	16	60		GLACIAL TILL		As Above, Very Dense, Little Gravel (SM)	
						10.0				
10 - 12	S-5		16 - 18 - 24 - 27	20	42				As above, Dense (SM)	
						15.0			Boring Log B-14 Auger Refusal on Probable Bedrock, Exploration Terminated at a Depth of 14.0 Feet Below Ground Surface.	
						20.0				
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

APPENDIX B
Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	44.2	20.0	7.3	9.5	8.3	10.7	

TEST RESULTS (D6913)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1	66.2		
.75	55.8		
0.5	48.5		
.375	43.3		
#4	35.8		
#10	28.5		
#20	22.8		
#40	19.0		
#60	16.5		
#100	14.0		
#200	10.7		

* (no specification provided)

Material Description

Light Red-Brown poorly graded gravel with silt and sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GP-GM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 34.3111 D_{85}= 32.4987 D_{60}= 22.1454
D_{50}= 13.8553 D_{30}= 2.4009 D_{15}= 0.1853
D_{10}= C_u= C_c=

Remarks

Date Received: 05.02.17 **Date Tested:** 05.05.17

Tested By: JL

Checked By: Matthew Colman, P.E.

Title: Laboratory Manager

Source of Sample: Borings **Depth:** 5-7' **Date Sampled:**

Sample Number: B-8 / S-8

Thielsch Engineering Inc.

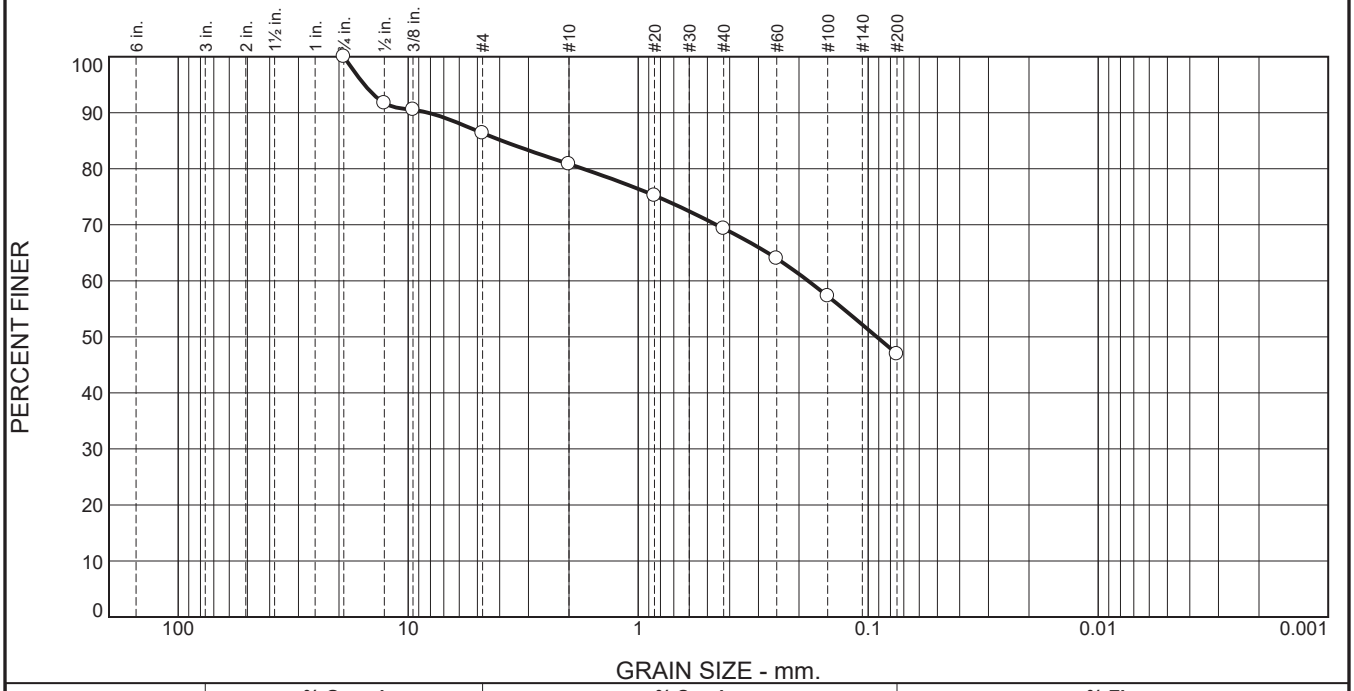
Cranston, RI

Client: Whitestone Associates

Project: WBDC
Worcester, MA

Project No: GM1714433.00 **Figure** 17-S-586

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	13.6	5.6	11.5	22.4	46.9	

TEST RESULTS (D6913)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
0.5	91.7		
.375	90.5		
#4	86.4		
#10	80.8		
#20	75.2		
#40	69.3		
#60	64.0		
#100	57.3		
#200	46.9		

* (no specification provided)

Material Description

Grey silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 8.1812 D_{85}= 3.9070 D_{60}= 0.1825
D_{50}= 0.0918 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 05.02.17 **Date Tested:** 05.05.17

Tested By: JL

Checked By: Matthew Colman, P.E.

Title: Laboratory Manager

Source of Sample: Borings **Depth:** 7-9' **Date Sampled:**

Sample Number: B-13 / S-4

Thielsch Engineering Inc.

Cranston, RI

Client: Whitestone Associates

Project: WBDC
Worcester, MA

Project No: GM1714433.00 **Figure** 17-S-587

WHITESTONE ASSOCIATES, INC.

APPENDIX C
Supplemental Information (USCS, Terms and Symbols)

WHITESTONE ASSOCIATES, INC.
Environmental & Geotechnical Engineers & Consultants

352 TURNPIKE ROAD
SUITE 320
SOUTHBOROUGH, MA 01772
508.485.0755
www.whitestoneassoc.com

UNIFIED SOIL CLASSIFICATION SYSTEM

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMITS LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMITS GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS FOR SAMPLES WITH 5% TO 12% FINES

GRADATION*

% FINER BY WEIGHT

TRACE..... 1% TO 10%
LITTLE..... 10% TO 20%
SOME..... 20% TO 35%
AND..... 35% TO 50%

COMPACTNESS*
Sand and/or Gravel

RELATIVE DENSITY

LOOSE. ..... 0% TO 40%
MEDIUM DENSE.... 40% TO 70%
DENSE..... 70% TO 90%
VERY DENSE..... 90% TO 100%

CONSISTENCY*
Clay and/or Silt

RANGE OF SHEARING STRENGTH IN POUNDS PER SQUARE FOOT

VERY SOFT..... LESS THAN 250
SOFT..... ..... 250 TO 500
MEDIUM..... 500 TO 1000
STIFF..... 1000 TO 2000
VERY STIFF..... 2000 TO 4000
HARD..... GREATER THAN 4000

** VALUES ARE FROM LABORATORY OR FIELD TEST DATA, WHERE APPLICABLE. WHEN NO TESTING WAS PERFORMED, VALUES ARE ESTIMATED.*

L:\Geotechnical Forms and References\Reports\USCSTRMSSYM MA.docx

WHITESTONE ASSOCIATES, INC.
Environmental & Geotechnical Engineers & Consultants

352 TURNPIKE ROAD
SUITE 320
SOUTHBOROUGH, MA 01772
508.485.0755
www.whitestoneassoc.com

GEOTECHNICAL TERMS AND SYMBOLS

SAMPLE IDENTIFICATION

The Unified Soil Classification System is used to identify the soil unless otherwise noted.

SOIL PROPERTY SYMBOLS

N: Standard Penetration Value: Blows per ft. of a 140 lb. hammer falling 30" on a 2" O.D. split-spoon.
Qu: Unconfined compressive strength, TSF.
Qp: Penetrometer value, unconfined compressive strength, TSF.
Mc: Moisture content, %.
LL: Liquid limit, %.
PI: Plasticity index, %.
δd: Natural dry density, PCF.
▼: Apparent groundwater level at time noted after completion of boring.

DRILLING AND SAMPLING SYMBOLS

NE: Not Encountered (Groundwater was not encountered).
SS: Split-Spoon - 1 ⅜" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
AU: Auger Sample.
OB: Diamond Bit.
CB: Carbide Bit
WS: Washed Sample.

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

Term (Non-Cohesive Soils)	Standard Penetration Resistance
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Term (Cohesive Soils)	Qu (TSF)
Very Soft	0 - 0.25
Soft	0.25 - 0.50
Firm (Medium)	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00+

PARTICLE SIZE

Boulders	8 in.+	Coarse Sand	5mm-0.6mm	Silt	0.074mm-0.005mm
Cobbles	8 in.-3 in.	Medium Sand	0.6mm-0.2mm	Clay	-0.005mm
Gravel	3 in.-5mm	Fine Sand	0.2mm-0.074mm		

Other Office Locations:

▪ WARREN, NJ 908.668.7777
▪ CHALFONT, PA 215.712.2700
▪ STERLING, VA 703.464.5858
▪ EVERGREEN, CO 303.670.6905

WHITESTONE
ASSOCIATES, INC.
Environmental & Geotechnical Engineers & Consultants
Celebrating 25 Years 1994 – 2019

352 TURNPIKE ROAD
SUITE 320
SOUTHBOROUGH, MA 01772
508.485.0755
whitestoneassoc.com

September 13, 2019

via email

BOHLER ENGINEERING MA, LLC
352 Turnpike Road
Southborough, Massachusetts 01772

Attention: Nathaniel E. Mahonen, P.E.
Assistant Project Manager

Regarding: SUPPLEMENTAL GEOTECHNICAL INVESTIGATION
UTILITY ALIGNMENT BEDROCK ELEVATIONS
PROPOSED BIOMANUFACTURING CAMPUS
305 BELMONT STREET
WORCESTER, WORCESTER COUNTY, MASSACHUSETTS
WHITESTONE PROJECT NO.: GM1916604.000

Dear Mr. Mahonen:

Whitestone Associates, Inc. (Whitestone) is pleased to submit this rock probe summary letter in support of the proposed utility alignment at the site referenced above. Whitestone previously completed a May 19, 2017 *Report of Preliminary Geotechnical Investigation* for the site. During this geotechnical investigation, bedrock was encountered at depths that may affect deeper utility installation. Whitestone was requested to perform supplemental bedrock probes along the proposed utility alignment. Whitestone's supplemental geotechnical services were performed in accordance with our August 19, 2019 proposal.

PROJECT DETAILS

The subject property, located at 305 Belmont Street in Worcester, Worcester County, Massachusetts, currently is developed with the former Worcester State Hospital complex, portions of which have been demolished. The proposed redevelopment will include demolition of existing Worcester State Hospital structures and construction of five new buildings with footprints ranging from approximately 6,300 square feet to 122,000 square feet. An existing four-story structure will remain. The proposed construction also will include new pavements and utilities, including approximately 1,000 lineal feet of sewer and water.

FIELD INVESTIGATION

Field exploration was conducted by means of 28 bedrock probes, identified as P-1 through P-28. Test locations were established in the field by Whitestone and client representatives using normal taping procedures and estimated right angles. The bedrock probes were advanced with a FlexiROC T30 rock drill to termination depths that ranged from approximately four feet below ground surface (fbgs) to 20 fbgs.

Probes were typically advanced about five feet beyond the apparent bedrock surface, where encountered, in an attempt to delineate between boulders and bedrock. Bedrock probe locations and estimated bedrock surface elevations are shown on the *Test Location Plan,* included as Figure 1. Estimated bedrock depths and elevations are tabulated below.

ESTIMATED BEDROCK DEPTHS/ELEVATIONS							
Probe No.	**Bedrock Depth (fbgs)**	**Ground Elev. (ft)**	**Bedrock Surface Elev. (ft)**	**Probe No.**	**Bedrock Depth (fbgs)**	**Ground Elev. (ft)**	**Bedrock Surface Elev. (ft)**
P-1	20+	580	below 560	P-15	15+	606	below 591
P-2	20+	578	below 558	P-16	15+	609	below 594
P-3	15+	578	below 563	P-17	12	614	602
P-4	15+	580	below 565	P-18	12	616	604
P-5	15+	587	below 572	P-19	4	619	615
P-6	15+	589	below 574	P-20	8	624	616
P-7	15+	589	below 574	P-21	7	626	619
P-8	15+	580	below 565	P-22	14	626	612
P-9	20+	590	below 570	P-23	15+	624	below 609
P-10	15+	592	below 577	P-24	20+	587	below 567
P-11	15+	595	below 580	P-25	20+	585	below 565
P-12	15+	597	below 582	P-26	15+	582	below 567
P-13	15+	599	below 584	P-27	15+	579	below 564
P-14	15+	603	below 588	P-28	15+	576	below 561

Whitestone appreciates being of continued service to Bohler Engineering MA, LLC and Worcester Business Development Corporation. Please do not hesitate to contact us at with any questions regarding this summary letter.

Sincerely,

WHITESTONE ASSOCIATES, INC.

Jason R. Landry
Project Manager

Ryan R. Roy, P.E.
Principal, New England Region

JRL/br N:\Job Folders\2019\1916604GM\Reports and Submittals\GM1916604 SuppGI Rock Probes Worcester MA.docx
Enclosures

WHITESTONE
ASSOCIATES, INC.

FIGURE 1
Test Location Plan

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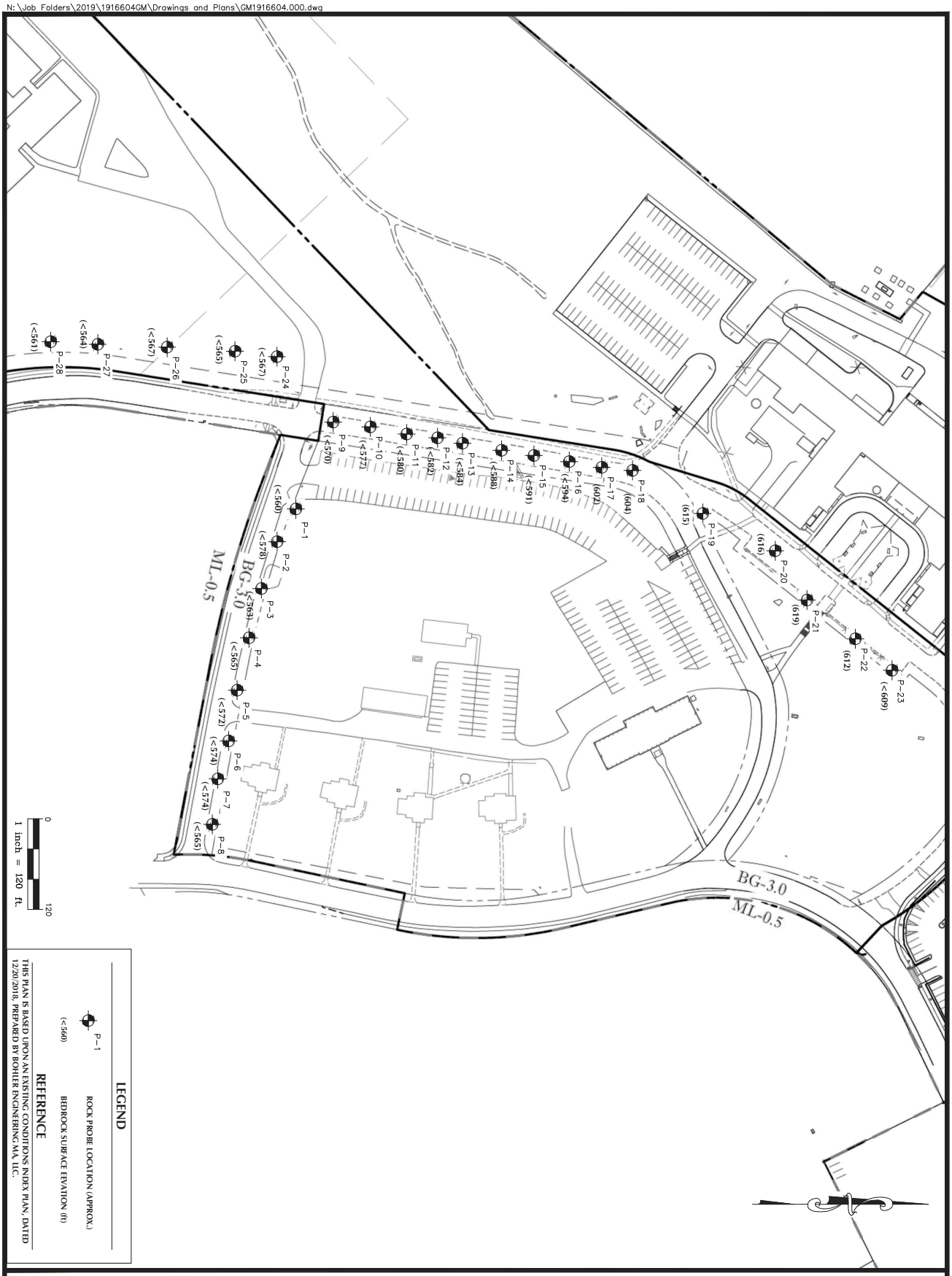


LEGEND

P-1 — ROCK PROBE LOCATION (APPROX.)

(<560) — BEDROCK SURFACE EEVATION (ft)

REFERENCE

THIS PLAN IS BASED UPON AN EXISTING CONDITIONS INDEX PLAN, DATED 12/20/2018, PREPARED BY BOHLER ENGINEERING MA, LLC.

PROJECT #: GM1916604.000
DESIGNED BY: MR
DATE: 9/13/19
SCALE: 1" = 120'
FIELD BK.:
PROJ. MGR.: RR
FIG./BK.: 1

DRAWING TITLE: **TEST LOCATION PLAN**

CLIENT: **BOHLER ENGINEERING MA, LLC**

PROJECT:
UTILITY ALIGNMENT BEDROCK ELEVATIONS
305 BELMONT STREET
WORCESTER, WORCESTER COUNTY, MASSACHUSETTS

WHITESTONE ASSOCIATES, INC.
Environmental & Geotechnical Engineers & Consultants
352 TURNPIKE ROAD, SUITE 320, SOUTHBOROUGH, MA 01772
508.485.0755 WHITESTONEASSOC.COM

Conference: Pre Bid X
Pre Construction ___

FOR: M21-10 HOSPITAL DRIVE PHASE II DATE: 11/9/2021

ATTENDANCE SHEET

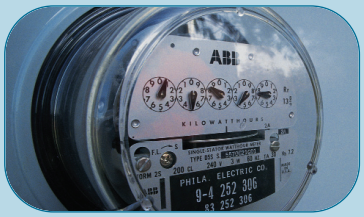
NAME	COMPANY	TEL. #	EMAIL
CHRIS GAGNE	DPW&P	(508)799-1454	GAGNRC@WORCESTERMA.GOV
Adrian Hubley	NGrid	508-713-2904	adrian.hubley@nationalgrid.com
Emilio Agustin	NGrid	"	"
Julie Holstrom	WBDC	508.755.5734	holstrom@worcesterbdc.com
Jim Murray	E.T.+L. Corp.	978-877-4353	JMurray@ETLcorp.com
Tom O'Rourke	Everssource	339 987 7042	Thomas.O'Rourke@eversource.com
Bill Carkin	WBDC	508-755-5734	Carkin@worcesterbdc.com
Alex Goncalves	Caracas Construction Corp	413-547-6200	Estimating@caracascorp.com
Greg Oswitt	J.H. Lynch & Sons, Inc.	508-756-6244	goswitt@jhlynch.com
Rob Farah	RM Pacella Inc	508-869-4100	rfarah@rmpacella.com
Michael E Daigneault	Worc DPW&P/water	508-799-1492	daigneaultm@worcesterma.gov
Vahram Poladkhanyan	N. Grid	508-468-9514	Vahram.Poladkhanyan@nationalgrid.com

Supplement to

Specifications for Electrical Installations

Underground Commercial Distribution (UCD) Installation and Responsibility Guide

Electric System Bulletin No. 759B
July 2010
(Supersedes all previous versions of ESB 759)



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Supplement to

Specifications for Electrical Installations

Underground Commercial Distribution (UCD) Installation and Responsibility Guide

Electric System Bulletin No. 759B
July 2010
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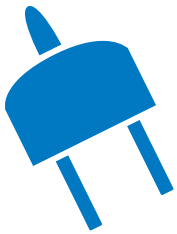

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URD Specifications and Installation Guide Acknowledgement (Job Spec/Signoff Forms)

The requirements and specifications outlined in this guide book must be strictly followed. Any requirements not adhered to can pose safety problems, can be detrimental to the installed system and must be corrected before final acceptance. The customer will bear full cost to make corrections to sub-standard installations.

Customer is responsible to provide enough lead time for the company to design job, provide inspections and install company equipment where applicable.

Typical lead times are shown below.

	Lead-Time	**Notes**
Design and Layout	Eight weeks	Company receives all required plans, load data and easement information
Pad Inspection NE	One day	Company inspector
Trench Inspection	3 days	Company inspector
Company Installation	4 weeks	After all inspections are approved and permits/easements are procured.
NOTE: The above times are estimates only.		

Project Title_____

Location_____

Owner/Developer_____

Customer's Representative _____ Date_____

Company Representative_____ Date_____

Specifications Issued_____ Date_____

Company's Copy

UCD Specifications and Installation Guide Acknowledgement

The requirements and specifications outlined in this guide book must be strictly followed. Any requirements not adhered to can pose safety problems, can be detrimental to the installed system and must be corrected before final acceptance. The customer will bear full cost to make corrections to sub-standard installations.

Customer is responsible to provide enough lead time for the company to design job, provide inspections and install company equipment where applicable.

Typical lead times are shown below Design and Layout.

	Lead-Time	**Notes**
Design and Layout	Eight weeks	Company receives all required plans, load data, and easement information
Pad Inspection NE	One day	Company inspector
Trench Inspection	Three days	Company inspector
Company Installation)	4 weeks	After all inspections are approved and permits/easements are procured.
NOTE: The above times are estimates only.		

Project Title_____

Location_____

Owner/Developer_____

Customer's Representative _____ Date_____

Company Representative_____ Date_____

Specifications Issued_____ Date_____

Customer's Copy

1.0 Scope

The purpose of this specification is to define, interpret and clarify the scope of work and material dealing with services to padmounted transformers and is a Supplement to Electric SYstem Bulletin (ESB) 750). This specification does not cover any primary metering.

It is important that the Specifications for Electrical Installations book (ESB 750) be obtained and referred to in conjunction with this supplement for these installations. Any reference in this specification to the Company shall mean the nationalgrid Company. Any reference to the Customer shall mean the Contractor, Developer or property owner.

2.0 General Requirements

All electrical wiring to be connected to the *Company* equipment shall be installed in accordance with one or all of the following:

- Local Municipal Inspection Authority
- State's Electrical Code
- National Electrical Code
- National Electrical Safety Code
- Applicable Distribution Construction Standards of the *Company*
- National Grid's Specifications for Electrical Installations

There shall be no attempt to deviate from either the Distribution Standards of the company or the *Company* construction plan without the approval of the *Company*. Any specifications noted shall supersede the Specifications for Electrical Installations booklet unless otherwise approved by the *Company*.

Often a pre-construction meeting is helpful to all parties to ensure timely completion of the project. The *Company* Business Service Representative will make the necessary arrangements for a pre-construction meeting, or a meeting to discuss changes. *Company* representatives will be available to discuss construction problems when requested or during a field visit

References:

- ESB 750 - Specifications for Electrical Installations
- ESB 754 - Outdoor Padmounted or Vault Enclosed Three Phase Transformer

All ESB's are available at **http://www.nationalgridus.com/electricalspecifications**

The Customer shall be responsible to have all electrical and physical design documents prepared and updated by a design professional, in accordance with Section 1.7 of ESB 750 for the trenching, conduit, transformer pad, and handhole installations.

3.0 Type of Service

Electric service shall be three phase, four wire, 208Y/120 volts or 480Y/277 volt supplied from a padmount transformer to be located on the Customer's premises. The primary electrical service to the padmounted transformer will be supplied from a pole or cable system owned by the Company, except in New Hampshire. In New Hampshire, the primary service to the transformer shall be customer owned.

4.0 Plans

When municipal approval is required, the *Company* shall receive final town approved development plans on a scale not less than one-inch equal to one hundred feet prior to engineering construction plans. The property site plan shall show all proposed and existing utilities, i.e. water, gas, sewer, cable television, telephone, etc.

Direct Burial Systems in general: the *Company* specifies an arrangement whereby the *Company's* power cables may run parallel with communication and other power cables, but not parallel with other utilities e.g. water, gas, sewer. These utilities shall be in a separate trench. The other utilities must maintain clearances as outlined in the NESC or by mutual agreement. Nationalgrid gas is permitted in the same trench with the following requirements: gas shall be at a minimum depth of 18" and shall maintain a minimum separation of 12" between all other utilities.

Conduit Systems in general: the *Company* requires a spare conduit for all *Company* owned duct systems, as shown in *Company* plans. The *Company* duct system when required must be in **a separate concrete envelope from all other utilities**. Other utilities must maintain clearances as outlined in the NESC.

5.0 Permits

In general, all applicable permits necessary to trench and excavate, including street openings and wetland permits, shall be obtained by the *Customer* and made available upon request if necessary. The *Customer* shall be responsible for including these padmount and conduit/trench specifications with the wetlands application for developments located in or near wetlands. A copy of the wetlands permit may be requested by the *Company* prior to acceptance of the conduit/trench system by the *Company*.

The excavator doing the excavation shall obtain the required DIGSAFE permits before any excavation may take place in a public way. The *Customer/Company* doing the excavation is urged to obtain copies of the applicable statute and become familiar with its requirements. Similarly, the Customer/ Company shall determine if the municipality in which the excavation is to be done requires that water, sewer or other utility, municipal or private, be contacted separately.

The *Customer* shall certify to the *Company* that areas in which the *Company* is to perform installation or maintenance work is free of preexisting contamination by hazardous wastes or materials and to indemnify the *Company* for any claims, costs, expensed, suits, demands, citations, fines or damages of any kind arising from the presence of any such contamination.

6.0 Easements

As a condition of service, the Applicant or *Customer* must provide the *Company* with an easement(s), properly executed by all owners of record drafted by the *Company*, for all Company owned facilities located on private property (to include User or Private Roads (NY) and Private Ways (MA, NH, RI)), whether or not such private property is owned by the *Customer*. The Applicant or *Customer* will provide such easement(s) prior to the start of the *Company's* construction and at no cost to the *Company*. The Applicant or *Customer* shall provide a copy of its mortgage and deed, together with a copy of the survey and/or plan of record, for the Company's use in preparation of the easement(s) as well as any other documents necessary for the Company to prepare such easement(s).

Rights-of-Way, Easements

In UCD, URD, or multiple occupancy building applications, the Customer shall provide the Company with two copies of the approved development map, certified as final by a design professional or licensed land surveyor, which the plan shall have been recorded or filed with the Registry of Deeds. The map shall indicate lot lines, building setback lines, grade lines, sidewalk, roadway, sewer, water, drainage, and

other facilities. The map shall also include the identification and, where appropriate, delineation of sensitive environmental resources including, but not limited to, wetlands, streams, archaeologically sensitive areas, and hazardous waste disposal areas, etc. In addition to this base information, this map shall clearly indicate the easement strips dedicated to the Company and the location of the lots (units) for which electric service is requested. The governmental authority having control over land use shall approve this map. In addition, when electronic maps are used, the Customer must consult the Company for submittal.

Rights-of-way and easements must be cleared of any obstructions at no charge to the Company. The applicant shall grade the right-of-way or easement to within six inches (150 mm) of final grade before the Company commences construction. The applicant must maintain the Company's clearance and grading requirements.

Easement application forms are located on pages 49 and 51.

7.0 Responsibility and Ownership

The division of ownership and responsibility shall be as outlined below by state. Typical installation specifications to reflect installation practices are shown in the back of this guide.

Massachusetts and Rhode Island

The *Company* will:

Supply, install, own and maintain:

primary cable, CT and PT's, Transformer and Meter.

*Note: *company* will not install CT's in CT cabinet.

Check the final torque connections to the transformer's secondary bushings.

Own and maintain:

Primary conduit system (installed by *Customer*).

Secondary cable installed by the customer from transformer to secondary splice box, where required.

The *Customer* will:

Install, own and maintain:

transformer pad, reinforcement and grounding, oil containment where required by the *Company* or local authority, transformer mechanical protection, secondary equipment (including a secondary splice box if required), connect secondary connectors for the transformer, self contained meter box where required by the *Company*.

Supply and install to *Company's* specification:

all primary conduits including concrete encasement, steel riser including 90 degree sweep and bonding clamp with tap, secondary cable from transformer to splice box if required. make up secondary cable ends, including final toque of the secondary cable to the transformer.

Note: The *Customer* will be held accountable for any transformer damage occurring due to improper secondary installation.

New Hampshire

The *Company* will:

Supply, install, own and maintain:

Transformer

CT and PT's and

Meter

* Note: *company* will not install CT's in CT cabinet.

Check the final torque connections to the transformer's secondary bushings.

Own and maintain:

Secondary cable installed by the *customer* from transformer to splice box where required.

The *Customer* will:

Install, own and maintain:

Primary cable and conduit system,

transformer pad, reinforcement and grounding,

oil containment where required by the *Company* or local authority,

transformer mechanical protection, steel riser including 90 degree sweep and bonding clamp with tap.

all secondary equipment (including a secondary splice box if required),

connect secondary connectors for the transformer,

self contained meter box where required by the *Company*.

Supply and install to *Company's* specification:

secondary cable from transformer to splice box if required.

make up secondary cable ends, including final toque of the secondary cable to the transformer.

Note: The *Customer* will be held accountable for any transformer damage occurring due to improper secondary installation.

New York

The *Company* will:

Supply, install, own and maintain:

primary cable,

transformer and

Meter.

Supply and maintain

CT and PT's

Check the final torque connections to the transformer's secondary bushings.

The *Customer* will

Install, own and maintain:

primary conduit and concrete encasement when required,

transformer pad, reinforcement and grounding,

oil containment where required by the *Company* or local authority,

transformer mechanical protection,

all secondary equipment (including a secondary splice box if required),

connect secondary connectors for the transformer,

self contained meter box where required by the *Company*,

steel riser including 90 degree sweep and bonding clamp with tap.

Supply to *Company's* specification when required:

open trench

Install to *Company's* specification when required:

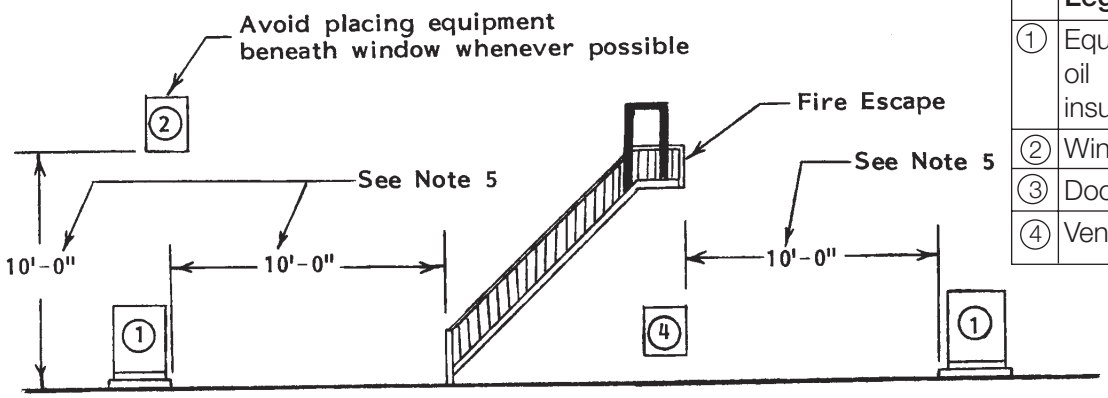
CT's and PT's

make up secondary cable ends, including final toque of the secondary cable to the transformer.

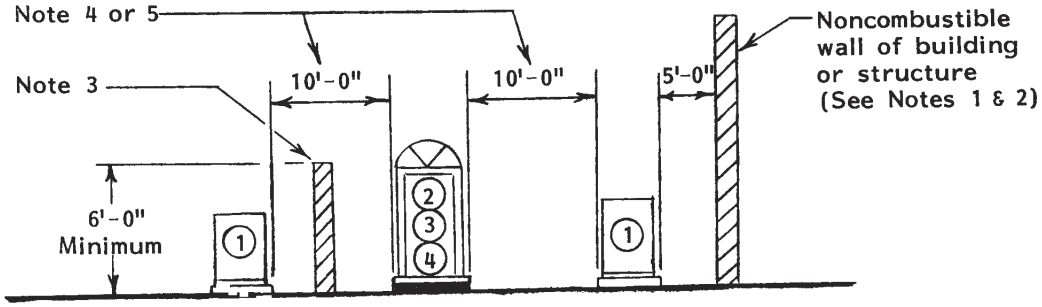
Note: The *Customer* will be held accountable for any transformer damage occurring due to improper secondary installation.

8.0 Transformer Clearance From a Building

Oil insulated equipment shall be located in compliance with the minimum clearances indicated below. For existing buildings, the transformer shall not block access to existing building systems, such as wall mounted fire sprinkler systems. The building owner's and/or tenants fire insurance carrier or local inspection authority may restrict the proximity of the equipment to doors, windows or combustible materials. It is the customer/developer's responsibility to determine the acceptability of the proposed location of the equipment.



	Legend
①	Equipment, oil insulated
②	Window
③	Door
④	Ventilating Duct



Notes:

1. Noncombustible material is defined as a material that will not ignite, burn, support combustion or release flammable vapors, when subjected to fire or heat, or as described by the latest edition of the NFPA-220.
2. No portion of a building or building structure shall overhang any part of the pad-mounted equipment.
3. In cases where required distances cannot be met, a noncombustible barrier, 6 foot minimum height, shall be constructed. This barrier shall be designed to provide adequate fire protection to the existing structure. A design for this structure shall be prepared and sealed by the customer's Professional Engineer or Registered Architect and shall further be approved by the local authority having jurisdiction of building code enforcement.
4. For exits from a public assembly room, such as an auditorium, a 10 foot minimum clearance should be increased to 25 feet, unless there is a barrier.
5. This requirement may vary between individual states. Refer to the building code regulations for the state involved.

9.0 Transformer Clearance From Objects

Clearances from objects:

A. An area measuring 10 feet from any point of the transformer pad shall be kept free of all:

- buried water lines, storm drainage lines, gas lines, other electric lines;
- underground fuel storage tanks; and
- above grade fire hydrants, cell towers, self contained diesel or diesel byproduct fueled generators, and outdoor enclosed generators.

Note: The 10 ft. clearance may be reduced with a noncombustible barrier (see Note 3) and shall not be less than five (5) feet from the edge of the transformer pad. The *Customer* or their authorized representative shall obtain this clearance reduction approval from the *Company* and the local AHJ(Authority Having Jurisdiction), as necessary, prior to the noncombustible barrier installation.

B. An area measuring 25 feet from any point of the transformer pad shall be kept free of all:

- exposed water lines, gas piping, sewer lines;
- open conductor electric lines; and
- above grade gas meters or regulator vents, fuel storage tanks or dispensing units, and non-enclosed gasoline/ propane / LP or LNG gas fueled generators.
- chemical storage silos / tanks.

Note: The 25 ft. clearance may be reduced to 10 ft. with a noncombustible barrier (see Note 3) and shall not be less than five (5) feet from the edge of the transformer pad. The *Customer* or their authorized representative shall obtain this clearance reduction approval from the *Company* and the local AHJ(Authority Having Jurisdiction), as necessary, prior to the noncombustible barrier installation.

10.0 Transformer Accessibility

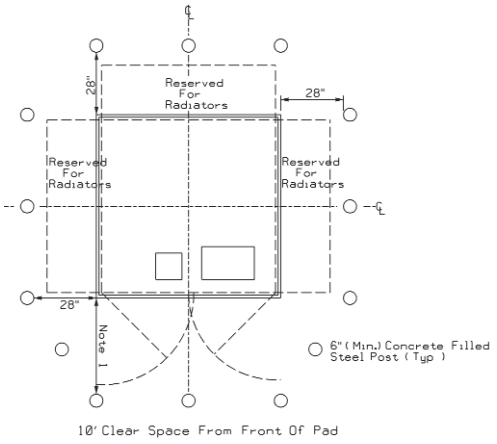
Equipment shall be located within 10 feet of a way open to vehicular traffic and a minimum distance from any structure such as poles, fences, etc. as a means to permit accessibility for installation and maintenance. A minimum of 10 feet of clear space shall be maintained in front of the equipment doors to permit installation and removal of separable connectors and fuses with shotgun stick.

11.0 Transformer Mechanical Protection/Bollards

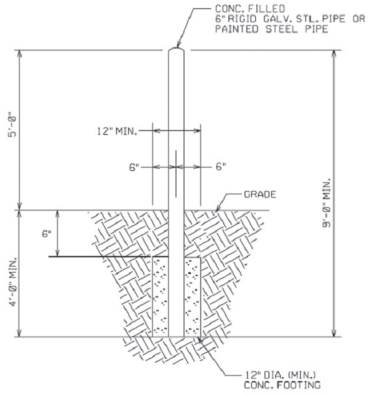
Whenever possible, equipment should be located so it is not subject to vehicular damage. If this is not feasible, adequate guards such as concrete filled pipes (Bollards) shall be placed to protect the equipment.

Bollards shall consist of 6 inch minimum diameter hot dip galvanized or painted steel pipes filled with concrete. When Bollards can not be painted at the time of installation, painted covers shall be installed. Page 56 shows manufacturer. Bollards are to be 5 feet above the ground and a minimum of 4 feet below the ground. Bollards to be set in a concrete footing as shown in detail below. Concrete is to be crowned on top of all bollards. Bollards shall be installed with due care to avoid interfering with ground grid and conduits. Refer to Pages 37 thru 40 for Transformer Pad dimensions. For switchgear locations, see pages 34 and 35.

The number, type (galvanized or steel) and locations of bollards shall be determined by Distribution Design/Planning, taking into account proximity to traffic and to buildings as well as other barriers to traffic. Other factors such as salt spray and fertilizers may impact type of bollard required. Suggested bollard locations and dimensions are shown below. The location of bollards shall not impede a door opening of 100 degrees.



10' Clear Space From Front Of Pad



TYPICAL BOLLARD DETAIL

Blow up drawing detailing this is located on page 44

Bollards Required	●
Bollards Not Required	Ⓧ

Picture of Bollard cover, use for when Bollards can not be painted.

Notes:

1. *Six foot minimum clearance from front of pad.*
2. *Distribution Design/Planning shall designate the number and location of Bollards by marking the Bollards of this drawing as follows:*
3. *Bollards shall be supported with a 12" minimum diameter concrete footing 6" below grade to base of the bollard.*
4. *For installations around oil containment curbs, install bollards six feet minimum on all applicable sides.*

12.0 Transformer pad

The *Customer* shall provide and install a concrete transformer foundation in accordance with the *Company* standards. Precast concrete transformer foundations built to *Company* standards are available from a variety of vendors listed on page 53. Spec sheets of the different size pads are shown on pages 37 thru 40.

Cast in place pads shall meet the following specifications. Concrete shall be a Mix M-4 detailed specifications are on pages 45 thru 48. Reinforcing in pad shall be # 5 grade 60 bars and shall conform to ASTM STANDARD A 615 of latest date. Reinforcing rods are to be located in center of the slab, with a minimum of 2 inches of clearance from face of concrete. All transformer pads must have and adequate base of 2 inches of sand and 12 inches of gravel as shown on pages 37 thru 40. The gravel shall be thoroughly compacted and the sand thoroughly wetted immediately before placing the concrete.

Massachusetts, New Hampshire and Rhode Island

The location of the concrete transformer pad, on the *Customer* premises, shall be approved by the *Company* in advance of the construction. The *Company* must, with sufficient notification (24 hours minimum) from the *Customer*, inspect the forming and reinforcing of the pad, the sub grade preparation, and the ground grid **prior** to the pouring of concrete. This requirement is critical. Failure to have inspection done may result in the need to remove and rebuild the concrete foundation

New York

The location of the concrete transformer pad, on the *Customer* premises, shall be approved by the *Company* in advance of the construction.

13.0 Transformer Secondary

Size and number of secondary cables shall be in accordance with the NEC and shall be approved by the electrical inspector or AHJ of the town or city involved. Maximum number of secondary cables to be physically connected to the Company's pad-mounted transformer is outlined below:

4 Hole Spades	6 sets 750 kcmil Max.
6 Hole Spades	8 sets 750 kcmil Max.
10 Hole Spades	10 sets 600 kcmil or 8 sets of 750 kcmil

Secondary cable requirements greater than this, will require a separate compartment, handhole, or bus duct.

Secondary cable shall not be installed until pad mount transformer has been set to ensure adequate length of secondary cable and connections.

All acceptable spade terminals are shown in Figures 1, 2 and 3. Minimum terminal thickness is to be ¼ inch, with 9/16 inch holes.

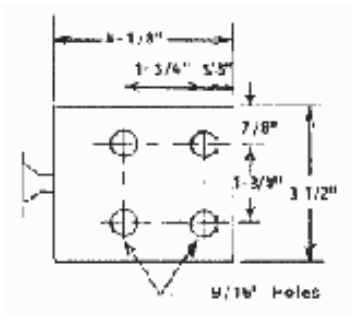


Figure 1
kVA Rating — L.V. Rating
75 – 300 — 208Y/120
75 – 500 — 480Y/277

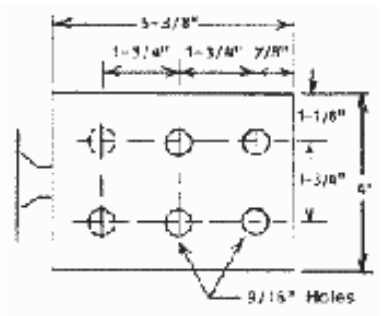


Figure 2
kVA Rating — L.V. Rating
500 — 208Y/120
750 – 1500 — 480Y/277

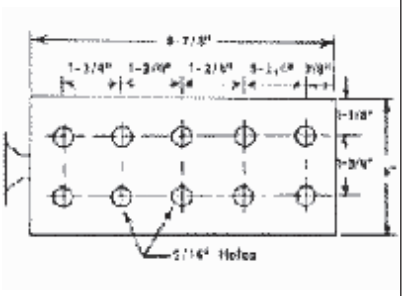


Figure 3
kVA Rating — L.V. Rating
750 – 1000 — 208Y/120
2000 – 2500 — 480Y/277

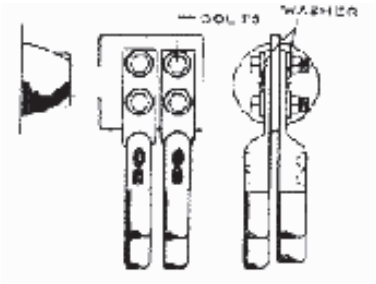


Figure 4
4 Cables – 500 kcmil & Below

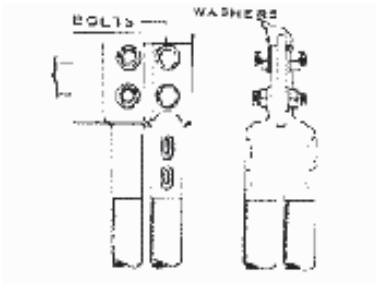


Figure 5

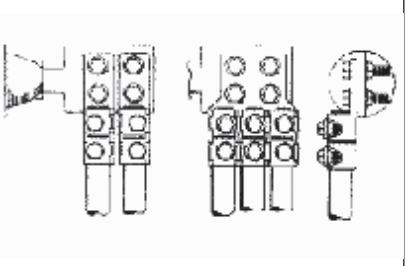


Figure 6

Notes:

1. *Figure 4 – Compression connections will accommodate up to four cables with a maximum individual lug width of 1¼ inch.*
2. *Figure 5 – Compression connections will accommodate two cables with lug greater than 1¾ inch width.*
3. *Figure 6 – Typical example of bolted connections for two, four or six cables to maximum capacity of lug.*
4. *Metering (CT's) mounted inside the padmounted transformer may reduce the number of sets of secondary that can be installed by blocking off some holes on the secondary spade. In some cases the customer may be required to purchase a secondary splice box.*
5. *A list of a few manufacturers that supply the connectors is located on page 56.*

13.1 Transformer Secondary Connections

All connectors and connector fasteners shall be furnished, installed, owned and maintained by the customer/developer. Connectors shall be approved by the *Company* prior to purchase. Final electrical connection to the transformer secondary terminals shall be inspected by the *Company*. The customer/developer shall make all final connections to the spades of the pad-mount transformer to a final torque of 40 foot pounds. Size and number of secondary cables shall be in accordance with the NEC and shall be approved by the electrical inspector or AHJ for the town or city involved.

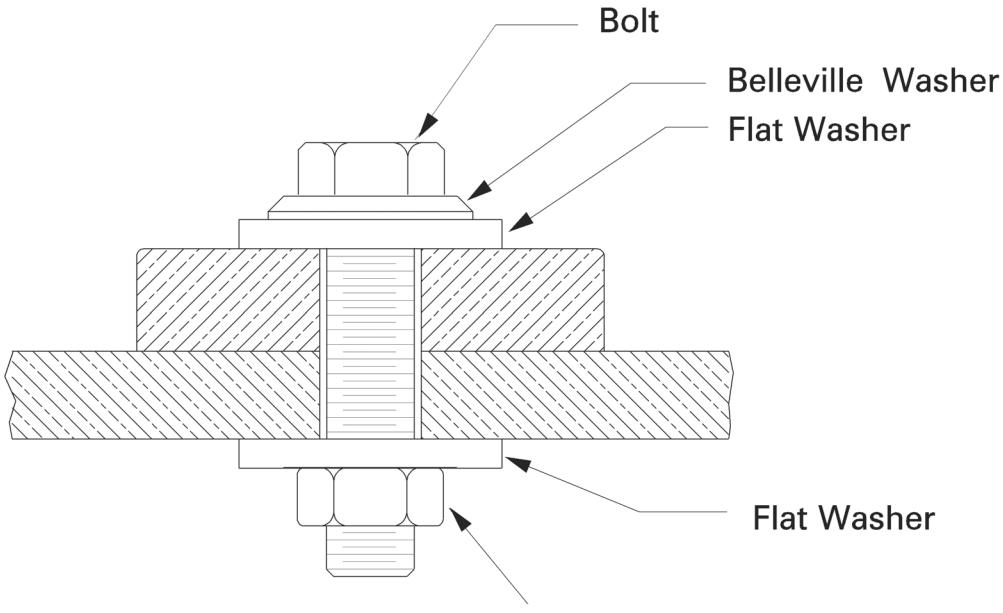
13.2 Secondary Bolt Assembly

The customer/developer shall supply and install aluminum connectors for use with aluminum cable or copper connectors for use with copper cable. Tin plated connectors can also be used as an alternate connector for aluminum and copper connectors. Connector shall be a cable to flat clamp or compression type connector, with a minimum of two holes in the flat pad and two clamping elements or two compressions per cable, and must be approved by *company* representative. Bolts and flat washers shall be grade 304 stainless steel. Belleville washers shall be grade 301 stainless steel. Nuts shall be waxed grade 316 stainless steel.

A. A flat washer is placed between the concave side of the belleville washer and the surface of the member being joined. The belleville is thus captured between the head of the bolt and the large flat washer. The flat washer should have an outside diameter greater than the flattened belleville's such that no overhand results. Select a flat washer that is twice as thick as the belleville for strength. (If not available, stack two or three thinner washers to achieve the same effect).

B. With the belleville washer captured between the flat washer and the bolt head, fit the assembly into its hole. When the washers are fitted in position, there should be no interference with washers of adjacent bolts and no overhang over surface edges.

C. Tighten the nut on the bolt (with a washer of its own) until a sudden, noticeable increase in torque is required to continue. The belleville washer is now flat. It is not necessary to "back off" the nut after tightening to this point.



13.3 Secondary Splice Box

A secondary splice box may be required where the customer's number of secondary cables exceeds the maximum allowed amount on the transformer. Supplying and installing this box is the *customer's* responsibility. The cables from the transformer to this box are to be specified by *company's* representative. The *customer* is responsible to supply and install the cables.

Once the service is energized the *company* will take over ownership of only the secondary cables from the transformer to the secondary splice box.

A list of a few manufacturers that supply the secondary splice box is located on page 56.

14.0 Transformer Sweep Entry

Conduit shall be installed as shown on Pages 37 thru 40 before slab is poured. Use 36 inch radius sweeps, with couplings, nipples and bushings as required. Sweeps for primary cables shall be galvanized steel or schedule 40 PVC. Conduits shall be raised a minimum of 1 inch approximately over the concrete slab. Expanding foam Hilti Inc. CF810 shall be used to fill inside the conduits after the primary/secondary is installed. Ownership of cable will determine who installs the foam on each cable. After pulling tape is in, install the expanding foam in any spare/empty conduits. Place a rag into empty conduits prior to the foam as a support for the foam while curing takes place.

After the concrete pad is cured, the remainder of the conduit primary and secondary openings through pad will be sealed with grout. Before sealing steel sweeps, the sweeps must have a bond clamp attached with a #4 Cu tap to connect to the ground grid. Fill the conduit primary and secondary openings with sand (no aggregate) to a grade of approximately 2 inches below the top of the concrete pad. Place a layer of concrete grout (no aggregate) 1 to 2 inches thick on top of the sand layer to seal the conduit entrance. Do not cover the conduit ground clamps with grout. The expanding foam may be used as an alternate for filling in the opening with sand and concrete grout. Ownership of conduits and pad will determine who seals openings. See page 62 for further details in *company* bulletin *09-09 Three Phase Pad-mounted Transformer Sealing*.

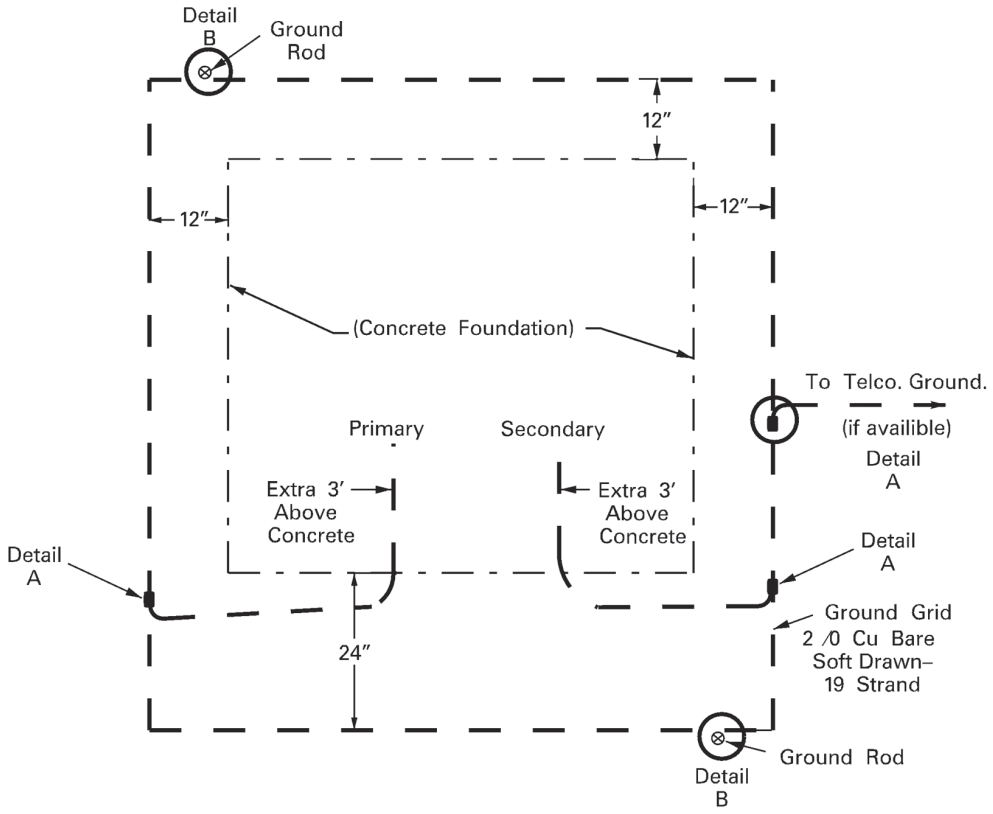
Expanding Foam
CF810 available at
Hilti Inc. 1-800-879-8000
Stuart C Irby Co 1-315-453-2970 and 1-315-329-0038

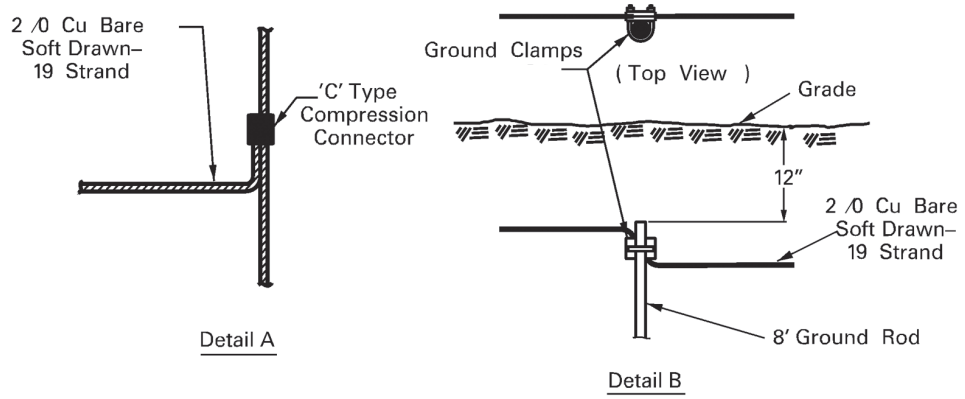
Spare conduits can also be sealed with conduit plugs, see page 54 for a list of manufacturers.

15.0 Transformer Grounding and Bonding

The ground grid shall be 2/0, bare, soft drawn, 19 strand copper wire. The wire shall be installed 12 inches below finished grade and located around the transformer pad as shown on page 17. Bond to all exposed metallic conduit and leave 3 feet of wire above pad for grounding transformer, one lead in the primary conduit window opening and the other lead in the secondary conduit window opening.

Two 5/8 inch diameter, 8 feet long copper weld ground rods and approved connectors shall be installed to 12" below finished grade. Leave the ground rods and grid exposed until inspected the *Company*. The ground grid is to be complete and backfilled prior to energizing the transformer. Connections to ground grid to be made as shown on Details A and B below, except that exothermic welding ("cad weld") shall be an acceptable alternative to a compression connection. Bolted connectors are only acceptable for the ground grid connections to the ground rods. The company will install the ground taps onto the transformer.





16.0 Oil Containment

This is to be used where oil containment is required by local authorities or where otherwise justified. This liner system will significantly slow the migration of oil into the under laying sub grade, allowing additional time to initiate a cleanup response. The polypropylene geotextile allows the passage of water but absorbs small quantities of oil. This design is intended to confine 100% of total transformer oil present, with a 20% reserve margin, for up to 36 hours. If additional confinement is desired consult the company Environmental Engineer. Follow the following installation steps. See Page 19 for construction detail. A precast containment barrier is available as an alternate to casting one in place, check with the precast suppliers on page 53 for availability. Precast curb can be one piece or made up of separate pieces assembled in the field.

Note: *on field assembled pieces. All pieced must be sealed together with rope tar, rubber sealant or equivalent.*

1) Build oil curb, this should be installed with concrete in accordance with Mix #4 per concrete specifications on pages 45 thru 48. Reinforcement to be #4, grade 60 rods minimum, 6 inches on center, bend rods around corners. Curb to be 24" deep with a minimum thickness of 6".
2) Install geotextile liner from top of walls and around bottom of containment area. Areas where conduit crosses overlap liner around conduit and seal with expanding foam.
3) Install 6" of silty sand on top of liner.
4) Install second layer of geotextile liner as noted in step 2.
5) Build up area for transformer pad with 6" of compacted gravel and level.
6) Install ground grid.
7) Set/build transformer pad.
8) Fill in conduit openings with silty sand or expanding foam up to the last two inches of the pad
9) Fill rest of conduit opening with concrete grout or expanding foam.
10) Fill area between slab and curb with 1½ inches uniformly graded crushed rock.

Geo-textile Liner

Generic name is: 16oz polypropylene geotextile also called filter fabric weighing 16oz/sqare yard.

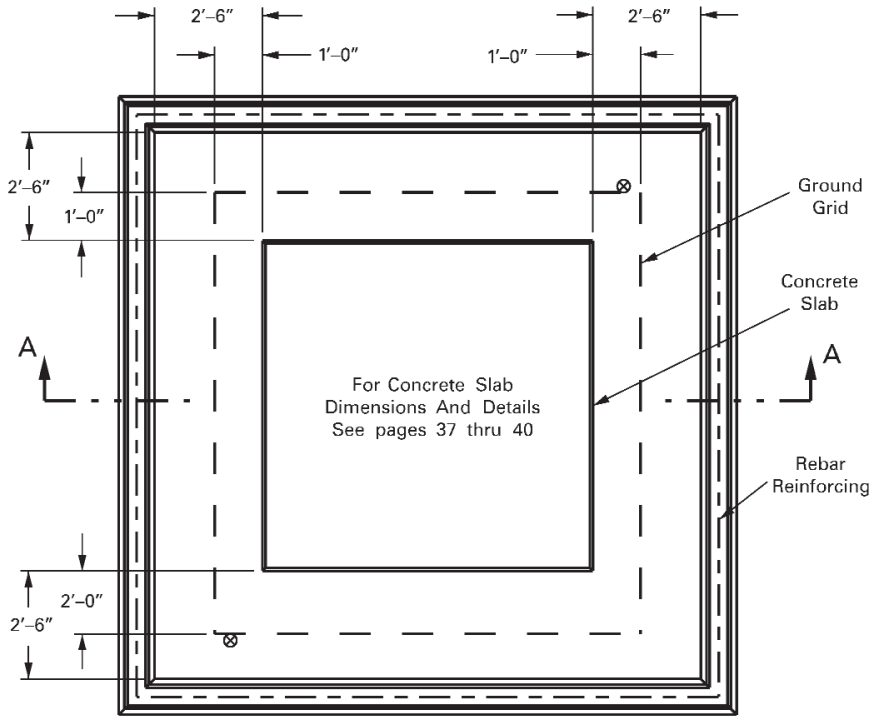
Brand names/Suppliers are:

AME1680 available from American Engineering Fabrics (AEF), Inc.
(Emphasize polypropylene not polyester)
New Bedford, MA@1-617-965-0007/1-800-770-2666 or from
Vellano Bros. Lancaster NY 1-716-684-7222, several other locations in
NY, MA, RI and NH, go to www.vellano.com

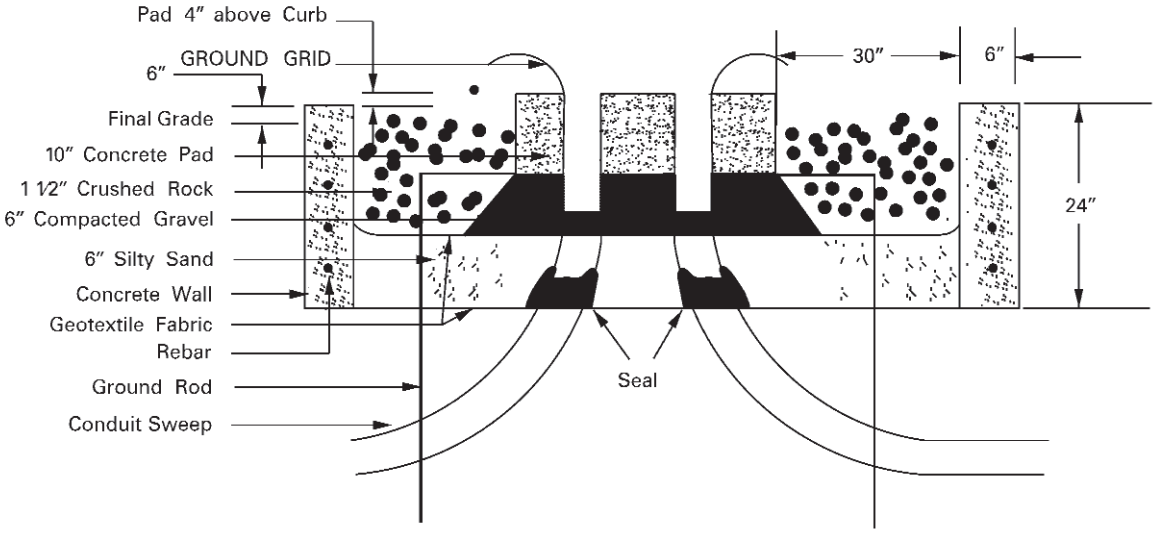
Synthetic Industries ST 160 available from Spartan Mills Inc's, Spartanburg, NC
1-803-576-2353

Carthage Mills FX-160HS / US Construction Fabrics LLC 90 Range Rd, Windham NH 03087
1-603-898-0532

Containment Area Plan View



Typical Cross Section of Containment Pad A-A



17.0 Riser Pole

The *Company* shall designate conduit riser locations on the pole. All primary risers shall be Galvanized Steel, this includes the 90 degree sweep. Per NESC all steel risers must be bonded 6” down from top of riser and the bond must be at least 8’ high from finished grade.

The *Customer* is responsible for providing and installing the bond clamps and the tap. The *Company* will make the bond connection from that riser bond tap to the ground system on the pole. Spare riser sweep shall be bonded also. Riser sweep in Direct Buried applications shall be concrete encased. Approved materials reference is located on page 54.

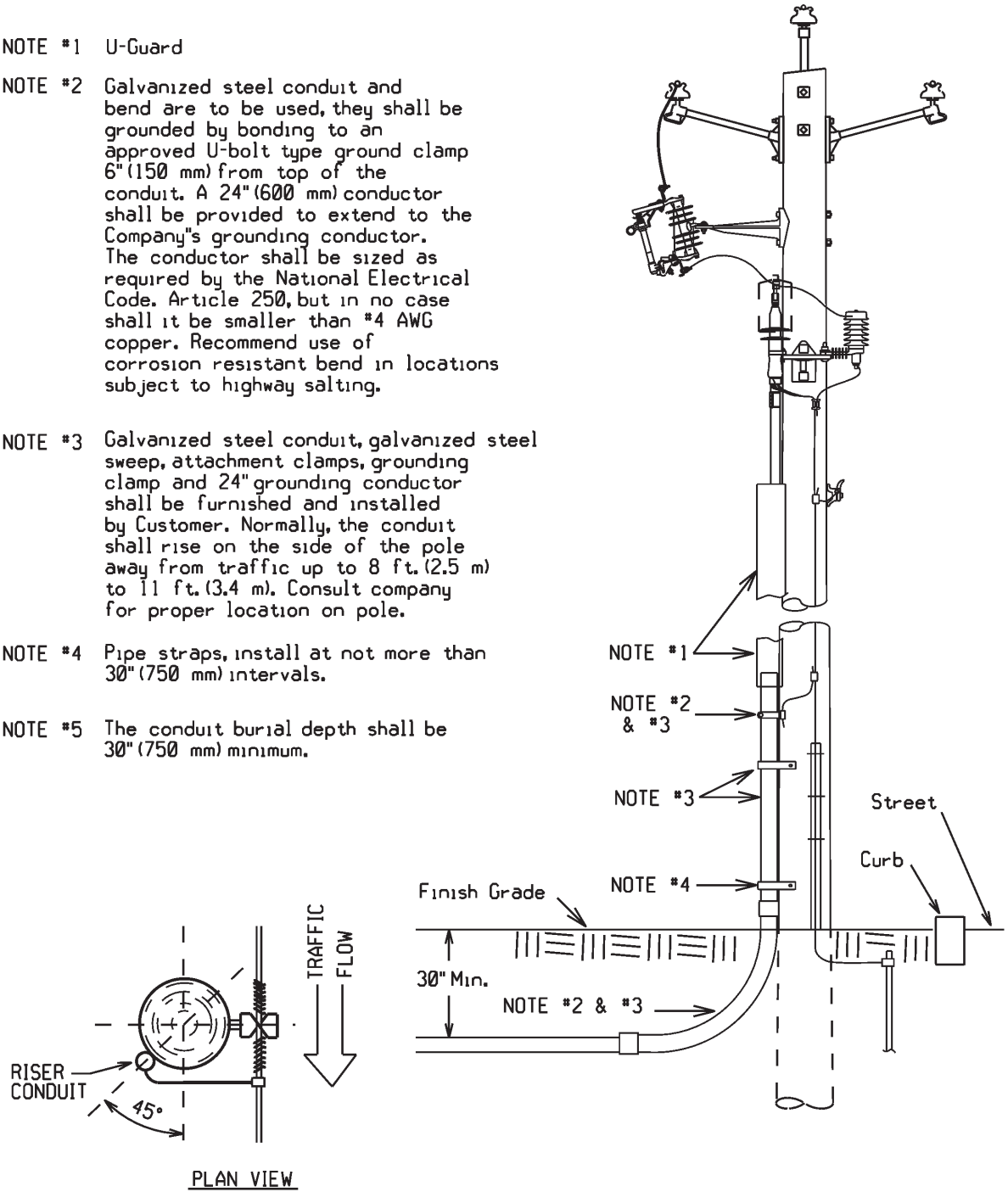
NOTE #1 U-Guard

NOTE #2 Galvanized steel conduit and bend are to be used, they shall be grounded by bonding to an approved U-bolt type ground clamp 6" (150 mm) from top of the conduit. A 24" (600 mm) conductor shall be provided to extend to the Company's grounding conductor. The conductor shall be sized as required by the National Electrical Code. Article 250, but in no case shall it be smaller than #4 AWG copper. Recommend use of corrosion resistant bend in locations subject to highway salting.

NOTE #3 Galvanized steel conduit, galvanized steel sweep, attachment clamps, grounding clamp and 24" grounding conductor shall be furnished and installed by Customer. Normally, the conduit shall rise on the side of the pole away from traffic up to 8 ft. (2.5 m) to 11 ft. (3.4 m). Consult company for proper location on pole.

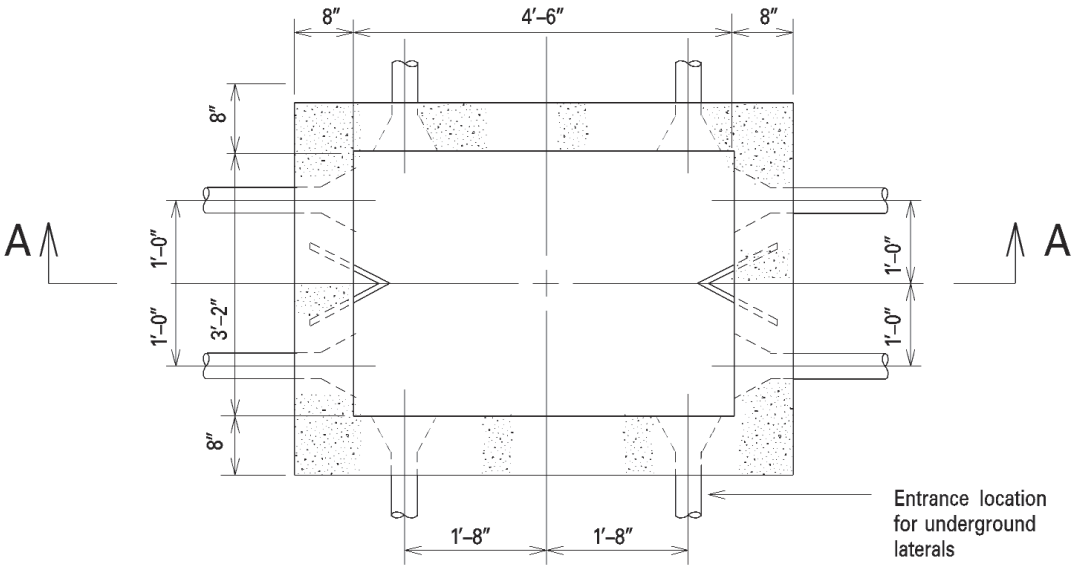
NOTE #4 Pipe straps, install at not more than 30" (750 mm) intervals.

NOTE #5 The conduit burial depth shall be 30" (750 mm) minimum.

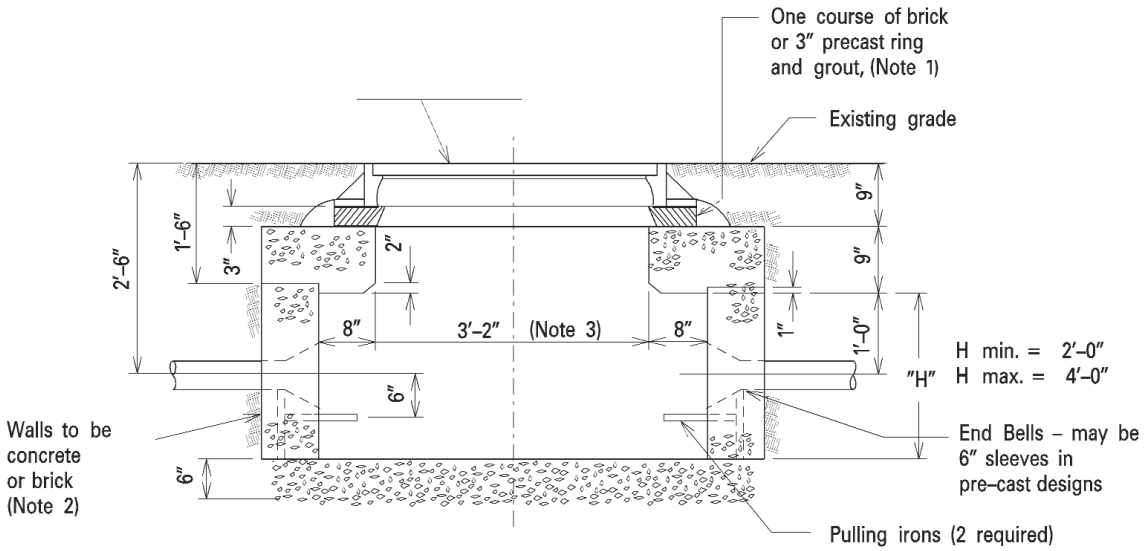


18.0 Heavy Duty Handhole

This primary conduit handhole may be specified in the design for installation in roadways or sidewalks areas where duct length requires extra pulling locations. Heavy duty handholes are supplied and installed by the *Customer*.



PLAN VIEW



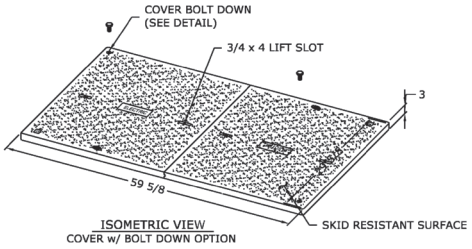
SECTION A–A

Notes:

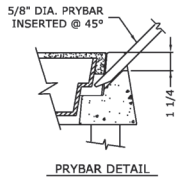
1. *Chimney height is kept to a minimum to facilitate placing completed splices in handhole from above grade.*
2. *Concrete minimum strength - See pages 45 thru 48.*
3. *Roof opening 3’ 2” inches x 3’ 2”.*
4. *Handhole frame, ring and cover are typically provided by the customer.*

19.0 Primary Cable Pull/Splice Box

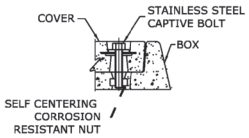
This primary conduit Pull/Splice Box may be specified in the design for installation in sidewalks or grass plot areas where duct length or design requires extra pulling locations or splices. The splice box is H20 rated and shall be installed in locations not frequently traveled over by vehicles. Pull/splice boxes are supplied and installed by the *customer*.



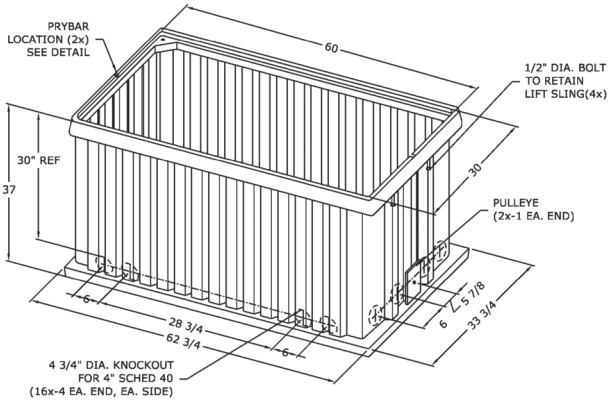
ISOMETRIC VIEW
COVER w/ BOLT DOWN OPTION



PRYBAR DETAIL



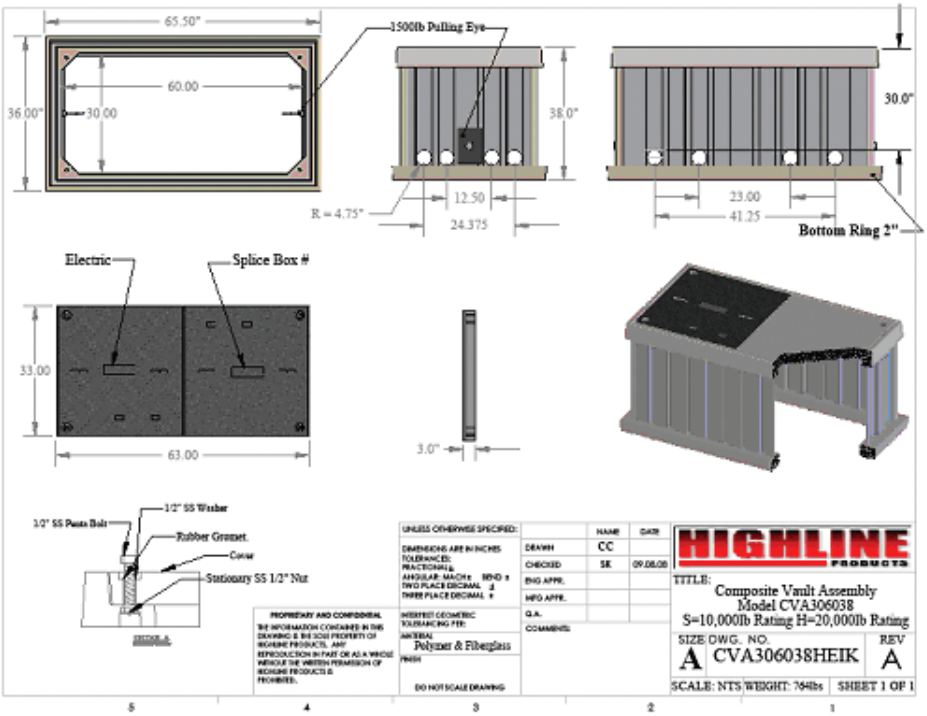
COVER BOLTDOWN DETAIL



ISOMETRIC VIEW
BOX

- MATERIAL: FIBERGLASS REINFORCED POLYMER CONCRETE & FIBERGLASS REINFORCED POLYMER
- COLOR: CONCRETE GRAY
- LOAD RATING: A16(ASTM C857)
- LOGO: ELECTRIC
- COVER WEIGHT: 215 LBS
- BOX WEIGHT: 263 LBS
- COVER & BOX TOAL WEIGHT: 478 LBS

CDR
PA12-30-60-37-0016



20.0 Trench Requirements

Final grades shall be established; the surface rough graded with in 6" from finished grade, roadway and property boundaries shall be staked or marked by the *Customer* before any trenching is started. Trench spoils shall be kept a distance of 2' minimum from excavated trench.

The *Customer* shall adhere to the construction plan and specifications specifying trench locations, trench depth and concrete encasement. Any deviation shall be subject to approval by the *Company*.

The *Company* shall be notified in advance of the backfilling of any electric facility (e.g. concrete, conduit, manholes, riser bends). The *Company* reserves the right to require re-excavation of the conduits and foundations if the *Customer* fails to have inspection done or backfills before inspection.

Trenches shall not be backfilled until concrete has set (for at least two hours) and until after approval by authorized *Company* personnel. *Note: if trench is subjected to traffic then the trench shall set for at least 12 hours.* All backfill shall be sand or gravel containing stones less than 1" in any dimension. Backfilling shall not take place over any open-ended (unplugged) conduits. *Company* approved red "Warning" tape shall be installed directly above the *Company's* cable eight to twelve inches below finished grade. Laying the warning tape directly on the cable, concrete or conduit is not acceptable. Certain installations in the public way may require flowable fill instead in place of normal backfill.

20.1 Trench Depth New York/New England Concrete Encased Conduit

Burial depths for electrical conduit shall be maintained not less than 30" from the top of the concrete encasement to grade during all phases of construction. The trench bottom shall be solid, undisturbed earth. Earth showing signs of peat, cinders, rubble, or any conditions not suitable for a stable foundation shall be reported to the *Company* for recommendation. Small pockets of unsuitable soil shall be replaced with compacted gravel (max. 2" stone). At riser pole end concrete encasement just before riser sweep.

20.2 Trench Depth Conduit Direct Buried New York (under certain circumstances agreeable with the *company*)

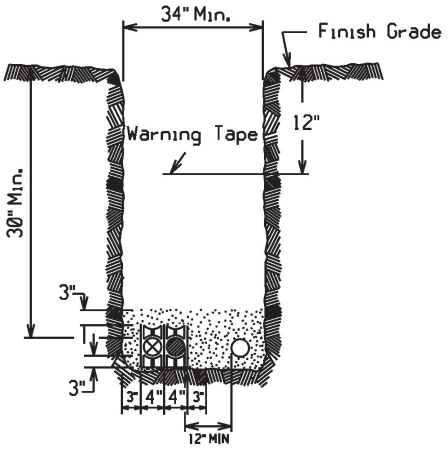
Burial depths for electrical conduit shall be maintained not less than 30" from the top of the conduit to grade during all phases of construction. The trench bottom shall be solid, undisturbed earth. Earth showing signs of peat, cinders, rubble, or any conditions not suitable for a stable foundation shall be reported to the *Company* for recommendation. Small pockets of unsuitable soil shall be replaced with compacted gravel (max. 2" stone).

20.3 Trench Depth Direct Buried New York

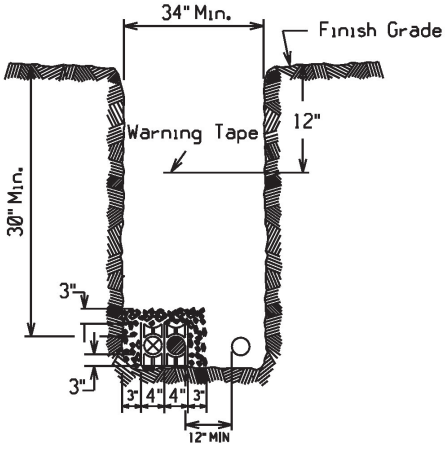
Burial depths for electrical cable shall be maintained not less than 30" to grade during all phases of construction. The trench bottom shall be solid, undisturbed earth. Earth showing signs of peat, cinders, rubble, or any conditions not suitable for a stable foundation shall be reported to the *Company* for recommendation. Small pockets of unsuitable soil shall be replaced with compacted gravel (max. 2" stone). Then 2" minimum of sand shall be the base to lay the cable on top of with another 4" minimum of sand to cover cable.

Figure 20.0-1 Typical Trenches

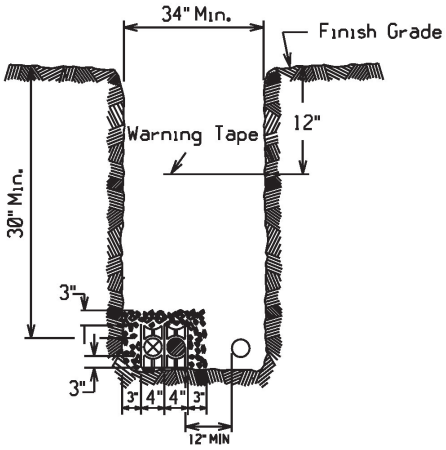
Conduit Trench



Conduit in Concrete Trench



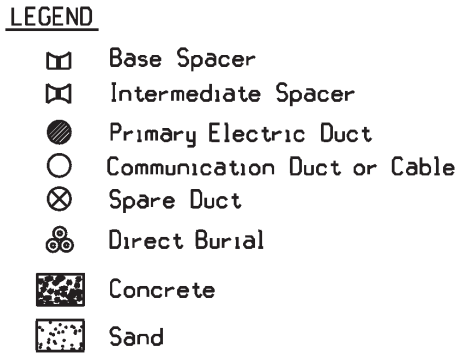
Direct Burial Trench

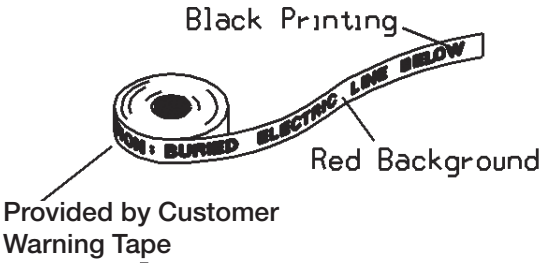


Notes:

1) If more than one set of primary is installed in the trench, separate primary by 6” minimum.
2) Nantucket MA area to use this trench with a spare 4” conduit to be installed at least 6” away from the direct burial cable.

Legend





Provided by Customer
Warning Tape

21.0 Conduit Requirements

The *Customer* shall be responsible for all trenching, excavating, backfilling, and installation of the primary duct system. Exceptions to this shall be in areas where there is an existing manhole and duct system and the limits of trenching by the *Customer* shall be determined by the *Company*. The *Customer* is also responsible to supply and install any necessary manhole, pullboxes, heavy duty handholes, frames and covers. Concrete encasement shall be provided and installed by the *Customer* as specified by the *Company*.

The *Customer* shall ascertain the requirements of the specific municipality in which the development is located. For example, some municipalities may require that the *Customer* employ a licensed electrician to direct the installation of all conduit intended for electric facilities.

Temporary mechanical protection over buried conduit and encasements is recommended to prevent crushing or damage during construction. This is the *Customer's* responsibility.

All road crossings shall, when practical, be perpendicular to the sidelines of the road.

The minimum size conduit shall be 4" schedule 60 DB. All sweeps at foundations and risers shall have a minimum radius of thirty-six inches (36"). The riser sweep shall be galvanized steel. The padmount transformer sweeps shall be galvanized rigid steel or schedule 40 - PVC, with the transformer sweeps rising typically 1" above the concrete pad. The *customer* shall install bell ends on the conduits. The *Customer* shall install conduit plugs in all unused conduits and pulling tape. At the riser pole, the galvanized rigid steel sweeps and the PVC/steel adaptors shall not be concrete encased. The *Customer* shall be responsible to install rigid galvanized steel straight conduit up the pole as shown on page 20, including conduit ground straps, up the riser pole (unless directed otherwise by the *Company*). The *Company* will specify on which quarter of the pole the riser shall be installed, usually away from oncoming traffic.

Except as noted on construction prints, curves and bends in conduit shall be gradual, and the radius of curvature shall not be less than forty feet. All curves shall be formed with 5-degree couplings. The minimum length between single, 5-degree couplings is 42". Heat bending is not allowed.

Conduit grade shall be such as to cause all ducts to drain toward one or both equipment foundations or pullboxes. Minimum pitch shall be three inches (3") per one hundred feet (100').

The *Customer* shall insure that clearances are met and maintained, and that they are inspected by the *Company*. Unless local jurisdictions require greater clearances, the minimum clearances shall be as follows:

Communication Systems – *Company* conduit shall not be directly above or below communication conduit, except when crossing below communication conduit at approximately right angles. *Company* conduit and communication conduit shall be separated by a minimum of 3" of concrete encasement.

Water, Gas, Sewer – *Company* conduit shall not be directly above or below these utilities, except when crossing above these utilities at approximately right angles. Where the paths of these utilities cross under *Company* conduits at approximately right angles, the minimum separation is 12". A minimum separation of 24" shall be maintained between parallel placement of any of these utilities and electrical conduit.

A 6-inch clearance shall be between conduit envelopes and major subsurface pipes (e.g. drainage pipes).

The *Customer* shall mandrel all primary conduits to insure their integrity **before** the *Company* shall attempt to pull any primary cable. The *Customer* shall furnish and install an approved synthetic, 2,500 pound test tape in each primary conduit run including risers. Pulling tape installation and mandrilling the duct shall be witnessed by the *Company*.

***Company* owned duct shall not share a concrete encasement with foreign utilities (e.g. do not place communication or private electrical duct in the same concrete encasement as *Company* duct).**

21.1 Pulling Tape

All conduits shall have a pulling tape, also known as "Mule Tape". This tape is to be to be rated for 2,500#. Manufacturers of this tape are listed on page 54.

21.2 Trench and Conduit System Inspection

In the applicable area, a designated *Company* inspector shall be responsible for the inspection of the trench and or conduit system being prepared and installed by the *Customer*, at stages of installation. The *Customer* shall provide the *Company* inspector with a minimum of 24 to 72 hours notice. Required inspections are:

1) After conduit, ground system, reinforcing bars and forming are completed; but before concrete is poured.

2) After concrete is poured but before backfilling.

3) After backfilling.

The inspection shall not be limited to the above.

22.0 Primary Cable and Electrical Equipment

The majority of installations will have the Company provide, install, and maintain the entire primary electrical system including the transformer, cable, cable accessories, terminations, and other miscellaneous primary electrical system components.

In some areas the *Customer* will (mostly New Hampshire) provide and maintain the entire primary electrical system. The *Company* will provide install and maintain the transformer and other miscellaneous primary electrical system components.

The designation and location of the riser pole(s) shall be determined by the *Company*.

The location of primary cable pull/splice boxes and/or heavy duty handholes shall be determined by the *Company*.

At those locations where manholes or above ground switchgear are required, additional specifications will be provided by the *Company*.

23.0 Secondary Cable and Conduit System

Secondary cables shall be installed underground in customer/developer furnished, installed, owned and maintained conduit system or raceway. Conditions requiring more secondary cables than the *Company*'s transformer secondary terminals can accommodate may require the customer/developer to supply an intermediate splice box to make a transition from National Electrical Code required cable capabilities (required to match main switch), to actual load cable capabilities. Page 56 lists manufacturers of the splice box.

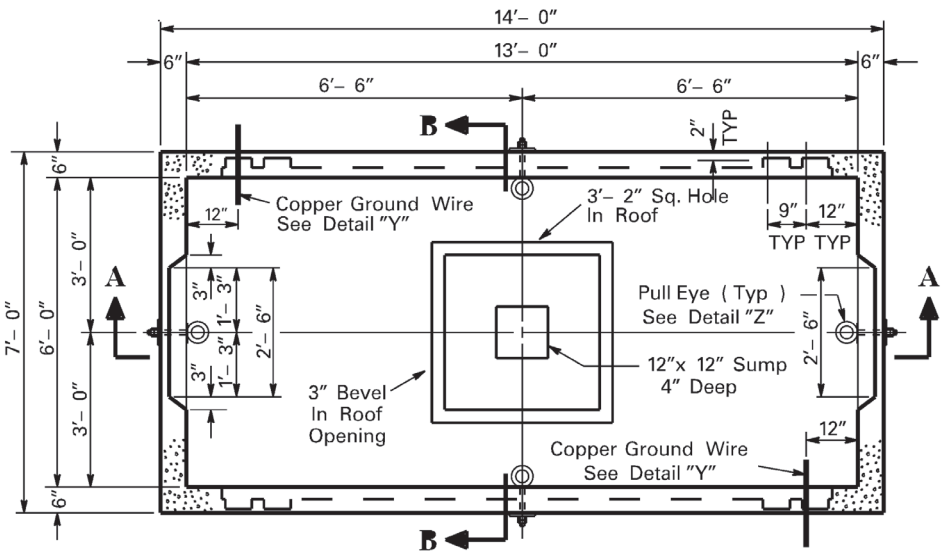
24.0 Metering

Refer to the *Company*'s Specifications for Electrical Installations book for the type of installation. Division of work and material will be performed with the approval and authorization of the *Company's* Metering Services Department.

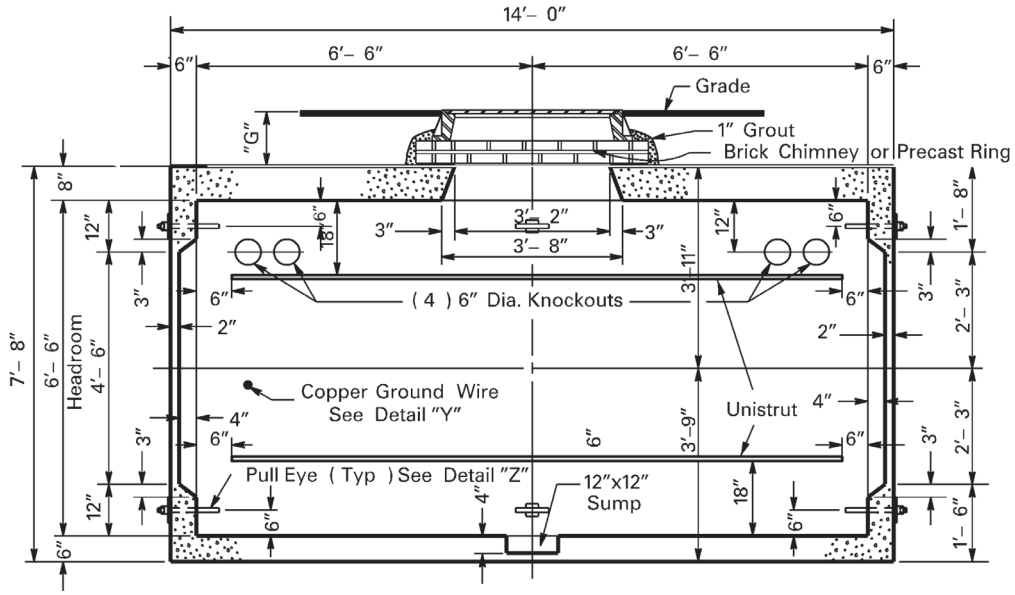
25.0 Manhole

Manhole installation may be required as part of the infrastructure to serve certain customers. The *Customer* shall provide and install the manhole to company specification. On page 53 lists precast concrete providers. Please contact the *company* if details are needed for specifications of manholes.

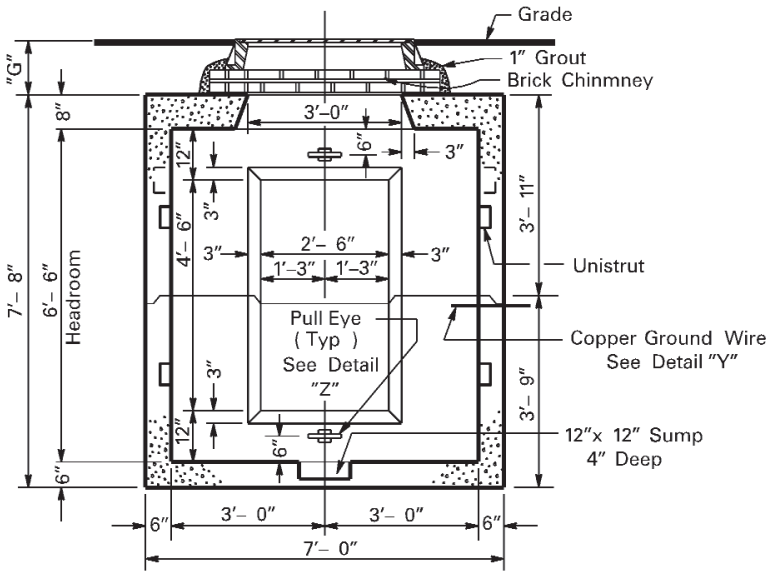
STD Item UM22



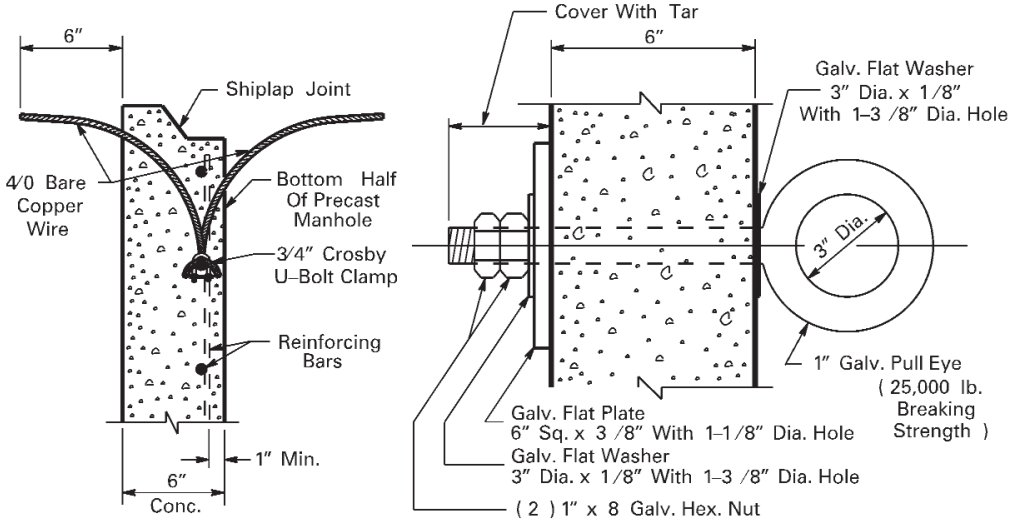
Plan



Section A–A



Section B–B



Detail "Y"
2 Required

Detail "Z"
4 Required

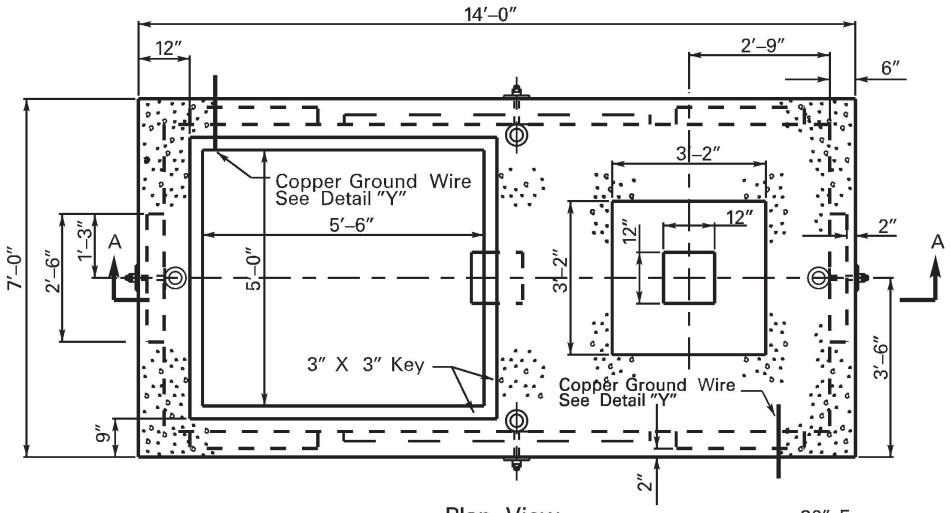
Note: Construction joint to be sealed with asphalt or equivalent.

25.1 Manhole Frame Ring and Cover

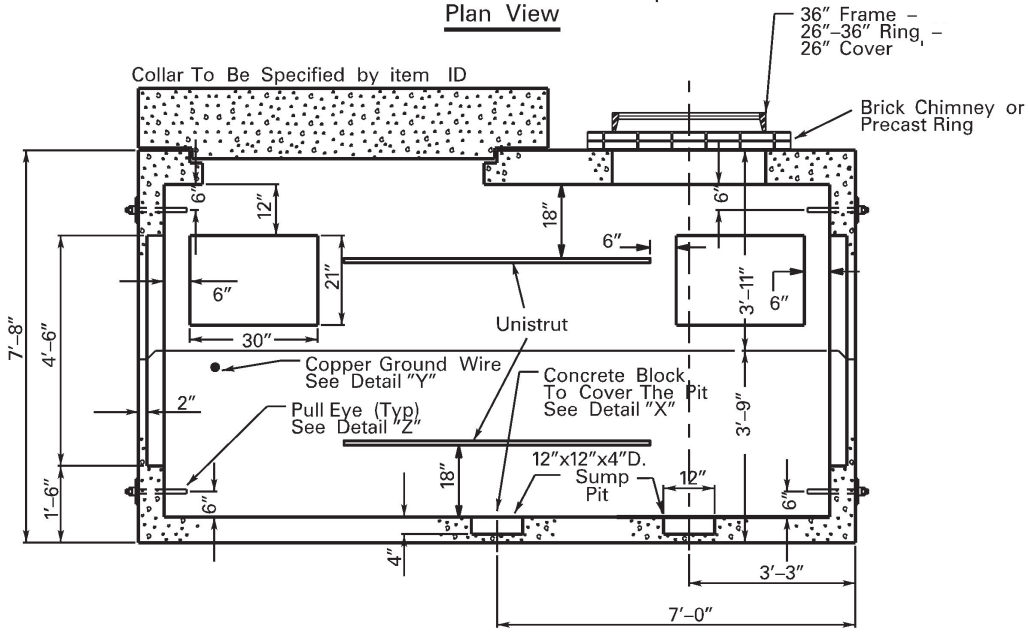
The *customer* shall be responsible for providing and installing the manhole frame ring and cover to finished grade. Approved frame, ring and covers are shown on page 60. Frame shall be installed on a chimney at least 6" in height minimum. The maximum allowable chimney shall be 36" from the top of the roof of the manhole to finished grade.

25.2 Switchgear Manhole

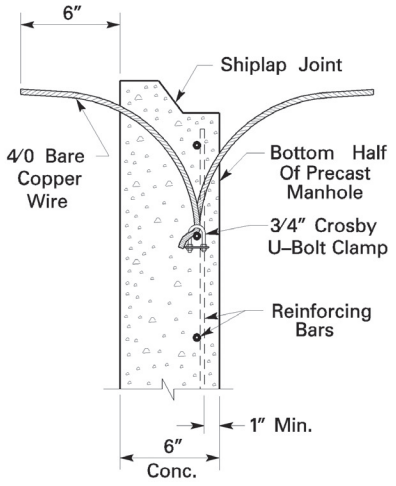
Switchgear installation may be required as part of the infrastructure to serve certain customers. The Customer shall provide and install the switchgear manhole to company specification. On page 57 lists precast concrete providers. The Company shall identify which collar shall be used from the choices on pages 30 and 31.



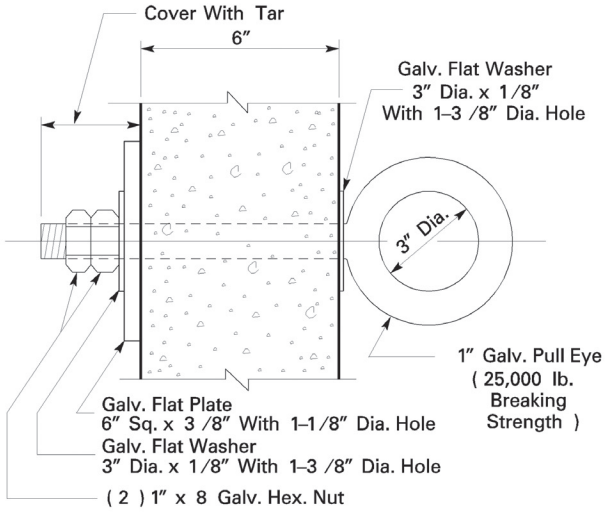
Plan View



Section A–A

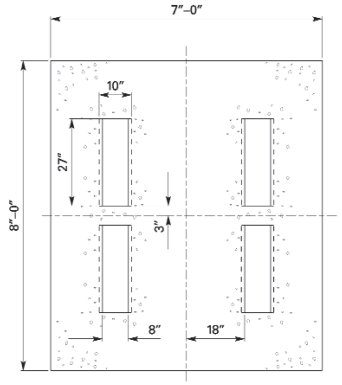


Detail "Y1"
2 Required

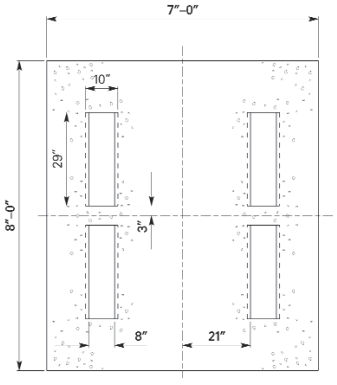


Detail "Z"
8 Required

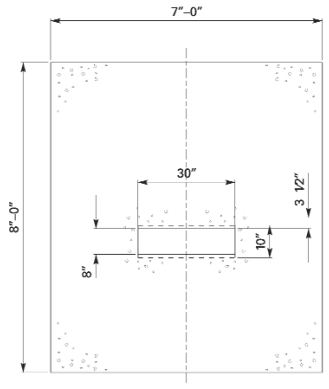
Switchgear collars



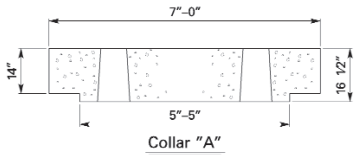
Collar "A"
15kV S/G Collar



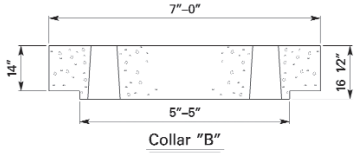
Collar "B"
25/35kV S/G Collar



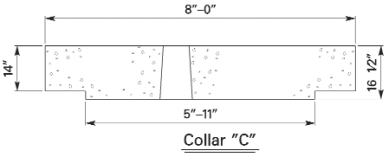
Collar "C"
PWVE Cooper Recloser



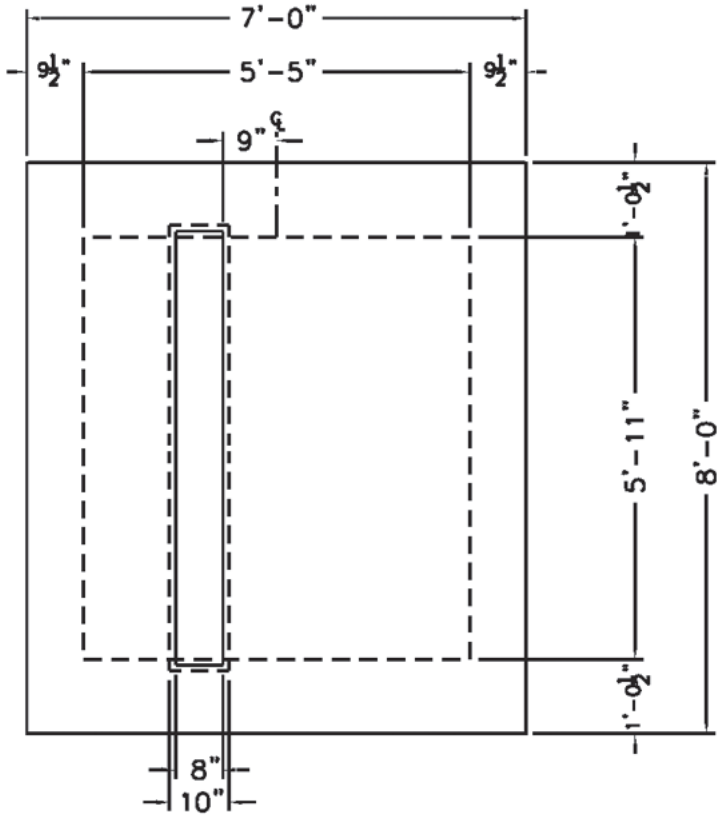
Collar "A"

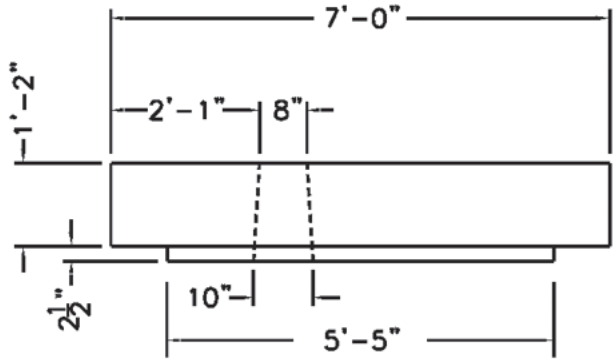


Collar "B"



Collar "C"

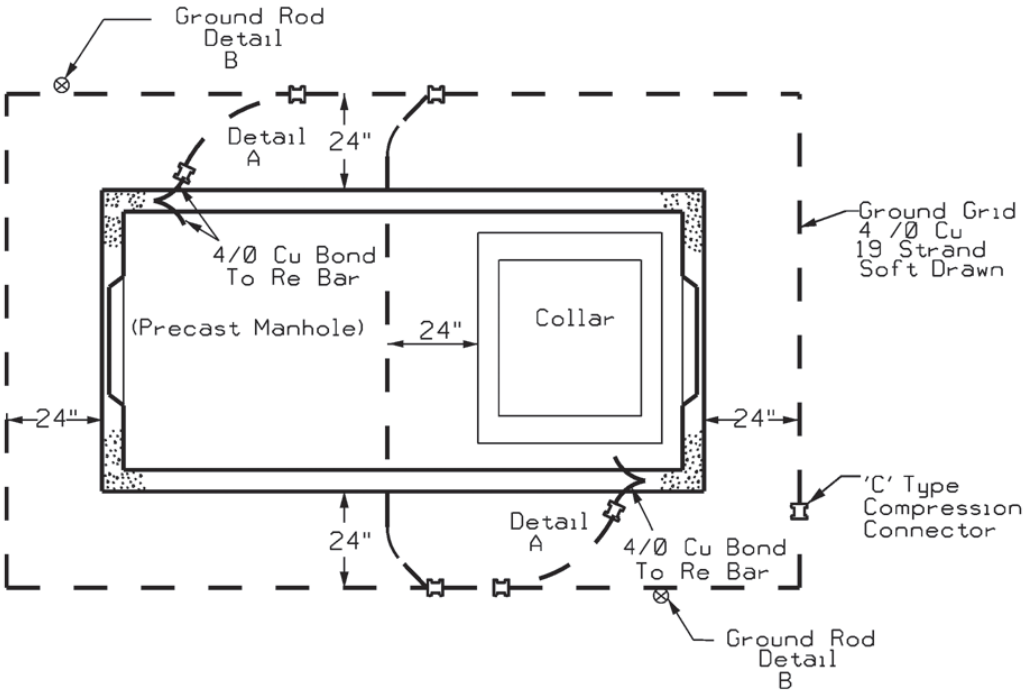




Collar D
35kV Vista Gear 3 AND 4 WAY

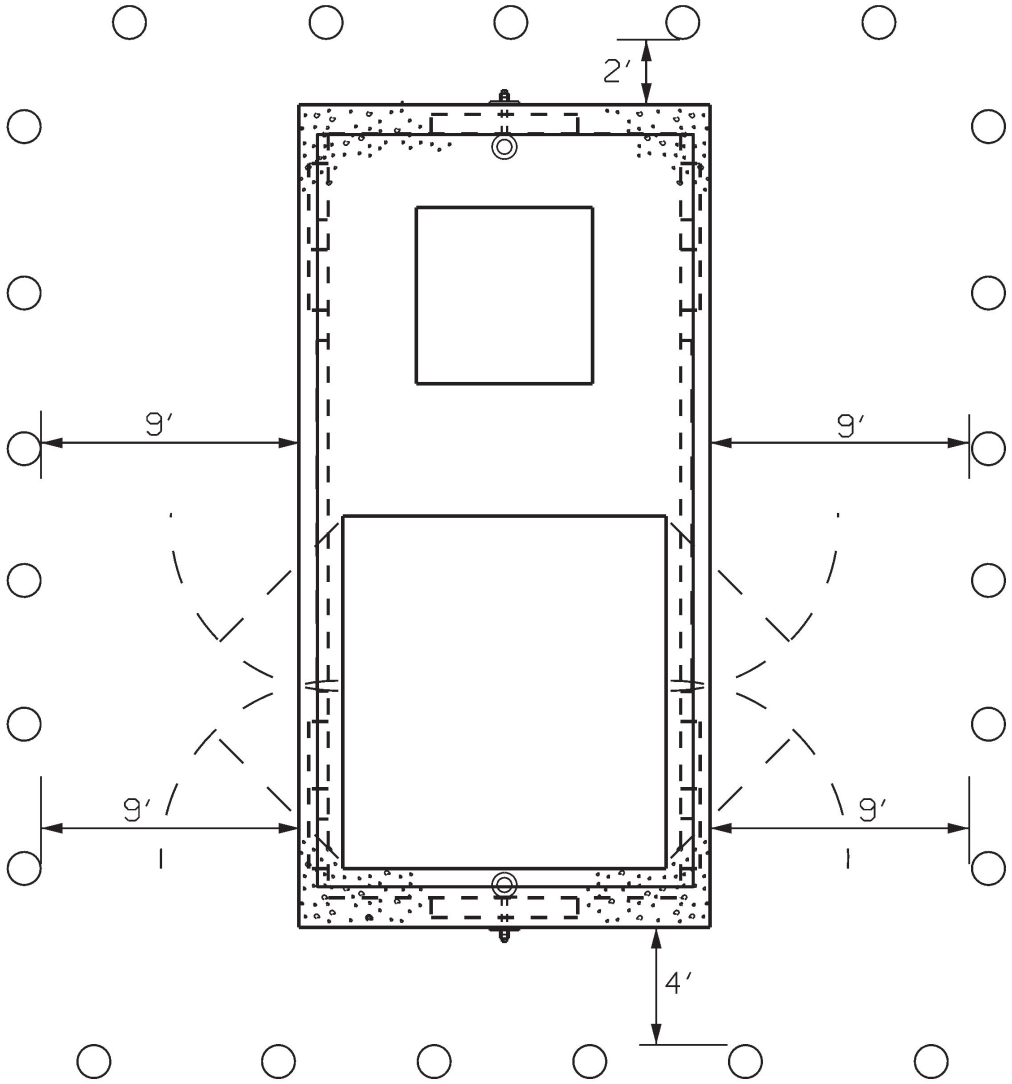
25.3 Switch Gear Manhole Ground Grid

The Customer shall install the ground grid for a switchgear manhole installation as shown in the picture.



25.4 Switch Gear Manhole Bollard Layout

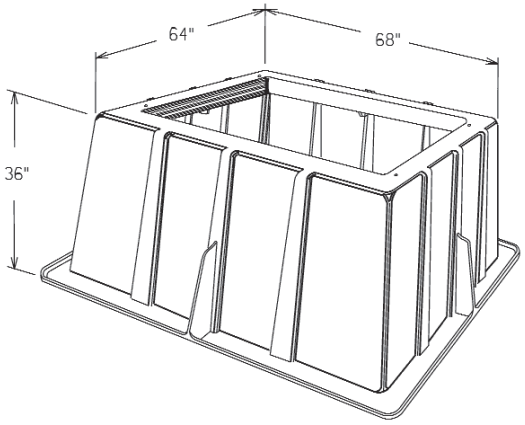
The drawing below depicts the locations for bollard installations around a switchgear manhole. Distribution Design/Planning and or company inspector shall designate the number and location of required bollards for each job. Refer to Transformer Mechanical Protection/ Bollards on page 12 for more details on Bollards.



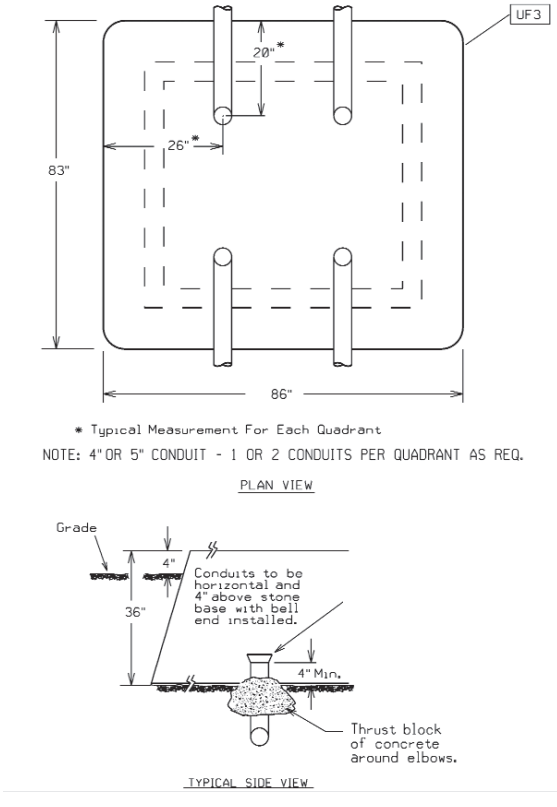
26.0 Fiberglass Switchgear Base with Conduit Entry's

The fiberglass switchgear base can be used as an alternate to the switchgear manhole in locations where allowed by the company. It is not recommended for installations where the primary coming into the base is 500MCM or larger.

***Note**: This base will only accommodate standard PMH-9, PMH 10, PMH 11 and PMH 12 switchgears.*

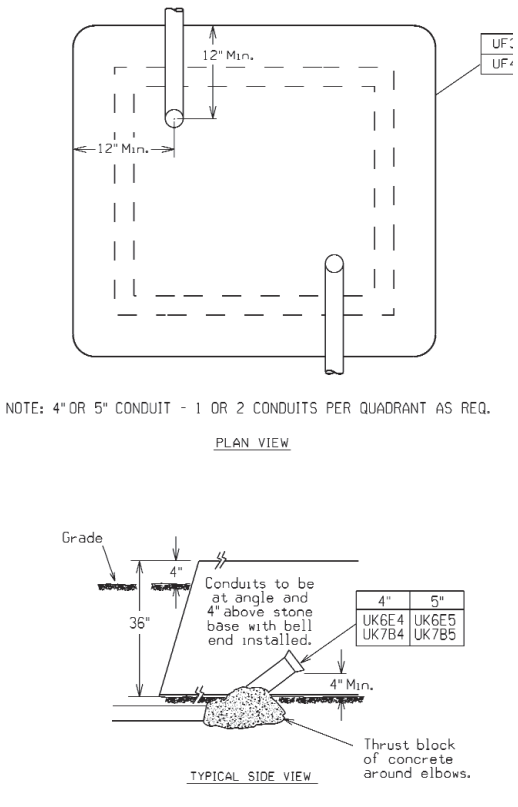


Typical Installation, Vertical Conduit Entry



4" or 5 " conduit

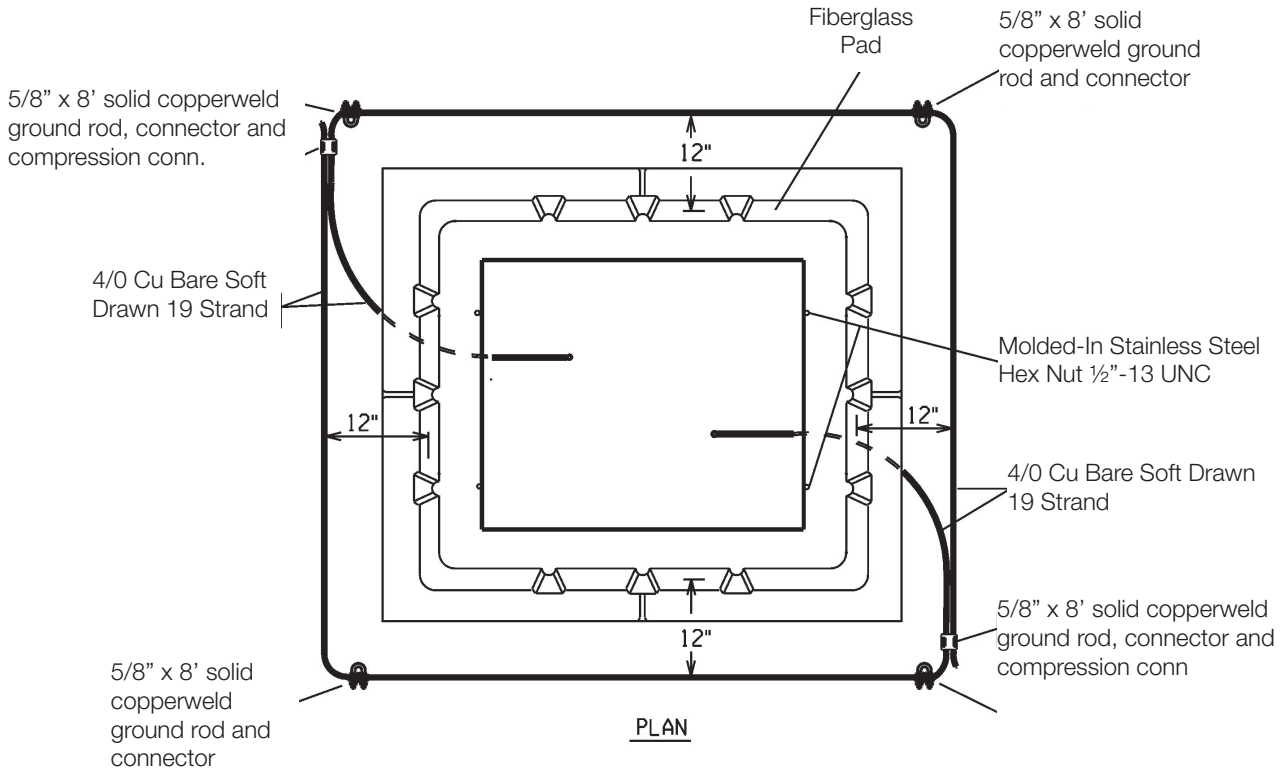
Typical Installation, Horizontal Conduit Entry

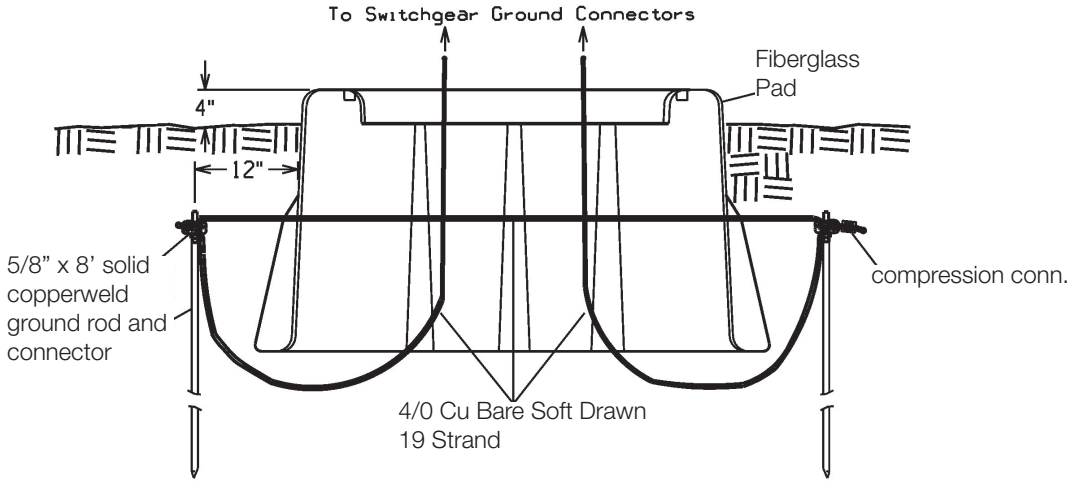


4" or 5 " conduit

26.1 Fiberglass Switchgear Ground Grid

The Customer shall install the ground grid for a fiberglass switchgear installation as shown in the picture.





Front Elevation

26.2 Switch Gear Fiberglass Boxpad Bollard Layout

The drawing below depicts the locations for bollard installations around a switchgear fiberglass boxpad. Bold outline referenced on drawing is the exposed outside sides of the boxpad. Distribution Design/Planning and or company inspector shall designate the number and location of required bollards for each job. Refer to Transformer Mechanical Protection/Bollards on page 12 for more details on bollards. Bold outline referenced on drawing below is the exposed outside sides of the boxpad.

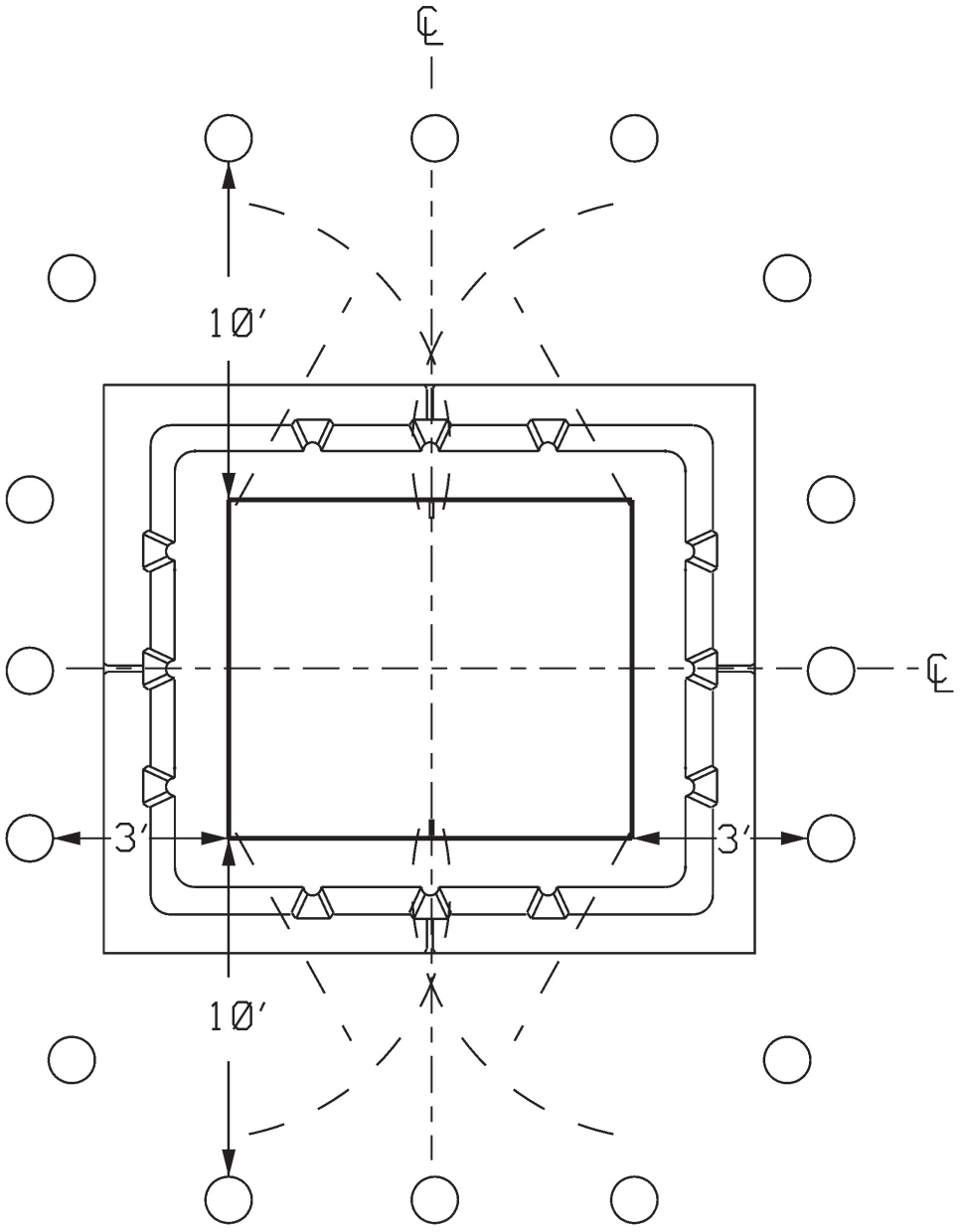


Figure 27.0-1 15kV Transformer Pad 75- 500kVA 44-113 (ref-44-113/UF8A)

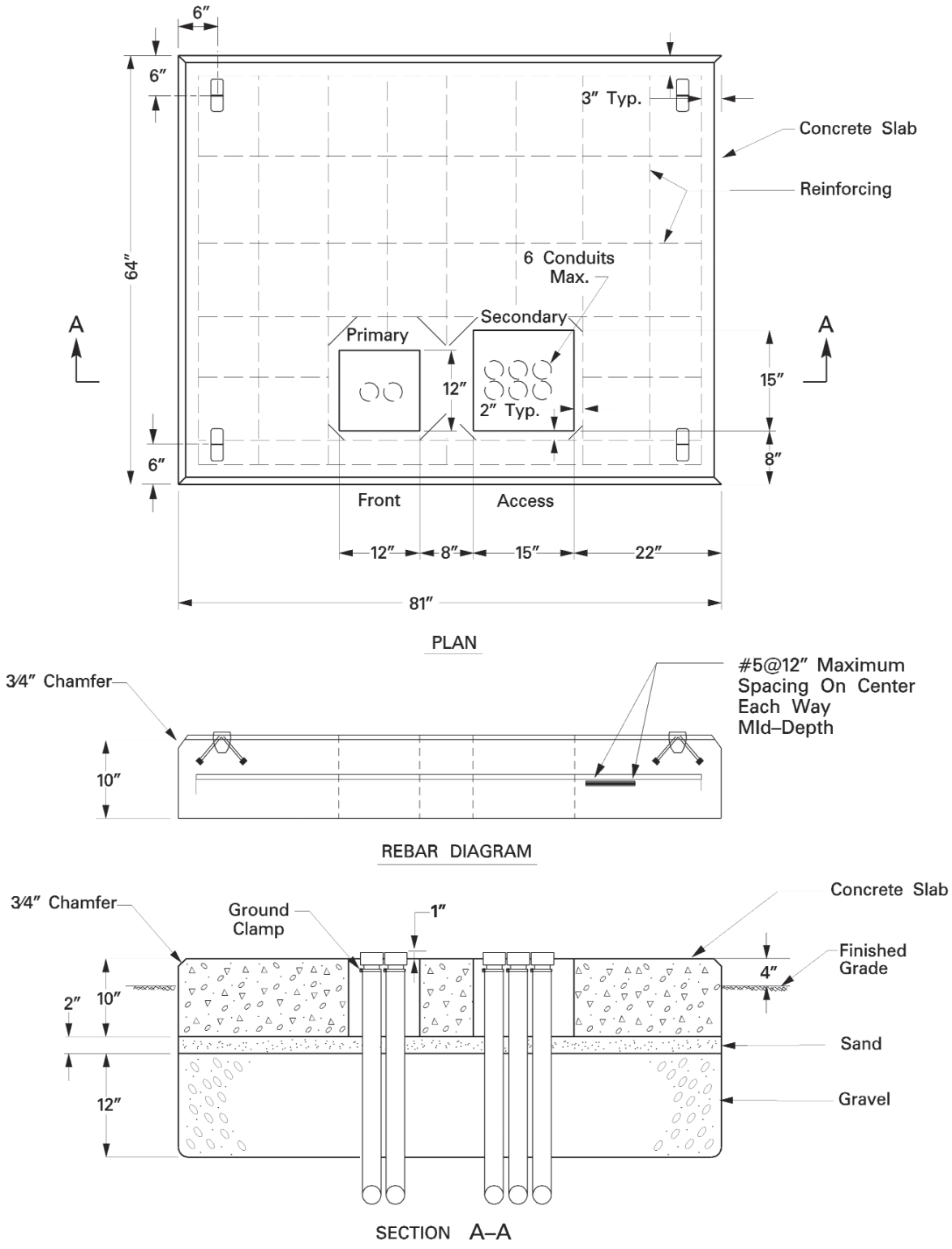
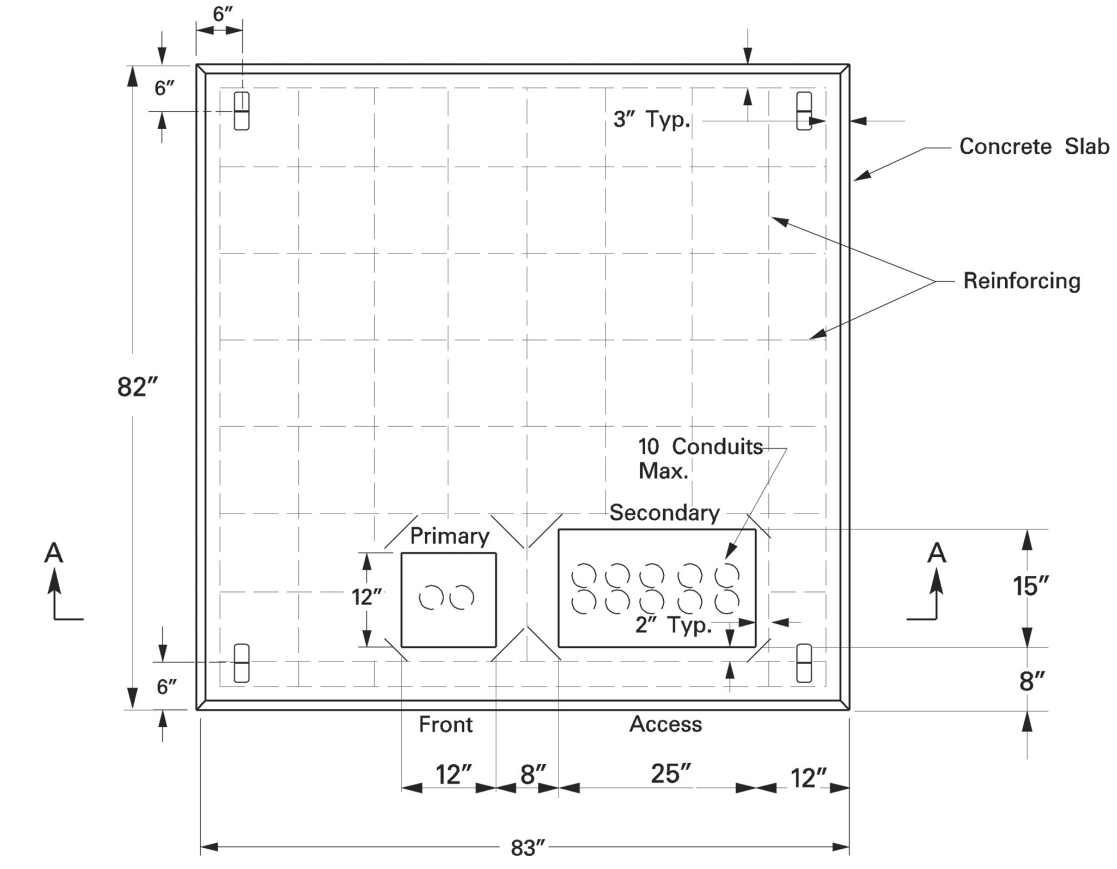
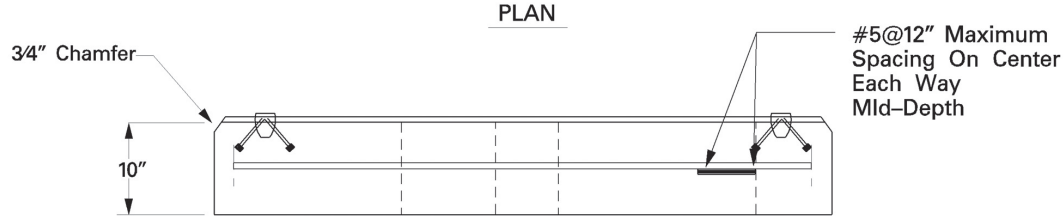


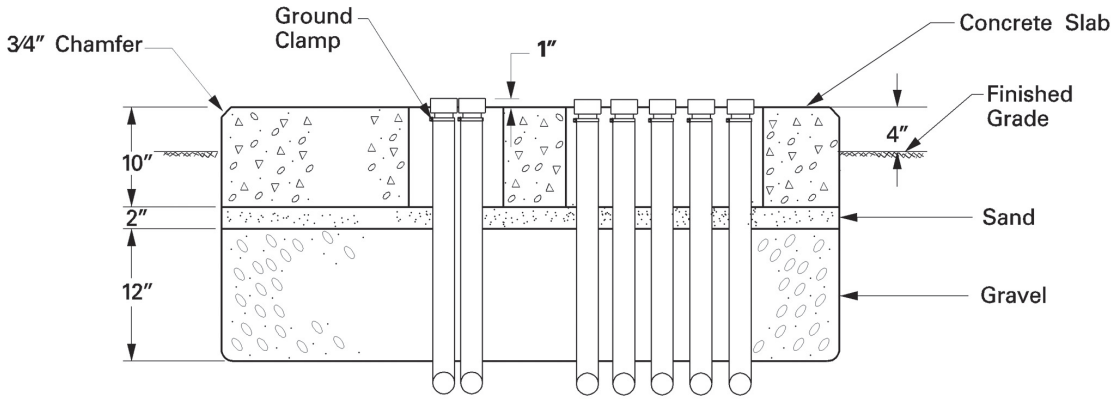
Figure 27.0-2 15kV Transformer Pad 750- 2500kVA 44-114 (ref-44-114/UF8B)



PLAN

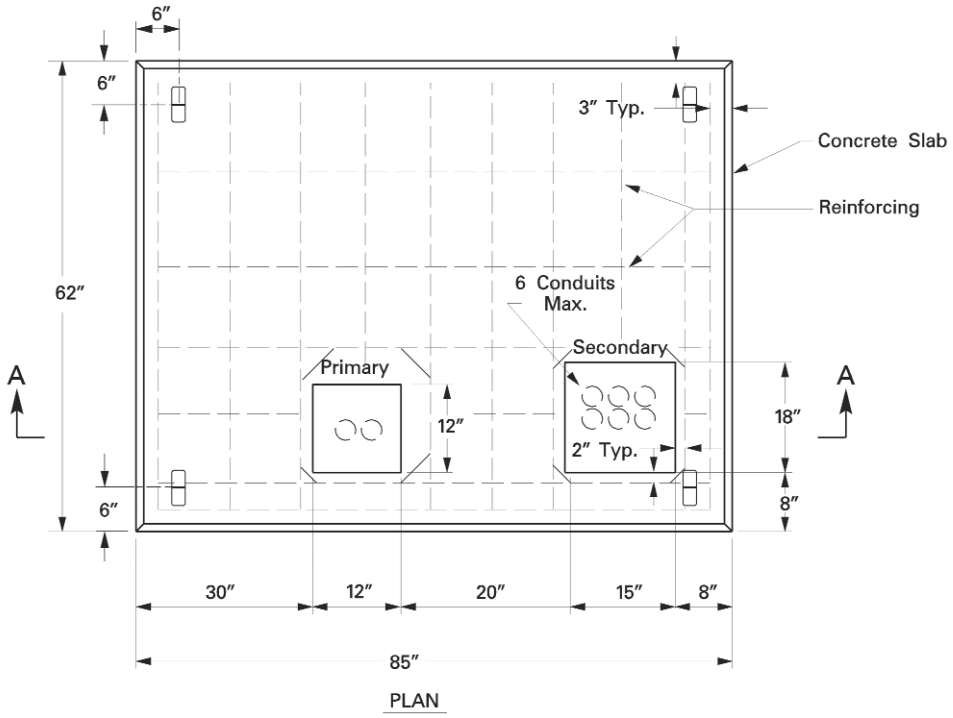


REBAR DIAGRAM

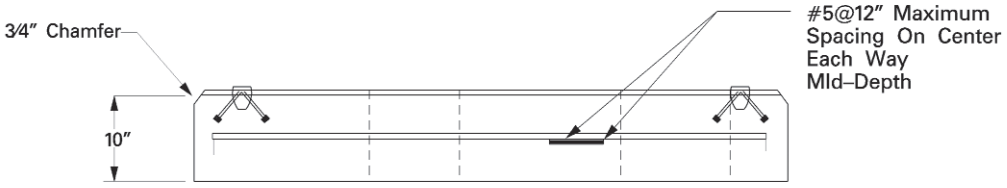


SECTION A–A

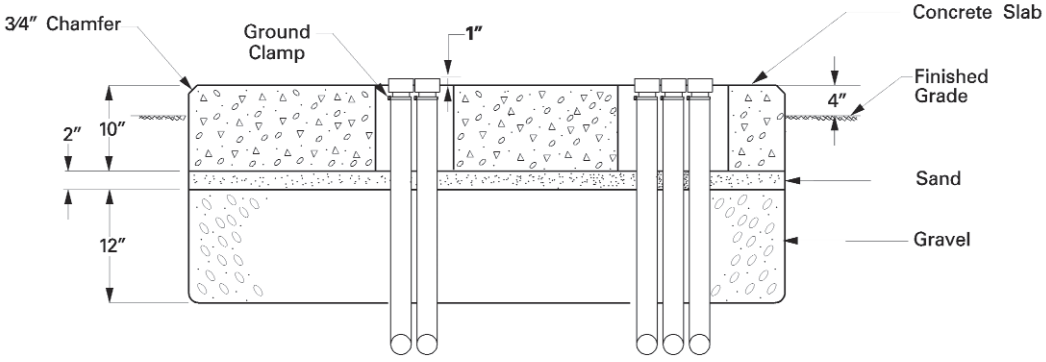
Figure 27.0-3 25-35kV Transformer Pad 75- 300kVA 44-115 (ref-44-115/UF8C)



PLAN

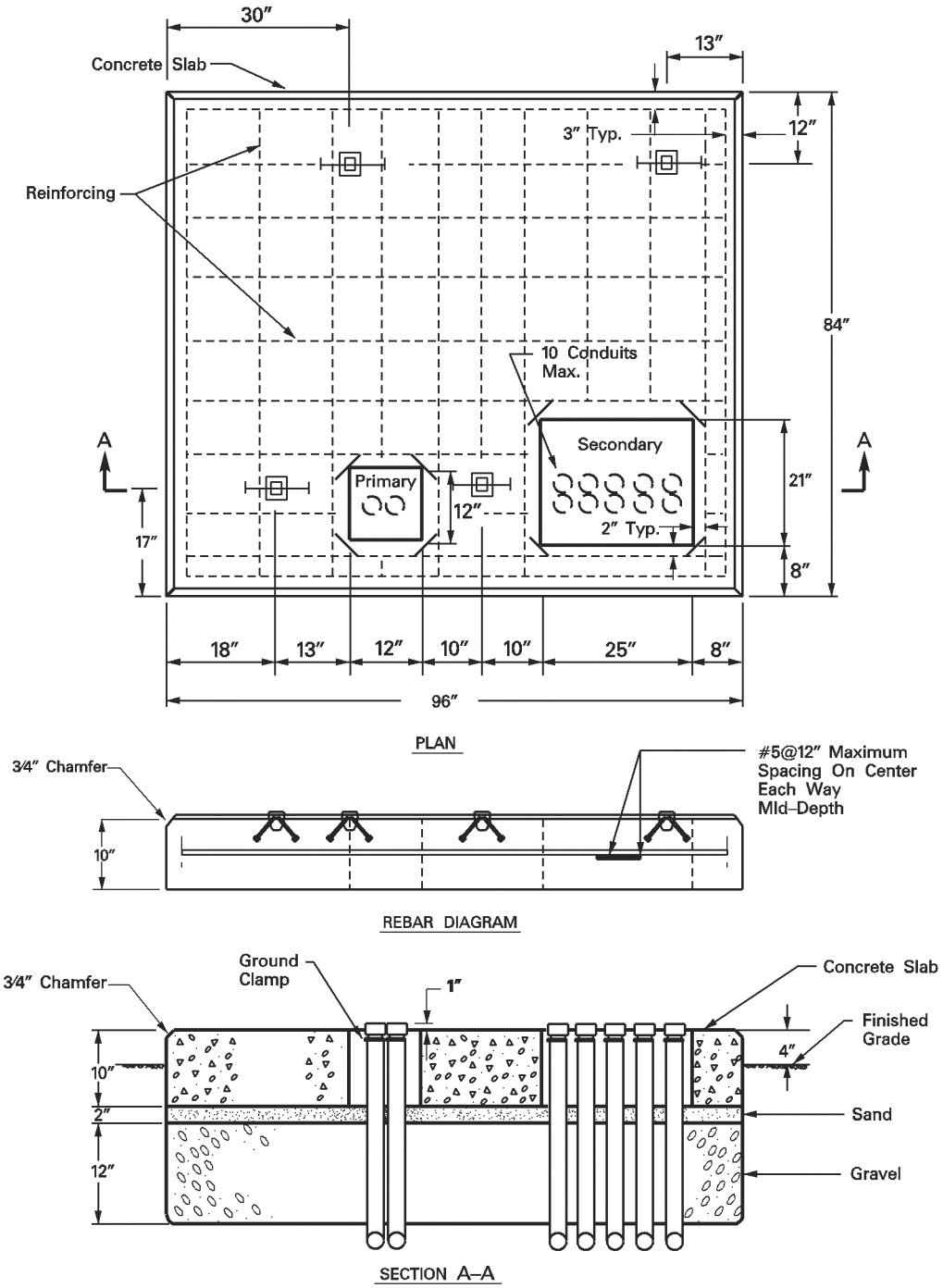


REBAR DIAGRAM



SECTION A–A

Figure 27.0-4 25-35kV Transformer Pad 500-2500kVA 44-116 (ref-44-116/UF8D)



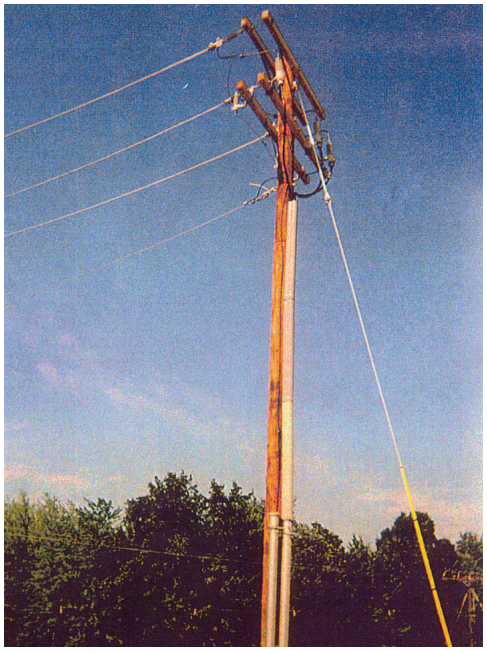
28.0 SAMPLE INSTALLATIONS

Picture of Conduit Installation Before Concrete Pour

Picture of Ballard Installation

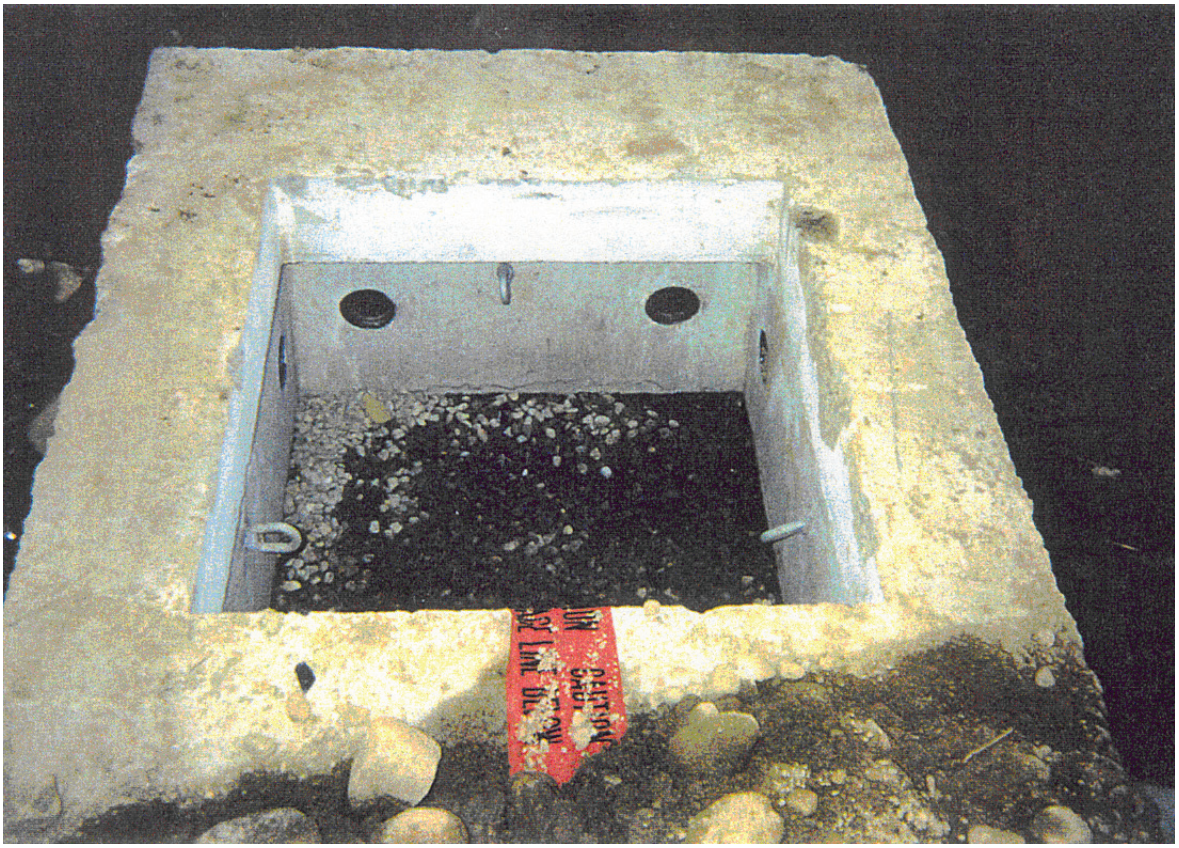
Pictures of a Riser Pole Installation

Riser Pole Bonding
Rigid Galvanized Steel. Bond higher than 8’ and at least 6” from top.

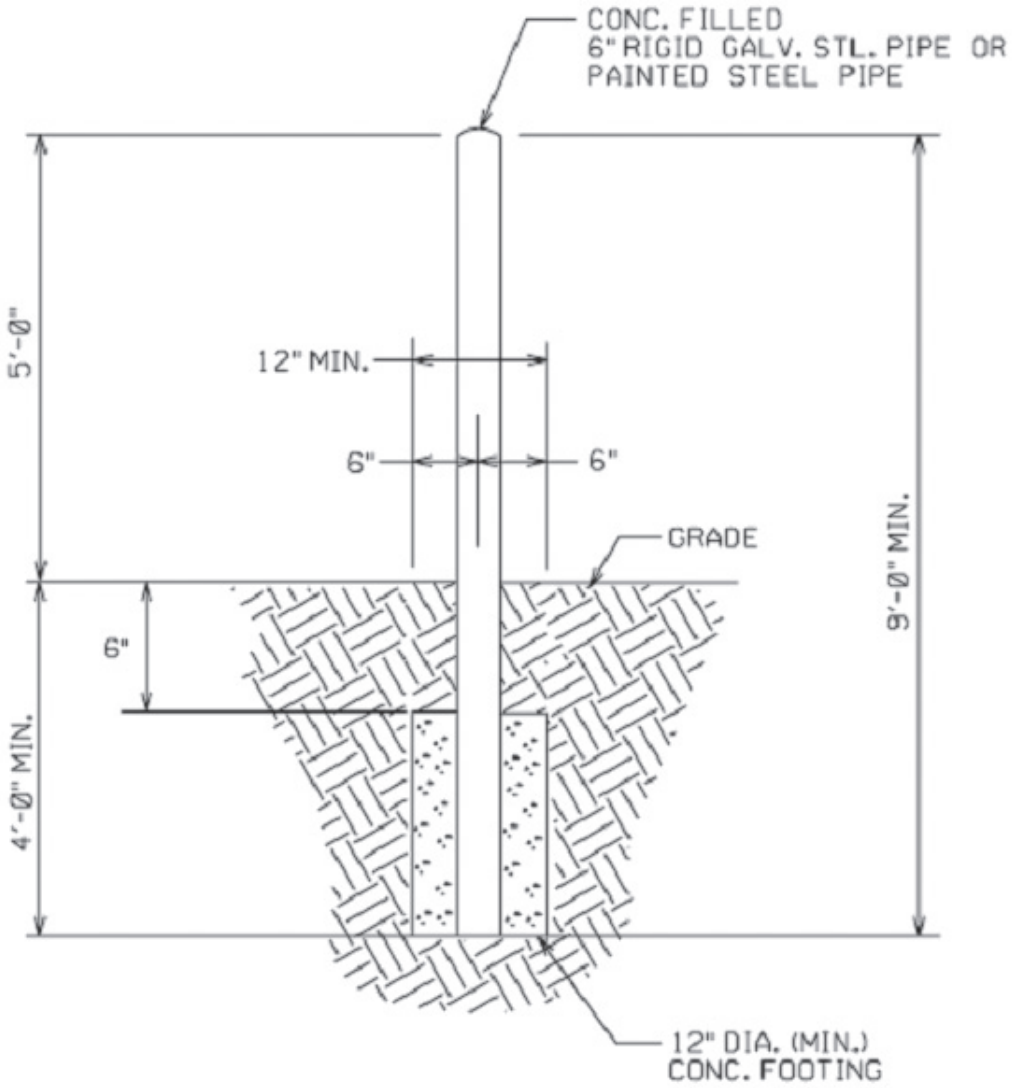


Completed Riser Pole
The Company will specify on which quarter of the pole the riser shall be installed, away from traffic.

Heavy Duty Handhole Installation



29.0 BOLLARD DETAIL



TYPICAL
BOLLARD DETAIL

30.0 CONCRETE SPECIFICATIONS

30.01 **SCOPE** - For general use of reinforced and plain concrete when job specifications are not being issued. Not for use when placing concrete underwater (Tremie concrete).

30.02 **MATERIALS** - Cement shall be a standard brand of Portland Cement Type II conforming to ASTM C150. If concrete is to be in contact with sea water or soils other than clean gravel, or if job conditions require earlier strength development than Type II provides, notify Civil Engineering for use of a higher strength or high-early strength concrete.

Sand shall be sharp and clean and shall conform to ASTM C33, latest revision.

Coarse aggregate shall be of gravel, crushed gravel or crushed stone and conform to ASTM C33, latest revision.

Water shall be from a potable water supply or tested and approved by Civil Engineering, assuring it is clean and free from injurious amounts of oil, acids, alkali, organic materials, or other harmful substances.

30.03 **READY-MIX CONCRETE** - Ready-mix concrete shall be proportioned at the plant. Mixing and delivery shall be in accordance with ASTM C94, latest revision. Mixes shall conform to Table 1 for minimum 28 day strength, nominal maximum size aggregate, and slump.

An air-entraining agent shall be added to concrete mixes in which the surface will be exposed to the elements. No other admixtures shall be used without approval of Civil Engineering. Air- entrainment content shall be as follows:

Mix M2 and M3:	7.0% plus or minus 2.0%	Mix M5:	4.5% plus or minus 1.5%
Mix M4:	5.0% plus or minus 1.5%	Mix M6 and M7:	6.0% plus or minus 1.0%

The Purchaser reserves the right to make tests at any time on materials used and concrete furnished by the ready-mix concrete supplier. The batch plant, equipment, and operating procedures are subject to inspection and approval by Civil Engineering or their qualified representative.

TABLE I - CONCRETE MIXES

Mix Number	Strength Minimum 28 Day Lbs/Square Inch	Aggregate Maximum Size Nominal	Slump Not More Than	Typical Uses
M1	2,000	1-1/2"	2"	Bedrock and Floor Fill
M2	2,000	1/2"	2"	Duct Lines - Tier Method
M3	2,000	1/2"	6"	Duct Lines - Unit Method
M4	3,000	1-1/2"	2"	Footings, Slabs on Ground, Foundation Walls, and Pile Caps
M5	3,000	1"	2"	Floor and Roof Slabs on Forms
M6	4,000	1"	2"	Hi-Strength Slabs and Walls
M7	5,000	1"	2"	Hi-Strength Slabs and Walls

Note: *If a greater slump is required, contact Civil Engineering for an additive to meet the specific job requirements.*

Ready-mix concrete shall be ordered in accordance with this Specification with a copy of same supplied to the ready-mix concrete manufacturer. The cubic yards, delivery point, time schedule, and applicable mix number for the particular application shall be specified on the order.

Delivery of a concrete batch in excess of the rated mixer drum capacity is cause for rejection. The latest drum inspection certificate should be available for verification.

30.04 **CONCRETE - DELIVERY AND MIXING** - In the event that delivery of concrete is called for when the air temperature is below 40º F the following shall apply:

a. When the air temperature is between 30º F and 40º F, the concrete shall be delivered in excess of 55º F.

b. When the air temperature is between 0º F and 30º F the concrete shall be delivered at a temperature in excess of 60º F.

In hot weather concrete shall be delivered at a temperature which will not cause difficulty from loss of slump, flash set, or cold joints. Discharge of concrete at the job site shall be completed within one (1) hour of adding the mixing water.

30.05 **CONCRETE - FORMS** - Formwork shall be designed and constructed in accordance with the American Concrete Institute's "Recommended Practice For Concrete Formwork", ACI 347, of latest date.

Forms shall be built substantially; true to form, lines, dimensions, and grades shown. They shall be braced and tied to maintain position and shape, without yielding to pressure of fluid concrete or other forces, including those produced by vibratory compaction.

Forms shall be constructed of 3/4" BB grade plywood supported with 2 x 4 studs on 16" centers. Forms shall not exceed a 10' pour height and form tie spacing shall not exceed 2'. Form ties and accessories, manufactured by Richmond Screw Anchor Company or equal, shall be used. Prefabricated forms are allowed after approval by Civil Engineering. The forms shall be vertical and symmetrical and in the largest sizes practicable. Sheets showing torn grain, worn edges, hole patches, or other defects, which impairs the texture of the concrete surface, shall not be used.

Forms shall be treated with approved form oil, before erection or reinforcing steel placement, to prevent adhesion of the concrete.

Forms shall be mortar-tight. For surfaces which will be exposed, the form faces shall be smooth and mortar-tight.

Forms shall be removed carefully to avoid damage to the concrete surfaces. The removal time is governed by the concrete's condition, curing temperature, curing time, and the forces the new concrete may be subjected. Under favorable curing conditions, forms may be removed no sooner after placement than the following:

- seven (7) days for supported floor and roof slabs
- 48 hours for wall and columns
- 24 hours for footing walls and piers
- 12 hours for underground duct lines

If high-early strength concrete is used, the above time periods may be reduced by one-half.

These periods presented are the cumulative number of days or fractions thereof, not necessarily consecutive, during which the concrete temperature is above 50º F. Whenever formwork is removed during the curing period, the exposed concrete shall be repaired immediately, finished, and cured as specified under "Concrete - Curing".

30.06 **CONCRETE - PLACEMENT** - Concrete shall not be placed until the forms, previously poured concrete surfaces, reinforced steel, and embedded parts have been cleaned of laitance, loose or defective concrete, soil on rock surface, and any other foreign materials.

All concrete placed when the air temperature is above 45º F shall be placed at the coolest temperature as practicable. Concrete placement is not permitted when hot weather conditions prevent proper placement and consolidation. Concrete will not be accepted if its temperature is in excess of 80º F.

When the mean daily temperature falls below 40º F, the minimum concrete temperature shall be 55º F and as close to this minimum as possible.

When the air temperature is below 40º F, provide suitable protection so the concrete can be maintained at a minimum of 50º F throughout the curing period. The protection and heat source, shall maintain the required temperature and moisture conditions without injury due to concentration of heat. All materials which the concrete contacts such as reinforcing, forms, ground, etc., shall be free of frost prior to placement.

Concrete temperature changes during and immediately following the curing period shall be as uniform as possible and shall not exceed 5º F in any one hour, nor 40º F in any 24 hour period. When heaters are used, prevent local surface heating and drying and provide adequate ventilation to prevent carbonation damage to exposed concrete surfaces. Thermostatic temperature controls shall be provided to control the heated enclosures to 50º F. Temperatures exceeding 80º F are to be avoided.

Concrete shall not be allowed to fall from the end of a chute, tube, or bucket more than 5 feet to point of deposit and shall have a fall free from obstructions. Chutes shall be metal or metal-lined.

Pumping equipment, pipelines, procedures, etc., shall be in accordance with ACI 304R, latest revision, and Civil Engineering shall be consulted for mix design of any pumped application. Conveying equipment for pumped concrete shall be of suitable kind, without “Y” sections and with adequate pumping capacity. No aluminum pipe shall be used. Placement shall be controlled so there is no separation in the discharged concrete. The maximum loss of slump in pumping equipment shall be 1½”.

Concrete shall be deposited as near to its final position as possible to avoid long flows in the forms. Concrete shall not be moved more than 10' from point of deposit. Concrete shall be placed in successive horizontal layers, ranging in thickness from 6" to 15" maximum. Concrete shall be placed within 1½ hours after addition of cement to the aggregate.

Where conditions make it difficult to place concrete uniformly and perform compaction at the bottom of forms, batches of mortar containing the same proportion of cement to sand as in the concrete mix shall be deposited first and spread over the cleaned surface to a depth of approximately 1".

Segregated, unworkable, and excessive slump concrete shall not be placed or, if placed, shall be removed and wasted as directed. High slump concrete resulting from addition of approved additives is acceptable for placement. Free water accumulating on new concrete during placement shall be removed as directed by the Engineer.

Placement and compaction methods shall ensure homogeneous concrete with maximum consolidation without segregation. Consolidate concrete by internal vibration, spading, or rodding by working it thoroughly around reinforcement, embedded items, and into corners of forms to eliminate all air or stone pockets which cause honeycombing,

pitting, or planes of weakness. Concrete contacting all formed surfaces shall be spaded manually to eliminate air bubbles.

Place horizontal construction joints at uniform vertical spacing unless otherwise shown on the drawings. Concrete shall not be placed to a depth of more than 10 feet in any 24 hour period, unless approved by Civil Engineering. All concrete placements shall be such as to keep cold joints from forming.

Whenever work is suspended on any section for more than one hour, the horizontal edges of the concrete next to the forms shall be brought to a plane perpendicular to the form face, and treated so no irregular, rough, or feathered edge joints show in the finished work. Before placing the next lift, clean the joint surface and remove all laitance. Immediately before placing new concrete wet the joint surface and remove all standing water.

Unless adequate weather protection is provided, do not place concrete during rain, sleet, or snow.

30.07 **CONCRETE - CURING** - Protect freshly deposited concrete from premature drying and hot or cold temperatures. Maintain a constant temperature throughout the curing period without drying.

All exposed concrete surfaces shall be kept continuously moist overnight by ponding, sprinkling, or by use of an approved membrane type curing compound, which conforms to ASTM C309, latest revision, and applied in conformance with the manufacturer's recommendations.

Curing shall continue, using one of the above methods or waterproof paper, for a 7 day period (3 days for high-early strength concrete) maintaining the concrete at a minimum temperature of 50° F as is practicable. Protective covering with tarpaulins, hay, straw, etc. shall be provided to retard moisture evaporation during hot weather and to prevent rain damage before hardening. Protective covering shall be available for immediate use at all times.

During the curing period, the concrete shall be protected from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration.

30.08 **SURFACE FINISH** - All surface fins shall be removed.

Exposed concrete surfaces shall not be given any special treatment to enhance appearance, such as rubbing with a stone, without permission of Civil Engineering.

30.09 **LOADING OF CONCRETE -** Normal concrete structures shall not be subjected to external loads in less than:

- four days for foundations, manhole floors, and walls
- seven days for floors, roofs, and columns

Each concrete placement shall be allowed to set 48 hours before addition of a subsequent pour upon it. If high-early cement is used this time period may be reduced by one-half.

Trenches containing concrete encased duct lines constructed on undisturbed original ground may be backfilled not less than two (2) hours after placement. Compaction by light tamping equipment may proceed immediately. Loading of the backfill by heavy equipment or traffic is not permitted before 12 hours after placement.

30.10 **WATERPROOFING -** Waterproofing is provided by the density of the concrete mix and the thickness of concrete. Care must be used in placing and compacting the concrete to eliminate all voids and potential leakage paths. When structures less than 8" thick must be waterproof, consult Civil Engineering to revise the mix design to achieve the desired waterproof result.

31.0 Easement Applications

31.1 NEW ENGLAND EASEMENT APPLICATION FORM

FOR NATIONAL GRID'S USE ONLY

Application for Easements (check one): ❒ OH (jointly owned or solely owned) ❒ UG ❒ Electric
❒ Padmount transformer only ❒ URD ❒ Gas

Work Request Number_____

Utility Engineer's Name:_____Telephone Number: _____

Please complete **ALL** of the sections below so that we may prepare an easement for your signature. Do not leave any sections unanswered. If a section does not apply to you simply put **"n/a"** on that line. Incorrect or incomplete information will delay service installation.

Property Owner(s):_____

Property Owner Mailing Address

Address: _____

City: _____

State & County _____

Zip _____

Property Address of Easement
(if different from mailing address)

Address: _____

City: _____

State & County _____

Zip _____

Customer Contact Person: _____

Daytime Phone(s): _____

Re: Subdivision Title: _____

1. Provide us with a **RECORDED** copy of the present owner's deed, Book_____ Page_____

   a) If multiple deeds make up the whole parcel, please include all deeds.

   b) If the Property Owner is a b1) CORPORATION, b2) TRUST, b3) PARTNERSHIP, or b4) LIMITED LIABILITY COMPANY, provide the following which is applicable:

   b1) President Name: _____Treasurer Name: _____
   See Footnote[1] Below

   Or

   Vice President:_____Asst. Treasurer:_____

[1] If neither "Name Combinations" is available, the person(s) signing the easement must have a Corporate vote authorizing them to sign on behalf of the Corporation.

b2) Trust: No. Of Trustees:_____Name(s): _____

Name of Trust:_____

b3) Partnership: Number of Partners:_____Name(s):_____

b4) LLC: Authorization to Sign, Name(s):_____

2. a) Provide us with an approved: "Definitive Subdivision Plan"

Plan Book:_____ Plan:_____ Dated:_____

b) If there is no recorded subdivision plan please include the following information:

Assessor's Map:_____Block:_____ and Lot:_____

3. Is your property mortgaged (circle one)? YES NO

If "YES", please complete this section:

a) Name of Bank/Company/Person holding mortgage(s):_____

b) Address of mortgage holder(s): _____

c) Date and recording information of mortgage(s): _____

Date:_____County Recorded:_____Book:_____Page:_____

Additional Comments:_____

Please contact your Account Manager or Service Administrator if you have any questions regarding this form.

31.2 NEW YORK EASEMENT APPLICATION FORM

Application For Utility Electric/Gas Distribution Easement

This Portion to be Completed by National Grid Representative
Application Date Received:_____
Type of Easement: ❒ OH (jointly owned or solely owned) ❒ UG Electric ❒ Gas ❒ Padmount transformer only ❒ URD
National Grid Representative_____ **Telephone**_____

Requestor of Service

Please complete **ALL** of the sections below so that we may prepare an easement for your signature. Do not leave any sections unanswered. If a section does not apply to you, simply put "n/a" on that line. **(Incorrect or incomplete information will delay service installation.)**

Property Owner(s): _____

Property Owner Mailing Address

Address: _____

City/Town: _____

State: _____

Zip Code: _____

Telephone: _____

Property Address of Easement
(if different from mailing address)

Address: _____

City/Town: _____

State & Country: _____

Zip Code: _____

Name of Subdivision: _____

Telephone: _____

Contact Person: _____

Daytime telephone(s): _____

1. Provide us with a **RECORDED** copy of the present owner's deed (and survey) if available. If multiple deeds make up whole parcel, please include all deeds.

   Book: _____ **Page:**_____

2. Tax map number of property where service is to be installed (SBL): _____

3. Recording reference to approved subdivision plan:

   Plan Book: _____**Plan:** _____ **Date:** _____

4. If the property owner is a (a) CORPORATION, (b) TRUST, (c) PARTNERSHIP, or (d) LIMITED LIABILITY COMPANY, provide the following which is applicable:

(a) CORPORATION NAME: _____

President:_____Treasurer:_____

Vice President: _____Assit. Treasurer: _____

(If none of the Officers listed above are available, the person(s) signing the easement must have a corporate vote authorizing them to sign on behalf of the Corporation.)

(b) TRUST NAME:_____

Number of Trustees:_____Names: _____

_____

(c) PARTNERSHIP NAME: _____

Number of Partners:_____Name(s):_____

(d) LIMITED LIABILITY COMPANY (LLC) NAME: _____

Authorization to sign – Name(s):_____

Note: As a public utility, National Grid is required to provide electric/gas service; however, you, the customer, are required to provide National Grid with all the easement rights necessary to install your electric/gas service, including any easement rights which must be acquired from others.

Please return or fax this document and the requested information to:

{National Grid Representative}

{Company name}

{Location: Street name}

{Location: City/Town, State, Zip Code}

{Fax number}

32.0 Concrete Approved Precast Manufacturers

Arrow Concrete Products
560 Salmon Brook St
Granby,CT 06035
Jim Jurczyk
1-860-653-5063

Fort Miller Company
P.O. Box 98
Schuylerville, NY 12871
Joe O'Malley
1-518-695-5000

Hoytes Concrete Products
7839 New Floyd Road
Rome NY 13440
Thomas Hoytes
1-877-336-7789

Kistner Concrete Products Inc.
5550 Hinman Rd
Lockport, NY 14094
1-716- 434-6157
Old Castle Precast
41 Almeida Rd
Rehoboth MA 02769
Bruce Blackledge
1-508-336-7600

United Concrete
173 Church St.
Yalesville CT 06492
Tom Long
1-203-535-4114

D.A. Collins
101 Route 67
Mechanicville, NY 12118
Andrew Timmis
1-518-664-9855

Grimm - Green Island
Green Island, NY 12183
1-518- 272-1100

Jefferson Concrete
22850 Murrock Circle
Watertown NY 13601
1-315-788-4171

Lakelands Concrete
7520 E. Main St. Lima NY 14485
Carl Ashley
1-585-624-1990

Shea Concrete
87 Haverhill Street
Amesbury, MA 01913
Greg Stratus
1-800-696-7432

Utility Precast Inc.
153 Cranberry Highway
Rochester MA 02770
1-508-291-1314

33.0 Approved Material – Underground Commercial Installations

National Grid Item ID	Item Description	Manufacturer 1 Part Number	Manufacturer 2 Part Number	Manufacturer 3 Part Number
		Conduit—Straight		
2010404	Conduit, 4", schedule 60 DB PVC	Carlon: 48815	IPEX: 8741	Cantex: A79EA42
2011024	Conduit, Galvanized, 4"	By Description		
		Conduit—Blends		
5690446	Bend, Galvanized, 4" 36" radius	BaynesJones 400R9036	Conditmfg TUB490D36RGALEL	
5690493	Bend, PVC Sch 40, 4", 90 Degree, 36" Rad.	Cantex: 5233842	Carlon: UA9FNB	Certifsaft 59734
		Spacers		
5646963	Spacer, 4", Base	GS Industries: 186-1	IPEX: 29573	
5646960	Spacer, 4", Inter.	GS Industries: 185-1	IPEX: 29557	
		Conduit Accessories		
5641210	Riser Strap, 4"	Electrical Materials: 50-4 USHD	BaynesJones MINRLAC HD-296	
7011830	Lag Screw, 1/4" x 2"	Elect. Materials: 106 or 106M	Joslyn J26486.1	PLH LSNW-142
3503074	Pipe Grd. Connector, 4" and 5"	Burndy GAR3905-BU	Thomasbett (0)3905-BU	
2010424	Temporay Duct Plug, 4" DB	Carlon: P258NT	Scepter 57	
2011254	Duct Plug Galvanized 4"	Crousehind PLG105		
2010434	Adapter, Female, PVC-Steel, 4"	Carlon: E942N	Cantex: 5140052	Scepter FA55
5693359	Coupling, 5 Degree, Bell-Spigot, 4"	Carlon: E244N	Cantex: 6151452	Certifsaft 59544
2010444	Coupling, 5 Degree, Bell-Bell, 4"	Ameripipe FT518	Carlon E2440NF	Scepter 7604360040
2010454	Straight Coupling, 4"	Carlon: E240N	Scepter 760443540	
2010464	Bell End Female 4"	Carlon: E997N	Cantex: 5144012	
9202062	Mule Tape	NEPTCO WP2500P	Arnco DLWP25	Condux 08096303
2011254	Plug Galvanized. 4" Threaded for Spare Riser	CROUSEHIND PLG105		
9202201	Plug Conduit 4" with metal loop for mule tape.	Carlon MAEPG7		

National Grid Item ID	Item Description	Manufacturer 1 Part Number	Manufacturer 2 Part Number	Manufacturer 3 Part Number
Transformer Foundations – Precast				
9200896	Three Phase 15 kV 75-500 kVA	Reference 044-113 UF8A	Lakeland UF8A	
9202324	Three Phase 15 kV 750-2500 kVA	Reference 044-114 UF8B	Lakeland UF8B	
9200898	Three Phase 25-35kV 75-300kVA	Reference 044-115 UF8C	Lakeland UF8C	
9200896	Three Phase 25-35kV 500-2500kVA	Reference 044-116 UF8D	Lakeland UF8D	
Grounding Accessories				
2011100	Grounding Bushing, 4"	CROUSEHIND GLL-10C	OZGEDNEY BLG 4122	
3503013	Grounding Rod 5/8" x 8' Solid Copperweld	ERITECH 615880	Galvin 6258	Joslyn: J8338
9201272	2/0 Cu, Bare, Soft Drawn, 19 Strand	By Description		
3503328	Ground Rod Clamp	Burndy: GRC58	Blackburn: JAB58H	Electromotion EM58DBW
5960412	"C" Connector, 2/0 – 2/0	Burndy: YC26C26TN		
3503074	Clamp, ground, conduit 4" heavy duty, Bronze	Burndy GAR3905-BU		
Splice box, Handhole, Switchgear Manhole				
5640808	Splice Box as shown on page 22	CDR Systems PA12-3060-37	Highline CVA306038HEIK	
5643075	Heavy Duty Handhole on page 21	Oldcastle Precast 502600		
9200893	Switchgear Manhole 15kV	OldcastlePrecast 202700/203400/203900		
9200894	Switchgear Manhole 25-35kV	Oldcastle Precast 202700/203400/204000		
2012198	Fiberglass Switchgear Base on page 33	HighLine HL-54		
Precast Oil Containment Wall				
9202153	Three Phase 15 kV 75-500 kVA	Oldcastle 13411	Lakeland TPC UF8A	Arrow S-OCC 134110
9202154	Three Phase 15 kV 750-2500 kVA	Oldcastle 135134	Lakeland TPC UF8B	Arrow S-OCC 135134
	Three Phase 25-35kV 75-300kVA	Oldcastle 13411	Lakeland TPC UF8C	
	Three Phase 25-35kV 500-2500kVA		Lakeland TPC UF8D	

National Grid Item ID	Item Description	Manufacturer 1 Part Number	Manufacturer 2 Part Number	Manufacturer 3 Part Number
	Manhole Frame, Ring and Cover			
5644514	Frame 36” square	Lebaron Foundry LE386	Syracuse Casting	
5644550	Ring 26” to 36”	Lebaron Foundry LE2836X1	Syracuse Casting	
5644360	Cover 26”	Lebaron Foundry L28C11	Syracuse Casting	

34.0 Other Materials/ Suppliers

Secondary connectors

Burndy Co

Richards Co

Utilco

Compression Connection Crimp Tool
(used for ground grids)

Burndy MD7-8 with the extra die set (W-BG).

Stuart C. Irby Co
4583 Buckley Road
Liverpool, NY 13088
Peter Karl
1-315-652-1238

Secondary Splice box

Elliot Industries

A.B.B.

Manhole frame, ring and cover

Lebaron Foundry
1-800-626-4653

Syracuse Casting
1-315-699-2601

Bollard Covers

Part number # BC760YW

Innoplast 1-800-516-9287

The materials in this book can be found at most Electrical supply stores, listed below are a few.

Baynes Electrical Supply
Southern MA and RI
1-800- 242-0911

Electrical Wholesalers
All of New England
1-800-522-3232

Granite City Electric
All of New England
1-800-850-9400

Graybar Electric
All service areas US
1-800-472-9227

Wesco
New Hampshire
1-800-258-5228

35.0 Job Check Off Sheets

35.1 3 PHASE UCD DIRECT BURIAL INSPECTION CHECK LIST NEW YORK

Do not backfill BEFORE trench has been inspected and approval by Company. Every item listed below must be inspected and checked by the company inspector.

N*	Y*	
		PRE-TRENCH *(no inspection)*
❒	❒	Final grade established, surface rough graded, and roadways staked.
❒	❒	Developer has Service Specifications on site.
❒	❒	Easement has been executed.
		TRENCH
❒	❒	Min. 30" depth from existing grade to top of cable during all phases of construction.
❒	❒	Electric infrastructure on “road side”, in all multi-utility trench installations.
❒	❒	Min. separation between electrical conduit and foreign conduits or pipes.
❒	❒	All road crossing perpendicular.
❒	❒	2” minimum of sand in base of trench.
		PRE-BACKFILL *(After cable is installed)*
❒	❒	4” of sand minimum on top of cable
❒	❒	Minimum separation to foreign utilities and subsurface pipes maintained.
❒	❒	Sand or screened backfill (with less than 1” stones) on-site for backfilling entire trench, (inspector may witness backfilling).
❒	❒	Warning tape 8" to 12" below finish grade and directly above electrical system.
❒	❒	No parallel non company utilities directly above or below electrical system.
		RISER POLE
❒	❒	90° BEND AND straight pipe galvanized steel conduit,. 90° Bend Concrete Encased
❒	❒	Steel-PVC adapter and steel sweep shall not be encased.
❒	❒	Ground clamp installed with tap.

**NOTE Y – Acceptable N – Deficient*

35.2 3 PHASE, CONDUIT ENCASED IN CONCRETE INSPECTION CHECK LIST

Do not pour concrete or backfill BEFORE conduit system inspection and approval by company inspector. Every item listed below must be inspected and checked by a company inspector.

N*	Y*	
		PRE-TRENCH *(no inspection)*
❒	❒	Final grade established, surface rough graded, and roadways staked.
❒	❒	Developer has Service Specifications on site.
❒	❒	Easement has been executed.
		TRENCH *(prior to concrete encasement)*
❒	❒	Min. 30" depth from existing grade to top of encasement during all phases of construction.
❒	❒	Electric conduits on “road side”, with 1 spare conduit, in all multi-utility trench installations.
❒	❒	Min. separation between electrical conduit and foreign conduits or pipes.
❒	❒	All road crossing perpendicular.
❒	❒	Conduit plugs installed.
❒	❒	Plastic spacers properly installed every 5 to 8’ intervals' and at every coupling.
❒	❒	All curves properly formed with 5° couplings.
❒	❒	Company conduits to be in separate encasement from all other utilities.
		PRE-BACKFILL *(after concrete encasement)*
❒	❒	Company conduit in separate encasement.
❒	❒	Minimum separation to foreign utilities and subsurface pipes maintained.
❒	❒	Encased concrete thickness > 3" around all conduits.
❒	❒	Sand or screened backfill (with less than 1” stones) on-site for backfilling entire trench, (inspector may witness backfilling).
❒	❒	Warning tape 8" to 12" below finish grade and directly above electrical conduit system.
❒	❒	No parallel non company utilities directly above or below electrical system.
		AFTER BACKFILL *(pre-conductor installation inspection)*
❒	❒	Install 2500 lb. Pulling Tape in all conduit after rodding with a mandrell.
		HEAVY DUTY HANDHOLE
❒	❒	6" of crushed stone under handhole.
❒	❒	Seal around conduit entrances with concrete or mortar.
❒	❒	Manhole cover at finish grade with 2 courses of brick and grout for chimney.
		PULLBOX/SPLICE BOX
❒	❒	4" of crushed stone under pullbox foundation.
❒	❒	Cover left secured to box when unattended.
❒	❒	Flush with sidewalk or slightly above any grassy area.
❒	❒	Installed behind curb or other protection to prevent damage (e.g. snowplow)
		RISER POLE
❒	❒	90° BEND AND straight pipe galvanized steel conduit.
❒	❒	Steel-PVC adapter and steel sweep shall not be encased.
❒	❒	Ground clamp installed with tap.

**NOTE Y – Acceptable N – Deficient*

35.3 3 PHASE UCD CONDUIT INSPECTION CHECK LIST NEW YORK

Every item listed below must be inspected and checked by the company inspector.

N*	Y*	
		PRE-TRENCH *(no inspection)*
❒	❒	Final grade established, surface rough graded, and roadways staked.
❒	❒	Developer has Service Specifications on site.
❒	❒	Easement has been executed.
		TRENCH
❒	❒	Min. 30" depth from existing grade to top of conduit during all phases of construction.
❒	❒	Electric infrastructure on “road side”, with 1 spare conduit if applicable, in all multi-utility trench installations.
❒	❒	Min. separation between electrical conduit and foreign conduits or pipes.
❒	❒	All road crossing perpendicular.
❒	❒	Conduit plugs installed.
❒	❒	Plastic spacers properly installed every 5 to 8’ intervals and at every coupling.
❒	❒	All curves properly formed with 5° couplings.
❒	❒	Company conduits to be in separate from all other utilities.
		PRE-BACKFILL
❒	❒	Company conduit separated from other utilities.
❒	❒	Minimum separation to foreign utilities and subsurface pipes maintained.
❒	❒	Sand or screened backfill (with less than 1” stones) on-site for backfilling entire trench, (inspector may witness backfilling).
❒	❒	Warning tape 8" to 12" below finish grade and directly above electrical conduit system.
❒	❒	No parallel non company utilities directly above or below electrical system.
		AFTER BACKFILL *(pre-conductor installation inspection)*
❒	❒	Install 2500 lb. Pulling Tape in all conduit after rodding with a mandrell.
		HEAVY DUTY HANDHOLE
❒	❒	6" of crushed stone under handhole.
❒	❒	Seal around conduit entrances with concrete or mortar.
❒	❒	Manhole cover at finish grade with 2 courses of brick and grout for chimney.
		PULLBOX/SPLICE BOX
❒	❒	4" of crushed stone under pullbox foundation.
❒	❒	Cover left secured to box when unattended.
❒	❒	Flush with sidewalk or slightly above any grassy area.
❒	❒	Installed behind curb or other protection to prevent damage (e.g. snowplow)
		RISER POLE
❒	❒	90° BEND AND straight pipe galvanized steel conduit.
❒	❒	Steel-PVC adapter and steel sweep shall not be encased.
❒	❒	Ground clamp installed with tap.

**NOTE Y – Acceptable N – Deficient*

35.4 TRANSFORMER FOUNDATION INSPECTION CHECK LIST

Do not pour concrete prior to inspection and approval by Company of the pad forming and reinforcement, the subgrade preparation, and the ground grid. Do not back fill after removing the forms prior to pad inspection. Every item listed below must be inspected and checked off by Company inspector.

N*	Y*	
		PRE-INSTALLATION
❒	❒	Proposed location within 10' of paved way open to vehicular access.
❒	❒	Proposed location has minimum of 10' clear space in front of transformer doors.
❒	❒	Proposed location has minimum clearance to buildings, doorways, windows, ventilation ducts, fire escapes, and other combustibles as per pages 14 and 15 of this guide.
❒	❒	Bollard locations are identified by Company.
❒	❒	Ground grid installation and two ground rods
		PRE-POURING
❒	❒	12" gravel and 2" sand below pad location.
❒	❒	Reinforcing bars.
❒	❒	Concrete forms correct height, size, orientation, opening, etc.
❒	❒	Concrete forms in correct location.
❒	❒	Ground grid installation and two ground rods.
❒	❒	36" radius at all 90° sweeps into pad stopping 1" above pad.
❒	❒	Secondary sweeps in place and proper number.
		AFTER POURING *(after removing forms and prior to backfilling)*
❒	❒	Pad correctly formed and 10" high.
❒	❒	¾" chamfer along the edges. Sweeps 1" above pad.
		AFTER BACKFILL
❒	❒	6" protective bollards are correctly installed.
❒	❒	Pad 5" above final grade.
❒	❒	Pad has 10' of clear space in front of transformer doors, is 10' from an accessible paved way and has the minimum clearance to other structures.

**NOTE Y – Acceptable N – Deficient*

36.0 Cable Installation Maximum Pull Chart

Straight cable pull chart typical maximum pulls						
	15kV Class			35kV Class		
Wire Size	Riser to Pad	Riser to Pull Box	Pull box to Pull Box	Riser to Pad	Riser to Pull Box	Pull box to Pull Box
#2 AL	530	605	750	n.a.	n.a.	n.a.
1/0 AL	n.a.	n.a.	n.a.	320	360	750
2/0 CU	n.a.	n.a.	n.a.	615	695	750
4/0 CU	695	720	750	n.a.	n.a.	n.a.

Note:

1) All Calculations are based on a straight pulls
2) All conduits are 4”
3) Assume 50Lb reel drag
4) Assume .5 for coefficient of friction
5) Pulls are in feet
6) Pulls distances are shown from worst case pulling end.

37.0 Padmount Compartment Sealing Requirement

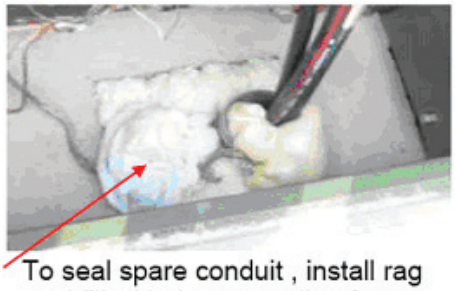
Issued by Standards #09-09

Safety
Standards
Work Methods

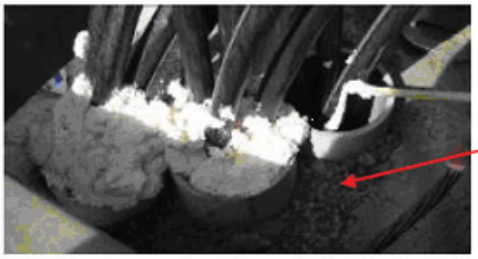
THREE PHASE PADMOUNTED TRANSFORMER SEALING

Padmounted transformer compartment areas shall be sealed to minimize the direct release of transformer fluid into the ground through the primary and secondary compartment areas of the transformer. Sealing the compartment areas will better contain the release, allowing the fluid to be noticed more promptly.

The following describes how to seal the compartments areas. Compartment areas shall be filled with sand to a grade of 4" below the top of the concrete pad. On top of the sand a concrete grout (no aggregate) or expanding foam (STD Item UF10) shall be installed to the top to the concrete pad. The installer of the transformer pad and conduit is required to seal the compartment areas. All conduits shall also be filled in with expanding foam. The customer is required to seal all conduits where they are installing customer owned cables, this includes the spare conduits in that duct bank. The company is required to seal all conduits where they are installing company owned cables, this includes the spare conduits in that duct bank. This detail is further explained in the Underground Construction Standards book in section 44.20. Note: Keep the expanding foam stored in a heated environment to make applying easier.

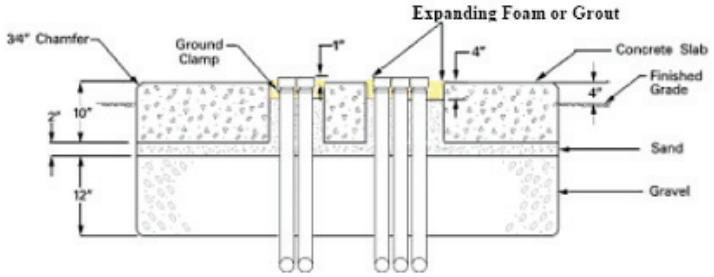


To seal spare conduit , install rag and fill with the expanding foam.



Grouted Area

Apply expanding foam in between all cables to form a complete seal.



Cross section view of a padmounted transformer having primary and secondary compartments filled with sand and Expanding Foam.

38.0 Revision History

Version	Date	Description of Revision
1.0	07/19/10	New document superseding all previous versions of ESB 759B.

National Grid is an international energy delivery company. In the U.S., National Grid delivers electricity to approximately 3.3 million customers in Massachusetts, New Hampshire, New York and Rhode Island, and manages the electricity network on Long Island under an agreement with the Long Island Power Authority (LIPA). It is the largest distributor of natural gas in the northeastern U.S., serving approximately 3.4 million customers in Massachusetts, New Hampshire, New York and Rhode Island. National Grid also owns over 4,000 megawatts of contracted electricity generation that provides power to over one million LIPA customers.

National Grid
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Waltham, MA 02451-1120
1-800-322-3223 New England
1-800-642-4272 New York
www.nationalgridus.com

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CM4518_759B 9/10

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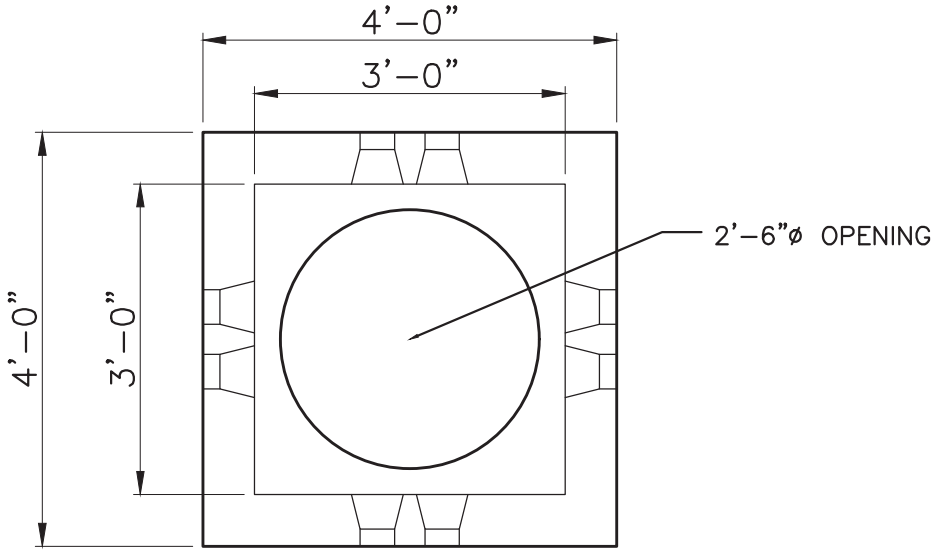
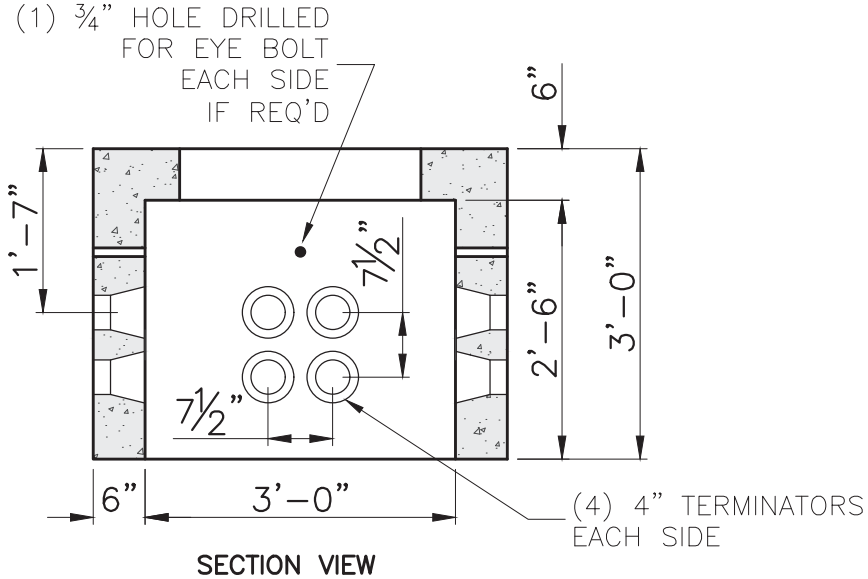
HANDHOLE 36" X 36" H-20



PLAN VIEW



SECTION VIEW

OPEN BOTTOM

NOTES:

1. CONCRETE: 5,000 PSI MINIMUM AFTER 28 DAYS.
2. DESIGN LOADING: AASHTO HS20-44, 0 TO 5 FEET COVER.
3. STEEL REINFORCEMENT CONFORMS TO ASTM A615, GRADE 60.
4. MINIMUM STEEL COVER 1".
5. OPTIONAL OPENINGS AVAILABLE BY SPECIAL ORDER.

SHEA PRODUCT ID:	HH-333H	FILE NAME:	HANDHOLE 36X36 H-20		
WEIGHT (LBS):	3340	DRAWN BY:	L.P.	DATE: 1/16/2018	PAGE: I.B.5

NPCA CERTIFIED PLANT