



CUY-90-14.90

PID 77332/85531

APPENDIX GE-11

**Horizontal and Vertical Drains
(Contract Document)**

State of Ohio
Department of Transportation
Jolene M. Molitoris, Director

**Innerbelt Bridge
Construction Contract Group 1 (CCG1)**

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Updated Page Numbers: 6, 11

HORIZONTAL DRAINS

9-30-11

1. DESCRIPTION

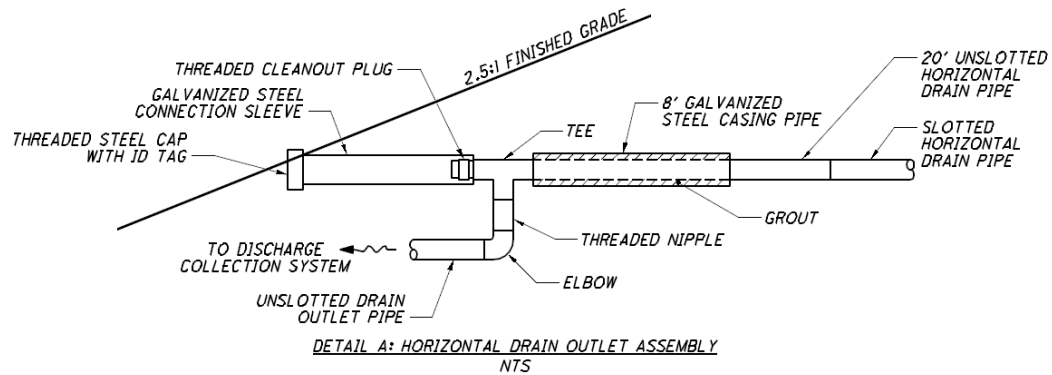
This work consists of (1) furnishing and installing horizontal drain pipes at locations shown on the plans and as described in this specification, (2) furnishing and installing a ground water discharge collection system designed by the Design Build Team (DBT), (3) designing, constructing, and maintaining erosion and sediment control for the duration of horizontal drain installation process to prevent sediment-laden drill water from directly entering any stream or water course, (4) furnishing all labor, materials, tools, equipment, and incidentals necessary for determining the elevations of the installed drains, (5) performing all work necessary to make the drainage system fully functional and effective, and (6) restoring the ground surface that becomes disturbed as a result of the horizontal drain installation in accordance with C&MS 503.

1.1. General

Submit a drilling/installation plan to the Engineer 14 days prior to beginning any horizontal drain related work. The plan is to include (1) details of the experience of the personnel that will direct field activities and operate the drilling equipment, (2) the method and equipment proposed for installing the horizontal drains, (3) the erosion and sediment control plan, (4) a seal detail indicating the materials to be used, (5) the sequence of construction, (6) detailed design plans of the drainage collection system showing all proposed dimensions, materials, and connections, and (7) a proposed plan for demonstrating that the completed system is fully functional and effective. Horizontal drain related work is not to be performed without prior approval of the installation plan by the Engineer. Prior to beginning drilling work, the drilling foreman and lead driller are to meet with the Engineer to review the drilling program.

1.2. Outlet Drain Assemblies

All connections are to consist of standard water fittings and are to be water-tight. Each outlet assembly is to consist of a threaded cleanout plug on the outlet end of each drain. Place the cleanout plug below grade and make it accessible through a steel connection sleeve extending to the 2.5:1 finished grade line and fitted with a threaded cap. The connection sleeve from the surface cap to the cleanout plug is to be a minimum of 36 inches long. Behind the cleanout plug the drain is to include a tee which connects to an outlet pipe. See Detail "A" shown below.



1.3. Site Restoration

Clean the drilling site of all drill cuttings, waste, rubbish, and miscellaneous debris, and dispose of the materials off-site in a lawful manner. Restore the graded slope to the plan dimensions by grading, removal of the erosion and sediment control measures, and in accordance with C&MS 203 embankment construction procedures.

2. MATERIALS

2.1. Plastic Drain Pipe

Horizontal drains are to consist of nominal 1 ½ inch, Schedule 80 polyvinyl chloride (PVC) plastic pipe conforming to the requirements of ASTM D 1785. At the option of the Contractor, the type, grade, and design stress designation of the pipe can be either 1120, 1220, 2110, 211, 2116, or 2120 as specified in ASTM D 1785.

The slotted pipe is to have 2 rows of slots. The rows are to be in the longitudinal direction of the pipe and the slots are to be cut in the circumferential direction of the pipe. The rows are to be centered on 2 of the third points (120 degrees apart) of the pipe circumference. Slots are to be spaced uniformly along the pipe. The minimum opening will be measured on the inner surface of the pipe. In each row of slots, provide 25 slots per linear foot with 0.04 inch wide slots, resulting in a minimum opening area of 1.00 square inches per linear foot.

Fittings for the PVC plastic pipe shall be Schedule 80 Type II PVC solvent weld type fittings conforming to the requirements in ASTM Designation: D 2467. Machined male and female ends may be used in lieu of couplings.

Unslotted/imperforated PVC plastic pipe, 20 feet in length, is to be provided at the outlet of the drain.

2.2. Galvanized Steel Pipe

Provide standard weight galvanized steel pipe for the connection sleeve and the horizontal drain casing. The galvanized steel pipes shall have a 3/8" wall thickness. The galvanized steel pipe shall be in accordance with the specification of ASTM A 53, except the hydrostatic test will not apply.

2.3. Cement/Bentonite Grout

Fill the annular space between the steel casing pipe and the unslotted PVC plastic pipe with a cement/bentonite grout for a length of 8 feet. The cement/bentonite grout shall be in accordance with the ODOT Specifications for Geotechnical Explorations, Appendix F Section 3.3.4. Other permanent sealing methods such as substituting a two-part polyurethane foam for the cement will be considered.

3. INSTALLING HORIZONTAL DRAINS

3.1. Drains

The drains are to be installed at locations as shown on the plans. The length, orientation, and approximate location of each of the drains are to be as listed in Table 1. Adjust horizontal drain location(s) when the plan proposed horizontal drain would intersect the pier foundation for the proposed westbound I-90 Viaduct Structure. The exact location and sequence of placing horizontal drains is to be as determined and documented by the DBT. The DBT must prepare and submit to the Engineer a set of horizontal drains as-built plans.

The horizontal drain holes shall be drilled with rotary equipment capable of drilling 3-inch to 6-inch diameter holes up to 200 feet in length to the designated lines and grades through existing subsurface formations. Drill the holes for the horizontal drains at approximately 4 feet \pm 2 feet (measured vertically) above the toe of the 2.5:1 slope. Maintain a positive upward slope of at least 1% behind the collar of the hole for the full length of the hole. Drain holes within each array are to be horizontally located at a spacing of approximately 5 feet.

Drill with casing and/or hollow drill rods to allow the insertion of the 1 1/2 inch PVC drain pipe to the full depth of hole prior to removal of the casing and/or hollow drill rods. If drill rods are used as casing, knock off the drill bit at the full depth of the hole to allow insertion of the PVC drain pipe to the full depth of the horizontal drain subsequent to retraction of the drill rods. Securely plug the entrance end of the pipe with a rounded or pointed plug that is not to extend more than 6 inches beyond the end of the pipe. The plug can be made of wood, plastic, or other nonporous material. Install the plastic pipe by inserting the pipe inside the drill rod and then retracting the drill rod so that the drilled hole is cased for the full depth of the horizontal drain. The plastic pipe is to be installed in such a manner that the plastic casing will be cemented together where necessary to form a continuous tube and will not be telescoped or damaged to the extent that its

drainage efficiency would be impaired when completed. The two rows of slots are to be oriented along the top of the plastic pipe. Remove temporary casing or drill rods with provisions to ensure that the PVC drain pipe is not damaged or pulled out any distance.

Drilling muds will not be permitted; however the contractor may use a biodegradable drilling fluid.

During the drilling operations, the Contractor is to determine and record the elevation of the drilled hole at 10-foot intervals and the elevation at the upper end of the completed drain hole. The measurements may be made by inserting tubes or pipes and measuring liquid levels or by other means satisfactory to the Engineer.

Upon completion of installation of all the horizontal drains, flush the inside of the 1 ½ inch PVC drain pipe with clean potable water. Use a jet nozzle on the end of a tube inserted the full length of the drain pipe to accomplish the flushing. Operate the water jet during insertion and removal to flush possible contaminants in pipe slots and any blockages within the pipe. The jet nozzle is to have a minimum of six equally spaced holes made on 15 degree angles with the axis of the base (for side-flushing) and a single hole at the tip of the head. Water pressure is to be approximately 500 to 1000 psi. Dispose of the water used for drilling and water developed during drilling operations in such a manner that water does not damage the project work site or the environment. . Follow with a flushing of the pipe until return water contains no soil particles.

3.2. Installing Seals

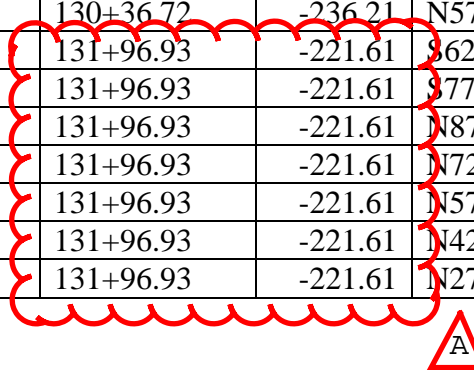
The drawings show an 8 ft long galvanized pipe sealed in grout near the end of the drain to force water to exit the slope through the drain pipe. A galvanized steel casing pipe shall be inserted into the drill hole and is to penetrate the ground eight feet past the tee. The casing is to have an outside diameter slightly larger than the drill hole to form a tight fit.

3.3. Horizontal Drain Identification

Identify each horizontal drain with the length of the drain and the number assigned in the plans or provided by the engineer. Scribe or stamp the identification on a brass plate or long lasting tag securely attached to the threaded steel cap at the end of the steel connection sleeve. Identification plates shall be furnished for each drain and shall be 12 gauge brass, 1 inch wide by 4 inches long, with a number assigned by the engineer.

Table 1: Length, orientation, and approximate location of the horizontal drains

Drain Number	Station (Prop. IR 90)	Offset	Bearing	Inclination (Percent)	Approximate Length (FT)
A1	131+21.74	-10.75	N84°19'44"E	5	145
A2	131+21.74	-10.75	S80°40'16"E	5	145
A3	131+21.74	-10.75	S65°40'16"E	5	145
A4	131+21.74	-10.75	S50°40'16"E	5	145
A5	131+21.74	-10.75	S35°40'16"E	5	145
A6	131+21.74	-10.75	S20°40'16"E	5	145
A7	131+21.74	-10.75	S05°40'16"E	5	145
B1	129+73.44	-59.83	S66°16'05"E	5	145
B2	129+73.44	-59.83	S51°16'05"E	5	145
B3	129+73.44	-59.83	S36°16'05"E	5	145
B4	129+73.44	-59.83	S21°16'05"E	5	145
B5	129+73.44	-59.83	S06°16'05"E	5	145
B6	129+73.44	-59.83	S08°43'55"W	5	145
B7	129+73.44	-59.83	S23°43'55"W	5	145
C1	129+52.40	-134.29	S05°01'06"E	5	145
C2	129+52.40	-134.29	S09°58'55"W	5	145
C3	129+52.40	-134.29	S24°58'55"W	5	145
C4	129+52.40	-134.29	S39°58'55"W	5	145
C5	129+52.40	-134.29	S55°58'55"W	5	145
C6	129+52.40	-134.29	S69°58'55"W	5	145
C7	129+52.40	-134.29	S84°58'55"W	5	145
D1	130+36.72	-236.21	S32°55'30"W	5	145
D2	130+36.72	-236.21	S47°55'30"W	5	145
D3	130+36.72	-236.21	S62°55'30"W	5	103
D4	130+36.72	-236.21	S77°55'30"W	5	100
D5	130+36.72	-236.21	N87°04'30"W	5	85
D6	130+36.72	-236.21	N72°04'30"W	5	79
D7	130+36.72	-236.21	N57°04'30"W	5	79
E1	131+96.93	-221.61	S62°55'30"W	5	86
E2	131+96.93	-221.61	S77°55'30"W	5	65
E3	131+96.93	-221.61	N87°04'30"W	5	55
E4	131+96.93	-221.61	N72°04'30"W	5	51
E5	131+96.93	-221.61	N57°04'30"W	5	51
E6	131+96.93	-221.61	N42°04'30"W	5	55
E7	131+96.93	-221.61	N27°04'30"W	5	65



A	Updated NS drive grading	ELR	11/14/11
NO.	REVISIONS	BY	DATE

VERTICAL GAS RELIEF DUCTS

11-23-09

1. DESCRIPTION

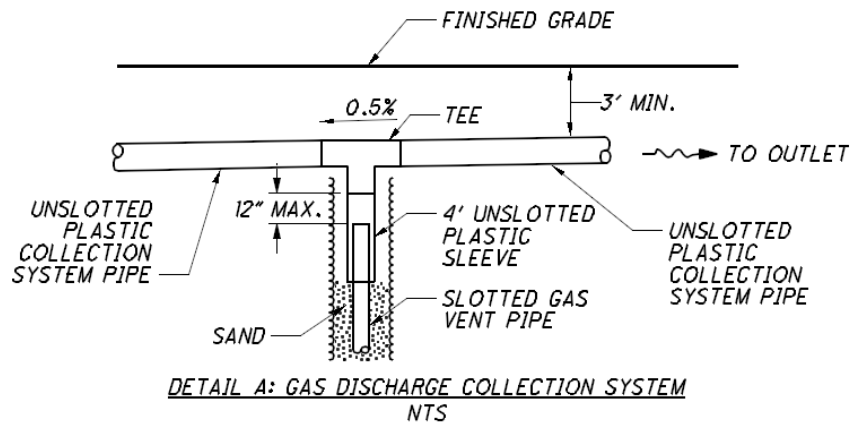
This work consists of (1) furnishing and installing vertical gas relief ducts at locations shown on the plans and as described in this specification, (2) furnishing and installing a gas discharge collection system designed by the Design Build Team (DBT), (3) designing, constructing, and maintaining erosion and sediment control for the duration of the vertical gas relief duct installation process to prevent sediment laden drill water from directly entering any stream or water course, (4) furnishing all labor, materials, tools, equipment, and incidentals necessary for determining the elevations of the completed borehole, (5) performing all work necessary to make the gas relief system fully functional and effective, and (6) restoring the ground surface that becomes disturbed as a result of the vertical gas relief duct installation in accordance with C&MS 503.

1.1. General

Submit a vertical gas relief ducts drilling/installation plan to the Engineer 14 days prior to beginning any work. The plan is to include (1) details of the experience of the personnel that will direct field activities and operate the drilling equipment, (2) the method and equipment proposed for installing the vertical gas relief ducts, (3) the erosion and sediment control plan, (4) the sequence of construction, (5) detailed design plans of a collection system that directs the gas to one common outlet and shows all proposed dimensions, materials, and connections, and (6) a proposed plan for demonstrating that the completed system is fully functional and effective. Vertical duct related work is not to be performed without prior approval of the installation plan by the Engineer. Prior to beginning drilling work, the drilling foreman and lead driller are to meet with the Engineer to review the drilling program.

1.2. Gas Discharge Collection System

The Gas Discharge Collection System consists of a manifold arrangement of pipes constructed as necessary to direct the gas to an outlet. All connections will consist of standard water fittings and will be watertight. The collection system for the vertical ducts will consist of all necessary tees, plugs, street ells, outlet pipe, and steel grating required for conveying gas from the vertical vent pipes to the discharge point. The collection system will be located a minimum of 3 feet below the finished ground surface. The outlet pipe from the vertical ducts to the discharge point will consist of solid wall pipe. The collection system will have a minimum 0.5% grade sloped up toward the outlet point to ensure gas venting. Steel grating will be installed over the outlet point. See Detail "A" shown below.



1.3. Site Restoration

Clean the drilling site of all drill cuttings, waste, rubbish, and miscellaneous debris, and dispose of the materials off-site in a lawful manner. Restore the access road to the pre-construction condition by grading, removal, filling and/or smoothing of erosion and sediment control measures, and C&MS 203 embankment construction procedures.

2. MATERIALS

2.1. Plastic Vent Pipe

Vertical gas relief ducts are to consist of nominal 3.25 inch pipe in accordance with AASHTO M 252 except as follows. Provide slot-type perforations located at 90° spacing around the pipe. The pipe stiffness is to be 60 psi at 5% deflection when tested in accordance with Section 9.

Slots are to be spaced uniformly along the pipe. The minimum opening will be measured on the inner surface of the pipe. In each row of slots provide 25 slots per linear foot with 0.04 inch wide slots, resulting in a minimum opening area of 1.00 square inch per linear foot.

Non-perforated pipe is to be provided for the Gas Discharge Collection System. The non-perforated pipe is to consist of nominal 4 inch, Schedule 80 polyvinyl chloride (PVC) plastic pipe conforming to the requirements of ASTM D 1785. At the option of the Contractor, the type, grade, and design stress designation of the pipe can be either 1120, 1220, 2110, 2111, 2116, or 2120 as specified in ASTM D 1785.

Fittings for all pipes are to be factory-made, welded fittings and be of at least equal strength as the pipes.

2.2. Steel Vent Grate

Cover the outlet point of the Gas Discharge Collection System with ½" x ½" mesh, 16-gauge steel, hot galvanized wire cloth.

2.3. Aggregate

Fill the annular space in the drill hole around the slotted vertical vent pipe with sand conforming to C&MS 703.06.

3. INSTALLING VERTICAL GAS RELIEF DUCTS

3.1. Ducts

Install the vertical ducts at locations as shown on the plans. The depth and approximate location of each of the ducts are listed in Table 1. Relocate all ducts that would intersect with any pier foundations for the proposed Westbound Central Viaduct substructure. Boreholes that encounter bedrock at depths shallower than shown in Table 1 can be terminated at the bedrock elevation. The exact location and sequence of placing vertical ducts is to be as determined and documented by the DBT. The DBT must prepare and submit to the Engineer a set of vertical gas relief duct as-built plans.

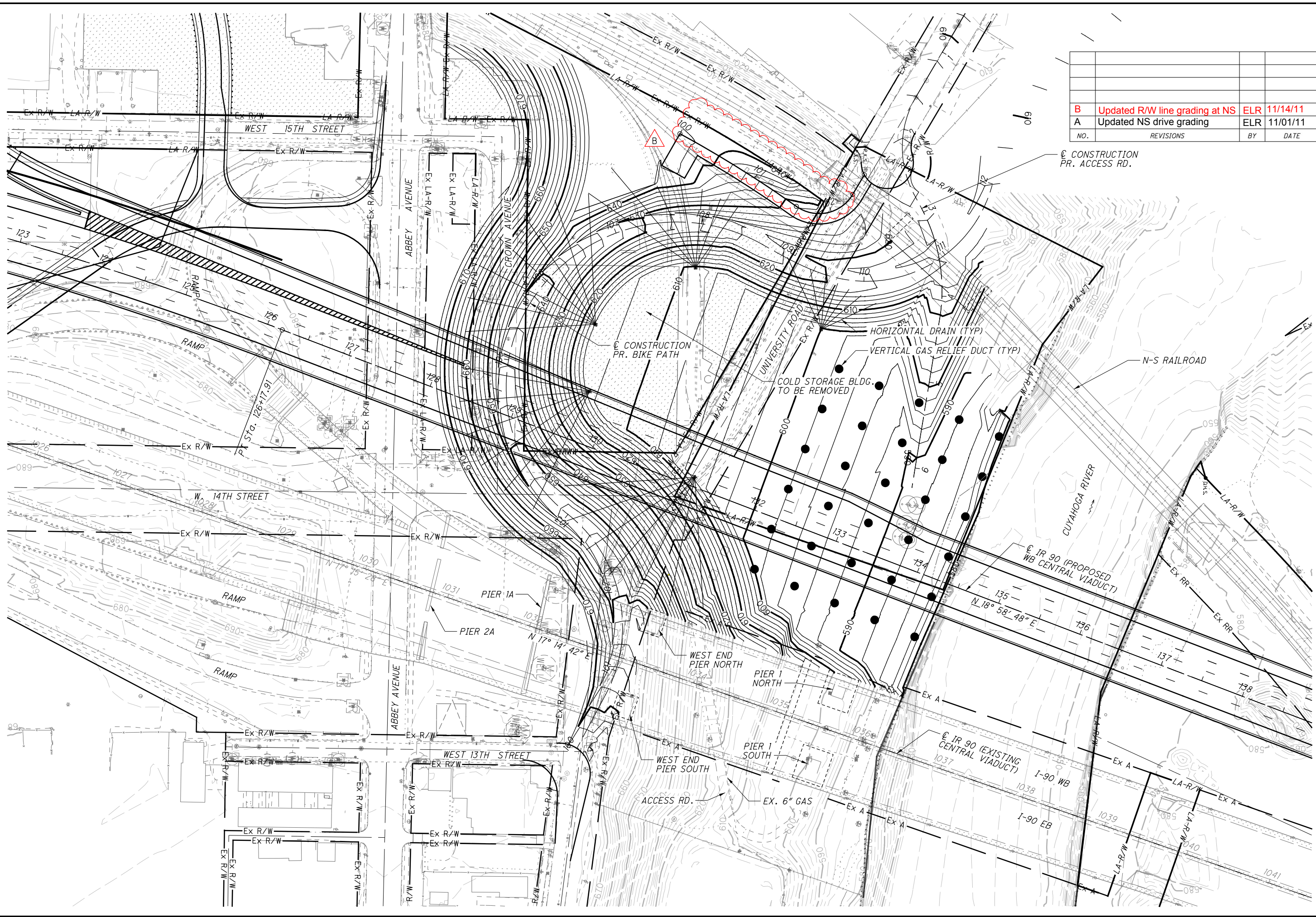
Drill holes with rotary equipment such as hollow stem augers capable of drilling a minimum inside hole diameter larger than 3.75 inches up to the designated depths through existing subsurface formations. Drill with hollow stem augers to allow the insertion of the plastic vent pipe to the full depth of hole prior to removal of the casing and/or hollow drill rods. Plug the bottom of the hollow stem augers with a piece of wood to prevent soil from entering inside the augers. Securely plug the bottom end of the plastic pipe with an end cap fitting of at least equal strength as the pipe. Install the plastic pipe by inserting the pipe inside the hollow stem augers and then retracting the drill augers. The plastic pipe is to be installed in such a manner that the plastic pipe will be cemented together where necessary to form a continuous tube and will not be telescoped or damaged to the extent that its ventilation efficiency would be impaired when completed. Remove the hollow stem augers with provisions to ensure that the plastic pipe is not damaged or pulled out any distance.

Furnish water for the drilling operations. Re-circulate water to reduce discharge and to prevent environmental impacts. Use pumps as necessary for recirculation. Water used for drilling and water developed during drilling operations shall be completely contained by the Contractor. Drill cuttings shall be removed from the site.

Table 1. Depth and Approximate Location of the Vertical Gas Relief Ducts

Vertical Gas Relief Duct Number	Approximate Station (Prop. IR 90)	Approximate Offset	Depth (FT)
A1	134+23.50	70.49	119
A2	133+73.53	68.74	123
A3	133+23.56	66.98	125
A4	132+73.59	65.22	129
A5	132+23.62	63.46	132
B1	134+25.25	20.53	119
B2	133+75.29	18.77	123
B3	133+25.32	17.01	125
B4	132+75.35	15.25	129
B5	132+25.38	13.49	132
C1	134+27.01	-29.44	119
C2	133+77.04	-31.20	123
C3	133+27.08	-32.96	125
C4	132+77.11	-34.72	129
C5	132+27.14	-36.48	132
D1	134+28.77	-79.41	119
D2	133+78.80	-81.17	123
D3	133+28.83	-82.93	125
D4	132+78.87	-84.69	129
D5	132+28.90	-86.45	132
E1	134+30.53	-129.38	119
E2	133+80.56	-131.14	123
E3	133+30.59	-132.90	125
E4	132+80.62	-134.66	129
E5	132+30.66	-136.42	132
F1	134+32.29	-179.35	119
F2	133+82.32	-181.11	123
F3	133+32.35	-182.87	125
F4	132+82.38	-184.63	129
F5	132+32.41	-186.39	132

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NO.	REVISIONS	BY	DATE
B	Updated R/W line grading at NS	ELR	11/14/11
A	Updated NS drive grading	ELR	11/01/11

⊕ CONSTRUCTION PR. ACCESS RD.

⊕ CONSTRUCTION PR. BIKE PATH

HORIZONTAL DRAIN (TYP)
VERTICAL GAS RELIEF DUCT (TYP)

N-S RAILROAD

CUYAHOGA RIVER

⊕ IR 90 (PROPOSED WB CENTRAL VIADUCT)
N 18° 58' 48" E

⊕ IR 90 (EXISTING CENTRAL VIADUCT)

I-90 WB
I-90 EB

ACCESS RD.

EX. 6" GAS

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A	Updated NS drive grading	ELR	11/01/11
NO.	REVISIONS	BY	DATE



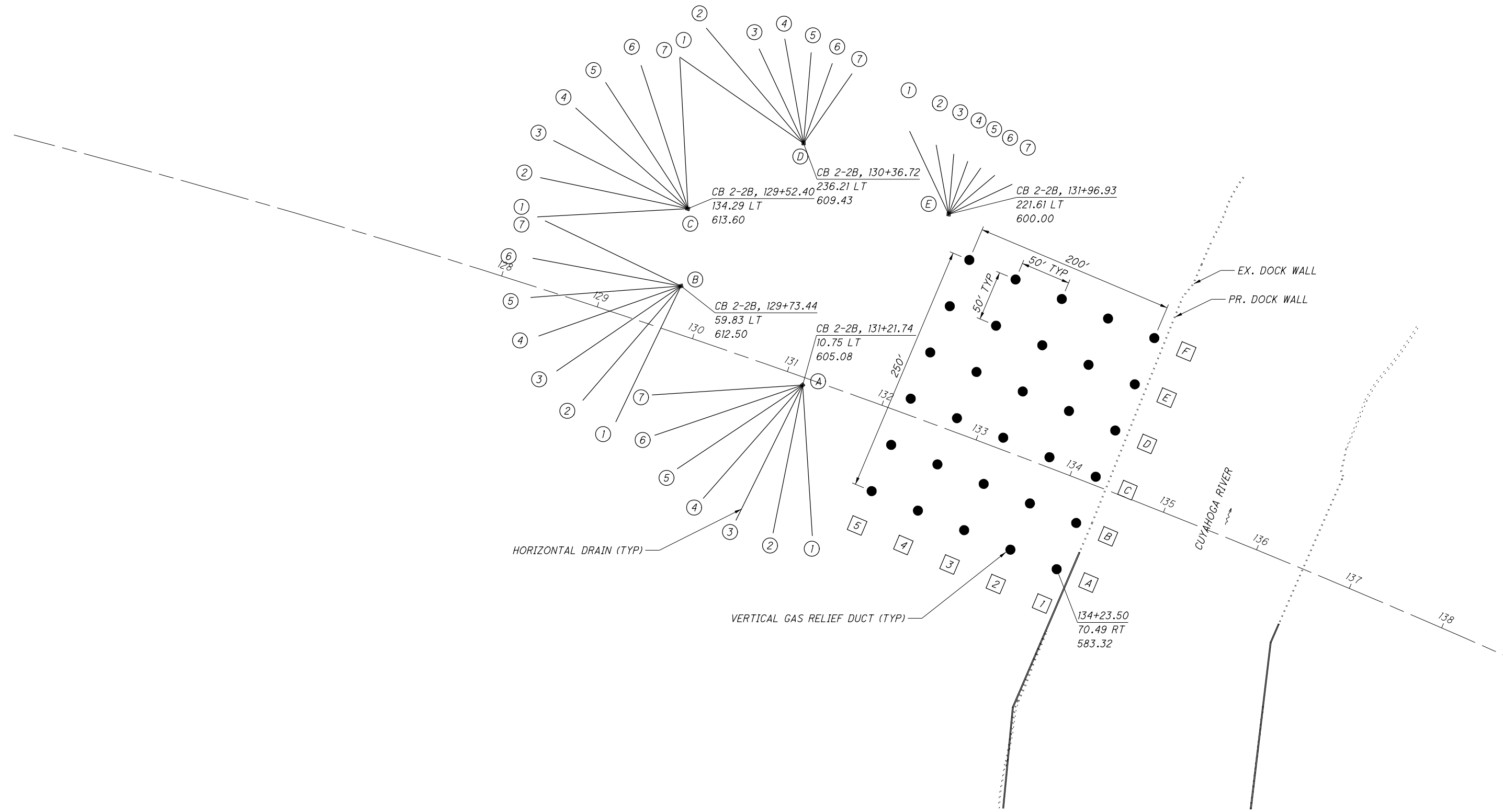


 HORIZONTAL SCALE IN FEET

**HORIZONTAL DRAIN & VERTICAL DUCT DETAIL
CUYAHOGA RIVER WEST BANK**

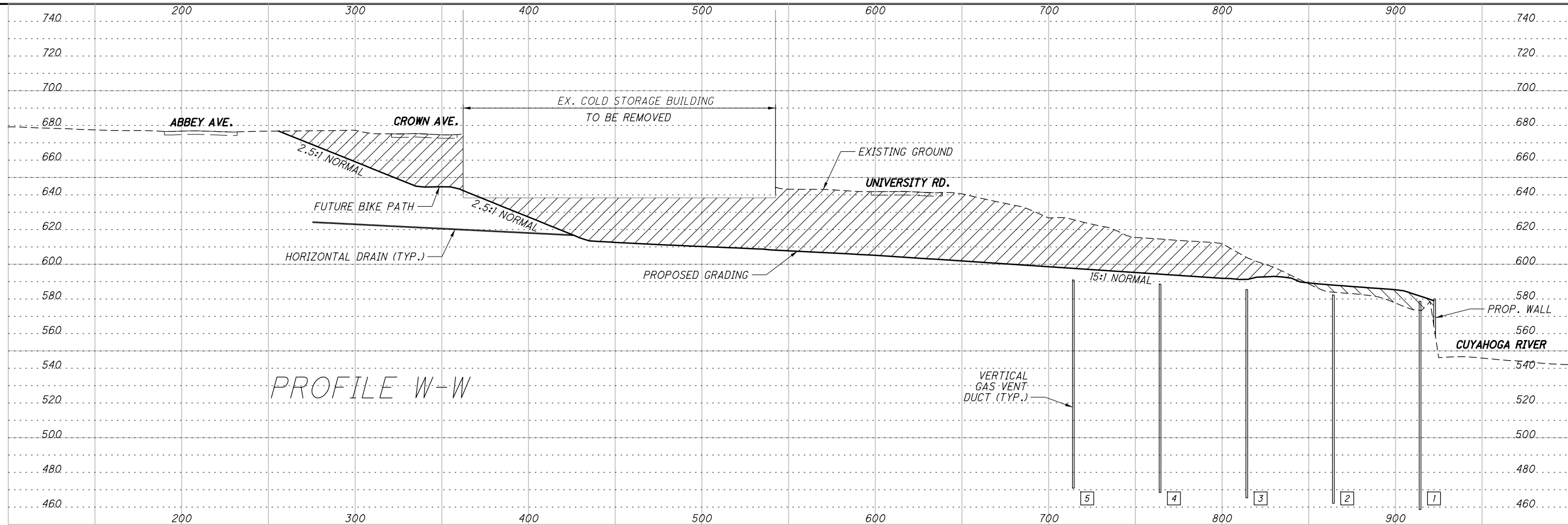
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NOTES:
 1. STATIONS AND OFFSETS ARE REFERENCED TO \odot CONSTRUCTION IR 90 (PROPOSED WB CENTRAL VIADUCT).

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CALCULATED
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HORIZONTAL DRAIN & VERTICAL DUCT PROFILE

CUY-90-14.92

3
3

NO.	REVISIONS	BY	DATE
A	Updated NS drive grading	ELR	11/01/11