Memorandum

To: Gerold Noyes
Vermont Department of Environmental Conservation
Waste Management and Prevention Division

Date: Draft April 18, 2016

Project #: 57603.00

From: Rachel Lomonaco & Meddie J. Perry, CGWP

Re: Middlebury WRCS(23) Bridge Project
Pre-Construction Soil and Groundwater Sampling Work Plan

INTRODUCTION

On behalf of the Vermont Agency of Transportation ("VTrans") and the Town of Middlebury, VHB has prepared this pre-construction soil and groundwater sampling work plan ("Work Plan") for the Middlebury WCRS(23) Bridge Project ("the Project") which includes the full replacement of two roadway bridges in downtown Middlebury where Main Street and Merchants Row span the Vermont Railway, Inc. ("VTR") track. The purpose of the Project is to replace the two bridges with a single tunnel and to depress the VTR track by several feet with excavation required up to approximately 12 feet below existing grade in the area of the current bridges. The track lowering is to comply with federal and state requirements to accommodate taller freight traffic along the VTR track.

This work plan provides protocols for a pre-construction characterization of the Project area to investigate the condition of soil and groundwater that are expected to be encountered within the Project area during Project construction. Specifically, the work plan provides a review of the history of the Project area with respect to contaminants of concern, and outlines procedures to complete soil and groundwater sampling and analysis of contaminants of concern. The results of this investigation will serve to advise VTrans and the Town of Middlebury of design constraints, allowable soil and groundwater handling practices, and disposal requirements for soils and materials that are encountered during Project construction.

PROJECT AREA

The Project area is located within downtown Middlebury, Vermont to the east of the Otter Creek. A Project Location Map is included on page 1 of the Attachment. Soil Work Plan Engineering Plan sets are included on pages 2-9 of the Attachment. Note that the work plan narrative refers to locations within the Project area in accordance with stationing notation (e.g., 10+00) as defined in the Soil Work Plan Engineering Plan sets.

The Project limits include approximately 3,575 feet of the State right-of-way ("ROW") from the railroad bridge over the Otter Creek (southern limit; Station 10+00) to just north of the Elm Street Bridge (northern limit; Station 45+75). The Project area also includes the Town of Middlebury road ROWs, which are elevated above the VTR track, and includes Main Street from the Merchants Row intersection to Seymour Street and Merchants Row from the Main Street intersection to South Pleasant Street. Additionally, the Project area includes a portion of Triangle Park and areas to the south of Merchants Row, between the VTR track and the bank of the Otter Creek, and an access road to the VTR track off of the western end of Water Street. Lastly, the Project area includes areas to the north of Main Street, in the former location of the Lazarus building (20 Main Street, Middlebury, VT) and an existing underground stormwater pipe and outfall which outlets to the Otter Creek.

Based on a preliminary geotechnical assessment completed by Otter Creek Engineering ("OCE"), the railroad alignment consists of ballast from approximately 0-2 feet below current grade that is partially or completely entrained in soil (OCE, 2013; OCE, 2014). Below the ballast is fill consisting of silty clay to silty sand, with some gravel and underlain by till. Additionally, according to the geotechnical assessment, exposed bedrock is located near the Main Street Bridge abutment and shallow bedrock has been identified in this area

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from Station 25+75 to Station 28+25. Reportedly, bedrock is composed of moderately hard limestone, marble and phyllite (GeoDesign, 2014). According to this geotechnical assessment, Main Street and Merchants Row are composed of several inches of asphalt, underlain by several feet of fill generally consisting of silt, sand and gravel (GeoDesign, 2013). Coal and brick fragments have been noted in fill below Main Street and Merchants Row (GeoDesign, 2013).

Groundwater has been found to be flowing to the west, toward the Otter Creek, and water table elevations are relatively shallow, generally between 1 and 9 feet below existing grade (OCE, 2014; OCE, 2015). Water has been observed to seep from the existing retaining walls north of the Main Street overpass, and surface water runoff from surrounding areas flows downward into the track trough. Water from both of these sources has been reported to pool and collect at the track level, creating icy track conditions in winter months.

PROJECT DESCRIPTION

In general, the Project will involve the replacement of the Merchants Row and Main Street Bridges with a single precast concrete box tunnel. The VTR track will be lowered with excavation below existing grade estimated at approximately 12 feet in the area of the existing bridges, in order to accommodate the new tunnel structure. Grade along the railroad track, to the north and south of the tunnel will be lowered to accommodate a maximum 1% grade as required for railroad design. U-shaped concrete retaining walls ("U-walls"), retaining walls, and/or sheet pile walls, will be placed on either end of the tunnel to stabilize track side slopes.

Stormwater underdrains will be located within the concrete tunnel and concrete U-walls (Station 20+00 to Station 37+50) to accommodate stormwater flow through these areas. Within tunnel and U-wall areas, the stormwater system is designed to be separated from the water table with pre-cast concrete units where the joints are designed to be water tight. These drains will discharge to the bank of the Otter Creek, via an existing outfall at Station 27+25 (a stormwater discharge permit is being sought from the VT DEC). To the south of the tunnel and U-wall areas (Station 10+00 to Station 20+00), stormwater swales will be located on the east and west sides of the track. These swales will be pitched to one of two existing outfalls on the Otter Creek (Station 15+25 and Station 27+25) via above ground swales and/or underground pipes). From the northern limit of the tunnel and U-wall to the Elm Street Bridge (Station 37+50 to Station 42+00) stormwater swales will be located on the east and west sides of the tracks. These swales will have perforated underdrains which will be pitched toward catch basins on the east and west side of the tracks at Station 37+60 and stormwater will be diverted west and north to the Town's stormwater system along Elm Street via underground piping. North of the Elm Street Bridge (Station 42+00 to Station 45+75) no drainage structures will be installed.

The Project will involve the disturbance of soil and possibly groundwater in the following portions of the construction area:

1. <u>Temporary Access Road</u>: The temporary access road is proposed to be located to the east of the VTR track from Station 10+00 to Station 14+00, crossing the track at Station 14+00, and continuing to the west of the VTR track from Station 14+00 to Station 21+75. Excavation of soil to 1 foot below ground surface ("bgs") is anticipated, to install new gravel subbase and asphalt surfacing. Approximately 400 cubic yards (650 tons) of material is expected to be generated from this excavation. A typical section of the temporary access road construction is included on page 10 of the Attachment.

2. <u>Drainage Structures</u>: Stormwater drainage infrastructure construction will include installing new storm drains and service lines along the upgraded railroad tracks. The new storm drains will be connected to an existing outfall located to the north of Main Street, along the bank of the Otter Creek. Storm drain connections will be completed using jack-and-bore type

drilling with a 60 inch horizontal borehole through subsurface bedrock. The drill launch and receiving pits will be constructed as follows:

a. Launch Pit (Station 27+25): Excavation will be approximately 20 feet by 30 feet by 45 feet deep, with approximately 12 feet to the bedrock interface. Approximately 270 cubic yards (440 tons) of material is expected to be generated from the Launch Pit excavation.
b. Drive #1 Receiving Pit (Otter Creek Outfall): Excavation approximately 10 feet by 20 feet by 5 feet deep. Approximately 40 cubic yards (65 tons) of material is expected to be generated from this excavation.
c. Drive #2 Receiving Pit (Station 25+37): Excavation approximately 15 feet by 15 feet by 45 feet deep. Approximately 35 feet to the bedrock interface. Approximately 300 cubic yards (490 tons) of material is expected to be generated from this excavation.
d. Drive #3 Receiving Pit (Station 29+00): Excavation approximately 15 feet by 15 feet by 25 feet deep. Approximately 15 feet to the bedrock interface. Approximately 125 cubic yards (200 tons) of material is expected to be generated from this excavation.

Drainage profiles for each of the launch/receiving pits and connecting structures are included on pages 11-13 of the Attachment.

3. Railroad Track: Soil will be excavated to a maximum of 12 feet below existing grade under the existing bridges. Excavation of the track is required between from the railroad bridge over the Otter Creek (southern limit, Station 10+00) to just north of the Elm Street Bridge (northern limit, Station 45+75) to accommodate the depression under the existing bridges. U-walls, retaining walls, and sheet pile walls will be installed to the north and south of the tunnel area (Station 16+75 to Station 40+00) for track wall stabilization. Approximately 30,000 cubic yards (49,000 tons) of material is expected to be generated from this excavation. Typical sections of the track reconstruction (sheet piling, U-walls, tunnel, retaining walls and other areas) are included on pages 14-20 of the Attachment.

4. Main Street: Excavation of soil within the existing road ROW is required for bridge removal and to accommodate new supportive concrete approach slabs. Excavation of soil to 2 feet below existing grade from Station 200+75 to Station 203+00 excluding the bridge substructure where soils do not exist, and up to 4 feet below existing grade within approximately 25 feet of the existing track retaining walls. Approximately 1,700 cubic yards (2,750 tons) of material is expected to be generated from this excavation. A typical section of the Main Street reconstruction is included on page 21 of the Attachment.

5. Merchants Row: Excavation of soil within the existing road ROW is required for bridge removal and to accommodate new supportive concrete approach slabs. Excavation of soil to 2 feet below existing grade from Station 101+75 to Station 104+25, excluding the bridge substructure where soils do not exist, and up to 4 feet below existing grade approximately 25 feet east or west from the existing track retaining walls. Approximately 1,600 cubic yards (2,600 tons) of material is expected to be generated from this excavation. A typical section of the Merchants Row reconstruction is included on page 21 of the Attachment.

6. Triangle Park: Excavation of soil within the eastern portion of Triangle Park is required to accommodate the new tunnel and install new track side wall support structures. Excavation of soil to approximately 24 feet below existing grade from Station 24+25 to Station 25+75, including all area within 10-15 feet from the existing western track retaining wall. Approximately 650 cubic yards (1,100 tons) of material is expected to be generated from this excavation.

PROJECT AREA HISTORY

VHB completed a review of available documents to assess the known and potential soil and groundwater conditions within the Project Area. The review included examination of historic Sanborn Maps, a review of the VT DEC Sites Management database and recent geotechnical reports for the Project area for information about subsurface conditions and known contamination.

Sanborn Map Review

A review of Historic Sanborn Maps (dated 1885, 1892, 1905, 1910, 1920, 1927 and 1944) identifies that the Project area was occupied by a railroad track since at least 1885 in the same general alignment as present-day VTR track. The Main Street and Merchants Row Bridges also existed since at least 1885.

The area between the Otter Creek truss bridge (Station 10+00) and the Cross Street Bridge (Station 15+00) is not shown in the early maps. The 1920, 1927 and 1944 maps extend to this area and depict an ice house and ice storage sheds to the west of the tracks, and a lumber yard and several dwellings to the east of the tracks.

The area to the west of the tracks between the Cross Street Bridge (Station 15+00) and Merchants Row (Station 23+25) contained several storage buildings located near the bank of the Otter Creek (1885 through 1927) and the heating plant for buildings along Merchants Row, consisting of an oil house and gasoline house (1910 through 1944). The area to the east of the tracks historically contained several dwellings. The former Town Hall was located to the east of the tracks, just south of Merchants Row and a gasoline tank is visible to the south of the former Town Hall building in the 1885 and 1892 maps.

The maps indicate that a variety of shops existed along Main Street and Merchants Row in the central Project area, where these streets cross over the VTR track (Station 23+25 to Station 26+50). The former Lazarus Building (Station 27+25) is shown on all of the maps and was occupied by a tailor shop (1885 and 1892), billiards hall (1905), wallpaper and variety store (1910) and unidentified shops (1920, 1927 and 1944). The Lazarus Building was recently demolished.

The area just north of the Main Street Bridge and west of the tracks (Station 29+00 to Station 35+00) was historically occupied by the Marble Works, with several stone cutting and polishing buildings. A coal storage shed was located just west of the tracks (approximately Station in the 30+00) in the 1905, 1910, 1920, 1927 and 1944 maps. The east side of the tracks, in this area, was historically occupied by dwellings.

In the northern portion of the Project area but to the south of the Elm Street Bridge (Station 35+00 to Station 42+00), the surrounding area was historically occupied by dwellings and a railroad passenger depot. In the 1944 map, several buried gasoline tanks were also noted to the east of the tracks, along the east side of the current day Seymour Street (approximately Station 37+50 to Station 40+00) and were associated with historic filling stations.

In the far northern portion of the Project area, to the north of the existing Elm Street Bridge (Station 42+00 to Station 45+75), the areas to the west of the tracks were occupied by residences and the areas to the west were occupied by a railroad yard, consisting of multiple tracks, a freight depot, coal shed, lumber storage and a machine shop. On the 1885, 1892 maps a 46,000 gallon petroleum tank is visible approximately 100 feet east of the Project area. In the 1920, 1927 maps several different oil and gasoline tanks are visible approximately 100 feet to the east of the Project area.

Train Derailment Investigation

On October 22, 2007 an accidental train derailment occurred between the Otter Creek truss bridge (Station 10+00) and the Merchants Row Bridge (Station 23+25). Reportedly, 25 railcars were derailed, 15 of which contained gasoline and 10 of which contained road salt (OCE, 2008). All the cars overturned to the west of the track, toward the Otter Creek. Reportedly, gasoline leaked from 7 of the 15 overturned railcars and road salt spilled from 4 of the 10 railcars (OCE, 2008). The estimated volume of gasoline released to the environment was between 200 to 1,800 gallons (OCE, 2008). The remainder of the petroleum from the overturned railcars was pumped into truck tankers and hauled off-site. The gasoline spill impacted soil, groundwater, and surface water (Otter Creek) near the derailment area. Additionally, during the derailment, petroleum infiltrated the Town of Middlebury sewer system and was treated at the sewage treatment plant. Sorbent booms were placed in the Otter Creek between October and December 2007. Road salt was manually shoveled out of the derailment area by hand. The Middlebury Train Derailment site was listed by the VT DEC as a hazardous waste site (VT DEC #20093912). In December 2009 and January 2010, injections of chemical oxidants (RegenOx™ and ORC Advanced®) were completed within the derailment area as a form of groundwater remediation (OCE, 2010).

Two surficial soil samples collected in 2007 (MW-07, -08 and -09) were analyzed for Volatile Organic Compounds ("VOCs") and Total Petroleum Hydrocarbons ("TPH") Gasoline Range Organics ("GRO") and indicated the presence of benzene, toluene, ethylbenzene, xylenes, naphthalene, trimethybenzene, and TPH GRO in excess of the VT DEC residential and industrial Soil Screening Values ("SSVs"). Seven surficial soil samples collected in 2009 (SB-09-01 through -07) were analyzed for TPH GRO and lead, both of which were present at concentrations below the VT DEC residential SSVs (OCE, 2010). PID headspace readings form these 2007 and 2009 soil samples were generally elevated (>100 ppm).

To the west of the VTR track, between the Otter Creek truss bridge and Merchants Row Bridge, 10 groundwater monitoring wells (MW-07-01 through -10) were installed in 2007. Three of these wells (MW-07-03, -04, -05) were destroyed in 2009 during construction of the Cross Street Bridge. One new well was installed in 2009 (MW-09-01) and ten new monitoring (MW-10-01 through -10) wells were installed in 2010. There are currently a total of 18 wells associated with VT DEC #20093912, 13 of which have been recommended for permanent closure. The November 2015 groundwater monitoring data indicates that the Vermont Groundwater Enforcement Standards ("VGES") are exceeded for benzene in four wells (OCE, 2015). Annual groundwater monitoring is ongoing.

Geotechnical Investigations

In 2013, GeoDesign completed two geotechnical investigations within the Project area. In March 2013, GeoDesign advanced 31 ledge probes, 25 soil borings and 11 test pits. PID headspace readings from soils within the VTR track, Merchants Row, Main Street and behind the eastern retaining wall, north of Main Street, were relatively low (<4 ppm; GeoDesign, 2013). In October/November 2013, GeoDesign completed additional soil borings, ledge probes and rock coring. No PID headspace readings were collected during this assessment (GeoDesign, 2014).

In March 2016, GeoDesign completed seven test pits along the railroad tracks, under the Main Street Bridge. The test pits were advanced to determine the depth to bedrock and depth of pier support structures which support the Main Street Bridge. Test pits indicated that the depth to bedrock varies from approximately 5.4 feet below grade near the southern limit of the Main Street Bridge to approximately 1.4 feet below grade near the northern limit of the Main Street Bridge.

During GeoDesign's March and October/November 2013 geotechnical investigations, eight groundwater wells were installed along the VTR track to monitor the groundwater elevation within the Project area. Each well was installed with 5 or 10 feet of factory slotted screen and was backfilled with clean filter sand to above the well screen, capped with a bentonite plug and backfilled with native materials to the ground surface (GeoDesign, 2013; GeoDesign, 2014). Each well is capped with a PVC expansion plug and finished with a flush mounted road box at ground surface. Well construction details are included in the table below.

Existing Groundwater Monitoring Wells – VTR Track				
Well ID	**Station**	**Well Depth***	**Well Screen***	**Installation Date**
GBD-2 (OW)	13+75	10	5-10	Oct/Nov2013
GBD-5 (OW)	18+00	7	3-7	Oct/Nov 2013
RR-11 (OW)	21+00	10	5-10	March 2013
RR-13 (OW)	23+00	10	5-10	March 2013
RR-16 (OW)	25+50	10	5-10	March 2013
RR-1 (OW)	29+00	10	5-10	March 2013
GBD-16 (OW)	32+00	15	5-15	Oct/Nov 2013
GDB-20 (OW)	35+50	30	20-30	Oct/Nov 2013
*Units in feet below ground surface ("bgs").				

Soil boring and well construction logs for the wells listed in the table above are included on pages 36-45 of the Attachment.

Conceptual Site Model and Evaluation of Contaminants of Concern

The Project area is located in downtown Middlebury, Vermont and generally consists of a railroad track and two elevated roadways. The purpose of the Project is to replace the Main Street and Merchants Row Bridges with a single tunnel and to depress the VTR track by several feet with excavation required as deep as approximately 12 feet below existing grade in the area of the current bridges.

Within the railroad alignment, shallow soils consists of stone ballast entrained in soil from current grade to approximately two feet deep. Below the ballast and outside of the railroad alignment, shallow soils consist of silty clay to silty sand, with some gravel, and are underlain by till. Main Street and Merchants Row consist of several inches of asphalt, underlain by several feet of fill, generally consisting of silt, sand and gravel. Shallow or exposed bedrock is located along the rail road track, near the Main Street Bridge abutment. Groundwater has been found to be flowing to the west, toward the Otter Creek, and water table elevations are relatively shallow.

The following contaminants of concern were identified through a review of historic Sanborn Maps, the VT DEC Sites Management database and recent geotechnical reports for the Project area:

- Petroleum-impacted soil and groundwater have been identified and are likely to be encountered in the southern Project area (approximately Station 10+25 to Station 20+00) in association with a 2007 train derailment (VT DEC #20093912).

- The historic site use as a railroad corridor indicates the likelihood of surficial soil contamination within the Project area. Railroad contaminants typically include, but are not limited to, metals (specifically lead and arsenic), PAHs, petroleum compounds, herbicides and pesticides.

- Surficial soil and shallow groundwater contamination is likely in consideration of the following historic adjoining site uses:
  - railroad yard and petroleum storage tanks to the east of the tracks at Station 42+00 to Station 45+75,
  - coal storage shed to the west of the tracks at Station 30+00,
  - petroleum underground storage tanks to the east of the tracks at Station 37+50 to Station 40+00,
  - petroleum heating tanks east of the tracks associated with the former Town Hall at Station 20+50, and
  - petroleum heating tanks west of the tracks associated with the buildings along Merchants Row at Station 22+25

The Otter Creek has been identified as a potential receptor for this Project, although surface water sampling associated with the train derailment (VT DEC #20093912) has indicated that this potential receptor is not currently impacted by the groundwater contamination within the southern Project area. In addition, another potential receptor is a Class II wetland is mapped by the Vermont State Wetland Inventory to the west of the southern Project area, near the Otter Creek. No other wetlands, water bodies, drinking water wells or source protection areas have been identified within the vicinity of the Project area. The surrounding area is supplied with potable water from the municipal system.

The primary concern associated with potential contamination at the Project is the management of contaminated soils that must be excavated for construction, and the need to comply with the applicable regulations for worker exposure, soil placement or stockpiling, and final disposal.

SOIL SAMPLING WORK PLAN

VHB presents this soil sampling work plan to perform pre-construction site characterization in order to assess the condition of soil within the Project area that may be disturbed as part of Project construction. Based on Project design, a net cut of soil is anticipated from each Project sub-area (temporary access road, drainage structures, railroad track, Main Street and Merchants Row); therefore soil will be characterized based on the contaminants of concern as determined by review of the Project area history, and to determine the appropriate handling practices and disposal requirements, as necessary.

Prior to any drilling or digging, DigSafe will be contacted to mark out underground utilities within the Project area. Drilling will be completed using a Geoprobe rig, or equivalent, by a licensed drilling company. An environmental scientist with OSHA HAZWOPER certification and appropriate field training will observe the drilling, log soils, and will use a photoionization detector ("PID") with a properly calibrated 11.2 eV lamp to screen soil for contamination. Soil screening will be completed in accordance with VHB's field screening standard operating procedure included on pages 22-24 of the Attachment.

Soil borings will be advanced within the Project area and soil sampling will be completed as follows:

Soil Sampling Summary			
Project Sub-area	**General Notes**	**Soil Boring Stations**	**Sampling Depth**
Temporary Access Road	One soil boring every 100 feet of roadway. Soil borings will be advanced to proposed construction depths (1ft bgs).	Stations: 11+75, 12+75, 13+75, 14+75, 15+75, 16+75, 17+75, 18+75, 19+75 and 20+75.	1ft bgs
Drainage Structures	One soil boring from each launch and receiving pit. Soil borings will be advanced to proposed construction depths or to bedrock, whichever is shallower.	Station 25+37 (Receiving Pit #2)	2ft bgs and bedrock interface.
		Station 27+25 (Launch Pit)	2ft bgs and bedrock interface.
		Station 29+25 (Receiving Pit #3)	2ft bgs and bedrock interface.
		Otter Creek Outfall (Receiving Pit #1)	2ft bgs and proposed construction depths or to bedrock, whichever is shallower.
Railroad Track	One soil boring every 50 feet of track. Soil borings will be advanced to proposed construction depths or to bedrock, whichever is shallower.	Stations: 10+00 to 15+00 (every 50 feet)	2ft bgs
		Stations: 15+50 to 20+50 (every 50 feet)	2ft and 6ft bgs
		Stations: 21+00 to 25+00 (every 50 feet)	2ft, 6ft and 12ft bgs
		Stations: 25+50 to 28+00 (every 50 feet)	2ft bgs, or bedrock interface
		Stations: 28+50 to 38+00 (every 50 feet)	2ft and 6ft bgs
		Stations: 38+50 to 45+50 (every 50 feet, except Station 42+00 where a railroad bridge is located over Elm Street)	2ft bgs
Main Street	One soil boring every 50 feet of roadway. Soil borings will be advanced to proposed construction depths.	Stations: 102+00, 102+50, 103+00, 103+50, 104+00.	2ft bgs
Merchants Row	One soil boring every 50 feet of roadway. Soil borings will be advanced to proposed construction depths.	Stations: 201+00, 201+50, 202+00, 202+50, 203+00.	2ft bgs
Triangle Park	One soil boring every 50 feet of park, to be disturbed. Soil borings will be advanced to proposed construction depths.	Stations: 24+75, 25+25 10-15 feet east of the existing track retaining wall.	2ft and 24ft bgs

Proposed soil boring locations are depicted on the Soil Work Plan Engineering Plans on page 2-9 of the Attachment.

Soil samples will be collected in accordance with VHB's soil collection standard operating procedure included on pages 25-28 of the Attachment. All soil samples will be preserved on ice and delivered to a certified testing laboratory, under a chain of custody. Soil samples will be submitted for the following laboratory analysis:

- VOCs via EPA 8260
- Semi Volatile Organic Compounds ("SVOC") via EPA 8270
- RCRA 8 metals by various analytical methods
- TPH GRO and Diesel Range Organics ("DRO") via EPA method 8015
- PCBs by EPA method 8082
- Pesticides via EPA method 8080
- Herbicides via EPA method 8151A
- Corrosivity
- Reactivity
- Ignitability

GROUNDWATER SAMPLING WORK PLAN

VHB presents this groundwater sampling work plan perform pre-construction site characterization in order to assess the condition of groundwater within the Project area that may be encountered or disturbed as part of Project construction. Based on Project design, and the expected depth to groundwater, it is likely that groundwater would infiltrate excavation areas. Therefore, the condition of groundwater will be assessed using existing monitoring wells and proposed new monitoring wells to determine the appropriate handling practices and disposal requirements, as necessary.

As previously discussed, an established array of groundwater monitoring wells associated with VT DEC #20093912 exists along the VTR track; therefore, no additional groundwater wells are proposed to be installed in association with the VTR track. However, no groundwater wells are located near the drainage structures, therefore groundwater monitoring wells will be installed in each of the drainage structures launch and receiving pits, generally terminating at proposed construction depths or bedrock, whichever is shallower. Depending on depth, five or ten feet of factory slotted screen will be installed in the bottom of the well, with solid riser to ground surface. The well annulus will be filled with clean filter sand to above the well screen, capped with a bentonite plug and backfilled with native materials to ground surface. A steel flush-mounted well box will be installed at ground surface and the well casing will be capped with a PVC expansion plug. Prior to any drilling or well installations, DigSafe will mark out underground utilities nearby the proposed drilling areas. Drilling will be completed using a Geoprobe rig, or equivalent, by a licensed drilling company.

Groundwater wells will be installed within the Drainage Structure launch/receiving pit footprints and groundwater sampling will be completed using these new and existing wells as follows:

Groundwater Sampling Summary			
Project Sub-area	**General Notes**	**Well Stations**	**Sampling Methods**
Drainage Structures	Install one overburden well in each of the launch/receiving pits, generally terminating at proposed construction depths or bedrock, whichever is shallower. Sample groundwater within these newly installed wells.	Station 25+37 (Receiving Pit #2)	Low flow purge procedures.
		Station 27+25 (Launch Pit)	
		Station 29+00 (Receiving Pit #3)	
		Otter Creek Outfall (Receiving Pit #1)	
Railroad Track	Sample groundwater within these existing wells which were previously installed along the VTR track by GeoDesign in 2013.	Station 13+75 GBD-2(OW)	Low flow purge procedures.
		Station 18+00 GBD-5(OW)	
		Station 21+00 RR-11(OW)	
		Station 23+00 RR-13(OW)	
		Station 25+25 RR-16(OW)	
		Station 29+00 RR-1(OW)	
		Station 32+00 GBD-16(OW)	
		Station 35+50 GDB-20(OW)	

Proposed groundwater well locations are included in the Soil Work Plan Engineering Plans on pages 2-9 of the Attachment.

Each well will be sampled using a peristaltic pump, and disposable dedicated tubing using standard low-flow purge procedures. Groundwater samples will be collected in accordance with VHB's low flow groundwater collection standard operating procedure included on pages 29-35 of the Attachment. All groundwater samples will be preserved on ice and delivered to a certified testing laboratory, under a chain of custody. Groundwater samples will be submitted for the following laboratory analysis:

- VOCs via EPA 8260

SCHEDULE

The Project team will initiate the proposed pre-construction in-situ characterization as soon as possible upon receipt of written work plan approval by the VT DEC. VHB's goal is to commence soil borings and monitoring well installation during the spring of 2016 because construction of the temporary access road and drainage structures is anticipated for the 2016 construction season and is planned to be bid as a VTrans early release package. Construction of the railroad track and bridges is anticipated for the 2017 or 2018 construction season and is planned to be bid as a VTrans construction release package. Therefore, characterization of soil and groundwater within the temporary access road and drainage structures will be prioritized to maintain the current construction schedule and may occur prior to characterization in the railroad track, Main Street or Merchants Row.

Results will be reported to the VT DEC within approximately 60 days from the receipt of laboratory results unless the results indicate a new release which would be reported to the VT DEC as soon as possible. VHB anticipates submitting two follow up reports for the Project; one report for the early release bid package and one report for the construction release bid package. The reports will contain, soil boring logs, tabulated data, laboratory analytical reports and a narrative presenting a sensitive receptor survey, and VHB's findings and recommendations for contaminated media management and disposal options.

ATTACHMENTS

Page 1:	Location Map
Pages 2-9:	Soil Work Plan Engineering Plan (sheet 1-8)
Page 10:	Temporary Access Road Section
Pages 11-13:	Drainage Structure Profiles
Pages 14-20:	Typical Railroad Sections
Page 21:	Main Street & Merchants Row Sections
Pages 22-24:	PID Soil Screening SOP
Pages 25-28:	Soil Sampling SOP
Pages 29-35:	Low-flow Groundwater Sampling SOP
Pages 36-45:	Well logs GeoDesign 2013 wells

REFERENCES

(OCE, 2008), Otter Creek Engineering, Inc., "Vermont Railway, Inc. Middlebury Train Derailment, Middlebury, Vermont, Subsurface Investigation Report." September 2008.

(OCE, 2010), Otter Creek Engineering, Inc., "Vermont Railway, Inc. Middlebury Train Derailment (Site #2009-3912), Middlebury, Vermont, Remediation Assessment Report." June 2011.

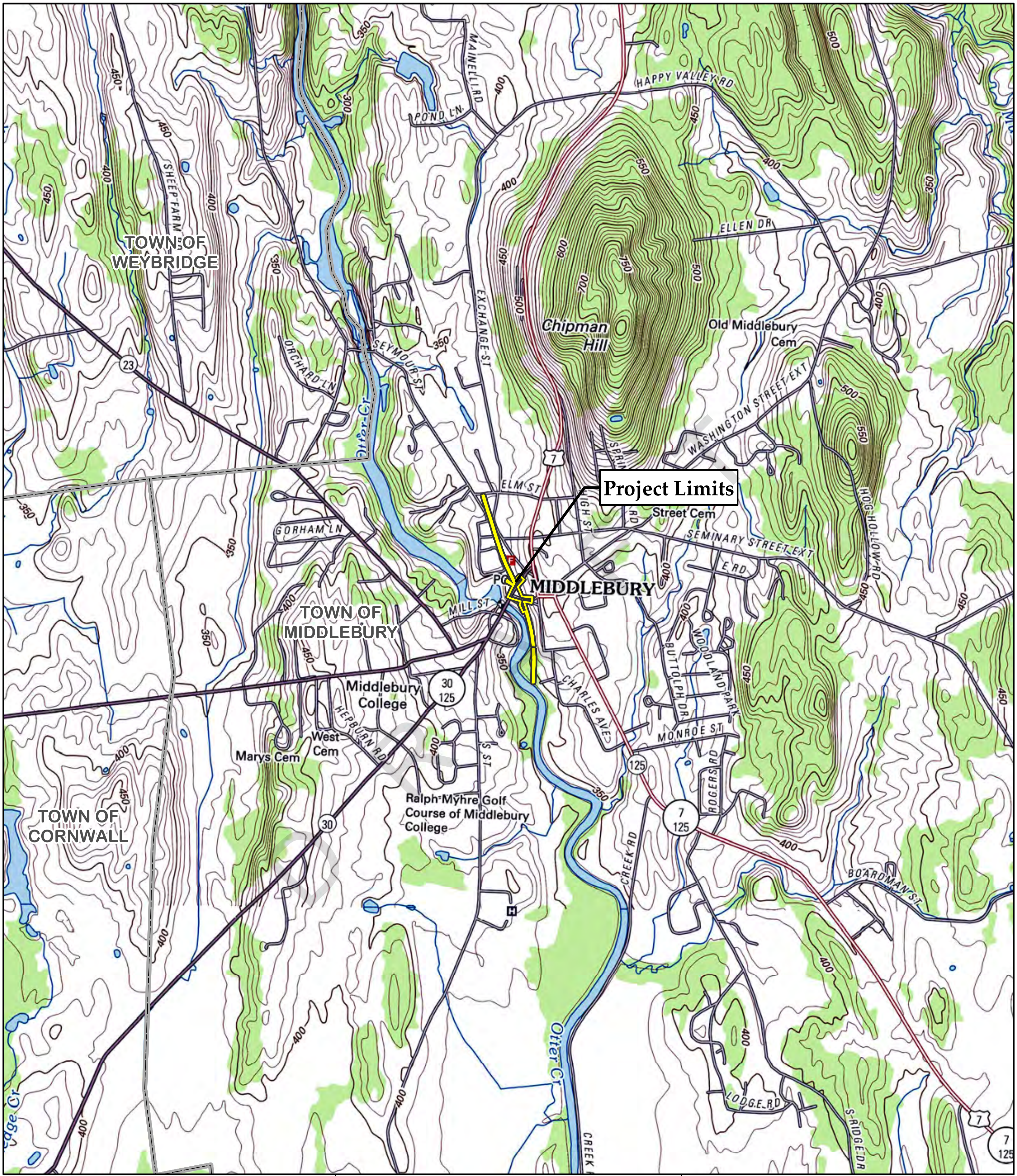
(OCE, 2014), Otter Creek Engineering, Inc., "Vermont Railway, Inc. Middlebury Train Derailment (Site #2009-3912), Middlebury, Vermont, Monitor and Water Quality Report – December 2014." January 2015.

(OCE, 2015), Otter Creek Engineering, Inc., "Vermont Railway, Inc. Middlebury Train Derailment (Site #2009-3912), Middlebury, Vermont, Monitor and Water Quality Report – November 2015." April 2016.

(GeoDesign, 2013), GeoDesign, Inc. "Phase A Geotechnical Data Report, Middlebury WRCS(23), Bridge No. 2 and 102 over the Vermont Railway, Middlebury, VT." May 14, 2013.

(GeoDesign, 2014), GeoDesign, Inc. "Phase B Geotechnical Data Report, Middlebury WRCS(23), Main St Bridge No. 102 and Merchants Row Bridge No. 2 over the Vermont Railway, Middlebury, VT." January 10, 2014.

ATTACHMENT



Legend

- Project Limits = 3.38 Acres
- Town Boundary

Town of Middlebury
Middlebury WCRS (23) - Bridge Project
Middlebury, Vermont
Site Location Map

July 25, 2013

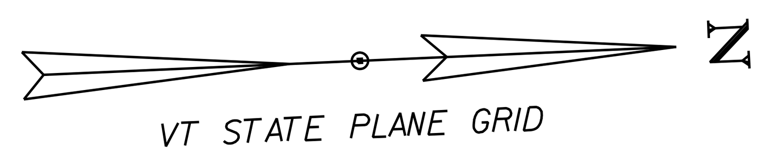
2,000 1,000 0 2,000 Feet

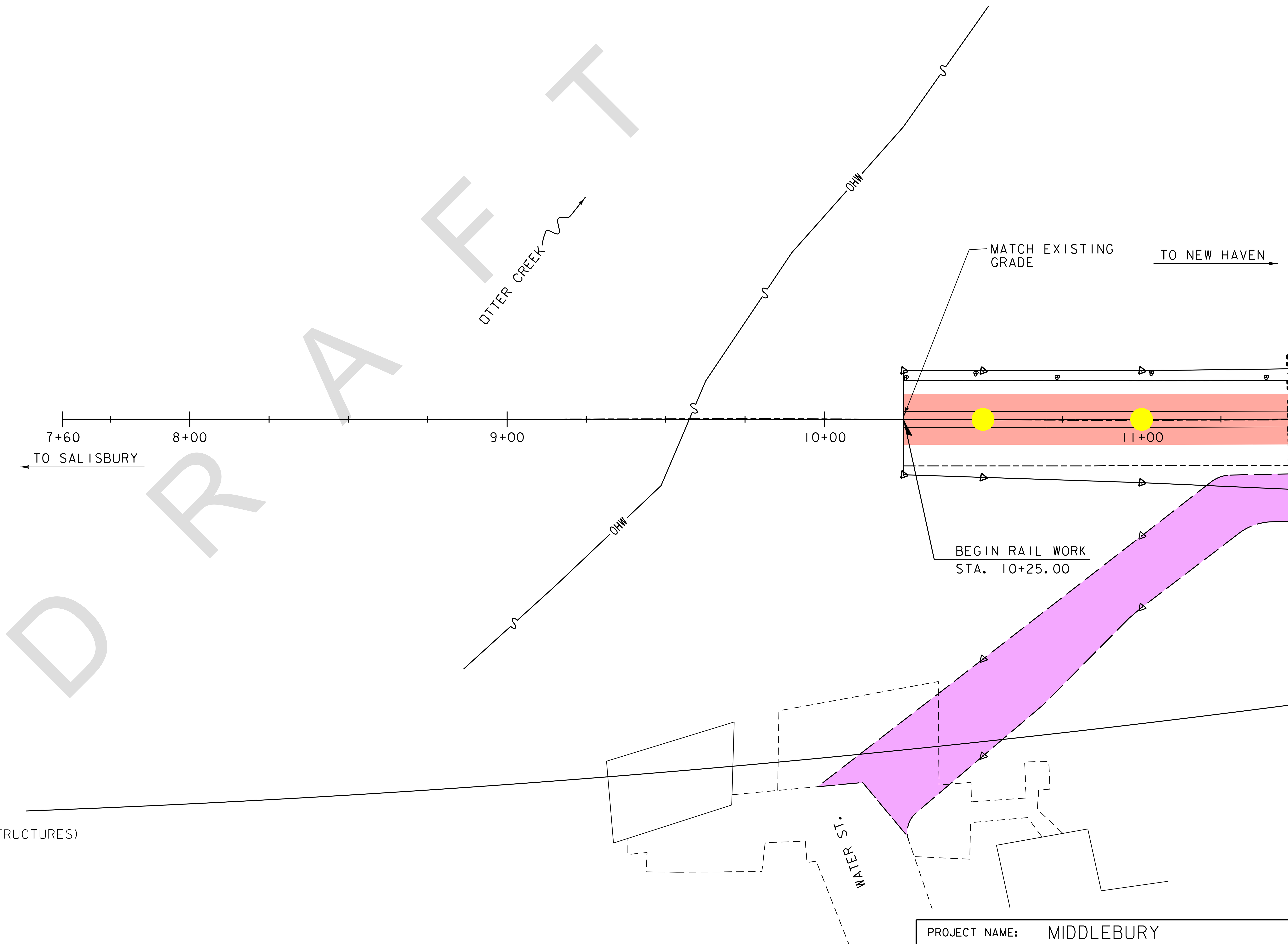
Sources: Background - USGS Topographic Quads (Cornwall and Middlebury, 2012); Town Boundaries from VCGI (2009).

Vanasse Hangen Brustlin, Inc.

Prepared by: jtherrien

F:\57603.00\GIS\Project\Site Location Map.mxd





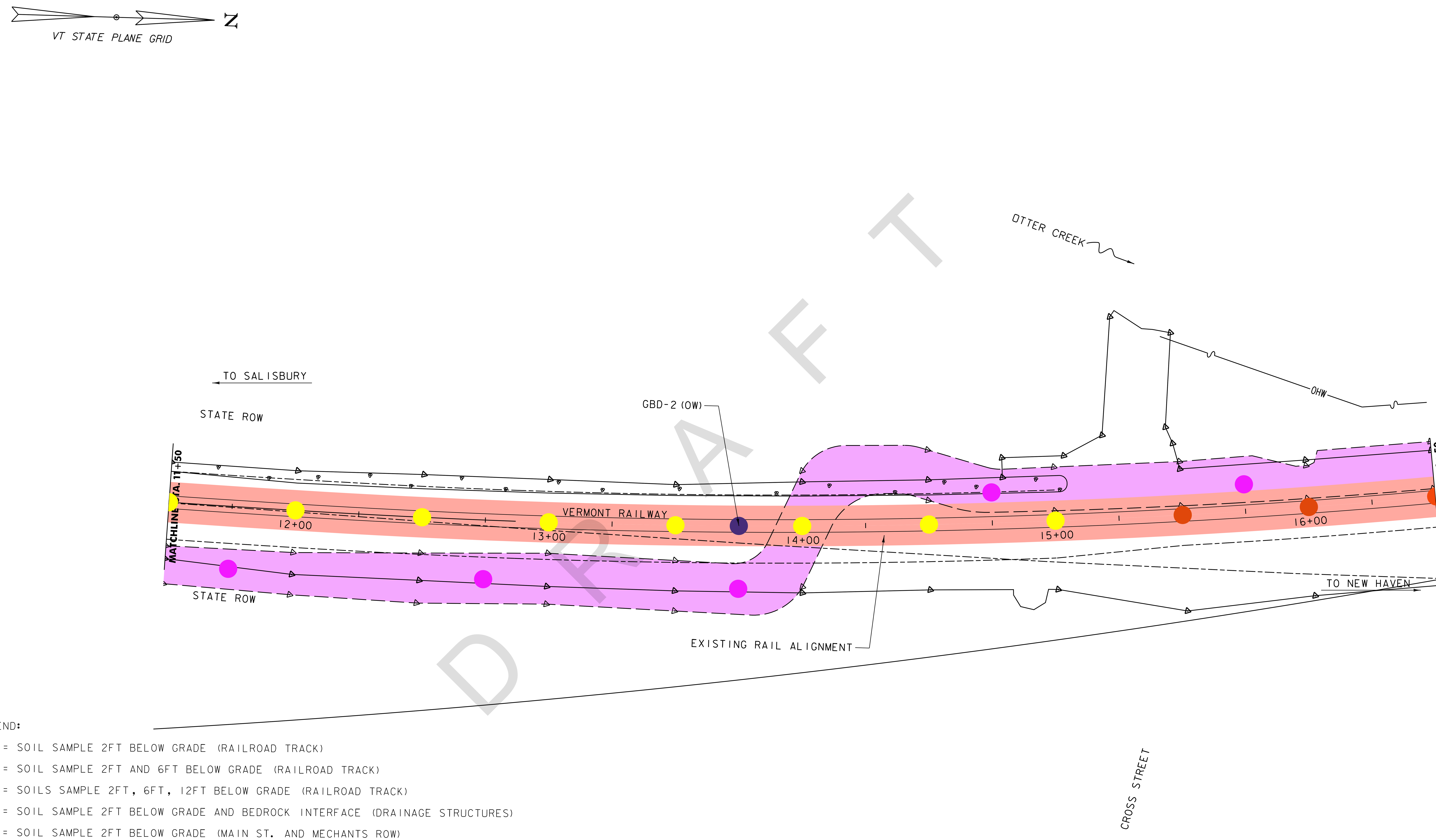
LEGEND:

- = SOIL SAMPLE 2FT BELOW GRADE (RAILROAD TRACK)
- = SOIL SAMPLE 2FT AND 6FT BELOW GRADE (RAILROAD TRACK)
- = SOILS SAMPLE 2FT, 6FT, 12FT BELOW GRADE (RAILROAD TRACK)
- = SOIL SAMPLE 2FT BELOW GRADE AND BEDROCK INTERFACE (DRAINAGE STRUCTURES)
- = SOIL SAMPLE 2FT BELOW GRADE (MAIN ST. AND MECHANTS ROW)
- = SOIL SAMPLE 1FT BELOW GRADE (TEMPORARY ACCESS ROAD)
- = APPROXIMATE LOCATION OF EXISTING GROUNDWATER MONITORING WELLS

vhb

PROJECT NAME: MIDDLEBURY
PROJECT NUMBER: WCRS(23)

FILE NAME: z10g044nul_Soil-Characterization.dgn	PLOT DATE: 2/19/2016
PROJECT LEADER: M.A. COLGAN	DRAWN BY: M.F. SUFFEL
DESIGNED BY: R. LOMONACO	CHECKED BY: R. LOMONACO
SOIL WORK PLAN (1 OF 8)	SHEET 1 OF 8



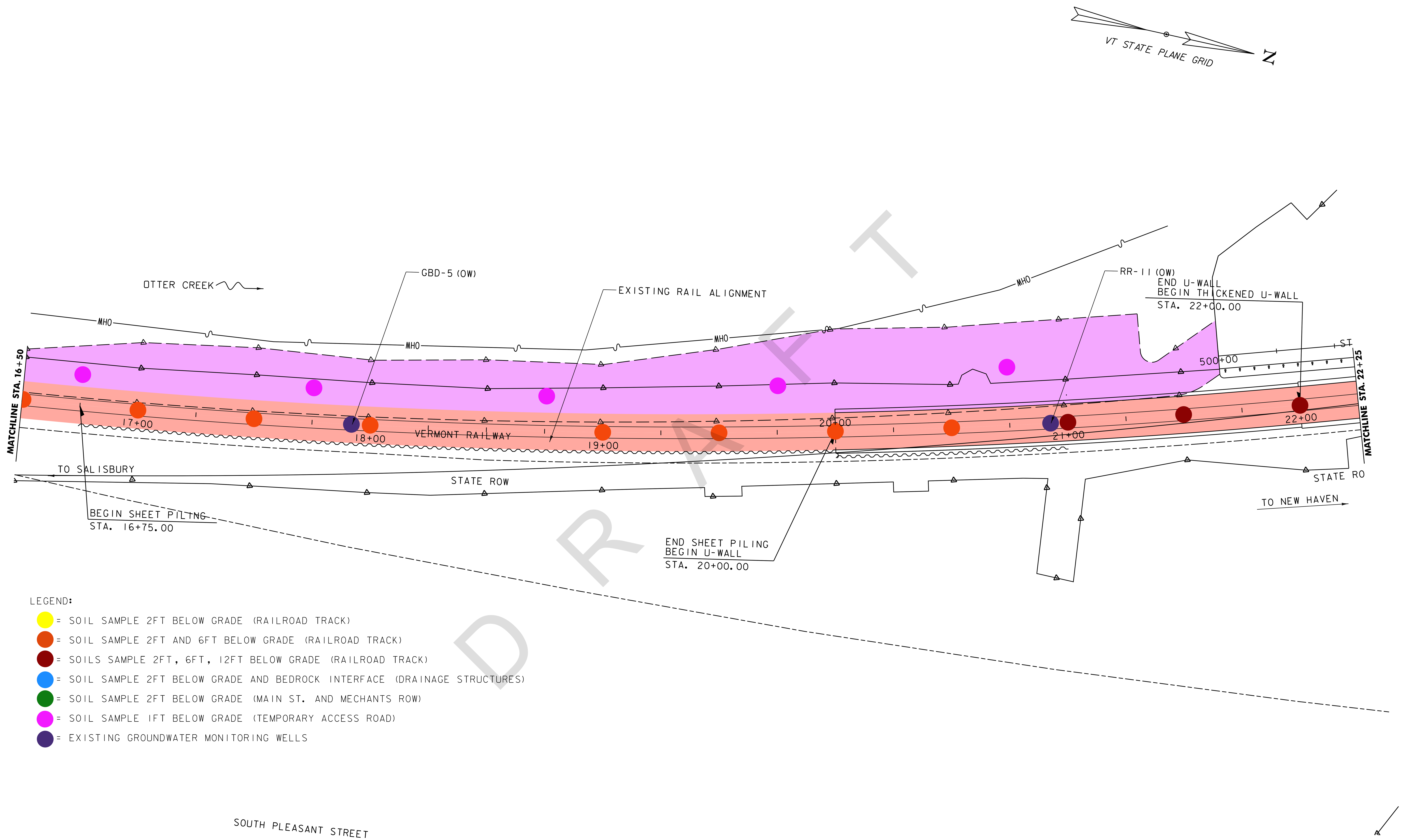
LEGEND:

- = SOIL SAMPLE 2FT BELOW GRADE (RAILROAD TRACK)
- = SOIL SAMPLE 2FT AND 6FT BELOW GRADE (RAILROAD TRACK)
- = SOILS SAMPLE 2FT, 6FT, 12FT BELOW GRADE (RAILROAD TRACK)
- = SOIL SAMPLE 2FT BELOW GRADE AND BEDROCK INTERFACE (DRAINAGE STRUCTURES)
- = SOIL SAMPLE 2FT BELOW GRADE (MAIN ST. AND MECHANTS ROW)
- = SOIL SAMPLE 1FT BELOW GRADE (TEMPORARY ACCESS ROAD)
- = EXISTING GROUNDWATER MONITORING WELLS

vhb

PROJECT NAME: MIDDLEBURY
PROJECT NUMBER: WCRS(23)

FILE NAME: z10g044nul_Soil-Characterization.dgn
PLOT DATE: 2/19/2016
PROJECT LEADER: M.A. COLGAN
DRAWN BY: M.F. SUFFEL
DESIGNED BY: R. LOMONACO
CHECKED BY: R. LOMONACO
SOIL WORK PLAN (2 OF 8)
SHEET 2 OF 8



PROJECT NAME:	MIDDLEBURY
PROJECT NUMBER:	WCRS(23)

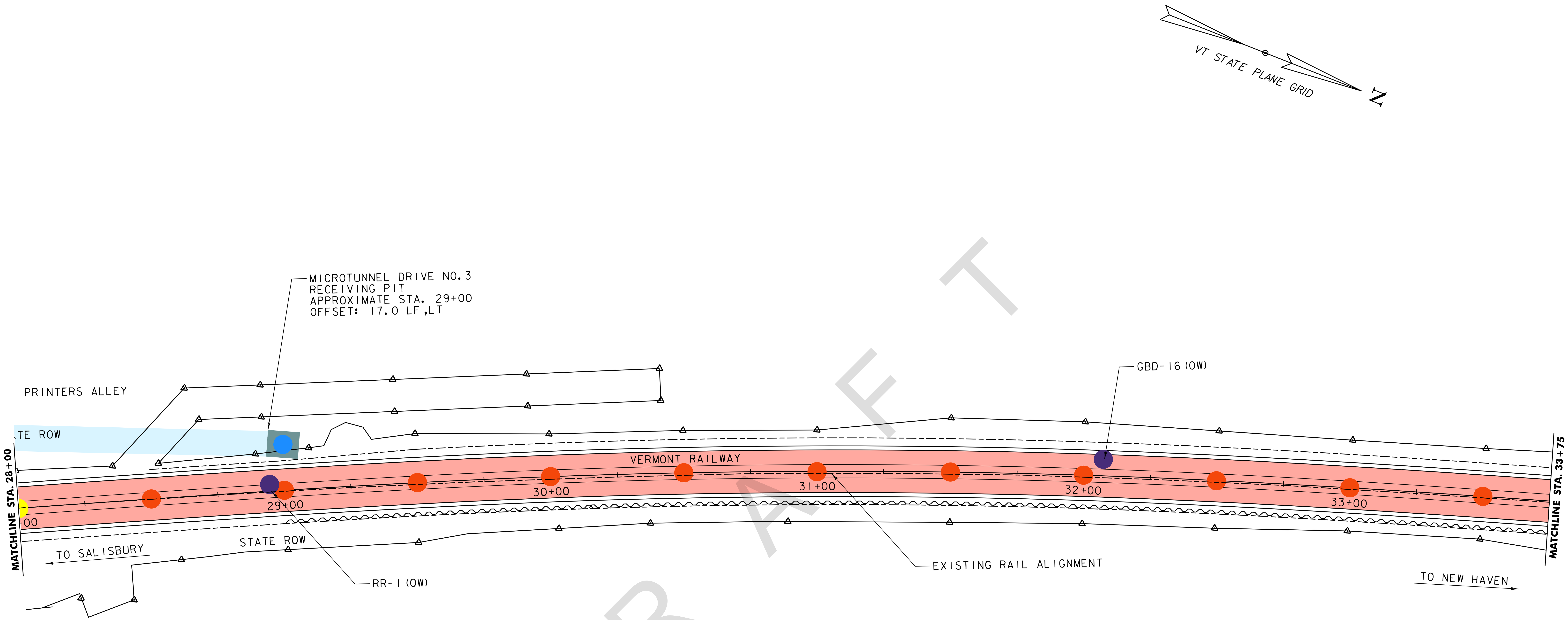
FILE NAME: z10g044nul_Soil-Characterization.dgn	PLOT DATE: 2/19/2016
PROJECT LEADER: M.A. COLGAN	DRAWN BY: M.F. SUFFEL
DESIGNED BY: R. LOMONACO	CHECKED BY: R. LOMONACO
SOIL WORK PLAN (3 OF 8)	SHEET 3 OF 8

vhb

PROJECT NAME:	MIDDLEBURY
PROJECT NUMBER:	WCRS(23)

FILE NAME: zl0g044nul_Soil-Characterization.dgn PLOT DATE: 2/19/2016
PROJECT LEADER: M.A. COLGAN DRAWN BY: M.F. SUFFEL
DESIGNED BY: R. LOMONACO CHECKED BY: R. LOMONACO
SOIL WORK PLAN (4 OF 8) SHEET 4 OF 8

vhb



LEGEND:

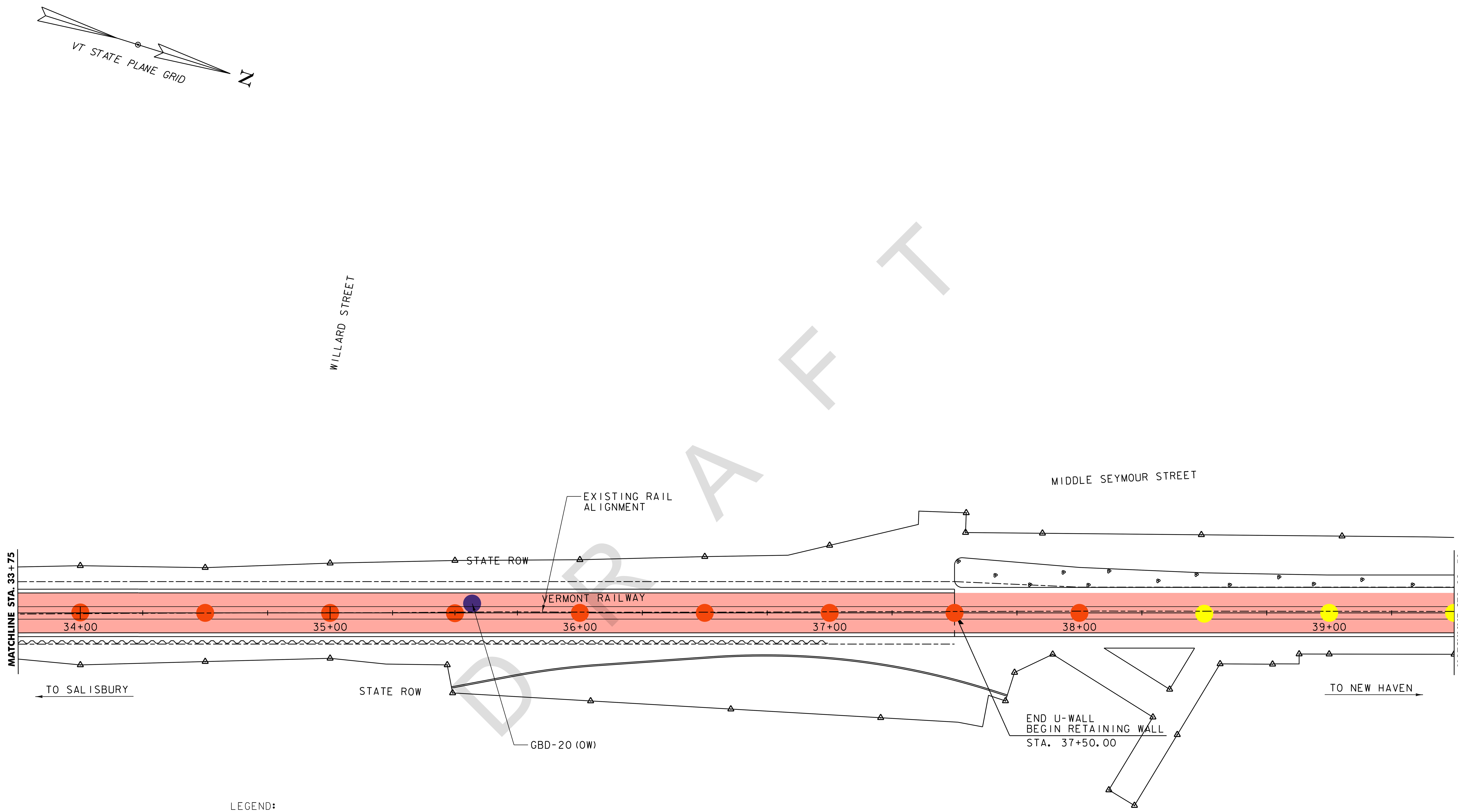
- = SOIL SAMPLE 2FT BELOW GRADE (RAILROAD TRACK)
- = SOIL SAMPLE 2FT AND 6FT BELOW GRADE (RAILROAD TRACK)
- = SOILS SAMPLE 2FT, 6FT, 12FT BELOW GRADE (RAILROAD TRACK)
- = SOIL SAMPLE 2FT BELOW GRADE AND BEDROCK INTERFACE (DRAINAGE STRUCTURES)
- = SOIL SAMPLE 2FT BELOW GRADE (MAIN ST. AND MECHANTS ROW)
- = SOIL SAMPLE 1FT BELOW GRADE (TEMPORARY ACCESS ROAD)
- = EXISTING GROUNDWATER MONITORING WELLS

vhb

PROJECT NAME: MIDDLEBURY
PROJECT NUMBER: WCRS(23)

FILE NAME: z10g044nul_Soil-Characterization.dgn
PLOT DATE: 2/19/2016
PROJECT LEADER: M.A. COLGAN
DRAWN BY: M.F. SUFFEL
DESIGNED BY: R. LOMONACO
CHECKED BY: VHB
SOIL WORK PLAN (5 OF 8)
SHEET 5 OF 8

VHB 57603



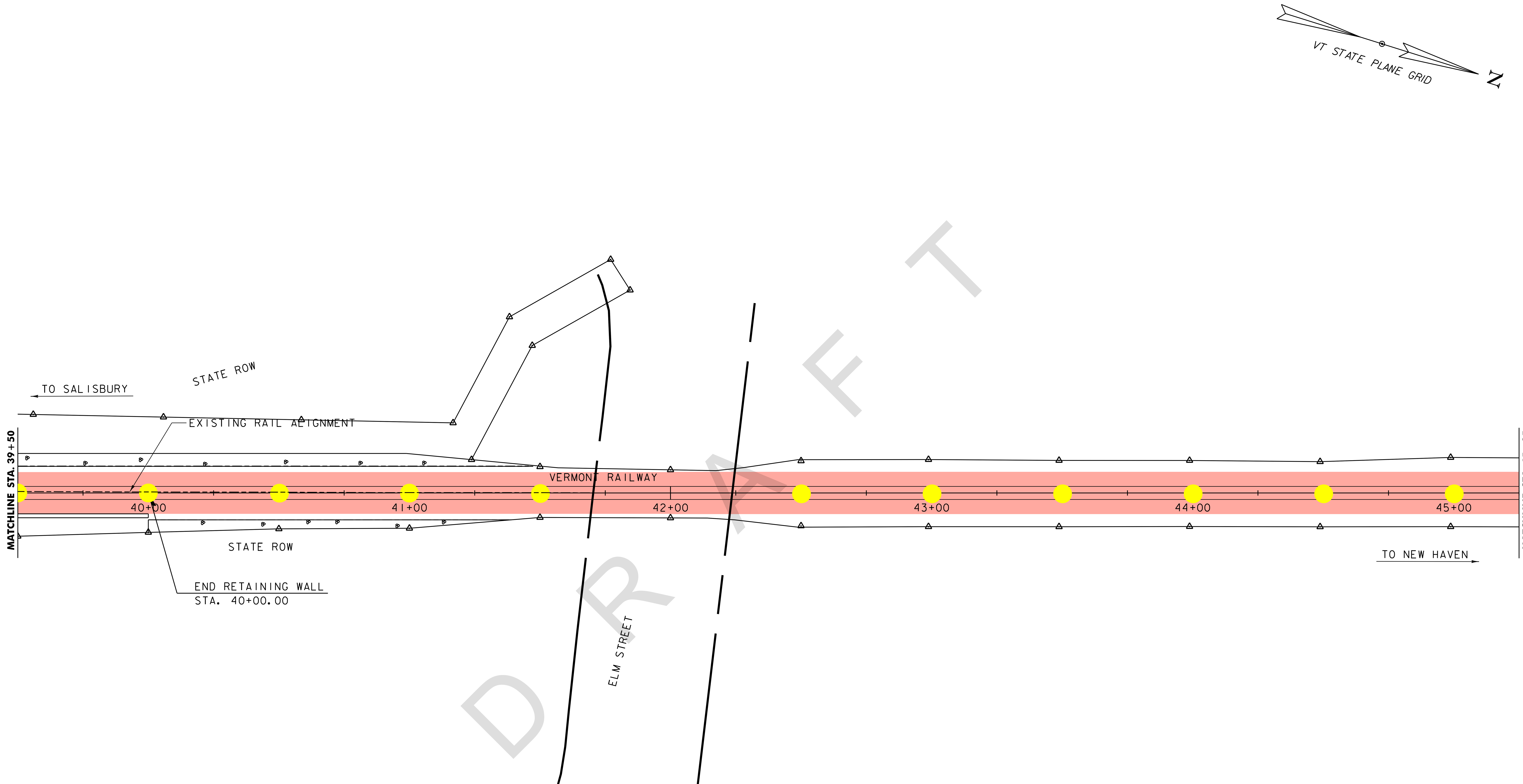
LEGEND:

- (yellow) = SOIL SAMPLE 2FT BELOW GRADE (RAILROAD TRACK)
- (orange) = SOIL SAMPLE 2FT AND 6FT BELOW GRADE (RAILROAD TRACK)
- (dark red) = SOILS SAMPLE 2FT, 6FT, 12FT BELOW GRADE (RAILROAD TRACK)
- (blue) = SOIL SAMPLE 2FT BELOW GRADE AND BEDROCK INTERFACE (DRAINAGE STRUCTURES)
- (green) = SOIL SAMPLE 2FT BELOW GRADE (MAIN ST. AND MECHANTS ROW)
- (magenta) = SOIL SAMPLE 1FT BELOW GRADE (TEMPORARY ACCESS ROAD)
- (purple) = EXISTING GROUNDWATER MONITORING WELLS

vhb

PROJECT NAME: MIDDLEBURY	
PROJECT NUMBER: WCRS(23)	
FILE NAME: z10g044nul_Soil-Characterization.dgn	PLOT DATE: 2/19/2016
PROJECT LEADER: M.A. COLGAN	DRAWN BY: M.F. SUFFEL
DESIGNED BY: R. LOMONACO	CHECKED BY: R. LOMONACO
SOIL WORK PLAN (6 OF 8)	SHEET 6 OF 8

VHB 57603

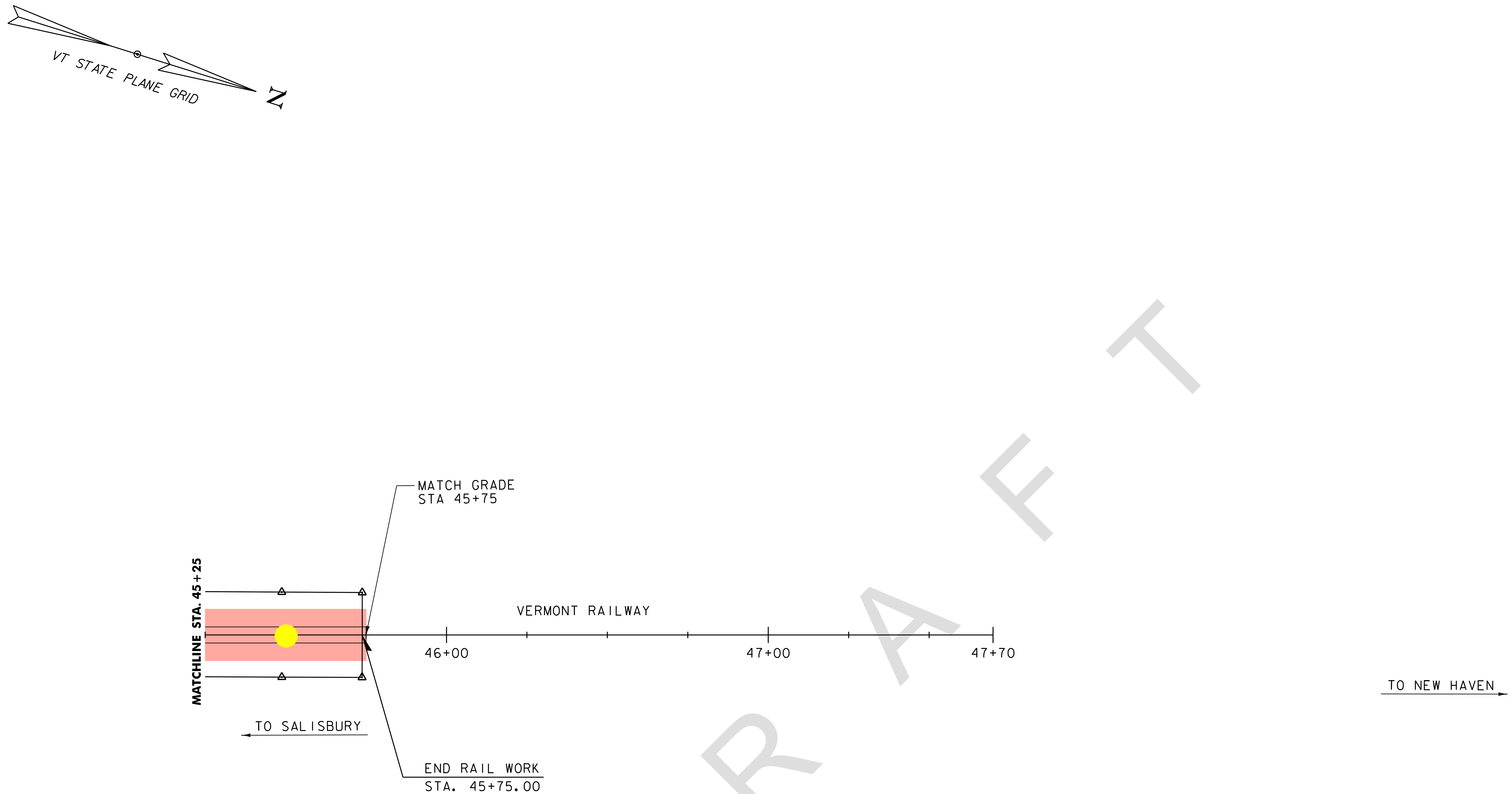


LEGEND:

- = SOIL SAMPLE 2FT BELOW GRADE (RAILROAD TRACK)
- = SOIL SAMPLE 2FT AND 6FT BELOW GRADE (RAILROAD TRACK)
- = SOILS SAMPLE 2FT, 6FT, 12FT BELOW GRADE (RAILROAD TRACK)
- = SOIL SAMPLE 2FT BELOW GRADE AND BEDROCK INTERFACE (DRAINAGE STRUCTURES)
- = SOIL SAMPLE 2FT BELOW GRADE (MAIN ST. AND MECHANTS ROW)
- = SOIL SAMPLE 1FT BELOW GRADE (TEMPORARY ACCESS ROAD)
- = EXISTING GROUNDWATER MONITORING WELLS

PROJECT NAME: MIDDLEBURY	
PROJECT NUMBER: WCRS(23)	
FILE NAME: z10g044nul_Soil-Characterization.dgn	PLOT DATE: 2/19/2016
PROJECT LEADER: M.A. COLGAN	DRAWN BY: M.F. SUFFEL
DESIGNED BY: R. LOMONACO	CHECKED BY: R. LOMONACO
SOIL WORK PLAN (7 OF 8)	SHEET 7 OF 8

VHB 57603



LEGEND:

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- = SOIL SAMPLE 2FT AND 6FT BELOW GRADE (RAILROAD TRACK)
- = SOILS SAMPLE 2FT, 6FT, 12FT BELOW GRADE (RAILROAD TRACK)
- = SOIL SAMPLE 2FT BELOW GRADE AND BEDROCK INTERFACE (DRAINAGE STRUCTURES)
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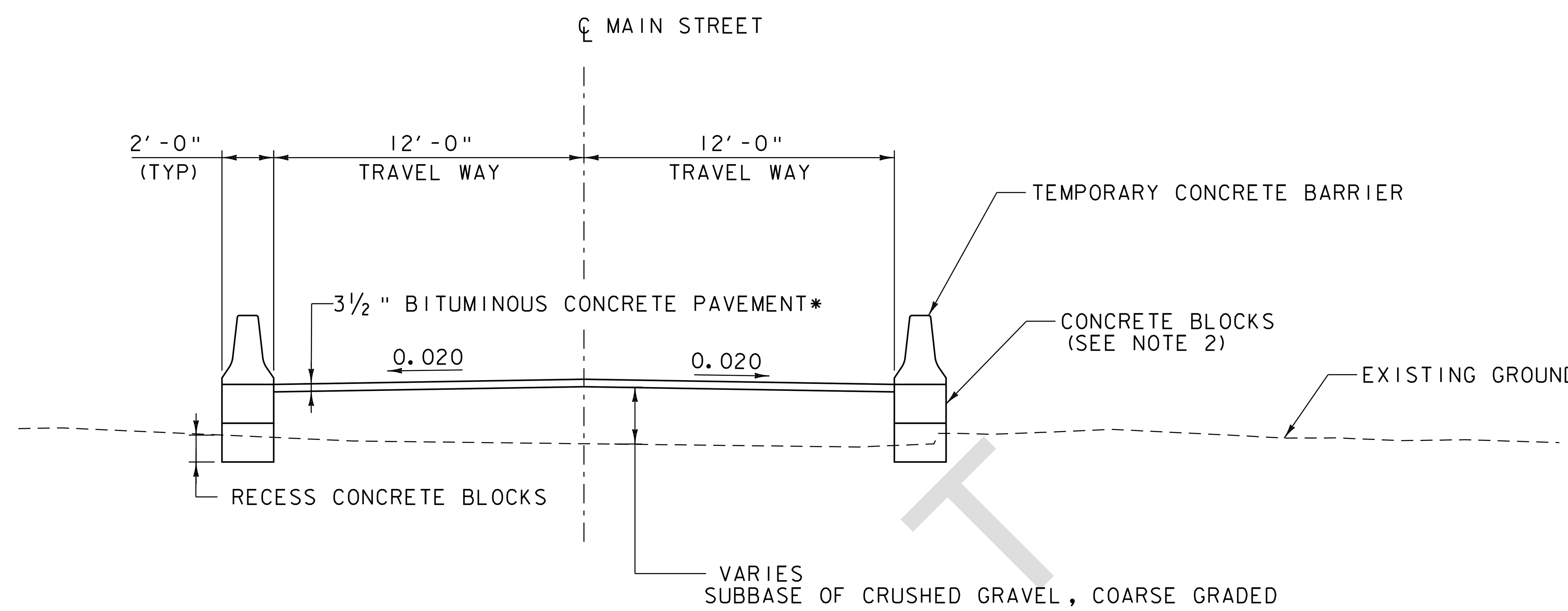
- = SOIL SAMPLE 1FT BELOW GRADE (TEMPORARY ACCESS ROAD)
- = EXISTING GROUNDWATER MONITORING WELLS

PROJECT NAME: MIDDLEBURY	
PROJECT NUMBER: WCRS(23)	
FILE NAME: z10g044nul_Soil-Characterization.dgn	PLOT DATE: 2/19/2016
PROJECT LEADER: M.A. COLGAN	DRAWN BY: M.F. SUFFEL
DESIGNED BY: R. LOMONACO	CHECKED BY: R. LOMONACO
SOIL WORK PLAN (8 OF 8)	SHEET 8 OF 8

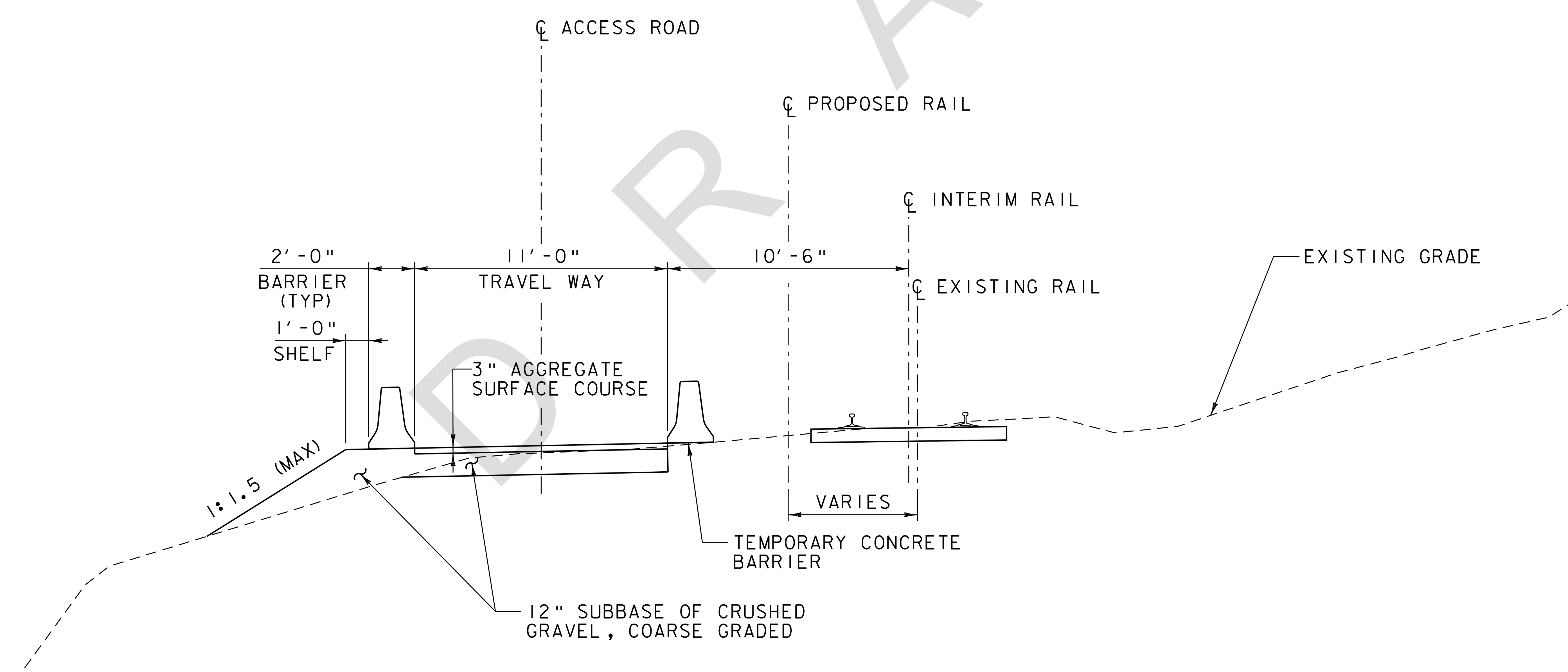
VHB 57603



* (1) 1½" LIFT OF TYPE II OVER
(1) 2" LIFT OF TYPE III

TYPICAL MAIN ST TEMPORARY ROAD SECTION

SCALE ¼" = 1'-0"



TYPICAL TEMPORARY ACCESS ROAD SECTION

SCALE ¼" = 1'-0"

NOTES:

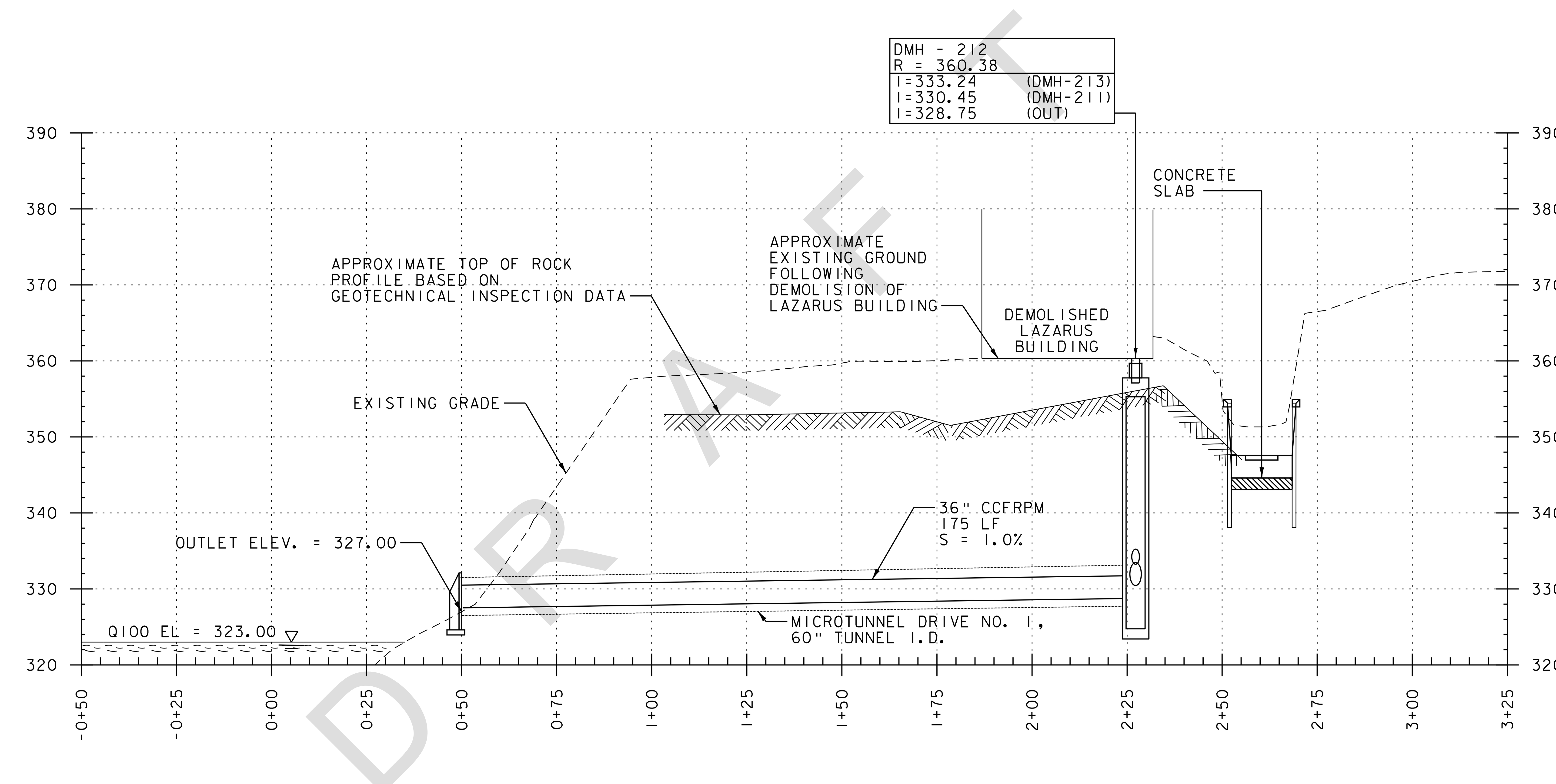
1. ALL WORK ASSOCIATED WITH THE INSTALLATION AND REMOVAL OF MAIN ST TEMPORARY ROAD WILL BE INCLUDED IN THE UNIT PRICE BID FOR CONTRACT ITEM 528.11.

2. TEMPORARY CONCRETE BLOCKS OR RETAINING STRUCTURES TO BE DESIGNED AND DETAILED WITH ADDITIONAL CMGC INPUT DURING FINAL DESIGN.

3. ALL WORK ASSOCIATED WITH THE INSTALLATION AND REMOVAL OF THE TEMPORARY ACCESS ROAD WILL BE INCLUDED IN THE UNIT PRICE BID FOR CONTRACT ITEM 900.645, "SPECIAL PROVISION (TEMPORARY ACCESS ROAD)".

vhb

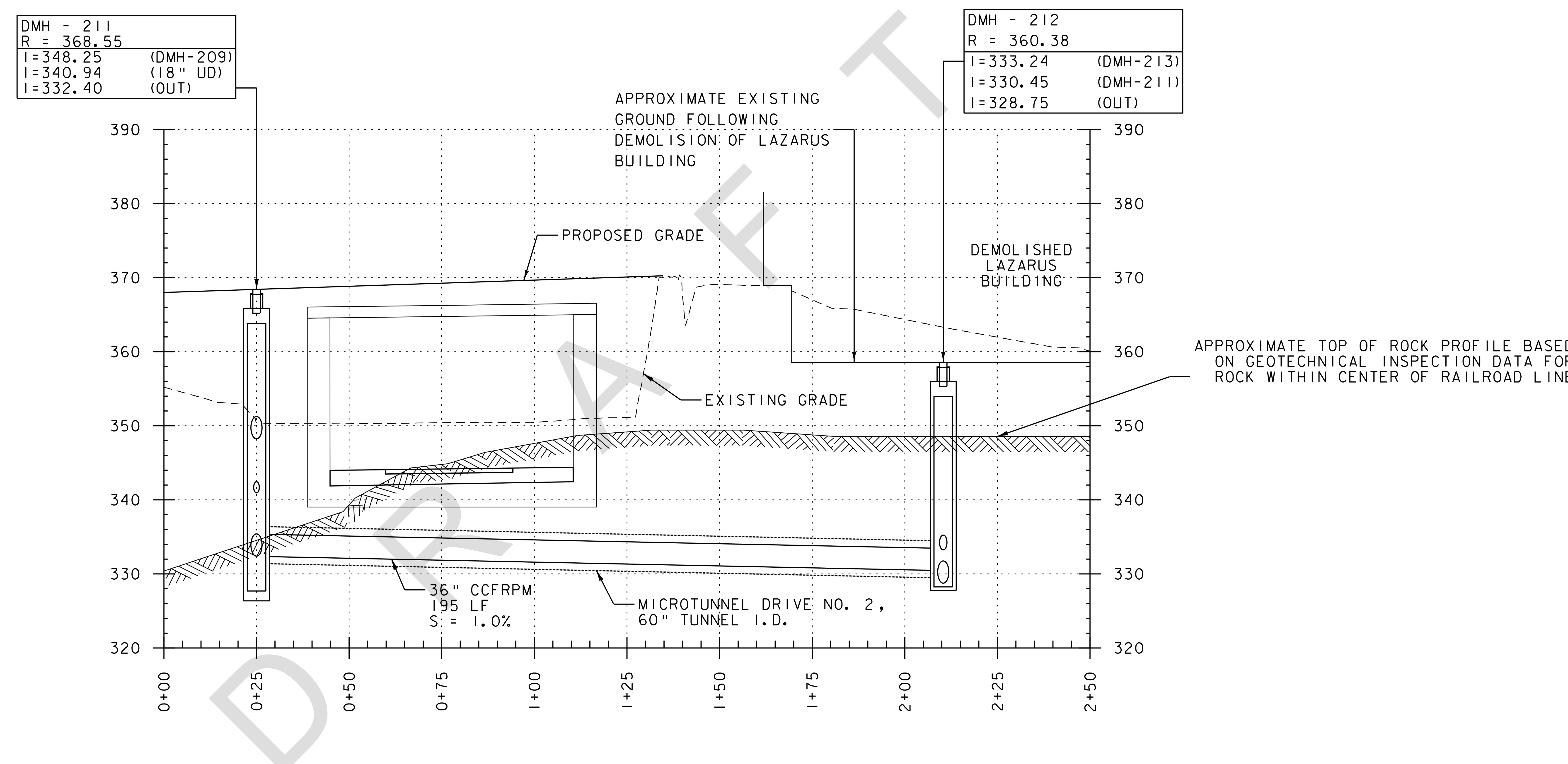
PROJECT NAME: MIDDLEBURY	
PROJECT NUMBER: WCRS(23)	
FILE NAME: z10g044typ.dgn	PLOT DATE: 10/20/2015
PROJECT LEADER: M.A. COLGAN	DRAWN BY: E.A. FIALA
DESIGNED BY: E.A. FIALA	CHECKED BY: VHB
TYPICAL ROADWAY SECTIONS (4 OF 5)	SHEET 13 OF 158



DRAINAGE OUTLET PROFILE

MICROTUNNEL DRIVE NO. 1
STA. 0+50 - 2+25
SCALE 1" = 20' HORIZONTAL
1" = 10' VERTICAL

PROJECT NAME: MIDDLEBURY	
PROJECT NUMBER: WCRS(23)	
FILE NAME: z10g044pro_Utilities.dgn	PLOT DATE: 10/20/2015
PROJECT LEADER: M.A. COLGAN	DRAWN BY: A.J. GOUDREAU
DESIGNED BY: J.D. TREARCHIS	CHECKED BY: T.M. GINGRAS
DRAINAGE OUTLET PROFILE	SHEET 63 OF 158

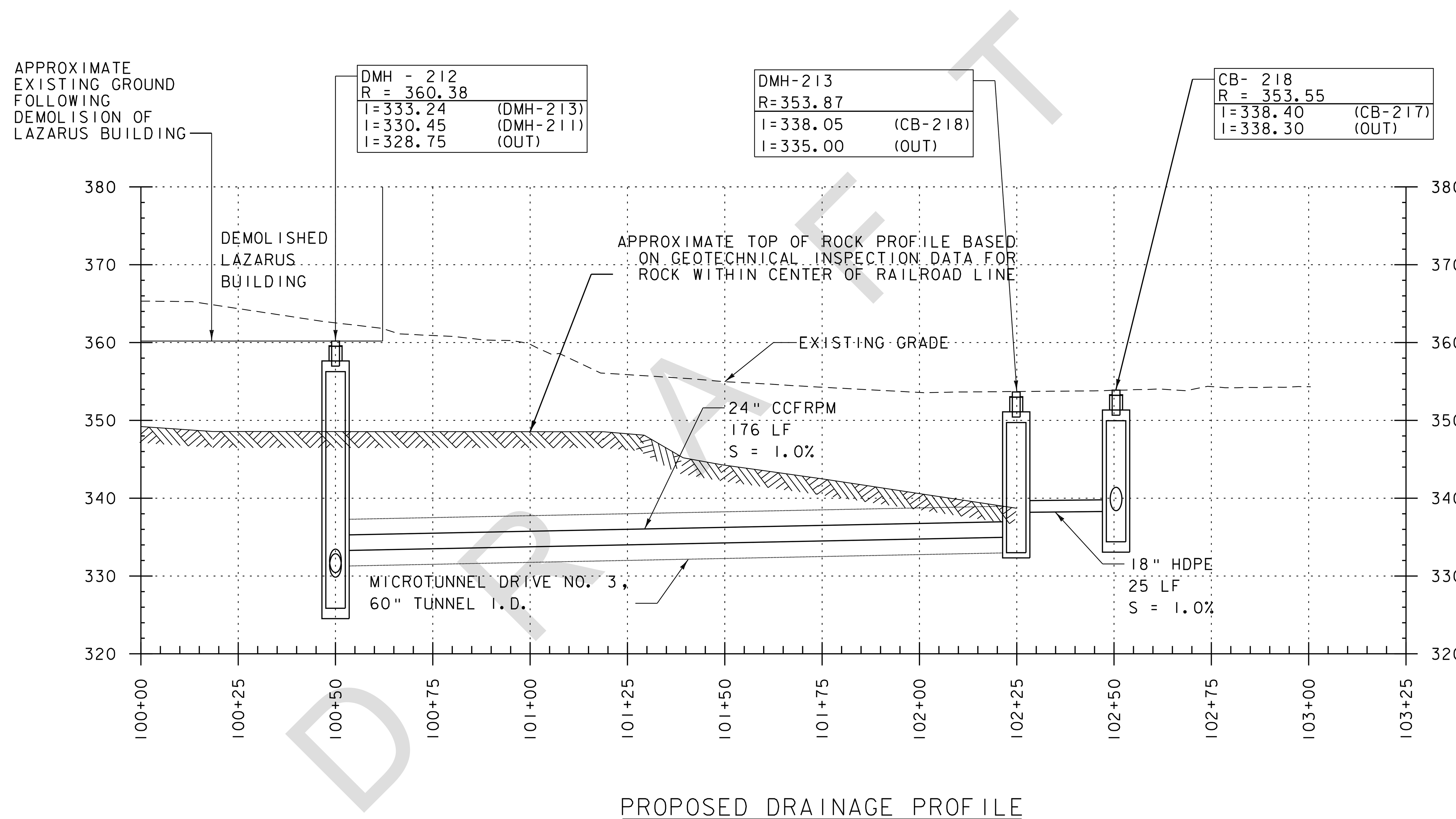


PROPOSED DRAINAGE PROFILE

MICROTUNNEL DRIVE NO. 2
STA. 0+00 - 2+50
SCALE 1" = 20' HORIZONTAL
1" = 10' VERTICAL

PROJECT NAME: MIDDLEBURY	
PROJECT NUMBER: WCRS(23)	
FILE NAME: z10g044pro_Utilities.dgn	PLOT DATE: 10/20/2015
PROJECT LEADER: M.A. COLGAN	DRAWN BY: P.A. MILLER
DESIGNED BY: J.D. TREARCHIS	CHECKED BY: T.M. GINGRAS
MICROTUNNEL DRIVE NO. 2 PROFILE SHEET	SHEET 64 OF 158

VHB 57603.00



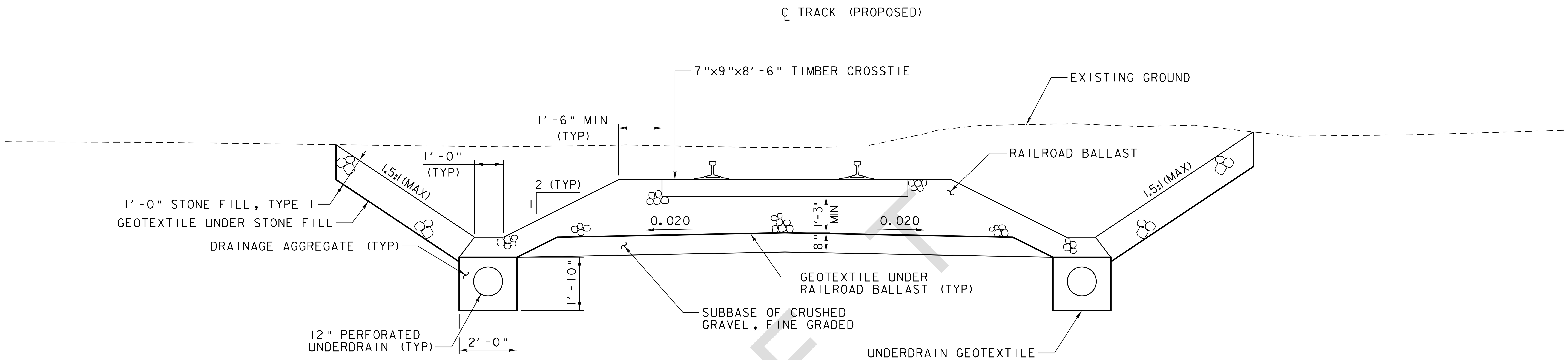
PROPOSED DRAINAGE PROFILE

MICROTUNNEL DRIVE NO. 3
STA. 100+50 - 102+50
SCALE 1" = 20' HORIZONTAL
1" = 10' VERTICAL

PROJECT NAME: MIDDLEBURY	
PROJECT NUMBER: WCRS(23)	
FILE NAME: z10g044pro_Utilities.dgn	PLOT DATE: 10/20/2015
PROJECT LEADER: M.A. COLGAN	DRAWN BY: P.A. MILLER
DESIGNED BY: J.D. TREARCHIS	CHECKED BY: T.M. GINGRAS
MICROTUNNEL DRIVE NO.3 PROFILE SHEET	SHEET 65 OF 158

vhb

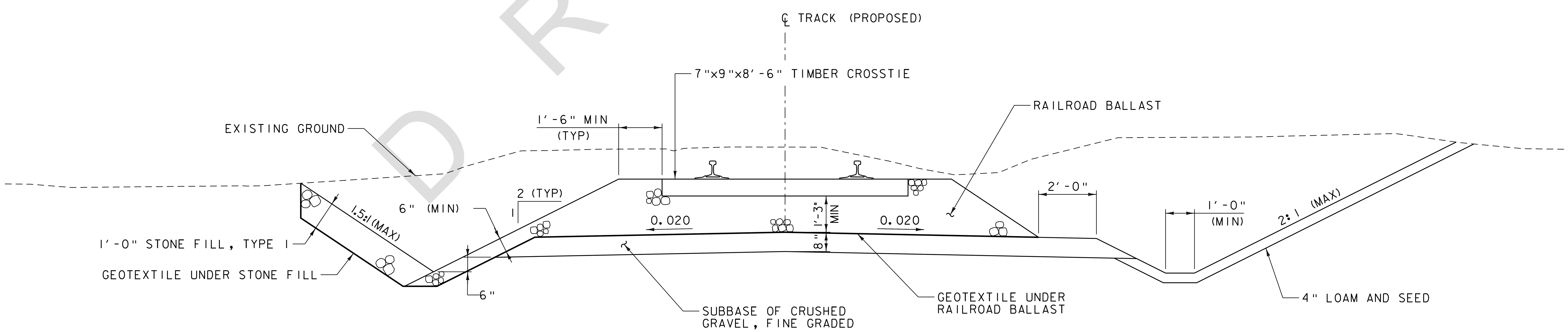
VHB 57603.00



NOTE: RAILROAD ROW VARIES AND IS NOT SHOWN.

TYPICAL NORTH RAIL SECTION

STA. 40+50 - 41+50
SCALE 1/2" = 1'-0"



NOTE: RAILROAD ROW IS 33'-0" FROM CENTERLINE
OF TRACK ON EACH SIDE AND IS NOT SHOWN.

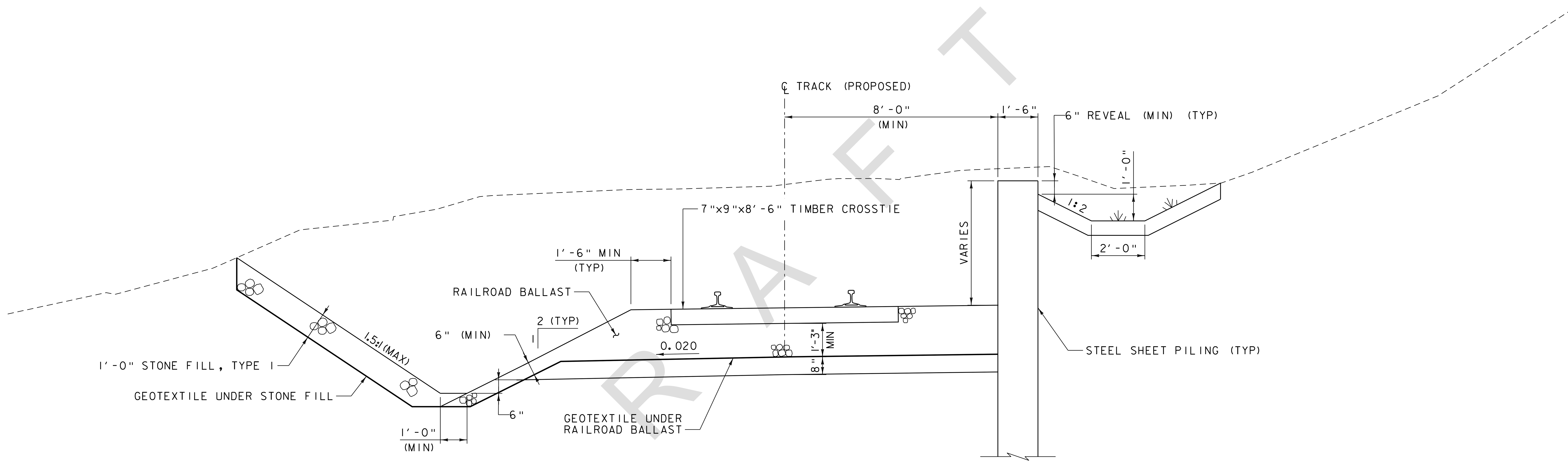
TYPICAL SOUTH RAIL SECTION

STA. 10+50 - 16+75
SCALE 1/2" = 1'-0"

PROJECT NAME: MIDDLEBURY
PROJECT NUMBER: WCRS(23)

vhb

FILE NAME: z10g044typ.dgn	PLOT DATE: 10/20/2015
PROJECT LEADER: M.A. COLGAN	DRAWN BY: E.A. FIALA
DESIGNED BY: G.J. BOLES	CHECKED BY: VHB
TYPICAL RAIL SECTION (1 OF 7)	SHEET 3 OF 158



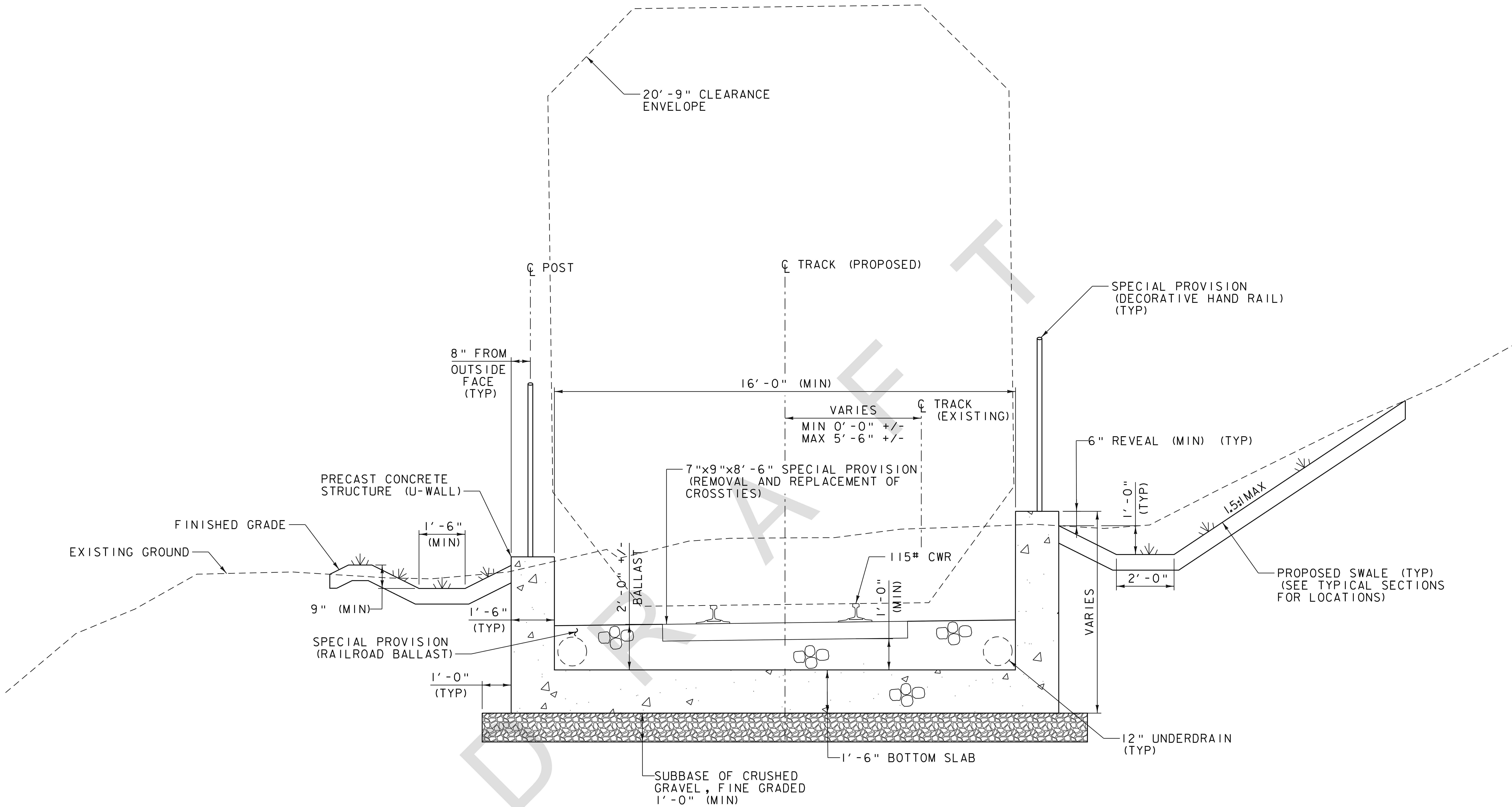
NOTE: RAILROAD ROW VARIES AND IS NOT SHOWN.

TYPICAL STEEL SHEET PILING SECTION

STA. 16+75 - 20+00
SCALE ½" = 1'-0"

PROJECT NAME: MIDDLEBURY	
PROJECT NUMBER: WCRS(23)	
FILE NAME: z10g044typ.dgn	PLOT DATE: 10/20/2015
PROJECT LEADER: M.A. COLGAN	DRAWN BY: E.F. LAWES
DESIGNED BY: HMM/VHB	CHECKED BY: M.A. COLGAN
TYPICAL RAIL SECTION (2 OF 7)	SHEET 4 OF 158

VHB 57603

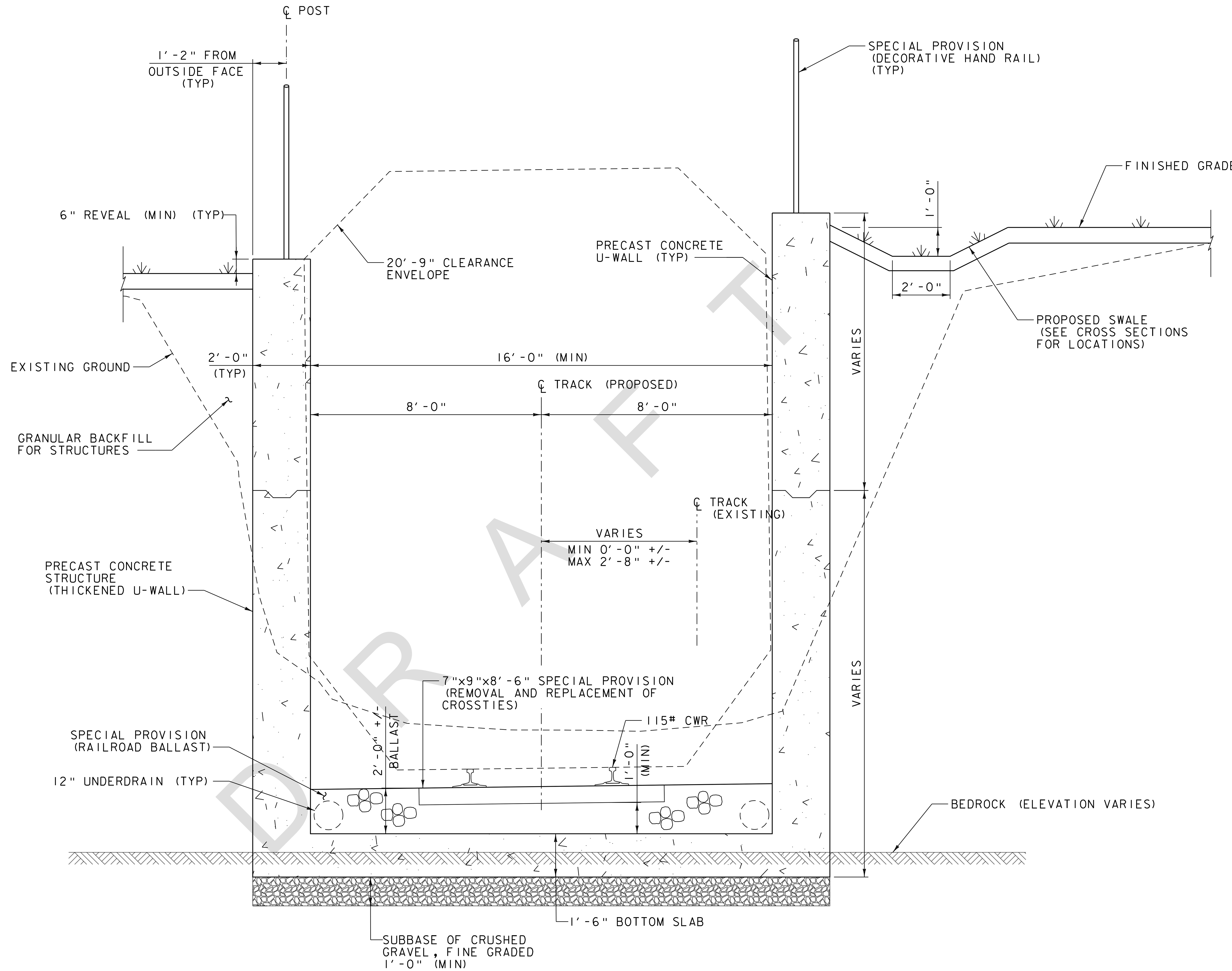


NOTE: RAILROAD ROW VARIES AND IS NOT SHOWN.

TYPICAL PRECAST CONCRETE STRUCTURE (U-WALL) SECTION

STA. 18+25 TO 20+00
STA. 27+50 TO 37+50
SCALE ½" = 1'-0"

PROJECT NAME: MIDDLEBURY	
PROJECT NUMBER: WCRS(23)	
FILE NAME: z10g044typ.dgn	PLOT DATE: 10/20/2015
PROJECT LEADER: M.A. COLGAN	DRAWN BY: E.A. FIALA
DESIGNED BY: VHB/HMM	CHECKED BY: M.A. COLGAN
TYPICAL RAIL SECTION (3 OF 7)	SHEET 5 OF 158



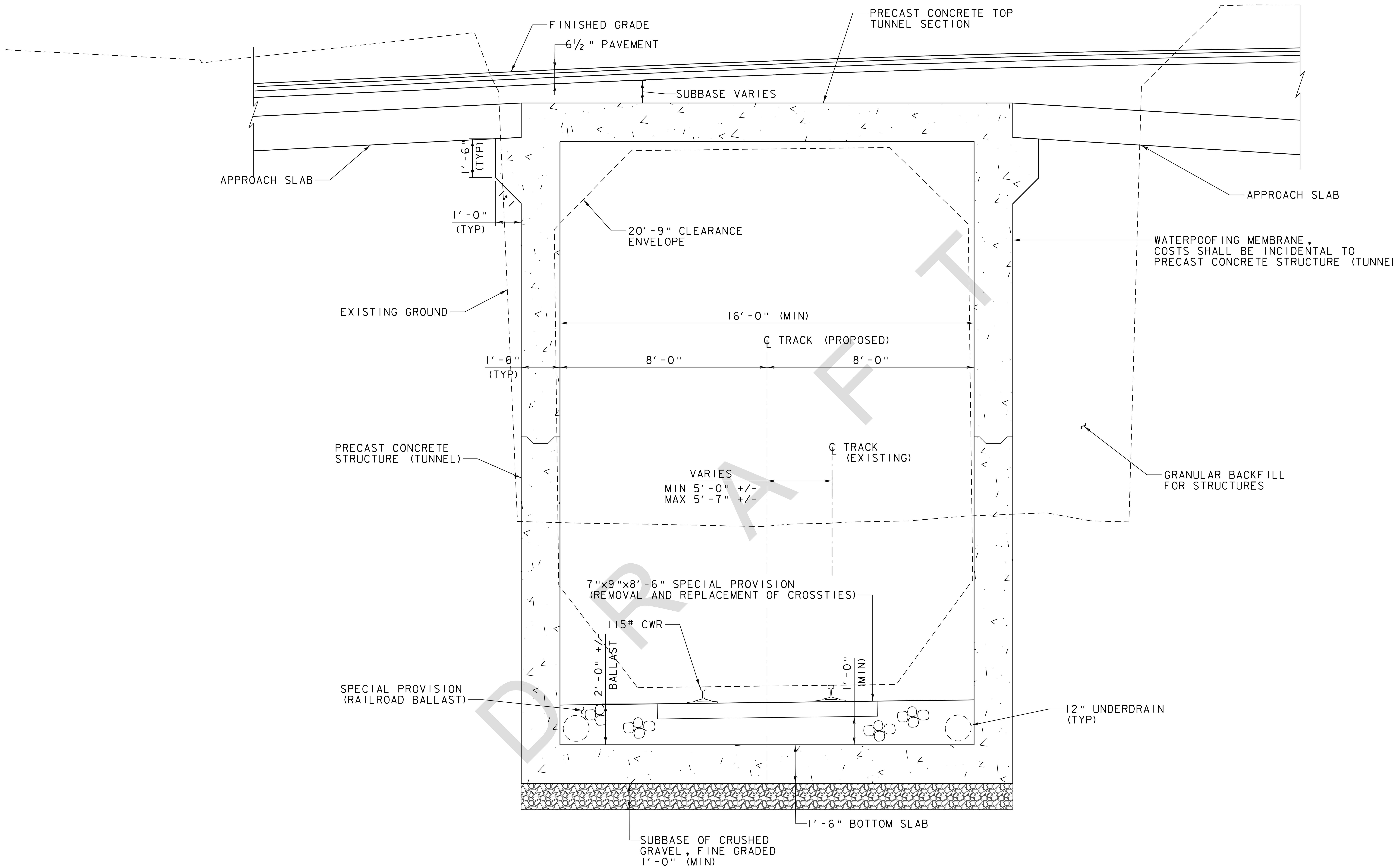
NOTE: RAILROAD ROW VARIES AND IS NOT SHOWN.

TYPICAL PRECAST CONCRETE STRUCTURE (THICKENED U-WALL) SECTION

STA. 22+00 - 23+24
STA. 26+64 - 27+50
SCALE ½" = 1'-0"

PROJECT NAME: MIDDLEBURY	
PROJECT NUMBER: WCRS(23)	
FILE NAME: z10g044typ.dgn	PLOT DATE: 10/20/2015
PROJECT LEADER: M.A. COLGAN	DRAWN BY: E.A. FIALA
DESIGNED BY: HMM/VHB	CHECKED BY: M.A. COLGAN
TYPICAL RAIL SECTION (4 OF 7)	SHEET 6 OF 158

VHB 57603

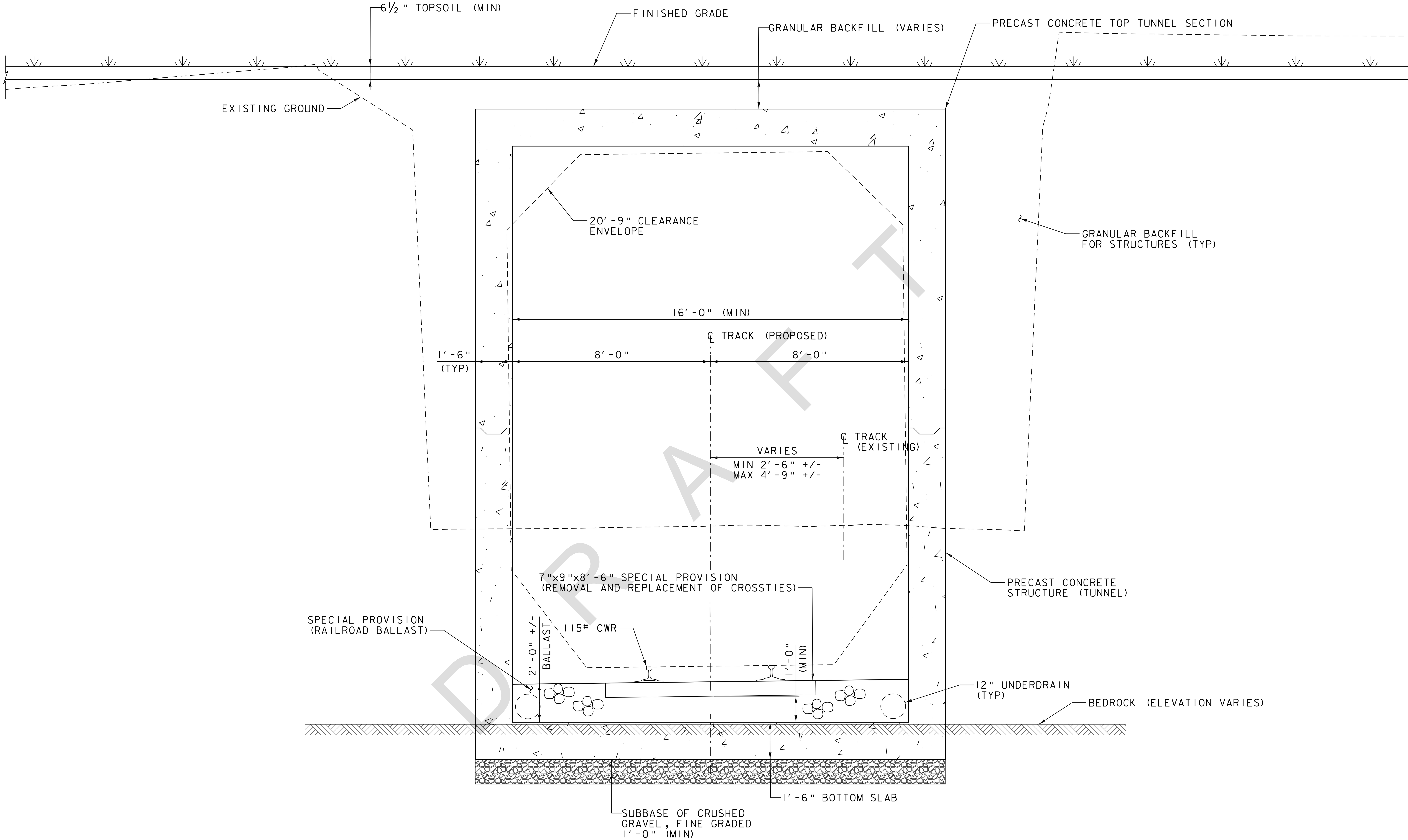


TYPICAL TUNNEL SECTION (ROADWAY)

STA. 23+24 - 24+18
STA. 25+69 - 26+64
SCALE ½" = 1'-0"

PROJECT NAME: MIDDLEBURY	
PROJECT NUMBER: WCRS(23)	
FILE NAME: z10g044typ.dgn	PLOT DATE: 10/20/2015
PROJECT LEADER: M.A. COLGAN	DRAWN BY: K.C. BARRY
DESIGNED BY: HMM/VHB	CHECKED BY: M.A. COLGAN
TYPICAL RAIL SECTION (5 OF 7)	SHEET 7 OF 158

VHB 57603



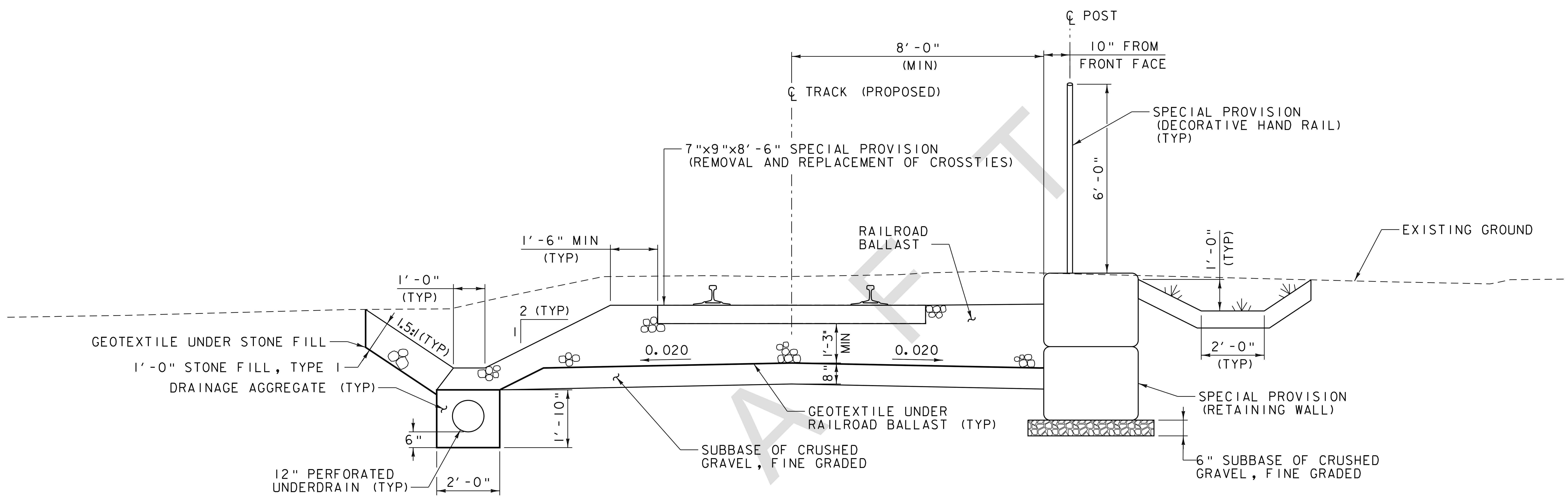
TYPICAL TUNNEL SECTION (PARK)

STA. 24+18 - 25+69
SCALE ½" = 1'-0"

PROJECT NAME: MIDDLEBURY	
PROJECT NUMBER: WCRS(23)	
FILE NAME: z10g044typ.dgn	PLOT DATE: 10/20/2015
PROJECT LEADER: M.A. COLGAN	DRAWN BY: E.A. FIALA
DESIGNED BY: HMM/VHB	CHECKED BY: M.A. COLGAN
TYPICAL RAIL SECTION (6 OF 7)	SHEET 8 OF 158

vhb

VHB 57603



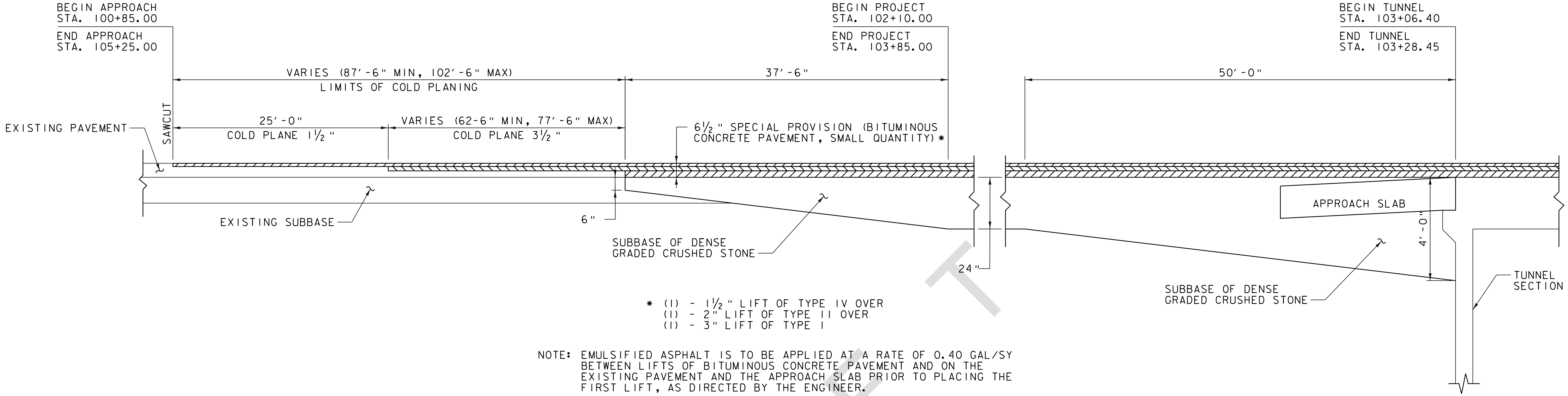
NOTE: RAILROAD ROW VARIES AND IS NOT SHOWN.

TYPICAL RETAINING WALL SECTION

STA. 37+50 - 40+00
SCALE ½" = 1'-0"

PROJECT NAME: MIDDLEBURY	
PROJECT NUMBER: WCRS(23)	
FILE NAME: z10g044typ.dgn	PLOT DATE: 10/20/2015
PROJECT LEADER: M.A. COLGAN	DRAWN BY: E.A. FIALA
DESIGNED BY: K.Z. SMITH	CHECKED BY: VHB
TYPICAL RAIL SECTION (7 OF 7)	SHEET 9 OF 158

VHB 57603

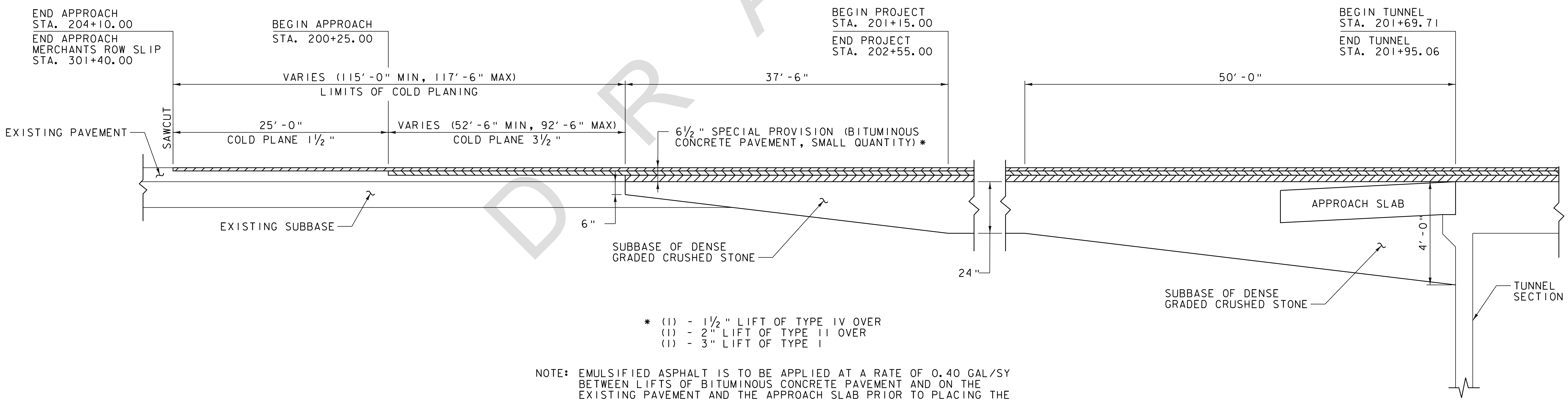


* (1) - 1½" LIFT OF TYPE IV OVER
(1) - 2" LIFT OF TYPE II OVER
(1) - 3" LIFT OF TYPE I

NOTE: EMULSIFIED ASPHALT IS TO BE APPLIED AT A RATE OF 0.40 GAL/SY BETWEEN LIFTS OF BITUMINOUS CONCRETE PAVEMENT AND ON THE EXISTING PAVEMENT AND THE APPROACH SLAB PRIOR TO PLACING THE FIRST LIFT, AS DIRECTED BY THE ENGINEER.

MAIN STREET APPROACH SECTION

NOT TO SCALE



* (1) - 1½" LIFT OF TYPE IV OVER
(1) - 2" LIFT OF TYPE II OVER
(1) - 3" LIFT OF TYPE I

NOTE: EMULSIFIED ASPHALT IS TO BE APPLIED AT A RATE OF 0.40 GAL/SY BETWEEN LIFTS OF BITUMINOUS CONCRETE PAVEMENT AND ON THE EXISTING PAVEMENT AND THE APPROACH SLAB PRIOR TO PLACING THE FIRST LIFT, AS DIRECTED BY THE ENGINEER.

MERCHANTS ROW APPROACH SECTION

NOT TO SCALE

PROJECT NAME: MIDDLEBURY
PROJECT NUMBER: WCRS(23)

FILE NAME: z10g044typ.dgn
PROJECT LEADER: M.A. COLGAN
DESIGNED BY: D.M. PECK
TYPICAL ROADWAY SECTIONS (5 OF 5)

PLOT DATE: 10/20/2015
DRAWN BY: A.J. GOUDREAU
CHECKED BY: VHB

vhb

VHB 57603

Photoionization Detector Field Screening Procedure

PID Calibration and Calibration Log

All PID assays will be completed on-site using a minimum 10.2 electron volt (eV) unit. Prior to the collection and screening of samples, complete the following:

- Calibrate the PID unit to a benzene equivalent (e.g. 100 ppm isobutylene) in accordance with the manufacturer's instructions
- Perform calibrations each day the instrument is in use. Calibrate the instrument on-site and whenever significant climatic changes occur during screening activities
- Maintain an instrument log book, which may be reviewed by the DEC SMS upon request. Record the following:
  - PID make and model
  - The date and time of the calibration
  - Type of calibration gas used
  - Weather conditions including: relative humidity, wind, temperature, sample locations, background air and empty container values, and any other relevant information

PID Monitoring Procedures for Excavation Work

During excavations, ambient airspace will be continually monitored with a PID for health and safety purposes as well as acquiring a background ambient air reading. The ambient air reading will be collected away from overt sources of VOCs including but not limited to excavation equipment, construction materials, and indelible markers.

Material being excavated, moved, or disturbed will be screened directly with the PID:

- In areas with no evidence of gross contamination or of suspected contamination, approximately 10% of soil being disturbed or excavated will be subject to field screening within the bucket of the excavator (e.g. one out of every ten excavator bucketfulls will be PID-screened).
- In areas of suspected contamination or with visual and olfactory evidence of contamination, <u>each</u> excavator bucket will be screened with a PID.

PID screening of material will consist of creating a narrow linear depression in the soil contained within the excavator bucket with a clean implement or a clean nitrile-gloved hand. The PID probe will be inserted into and moved along the depression for a continuous headspace reading while a clean nitrile gloved hand is cupped over the top of the depression and moved along with the PID probe. The most elevated reading will be recorded along with soil characteristics including depth, lateral location, time of screening, maximum PID reading, color, texture, moisture content, and olfactory observation. Areas of elevated PID screen readings (>10 ppm above the ambient background reading) and areas of visual/olfactory evidence of contamination will be collected for headspace measurements (see "Bag or Jar Headspace Technique" section below).

Prior to collecting samples for bag or jar headspace readings, an ambient (background) concentration reading should be completed. The background sample should be taken away from any overt sources of VOCs.

Prior to sample collection, an overview screen of the soil core or excavation bucket should be completed by creating a narrow linear depression in the soil with a clean implement and slowly sweeping the PID through the depression approximately one-inch from the soil. Cup one hand over the depression and inlet of the PID and note areas of maximum readings. Collect composite samples from the entire core or bucket, in addition to discrete samples where elevated PID measurements are observed, for bag or jar headspace readings.

Bag or Jar Headspace Technique

Soil samples collected during soil excavation or soil boring activities will be field screened in accordance with the headspace technique outlined below:

- **Jar**: Half fill one clean glass jar with the sample to be analyzed. Quickly cover the open top with two sheets of clean aluminum foil and subsequently apply screw cap to tightly seal the jars. Wide-mouth or mason-type jars are preferred. Jars ranging in size from 8 ounces (approximately 250 ml) to 16 ounces (approximately 500 ml) total capacity may be used. <u>Vigorously shake jar for 15 seconds prior to development period</u>.

- **Bag**: Half fill one clean plastic bag with the sample to be analyzed. Quickly seal the bag. Mix soil while bag is closed to homogenize, then <u>vigorously shake jar for 15 seconds prior to development period</u>.

- Allow headspace development for at least 10 minutes. Where ambient temperatures are below 32°F (0°C), headspace development should be within a heated vehicle or building. The screening will be conducted utilizing a portable photoionization detector (PID).

- Subsequent to headspace development, <u>vigorously shake jar or bag for 15 seconds</u>. For the jar technique, remove screw lid and expose foil seal. Quickly puncture foil seal with instrument sampling probe, to a point about one-half of the headspace depth. For the bag technique, open a small section of the bag and insert PID inlet tube to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particles.

- Following probe insertion through foil seal or zip seal, record highest meter response as the jar headspace concentration. Maximum response should occur between 2 and 5 seconds. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture. If this condition develops due to high organic concentrations, the concentration should be recorded as being greater than the concentration at which the erratic response began. If it is believed that headspace moisture interfered with the results, as indicated by soil visual or textural observations, a water filter should be placed on the end of the PID and an additional sample should be collected and field screened.

- Allow PID to return to ambient concentrations prior to completing subsequent measurements. If PID does not return to ambient concentrations recalibration or cleaning of the unit may be necessary.

Adapted from:

Vermont Department of Environmental Conservation (DEC) Investigation and Remediation of Contaminated Properties Procedure (IROCPP), April 2012.

Massachusetts Department of Environmental Protection (DEP) Policy #WSC-94-400, "Interim Remediation Waste Management Policy for Petroleum Contaminated Soils"

Soil Sample Collection and Decontamination Procedures

Soil Sample Collection

Soil samples collected for laboratory analyses will be collected using appropriate sample containers, as provided by the receiving laboratory. Precleaned containers shall be requested from the laboratory that meet the requirements in "Specifications and Guidance for Contaminant-Free Sample Containers", EPA540/R-93/051, PB93-963316, December 1992. Prior to sampling, all sampling utensils shall be decontaminated in accordance with the procedures outlined in the section to follow, "Decontamination Procedures".

Samples obtained for volatile organic compound (VOC) toxicity characteristic leaching procedure (TCLP) analysis will be collected as grab samples in 4 ounce wide-mouth clear glass jars with teflon septa lids, or in bottles provided by the accepting laboratory. Samples will be collected in a manner to limit VOC losses; for example, no mixing of the VOC soil sample will occur and minimum air exposure will be permitted. VOC samples will be collected first followed by the sampling for additional analyses. Refer to the following section titled "Soil Sample Collection for Total VOCs and TPH-GRO via USEPA Method 8260/5035" for information regarding sampling of total VOCs and TPH-GRO

Soil samples collected for additional analyses (non-VOC) will be collected in bottles provided by the accepting laboratory. Preservation for soil samples will include placement on ice in a cooler for shipment to the laboratory.

During all soil sampling, the following general procedures will be followed:

- Field screening and visual inspection to identify the soil to be collected for laboratory analyses;
- Obtain the most representative, homogeneous sample as possible. If collecting for VOCs, minimize soil disturbance to limit VOC losses. All sampling tools will be pre-cleaned stainless steel. As appropriate, soil samples will be composited in clean stainless steel bowls;
- Remove all large stones from the soil sample (greater than 1/4-inch);
- Place the sample into the laboratory-supplied container. Sample shall be packed as tightly as possible to remove air pockets;

- Clean threads of jar and place teflon lid on tightly. Care shall be taken not to trap soil grains within the threads of the jar and lid;
- Label and preserve the sample as discussed in the section "Sample Handling, Documentation and Chain-of-Custody requirements";
- Discard outer protective gloves between each sample event; and
- Decontaminate samples tools as described in the section, "Decontamination Procedures".

Soil Sample Collection for Total VOCs via USEPA Method 8260/5035

Samples obtained for total VOC or TPH-GRO analysis will be collected as grab samples in 40 mL methanol preserve vials. Methanol shall be pre-weighed from the laboratory. Between 5 to 25 grams of soil should be collected. The desired ratio of grams soil/mL methanol is 1:1, within a tolerance of +/-25%, however, the soil must be completely immersed in methanol. An additional sample of (unpreserved) soil must be collected to allow for a determination of moisture content, and the normalization of data to a dry-weight basis. Samples will be collected in a manner to limit VOC losses; for example, no mixing of the VOC soil sample will occur and minimum air exposure will be permitted. VOC samples will be collected first followed by the sampling for additional analysis. The collection procedure will be as described below as transcribed from Endyne, Inc. Laboratory Services instructions.

<u>Collection of Samples for Analysis</u>

Soil Sampling for total VOCs will be as follows:

1. Inspect the 40 mL methanol preserve vial. Each vial will contain a five character identification number which will correspond to a specific weight of methanol as prepared by the laboratory (approximately 10 mL of methanol). Each vial also contains a line indicating the initial meniscus of the methanol. Ensure that the line matches the methanol meniscus. If they do not match, do not use that vial.
2. Collect approximately 10 grams of soil, which typically corresponds to ¾ to one inch of soil.
3. No soil should be left on the outside of the vial, the threads of the screw, or the screw to cap. Add the soil so that no methanol is splashed out of the container. If methanol is lost during the sampling, the analysis will not be accurate. In this instance, discard the vial and use a new one. At this point, return to bullet number 1 and repeat the soil collection procedure.
4. Screw the cap onto the vial and check that the seal is secure. Swirl the methanol inside the vial so that the methanol covers the top of the soil. Mark the new meniscus with a permanent marker.

5. Using a four ounce or larger pre-cleaned, non-preserved glass jar, fill the jar to the top (a plastic syringe need not be used) using a pre-cleaned or disposable scoop. Ensure that the threads of the jar and cap are free of soil prior to screwing on the cap. This non-preserved sample will be submitted to the laboratory for moisture determination. This jar shall have the same sample identification number as the methanol preserved vial it corresponds to.
6. If possible, the samples shall be chilled to 4° C before packing them in the cooler.

Vials shall be wrapped in bubble wrap to ensure that they do not break during transportation. Ice packs or bagged ice shall be placed in between and on top of all samples after they are placed in a cooler. The temperature within the cooler shall be maintained at 4 degrees C. If not stored in a refrigerator dedicated to the storage of samples, all samples will be picked up or delivered to the laboratory within 24-hours of their collection.

Soil Sample Preservation

Samples will be collected in pre-cleaned glass containers and stored in cool conditions (approximately 4°C). After collection, samples will be promptly placed in a cooler with ice packs to preserve the samples; no chemical preservative will be added. Samples will be submitted on the same day of collection to a Vermont-certified laboratory for chemical analysis. The samples will remain refrigerated at the laboratory until analysis.

Decontamination Procedures

The method of choice for decontamination should be that which most fully removes site contaminants from the sampling equipment with least interference to the ultimate chemical analysis. Site and weather conditions frequently impose constraints upon the preferred method. Excavation contractor will be responsible for decontaminating excavation equipment.

The general decontamination methods and compounds that can be used are as follows:

- Equipment to be utilized in the collection of samples for metals analysis should be cleaned by the following steps:

  1. Wash equipment with a non-phosphate detergent solution (e.g. Alconox) and a brush.
  2. Rinse thoroughly with tap water.

- Equipment to be used for collection of samples for TPH, oil identification, and oil and grease analyses should be cleaned by the following steps:

1. Wash equipment with a non-phosphate detergent-solution (e.g. Alconox) and a brush.
2. Rinse with tap water.
3. Rinse with reagent grade methanol.
4. Rinse thoroughly with deionized water.
5. Repeat this at each location.

- Equipment to be used for collection of semi-volatile organics (which include base-neutral extractables, PCBs, herbicides and pesticides) should be cleaned by the following steps:

1. Wash equipment with a non-phosphate detergent-solution (e.g. Alconox) and a brush.
2. Rinse with tap water.
3. Rinse with technical grade acetone.
4. Rinse with pesticide grade hexane.
5. Rinse thoroughly with deionized water.
6. Repeat this procedure at each sampling location.

- Equipment to be used for collection of samples for volatile organics analysis should be cleaned by the following steps:

1. Wash equipment with a non-phosphate detergent-solution (e.g. Alconox) and a brush.
2. Rinse with tap water.
3. Rinse with reagent grade methanol.
4. Rinse thoroughly with deionized water.
5. Repeat this procedure at each location.

- Steam cleaning is another acceptable technique for field decontamination.

More than one method or compound may be used in series for a particular site. In extreme cases, disposable equipment is recommended over decontamination. This is because the level of effort and costs required to adequately clean the equipment and dispose of the cleaning solutions may not be warranted.

Adapted from:
Standard References for Monitoring Wells, The Massachusetts Department of Environemtnal Protection, DEP Publication #WSC-310-91

Low Flow Groundwater Sample Collection Procedures

Low Flow Groundwater Sample Collection

Low Flow groundwater sampling is used to collect water samples that reflect the total mobile organic and inorganic loads transported through the subsurface under ambient flow conditions with minimal physical and chemical alterations from sampling operations. In essence, indicator parameters are monitored while using low pumping rates to determine when groundwater stabilization occurs and subsequently when sample collection may begin.

Low Flow groundwater samples will be collected in accordance to the USEPA Region 1 Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells, dated January 19, 2010.

Equipment

Pumps

If the hydraulic head of the well is less than 20 feet a peristaltic pump and dedicated disposable tubing may be utilized.

If the hydraulic head of the well is greater than 20 feet an appropriately sized stainless steel low-flow submersible pump equipped with disposable or dedicated tubing will be utilized. Geo-subs, Grundfos pumps or bladder pumps are appropriate examples of submersible pumps.

The pumps will be run off of a power source. Usually, peristaltic pumps will require a battery pack or car battery while submersible pumps may require a generator.

- It is important to note in the field notebook which pumps are used at each well for applicability to Equipment Blank samples. Each pump will have a specific serial number.

Tubing

Tubing will be Teflon or Teflon lined polyethylene tubing (preferably ¼ inch internal diameter for peristaltic set up or 3/8 inch internal diameter for submersible pump set up). Silastic tubing will be used for the section around the rotary head of the peristaltic pump. Metal barb fittings can be used to splice lengths of tubing together. These barbs will need to be decontaminated prior to use in each well (see decontamination procedure below).

Water Level Indicator

A water level probe is required to measure water levels and drawdown in the well. The water level probe should be capable of a 0.01 foot accuracy.

Alternately, an oil/water interface probe can be used if free phase product is expected. Note that oil/water interface probes are fragile instruments and should not be used for measuring total depth of a well.

A steel tape measure with a weighted plumb bob should be used to sound the total depth of the wells.

Monitoring Equipment

A YSI multi-phase meter fitted with a transparent 250 mL flow-through-cell will be used. The YSI meter will be capable of measuring pH, oxidation-reduction potential (ORP), dissolved oxygen (DO), specific conductance and temperature.

Turbidity measurements will be completed with the use of a LaMotte turbidity meter. Turbidity samples will be collected from the outlet of the flow-through-cell using a T-connection barb which can be opened or closed to allow the passage of water.

The YSI and turbidity meter will be calibrated at the beginning of each day of sampling. A calibration check will be performed at the end of each day to verify that the instrument is functioning properly. In addition, calibration checks can be performed at any time during the sampling day at the samplers' discretion.

- Daily calibration documentation will be recorded in the field notebook
- It is important to record in the field notebook which meters are used at each wells for applicability to calibration notes. Each meter will have a specific serial number.

Water Level Measurements

Prior to monitoring or pumping the sampler should measure water level depth and total well depth and record in the field book. Care should be taken to minimize water column disturbance.

After the initial sampling round, total well depth can be measured annually to minimize water column disturbance, unless a 'silting' problem is apparent. Measurements of total depth will indicate whether a well is filling-in due to silt accumulation. It is recommended that subsequent total depth measurement occur after well purging/sampling to minimize water column disturbance.

Installing the Pump

For a submersible pump, attach the tubing to the pump head. Lower the pump head, tubing and electrical line using the safety cable, taking care to minimize water column disturbance. Lower the pump to the appropriate depth (see note below). Secure the cables and tubing to the well casing using a fastener or clip. Connect the discharge end of the tubing to the flow-through-cell/YSI and connect the pump to the power source.

For a peristaltic pump, lower the tubing down the well to the appropriate depth (see note below), taking care to minimize water column disturbance. Connect the tubing to appropriately size silastic tubing which will fit the pump rotary head. Connected the discharge end of the silastic tubing to the flow-through-cell/YSI and connect the pump to the power source.

The pump head/tubing intake should be located at an appropriate depth that will remain underwater at all times. If the well screen interval is known, then the pump head/tubing intake should be placed in the center of the well screen interval. If the well screen interval is not known then the pump head/tubing intake should be placed 2 to 5 feet from the bottom of the well to minimize mobilization of particulates present at the bottom of the well. It is recommended that the intake depth remain the same for each well for each sampling event.

Purging

Start the pump at a relatively low speed and slowly increase the speed until discharge occurs. Try to match pumping rate used during previous sampling events (if known) for consistency. Adjust the pump speed until there is little to no water level drawdown (as measured with a water level meter at 5 minute intervals) and record any pumping rate adjustments.

- The pumping rate should remain constant while monitoring indicator parameters and while collecting samples
- The pump must be able to 'turn over' a flow-through-cell volume between measurements (i.e. 250 mL vessel with a pumping rate of at least 50mL/min)

Purge water will be discharged into a graduated bucket and total amount of purge water will be noted on the field sheet.

If initial purge water is silty or cloudy then disconnect from the flow-through-cell and discharge the water directly to the graduated bucket. Clean the flow-through-cell of silt or debris with deionized water. Continue to measure water levels at 5 minute intervals until the water clears, then re-connect to the flow-through-cell and continue monitoring.

Monitoring of Indicator Parameters

Wait for the flow-through-cell to completely fill. When discharge occurs from the cell, begin monitoring indicator parameters at 5 minute intervals. Stabilization of the parameters is considered to have occurred once the change between 2 consecutive readings is within the limits in the table below:

Indicator Parameter	Units	Stabilization
Temperature	°C	3% *
pH	s.u.	±0.1 s.u.
Specific Conductance	mS/cm	3% *
DO	mg/L	10% *
ORP	mV	±10 mV
Turbidity	NTU	10% *
* Denotes percent change between current reading and previous reading.		

If after 2 hours of purging indicator parameters have not stabilized, samples will be collected but data will need to be qualified and noted that stabilization did not occur.

If the flow-through-cell needs to be cleaned during purging, continue pumping and disconnect the cell for cleaning, then reconnect after cleaning and continue monitoring. Record cleaning time interval and purpose.

Collecting Water Samples

Once stabilization has been attained, or the well has been purged for 2 hours, samples may be collected.

Pumps should not be removed between purging and sampling operations and the pumping rate should remain constant. While the pump is still running, disconnect the flow-through-cell and T-connector barb and collect a sample directly from the pump's tubing.

- Samples must <u>Not</u> be collected from the flow-through-cell outlet.

Water samples shall be preserved according to the protocol established for the specific analytical method and for specific regulatory requirements (see sub-sections below for specific analysis requirements). The laboratory should be contacted to ensure that the proper sample preparation and sample preservation measures are taken prior to receipt of sample containers.

Samples will be collected in pre-cleaned glass or plastic containers and stored in a clean cooler with ice packs to preserve the samples (approximately 4°C). Samples will be submitted on the same day of collection to a certified laboratory for chemical analysis. The samples will remain refrigerated at the laboratory until analysis is completed.

Collection of Groundwater Samples for Volatile Organic Analysis ("VOA")

VOA sampling is preferred through the use dedicated disposable bailers; however, pumps may be used if care is taken to avoid aeration of groundwater prior to and during pumping (low pumping rate and small diameter tubing as specified above).

- Uncap the sample bottle taking care not to touch the teflon-faced septum. If the septum is contaminated in any way, it should be replaced.
- The sample bottle should have a pre-measured amount of concentrated hydrochloric acid ("HCl") added to it by the laboratory.
- Fill the sample vial slowly from bailer or equivalent discharge point, minimizing air entrainment. Fill to a convex meniscus but do not overflow.
- Place the teflon-faced silicone rubber septum on the convex meniscus, teflon side down, and screw cap on.
- If air bubbles are present, open the bottle, and add additional sample to eliminate air bubbles, then reseal and repeat previous step.
- If more than three attempts are made to preclude air bubbles, then a different vial should be used.

Collection of Groundwater Samples for Metals Analysis

Metals samples can be analyzed for "dissolved metals" or "total metals". This is an important distinction since filtering of samples is required for "dissolved metals" analysis while it is not (non-filtered) for "total metals" analysis.

When field filtering is required a dedicated disposable filter will be used. If the water is thought to be contaminated by organic solvents, use of filter medium such as cellulose or polycarbonate must be avoided; glass fiber or teflon filters should be used. The laboratory should be advised if samples have been filtered in the field. A general outline of the sampling procedure is as follows.

- Fill the sample container from sampling device or equivalent discharge point.
    - Filtering should occur at this step, if required. The dedicated disposable filter can be attached to the discharge end of the pump tubing for sample collection.
- Add sufficient 1:1 Nitric Acid to the sample to bring the pH down to 2.0 for sample preservations. Check with pH strips to ensure enough acid was used.

Decontamination Procedure

Decontamination of submersible pumps should occur prior to sampling the first well and the following sampling of each well, thereafter. The pump, support cable, electrical wires, fittings and water level probe should be decontaminated by:

- Flushing/Rinsing with potable water
- Flushing/Rinsing with non-phosphate detergent solution
- Flushing/Rinsing with potable water
- Flushing/Rinsing with methanol or isopropyl alcohol
- Flushing/Rinsing with distilled/deionized water (cannot be recycled water)

Do not use distilled/deionized water stored in plastic (polyethylene) containers for decontamination as the plastic will leach phthalates and may actually introduce contamination. Instead, Nalgene glass, or Teflon vessels/bottles should be used.

Decontamination solution can be pumped from buckets through the pump and can be recycled but must be periodically changed. It is recommended that detergent and alcohols be used sparingly and that water flushing be extended.

Tubing will be disposable or dedicated to a specific well and therefore, should not require decontamination.

QA/QC Procedure

If volatiles (VOC or SVOC) analysis is completed Trip Blank samples will be required. Trip Blank samples will consist of analyte-free water (deionized water) collected in pre-cleaned containers with appropriate preservatives as required by specific regulatory requirements. The Trip Blank sample will be added to each sample cooler that contains volatiles samples and will be collected prior to sampling, taken to the sampling site and returned to the laboratory for analysis.

Field Duplicates will be collected to determine precision of the sampling procedure. Field Duplicates will be required from at least one monitoring well during any sampling event and up to 10% of field samples collected. Collection of samples will occur in sequence (i.e. VOC original, VOC duplicate, SVOC original, SVOC duplicate, Metals original, Metals duplicate, etc.).

If dedicated disposable tubing cannot be utilized then Equipment Blanks are required. The Equipment Blank will be collected to determine if the sampling pump imparts analyte carry over from well to well. Decontamination of the pump and cable should be followed in order to minimize or eliminate carry over. Equipment Blank samples will be collected by passing clean deionized water through the pump and collecting the discharge. The Equipment Blank will include the pump only as tubing will either be disposable or dedicated.

- If the pump is dedicated to the well, the Equipment Blank will be collected prior to its placement in the well.
- If the pump is used to sample multiple wells, the Equipment Blank is normally collected after sampling from contaminated wells and not after background wells. One Equipment Blank per pump set-up, per day will be required.

Additional Considerations

It is recommended that low flow sampling be conducted when air temperature is above 32°F (0°C). If used below this temperature special precautions will need to be taken to prevent groundwater from freezing in the equipment. Ice formation in the flow-through-cell will cause the monitoring probes to act erratically.

If sampling occurs in direct sunlight or hot ambient air conditions, air temperature may cause groundwater in the tubing and flow-through-cell to heat up. During these conditions, the sampler will need to shade the equipment and the tubing exiting the monitoring well should be kept as short as possible.

Adapted from:

Low Stress (Low Flow) purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells, U.S. Environmental Protection Agency Region I, EQASOP-GW 001, January 30, 2010.

Standard References for Monitoring Wells, Massachusetts Department of Environmental Protection, DEP Publication #WSC-310-91

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BORING LOG

Project Name

Middlebury WCRS (23)
Phase B
Middlebury, VT

Boring No.: **GDB-2(OW)**
Page No.: 1 of 1
File No.: 837-65.1
Checked By: DTH

Boring Company:	TransTech Drilling Services
Foreman:	John Leonhardt
GeoDesign Rep.:	Jacob Wimett
Date Started:	October 31, 2013
Date Finished:	October 31, 2013
N. Coordinate:	551447.1
E. Coordinate:	1464979.8
Ground Surface Elevation (feet):	351
Station:	13+75
Offset:	0 ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 550X ATV	
Hammer Type:	Automatic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
10/31/13, 11:15	7.7	343.3	In augers (20 min.)
11/12/13, 16:00			Dry well (to 9.6')

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		S1	SS	24	16	0	4	8	16	15		
		S2	SS	24	18	2	10	6	9	12		
5		S3	SS	24	15	4	5	7	6	9		
		S4	SS	24	18	6	4	7	18	27		
		S5	SS	24	9	8	5	14	75	27		
10												
		S6	SS	24	12	10	16	14	8	7		9.8
15		S7	SS	24	4	14	5	14	15	19		
20		S8	SS	24	11	19	4	8	20	35		
25		S9	SS	12	6	24	28	56/6"				10.2
30												

Strata Description (Depth & Elevation (feet))

Depth (ft)	Strata	Elevation
0	Fill	
3	Sandy Silt	348.0
7	Sand & Gravel	344.0
10	Gravelly Sand & Silt (with Inferred Cobbles)	341.0
20	Glacial Till	331.0
25	Bottom of Exploration at 25.0 ft	326.0

Sample Description

Classification System: Burmister

S1) Medium dense, black-brown fine to coarse SAND, some (+) fine to coarse Gravel, some Silt, slightly moist.

S2) Medium dense,
S2A - Top 7": Brown fine to medium SAND, trace fine Gravel, trace Silt, slightly moist.
S2B - Bottom 11": Brown to olive brown SILT, some fine Sand, trace Organic Matter (concentrated at top of sample), slightly moist.

S3) Medium dense, brown SILT, little fine Sand, moist.

S4) Medium dense,
S4A - Top 9": Olive brown with orange mottling SILT, some fine Sand, little Clayey Silt, very moist.
S4B - Bottom 9": Brown fine to coarse SAND, some fine to coarse gravel, some(-) Silt, wet.

S5) Refusal, brown, fine to coarse SAND and fine to coarse GRAVEL, little (+)Silt, wet.

S6) Medium dense, gray SILT, some (+) fine to coarse Sand, little fine Gravel, wet.

S7) Medium dense, gray fine to coarse SAND and SILT, trace fine Gravel, wet.

S8) Medium dense, light brown fine to medium SAND and SILT, trace fine Gravel, wet.

S9) Refusal, gray fine to coarse SAND and SILT, little fine Gravel, wet.

Well Log

Remarks

1) Northing, Easting, and Elevation based on survey by VHB.
2) Sampling of S2, S4, and S6 was not performed in accordance with ASTM D 1586 requirements (borehole was not cleared with augers between consecutive samples) and blow counts do not represent SPT N values.
3) Frequent auger grinding and chatter below 10' deep through inferred cobbly or gravelly soils.
4) Removed augers and backfilled hole. Offset 2' north and drilled to 10' deep to install observation well. Placed flush mount cover at rail tie level.
5) Boring terminated with split spoon refusal at approximately 25.0 feet deep.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: **GDB-2(OW)**

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BORING LOG

Project Name

Middlebury WCRS (23)
Phase B
Middlebury, VT

Boring No.: **GDB-5(OW)**

File No.: 837-65.1
Checked By: DTH

Boring Company:	TransTech Drilling Services
Foreman:	John Leonhardt
GeoDesign Rep.:	Jacob Wimett / Joshua Gilman
Date Started:	November 1, 2013
Date Finished:	November 1, 2013
N. Coordinate:	551864
E. Coordinate:	1464953
Ground Surface Elevation (feet):	349
Station:	17+93
Offset:	11 ft Left

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 550X ATV	
Hammer Type:	Automatic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
11/1/13, 9:00	1.0	348.0	In augers (30 min.)
11/4/13, 8:00	1.0	348.0	In open borehole
11/12/13, 15:50	1.7	347.3	In well.

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		S1	SS	24	12	0	1	1	3	2		
		S2	SS	24	13	2	2	2	3	3		
5		S3	SS	24	12	4	2	3	3	4		23.5
		S4	SS	13	6	6	2	34	50/1"			
		S5	SS	24	18	8	7	12	20	23		
10												
		S6	SS	24	11	10	12	21	24	24		
15		S7	SS	2	2	14	50/2"					
20		S8	SS	14	14	19	37	71	50/2"			
25												
30												

Strata Description

Depth & Elevation(feet)	Strata	Elevation
	Topsoil	
1	Fill	348.0
7	Silty Sand & Gravel (with Inferred Cobbles & Boulders)	342.0
10	Glacial Till	339.0
20.2	Bottom of Exploration at 20.2 ft	328.8

Sample Description

Classification System: Burmister

S1) Very loose, black SILT, some fine to coarse Sand, trace fine to coarse Gravel, trace Organics, moist. (Topsoil).

S2) Medium / loose, brown SILT & CLAY and fine to coarse SAND, trace Organics, trace fine Gravel, wet.

S3) Medium / loose, brown SILT & CLAY and fine to coarse SAND, trace fine Gravel, trace Organics, wet.

S4) Refusal, brown SILT & CLAY and fine to coarse GRAVEL (fractured), little fine to coarse Sand, trace Organics, wet.

S5) Dense, tan-brown fine to coarse SAND, little fine Gravel, little Silt, wet.

S6) Dense, tan-brown fine to coarse SAND, some Silt, little fine Gravel, wet.

S7) Refusal, tan-brown fractured fine to coarse GRAVEL and SILT, little fine to coarse Sand, wet.

S8) Refusal, tan-brown SILT and fine to coarse SAND, little fine Gravel, wet.

Well Log

Remarks

1) Northing, Easting, and Elevation shown based on visual estimates by GeoDesign personnel and an electronic site plan provided by VHB.
2) Sampling of S2, S4, and S6 was not performed in accordance with ASTM D 1586 requirements (borehole was not cleared with augers between consecutive samples) and blow counts do not represent SPT N values.
3) Well installed in adjacent borehole drilled between the rails. First two attempted well locations were abandoned based on refusals on inferred boulders at approximately 4 feet deep.
4) Auger grinding at 7' deep on inferred boulder.
5) Frequent auger grinding and rig chatter below 7' deep through inferred bouldery / cobbly soils.
6) Boring terminated with split spoon refusal at approximately 20.2 feet deep.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane;
WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: **GDB-5(OW)**

BORING LOG

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Project Name

Middlebury WCRS (23)
Phase B
Middlebury, VT

Boring No.: **GDB-16(OW)**

File No.: 837-65.1
Checked By: DTH

Boring Company:	TransTech Drilling Services
Foreman:	John Leonhardt
GeoDesign Rep.:	Jacob Wimett
Date Started:	November 8, 2013
Date Finished:	November 8, 2013
N. Coordinate:	553170.9
E. Coordinate:	1464435.6
Ground Surface Elevation (feet):	355.6
Station:	32+00
Offset:	16 ft Left

	Casing:	Sampler:
Type:	Flush	SS
I.D.:	4.0 in.	1.38 in.
Hammer Wt.:	140 lbs	140 lbs
Hammer Fall:	30 in.	30 in.
Rig Type:	CME 550X ATV	
Hammer Type:	Automatic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
11/12/13, 15:40	3.3	352.3	In well.

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)
		S1	SS	24	11	0	2	2	4	6		13.6
		S2	SS	24	7	2	4	4	5	6		35.9
5		S3	SS	24	11	4	2	3	3	2		57.1
		S4	SS	24	19	6	3	2	3	3		55.7
		S5	SS	24	24	8	1	2	2	2		43.6
10												
		S6	SS	24	24	10	3	2	2	2		43.2
15		S7	SS	24	24	14	WOH	WOH	WOH	1		49.5
20		S8	SS	24	24	19	WOH	WOH	WOH	WOH		36.3
25		S9	SS	24	24	24	WOR	WOH	WOH	WOH		68.9
30		S10	SS	24	24	29	WOR	WOH	WOH	2		35.0 / 14.8
35		S11	SS	24	16	34	4	2	3	5		33.1

Strata Description

Depth & Elevation(feet)

	Fill	
2	Layered Silty Clay	353.6
14	Silty Clay	341.6
30.5	Sandy Gravelly Clay & Silt	325.1

Sample Description

Classification System: Burmister

S1) Loose, brown-black fine to coarse SAND, some Silt, little fine to coarse Gravel, trace Coal Ash, trace Organics, slightly moist.

S2) Stiff / Loose, gray mottled with light brown SILT and brown layered CLAY & SILT, little (-) fine Sand, moist.

S3) Medium, brown finely parted Silty CLAY, trace fine Sand, trace Root Pinholes, wet.

S4) Medium, light brown with occasional orange and gray finely parted Silty CLAY, trace fine Sand, trace Silt seams, trace Root Pinholes and decayed Roots, wet.

S5) Medium, purple gray to brown occasionally parted Silty CLAY, trace Silt, trace fine Sand (partings), wet.

S6) Medium, purple gray Silty CLAY, trace gray Silt seams, wet.

S7) Very soft, gray Silty CLAY, wet.

S8) Very soft, gray Silty CLAY, wet.

S9) Very soft, gray Silty CLAY, wet.

S10) Very soft,
S10A - Top 18": Gray Silty CLAY, wet.
S10B - Bottom 6": Gray Silty CLAY, some fine to coarse Sand, little fine Gravel, wet.

S11) Medium, gray CLAY & SILT, some (+)

Well Log

Remarks

1) Northing, Easting, and Elevation based on survey by VHB.
2) Sampling of S2, S4, and S6 was not performed in accordance with ASTM D 1586 requirements (borehole was not cleared with roller bit between consecutive samples) and blow counts do not represent SPT N values.
3) Moisture observations in the sample descriptions may not accurately reflect in-situ conditions due to continuously adding water to the borehole during roller bit advance.
4) Sample S3 at 4' deep appeared disturbed as if the sampler was pushing a piece of gravel.
5) Driller advanced casing to 5' deep. Borehole was advanced open hole with the roller bit for the remainder of the borehole.
6) Driller noted an increase in roller bit resistance with rig chatter beginning at 31.5' deep.

Notes:

1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: **GDB-16(OW)**

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BORING LOG

Project Name

Middlebury WCRS (23)
Phase B
Middlebury, VT

Boring No.: **GDB-16(OW)**

File No.: 837-65.1
Checked By: DTH

Boring Company:	TransTech Drilling Services
Foreman:	John Leonhardt
GeoDesign Rep.:	Jacob Wimett
Date Started:	November 8, 2013
Date Finished:	November 8, 2013
N. Coordinate:	553170.9
E. Coordinate:	1464435.6
Ground Surface Elevation (feet):	355.6
Station:	32+00
Offset:	16 ft Left

	Casing:	Sampler:
Type:	Flush	SS
I.D.:	4.0 in.	1.38 in.
Hammer Wt.:	140 lbs	140 lbs
Hammer Fall:	30 in.	30 in.
Rig Type:	CME 550X ATV	
Hammer Type:	Automatic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
11/12/13, 15:40	3.3	352.3	In well.

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation (feet))	Sample Description (Classification System: Burmister)
													Sandy Gravelly Clay & Silt *(Continued)*	fine to coarse Sand, little fine Gravel, wet.
40		S12	SS	24	2	39	3	5	5	4		17.5		S12) Medium dense, gray fine GRAVEL and fine to coarse SAND, little Silt, wet. (Likely roller bit cuttings).
45		S13	SS	24	18	44	2	2	4	2		11.6		S13) Medium / very loose, gray SILT & CLAY and fine to coarse SAND, little fine Gravel, wet.
													47 Glacial Till 308.6	
													49.3	
50		S14	SS	4	1	49	100/4"					7.4	Bottom of Exploration at 49.3 ft 306.3	S14) Refusal, fractured fine GRAVEL, some fine to coarse Sand, trace Silt, wet. (Possible roller bit cuttings).
55														
60														
65														
70														

Well Log

Remarks

7) Sample S12 at 39' deep appears to be entirely composed of roller bit cuttings. Infer spoon to be pushing piece of gravel.
8) Driller noted increase in roller bit resistance at 47' deep on inferred transition to glacial till soils.
9) Boring terminated with split spoon refusal at approximately 49.3 feet deep.
10) Upon completion, offset 2.5' north and set well to 15' deep.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: **GDB-16(OW)**

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BORING LOG

Project Name

Middlebury WCRS (23)
Phase B
Middlebury, VT

Boring No.: **GDB-20(OW)**

Page No.: 1 of 1

File No.: 837-65.1

Checked By: DTH

Boring Company:	TransTech Drilling Services
Foreman:	John Leonhardt
GeoDesign Rep.:	Jacob Wimett
Date Started:	November 6, 2013
Date Finished:	November 6, 2013
N. Coordinate:	553519.8
E. Coordinate:	1464326.4
Ground Surface Elevation (feet):	358.9
Station:	35+66
Offset:	11 ft Left

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 550X ATV	
Hammer Type:	Automatic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
11/6/13, 9:30	5.0	353.9	Perched in silt seams.
11/6/13, 14:00	23.0	335.9	Stabilized in augers (3 hrs
11/12/13, 15:30	7.8	351.2	In well.

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		S1	SS	24	10	0	1	3	3	3		
		S2	SS	24	17	2	4	4	5	6		
5		S3	SS	24	24	4	2	3	5	5		
		S4	SS	24	24	6	3	3	3	3		
		S5	SS	24	24	8	1	2	2	3		
10												
		S6	SS	24	24	10	2	2	3	4		
15		S7	SS	24	24	14	1	2	2	3		40.8
20		S8	SS	24	24	19	WOH	WOH	WOH	1		
25		S9	SS	24	24	24	WOR	WOH	WOH	2		
30		S10	SS	24	4	29	8	12	22	24		
		S11	SS	24	24	31	12	27	43	40		
35												

Strata Description

Depth & Elevation (feet)	Strata	Elevation
	Fill	
1	Layered Clay & Silt / Silty Clay	357.9
14	Silty Clay	344.9
27	Glacial Till	331.9
33	Bottom of Exploration at 33.0 ft	325.9

Sample Description

Classification System: Burmister

S1) Loose, black fine to medium SAND and SILT, little Coal Slag, trace fine Gravel, trace Organics, moist.

S2) Stiff, brown mottled with gray, olive, and orange layered CLAY & SILT, trace fine Sand, trace (-) fine Gravel, trace (-) Organic Fibers (concentrated in top 5" of sample), moist.

S3) Stiff, light brown layered CLAY & SILT, little light gray SILT (seams), trace Organic Fibers (in Silt seams), moist with wet seams.

S4) Medium, light brown parted Silty CLAY, trace fine Gravel, trace fine Sand, trace Root Pinholes and decayed Roots, moist.

S5) Medium, light brown parted Silty CLAY, trace (-) fine Gravel, trace fine Sand, trace Root Pinholes and decayed Roots, moist.

S6) Medium, light brown occasionally parted with gray Silty CLAY, trace gray Silt (seams), trace (-) fine Sand (in Silt seams), moist.

S7) Medium, gray Silty CLAY, trace (-) light gray Silt lenses, moist.

S8) Very soft, gray Silty CLAY, trace (-) Silt, trace (-) fine Sand seams, wet.

S9) Very soft, gray Silty CLAY, trace fine to medium Sand (seams to 1/8" thick), wet.

S10) Dense, gray SILT, some fine to coarse Sand, little fine Gravel, wet.

S11) Very dense, gray SILT, some fine to coarse Sand, trace fine Gravel, wet.

Well Log

Remarks

1) Northing, Easting, and Elevation based on survey by VHB.
2) Sampling of S2, S4, S6, and S11 was not performed in accordance with ASTM D 1586 requirements (borehole was not cleared with augers between consecutive samples) and blow counts do not represent SPT N values.
3) Driller noted an increase in auger resistance beginning at 27' at inferred transition to glacial till soils.
4) Boring terminated without split spoon refusal at approximately 33 feet deep.
5) Installed observation well to bottom of borehole. Set flush mount well cover at ground surface.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: **GDB-20(OW)**

BORING LOG

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Project Name

Middlebury WCRS (23)
Bridges 2 and 102
Middlebury, VT

Boring No.: **RR-1(OW)**
Page No.: 1 of 1
File No.: 837-65
Checked By: AJB

Boring Company:	TransTech Drilling Services
Foreman:	James Burrowbridge
GeoDesign Rep.:	Joshua Gilman
Date Started:	March 19, 2013
Date Finished:	March 19, 2013
N. Coordinate:	552896.9731
E. Coordinate:	1464566.734
Ground Surface Elevation (feet):	353.05
Station:	19+00
Offset:	0 ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 550X ATV	
Hammer/Rod Type:	Automatic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
3/19/13, 9:00	4.0	349.1	Wet sample
3/27/13, 9:30	1.2	351.9	In well
3/28/13, 8:45	1.2	351.9	In well
5/1/13, 8:10	1.4	351.7	In well
10/30/13, 11:15	1.8	351.3	In well
11/12/13, 16:30	1.5	351.6	In well

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)
		S1	SS	24	10	2	6	12	13	7		
5		S2	SS	24	16	4	2	3	5	6		
		S3	SS	24	6	6	3	3	3	4		
		S4	SS	24	12	8	4	8	7	6		
10												
15												
20												
25												
30												

Strata Description (Depth & Elevation (feet))	Sample Description (Classification System: Burmister)
Ballast	
2 Clay & Silt 351.1	S1: Medium dense, dark brown fine to coarse SAND, some Clayey Silt, trace fine Gravel, moist.
	S2: Stiff, gray CLAY & SILT, some fine to coarse Sand, trace fine Gravel, wet.
	S3: Medium, gray CLAY & SILT and fine to coarse SAND, trace fine Gravel, wet.
	S4: Very stiff, brown CLAY & SILT and fine to coarse SAND, trace fine Gravel, wet.
10 Bottom of Exploration at 10.0 ft 343.1	

DRAFT

Remarks

1) Station and offset shown are based on taped measurements made in the field by GeoDesign personnel from stationing marked in the field by VHB. Ground surface elevation shown is estimated from a topographic site plan provided by VHB.
2) All samples screened in the field using an Ion Science Phocheck Model 1000 PID calibrated onsite to a 100 ppm isobutylene standard.
3) Exploration terminated at 10 feet with no refusal.
4) Monitoring well installed to bottom of borehole, with PVC cover flush with adjacent ties.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made. A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No. **RR-1(OW)**

BORING LOG

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Project Name

Middlebury WCRS (23)
Bridges 2 and 102
Middlebury, VT

Boring No.: **RR-11(OW)**
Page No.: 1 of 1
File No.: 837-65
Checked By: AJB

Boring Company:	TransTech Drilling Services
Foreman:	James Burrowbridge
GeoDesign Rep.:	Joshua Gilman
Date Started:	March 21, 2013
Date Finished:	March 21, 2013
N. Coordinate:	552162.9481
E. Coordinate:	1464877.719
Ground Surface Elevation (feet):	350.5
Station:	11+00
Offset:	5 ft RT

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 550X ATV	
Hammer/Rod Type:	Automatic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
3/21/13, 10:25	4.0	346.5	Wet sample (perched)
3/21/13, 11:00	8.0	342.5	Wet sample
3/27/13, 9:15	1.2	349.3	In well
3/28/13, 8:15	1.2	349.3	In well
5/1/13, 8:15	0.9	349.6	In well
10/30/13, 11:30	0.8	349.7	In well
11/12/13, 16:10	1.0	349.5	In well

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description Depth & Elevation(feet)	Sample Description Classification System: Burmister
													Ballast	
		S1	SS	24	10	2	9	12	13	21			2 Fill 348.5	S1: Medium dense, brown fine to coarse SAND, some Silt, some fine to coarse Gravel, moist.
5		S2	SS	24	9	4	6	14	39	100/6"				S2: Very dense, brown fine to coarse SAND and fine to coarse GRAVEL, some Silt, moist (wet top 3").
		S3	SS	14	13	6	31	42	100/2"				6 Glacial Till 344.5	S3: Refusal, brown fine to coarse SAND and SILT, some fine to coarse Gravel, slightly moist.
		S4	SS	5	5	8	100/5"							S4: Refusal, brown fine to coarse SAND and SILT, some fine to coarse Gravel, wet.
10													10 Bottom of Exploration at 10.0 ft 340.5	
15														
20														
25														
30														

DRAFT

Remarks

1) Station and offset shown are based on taped measurements made in the field by GeoDesign personnel from stationing marked in the field by VHB. Ground surface elevation shown is estimated from a topographic site plan provided by VHB.
2) All samples screened in the field using an Ion Science Phocheck Model 1000 PID calibrated onsite to a 100 ppm isobutylene standard.
3) Driller noted hard resistance to auger advance from 6 to 10 feet deep (possible cobbles/boulders).
4) Exploration terminated at 10 feet (No Refusal).
5) Monitoring well installed to bottom of borehole, with 6-inch protective flush mount cover.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made. A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

BORING LOG

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Project Name

Middlebury WCRS (23)
Bridges 2 and 102
Middlebury, VT

Boring No.: **RR-13(OW)**
Page No.: 1 of 1
File No.: 837-65
Checked By: AJB/JFW

Boring Company:	TransTech Drilling Services
Foreman:	James Burrowbridge
GeoDesign Rep.:	Joshua Gilman
Date Started:	March 25, 2013
Date Finished:	March 25, 2013
N. Coordinate:	552365.4381
E. Coordinate:	1464814.311
Ground Surface Elevation (feet):	350.1
Station:	13+13
Offset:	5 ft RT

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 550X ATV	
Hammer/Rod Type:	Automatic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
3/25/13, 0:00	16.0	334.1	Wet spoon tip
5/1/13, 8:20	1.2	348.9	In well
10/30/13, 13:00	1.3	348.8	In well
11/12/13, 16:20	1.8	348.3	In well

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		S1	SS	24	16	2	9	29	27	39		
5		S2	SS	24	16	4	21	23	20	26		
		S3	SS	20	18	6	17	60	70	100/2"		
		S4	SS	11	11	8	31	100/5"				
10												
15		S5	SS	24	24	14	35	55	57	67		
		S6	SS	0	0	16.9	50/0"				4	
		C1	C	60	60	17	[REC= 100%; RQD= 51%]					
											5	
20											5	
											5	
											5	
		C2	C	60	60	22	[REC= 100%; RQD= 81%]				4	
											4	
25											4	
											4	
											4	
30												

Strata Description / Sample Description (Classification System: Burmister)

Depth & Elevation (feet)	Strata	Sample Description
0	Ballast	
2 / 348.1	Fill	S1: Dense, tan gray fine to coarse GRAVEL (including marble chips) and SILT, some fine to coarse Sand, moist.
4 / 346.1	Glacial Till	S2: Very dense, tan fine to coarse SAND and SILT, trace fine to coarse Gravel, moist.
		S3: Very dense, tan gray SILT and fine to coarse SAND, some fine to coarse Gravel, moist to dry (tan, mottled and moist top half of sample, gray and dry bottom half).
		S4: Refusal, gray SILT and fine to coarse SAND, little fine to coarse Gravel, dry.
		S5: Very dense, gray SILT and fine to coarse SAND, some fine to coarse Gravel, dry (spoon tip wet).
17 / 333.1	Bedrock	S6: Refusal, no recovery.
		C1: Fair quality, moderately hard, fresh to slightly weathered, very close to moderate jointing, gray and white banded MARBLE. Fracturing ~0 to 20 degrees from horizontal. Strong reaction to dilute HCl.
		C2: Good quality, moderately hard, fresh, close to moderate jointing, gray and white banded MARBLE. Strong reaction to dilute HCl.
27 / 323.1	Bottom of Exploration at 27.0 ft	

Inclino. Log

Remarks

1) Station and offset shown are based on taped measurements made in the field by GeoDesign personnel from stationing marked in the field by VHB. Ground surface elevation shown is estimated from a topographic site plan provided by VHB.
2) All samples screened in the field using an Ion Science Phocheck Model 1000 PID calibrated onsite to a 100 ppm isobutylene standard.
3) HSAR and SSR at 17 feet deep. Driller pulled augers, spun 4" FJ casing and set up to core C1.
4) Groundwater monitoring well installed 3/28/13 by augering adjacent to exploration. Well installed to bottom of borehole, with 6-inch protective flush mount cover.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made. A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No. **RR-13(OW)**

GEODESIGN INCORPORATED
Geotechnical / Construction / Environmental Engineers and Scientists
P.O. Box 699
Windsor, VT 05089
Phone: 802-674-2033/Fax: 802-674-5943
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So. Burlington, VT 05403
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BORING LOG

Project Name

Middlebury WCRS (23)
Bridges 2 and 102
Middlebury, VT

Boring No.: **RR-16(OW)**

File No.: 837-65
Checked By: JFW

Boring Company:	TransTech Drilling Services
Foreman:	James Burrowbridge
GeoDesign Rep.:	Joshua Gilman
Date Started:	March 26, 2013
Date Finished:	March 27, 2013
N. Coordinate:	552600.271
E. Coordinate:	1464718.142
Ground Surface Elevation (feet):	350.37
Station:	15+67
Offset:	6 ft RT

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 550X ATV	
Hammer/Rod Type:	Automatic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
3/26/13, 15:30	6.0	344.4	Wet sample
3/27/13, 9:20	0.0	350.4	In open hole overnight
3/28/13, 8:20	1.6	348.8	In well
5/1/13, 8:30	1.9	348.5	In well
10/30/13, 13:40	1.8	348.6	In well

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)
		S1	SS	24	4	2	9	7	7	3		
5		S2	SS	24	12	4	1	3	4	9		
		S3	SS	24	12	6	18	19	13	12		
		S4	SS	13	3	8	11	14	50/1"			
10												
		C1	C	26	26	11	[REC= 100%; RQD= 0%]				4	
											10	
		C2	C	34	34	13.2	[REC= 100%; RQD= 12%]				5.5	
15											4.5	
											10	
		C3	C	6	6	16	[REC= 100%; RQD= 0%]				10	
		C4	C	36	35	16.5	[REC= 97%; RQD= 63%]				6	
											6	
20											10	
25												
30												

Strata Description (Depth & Elevation (feet))

Depth	Strata	Elevation
	Ballast	
2	Silty Sand & Gravel	348.4
9	Boulder/ cobbles	341.4
12	Bedrock	338.4
19.5	Bottom of Exploration at 19.5 ft	330.9

Sample Description
Classification System: Burmister

S1: Medium dense, gray fine to coarse SAND and fine to coarse GRAVEL, some Silt, moist to wet.

S2: Loose, gray fine to coarse SAND and SILT, little fine Gravel, moist to wet.

S3: Dense, tan fine to coarse SAND and fine to coarse GRAVEL, little Silt, wet.

S4: Refusal, tan fine to coarse SAND and fine to coarse GRAVEL, some Silt, wet.

C1:Top 6" Boulder fragments.
Bottom 20": Very poor quality, moderately hard, fresh to slightly weathered, close jointed gray with white banding LIMESTONE (upper 7") grading to very close jointed dark gray PHYLLITE with occasional thin (<1/8" thick) beds of Limestone and pyrite inclusions. Fracturing near horizontal in Limestone portions and at ~65 degrees from horizontal in Phyllite portions. Strong reaction to HCl in Limestone portions with no reaction in Phyllite portions.

C2: Very poor quality, moderately hard fresh to slightly weathered, shattered to close jointed, dark gray with occasional white bands interbedded PHYLLITE and LIMESTONE. Fracturing typically occuring along Phyllite beds at ~65 degrees from horizontal. Strong reaction to HCl in Limestone beds with no reaction in the Phyllite.

C3: Very poor quality, moderately hard, fresh to slightly weathered, shattered, dark gray LIMESTONE with thin (~1/8" thick) Phyllite bedding. Strong reaction to HCl on Limestone surfaces with no reaction on Phyllite surfaces.

Inclino. Log

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Remarks

1) Station and offset shown are based on taped measurements made in the field by GeoDesign personnel from stationing marked in the field by VHB. Ground surface elevation shown is estimated from a topographic site plan provided by VHB.
2) All samples screened in the field using an Ion Science Phocheck Model 1000 PID calibrated onsite to a 100 ppm isobutylene standard.
3) Driller noted increased auger grinding and rig chatter advancing from approx 9 to 11 feet deep (possible fractured/weathered bedrock).
4) HSAR at 11 feet deep. Driller advanced 4" FJ casing with spin shoe and cored Day 2.
5) Monitoring well installed to bottom of borehole, with 6-inch protective flush mount cover.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
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A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No. **RR-16(OW)**

GEODESIGN INCORPORATED
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So. Burlington, VT 05403
Phone: 802-652-5140

BORING LOG

Project Name

Middlebury WCRS (23)
Bridges 2 and 102
Middlebury, VT

Boring No.: **RR-16(OW)**

File No.: 837-65
Checked By: JFW

Boring Company:	TransTech Drilling Services
Foreman:	James Burrowbridge
GeoDesign Rep.:	Joshua Gilman
Date Started:	March 26, 2013
Date Finished:	March 27, 2013
N. Coordinate:	552600.271
E. Coordinate:	1464718.142
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	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
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Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description Depth & Elevation(feet)	Symbol	Sample Description Classification System: Burmister	Inclino. Log
															C4: Fair quality, moderately hard fresh, close to moderate jointing, interbedded dark gray PHYLLITE with pyrite inclusions and light gray/ white LIMESTONE (upper 12") grading to light gray with occasional white banding LIMESTONE (bottom 24"). Fracturing up to ~ 20 degrees from horizontal. Strong reaction to HCL on Limestone surfaces with no reaction on Phyllite surfaces.	
35																
40																
45																
50																
55																
60																

Remarks

DRAFT

Notes:
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Boring No. **RR-16(OW)**