REVIEW COMPLETE	
PM	Katherine S. DeStefano, P.E. 05/16/2024
BRIDGES	
CONSTRUCT	
DRAINAGE	Tami Brehm, P.E. 05/20/2024
ENVIRON	L. Keith Smith, P.E. 05/21/2024
GEOTECH	
ITS	
MOT	
PAVEMENT	Jennifer Elston, 05/22/2024
ROADWAY	Katherine S. DeStefano, P.E. 05/16/2024
R/W	
SURVEY	
TRAFFIC	Teri C. Scanlon, P.E. 06/06/2024
UTILITIES	
OTHER	Tom Mazza, 06/21/2024
OTHER	

BUT-75/VAR 5.22/VAR FEASIBIL[illegible]TY STUDY
PID 117275

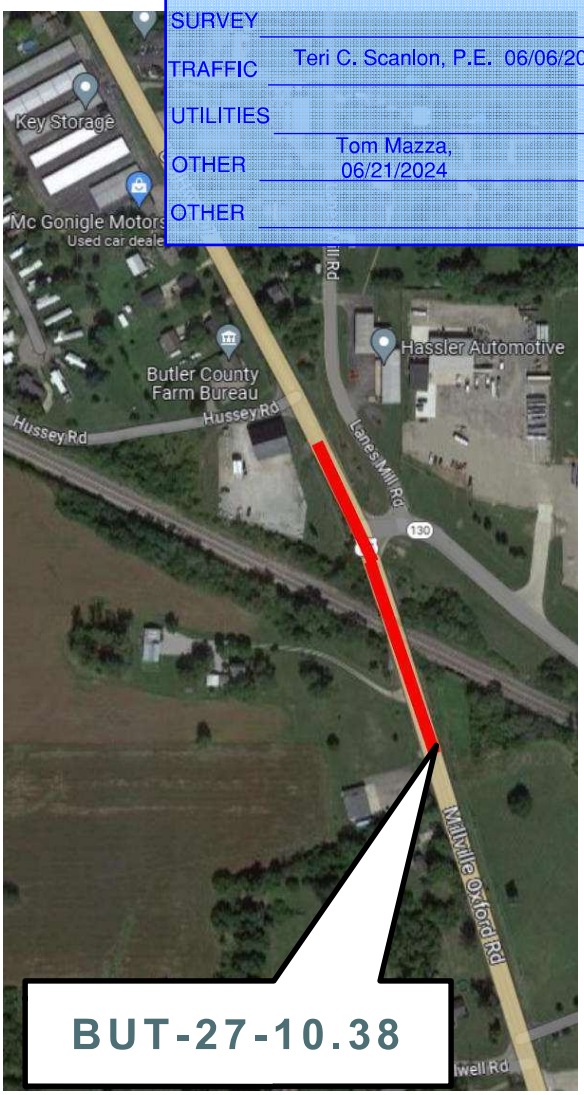
Prepared for:

Ohio Department of Transportatio[illegible]

505 South S.R. 741

Lebanon, Ohio 45036

Original: May 1, 2024



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1.0 INTRODUCTION

Chagrin Valley Engineering (CVE) has been retained by the Ohio Department of Transportation (ODOT) District 8 office to provide a Feasibility Study for the pavement replacement and vertical clearance improvements underneath two (2) bridges located in Butler County, Ohio. The locations are US 27 under CSX Railroad (SFN 0900729) in Hanover Township and SR 4 under CSX Railroad (SFN 0900451) in Madison Township. These locations are here forth identified as the following: BUT-27-10.38 and BUT-4-23.90.

The vertical clearance improvement alternatives for BUT-4-23.90 to be analyzed include: existing vertical clearance (13.8'), 14.0', 14.5' and 15.0'.

The vertical clearance improvement alternatives for BUT-27-10.38 to be analyzed include: existing vertical clearance (14.0') and 14.5'.

The BUT-4-23.90 full depth pavement reconstruction project limits are from south of the SR 4 / Catalina Court (TR 80209) intersection for all options to north of the Madison Township Fire Station property at 6415 Germantown Road, for the 13.8' alternative and 14.0' alternative. Reconstruction limits for the 14.5' alternative end in the middle of the Madison Township Fire Station property at 6415 Germantown Road and the 15.0' option ends at the south end. Additionally, BUT-4 will be resurfaced to the north approach slab of the BUT-4-23179 (SFN 0900397) bridge over the Great Miami River, a distance of over 3000 feet to the south of the reconstruction limits. BUT-4 will be resurfaced to north of Catalina Court, with different ending distances depending on the vertical clearance alternative chosen.

The BUT-27-10.38 project limits include replacement of all of the existing concrete pavement from south of the US 27 / Hussey Road (TR 228) intersection to just north of 2143 Millville Oxford Road (US 27) for a distance of approximately 700 feet. There will be minor resurfacing on each end of the US 27 pavement reconstruction, ending at Sta. 18+27 (14.5' vertical clearance) or Sta. 17+27 (14.0' vertical clearance) which is north of the north radius return of Hussey Road (TR 228), and beginning at Sta. 5+50 on the south end. Included within the project limits is the US 27 / SR 130 (Old Oxford Road) intersection and will either include 63 feet (14.0' alternative) or 73 feet (14.5' alternative) of reconstruction or resurfacing on SR 130 (measured from the intersection with US 27) in order to tie into the new US 27 profile.

2.0 PURPOSE NEED AND SUMMARY

and

The purpose of this project is to improve the pavement condition and increase the vertical clearance for US 27 under the CSX Railroad (SFN 0900729) bridge in Hanover Township and SR 4 under the CSX Railroad (SFN 0900451) bridge in Madison Township. The US 27 pavement has a PCR of 69 and the SR 4 pavement has a PCR of 70 (south of the bridge) and 78 (north of the bridge). The PCR for SR 4 north of the bridge will improve since there is a project to resurface the road (BUT-4-24.00, PID 107580).

3.0 ALTERNATIVES CONSIDERED AND DISMISSED

ODOT provided the vertical clearance alternatives to be analyzed for each location as noted below.

The purpose has been stated but must also stipulate the need:
"These improvements are necessary to increase overall safety for the traveling public by preventing future bridge impacts with passing vehicles at each location as well as eliminate the hazard of ponding water on the pavement at the BUT SR 4 structure. "

3.1 BUT-4-23.90 Alternatives

The BUT-4-23.90 vertical clearance improvement alternatives analyzed include: existing vertical clearance (13.8'), 14.0', 14.5' and 15.0'. The No Build Alternative was not evaluated since the pavement needs to be replaced due to condition.

The 13.8' vertical clearance improvement maintains the existing vertical clearance and requires pavement reconstruction from Sta. 1297+55 to Sta. 1299+28.00 for a distance of 173 feet.

The 14.0' vertical clearance improvement alternative increases the vertical clearance to 14.0' and requires pavement reconstruction from Sta. 1297+05 to Sta. 1300+65 for a distance of 360 feet.

The 14.5' vertical clearance improvement alternative increases the vertical clearance to 14.5' and requires pavement reconstruction from Sta. 1296+50 to Sta. 1301+18.50 for a distance of 468.50 feet.

Why is does this location have an alternative to improve clearance to 15' when BUT-27 is only to 14.5'? What is the minimum requirement?

The 15.0' vertical clearance improvement alternative increases the vertical clearance to 15.0' and requires pavement reconstruction from Sta. 1295+60 to Sta. 1301+18.50 for a distance of 558.50 feet.

3.2 BUT-27-10.38 Alternatives

The BUT-27-10.38 vertical clearance improvement alternatives analyzed include: existing vertical clearance (14.0') and 14.5'. The No Build Alternative was not evaluated since the pavement needs to be replaced due to condition.

The 14.0' vertical clearance improvement alternative maintains the vertical clearance to 14.0' and requires pavement reconstruction from Sta. 7+40 to Sta. 14+50 for a distance of 710 feet.

The 14.5' vertical clearance improvement alternative increases the vertical clearance to 14.5' and requires pavement reconstruction from Sta. 7+40 to Sta. 15+50 for a distance of 810 feet.

4.0 KEY ISSUES

4.1 Traffic Analysis

This project does not require certified traffic. Design designation data was provided via TFMS.

Rename this section.

4.1.1 Certified Traffic

Traffic data for this project was developed by ODOT District 8 using the Traffic Forecast Management System (TFMS) Tool to calculate the average daily traffic (ADT), percentage of truck traffic, and other pertinent design designation information and summarized in **Figure 1.**

Figure 1: Traffic Data Summary

Feature	BUT-4-23-24.44	BUT-4-24.44-26.39	BUT-27-6.87-10.46	BUT-27-10.46-10.52	BUT-130-0.00-2.85
ADT (2027)	11,500	7,600	7,600	10,000	3,800
ADT (2047)	13,000	10,000	7,600	10,000	4,500
DHV	1,600	1,200	1,000	1,200	600

K	12.4%	12.5%	13.4%	11.9%	12.9%
D	53.7%	51.5%	52.6%	56.5%	52.3%
T24	4.0%	3.0%	4.0%	3.0%	2.0%

The traffic data was used to develop the roadway design criteria pertinent to each location. The criteria are based on various sections and figures in the L&D Manual, Volume One and establish the design parameters for the geometry, cross section, and other elements of the roadway.

4.1.2 Safety

A safety analysis was not part of the scope for this project.

4.2 Roadway Information

Existing roadway information is summarized in **Figure 2**:

Figure 2: Existing Roadway Information

Feature	**BUT-4-23.90**	**BUT-27-10.38**
Road Name	Germantown Road	Millville Oxford Road
Design Functional Classification	Urban Principal Arterial	Rural Principal Arterial
NHS System	Yes	Yes
Design Speed (MPH)	45	50
Legal Speed (MPH)	45	45

4.2.1 Pavement Design

The proposed full depth pavement composition has been provided by ODOT and is the same for BUT-4-23.90 and BUT-27-10.38 and is summarized in **Figure 3** as follows:

Figure 3: Full Depth Pavement Design

Depth	**Item Number**	**Item Description**
1.25”	441	Asphalt Concrete Surface Course, Type 1, (448), PG64-22
N/A	407	Non-Tracking Tack Coat (0.055 GAL/SY)
1.75”	441	Asphalt Concrete Intermediate Course, Type 2, (448)
N/A	407	Non-Tracking Tack Coat (0.055 GAL/SY)
6”	301	Asphalt Concrete Base, PG64-22, (449)

6”	304	Aggregate Base
14”	204	Excavation of Subgrade
14”	204	Granular Material, Type C, As Per Plan
N/A	204	Geotextile Fabric

The plan note for Item 204 – Granular Material, Type C, As Per Plan is as follows:

The granular material Type C shall be comprised of crushed carbonate stone. All other items of 204 shall apply.

Resurfacing typical sections are summarized in **Figure 4** as follows:

Figure 4: Resurfacing Pavement Design

Depth	**Item Number**	**Item Description**
3”	254	Pavement Planing, Asphalt Concrete, 3”
1.25”	441	Asphalt Concrete Surface Course, Type 1, (448), PG64-22
N/A	407	Non-Tracking Tack Coat (0.055 GAL/SY)
1.75”	441	Asphalt Concrete Intermediate Course, Type 2, (448)
N/A	407	Tack Coat, 702.13 (0.07 GAL/SQ YD) if over existing concrete or Non-Tracking Tack Coat (0.055 GAL/SY) if over existing asphalt

4.2.2 Bicycle and Pedestrian Features

The proposed sidewalk does not meet the standards in ODOT's Multimodal Design Guide. See my comment in the cross sections for more details.

The BUT-4 location has existing narrow sidewalks that will be removed within the limits of the pavement reconstruction. The proposed condition will include 6’ sidewalks on each side of the road. The sidewalk on each side will be extended north to the southern radius return of Catalina Court and a new pedestrian crossing and curb ramps will be provided.

The BUT-27 location does not have any pedestrian features ~~and will not have any in the proposed condition~~.

4.2.3 Typical Sections

The BUT-4 existing composite typical section has 3” of asphalt over 7” concrete with the limits of the pavement reconstruction. Reconstruction typical sections for BUT-4 are provided in **Appendix D**.

The BUT-27 existing concrete typical section has 10” reinforced concrete pavement over 6” aggregate base in the travel lanes and shoulders. The BUT-27 existing composite section has 5” of asphalt over 7” concrete in the travel lanes and 10” of asphalt over 6” of aggregate base in the shoulders. Reconstruction typical sections for BUT-27 are provided in **Appendix K**.

4 ...,there is no indication of pedestrians utilizing this roadway section, and therefore, there will not be any proposed pedestrian features incorporated into the improvements.

4.2.4 Horizontal & Vertical Alignments

The horizontal alignment for BUT-4 is unchanged and the vertical alignment for the various alternatives are shown on the plan and profile sheets. Plan and profile sheets for BUT-4 are provided in **Appendix C**.

The horizontal alignment for BUT-27 is unchanged and the vertical alignment for the various alternatives are shown on the plan and profile sheets. Plan and profile sheets for BUT-27 are provided in **Appendix J**.

4.2.5 Cross Sections

Critical cross sections for BUT-4 are shown for the various alternatives. Cross sections for BUT-4 were taken at the proposed sag point, a representative bridge section, point of minimum vertical clearance, just past the north abutment (a R/W pinch point) and location of new catch basins and are provided in **Appendix E**.

Critical cross sections for BUT-27 are shown for the various alternatives. Cross sections for BUT-27 were taken at the proposed sag point, a representative bridge section, point of minimum vertical clearance, just past the north abutment (at lateral R/W pinch points), existing 24" storm sewer crossing, and SR 130 intersection and are provided in **Appendix L**.

4.2.6 Lighting

There is no lighting on SR 4 within the reconstruction limits and none is proposed. Intersection lighting is present at the US 27 intersection with SR 130 and will not be disturbed.

4.2.7 Signing and Pavement Markings

The permanent pavement markings for BUT-4-23.90 and BUT-27-10.38 will be Item 644 – Thermoplastic on asphalt surfaces. Placement of proposed pavement markings and raised pavement markers (RPM) shall meet current ODOT design standards. Vertical clearance signs may need to be removed and replaced depending on the vertical clearance alternative selected. Other signs will not be replaced unless current signage does not meet recommended standards or signs are impacted by the proposed project.

4.2.8 Property Access and Driveways

4.2.8.1 BUT-4-23.90 Property Access and Driveways

Access to all drives will be maintained at all times. Driveway information for BUT-4-23.90 properties located within the project limits is summarized in **Figure 5**:

Figure 5: BUT-4 Driveway Impacts

Station	Side	Address	Type	Impacts
1295+63.91	West	6401	Commercial asphalt drive.	Impacts in 15.0' alternative. *
1296+39.19	East	No address	Field concrete drive apron only	Impacts in 15.0' alternative. *

1296+93.94	West	6415	Commercial asphalt drive for fire station. Drive apron is concrete but only within the sidewalk.	Impacts in 14.5' and 15.0' alternatives. *
1297+92.34	East	6400	Commercial concrete drive apron	Impacts in 14.0', 14.5' and 15.0' alternatives. *

* ODOT's commercial drive apron standards were impractical for the 14.5' and 15.0' alternatives.

4.2.8.2BUT-27-10.38 Property Access and Driveways

Access to all drives will be maintained at all times. Driveway information for BUT-27-10.38 properties located within the project limits is summarized in **Figure 6**:

Figure 6: BUT-27 Driveway Impacts

Station	Side	Address	Type	Impacts
7+02.65	West	2143	Commercial asphalt drive	No impacts in any alternative.
7+50.54	West	No address	Field asphalt drive apron only	No impacts in any alternative.
8+90.48	West	2149	Residential asphalt drive apron with gravel drive	No impacts in 14.5' alternative. Drive requires reconstruction in 14.0' alternative.
14+92.27	West	2173	Commercial concrete drive apron only	No impacts in 14' alternative. Impacted in 14.5' alternative.

4.2.9 Potential Design Exceptions

CVE reviewed each location for potential design exceptions and the following design exceptions are anticipated:

SR 4 – This is classified as a low speed facility (design speed <50 mph) and the only possible design exception is lane width, which meets criteria for all vertical clearance alternatives.

US 27 – This is classified as a high speed facility (design speed ≥50 mph) and a design exception is required for shoulder width for either vertical clearance alternative.

This sounds like a contradiction. If all criteria is met then no DE is required. Per Appendix D the Typical Sections show enough pavement width to provide for minimum lane and shoulder width. The turn lane can be reduced to 11 feet, if needed.

4.3 Roadway Design Criteria

The roadway design criteria for each location in shown in **Appendix A**.

4.4 BUT-4-23.90 Drainage

The existing drainage system is comprised of a closed system with storm sewers, underdrains, a 68”x43” culvert located underneath the CSX Railroad bridge, and a retention pond located on the east side, south of the CSX Railroad bridge behind Amatulli Produce. East side catch basins north of the bridge drain across the road to the trunk line located on the west side in various locations. The catch basin pair located at the proposed sag drain from the west side to the east side draining towards the trunk line now crossed over to the east into the retention pond. The project area north of the 68”x43” culvert drains to the retention pond and the project area south of the 68”x43” culvert drains south eventually outletting to the Great Miami River.

In the pavement reconstruction sections where the sidewalk is widened, the four existing catch basins located around the bridge will be removed and either replaced with a new catch basin, relocated to the proposed sag or replaced with a new manhole. The remaining impacted catch basins in the reconstruction limits for the respective options will be adjusted to grade and conduit will be cleaned or replaced as noted by ODOT in the project scope and labelled on the plans. New catch basins will be added at the sag point for each alternative. In the pavement resurfacing section, catch basins and inlets will not need to be reconstructed since they are either located in the curb and gutter (north of Trenton Franklin Road) or located in the median (south of Trenton Franklin Road) and will not be disturbed. All manholes located in the pavement will be adjusted to grade.

The drainage will be reconfigured on the west side south of Catalina Court to allow for the sidewalk to be constructed all the way to Catalina Court.

There are no Federal Emergency Management Agency (FEMA) Floodplains or wetlands within the project limits.

In the existing condition, there is a catch basin at Sta. 1298+30, 19.90’ LT that drains both east toward the retention pond and south toward the Great Miami River. In our proposed condition, this catch basin will be removed and the drainage underneath the CSX Railroad Bridge will be independent of the roadway drainage to the Great Miami River. All drainage underneath the CSX Railroad Bridge will flow east toward the retention pond. Additionally, the FEMA flood elevation at the Great Miami River is 649 and the roadway profile elevations are 652.35. No vertical clearance alternatives will impact any flooding from the Great Miami River.

we want to keep th

We performed spread calculations and spread is violated in the existing condition within the resurfacing and reconstruction sections. We’ve added nominal additional impervious area with the sidewalk extension. We are proposing to add new catch basins north of the CSX Railroad bridge on each side of the road to help mitigate spread concerns. We chose CB-3’s instead of CB-3A’s to further reduce spread and limit bypass flow. However, the flat slopes that are present mean that there still is a spread violation, unless we want to keep adding basins until the spread is below 6 feet.

We prepared representative cross sections and note the proposed pavement buildup conflicts with the new 12” storm sewer laterals. This conflict can be mitigated by eliminating the 14” excavation of subgrade at the storm sewers. In the 14.0’, 14.5’ and 15.0’ alternatives, the proposed pavement buildup conflicts with the existing 68”x43” culvert. Likewise, this conflict can be mitigated by reducing or eliminating the 14” excavation of subgrade at the culvert.

Alec Sadowski, what are your thoughts?

L&D Volume 2 C1103.6 will likely be revised in July to state "Flat profile grades in sags often lead to an excessive number of basins based on spread calculations. For this situation, consider PBPD where the spread is not checked any closer than 25 to 50 feet between basins leading up to the sag." The wording may change slightly, but given the flooding issues and the fact that maintenance checks the grates for debris clogging before every event, I do not want to have less structures than required.

Please see how many catch basins are needed to meet allowable spread requirements using a minimum spacing of 25' and of 50'. There should be 2 on each side near the sag.

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There are no underdrains under the CSX Railroad bridge currently and none are proposed. We propose to include underdrains in the reconstruction sections up to the point where they can be drained without an additional excavation underneath the CSX Railroad bridge.

The drainage area map, conduit inventory and calculations are provided in **Appendix B**.

4.4.1 BUT-4-23.90 Flap Gate

The existing Calco Gate control structure is located within the existing manhole No. 2 at Sta.52+05.50 (from 1955 record plans) that is 54" (presumed square), 22' deep and located within the pavement. The control structure is currently inoperable and has seized in the half-open position. ODOT owns the structure and requested options to address the inoperable gate. See **Figure 7** for plan view of the flap gate, **Figure 8** for profile view and **Figure 9** for section view.

Figure 7: BUT-4 Flap Gate Plan View

Figure 8: BUT-4 Flap Gate Profile View

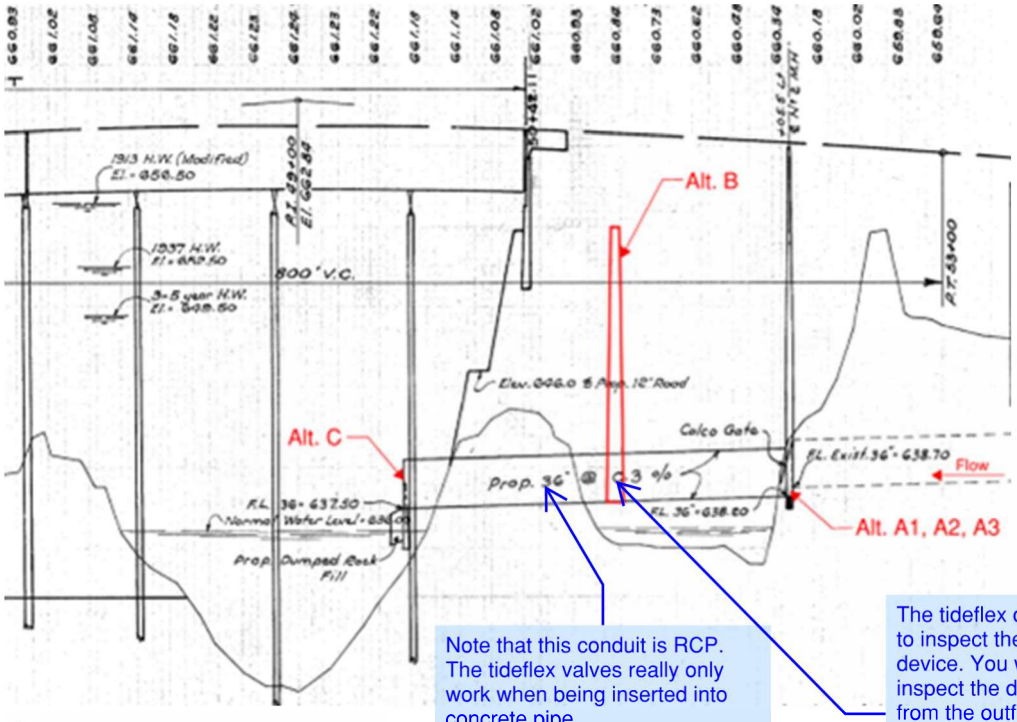
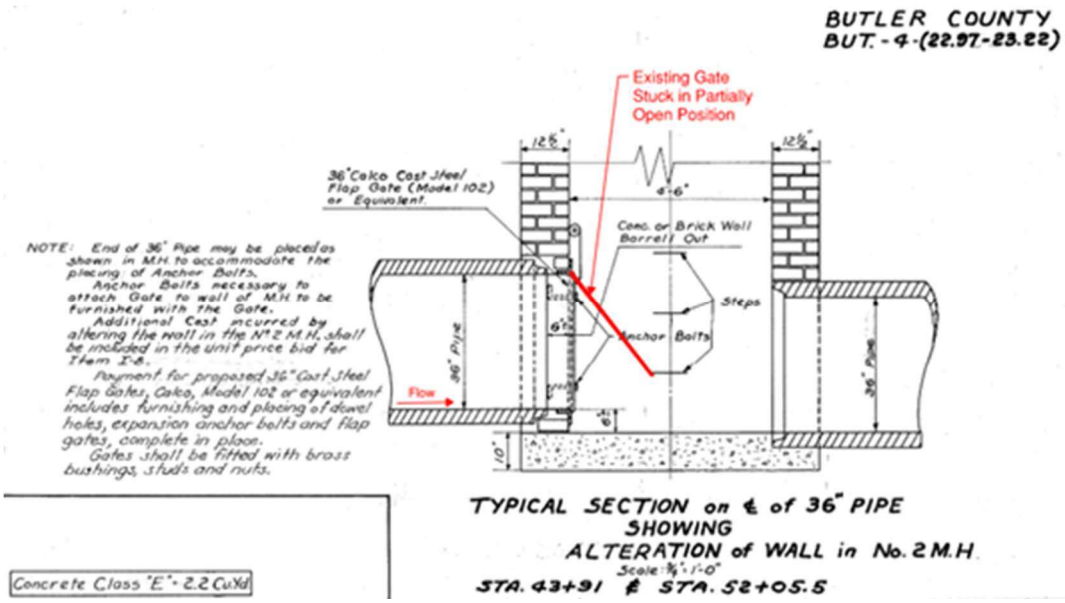
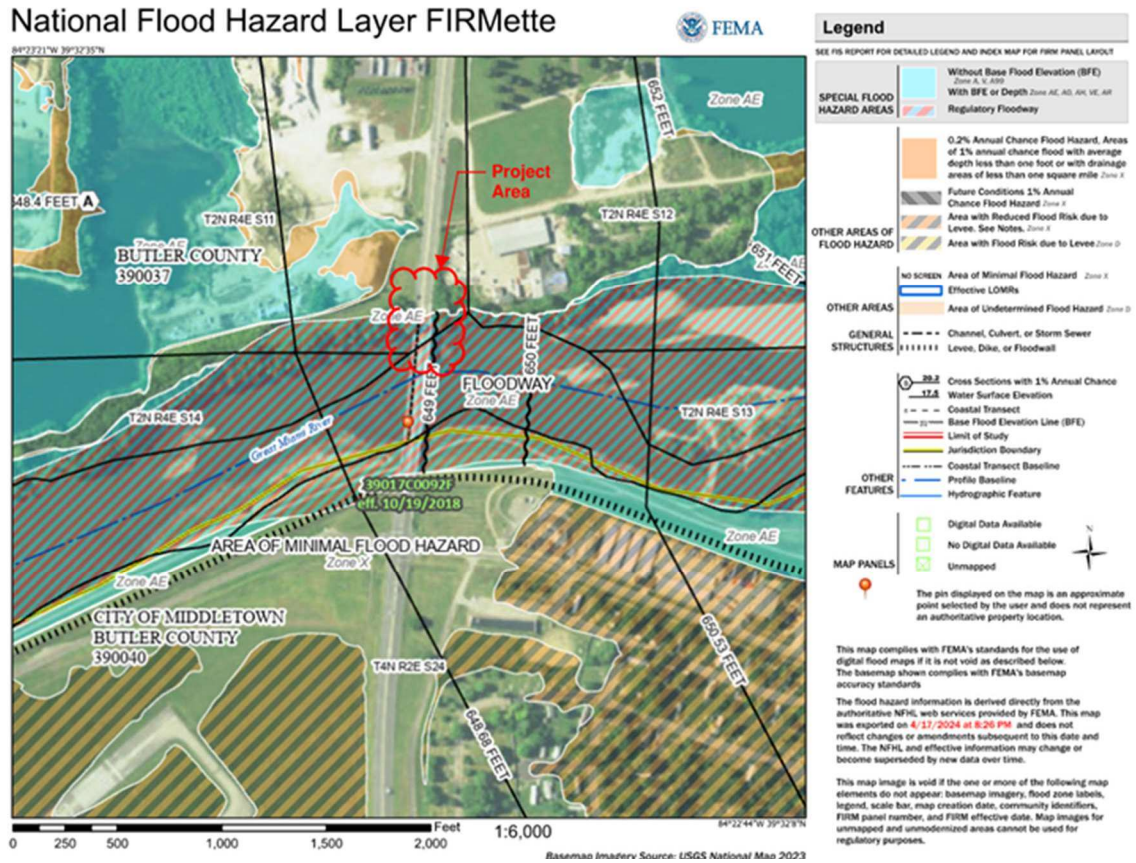


Figure 9: BUT-4 Flap Gate Section View



The ground slopes upward from the riverbank north toward existing MH No. 2 to elevations 651 and 652 within special flood hazard areas as shown in the FEMA FIRMette in **Figure 10**, providing localized surficial floodway storage regardless of the flap valve configuration on the 36" storm sewer.

Figure 10: BUT-4 FEMA FIRMette



The existing structure near STA 1298+42 Lt allows for flow to go either towards the retention pond or towards the GMR. The proposed removes the flow toward the GMR.
* Based on County Crews stating that the flooding has stopped once they cleaned out the retention pond and that the 100 year BFE for GMR is several feet above the pavement surface elevation, I don't think it makes sense to direct more flow to the retention pond.

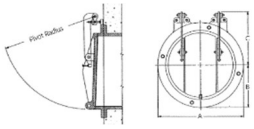
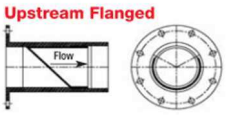
The tributary stormwater drainage area located to the north of the pavement lowering for SR 4 is being redirected to an existing stormwater retention basin that parallels the railroad tracks, effectively separating the downstream collection system from the area of lowering. As a result, any backwater effect within the 36-inch diameter storm sewer from flooding and high-water levels in the Miami River will not reach the area of pavement lowering.

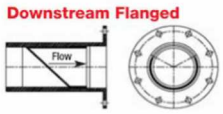
The base flood elevation of 649 will remain approximately 3' below the proposed elevation of SR 4 after it is lowered less than one foot at the sag under the CSX Railroad bridge to roughly new elevation 652.

Figure 11 details the various flap gate options.

Figure 11: BUT-4 Flap Gate Options

Alt.	Description	Pros	Cons	Cost Estimate
A1	Do nothing, allowing the existing Calco Flap Gate to remain as-is in the half-open position.	Flow from upstream tributary areas adequately passes through with river surface elevation less than 638.70, zero cost alternative.	Eventual failure on undetermined timeline, difficult to remove in 22' deep structure, could ultimately obstruct storm flow from tributary upstream areas from reaching the river.	$0
A2	Remove the existing Calco Flap Gate to eliminate the control structure.	Removal eliminates the risk of eventual failure and gate falling into the flow line.	Confined space construction, will not restrict water and debris from filling the 36" sewer during flooding events, work requires excavation and removal of the top manhole section, pavement replacement, MOT.	$45,000

Alt.	Description	Pros	Cons	Cost Estimate
A3	Replace the Calco Flap Gate with a new Mueller HydroGate Flap Gate in the existing structure 	Older technology, restores original functionality allowing dry weather flow to outlet to the river and to close during river flooding, restricting water and debris from filling the 36" sewer.	Confined space construction, heavy replacement unit, existing structure may have deterioration that could affect ability to mount the unit properly, work requires excavation and removal of the top manhole section, pavement replacement, MOT, higher maintenance cost, lower reliability.	$70,000
B	Install a new control structure manhole with TideFlex Inline Checkmate Valve at a location off the existing pavement. 	Newer technology, restores original functionality allowing dry weather flow to outlet to the river, and to close during river flooding, restricting water and debris from filling the 36" sewer, device installed within pipe, straightforward manhole construction, located outside the pavement, ~12' deep for ease in continued O&M, no MOT required, out of sight and protected from floating debris in river, minimal maintenance.	Requires off-road access, recommend quarterly inspection of Checkmate valve, restoration of unpaved area, and includes cost of Alternative A2 to remove the existing Calco Flap Gate.	$110,000

Alt.	Description	Pros	Cons	Cost Estimate
C	Install a TideFlex Inline Checkmate Valve on the downstream 36" outfall to the Miami River. 	Newer technology, restores original functionality allowing dry weather to outlet to the river, and to close during river flooding, restricting water and debris from filling the 36" sewer, located outside the pavement, no MOT required, ease of installation, device installed within pipe, out of sight and protected from floating debris in river, minimal maintenance.	Difficult to access for O&M, recommend quarterly inspection of Checkmate valve, requires off-road or river access, installation adjacent to river may add additional cost if cofferdam required, and includes cost of Alternative A2 work to remove the existing Calco Flap Gate.	$105,000

Of the Alternatives presented herein, Alternative A1 is not supported based upon the risk of eventual failure of the Calco Flap Gate and the difficulty in removing it from obstructing the flow line in an emergency situation. The remaining Alternatives A2, A3, B, and C, each require the removal of the existing Calco valve to eliminate its risk of failure. With an interest in utilizing a newer technology with minimal maintenance requirements to prevent flood waters and debris from entering into and obstructing the existing 36-inch diameter storm sewer, and to provide ease for vehicular access for standard operation and maintenance activities at a new location off the existing pavement, Alternative B is the preferred solution despite its higher cost.

ODOT will coordinate the disposition of the flap gate with the Miami Conservancy District (MCD).

I don't know how lo
partially open, but u
should remove it an
reasons:
* Based on the 1
roadway elevation c
doesn't appear to b
from flooding.
* I discussed th
Crews. He mention
of the retention pon
frequent than previo
in that area in the la
instructed to assure
potential weather ev
* The designer n
prevention device w
the 36". Looking at
doesn't appear to b
* I discussed wit
flood protection sys
river.

4.4.2 BUT-4-23.90 Retention Pond

The retention pond will need to be excavated to remove the excess sediment that has accumulated since the last cleaning in 2013. According to the 1963 plans, the invert elevation of the 60" pipe that outlets to the retention pond is 645.20 and the elevation of the bottom depth of the retention pond is 644.50 which is an elevation difference of 0.7 feet.

The survey for this project indicated that the invert elevation of the 60" pipe that outlets to the retention pond is 644.65 and the elevation of the bottom depth of the retention pond bottom is 645.48 on the west side which is a positive elevation difference of 0.83 feet.

Since the 60" pipe invert elevations are different, it means there is a datum change of 645.20-644.65 = 0.55 feet lower today than 1963. This datum change means that the bottom of pond elevation today should be 644.50-0.55 = 643.95. The pond should be excavated to a bottom of elevation of 643.95 to remove the excess sediment.

4.4.3 BUT-4-23.90 BMP

An exact calculation will be performed during detailed design to determine earth disturbed area (EDA) for the Notice of Intent (NOI) application form and the need for Post Construction Best Management Practices (BMP) to be implemented on this project. Our preliminary calculations appear to indicate that the EDA is greater than 1 acre and will require BMP. We will discuss BMP options and locations during detailed design.

4.5 BUT-27-10.38 Drainage

The existing drainage system is comprised of an open and closed system with ditches, drive pipes, storm sewers, underdrains, and a 3'x3' culvert. West side catch basins north of SR 130 drain across the road to the trunk line on the east side of US 27. East side catch basins south of SR 130 drain across the road to the trunk line located in the west curb or shoulder of US 27. The project area drains to a 36" pipe in the southwest quadrant.

The proposed project will require reconstructing or adjusting to grade all catch basins where the curb and gutter is added. New catch basins will be added at the sag point for each alternative. Other catch basins and manholes located in the pavement will be adjusted to grade.

There are no Federal Emergency Management Agency (FEMA) Floodplains or wetlands within the project limits.

We performed spread calculations and there are no spread violations within the project limits.

We prepared representative cross sections and note the proposed pavement buildup conflicts with the 24" storm sewer trunk line and 24" crossing pipe. This conflict can be mitigated by eliminating the 14" excavation of subgrade at the storm sewers.

Proposed underdrains will generally match locations of existing underdrains.

I assume this is acceptable, Alec?

The drainage area map, conduit inventory and calculations are provided in **Appendix I**.

4.5.1 BUT-27-10.38 BMP

An exact calculation will be performed during detailed design to determine earth disturbed area (EDA) for the Notice of Intent (NOI) application form and the need for Post Construction Best Management Practices (BMP) to be implemented on this project. Our preliminary calculations appear to indicate that the EDA is greater than 1 acre and will require BMP. We will discuss BMP options and locations during detailed design.

4.6 BUT-4-23.90 Structural Considerations

BUT-4 is underneath the CSX Railroad bridge (BUT-4-23.94, SFN 0900451, CSXT Bridge #BE-40.10). This bridge was built in 1941 and is a 71' long single span, steel beam, bridge on cast-in-place concrete abutments with spread footings. The bridge skew is 32.17 degrees right forward.

To mitigate any structural concerns, the proposed sidewalk will be constructed at the same elevation or higher as the existing sidewalk underneath the CSX Railroad bridge. In the 13.8' alternative, the maximum curb height is 6" and the back of walk elevation ends up 4" higher than existing on the left side and 6" higher on the right side. In the 14.0' alternative, the maximum curb height is 6" and the back of walk elevation ends up 1" higher than existing on the left side and 3" higher on the right side. In the 14.5' alternative, the maximum curb height is 1' and in the 15.0' alternative, the maximum curb height is 1.5', with both options matching the existing back of walk

elevation. The curb heights for the 14.5’ and 15.0’ alternatives are too high for an ODOT standard curb and will require a wall.

4.7 BUT-27-10.38 Structural Considerations

BUT-27 is underneath the CSX Railroad bridge (BUT-27-10.44, SFN 0900729, CSXT Bridge #BD-33.10). This bridge was built in 1938 and is a 70’ long single span, steel beam, bridge on cast-in-place concrete abutments with spread footings. The bridge skew is 43.28 degrees left forward.

To mitigate any structural concerns, the proposed top of curb on the curb and gutter will be constructed at the same elevation as the existing curb and gutter underneath the CSX Railroad bridge. In the 14.0’ alternative, the maximum curb height is 6” and in the 14.5’ alternative, the maximum curb height is 10”.

4.8 BUT-4-23.90 Maintenance of Traffic (MOT)

The existing pavement width is 46’ which allows for part-width construction with two lanes of traffic maintained on one lane using temporary signals. MOT Typical Sections are provided in **Appendix G**.

Sequencing: We recommend sequencing the construction into two (2) Stages with the pavement reconstruction as Stage 1 and resurfacing to the Great Miami River as Stage 2. Stage 1 traffic can be maintained with a temporary signal located at Catalina Court (TR 80209) and the other temporary signal located south of the reconstruction limits. We suggest constructing the west side first in Stage 1, Phase 1 and the east side should be constructed next in Stage 1, Phase 2.

Stop Bars: The stop bar locations on the north side of US 27 vary based on the reconstruction limits for each option. Stop bars are located at 50 foot offsets from the merging edge line on either end of the work zone as per ODOT Standard Drawing MT-96.11.

Drives: The drives located within the reconstruction limits will need to be constructed in a Sub-Phase and accommodations provided to maintain drive access at all times. Drives will be signalized to coordinate directional traffic movements and forbid conflicting traffic movements attributed to drive egress during one-lane maintenance of traffic.

Existing Walks: The existing sidewalks will be closed when the abutting pavement is being constructed. A pedestrian detour is possible at Trenton Franklin Road, however there is no crossing at Catalina Court and sidewalk closure signs will need to be posted instead.

Evaluation: The project site was evaluated for MOT schemes where two-way traffic would be maintained through the work zone using temporary signals or one direction of traffic would be detoured. Highway Capacity Software (HCS) was used to perform the temporary traffic signal analysis and ODOT’s Road User Cost (RUC) workbook was used in conjunction with Google Maps to analyze the detour route. AM and PM peak hours were analyzed for the site with data from ODOT count station 40409 to develop anticipated delays and performance metrics for the temporary signals. These were then compared to the expected delays associated with the detour route drive times.

Detour Route: The available state route detour for northbound or southbound traffic would be from SR 4 to SR 73 to SR 123 and back to SR 4 taking traffic through the Cities of Carlisle, Franklin, and Middletown. This route passes by two emergency services buildings, crosses four at-grade railroad crossings, and passes through 11 signalized intersections. The expected drive

time for this route is 16-18 minutes, although this would be expected to increase with additional traffic added to the route. The detour summary is shown in **Figure 12**. The ODOT Road User Cost workbook was utilized to determine the expected cost of the delay cost per day, which was found to be $27,561 and $21,539 for the northbound and southbound detour routes, respectively. The detailed RUC sheets are contained within **Appendix G**. The local detour could be Trenton Franklin Road (CR 81) to Franklin Madison Road (TR 9) to Thomas Road (TR 91).

Figure 12: BUT-4 Detour Summary

	Normal Route		State Route Detour	
Travel Direction	NB	SB	NB	SB
Length (mi)	6.3	6.3	10.7	10.5
Drive Time (min)	8	8	18	16
Delay (min)	0	0	10	8

Temporary Signal: At the north end of the project site, the temporary signal is expected to be installed at the intersection of OH 4 and Catalina Court. At the south end of the project site, the temporary signal is expected to be installed approximately 525 feet south of the railroad overpass.

Capacity Analysis: For the capacity analysis, AM and PM peak hours were analyzed with ODOT count station data to develop anticipated delays (per vehicle based on approach) and performance metrics for the temporary signals. HCS analysis is included in **Appendix G**. The resulting delays, as reported for the AM and PM peak hour, were then standardized for an average vehicle trip using the Hourly Percent by Vehicle Type spreadsheet (provided by ODOT) to compare to the expected delays at the signal equated to the additional drive times associated with the detour routes. This delay was calculated to be approximately 2 minutes per vehicle for northbound and southbound trips, normalized across all hours of the day. The HCS Analysis Summary is shown in **Figure 13**:

Figure 13: BUT-4 HCS Analysis Summary

Temporary Signal	AM Peak Hour		PM Peak Hour	
Approach Direction	NB	SB	NB	SB
WZ Length (ft)	1200	1050	1200	1050
Volume (veh)	361	320	521	587
V/C Ratio	1.028	1.005	1.623	1.625
Back of Queue* (ft)	722	644	1629	1827
Approach Delay (s/veh)	111.2	108.9	353.0	350.5

These are very long queues, approximately 65-75 vehicles with almost 6 minutes of delay per vehicle!

A temporary signal will perform very poorly in the peak PM.

Level of Service (A to F)	F	F	F	F
	NB		SB	
Standard Delay (min/veh)	2.2		2.0	

* 95th Percentile

Based on the analysis, AM peak hour queueing does not indicate conflict but in the 95th percentile of the PM peak hour, northbound traffic is anticipated to queue 1629 feet which passes the OH 4 / Trenton-Franklin Road intersection south of the project site, and southbound traffic is expected to queue 1827 feet which passes the TWSC intersection of OH 4 & Corlee Ln to the north of the site. In both instances, traffic backup from the temporary signal could impact the performance of adjacent local intersections.

Cost Comparison: As mentioned previously, ODOT's RUC workbook was utilized to determine the expected cost associated with the additional drive time of the northbound and southbound state detour route. These costs were then directly compared to the additional drive time associated with the normalized northbound and southbound delay at the temporary signal. In both cases, delay cost per day was calculated using Average Daily Traffic (ADT), which was determined by dividing ODOT count station AADT by the corresponding ODOT seasonal adjustment factor. The cost comparison is shown in **Figure 14** and detailed RUC sheets and delay analyses are contained in **Appendix G**.

Figure 14: BUT-4 Cost Comparison

	Northbound		Southbound	
Vehicle Type	Car	B/C Truck	Car	B/C Truck
ADT	5,690	237	5,541	238
User Cost Per Vehicle Per Hour	$26.13	$70.52	$26.13	$70.52
	Temp. Signal	SR Detour	Temp. Signal	SR Detour
Delay (min)	2.2	10	2.0	8
Delay (hrs)	0.036	0.167	0.034	0.133
Avg Delay Cost Per Day	$5,971	$27,561	$5,474	$21,539

Conclusions: Based on the temporary signal analysis, both northbound and southbound traffic are anticipated to have a standardized delay of approximately 2 minutes per vehicle. By comparison, the state route detour is anticipated to add an additional 8-10 minutes of drive time per vehicle, which equates to a delay savings per day of approximately $21,600 for northbound traffic and $16,000 for southbound traffic by using the temporary signal. That said, queue analysis at the temporary signal indicates that backup in the PM peak hour may interfere with local traffic at the

We are comparing the standardized delay across the full day for the temporary signal vs. the detour delay time.

I wouldn't expect the detour delay time to vary much depending on the time of day. Therefore, it may make more sense to compare the peak hour delay at the temporary signal to the peak hour delay for a detour. This would be a more uniform comparison (same time of day).

intersections directly north and south of the site. Based on this analysis, the use of a detour can mitigate excessive traffic and allowing one-way northbound traffic at the work zone allows a direct route for the Madison Township fire department to serve the majority of their community. For these reasons, we are recommending to detour Southbound traffic along the state route detour route.

4.9 BUT-27-10.38 Maintenance of Traffic (MOT)

The existing pavement width varies from 38' on the north end (north of SR 130) to 44' on the south end (south of SR 130). These widths allow for part-width construction with two lanes of traffic maintained on one lane using temporary signals. MOT Typical Sections are provided in **Appendix N**.

Sequencing: We recommend sequencing the construction into one (1) Phase with the pavement reconstruction. The west side (outlet side) of the new storm sewer lateral located at the new sag point should be constructed first in Phase 1 and the east side (inlet side) of the new storm sewer system should be constructed next in Phase 2.

Stop Bars: The stop bar locations on the north side of US 27 vary based on the reconstruction limits for each option. Stop bars are located at 50 foot offsets from the merging edge line on either end of the work zone as per ODOT Standard Drawing MT-96.11.

Drives: The drives located within the reconstruction limits will need to be constructed in a Sub-Phase and accommodations provided to maintain drive access at all times. Drives will be signalized to coordinate directional traffic movements and forbid conflicting traffic movements attributed to drive egress during one-lane maintenance of traffic.

Evaluation: The project site was evaluated for MOT schemes where two-way traffic would be maintained at the site using temporary signals or one direction of traffic would be detoured. HCS was used to perform the traffic signal analysis and ODOT's Road User Cost (RUC) workbook was used in conjunction with Google Maps to analyze the detour route. Two state route detours were reviewed, and an additional analysis was conducted to determine whether OH 130 could remain open at OH 27 and to determine what additional delays would be incurred by traffic passing through the site. AM and PM peak hours were analyzed for the site with data from ODOT count station 3109 (US 27) and 13609 (OH 130) to develop anticipated delays and performance metrics for the temporary signals. These were then compared to the expected delays associated with the detour route drive times.

Detour Route: The primary state route detour (State Route Detour1) for northbound or southbound US 27 traffic would be from US 27 to SR 129, to SR 177, to SR 73, and back to US 27 through Millville, Hamilton, & Oxford. This route passes by one emergency services building, crosses two at-grade railroad crossings, passes by three grade schools and Miami University, and passes through 30 signalized intersections. The expected drive time for this approximately 19-mile-long route is 30-35 minutes resulting in 10-15 minutes of delay per vehicle. The ODOT Road User Cost workbook was utilized to determine the expected cost of the delay cost per day, which was found to be $28,849 and $18,703 for the southbound and northbound detour routes, respectively. The detailed RUC sheets are contained within **Appendix N**. No local detours are anticipated to be signed for US 27 traffic. It should be noted that a recent intersection reconfiguration project at the intersection of SR 129 at SR 177 prohibits eastbound left turns from

SR 129 to northbound SR 177, which increases the length and duration of the northbound detour route.

The secondary state route detour (State Route Detour 2) for northbound or southbound US 27 traffic would be from US 27 to SR 129 to SR 732 back to US 27 through Millville & Oxford. This route passes by no emergency service buildings or schools, crosses one at-grade railroad crossing, and passes through 8 signalized intersections. While this route does avoid Miami University, it does pass through the middle of the City of Oxford. The expected drive time for this 15.6-mile-long route is 26 minutes resulting in 6 minutes of delay per vehicle. The detour summary is shown in **Figure 15**. The ODOT Road User Cost workbook was utilized to determine the expected cost of the delay cost per day, which was found to be $11,540 and $11,222 for the southbound and northbound detour routes, respectively. The detailed RUC sheets are contained within **Appendix N**. This route could be shortened by utilizing Locust Street within Oxford - the at-grade crossing on Locust Street has been upgraded and is preempted whereas the at-grade crossing on OH 732 at E Chestnut has not – resulting in a similar travel time, but fewer turns and signalized intersections to navigate.

Figure 15: BUT-27 Detour Summary

	Normal Route		State Route Detour 1		State Route Detour 2	
Travel Direction	NB	SB	NB	SB	NB	SB
Length (mi)	11	11	18.6	18.2	15.6	15.6
Drive Time (min)	20	20	30	35	26	26
Delay (min)	0	0	10	15	6	6

The primary state route detour for eastbound or westbound through traffic would be from SR 130 to SR 177 to SR 73 and back to US 27. This route does not pass by any emergency services buildings, passes by one grade school & Miami University, and passes through five signalized intersections. While this detour route is 10.2 miles long, the drive is typically two minutes shorter per vehicle than that of the primary route utilizing SR 130 to US 27 to travel to Oxford. Local traffic would be able to utilize several options for local detours:

1) SR 177 to Stillwell Beckett Road back to US 27
2) SR 130 to Lanes Mill Road to Stillwell Beckett Road back to US 27
3) SR 130 to Darrtown Road to Stillwell Beckett Road back to US 27

Each of the local detours adds 0-2 minutes of additional travel time, but relies on narrow, local roadways. Lanes Mill Road is approximately 22 feet wide. Stillwell Beckett Road is approximately 20 feet wide. The typical drive time for all three routes is 7-9 minutes, but would be expected to increase with additional traffic added to the routes.

Temporary Signal: At the north end of the project site, the temporary signal is expected to be installed just north of the intersection of US 27 and Hussey Road. At the south end, the temporary signal is expected to be installed approximately 500 feet south of the railroad bridge.

Capacity Analysis: For the capacity analysis, AM and PM peak hours were analyzed with ODOT count station data to develop anticipated delays (per vehicle based on approach) and performance metrics for the temporary signals. HCS analysis is included in **Appendix N**. The resulting delays, as reported for the AM and PM peak hour, were then standardized for an average vehicle trip using the Hourly Percent by Vehicle Type spreadsheet to compare to the expected delays at the signal equated to the additional drive times associated with the detour routes. This delay was calculated to be approximately 1 minute per vehicle with SR 130 closed and 2 minutes per vehicle with SR 130 open for northbound and southbound trips, normalized across all hours of the day. The HCS Analysis Summary for SR 130 closed is shown in **Figure 16** and for SR 130 open is shown in **Figure 17**:

Figure 16: HCS Analysis (SR 130 Closed)

Temporary Signal	AM Peak Hour		PM Peak Hour	
Approach Direction	NB	SB	NB	SB
WZ Length (ft)	1295	1295	1295	1295
Volume (veh)	243	309	404	318
V/C Ratio	0.801	0.848	1.143	1.116
Back of Queue* (ft)	397	487	884	704
Approach Delay (s/veh)	71.6	71.9	149.2	147.8
Level of Service (A to F)	E	E	F	F
	NB		SB	
Standard Delay (min/veh)	0.9		1.0	

* 95th Percentile

Figure 17: BUT-27 HCS Analysis (SR 130 Open)

Temporary Signal	AM Peak Hour		PM Peak Hour	
Approach Direction	NB	SB	NB	SB
WZ Length (ft)	1295	1295	1295	1295
Volume (veh)	243	309	404	318
V/C Ratio	1.006	1.033	1.502	1.446
Back of Queue* (ft)	569	691	1289	999
Approach Delay (s/veh)	135.4	134.1	317.6	300.5
Level of Service (A to F)	F	F	F	F
	NB		SB	
Standard Delay (min/veh)	1.9		2.0	

* 95th Percentile

Based on the analysis, queueing does not indicate conflict with the US 130 closure or in the AM peak hour with US 130 open, but in the 95th percentile of the PM peak hour northbound traffic is anticipated to queue 1289 feet which passes the TWSC intersection of US 27 & Stillwell Road south of the project site. In this instance, traffic backup from the temporary signal could impact the performance of the adjacent local intersection.

Cost Comparison: As mentioned, ODOT's RUC workbook was used to determine the expected cost associated with the extra drive time of the northbound and southbound state detour routes. These costs were then directly compared to the additional drive time associated with the normalized northbound and southbound delay at the temporary signal, with and without the closure of US 130. In all cases, delay cost per day was calculated using Average Daily Traffic (ADT), which was determined by dividing ODOT count station AADT by the corresponding ODOT seasonal adjustment factor. The cost comparison is shown in **Figure 18** and the detailed RUC sheets and delay analyses are contained in **Appendix N**.

Figure 18: BUT-27 Cost Comparison

	Northbound		Southbound	
Vehicle Type	Car	B/C Truck	Car	B/C Truck
ADT	3,680	228	3,888	196
User Cost Per Vehicle Per Hour	$26.13	$70.52	$26.13	$70.52
Temp. Signal	SR 130 Closed	SR 130 Open	SR 130 Closed	SR 130 Open
Delay (min)	0.9	1.9	1.0	2.0
Delay (hrs)	0.015	0.032	0.017	0.033
Avg Delay Cost Per Day	$1,732	$3,554	$1,912	$3,781
	SR Detour 1	SR Detour 2	SR Detour 1	SR Detour 2
Delay (min)	10	6	15	6
Delay (hrs)	0.167	0.100	0.250	0.100
Avg Delay Cost Per Day	$18,703	$11,222	$28,849	$11,540

Conclusions: Based on the temporary signal analysis, both northbound and southbound traffic are anticipated to have a standardized delay of approximately 2 minutes per vehicle with OH 130 open and 1 minute with OH 130 closed. By comparison, state route detour 1 is expected to add 10-15 minutes of drive time per vehicle and state route detour 2 to add 6 minutes. Relative to delay cost per day for detour 1, approximately $17,000 northbound and $27,000 southbound is saved using the temporary signal with US 130 closed, and approximately $15,000 northbound and $25,000 southbound is saved using the temporary signal with US 130 open. For detour 2 relative delay cost per day, approximately $9,500 northbound and southbound is saved using the temporary signal with US 130 closed, and approximately $7,700 northbound and southbound is saved using the temporary signal with US 130 open. That said, queue analysis at the temporary signal indicates that backup in the PM peak hour with US 130 open may interfere with local traffic at the intersection directly south of the site. For these reasons, we are recommending the closure of SR 130 and the detour of northbound traffic along the state route detour route 2.

4.10 BUT-4-23.90 Right-of-Way (R/W)

R/W is anticipated for the following vertical clearance alternatives as shown in **Figure 19**:

Figure 19: BUT-4 R/W Needs

Alternative	R/W Needed	Parcel #	Area	Cost
1 – 13.8' Vertical Clearance	Yes, temporary	E2210020000024 for Madison Township. No parcel # for CSX Railroad property.	1260 SF	TBD*
2 – 14.0' Vertical Clearance	Yes, temporary	E2210020000024 for Madison Township. No parcel # for CSX Railroad property.	1240 SF	TBD*
3 – 14.5' Vertical Clearance	Yes, temporary	E2210020000024 and E2210020000025 for Madison Township. No parcel # for CSX Railroad property.	2185 SF	TBD*
4 – 15.0' Vertical Clearance	Yes, temporary	E2210020000024 and E2210020000025 for Madison Township. E2250091000004 for Poasttown First Church of God. No parcel # for CSX Railroad property.	3130 SF	TBD*

* A construction agreement would be needed with CSX Railroad if R/W is to be acquired and those costs would be determined at a later date.

4.11 BUT-27-10.38 Right-of-Way (R/W)

R/W is anticipated for the following vertical clearance alternatives as shown in **Figure 20**:

Figure 20: BUT-27 R/W Needs

Alternative	R/W Needed	Parcel #	Area	Cost
1 – 14.0' Vertical Clearance	Yes, temporary	No parcel # for CSX Railroad property.	225 SF	TBD*
2 – 14.5' Vertical Clearance	Yes, temporary	No parcel # for CSX Railroad property.	315 SF	TBD*

* A short 140' long retaining wall is possible to eliminate the 2:1 slopes and avoid R/W just past the bridge on the west side. This wall could be extended to eliminate the 2:1 slopes even where R/W is not needed. A construction agreement would be needed with CSX Railroad if R/W is to be acquired and those costs would be determined at a later date.

4.12 BUT-4-23.90 Geotechnical

ODOT's Central Office Geotechnical Section reviewed the BUT-4-23.94 location and provided the following comments:

"The posted clearance is 13'-7" and the desired clearance is 14'-0" to 14'-6". The overpass is a single span railroad bridge on full height wall abutments. Resource International performed a roadway exploration immediately south of the bridge in 2002 (PID 14922, BUT-4-23.74), exhibiting predominantly medium dense to lose granular soils. With a maximum grade change of 1 foot and maximum excavation of 2.5-foot, the project should not have an effect on the stability (passive resistance) of the RR wall abutment foundations, assuming the soils within the frost zone (30") were ignored in the original design. If the RR has a concern, the complete details of the abutment footing need to be made available, and the stability of the footing could be looked at considering the historic adjacent boring. Our opinion is that the planned subgrade treatment is warranted, and no new borings are necessary."

4.13 BUT-27-10.38 Geotechnical

ODOT's Central Office Geotechnical Section reviewed the BUT-27-10.46 location and provided the following comments:

"The existing clearance is 14'-0", and the preferred new clearance is 14'-6". The overpass is a single span railroad bridge on full height wall abutments. A roadway historic exploration was performed by ATEC in 1988 (BUT-27-10.40) with one boring south of the bridge and rest north. The borings exhibited A-6 soils overlying shallow shale bedrock (6.0 feet±) with no rock coring performed. Again, considering the fact that the planned excavation for this project will be less than 2 feet, we would expect the abutment foundation design to ignore the soil within the frost depth (30"), and therefore, the planned excavation to have no effect on the stability of the footing. If the RR has any concerns, they need to produce a detail of the abutment footing for analysis, and the stability can be looked at using the historic boring and some assumptions for the bedrock, if necessary. If there are any further concerns (which there shouldn't be) a boring would be necessary to characterize the rock. The ATEC exploration included lab CBRs at 98% and 100% compaction and resulted in CBR values between 5 and 6. Our opinion is that the planned subgrade treatment is warranted, and no new borings are necessary."

4.14 Utility Impacts

BG Engineering Group contacted Ohio Utilities Protection Service (OUPS) and obtained record utility plans for this project.

The Stage 1 plan sheets will be mailed to each utility within the project limits once a preferred alternative has been selected by ODOT. The utility responses will be collected and sent to ODOT. The comments will be addressed in detailed design. The utility impacts are the reduced cover over the telephone for the BUT-4-23.90 location and reduced cover over the 4" gas line and traffic signal conduit for the BUT-27-10.38 location.

Utility information for the BUT-4-23.90 location is summarized in **Figure 21**:

Figure 21: BUT-4 Utility Information

Utility	Owner	Size	Location	Impacts and Comments
Electric and Lighting	Duke Energy	N/A	Both sides	No impacts.
Water	Southwest Regional Water	12”	West side	No impacts.
Telephone	AT&T Ohio	Unk.	East side under sidewalk	Reduced cover in the 14.5’ and 15.0’ alternates
Cable	Charter Communications	N/A	Overhead on poles	No impacts.
Gas	Duke Energy	8”	East side	No impacts.
Sanitary Sewer	N/A	N/A	N/A	N/A

Utility information for the BUT-27-10.38 location is summarized in **Figure 22**:

Figure 22: BUT-27 Utility Information

Utility	Owner	Size	Location	Impacts and Comments
Electric and Lighting	Duke Energy	N/A	Both sides	No impacts.
Electric	Butler Rural Electric Cooperative, Inc.	N/A	SR 130	No impacts.
Water	Southwest Regional Water	8”	West side	No impacts.
Telephone	Altafiber (formerly Cincinnati Bell)	N/A	Overhead on poles	No impacts.
Cable	Charter Communications	N/A	Overhead on poles	No impacts.
Gas	Duke Energy	8” 4”	8” on west side; 4” on east side	Reduced cover over 4” in both alternates
Sanitary Sewer	N/A	N/A	N/A	N/A
Traffic Signal	ODOT District 8	N/A	SR 130 intersection and along US 27. Pull boxes, 2” conduit and	Replace impacted loop detectors and adjust to

Signal could be upgraded to radar detection. Will the project affect the cable for the PTSWF sign?

			loop detectors on west side north of SR 130 and east side south of SR 130	grade for some pull boxes. Reduced cover over 2" conduit.

4.15 Railroad Coordination

Railroad coordination will begin with submission of this Feasibility Study to CSX through the Ohio Rail Development Commission (ORDC).

4.16 BUT-4-23.90 Environmental Impacts

The following is a summary of environmental resources with the project area and anticipated involvement with those resources under the feasible build alternatives:

Streams and Wetlands: No streams or wetlands are anticipated within the project corridor.

Floodplain: The project corridor is not located within a designated special flood hazard area.

Threatened and Endangered Species: Butler County is within the known habitat ranges of the Indiana bat, northern long-eared bats, the tri-colored bat, the bald eagle, the rayed bean mussel, and the eastern massasauga rattlesnake. Habitat for these species is not anticipated to be present within the project corridors.

Cultural Resources: Within the project corridor, there are no National Historic Landmarks or sites that have been determined eligible for the National Register of Historic Places. Although not currently listed on the NRHP, the Madison Township Fire Department Station is adjacent to the proposed project and the building was likely constructed in the 1900s. Under all build alternatives, the project is not expected to have impacts to historic properties.

Section 4(f)/6(f) Resources: There are no publicly-owned recreational facilities or facilities funded with Land & Water Conservation Funds within or adjacent to the project corridors.

Air Quality: All build alternatives are expected to be exempt from analysis for mobile source air toxics. The project is not located in an area that is currently in non-attainment for criteria air pollutants under the National Ambient Air Quality Standards.

Noise Levels: None of the project corridors will shift travel lanes modestly closer to noise sensitive receptors. If necessary, a noise analysis and, if warranted and feasibility, consideration for noise abatement will be undertaken; however, a noise analysis is not anticipated.

Drinking Water Resources: This project is located within the boundaries of a designated sole source aquifer and a drinking water resource protection area. Under all build alternatives, a plan note to protect groundwater resources will be included in the project plans.

Farmland: A majority of this project is located within an urbanized area and is not likely to require coordination under the Farmland Protection Policy Act. Additionally, acquisition under this project is not anticipated to exceed the coordination thresholds of ORC 929.05.

Regulated Materials: Multiple properties of concern are located within the vicinity of the project corridor. Additional investigations may be warranted if the selected alternative's footprint requires

involvement with the identified properties of concern. It is likely the involvement will be limited to a petroleum contaminated soils plan note.

Underserved Populations: US Census data indicate the following percentages of environmental justice populations within the corridor as shown in **Figure 23.** The project will not require relocations and right-of-way acquisition from private properties will be limited to non-residential properties. Under the build alternatives, the project is not expected to result in disproportionate adverse impacts to environmental justice populations.

Figure 23: BUT-4 Environmental Justice Populations

	% Population by Block Group
Minority	4
Low-Income	33

4.17 BUT-27-10.38 Environmental Impacts

The following is a summary of environmental resources with the project area and anticipated involvement with those resources under the feasible build alternatives:

Streams and Wetlands: No streams or wetlands are anticipated within the project corridor.

Floodplain: The project corridor is not located within a designated special flood hazard area.

Threatened and Endangered Species: Butler County is within the known habitat ranges of the Indiana bat, northern long-eared bats, the tri-colored bat, the bald eagle, the rayed bean mussel, and the eastern massasauga rattlesnake. Habitat for these species is not anticipated to be present within the project corridors.

Cultural Resources: Within the project corridor, there are no National Historic Landmarks or sites that have been determined eligible for the National Register of Historic Places. A cemetery may be in proximity to the proposed project. Under all build alternatives, the project is not expected to have impacts to historic properties.

Section 4(f)/6(f) Resources: There are no publicly-owned recreational facilities or facilities funded with Land & Water Conservation Funds within or adjacent to the project corridors.

Air Quality: All build alternatives are expected to be exempt from analysis for mobile source air toxics. The project is not located in an area that is currently in non-attainment for criteria air pollutants under the National Ambient Air Quality Standards.

Noise Levels: None of the project corridors will shift travel lanes modestly closer to noise sensitive receptors. If necessary, a noise analysis and, if warranted and feasibility, consideration for noise abatement will be undertaken; however, a noise analysis is not anticipated.

Drinking Water Resources: The project is not located within the boundaries of a designated sole source aquifer or a drinking water resource protection area.

Farmland: This project is not located entirely within an urbanized area and may require coordination under the Farmland Protection Policy Act. Additionally, acquisition under this project is not anticipated to exceed the coordination thresholds of ORC 929.05.

Regulated Materials: Two properties of concern are located within the vicinity of the project corridor. Additional investigations may be warranted if the selected alternative's footprint requires involvement with the identified properties of concern. It is likely the involvement will be limited to a petroleum contaminated soils plan note.

Underserved Populations: US Census data indicate the following percentages of environmental justice populations within the corridor as shown in **Figure 24**. The project will not require relocations and right-of-way acquisition from private properties will be limited to non-residential properties. Under the build alternatives, the project is not expected to result in disproportionate adverse impacts to environmental justice populations.

Figure 24: BUT-27 Environmental Justice Populations

	% Population by Block Group
Minority	13
Low-Income	24

4.18 BUT-4-23.90 Public Involvement

Public involvement activities will occur after approval of the preferred alternate. Owners, occupants and other identified stakeholders will be notified of the project as part of ODOT's public involvement process. Comments received from the public will be considered as design progresses.

4.19 BUT-27-10.38 Public Involvement

Public involvement activities will occur after approval of the preferred alternate. Owners, occupants and other identified stakeholders will be notified of the project as part of ODOT's public involvement process. Comments received from the public will be considered as design progresses.

4.20 BUT-4-23.90 Construction Cost Estimates

The following planning level costs, shown in **Figure 25**, are expected for each vertical clearance alternative. Itemized cost estimates are provided in **Appendix H.**

Figure 25: BUT-4 Estimated Construction Costs

Alternative	**Total Construction Cost**	**% Greater than Cheapest Alternative**
1 – 13.8' Vertical Clearance	$1,890,000	
2 – 14.0' Vertical Clearance	$2,070,000	9.5%
3 – 14.5' Vertical Clearance	$2,210,000	16.9%
4 – 15.0' Vertical Clearance	$2,420,000	28.0%

All alternative costs include a 30% design contingency for this stage of project development and an 18.9% inflation rate was included based on ODOT's inflation calculator and an assumption that

the midpoint of construction will be 7/15/2027. ODOT's inflation calculator is provided in **Appendix P**.

4.21 BUT-27-10.38 Construction Cost Estimates

The following planning level costs, shown in **Figure 26**, are expected for each vertical clearance alternative. Itemized cost estimates are provided in **Appendix O**.

Figure 26: BUT-27 Estimated Construction Costs

Alternative	Total Construction Cost	% Greater than Cheapest Alternative
1 – 14.0' Vertical Clearance	$1,400,000	
2 – 14.5' Vertical Clearance	$1,480,000	5.7%

All alternative costs include a 30% design contingency for this stage of project development and an 18.9% inflation rate was included based on ODOT's inflation calculator and an assumption that the midpoint of construction will be 7/15/2027. ODOT's inflation calculator is provided in **Appendix P**.

5.0 COMPARISON OF ALTERNATIVES

5.1 BUT-4-23.90

The alternative matrix, as shown in **Figure 27**, evaluates each vertical clearance alternative. Based upon these established criteria, the 14.0' vertical clearance alternative was selected as the preferred alternative.

Figure 27: BUT-4 Alternative Matrix

Criteria	1 – 13.8' Vertical Clearance	2 – 14.0' Vertical Clearance	3 – 14.5' Vertical Clearance	4 – 15.0' Vertical Clearance
Vertical Clearance Improvement	No	Yes	Yes	Yes
Profile Reduction/Maximum Cut	None	0.31' lower than 13.8' option	0.85' lower than 13.8' alternative	1.35' lower than 13.8' alternative
Curb Height at Bridge	6"	6"	1.0' which exceeds ODOT standard curb height, wall needed	1.5' which exceeds ODOT standard curb height, wall needed

Railroad Impacts	None	None	None	None
Cover over Storm Sewers	Some interference with the stabilization at 12" storm sewer laterals.	Stabilization interference with the new 12" storm sewer laterals and the existing 68"x43" culvert.	Reduced generally about 6" more compared to 14.0' alternative	Reduced generally about 12" more compared to 14.0' alternative
Maintenance of Traffic	Shortest work zone.	69.5' longer work zone on north end than 13.8' alternative.	53.5' longer work zone on north end than 14.0' alternative.	Same work zone length as 14.5' alternative.
Drive Impacts	No drives.	One drive.	Two drives that are unable to be designed following ODOT's commercial drive design criteria.	Four drives that are unable to be designed following ODOT's commercial drive design criteria.
Utility Impacts	None	None	Yes, reduced cover over telephone	Yes, reduced cover over telephone
Right-of-Way Impacts	Yes	Yes	Yes	Yes
Construction Costs	$1,890,000	$2,070,000	$2,210,000	$2,420,000

5.2 BUT-27-10.38

The alternative matrix, as shown in **Figure 28**, evaluates each vertical clearance alternative. Based upon these established criteria, the 14.5' vertical clearance alternative was selected as the preferred alternative.

Figure 28: BUT-27 Alternative Matrix

Criteria	1 – 14.0' Vertical Clearance	2 – 14.5' Vertical Clearance
Vertical Clearance Improvement	No	Yes

Profile Reduction/Maximum Cut	3” Max.	1.3’
Curb Height at Bridge	6”	Varies 10” Max.
Railroad Impacts	None	None
SR 130 Impacts	Ties in before Lanes Mill Road at Sta. 200+63.21, but the grade break is only .15% below the max allowable grade break, so it does not improve it as much as the 14.5' alternative.	Ties in before Lanes Mill Road at Sta. 200+73.53 and improves the existing vertical geometry/grade breaks which currently exceed ODOT's maximum allowable grade breaks.
Cover over Storm Sewers	Some interference with the stabilization.	Reduced generally about more 6” compared to 14.0’ alternative
Maintenance of Traffic	100’ shorter work zone than 14.5’ alternative	100’ longer work zone than 14.0’ alternative.
Drive Impacts	One drive impacted at Sta. 8+90.48. Limited to apron work within R/W.	One drive impacted at Sta. 14+92.27. Limited to apron work within R/W.
Utility Impacts	4” gas has reduced cover. 2” traffic signal conduit is now into the stabilization.	4” gas is now into the stabilization in some areas. 2” traffic signal conduit is now into the aggregate base.
Right-of-Way (R/W) Impacts	Yes, on west side, north of bridge	Yes, on west side, north of bridge
Construction Costs	$1,400,000	$1,480,000

6.0 CONCLUSION

6.1 BUT-4-23.90

The 14.0’ vertical clearance alternative was selected as the preferred alternative since it increases the vertical clearance from the existing condition with limited impacts compared to the 14.5’ and 15.0’ vertical clearance alternative.

6.2 BUT-27-10.38

The 14.5’ vertical clearance alternative was selected as the preferred alternative since it increases the vertical clearance from the existing condition for nominal additional cost and has similar impacts to the 14.0’ vertical clearance alternative.

7.0 NEXT STEPS

Upon approval of this report by the District, CVE will prepare a contract modification for detailed design of this project to complete the construction plans.

The project schedule indicates the feasibility study being completed in June 2024, which is on schedule. Stage 1 design plans are expected in December of 2024, Stage 2 design plans are expected in July of 2025, Stage 3 design plans are expected in November of 2025, and final plans in September of 2026.

Appendix A

Design Criteria

	BUT-75-05.22 PID 117275 - US 27/SR 4 DESIGN CRITERIA						
	ITEM	REMARKS	REF SECTION	US 27 (Millville Oxford Road)		SR 4 (Germantown Road)	
				PREFERRED	PROPOSED	PREFERRED	PROPOSED
DESIGN DESIGNATION	Design Functional Classification, FC		L&D Vol. 1 101	03 Principal Arterial Other (Rural)		03 Principal Arterial Other (Urban)	
	Design Speed (mph)		L&D Vol. 1 104	50		45	
	Legal Speed (mph)		L&D Vol. 1 104	45		45	
	Managing Agency			ODOT		ODOT	
	Location			Hanover Township		Madison Township	
	Number of Lanes			2 thru and a center turn lane		2 thru and a center turn lane	
	National Highway System (NHS) Project		ODOT Roadway Inventory	Yes		Yes	
	Federal Aid Primary (FAP) Route		ODOT Roadway Inventory	Yes		Yes	
	Current ADT (2027)		ODOT TFMS Tool	7600		11550	
	Design ADT (2047)		ODOT TFMS Tool	7600		13000	
	Design Hourly Volume (2047)		ODOT TFMS Tool	1000		1600	
	Directional Distribution, D		ODOT TFMS Tool	52.6%		53.7%	
	Trucks, T24 (24 Hour B&C)		ODOT TFMS Tool	4%		4%	
SIGHT DISTANCES	Stopping Sight Distance, SSD (ft)		L&D Vol. 1 201-1	425'	425'	360'	360'
	Minimum Passing Sight Distance, PSD (ft)		L&D Vol. 1 201-3	800'	800'	700'	700'
	Intersection Sight Distance - Passenger Car (Left) (ft)		L&D Vol. 1 201-5	555'	555'	500'	500'
	Intersection Sight Distance - Passenger Car (Right) (ft)		L&D Vol. 1 201-5	480'	480'	430'	430'
	Decision Sight Distance, DSD, stop (ft)	Rural Stop (A) and Urban Stop (B)	L&D Vol. 1 201-6	465' (A)	465' (A)	800' (B)	800' (B)
	Decision Sight Distance, DSD, change (ft)	Speed/Path/Direction Change (Rural C, Urban E)	L&D Vol. 1 201-6	750' (C)	750' (C)	930' (E)	930' (E)
HORIZONTAL DESIGN	Max. CL Deflection w/out Horizontal Curve		L&D Vol. 1 202-1	1° 05'	1° 05'	1° 40'	1° 40'
	Max. Degree of Curve		L&D Vol. 1 202-2	7° 30'	7° 30'	8° 00'	8° 00'
	Max. Degree of Curve w/out Superelevation		L&D Vol. 1 202-3	0° 45'	0° 45'	5° 40'	5° 40'
	Max. Superelevation Rate		L&D Vol. 1 202-7 to 202-10	0.080 ft/ft	0.080 ft/ft	0.039 ft/ft	0.039 ft/ft
	Max. Degree of Curve w/out Spiral		L&D Vol. 1 202-11	4° 30'	4° 30'	N/A	N/A
VERTICAL DESIGN	Terrain		L&D Vol. 1 103.2	Level		Level	
	Maximum Grade		L&D Vol. 1 203-1	4%	4%	6%	6%
	Minimum Grade		L&D Vol. 1 203.2.2	0.5% with Curb, 0.3% without Curb	0.5% with Curb, 0.3% without Curb	0.5% with Curb, 0.3% without Curb	0.5% with Curb, 0.3% without Curb
	Max. Grade Break w/out Vertical Curve		L&D Vol. 1 203-2	0.45%	0.45%	0.55%	0.55%
	Minimum "K" value for crest vertical curve		L&D Vol. 1 203-3	84	84	61	61
	Minimum Sight Stopping Distance (SSD) for crest vertical curve		L&D Vol. 1 203-3	425'	425'	360'	360'
	Minimum "K" value for sag vertical curve		L&D Vol. 1 203-6	96	96	79	79
	Minimum Sight Stopping Distance (SSD) for sag vertical curve		L&D Vol. 1 203-6	425'	425'	360'	360'
	Minimum length of vertical curve (ft)		L&D Vol. 1 203.3.3 & 203.3.4	150'	150'	135'	135'
	Minimum Vertical Clearance Over Roadway (ft)		L&D Vol. 1 302-1 to 302-3	14'	14'	14'	14'

	BUT-75-05.22 PID 117275 - US 27/SR 4 DESIGN CRITERIA						
	ITEM	REMARKS	REF SECTION	US 27 (Millville Oxford Road)		SR 4 (Germantown Road)	
				PREFERRED	PROPOSED	PREFERRED	PROPOSED
CROSS SECTION DESIGN	Minimum Lane Width (ft)		L&D Vol. 1 301-2 & 301-4	12	12'	12	12
	Treated Shoulder Width (Left) (ft)		L&D Vol. 1 301-3 & 301-4	8'	8'	1'-2' Paved	1'-2' Paved
	Treated Shoulder Width (Right) (ft)		L&D Vol. 1 301-3 & 301-4	8'	8'	1'-2' Paved	1'-2' Paved
	Curbed Shoulder Width (ft)		L&D Vol. 1 301-4	8'	8'	1'-2' Paved	1'-2' Paved
	Lateral Clearance Under Bridge		L&D Vol. 1 302-3	13'	Match existing	13'	Match existing
	Normal Cross Slope		L&D Vol. 1 301.1.5	0.016	0.016	0.016	0.016
	Pavement Transition Taper Rates		L&D Vol. 1 301.1.4	L=WS	L=WS	L=WS^2/60	L=WS^2/60
	Shoulder Transition Taper Rates		L&D Vol. 1 301.2.3.2	Decrease: 25:1 Increase: 5:1	Decrease: 25:1 Increase: 5:1	Decrease: 25:1 Increase: 5:1	Decrease: 25:1 Increase: 5:1
	Slope Treatment Adjacent to Curbed Streets		L&D Vol. 1 307-6	4% Minimum 8% Maximum	4% Minimum 8% Maximum	4% Minimum 8% Maximum	4% Minimum 8% Maximum
	Guardrail Offset (ft)		L&D Vol. 1 301-3	10'	10'	10'	10'
	Barrier Offset (ft)		L&D Vol. 1 301-3	13' (Total Graded Width may be reduced as much as 3' where MGS Guardrail with longer posts is used)	13' (Total Graded Width may be reduced as much as 3' where MGS Guardrail with longer posts is used)	13' (Total Graded Width may be reduced as much as 3' where MGS Guardrail with longer posts is used)	13' (Total Graded Width may be reduced as much as 3' where MGS Guardrail with longer posts is used)
	Grading Type		L&D Vol. 1 307.2.1	Clear Zone	Clear Zone	Clear Zone	Clear Zone
	Clear Zone (ft)	Foreslope 6:1 or Flatter	L&D Vol. 1 600-1	19	19	19	19
	Clear Zone (ft)	Foreslope 6:1 to 4:1	L&D Vol. 1 600-1	26	26	26	26
	Clear Zone (ft)	Backslope 6:1 or Flatter	L&D Vol. 1 600-1	21	21	21	21
	Clear Zone (ft)	Backslope 6:1 to 4:1	L&D Vol. 1 600-1	19	19	19	19
	Clear Zone (ft)	Backslope Steeper than 4:1	L&D Vol. 1 600-1	15	15	15	15
	Sidewalk Installations		MDG 2.5.1.1	N/A	N/A	Both sides	Both sides
	Walk Width (ft)		MDG 4.3.2	N/A	N/A	6'-8'	6'
	Walk Cross Slope		MDG 3.6.4	N/A	N/A	1.56%	1.56%
	Treelawn Width (ft)		MDG 4.3.2	N/A	N/A	2'-6'	0'

Design Manual Abbreviations:
MDG - Multimodal Design Guide
L&D Vol. 1 - Location and Design Manual, Volume 1
TFMS - Traffic Forecasting Management System

Will be difficult to achieve on the north west end of the project limits.

Appendix B

BUT-4 Drainage Area Map, Conduit Inventory and Calculations

BUT IR 75/VAR 5.22/VAR

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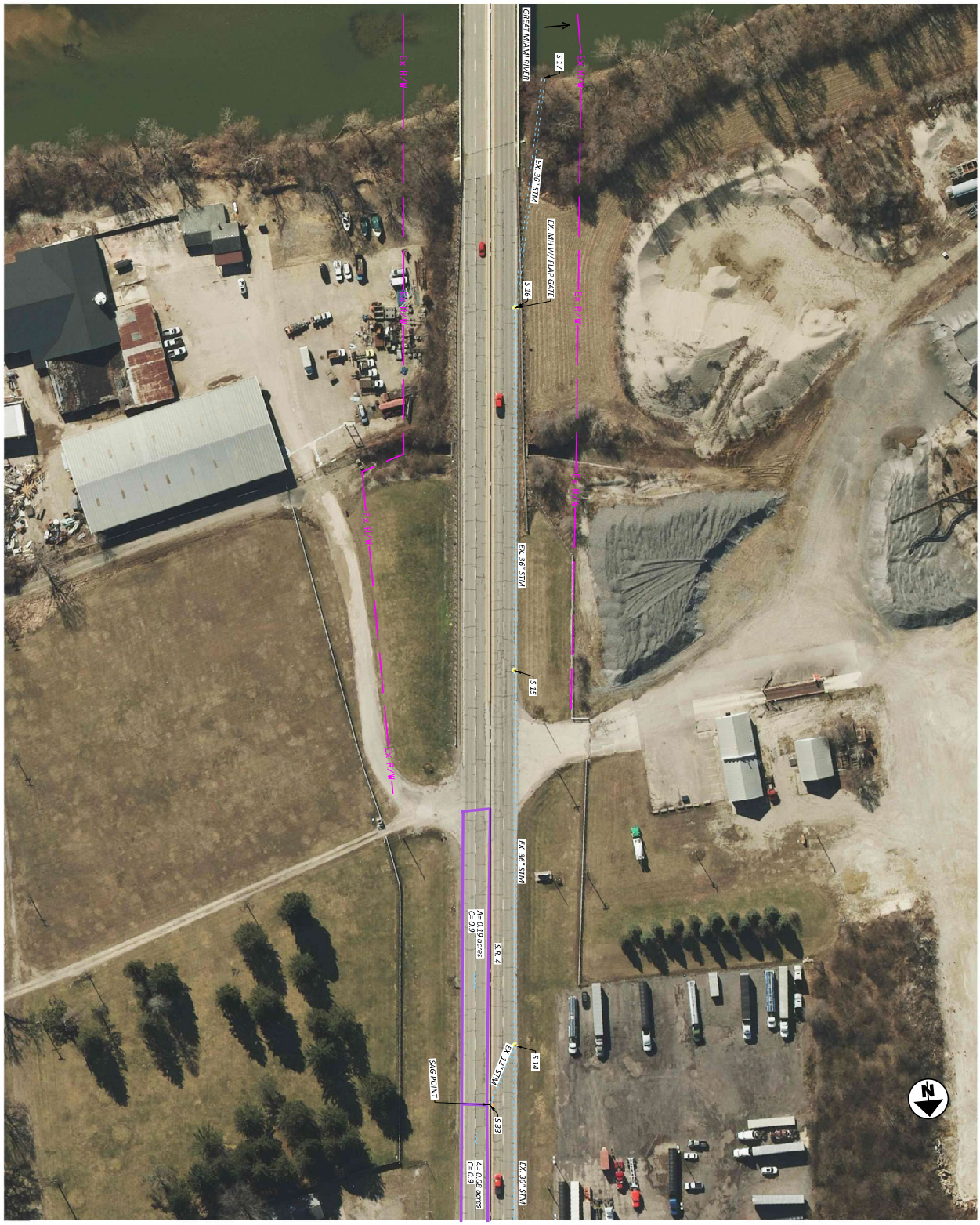

DRAINAGE AREA MAP
BUT-4 - SHEET 1

HORIZONTAL SCALE IN FEET
0 50
25 100

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: SAF
SIGNATURE:
DATE: CVP 04-25-2024
PROJECT ID: 117275
SHEET: P.1 | TOTAL: 5

BUT IR 75/VAR 5.22/VAR

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DRAINAGE AREA MAP
BUT-4 - SHEET 2

HORIZONTAL SCALE IN FEET
0 50
25 100

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: SAF
SIGNATURE: CVP 04-25-2024
PROJECT ID: 117275
SHEET: P.2 | TOTAL: 5

BUT IR 75/VAR 5.22/VAR

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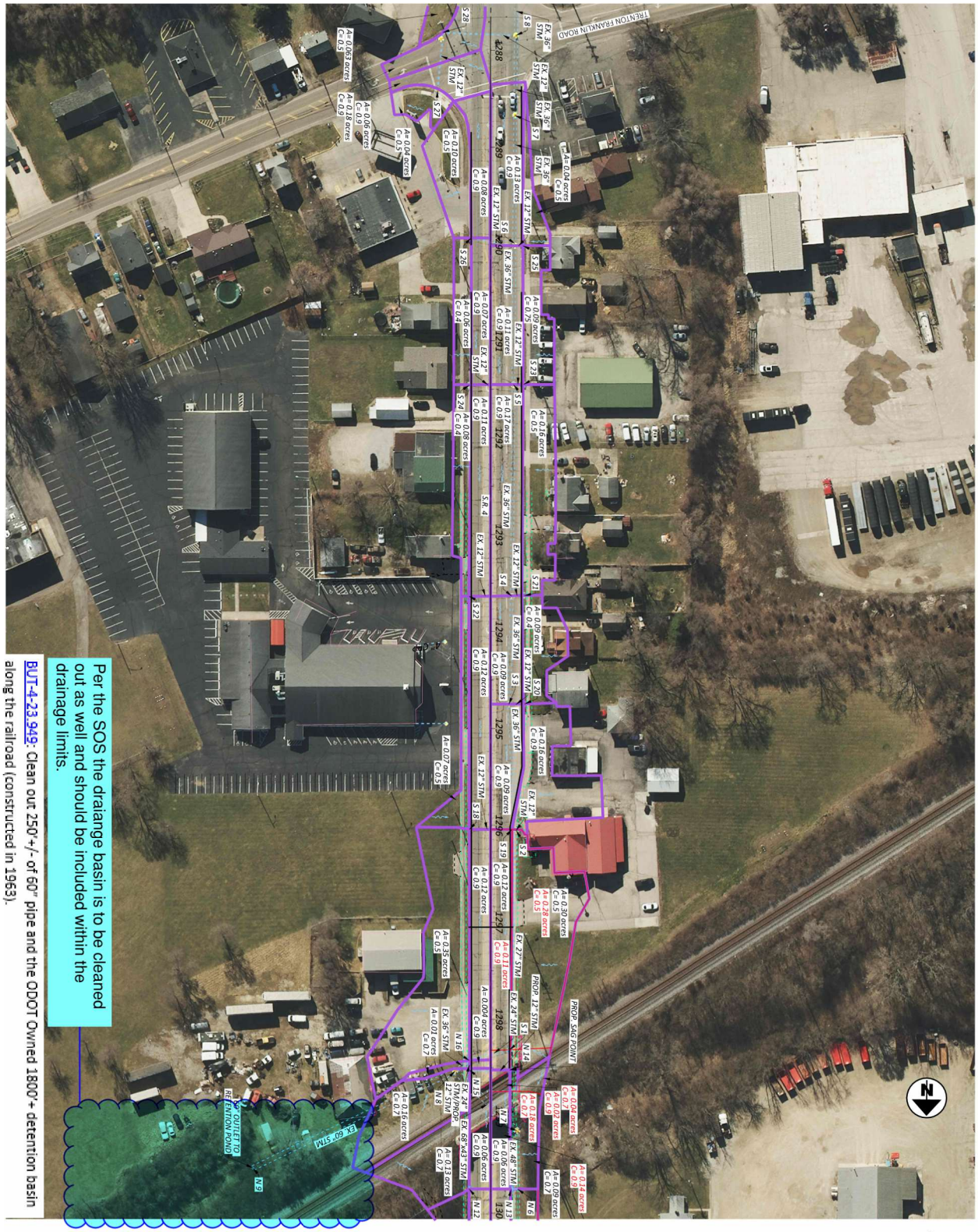

DRAINAGE AREA MAP
BUT-4 - SHEET 3

HORIZONTAL SCALE IN FEET
0 50
25 100

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: SAF
SUBMITTED: CVP 04-25-2024
PROJECT ID: 117275
SHEET: P.3 | TOTAL: 5

BUT IR 75/VAR 5.22/VAR

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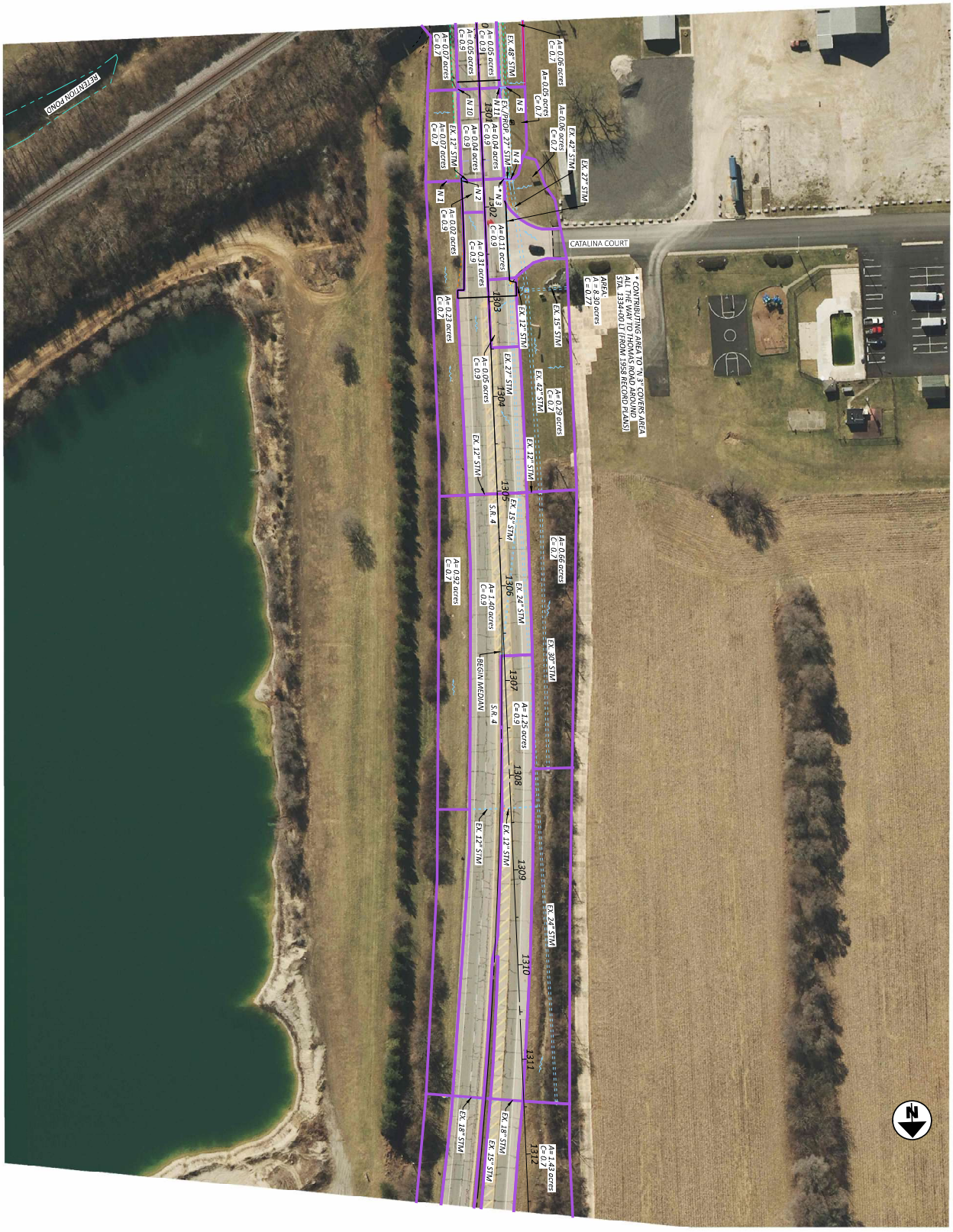

DRAINAGE AREA MAP
BUT-4 - SHEET 4

HORIZONTAL SCALE IN FEET
0 50
25 100

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: SAF
SUBMITTED: CVWP 04-25-2024
PROJECT ID: 117275
SHEET: P.4 | TOTAL: 5

BUT IR 75/VAR 5.22/VAR

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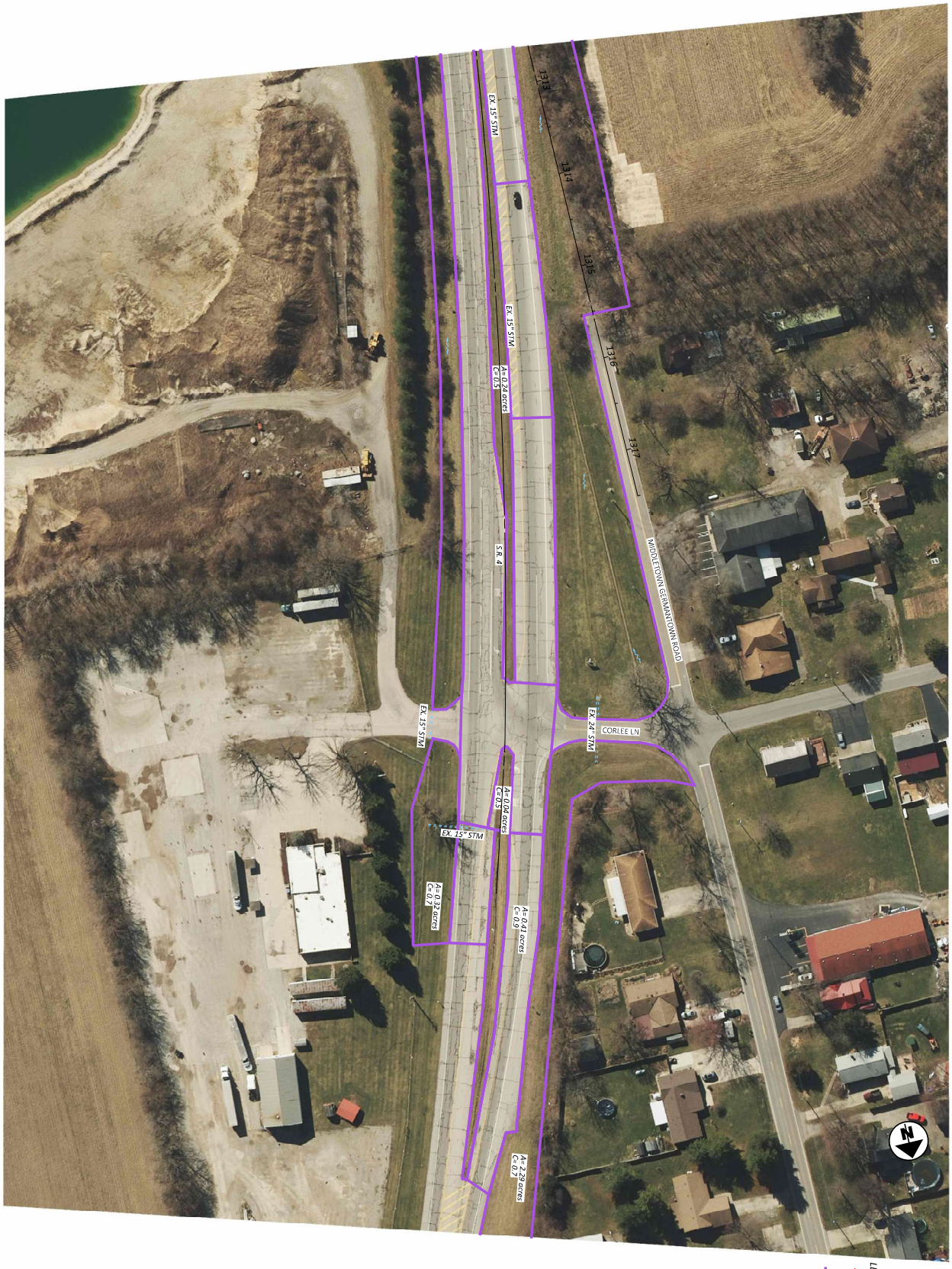

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: SAF
SURVEYOR:
PROJECT ID: 117275
SHEET: P.5 | TOTAL: 5

DRAINAGE AREA MAP
BUT-4 - SHEET 5

HORIZONTAL SCALE IN FEET
0 50
25 100

INLET SPACING DESIGN

PID : 117275 **Date :** 04/25/2024 **Project :** BUT IR 75/VAR/5.22/VAR **Location :** SR-4

Description : Existing BUT-04 East Inlet Spacing **Designer :** SAF

Rainfall Area: C **Storm Frequency (yr.) :** 5 **Total Allow. Spread (ft.) :** 6.00 * **Allowable Depth (ft.)** 0.42

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
1301+71	Begin																		
1298+53	CB-3	318.00	0.75	0.60	10.00	4.36	14.36	0.0043	0.0160	0.0160	0.00	0.0000	4.09	******	******	1.84	0.191	11.92	Sag **
1288+43	Begin																		
1289+94	CB-3	151.00	0.68	0.18	10.00	2.47	12.47	0.0032	0.0830	0.0160	2.00	0.1670	4.38	0.54	0.00	0.54	0.225	5.71	
1291+45	CB-3	151.00	0.67	0.13	10.00	2.51	12.51	0.0032	0.0830	0.0160	2.00	0.1670	4.37	0.38	0.00	0.38	0.203	4.32	
1293+63	CB-3	218.00	0.69	0.19	10.00	3.51	13.51	0.0033	0.0830	0.0160	2.00	0.1670	4.21	0.55	0.00	0.55	0.226	5.77	
1296+05	CB-3	242.00	0.75	0.19	10.00	4.13	14.13	0.0029	0.0830	0.0160	2.00	0.1670	4.12	0.59	0.00	0.59	0.235	6.29	***
1298+43	CB-3	238.00	0.60	0.47	10.00	2.72	12.72	0.0060	0.0830	0.0160	2.00	0.1670	4.34	1.22	0.00	1.22	0.260	7.86	***
1298+53	CB-3	10.00	0.76	0.01	10.00	0.20	10.20	0.0060	0.0830	0.0160	2.00	0.1670	4.78	******	******	0.05	0.086	1.04	End

SUMP DATA

Total Flow (cfs) : 1.89 **Ponded Depth (ft.) :** 0.154 **Spread on Pavement (ft.) :** 2.83

*2 ft was added to spread limit since a 14' lane is proposed
**Existing conditions violate spread within reconstruction limits
***Existing conditions violate spread within resurfacing limits

INLET SPACING DESIGN

PID : 117275 **Date :** 04/25/2024 **Project :** BUT IR 75/VAR/5.22/VAR **Location :** SR-4

Description :BUT-04 East Inlet Spacing **Designer :** SAF

Rainfall Area: C **Storm Frequency (yr.) :** 5 **Total Allow. Spread (ft.) :** 6.00* **Allowable Depth (ft.)** 0.42

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
1302+05	Begin																		
1301+71	CB-3	31.00	0.90	0.02	10.00	0.92	10.92	0.0043	0.0160	0.0160	0.00	0.0000	4.64	0.08	0.00	0.08	0.060	3.74	
1299+75	CB-3	96.00	0.78	0.12	10.00	1.90	11.90	0.0043	0.0160	0.0160	0.00	0.0000	4.47	0.35	0.06	0.42	0.109	6.83	**
1300+75	CB-3	100.00	0.77	0.11	10.00	1.96	11.96	0.0043	0.0160	0.0160	0.00	0.0000	4.46	0.37	0.07	0.44	0.112	6.98	**
1298+53	CB-3	122.00	0.73	0.35	10.00	1.74	11.74	0.0043	0.0830	0.0160	1.38	0.1670	4.50	******	******	1.22	0.244	9.49	Sag **
1288+43	Begin																		
1289+94	CB-3	151.00	0.68	0.18	10.00	2.47	12.47	0.0032	0.0830	0.0160	2.00	0.1670	4.38	0.54	0.00	0.54	0.225	5.71	
1291+45	CB-3	151.00	0.67	0.13	10.00	2.51	12.51	0.0032	0.0830	0.0160	2.00	0.1670	4.37	0.38	0.00	0.38	0.203	4.32	
1293+63	CB-3	218.00	0.69	0.19	10.00	3.51	13.51	0.0033	0.0830	0.0160	2.00	0.1670	4.21	0.55	0.00	0.55	0.226	5.77	
1296+05	CB-3	242.00	0.75	0.19	10.00	4.13	14.13	0.0029	0.0830	0.0160	2.00	0.1670	4.12	0.59	0.00	0.59	0.235	6.29	***
1298+43	CB-3	238.00	0.60	0.47	10.00	2.72	12.72	0.0060	0.0830	0.0160	2.00	0.1670	4.34	1.22	0.00	1.22	0.260	7.86	****
1298+53	CB-3	10.00	0.76	0.01	10.00	0.20	10.20	0.0060	0.0830	0.0160	2.00	0.1670	4.78	******	******	0.05	0.086	1.04	End

wap these

SUMP DATA

Total Flow (cfs) : 1.27 **Ponded Depth (ft.) :** 0.110 **Spread on Pavement (ft.) :** 2.42

*2 ft was added to spread limit since a 14' lane is proposed

**We have added two new basins to help mitigate spread. However, we have not added flow to this area and it violates spread in the existing condition

***Note that the allowable spread is exceeded however these inlets fall outside of the reconstruction limits

****We have not added a new basin to help mitigate spread because we have not added flow to this area and it violates spread in the existing condition

INLET SPACING DESIGN

PID : 117275 **Date :** 04/25/2024 **Project :** BUT IR 75/VAR/5.22/VAR **Location :** SR-4

Description : Existing BUT-04 West Inlet Spacing **Designer :** SAF

Rainfall Area: C **Storm Frequency (yr.) :** 5 **Total Allow. Spread (ft.) :** 6.00 * **Allowable Depth (ft.)** 0.42

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
1301+71	Begin																		
1298+75	CB-3	296.00	0.79	0.32	10.00	4.70	14.70	0.0043	0.0160	0.0160	0.00	0.0000	4.04	0.69	0.33	1.02	0.153	9.55	**
1298+32	CB-3	43.00	0.77	0.06	10.00	0.61	10.68	0.0043	0.0830	0.0160	2.00	0.1670	4.69	******	******	0.55	0.217	5.20	Sag
1288+33	Begin																		
1290+00	CB-3	167.00	0.81	0.17	10.00	2.72	12.72	0.0032	0.0830	0.0160	2.00	0.1670	4.34	0.60	0.00	0.60	0.232	6.16	***
1291+45	CB-3	145.00	0.83	0.20	10.00	2.32	12.32	0.0032	0.0830	0.0160	2.00	0.1670	4.40	0.73	0.00	0.73	0.246	7.00	***
1293+63	CB-3	218.00	0.71	0.33	10.00	3.32	13.32	0.0033	0.0830	0.0160	2.00	0.1670	4.24	0.99	0.00	0.99	0.266	8.27	***
1294+75	CB-3A	112.00	0.65	0.18	10.00	1.87	11.87	0.0031	0.0830	0.0160	2.00	0.1670	4.48	0.52	0.00	0.52	0.225	5.68	
1296+05	CB-3	130.00	0.90	0.25	10.00	2.09	12.09	0.0029	0.0830	0.0160	2.00	0.1670	4.44	1.00	0.00	1.00	0.271	8.58	***
1298+32	CB-3	248.00	0.61	0.39	10.00	2.89	12.89	0.0060	0.0830	0.0160	2.00	0.1670	4.31	******	******	1.03	0.248	7.10	End **

SUMP DATA

Total Flow (cfs) : 1.57 **Ponded Depth (ft.) :** 0.132 **Spread on Pavement (ft.) :** 2.63

*2 ft was added to spread limit since a 14' lane is proposed
**Existing conditions violate spread within reconstruction limits
***Existing conditions violate spread within resurfacing limits

INLET SPACING DESIGN

PID : 117275 **Date :** 04/25/2024 **Project :** BUT IR 75/VAR/5.22/VAR **Location :** SR-4

Description :BUT-04 West Inlet Spacing **Designer :** SAF

Rainfall Area: C **Storm Frequency (yr.) :** 5 **Total Allow. Spread (ft.) :** 6.00 * **Allowable Depth (ft.)** 0.42

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
1301+71	Begin																		
1300+75	CB-3	96.00	0.79	0.09	10.00	2.04	12.04	0.0043	0.0160	0.0160	0.00	0.0000	4.45	0.28	0.03	0.32	0.098	6.15	**
1299+75	CB-3	100.00	0.79	0.11	10.00	1.98	11.98	0.0043	0.0160	0.0160	0.00	0.0000	4.46	0.36	0.07	0.42	0.110	6.85	**
1298+53	CB-3	122.00	0.78	0.15	10.00	2.23	12.23	0.0043	0.0160	0.0160	0.00	0.0000	4.42	******	******	0.58	0.124	7.74	Sag **
1288+33	Begin																		
1290+00	CB-3	167.00	0.81	0.17	10.00	2.72	12.72	0.0032	0.0830	0.0160	2.00	0.1670	4.34	0.60	0.00	0.60	0.232	6.16	***
1291+45	CB-3	145.00	0.83	0.20	10.00	2.32	12.32	0.0032	0.0830	0.0160	2.00	0.1670	4.40	0.73	0.00	0.73	0.246	7.00	***
1293+63	CB-3	218.00	0.71	0.33	10.00	3.32	13.32	0.0033	0.0830	0.0160	2.00	0.1670	4.24	0.99	0.00	0.99	0.266	8.27	***
1294+75	CB-3A	112.00	0.65	0.18	10.00	1.87	11.87	0.0031	0.0830	0.0160	2.00	0.1670	4.48	0.52	0.00	0.52	0.225	5.68	
1296+05	CB-3	130.00	0.90	0.25	10.00	2.09	12.09	0.0029	0.0830	0.0160	2.00	0.1670	4.44	1.00	0.00	1.00	0.271	8.58	***
1298+53	CB-3	248.00	0.61	0.42	10.00	2.87	12.87	0.0060	0.0830	0.0160	2.00	0.1670	4.31	******	******	1.10	0.253	7.42	End ****

SUMP DATA

Total Flow (cfs) : 1.69 **Ponded Depth (ft.) :** 0.140 **Spread on Pavement (ft.) :** 2.70

*2 ft was added to spread limit since a 14' lane is proposed
**We have added two new basins to help mitigate spread. However, we have not added flow to this area and it violates spread in the existing condition
***Note that the allowable spread is exceeded however these inlets fall outside of the reconstruction limits
****We have not added a new basin to help mitigate spread because we have not added flow to this area and it violates spread in the existing condition

STORM SEWER SYSTEM

PID : 117275 **Date :** 04/25/2024 **Project :** BUT IR 75/VAR/5.22/VAR **Location :** SR-4

Description : Existing BUT-04 North Storm Sewer **Designer :** SAF

Rainfall Area: C **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 50

Minimum Pipe Size : 0.00 **Tailwater Elevation (ft.):** 644.65

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(50 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(50 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
N1	N3	1301+71	0.56	0.46	15.00	4.47	5.49	2.0	2.5	12	61.0	0.0120	650.59	4.51	3.63	0.0066	651.46	652.27	0.81	0.68	CB 2-5
begin		1301+71	0.56	0.46									649.86				651.06	653.22			0.015
N3	N4	1301+71	8.30	6.37	15.23	4.44	5.49	30.3	37.5	27	7.0	0.0186	648.90	10.29	39.35	0.0195	651.06	653.22	2.16	2.07	MH 3
		1301+72	8.86	6.82									648.77				650.92	652.58			0.015
N4	N7	1301+72	1.17	0.85	15.24	4.44	5.36	34.1	41.1	48	257.0	0.0025	646.76	5.09	67.35	0.0011	649.35	652.58	3.23	1.82	CB 2-2B
		1299+15	10.03	7.67									646.11				649.07	652.64			0.015
N7	N8	1299+15	0.00	0.00	16.08	4.33	5.31	33.2	40.8	54 *	89.0	0.0019	645.64	4.55	80.12	0.0006	648.69	652.64	3.95	2.50	MH 1
		1298+53	10.03	7.67									645.47				648.64	655.37			0.015
N15	N16	1298+51	0.01	0.01	10.00	5.32	6.37	0.1	0.1	24	9.0	0.0533	647.70	2.42	48.71	0.0000	649.10	651.91	2.81	2.21	CB 3
begin		1298+42	10.04	7.69									647.22				649.10	651.80			0.015
S1	N16	1298+32	0.39	0.24	10.00	5.32	6.37	1.3	1.5	24	44.0	0.0009	647.26	1.50	6.36	0.0001	649.10	652.00	2.90	2.74	CB 3
begin		1298+42	10.43	7.92									647.22				649.10	651.80			0.015
N16	N8	1298+42	0.47	0.28	10.49	5.22	6.37	2.8	3.4	36	19.0	0.0095	647.49	4.14	60.52	0.0000	649.10	651.80	2.70	1.31	CB 3
		1298+53	10.90	8.21									647.31				649.10	655.37			0.015
N8	N9	1298+53	0.00	0.00	16.40	4.29	5.22	35.2	42.8	60	232.0	0.0039	645.55	5.95	151.23	0.0004	648.15	655.37	7.22	4.82	MH 1
final		1299+53	10.90	8.21									644.65				648.06	649.65			0.015

**54" pipe size was used as an equivalent size to represent the 68"x43" elliptical pipe since it has the same approximate cross sectional area

STORM SEWER SYSTEM

Why was one system analyzed with 50 and the other with 25?

PID : 117275 **Date :** 04/25/2024 **Project :** BUT IR 75/VAR/5.22/VAR **Location :** SR-4

Description : Proposed BUT-04 North Storm Sewer **Designer :** SAF

Rainfall Area: C **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 50

Minimum Pipe Size : 0.00 **Tailwater Elevation (ft.):** 644.65

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(50 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(50 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
N1	N2	1301+71	0.56	0.46	15.00	4.47	5.49	2.0	2.5	12	16.0	0.0119	650.59	4.49	3.62	0.0066	651.50	652.27	0.77	0.68	CB 2-5
begin		1301+71	0.56	0.46									650.40				651.39	653.39			0.015
N2	N3	1301+71	0.02	0.02	15.06	4.47	5.49	2.1	2.6	12	45.0	0.0120	650.40	4.55	3.64	0.0072	651.39	653.39	2.00	1.99	CB 3
		1301+71	0.58	0.48									649.86				651.07	653.22			0.015
N3	N4	1301+71	8.47	6.51	15.22	4.44	5.49	31.0	38.4	27	7.0	0.0186	648.90	10.32	39.35	0.0204	651.07	653.22	2.15	2.07	CB 3
		1301+72	9.05	6.98									648.77				650.93	652.58			0.015
N4	N5	1301+72	1.00	0.71	15.24	4.44	5.44	34.2	41.9	48	97.0	0.0026	646.76	5.13	67.99	0.0011	649.59	652.58	2.99	1.82	MH 3
		1300+75	10.05	7.69									646.51				649.48	653.28			0.015
N10	N11	1300+75	0.11	0.09	10.00	5.32	6.43	0.5	0.5	12	44.0	0.0100	650.00	2.81	3.32	0.0003	650.28	652.74	2.46	1.74	CB 3
begin		1300+75	10.16	7.78									649.56				650.23	652.89			0.015
N11	N5	1300+75	0.09	0.07	10.26	5.27	6.43	0.8	1.0	12	5.0	0.0100	649.56	3.32	3.32	0.0011	650.23	652.89	2.66	2.33	CB 3
		1300+75	10.25	7.85									649.51				650.22	650.51			0.015
N5	N6	1300+75	0.00	0.00	15.55	4.40	5.39	34.5	42.3	48	100.0	0.0025	646.51	5.08	66.96	0.0012	649.35	650.51	1.16	0.00	MH BC
		1299+75	10.25	7.85									646.26				649.23	653.06			0.015
N12	N13	1299+75	0.12	0.09	10.00	5.32	6.43	0.5	0.6	12	43.0	0.0100	649.74	2.89	3.32	0.0004	650.04	652.34	2.30	1.60	CB 3
begin		1299+75	10.37	7.94									649.31				649.99	652.44			0.015

BC = BLIND CONNECTION

STORM SEWER SYSTEM

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(50 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(50 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
N13	N6	1299+75	1299+75	0.11 10.48	0.09 8.03	10.25	5.27	6.43	1.0	1.2	12	5.0	0.0100	649.31 649.26	3.46	3.32	0.0014	649.99 649.99	652.44 650.26	2.45	2.13	CB 3 0.015
N6	N7	1299+75	1299+15	0.00 10.48	0.00 8.03	15.88	4.35	5.36	35.0	43.1	48	60.0	0.0025	646.26 646.11	5.10	66.96	0.0012	649.16 649.09	650.26 652.64	1.10	0.00	MH BC 0.015
N7	N8	1299+15	1298+53	0.00 10.48	0.00 8.03	16.08	4.33	5.31	34.8	42.7	54 *	89.0	0.0019	645.64 645.47	4.60	80.12	0.0006	648.72 648.66	652.64 655.37	3.92	2.50	MH 1 0.015
N14 begin	N15	1298+52	1298+52	0.35 10.83	0.28 8.30	10.00	5.32	6.45	1.5	1.8	12	43.0	0.0100	649.13 648.70	3.87	3.32	0.0033	649.67 649.48	652.18 651.95	2.51	2.05	CB 3 0.015
N15	N16	1298+52	1298+42	0.36 11.19	0.27 8.57	10.19	5.28	6.43	2.9	3.5	12	10.0	0.0450	648.70 648.25	8.04	7.05	0.0128	649.30 649.17	651.95 651.83	2.65	2.25	CB 3 0.015
N16	N8	1298+42	1298+53	0.47 11.66	0.28 8.86	10.21	5.28	6.43	4.4	5.3	36	19.0	0.0100	647.50 647.31	4.81	62.18	0.0001	649.17 649.17	651.83 655.37	2.66	1.33	CB 3 0.015
N8 final	N9	1298+53	1299+53	0.00 11.66	0.00 8.86	16.40	4.29	5.22	38.0	46.2	60	232.0	0.0039	645.55 644.65	6.08	151.23	0.0004	648.20 648.10	655.37 649.65	7.17	4.82	MH 1 0.015

BC = BLIND CONNECTION

*54" pipe size was used as an equivalent size to represent the 68"x43" elliptical pipe since it has the same approximate cross sectional area

STORM SEWER SYSTEM

PID : 117275 **Date :** 04/25/2024 **Project :** BUT IR 75/VAR/5.22/VAR **Location :** SR-4

Description : Existing BUT-04 South Storm Sewer **Designer :** SAF

Rainfall Area: C **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 0.00 **Tailwater Elevation (ft.):** 637.50

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
S1	S2	1298+32	0.00	0.00	10.00	5.32	5.84	0.0	0.0	27	227.0	0.0011	647.29	0.00	9.39	0.0000	648.28	652.02	3.74	2.48	MH 3
begin		1296+05	0.00										647.05				648.28	653.43			0.015
S2	S3	1296+05	0.44	0.37	10.00	5.32	5.84	2.0	2.1	36	131.0	0.0037	647.03	2.67	37.64	0.0000	648.28	653.43	5.15	3.40	MH 3
		1294+75	0.44	0.37									646.55				648.28	653.35			0.015
S3	S4	1294+75	0.18	0.12	10.82	5.16	5.71	2.5	2.8	36	112.0	0.0037	646.55	2.87	37.62	0.0000	647.90	653.35	5.45	3.80	MH 3
		1293+63	0.62	0.48									646.14				647.90	653.65			0.015
S4	S5	1293+63	0.52	0.36	11.47	5.04	5.49	4.3	4.7	36	219.0	0.0032	646.07	3.20	35.16	0.0001	647.22	653.65	6.43	4.58	MH 3
		1291+45	1.14	0.85									645.37				647.21	654.31			0.015
S5	S6*	1291+45	0.33	0.25	12.61	4.84	5.36	5.3	5.9	36	144.0	0.0023	645.36	3.03	29.77	0.0001	646.93	654.31	7.38	5.95	MH 3
		1290+02	1.47	1.10									645.03				646.91	657.63			0.015
S6*	S7*	1290+02	0.35	0.26	13.40	4.71	5.24	6.4	7.1	36	135.0	0.0023	645.03	3.19	29.80	0.0002	646.66	657.63	10.97	9.60	MH 3
		1288+67	1.82	1.36									644.72				646.64	658.06			0.015
S7*	S8*	1288+67	0.00	0.00	14.11	4.60	5.17	6.3	7.0	36	82.0	0.0023	644.72	3.18	29.93	0.0001	646.46	658.06	11.60	10.34	MH 3
		1287+85	1.82	1.36									644.53				646.45	658.28			0.015
S8*	S9*	1287+85	0.34	0.27	14.54	4.54	5.10	7.4	8.3	36	87.0	0.0023	644.53	3.32	29.81	0.0002	646.30	658.28	11.98	10.75	MH 2
		1286+98	2.16	1.63									644.33				646.28	656.65			0.015

*Rim and invert elevations are interpolated from multiple record plans to represent the general system.
Stations are CVE generated and not from record plans

STORM SEWER SYSTEM

JUNCTION From	JUNCTION To	STATION From	STATION To	ΔAREA	ΣAREA (acres)	ΔCA	ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	RAINFALL INTENSITY (25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	DISCHARGE (cfs.) (25 yrs.)	PIPE DIAM. (in.)	PIPE LENGTH (ft.)	PIPE SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
S9 *	S10 *	1286+98	1283+87	0.00	2.16	0.00	1.63	14.97	4.48	4.87	7.3	7.9	36	312.0	0.0023	644.33 643.61	3.31	29.87	0.0002	645.61 645.55	656.64 657.31	11.03	9.31	MH 2 0.015
S10 *	S11 *	1283+87	1280+70	0.72	2.88	0.44	2.06	16.55	4.27	4.67	8.8	9.6	36	317.0	0.0023	643.61 642.88	3.49	29.84	0.0003	644.96 644.87	657.31 656.60	12.35	10.70	MH 2 0.015
S11 *	S12 *	1280+70	1278+84	0.00	2.88	0.00	2.06	18.06	4.08	4.56	8.4	9.4	36	187.0	0.0023	642.88 642.45	3.44	29.82	0.0003	644.48 644.43	656.60 645.45	12.12	10.72	MH 2 0.015
S12 *	S13 *	1278+84	1277+13	0.15	3.03	0.14	2.20	18.97	3.98	4.48	8.8	9.8	36	173.0	0.0041	642.45 641.74	4.29	39.84	0.0003	643.79 643.74	645.45 655.71	1.66	0.00	MH BC 0.015
S13 *	S14 *	1277+13	1273+26	0.08	3.11	0.07	2.27	19.64	3.91	4.28	8.9	9.7	36	386.0	0.0026	641.73 640.74	3.63	31.49	0.0003	642.92 642.73	655.71 657.62	12.79	10.98	MH 2 0.015
S14 *	S15 *	1273+26	1269+41	0.27	3.38	0.24	2.51	21.41	3.73	4.11	9.4	10.3	36	385.0	0.0026	640.73 639.74	3.69	31.53	0.0003	641.96 641.75	657.62 660.31	15.66	13.89	MH 2 0.015
S15 *	S16 *	1269+41	1265+69	0.00	3.38	0.00	2.51	23.15	3.57	3.95	9.0	9.9	36	373.0	0.0028	639.73 638.70	3.74	32.68	0.0003	640.91 640.70	660.31 662.63	19.40	17.58	MH 2 0.015
S16 *	S17 *	1265+69	1263+32	0.00	3.38	0.00	2.51	24.81	3.43	3.86	8.6	9.7	36	238.0	0.0029	638.20 637.50	3.79	33.72	0.0003	639.56 639.49	662.63 640.50	23.07	21.43	MH 2 0.015
final																								

BC = BLIND CONNECTION (existing concrete collar)

*Rim and invert elevations are interpolated from multiple record plans to represent the general system.
Stations are CVE generated and not from record plans

I would like to see higher tailwater elevations for if the GMR is higher than the outlet. Does a certain tailwater cause ponding on the roadway?

STORM SEWER SYSTEM

PID : 117275 **Date :** 04/25/2024 **Project :** BUT IR 75/VAR/5.22/VAR **Location :** SR-4

Description : Existing BUT-04 South Storm Sewer **Designer :** SAF

Rainfall Area: C **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 0.00 **Tailwater Elevation (ft.):** 637.50

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
S1	S2	1298+32	0.00	0.00	10.00	5.32	5.11	0.0	0.0	12	227.0	0.0011	647.29	0.00	1.08	0.0000	648.04	652.02	3.98	3.73	MH 3
begin		1296+05	0.00										647.05				648.04	653.43			0.015
S2	S3	1296+05	0.44	0.37	10.00	5.32	5.11	2.0	1.9	12	131.0	0.0037	647.03	2.70	2.01	0.0037	648.04	653.43	5.39	5.40	MH 3
		1294+75	0.44	0.37									646.55				647.56	653.35			0.015
S3	S4	1294+75	0.18	0.12	10.81	5.16	5.11	2.5	2.5	15	112.0	0.0037	646.55	3.02	3.64	0.0020	647.56	653.35	5.79	5.55	MH 3
		1293+63	0.62	0.48									646.14				647.34	653.65			0.015
S4	S5	1293+63	0.52	0.36	11.43	5.05	5.11	4.3	4.3	18	219.0	0.0032	646.07	3.26	5.54	0.0023	647.34	653.65	6.31	6.08	MH 3
		1291+45	1.14	0.85									645.37				646.84	654.31			0.015
S5	S6 *	1291+45	0.33	0.25	12.55	4.85	5.11	5.3	5.6	21	144.0	0.0023	645.36	3.05	7.07	0.0017	646.84	654.31	7.47	7.20	MH 3
		1290+02	1.47	1.10									645.03				646.60	657.63			0.015
S6 *	S7 *	1290+02	0.35	0.26	13.33	4.72	5.11	6.4	7.0	21	135.0	0.0023	645.03	3.12	7.08	0.0026	646.60	657.63	11.03	10.85	MH 3
		1288+67	1.82	1.36									644.72				646.25	658.06			0.015
S7 *	S8 *	1288+67	0.00	0.00	14.06	4.61	5.11	6.3	7.0	21	82.0	0.0023	644.72	3.13	7.11	0.0026	646.25	658.06	11.81	11.59	MH 3
		1287+85	1.82	1.36									644.53				646.00	658.28			0.015
S8 *	S9 *	1287+85	0.34	0.27	14.49	4.55	5.11	7.4	8.3	24	87.0	0.0023	644.53	3.32	10.11	0.0018	646.00	658.28	12.28	11.75	MH 2
		1286+98	2.16	1.63									644.33				645.84	656.65			0.015

*Rim and invert elevations are interpolated from multiple record plans to represent the general system.
Stations are CVE generated and not from record plans

STORM SEWER SYSTEM

JUNCTION From	JUNCTION To	STATION From	STATION To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	RAINFALL INTENSITY (25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	DISCHARGE (cfs.) (25 yrs.)	PIPE DIAM. (in.)	PIPE LENGTH (ft.)	PIPE SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
S9 *	S10 *	1286+98	1283+87	0.00 2.16	0.00 1.63	14.93	4.48	4.56	7.3	7.4	24	312.0	0.0023	644.33 643.61	3.31	10.13	0.0014	645.69 645.25	656.64 657.31	10.95	10.31	MH 2 0.015
S10 *	S11 *	1283+87	1280+70	0.72 2.88	0.44 2.06	16.50	4.27	4.56	8.8	9.4	24	317.0	0.0023	643.61 642.88	3.41	10.12	0.0023	645.25 644.52	657.31 656.60	12.06	11.70	MH 2 0.015
S11 *	S12 *	1280+70	1278+84	0.00 2.88	0.00 2.06	18.05	4.08	4.56	8.4	9.4	24	187.0	0.0023	642.88 642.45	3.39	10.11	0.0023	644.52 644.00	656.60 644.45	12.08	11.72	MH 2 0.015
S12 *	S13 *	1278+84	1277+13	0.15 3.03	0.14 2.20	18.97	3.98	4.48	8.8	9.8	24	173.0	0.0041	642.45 641.74	4.32	13.51	0.0025	643.78 643.30	644.45 655.71	0.67	0.00	MH BC 0.015
S13 *	S14 *	1277+13	1273+26	0.08 3.11	0.07 2.27	19.64	3.91	3.95	8.9	9.0	24	386.0	0.0026	641.73 640.74	3.57	10.68	0.0021	643.22 642.37	655.71 657.62	12.49	11.98	MH 2 0.015
S14 *	S15 *	1273+26	1269+41	0.27 3.38	0.24 2.51	21.44	3.73	3.95	9.4	9.9	24	385.0	0.0026	640.73 639.74	3.60	10.69	0.0026	642.37 641.31	657.62 660.31	15.25	14.89	MH 2 0.015
S15 *	S16 *	1269+41	1265+69	0.00 3.38	0.00 2.51	23.22	3.57	3.95	9.0	9.9	24	373.0	0.0028	639.73 638.70	3.69	11.08	0.0026	641.31 640.26	660.31 662.63	19.00	18.58	MH 2 0.015
S16 *	S17 *	1265+69	1263+32	0.00 3.38	0.00 2.51	24.91	3.43	3.86	8.6	9.7	24	238.0	0.0029	638.20 637.50	3.77	11.44	0.0024	639.70 639.06	662.63 640.50	22.93	22.43	MH 2 0.015
final																						

BC = BLIND CONNECTION (existing concrete collar)

*Rim and invert elevations are interpolated from multiple record plans to represent the general system.
Stations are CVE generated and not from record plans

P:\23365 - ODOT - BUT-75-5.22\117275\400-Engineering\Drainage\EngData\BUT-4 Drainage Inventory

CRS	CFN or SFN	Inlet Station	Inlet Offset	Outlet Station	Outlet Offset	Side	Inlet Structure	Inlet Survey Point #	Outlet Structure	Outlet Survey Point #	Size (in)	Length	Pipe Material	GA	Inventory Comments	Inspection Comments	ODOT Scope Disposition	Profile Work
BUT-4-23.359	0900427	Outside survey limits (53+50 Original Plans)	Outside survey limits (59.25' RT Original Plans)	Outside survey limits (53+50 Original Plans)	Outside survey limits (59.25' LT Original Plans)	Both	Headwall	Not surveyed	Headwall	Not surveyed	144x 144	78.5	4 sided concrete box	6	N/A. This is a bridge.	N/A. This is a bridge.	No work	No work
N/A	N/A	Outside survey limits (60+25 Original Plans)	Outside survey limits (CL Original Plans)	Outside survey limits (59+62.40 Original Plans)	Outside survey limits (25' LT Original Plans)	LT	Catch Basin	Not surveyed	Manhole	Not surveyed	12	64	RCP	N/A	Median curb basin. Not in ODOT TIMS.	Not in ODOT TIMS.	No work	No work
BUT-4-23.543	1981381	Outside survey limits (62+75 Original Plans)	Outside survey limits (CL Original Plans)	Outside survey limits (63+49.00 Original Plans)	Outside survey limits (25.5' LT Original Plans)	LT	Catch Basin	Not surveyed	Manhole	Not surveyed	12	35	RCP	6	Median curb basin	Misaligned section with slight joint separation.	No work	No work
BUT-4-23.590	1981389	Outside survey limits (65+25.00 Original Plans)	Outside survey limits (CL Original Plans)	Outside survey limits (65+25.00 Original Plans)	Outside survey limits (43' LT Original Plans)	LT	Catch Basin	Not surveyed	Manhole in TIMS Collar in Original Plans	Not surveyed	12	30	RCP	6	Curb basin in the median.	Edge of curb basin broken off section misalignment with slight joint separation.	No work	No work
BUT-4-23.306	1981382	1296+04.00	22.11' LT	Outside survey limits (49+67.50 Original Plans)	Outside survey limits (55' LT Original Plans)	LT	Manhole	Not surveyed	Half Height Headwall	Not surveyed	36	3200	RCP	7	Culvert runs from manhole with cfn. 1981365 23.894 to the river. Passing thru several manholes in south bound curb lane.	Culvert has 770 ft. Of new plastic changes to concrete under Fairfield intersection. Water control gate stuck half open. Minor rocks randomly throughout.	Replace or remove gate. Determine the necessity of the gate and extent/frequency of flooding if it is removed.	No profile work, but CVE recommends removing gate and reconstructing a new gate.
BUT-4-23.796	1981367	Outside survey limits (1289+93.78 Original Plans)	Outside survey limits (21.08' RT Original Plans)	Outside survey limits (1290+02.34 Original Plans)	Outside survey limits (33.41' LT Original Plans)	Both	Catch Basin	Not surveyed	Catch Basin	Not surveyed	12	54	RCP	6	Runs across main line older concrete new plastic extension.	Section minor misalignment.	No work	No work
BUT-4-23.827	1981355	1291+44.99	34.14' LT	1291+45.72	21.96' RT	Both	Catch Basin	SV5003	Catch Basin	SV5004	12	50	RCP	5	Older concrete with newer plastic extension.	Culvert concrete section in middle of turn lane is rises up 3" no infiltration.	March 2024 Update: No work. Original: Replace section of bad pipe. Bridge Department to determine limits.	March 2024 Update: No work. Original: Replace pipe.

P:\23365 - ODOT - BUT-75-5.22\117275\400-Engineering\Drainage\EngData\BUT-4 Drainage Inventory

CRS	CFN or SFN	Inlet Station	Inlet Offset	Outlet Station	Outlet Offset	Side	Inlet Structure	Inlet Survey Point #	Outlet Structure	Outlet Survey Point #	Size (in)	Length	Pipe Material	GA	Inventory Comments	Inspection Comments	ODOT Scope Disposition	Profile Work
BUT-4-23.869	1981366	1293+62.50	33.98' LT	1293+63.34	21.94' LT	Both	Catch Basin	SV686	Catch Basin	SV774	12	50	RCP	6	Older concrete culvert with 2 extension of smooth plastic	Slight misalignment to the concrete sections.	No work	No work
BUT-4-23.888	1981354	1294+74.62	34.12' LT	1294+75.14	18.93' LT	LT	Catch Basin	SV851	Manhole	SV3074	12	13	Corrugated Plastic	8	Runs from curb to center of lane	Null	No work	No work
BUT-4-23.918	1981365	1296+04.09	21.94' RT	1296+04.00	22.11' LT	Both	Catch Basin	SV3247	Catch Basin	SV3252	12	38	RCP	6	Main line	Culvert is misaligned.	Clean pipe	Clean pipes
BUT-4-23.962	1981353	1298+28.47	19.97' LT	1296+05.31	26.27' LT	LT	Catch Basin	SV3725	Manhole	SV3253	24	220	RCP	7	Running along white line /side walk.	Outlets in the Manhole, in front of Firehouse in the sidewalk. Inlet CB at the curb/gutter.	Clean concrete pipe. Clean plastic pipe and remove wood debris clogging CB/Manhole.	Clean pipes
BUT-4-23.968	1981352	1298+31.58	19.86' LT	1298+42.23	22.79' RT	Both	Catch Basin	SV3724	Catch Basin	SV3642	24	42	RCP	6	Runs from catch basin across main line to catch basin.	Culvert is misaligned in the center left and right.	Replace catch basin. Clean pipes.	Replace catch basins. Clean pipes
BUT-4-23.969	1981351	1298+74.35	19.86' LT	1298+31.58	19.86' LT	LT	Catch Basin	SV3746	Catch Basin	SV3724	27	40	RCP	7	Runs along white line south bound under railroad.	1/3 full of sediment pavement around catch basin broken up.	Replace catch basin. Clean pipes.	Replace catch basins. Clean pipes
BUT-4-23.973	1981350	1299+14.96	27.16' LT	1298+53.42	36.86' RT	Both	Manhole	SV3802	Manhole	SV4768	68x43	84	RCP	7	Runs at angle under railroad bridge.	Unseal cracks across pavement on the edge of where culvert cross. About 1/3 full of sediment.	Clean out 250'+/- of 60" pipe and the ODOT Owned 1800'+ detention basin along the railroad (constructed in 1963).	Clean pipes
BUT-4-24.025	1981343	1301+70.71	38.71' RT	1301+71.18	22.48' LT	Both	Catch Basin	SV3992	Catch Basin	SV4019	12	62	RCP	7	Runs across main line in manhole then 5 feet into catch basin.	Runs across main line to manhole.	No work	No work
BUT-4-24.024	1981347	1302+82.04	23.58' LT	1301+71.12	22.34' LT	LT	Manhole	SV4046	Manhole	SV4019	30	104	RCP	7	Runs south lane shoulder manhole to manhole then 5' to right to catch basin into 48" culvert under side walk.	Under right shoulder	No work	No work
BUT-4-24.025	1981349	1301+71.91	28.73' LT	1299+14.90	27.13' LT	LT	Catch Basin	SV4018	Manhole	SV3802	48	245	RCP	7	Runs south from 42" culvert toward railroad bridge under side walk.	Runs south toward railroad bridge	Clean pipes	Clean pipes
BUT-4-24.043	1981348	1202+89.50	40.54' LT	1301+71.91	28.73' LT	LT	Catch Basin	SV4047	Catch Basin	SV4018	42	104	RCP	7	Runs south toward rail road bridge under side walk.	Some minor debris in the inlet catch basin.	No work	No work

Appendix C

BUT-4 Preliminary Plan and Profile Sheets

BUT IR 75/VAR 5.22/VAR

MODEL: CL_SR-04 - Sheet 1 14.0' Clear PAPERSIZE: 17x11 (in.) DATE: 5/1/2024 TIME: 10:43:06 AM USER: flis
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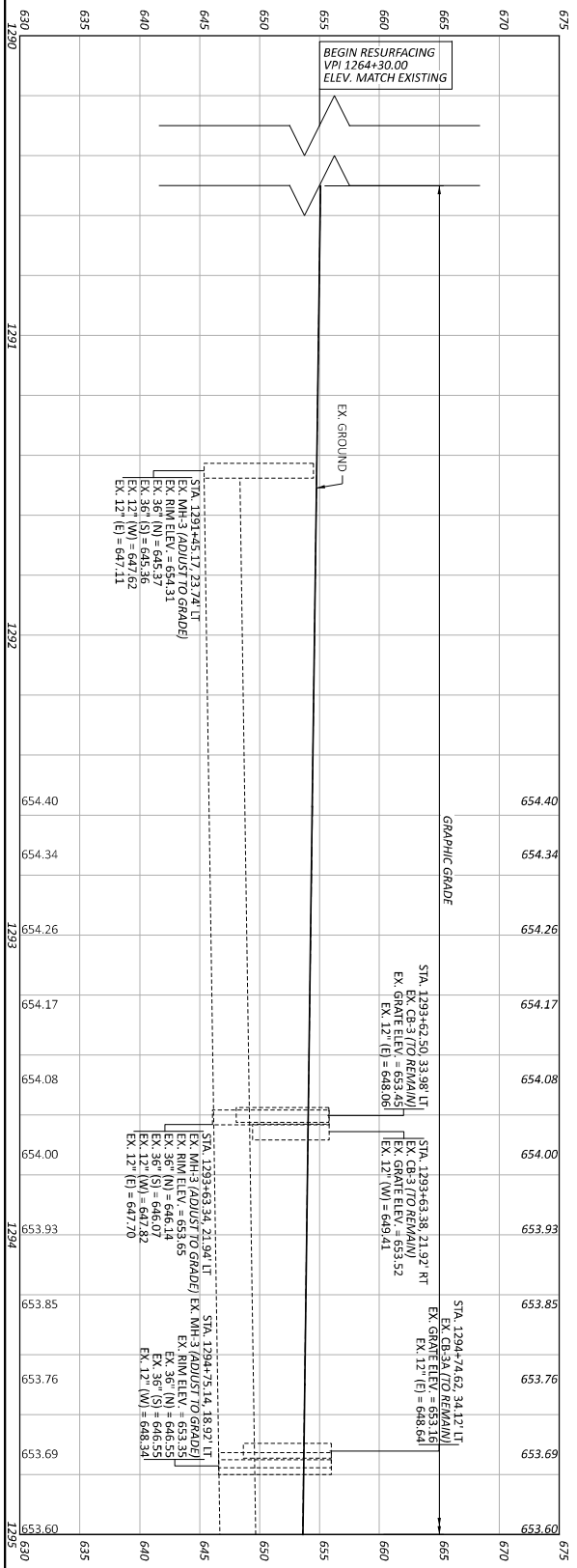

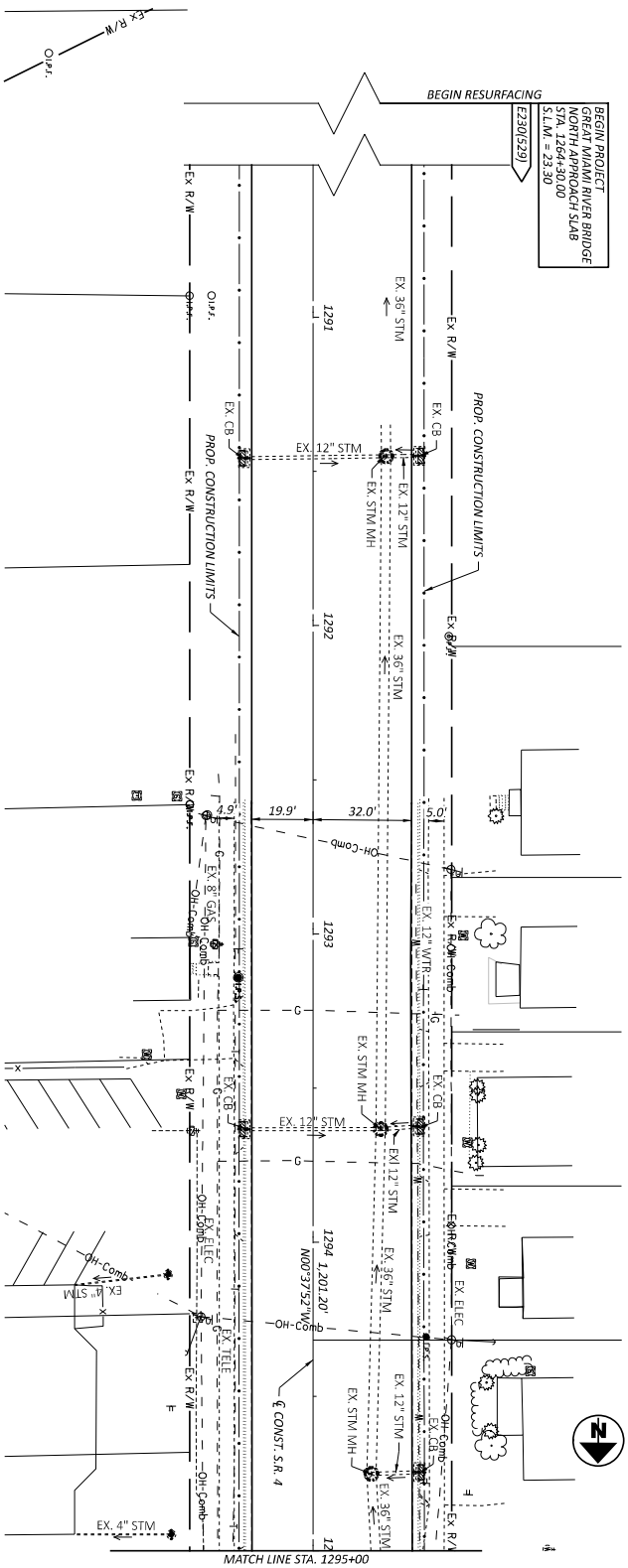

PLAN AND PROFILE - ALL VERTICAL CLEARANCE OPTIONS
S.R. 4 - BEGIN PROJECT TO STA. 1295+00.00

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: SAF
SUBMITTED: CVP 04-29-2024
PROJECT ID: 117275
SHEET: P.1 | TOTAL: 3

HORIZONTAL SCALE IN FEET
0 20
10 40

BUT IR 75/VAR/5.22/VAR

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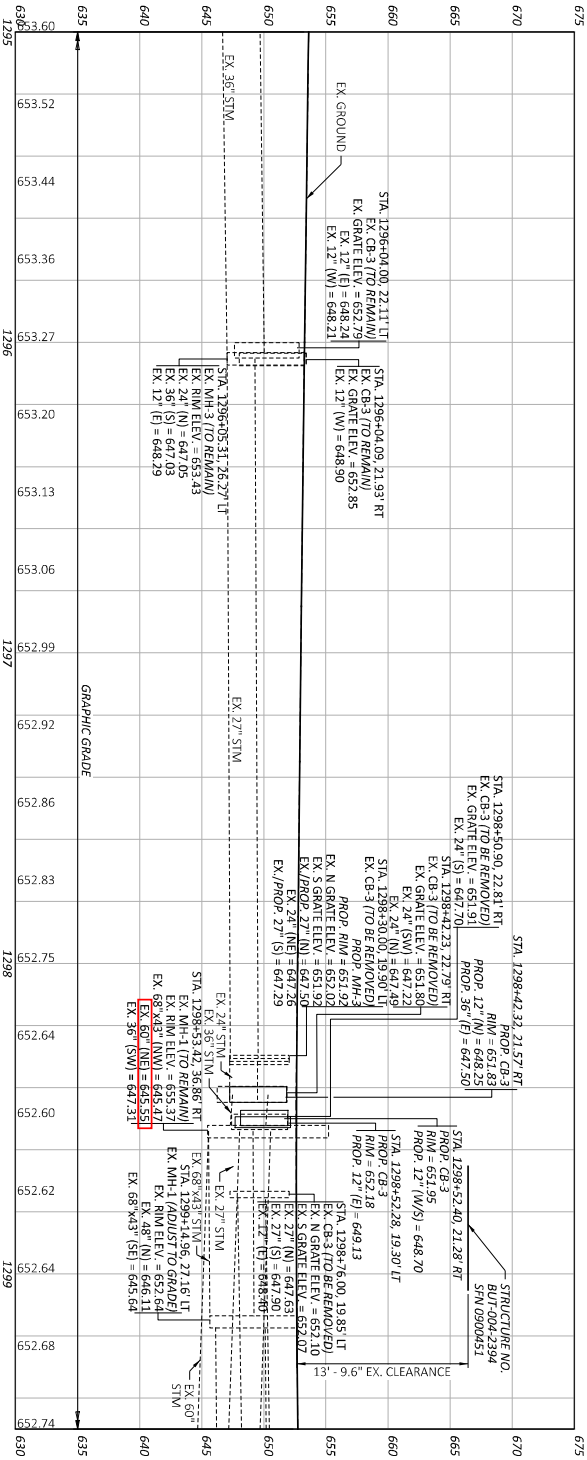

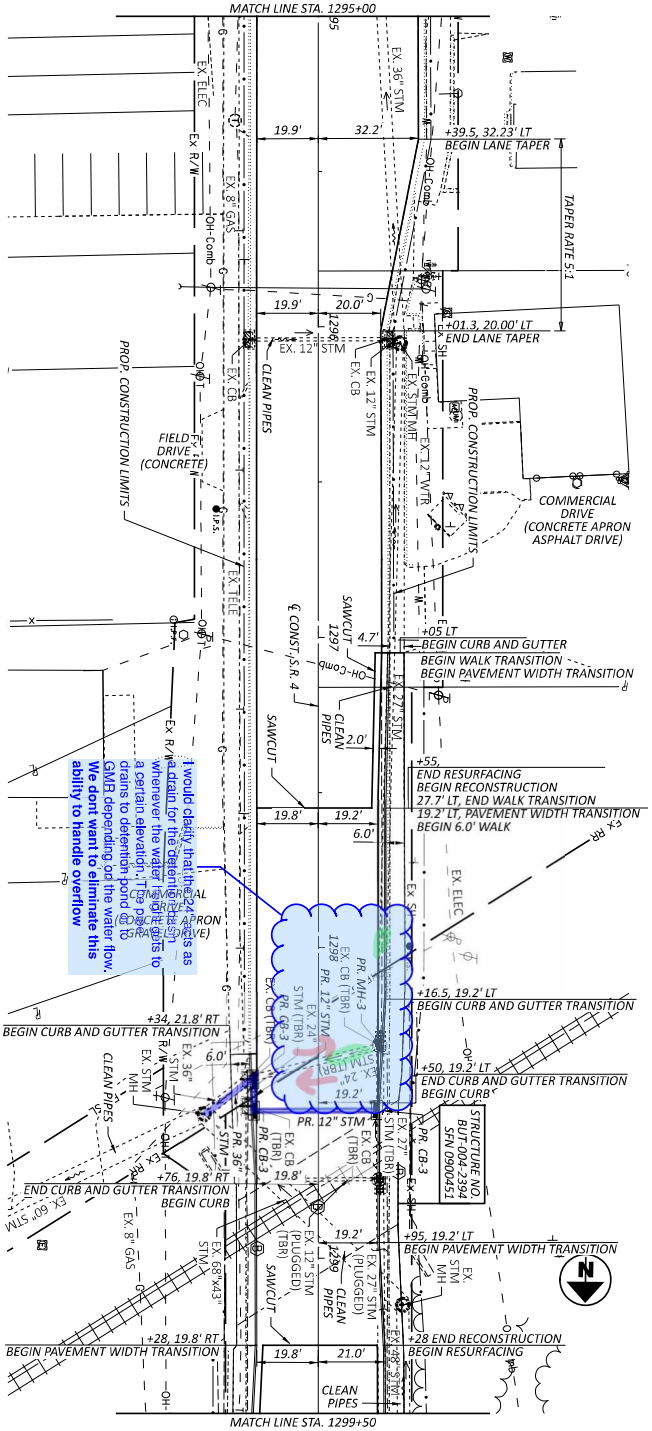

PLAN AND PROFILE - 13.8' VERTICAL CLEARANCE
S.R. 4 - BEGIN TO STA. 1299+50.00

HORIZONTAL SCALE IN FEET
0 20
10 40

SHEET	TOTAL
P.2	3

PROJECT ID: 117275
SUBMITTED: CVWP 04-29-2024
DESIGNED: SAF
DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING LTD.

BUT IR 75/VAR/5.22/VAR

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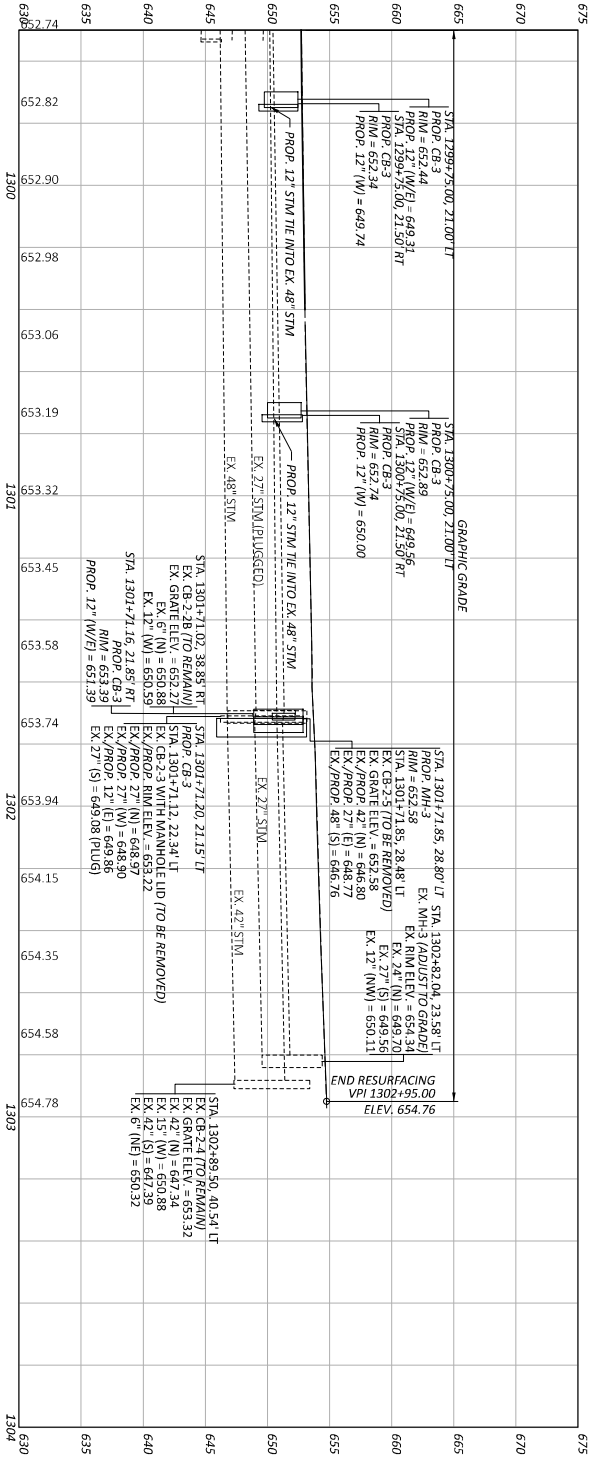

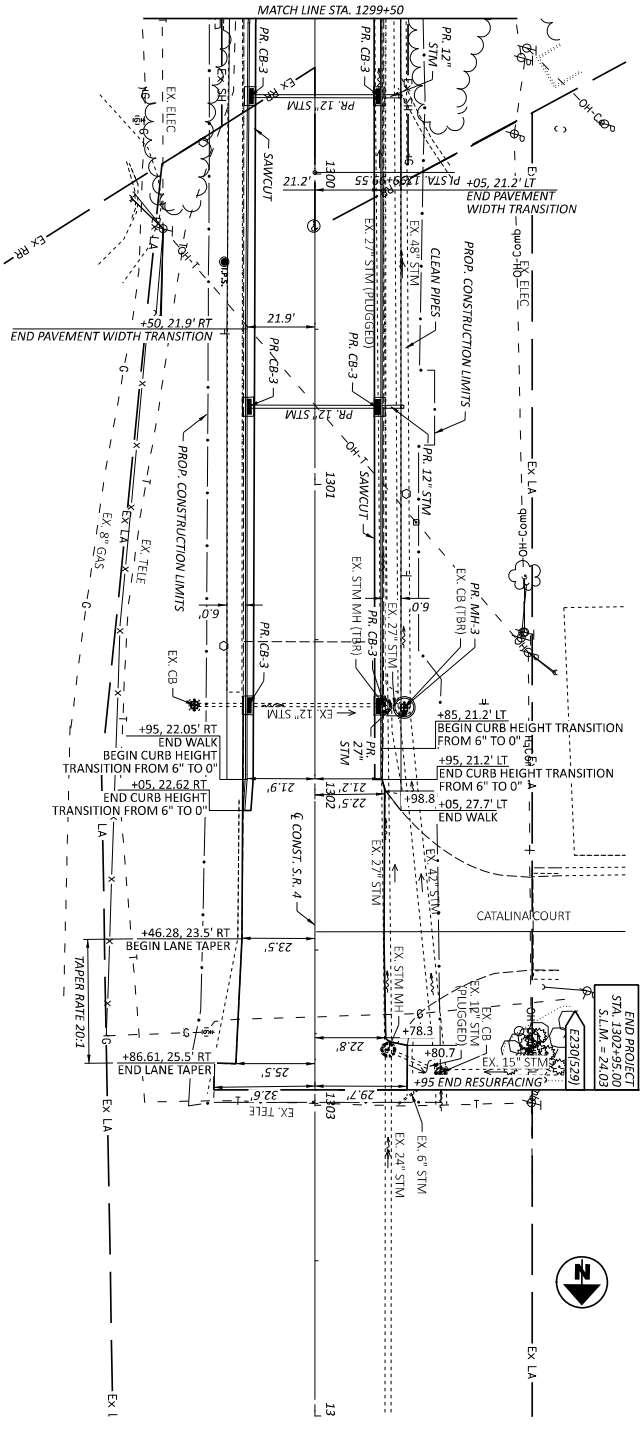

SHEET	TOTAL	PROJECT ID	REVISED	DESIGNER	DESIGN AGENCY
P.3	3	117275	CWP 04-29-2024	SAF	CHAGRIN VALLEY ENGINEERING, LTD.

PLAN AND PROFILE - 13.8' VERTICAL CLEARANCE
S.R. 4 - STA. 1299+50.00 TO END

HORIZONTAL SCALE IN FEET
0 20
10 40

BUT IR 75/VAR 5.22/VAR

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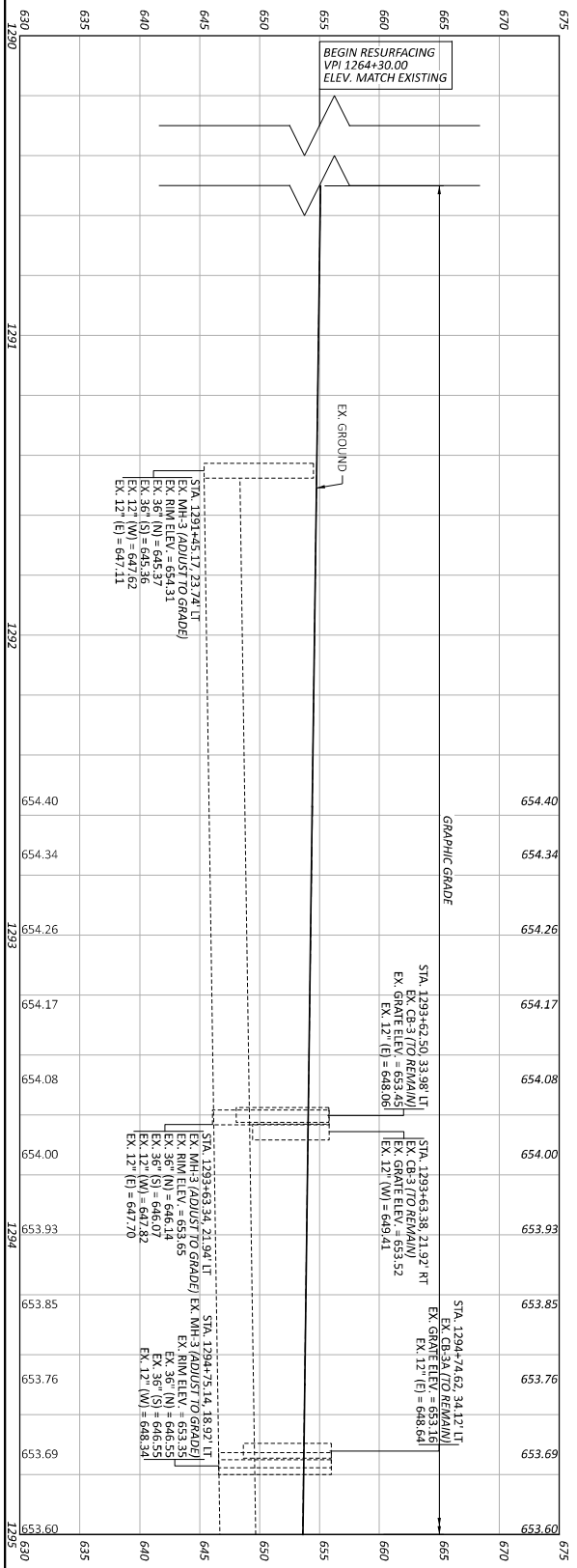
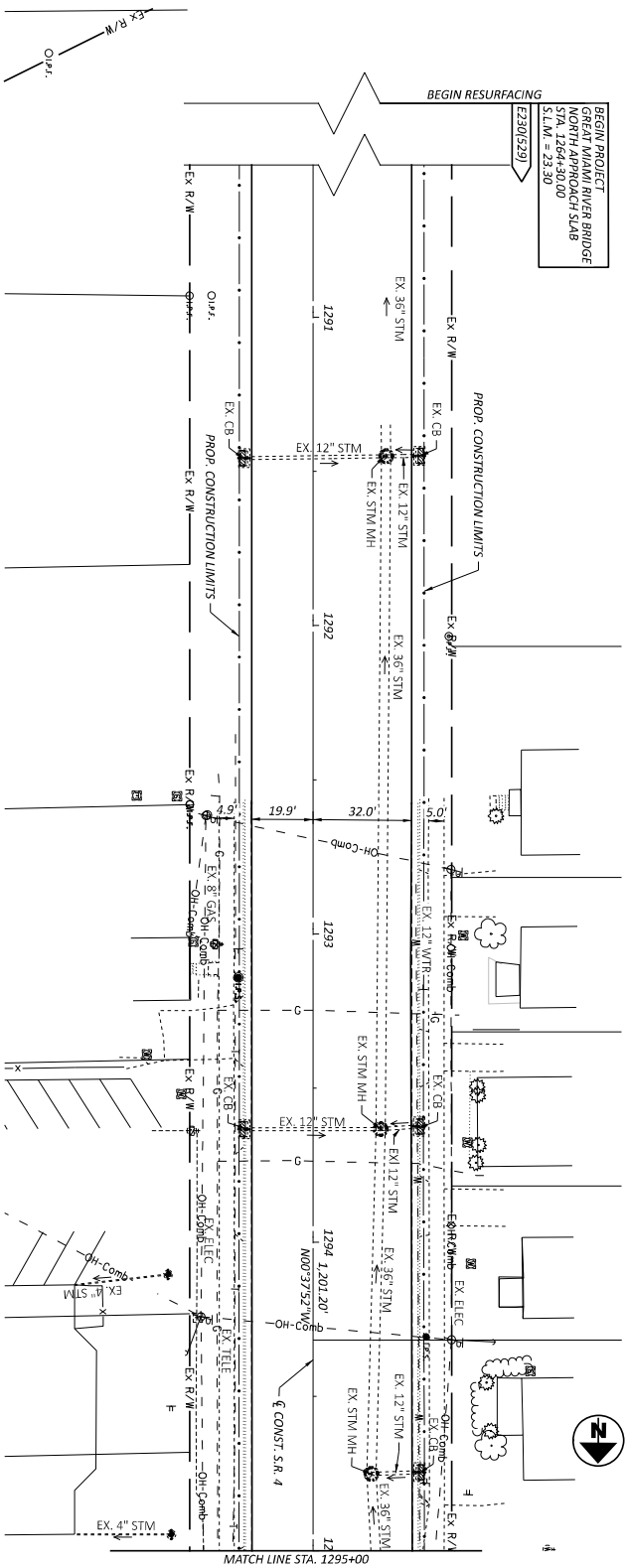
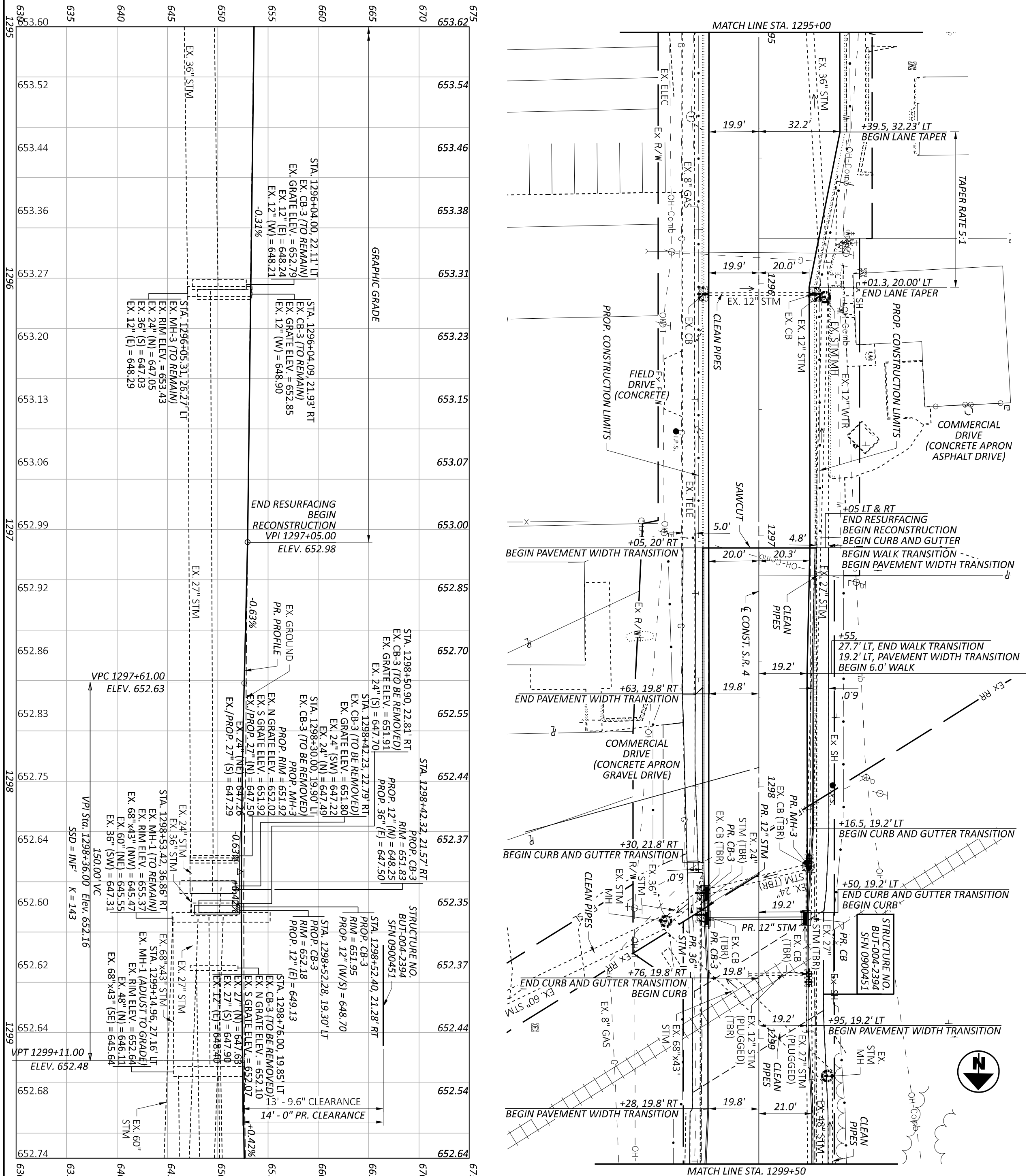




PLAN AND PROFILE - ALL VERTICAL CLEARANCE OPTIONS
S.R. 4 - BEGIN PROJECT TO STA. 1295+00.00

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: SAF
SUBMITTED: CVP 04-29-2024
PROJECT ID: 117275
SHEET: P.1 | TOTAL: 3

HORIZONTAL SCALE IN FEET
0 20
10 40



PLAN AND PROFILE - 14.0' VERTICAL CLEARANCE
S.R. 4 - STA. 1295+00.00 TO STA. 1299+50.00

HORIZONTAL SCALE IN FEET
0 10 20 40

BUT IR 75/VAR 5.22/VAR

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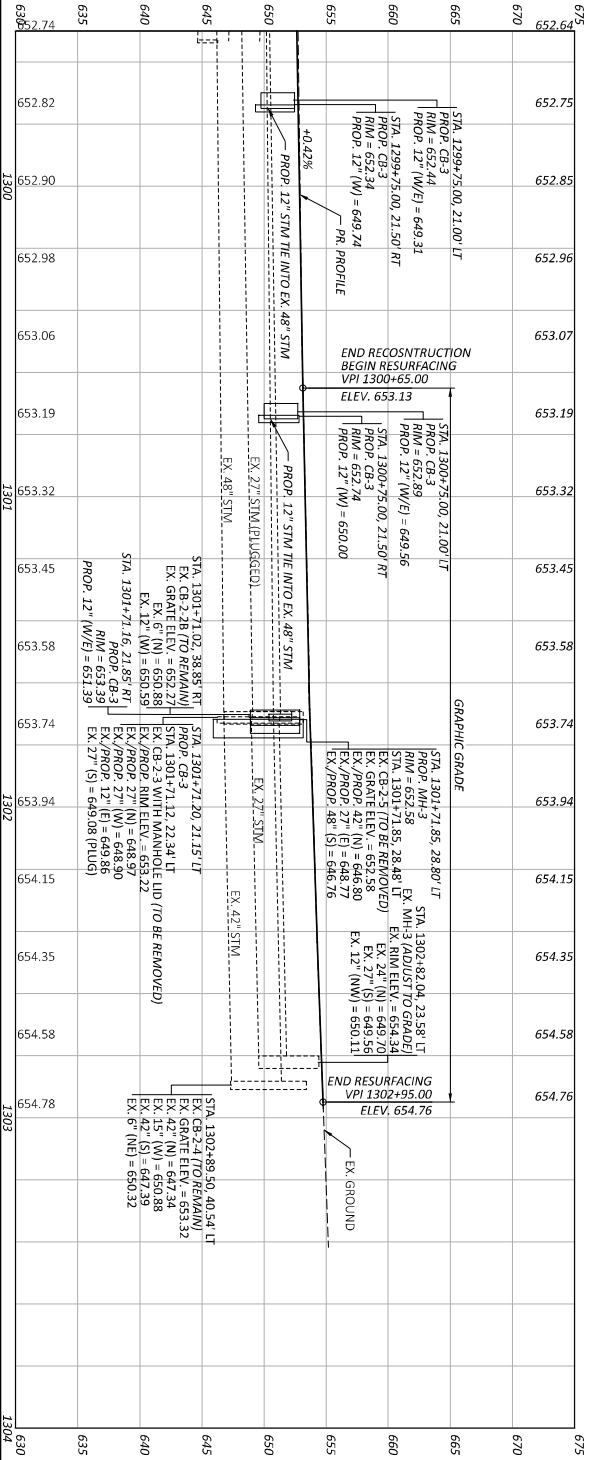

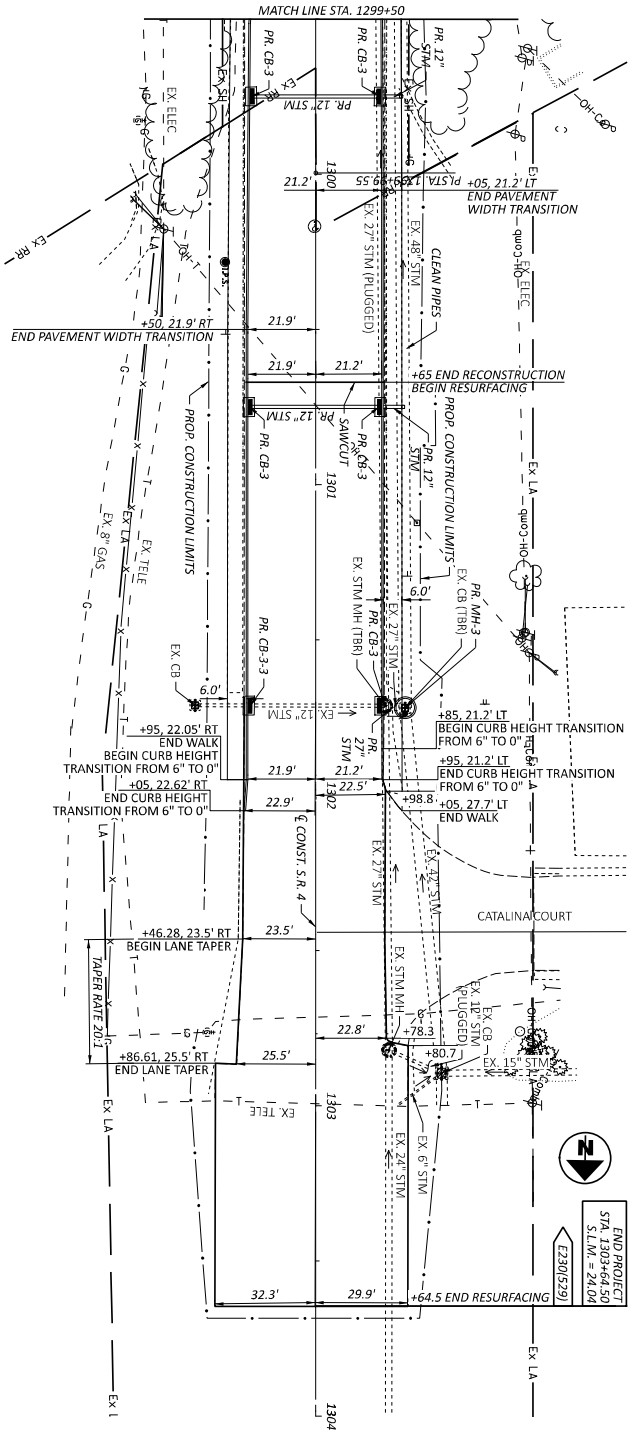

PLAN AND PROFILE - 14.0' VERTICAL CLEARANCE
S.R. 4 - STA. 1299+50.00 TO END PROJECT

HORIZONTAL SCALE IN FEET
0 20
10 40

SHEET	TOTAL
P.3	3

PROJECT ID: 117275
SUBMITTED: CWP 04-29-2024
DESIGNED: SAF
DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.

BUT IR 75/VAR 5.22/VAR

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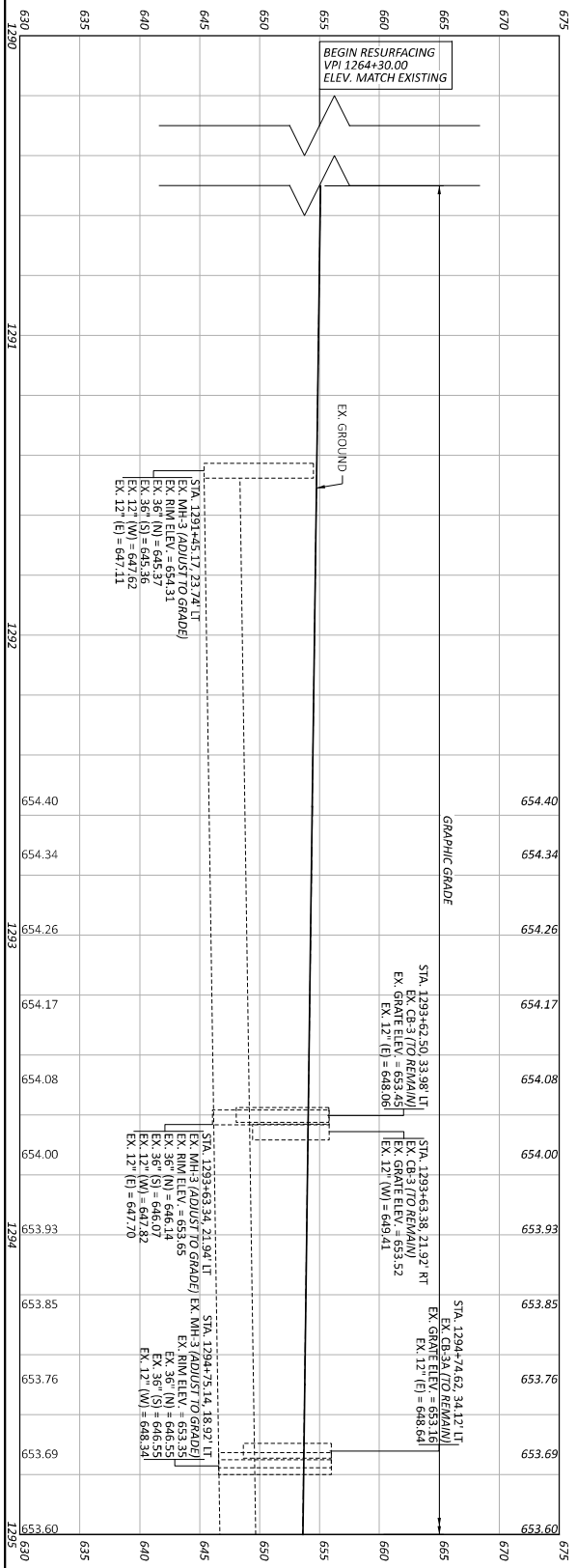

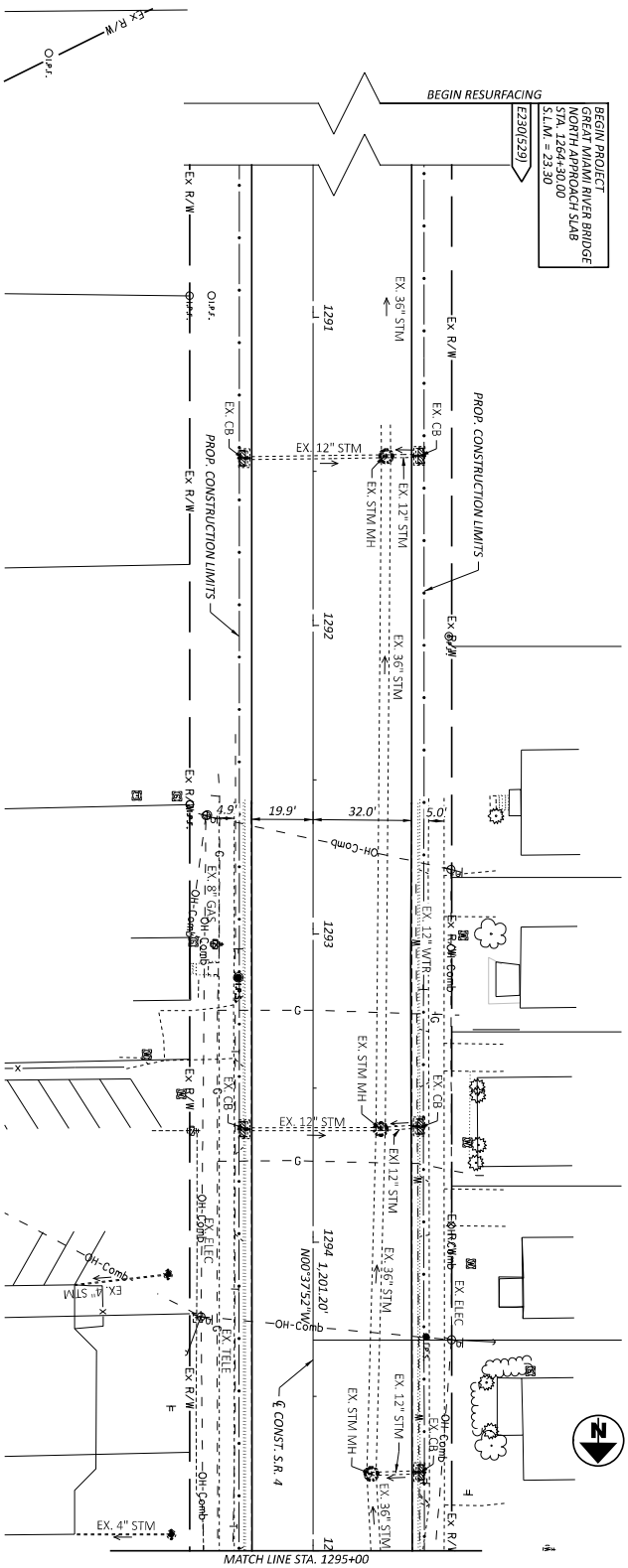

PLAN AND PROFILE - ALL VERTICAL CLEARANCE OPTIONS
S.R. 4 - BEGIN PROJECT TO STA. 1295+00.00

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: SAF
SUBMITTED: CVP 04-29-2024
PROJECT ID: 117275
SHEET: P.1 | TOTAL: 3

HORIZONTAL SCALE IN FEET
0 20
10 40

BUT IR 75/VAR/5.22/VAR

MODEL: CL_SR-04 - Sheet 2 14.5' Clear PAPERSIZE: 17x11 (in.) DATE: 5/1/2024 TIME: 10:43:34 AM USER: flis
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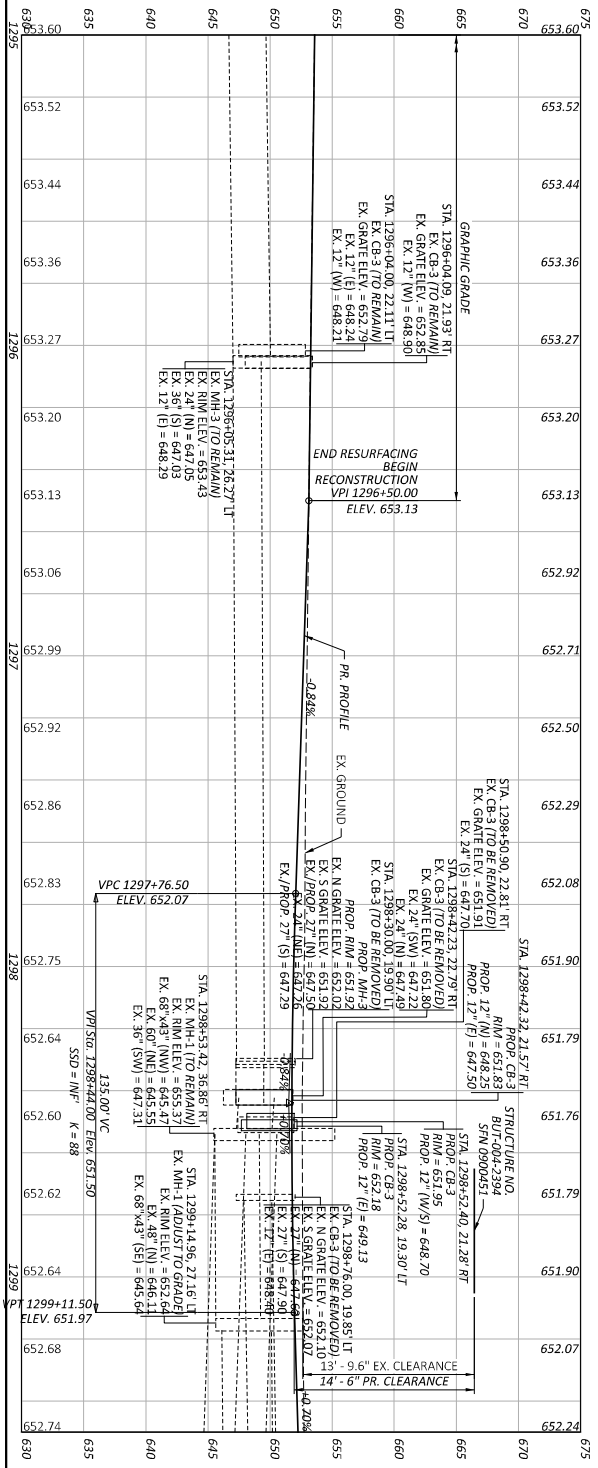

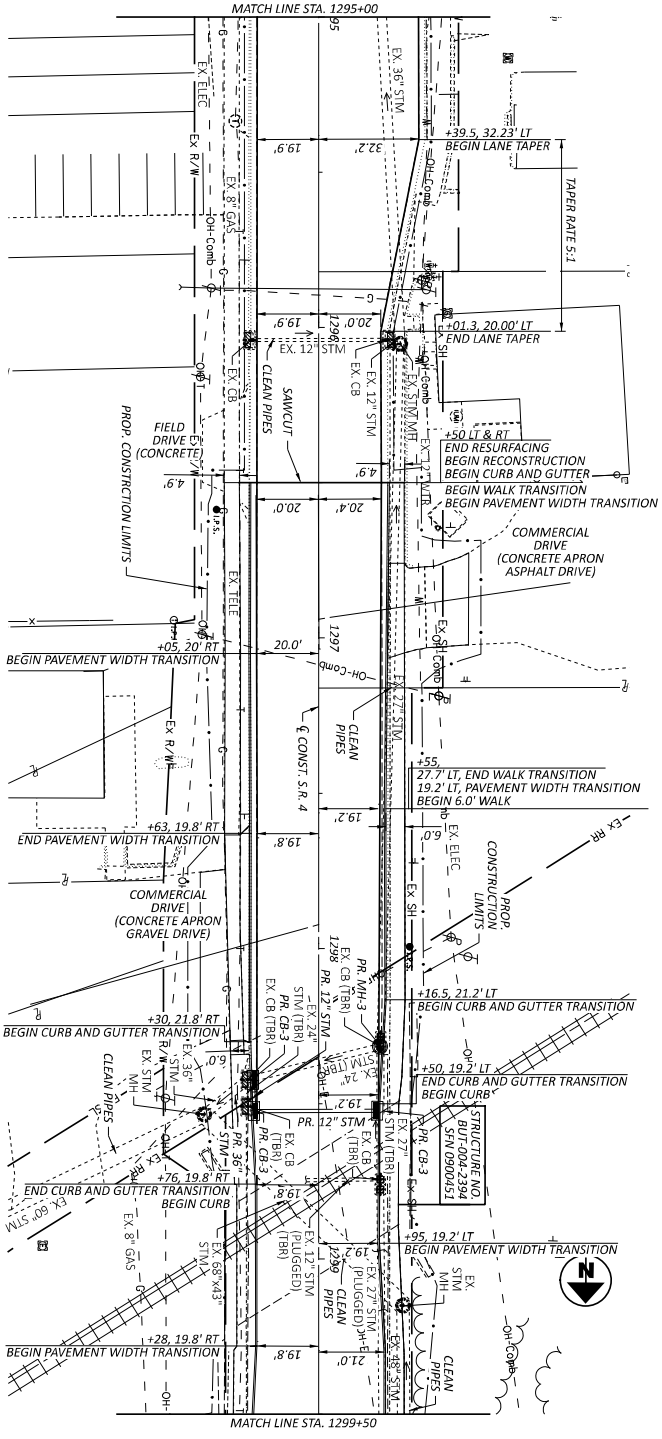

PLAN AND PROFILE - 14.5' VERTICAL CLEARANCE
S.R. 4 - BEGIN TO STA. 1299+50.00

HORIZONTAL SCALE IN FEET
0 20
10 40

SHEET	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
P.2 / 3	117275	CWP 04-29-2024	SAF	CHAGRIN VALLEY ENGINEERING, LTD.

MODEL: CL_SR-04 - Sheet 3 14.5' Clear PAPERSIZE: 17x11 (in.) DATE: 5/1/2024 TIME: 10:43:36 AM USER: flis
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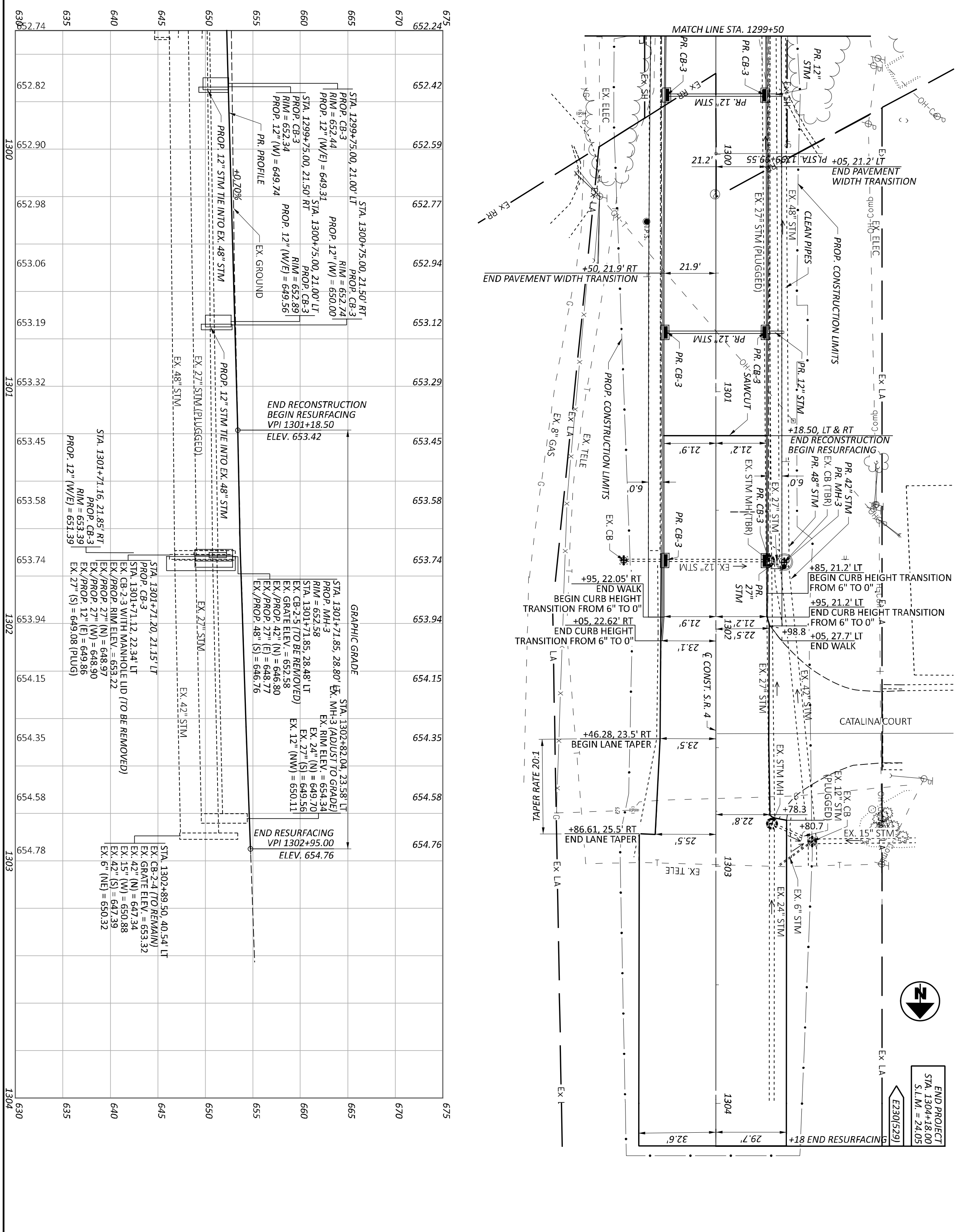

DESIGN AGENCY

CHAGRIN VALLEY ENGINEERING, LTD.

DESIGNER SAF

REVIEWER CWP 04-29-2024

PROJECT ID 117275

SHEET P.3 TOTAL 3

PLAN AND PROFILE - 14.5' VERTICAL CLEARANCE
S.R. 4 - STA. 1299+50.00 TO END

HORIZONTAL SCALE IN FEET
0 10 20 40

BUT IR 75/VAR 5.22/VAR

MODEL: CL_SR-04 - Sheet 1 14.0' Clear PAPERSIZE: 17x11 (in.) DATE: 5/1/2024 TIME: 2:45:07 PM USER: flis
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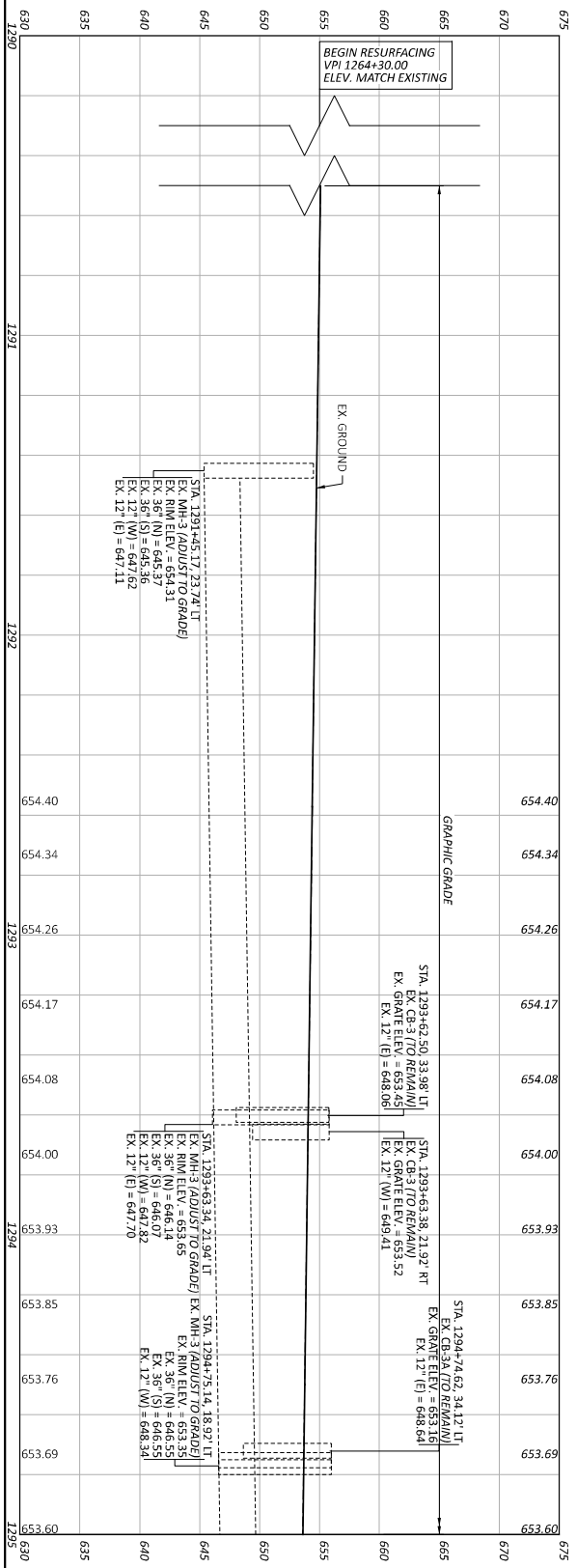

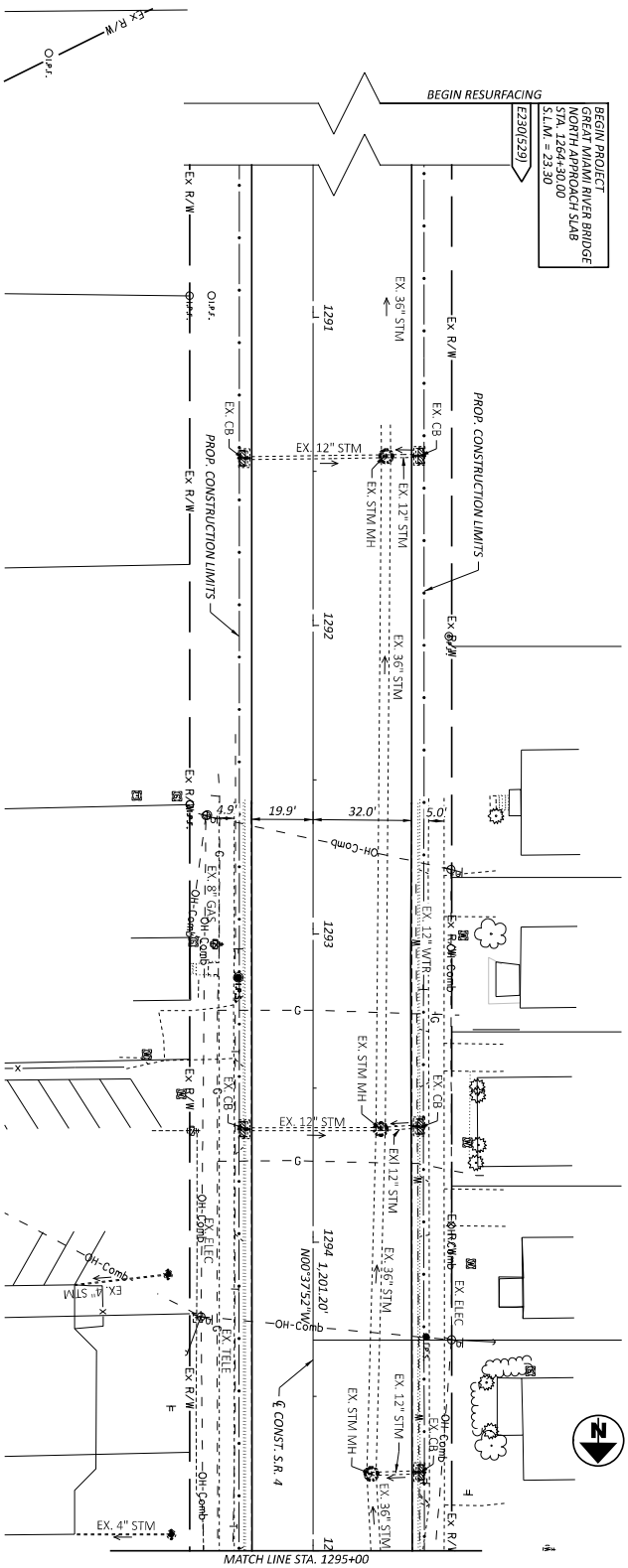

PLAN AND PROFILE - ALL VERTICAL CLEARANCE OPTIONS
S.R. 4 - BEGIN PROJECT TO STA. 1295+00.00

HORIZONTAL SCALE IN FEET
0 20
10 40

DESIGN AGENCY
CHAGRIN VALLEY ENGINEERING, LTD.

DESIGNER
SAF

SUBMITTED
CVP 04-29-2024

PROJECT ID
117275

SHEET | TOTAL
P.1 | 3

BUT IR 75/VAR/5.22/VAR

MODEL: CL_SR-04 - Sheet 2 15.0' Clear PAPERSIZE: 17x11 (in.) DATE: 5/1/2024 TIME: 2:45:24 PM USER: flis
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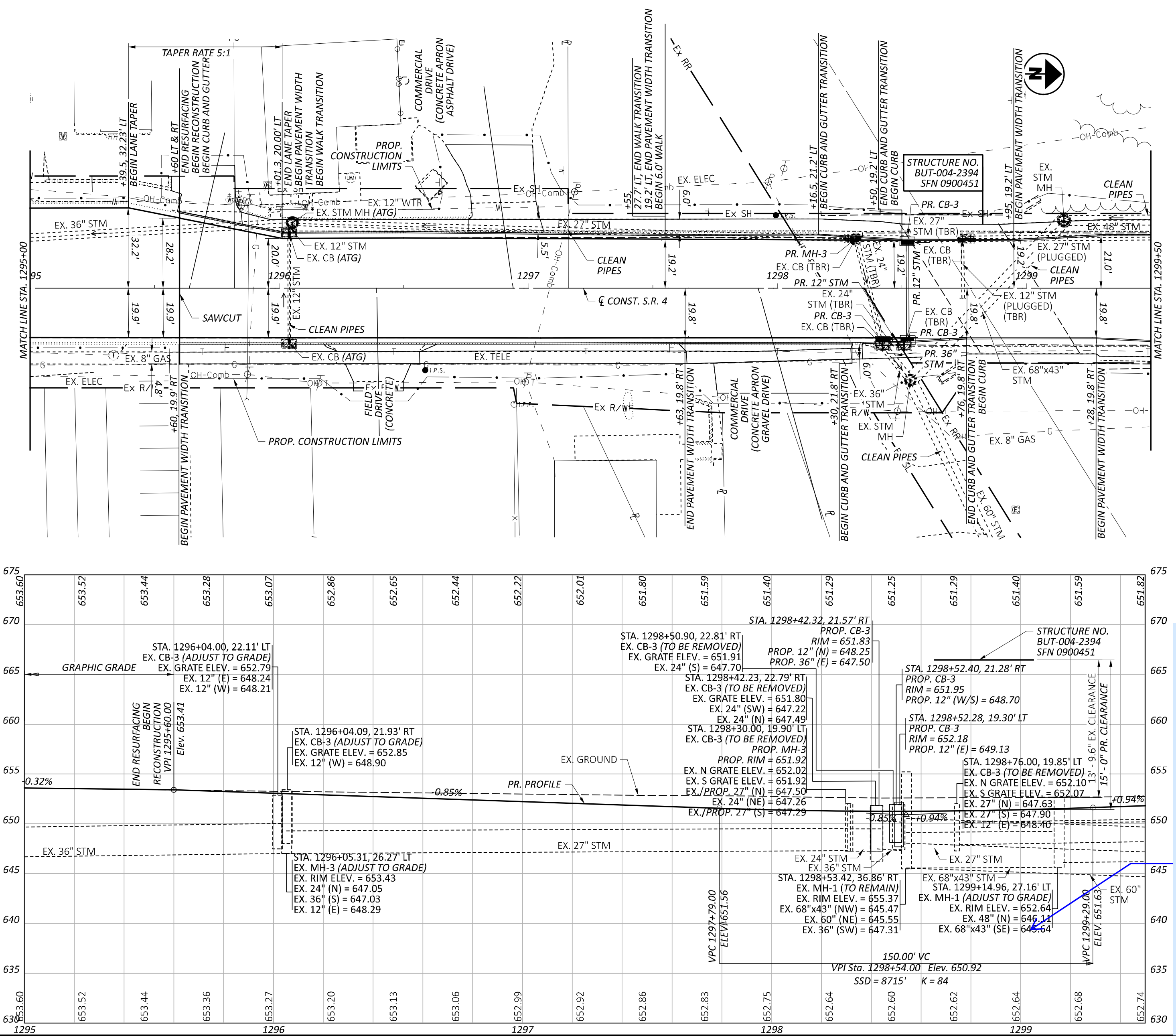

Comment from Brandon Collett and Tami Brehm:
With regard to the lowest vertical clearance we can get, the critical point on the shallowest pipe would be in the west gutter line. This has an invert elevation of 645.64 per their survey (note their sheet says SE, but I think they mean NW). To Determine the minimum PGL (Conservatively at STA 1299+00) would be:

Pipe Height = 43"/12
Pipe Wall Thickness = 5"/12
Minimum cover over Pipe = 15"/12
Cross slope = 0.16%x19.7' =0.32'
Total =63.32" = 5.28'

The lowest corresponding PGL with regard to this elevation is 646.11+5.28 = 651.39. Per page 69 of 178 on their Feasibility Study they have an elevation 651.40 at this location with a 15' vertical clearance, therefore it seems attaining a 15' vertical clearance is attainable with sufficient cover over the elliptical pipe. With regard to the subgrade treatment extending below the top of the pipe, I talked with Joe Smithson. He indicated that instead of excavating and replacing 14" of subgrade around the pipe and under the bridge, we can instead just use 2 layers of geogrid under the entire bridge. The first layer shall be placed at the bottom of the 6" aggregate base and the second layer shall be placed at the midheight of the base. Where the curb height exceeds the standard curb height to avoid the bridge footing, the curb should be poured integral with the sidewalk with a 45 degree chamfer on the underside to give it mass from sliding and it will improve durability.

Reviewing the CDSS Storm Sewer Calculations, the HGL currently be less than the pavement elevation, so this seems doable from a pipe cover standpoint and a ponding standpoint.

...AN AND PROFILE - 15.0' VERTICAL CLEARANCE
S.R. 4 - BEGIN TO STA 1299+50.00

HORIZONTAL SCALE IN FEET
0 10 20 40

PROJECT ID
117275

MODEL: CL_SR-04 - Sheet 3 15.0' Clear PAPERSIZE: 17x11 (in.) DATE: 5/1/2024 TIME: 2:45:26 PM USER: flis
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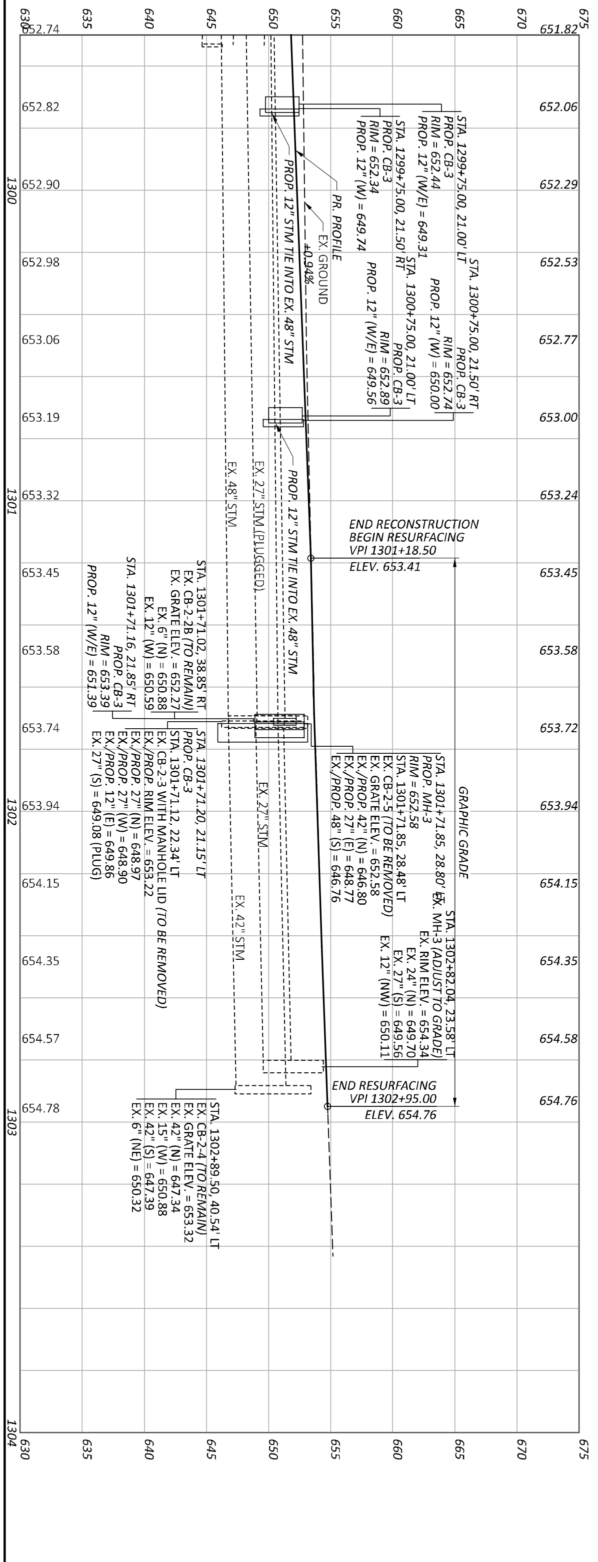
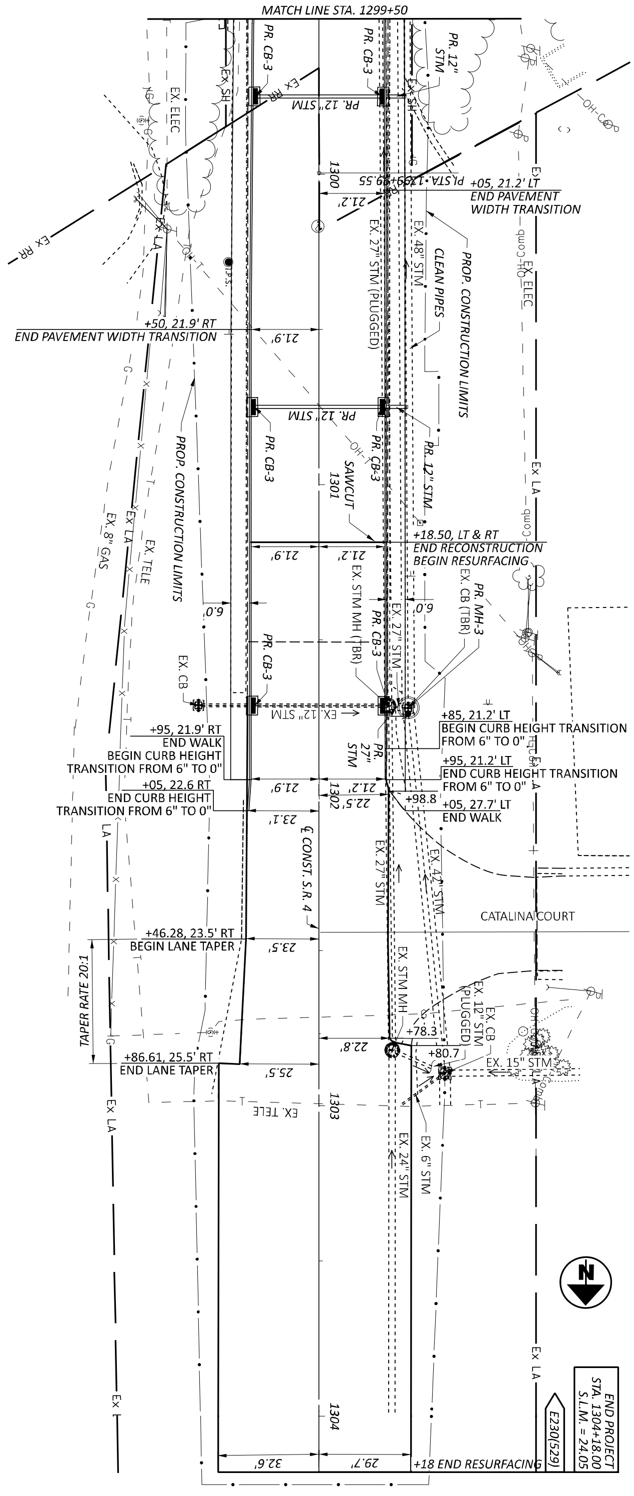




DESIGN AGENCY
CVE
CHAGRIN VALLEY ENGINEERING LTD.

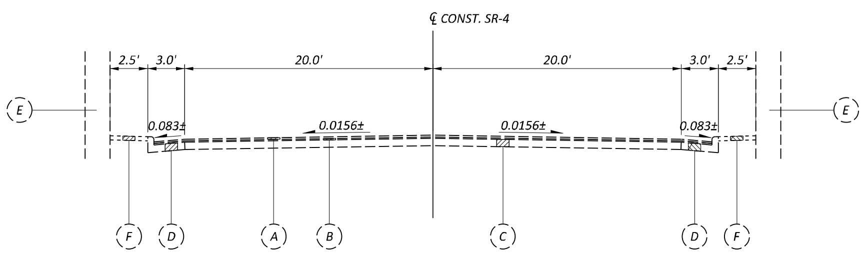
DESIGNER SAF
REVIEWER CWP 04-29-2024
PROJECT ID 117275
SHEET P.3 TOTAL 3

PLAN AND PROFILE - 15.0' VERTICAL CLEARANCE
S.R. 4 - STA. 1299+50.00 TO END

HORIZONTAL SCALE IN FEET
0 10 20 40

Appendix D

BUT-4 Representative Typical Sections

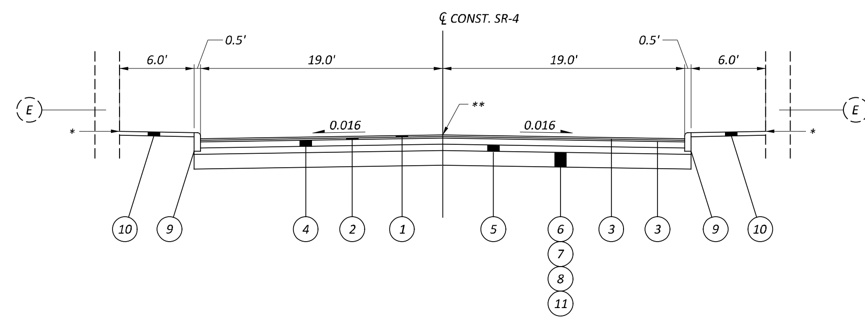


EXISTING REPRESENTATIVE NORMAL SECTION: SR-4

STA. 1298+85.23 (UNDER RAILROAD BRIDGE)

EXISTING LEGEND

- (A) 1.5" ASPHALT CONCRETE SURFACE COURSE
- (B) 1.5" ASPHALT CONCRETE INTERMEDIATE COURSE
- (C) 7" REINFORCED CONCRETE PAVEMENT
- (D) COMBINATION CURB AND GUTTER, TYPE 2 (MODIFIED, 3' WIDE)
- (E) BRIDGE ABUTMENT
- (F) 4" CONCRETE WALK



PROPOSED REPRESENTATIVE NORMAL SECTION: SR-4

STA. 1298+85.23 (UNDER RAILROAD BRIDGE)

PROPOSED LEGEND

- (1) ITEM 441 - 1.25" ASPHALT CONCRETE SURFACE COURSE, TYPE 1 (448), PG64-22
- (2) ITEM 441 - 1.75" ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE 2, (448)
- (3) ITEM 407 - NON-TRACKING TACK COAT (0.055 GAL/SY)
- (4) ITEM 301 - 6" ASPHALT CONCRETE BASE, PG64-22 (449)
- (5) ITEM 304 - 6" AGGREGATE BASE
- (6) ITEM 204 - 14" EXCAVATION OF SUBGRADE
- (7) ITEM 204 - 14" GRANULAR MATERIAL, TYPE C, AS PER PLAN
- (8) ITEM 204 - GEOTEXTILE FABRIC
- (9) ITEM 609 - CURB, TYPE 6
- (10) ITEM 608 - 4" CONCRETE WALK
- (11) ITEM 204 - PROOF ROLLING

* MATCH EXISTING TOP OF SIDEWALK ELEVATION

** PROPOSED IS 0.24' LOWER THAN EXISTING IN 14.0' OPTION, 0.8' LOWER THAN EXISTING IN 14.5' OPTION AND 1.3' LOWER THAN EXISTING IN 15.0' OPTION

REPRESENTATIVE TYPICAL SECTIONS - SR-4

DESIGN AGENCY
CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER CJD
REVIEWER CWP 04-25-24
PROJECT ID 117275
SHEET P.1 TOTAL 1

Appendix E

BUT-4 Critical Cross Sections

BUT IR 75/VAR/5.22/VAR

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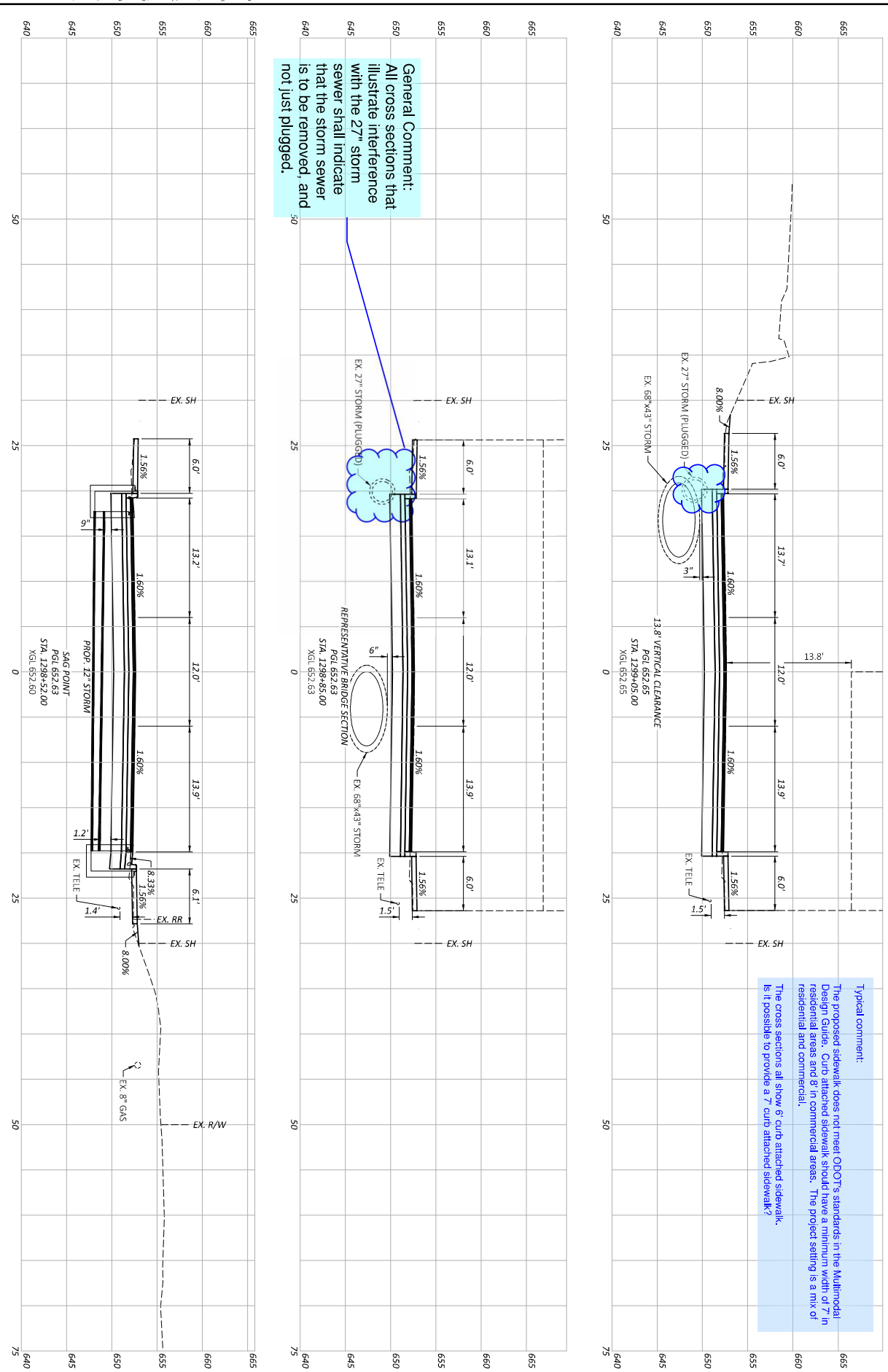

CROSS SECTIONS - SR 4- 13.8' (EX) CLEARANCE
STA. 1298+52.00, STA. 1298+85.00 AND STA. 1299+05.00

DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER	SAF
REVIEWER	CVP 04-29-2024
PROJECT ID	117275
SHEET	P.1
TOTAL	3

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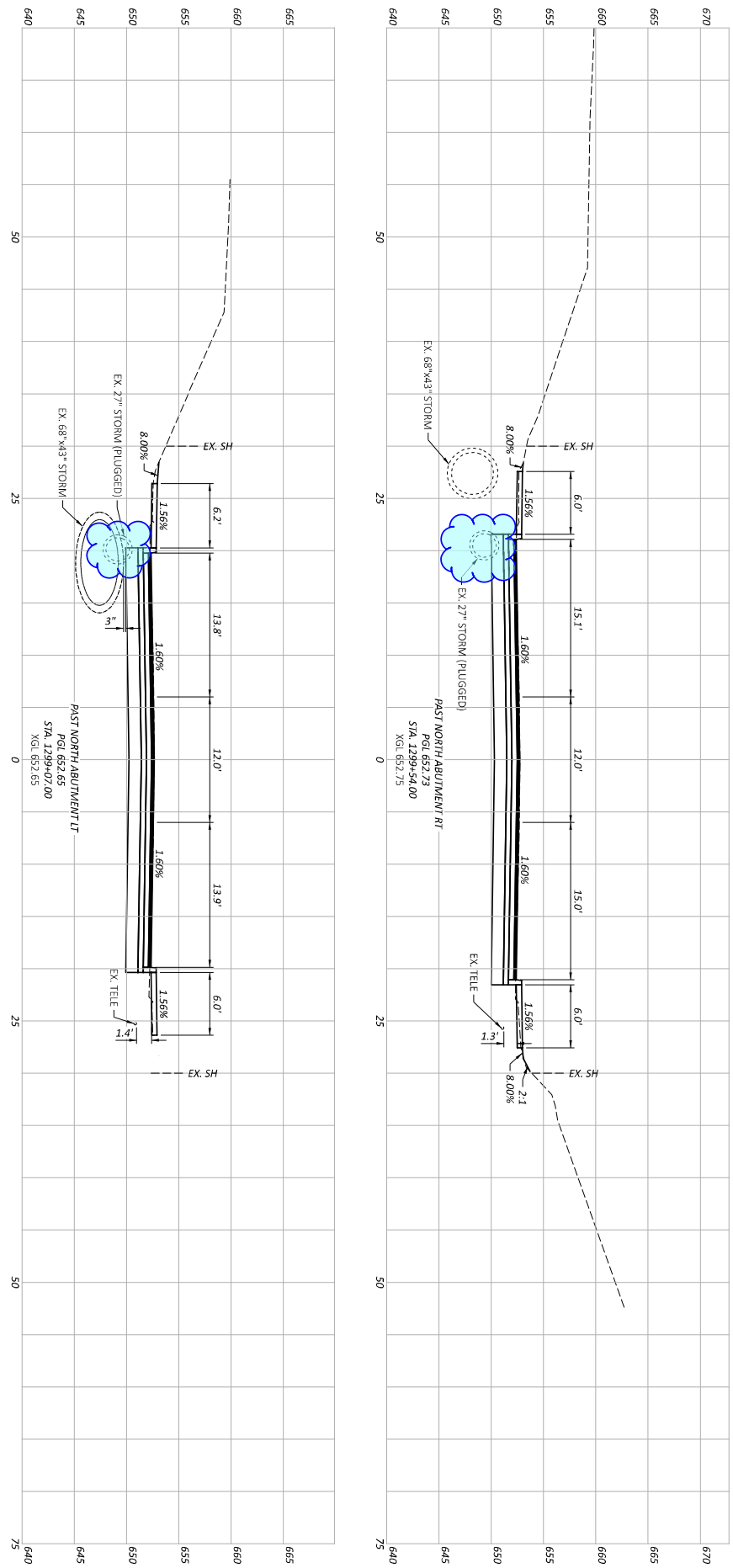

SHEET: P.2 / TOTAL: 3	PROJECT ID: 117275	SUBMITTED: CWP 04-29-2024	DESIGNED: SAF	DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.

CROSS SECTIONS - SR 4 - 13.8' (EX) CLEARANCE
STA. 1299+07.00 AND STA. 1299+54.00

BUT IR 75/VAR/5.22/VAR

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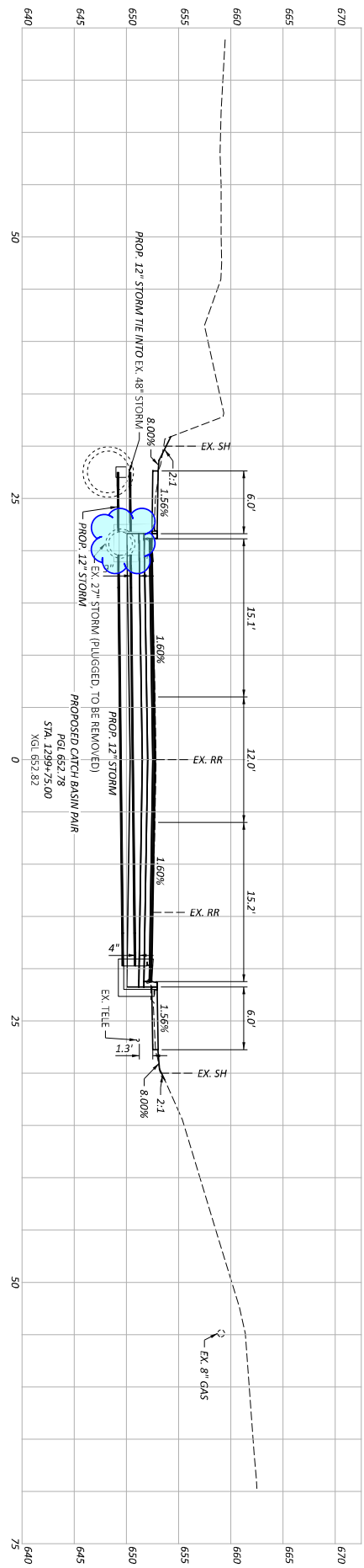

CROSS SECTIONS - SR 4 - 13.8' (EX) CLEARANCE
STA. 1299+75.00

SHEET	P.3
TOTAL	3
PROJECT ID	117275
REVISED	CWP 04-29-2024
DESIGNER	SAF
DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.

BUT IR 75/VAR/5.22/VAR

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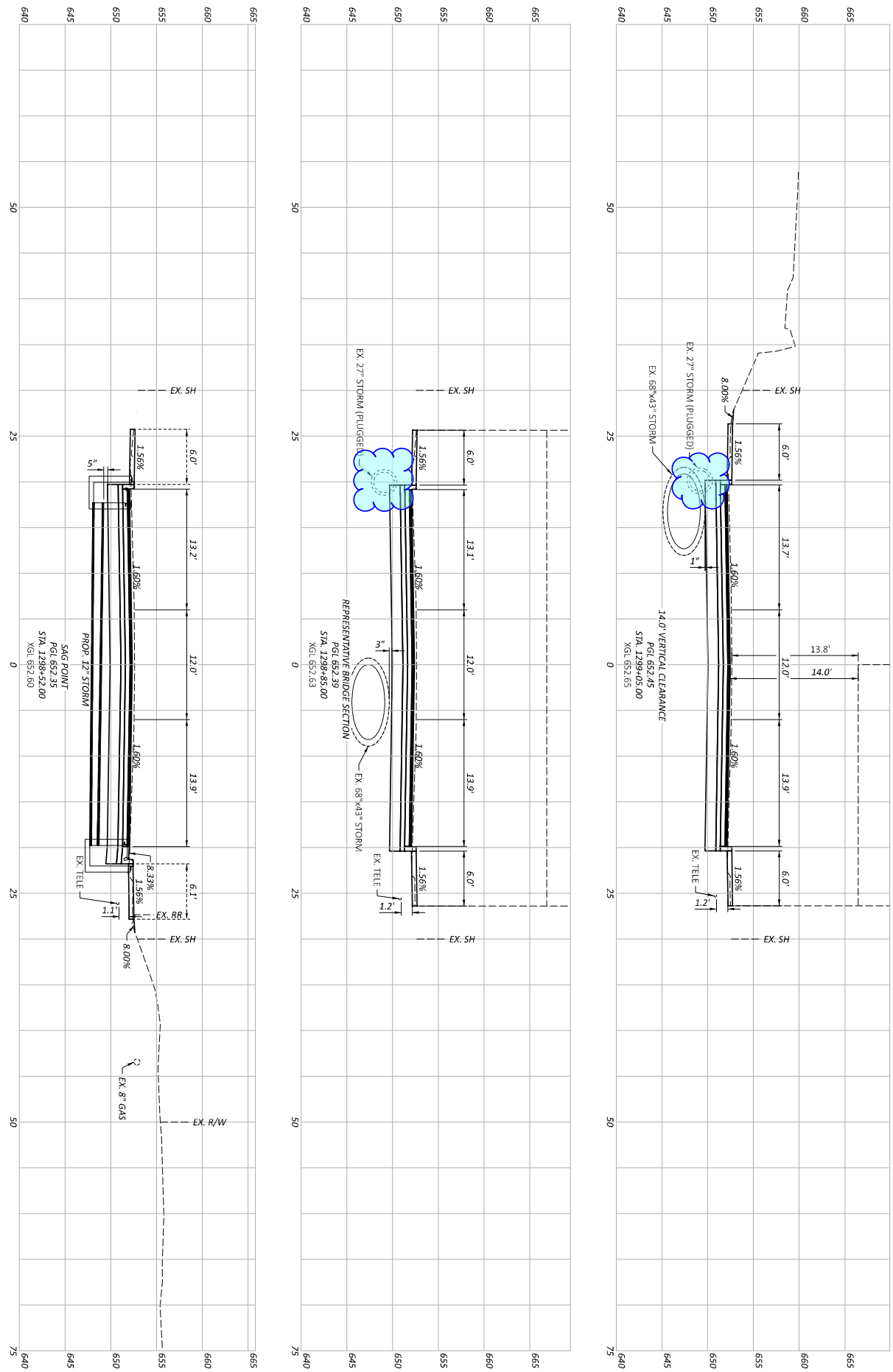

CROSS SECTIONS - SR 4 - 14.0' CLEARANCE
STA. 1298+52.00, STA. 1298+85.00 AND STA. 1299+05.00

SHEET	P.1 / TOTAL 3
PROJECT ID	117275
REVISIONS	CWP 04-29-2024
DESIGNER	SAF
DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.

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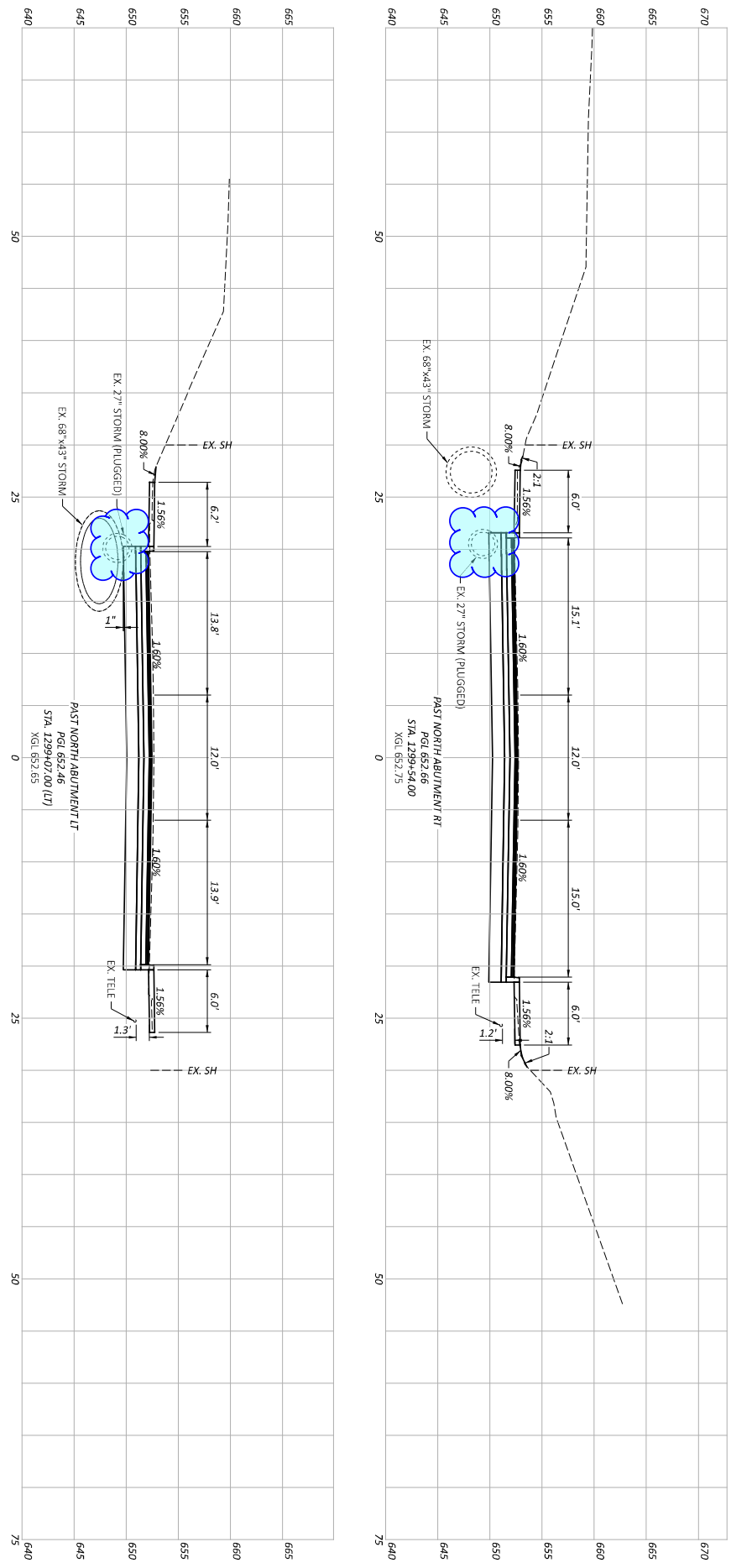

CROSS SECTIONS - SR 4 - 14.0' CLEARANCE
STA. 1299+07.00 AND STA. 1299+54.00

SHEET	P.2
TOTAL	3
PROJECT ID	117275
REVIEWED	CWP 04-29-2024
DESIGNER	SAF
DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.

BUT IR 75/VAR/5.22/VAR

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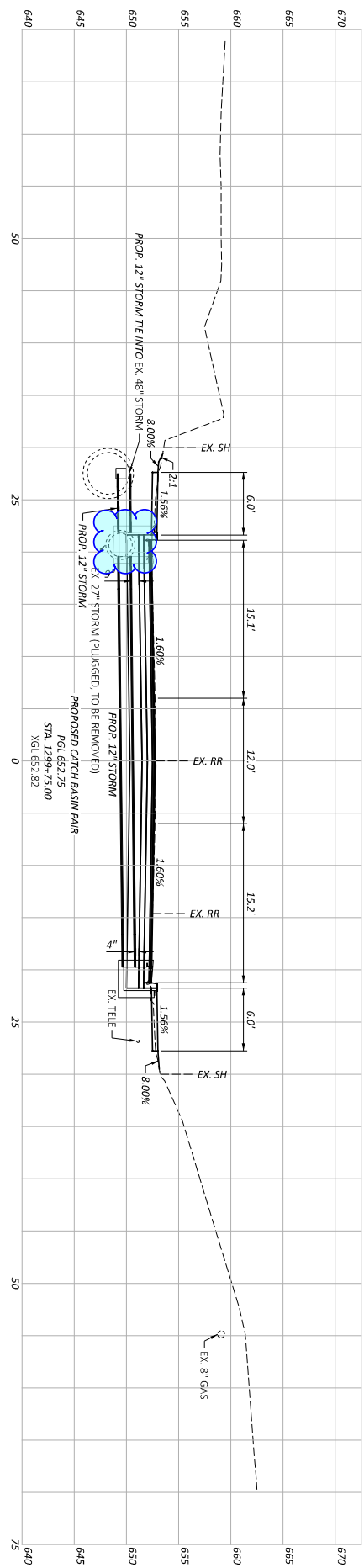

CROSS SECTIONS - SR 4 - 14.0' CLEARANCE
STA. 1299+75.00

SHEET	P.3
TOTAL	3
PROJECT ID	117275
SUBMITTED	CVP 04-29-2024
DESIGNED	SAF
DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.

BUT IR 75/VAR/5.22/VAR

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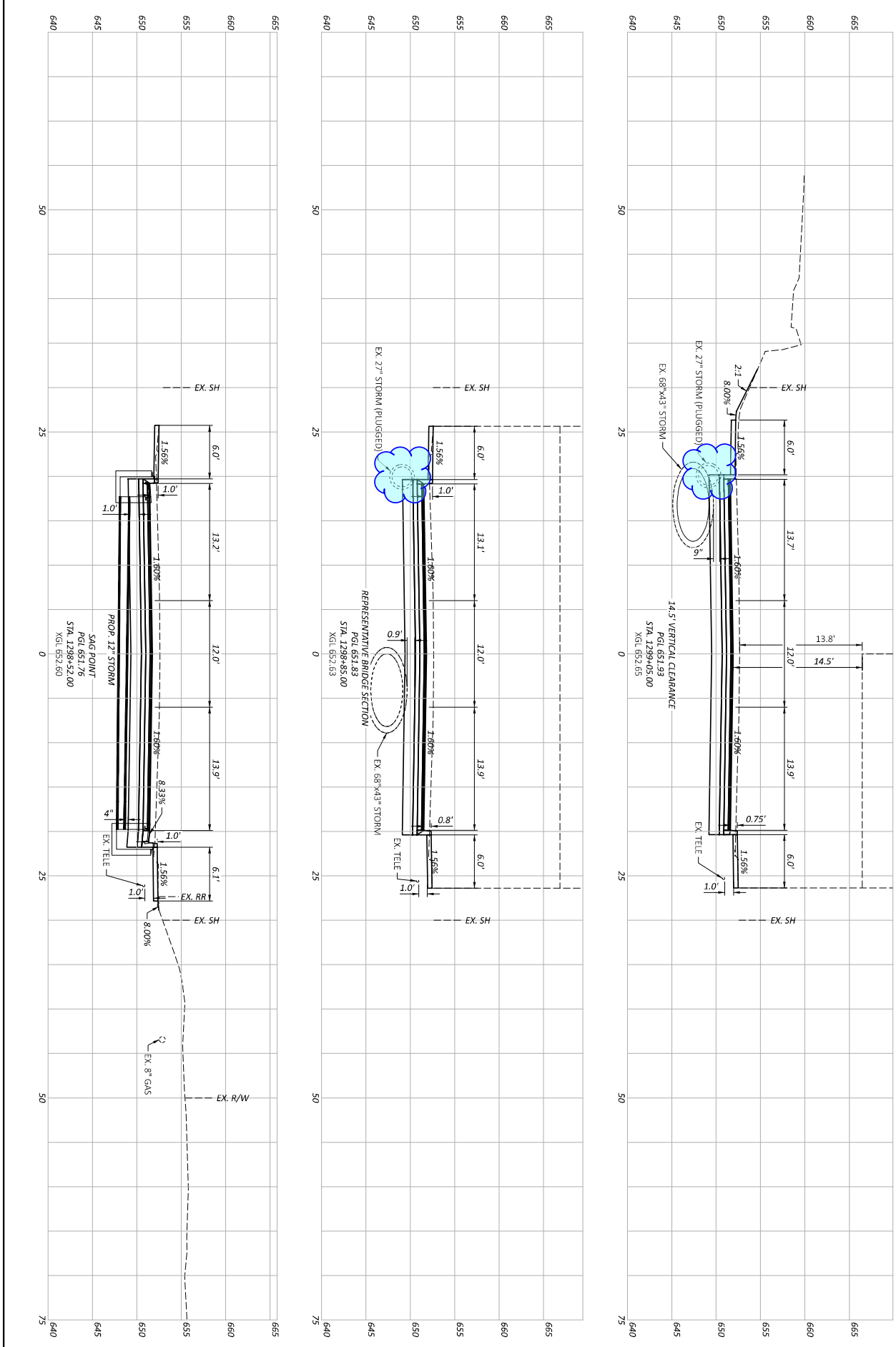

CROSS SECTIONS - SR 4 - 14.5' CLEARANCE
STA. 1298+52.00, STA. 1298+85.00 AND STA. 1299+05.00

SHEET P.1 TOTAL 3	DESIGNER SAF	DESIGN AGENCY CHAGRIN VALLEY ENGINEERING, LTD.	
PROJECT ID 117275	REVIEWER CVWP 04-29-2024		

BUT IR 75/VAR/5.22/VAR

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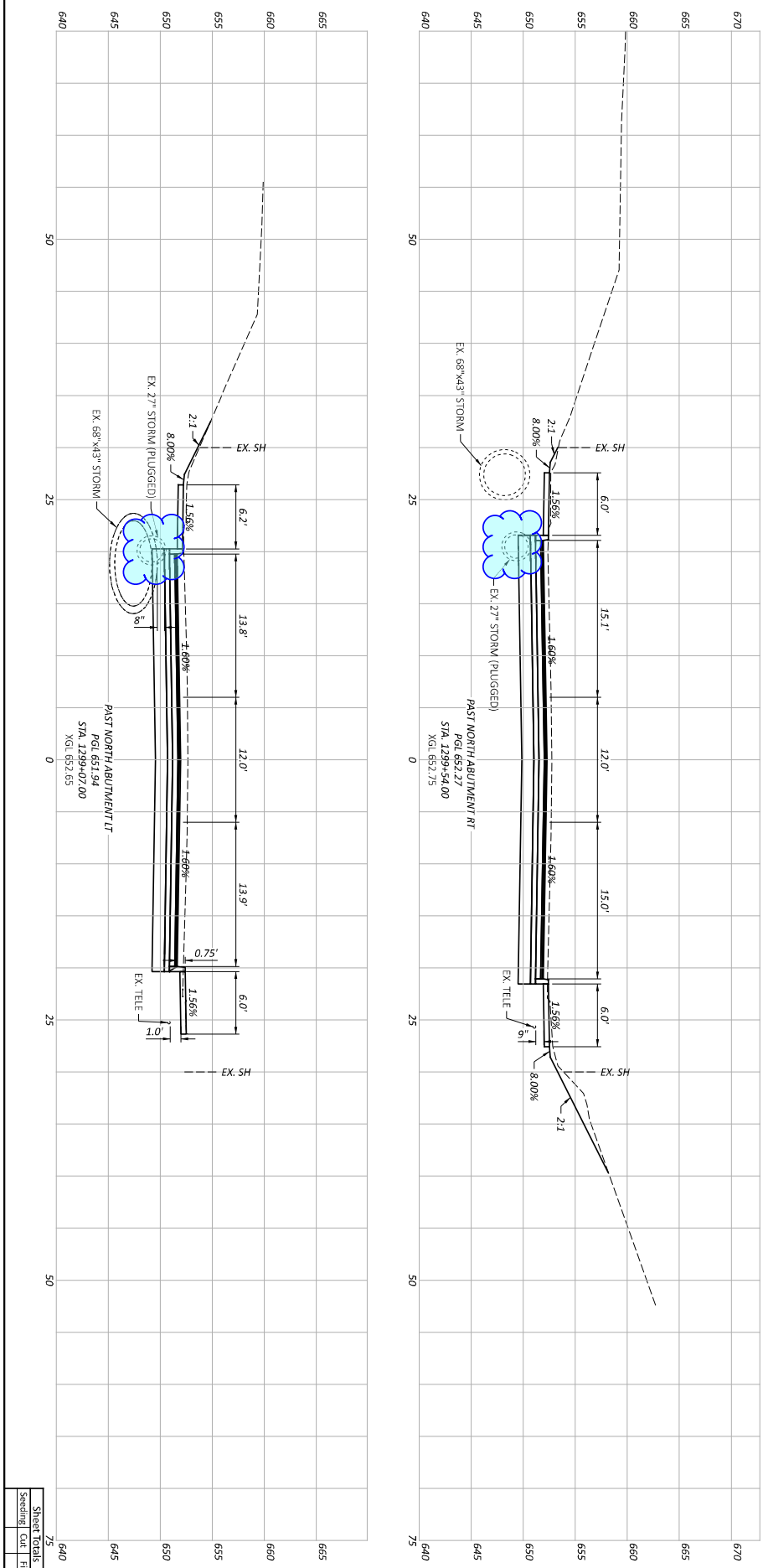

Sheet Totals	Seeding	Cut	Fill

SHEET	TOTAL
P.2	3

PROJECT ID: 117275

PAYMENT: CWP 04-29-2024

DESIGNER: SAF

CHAGRIN VALLEY ENGINEERING, LTD.

DESIGN AGENCY

CROSS SECTIONS - SR 4 - 14.5' CLEARANCE
STA.1299+07.00 AND 1299+54.00

BUT IR 75/VAR/5.22/VAR

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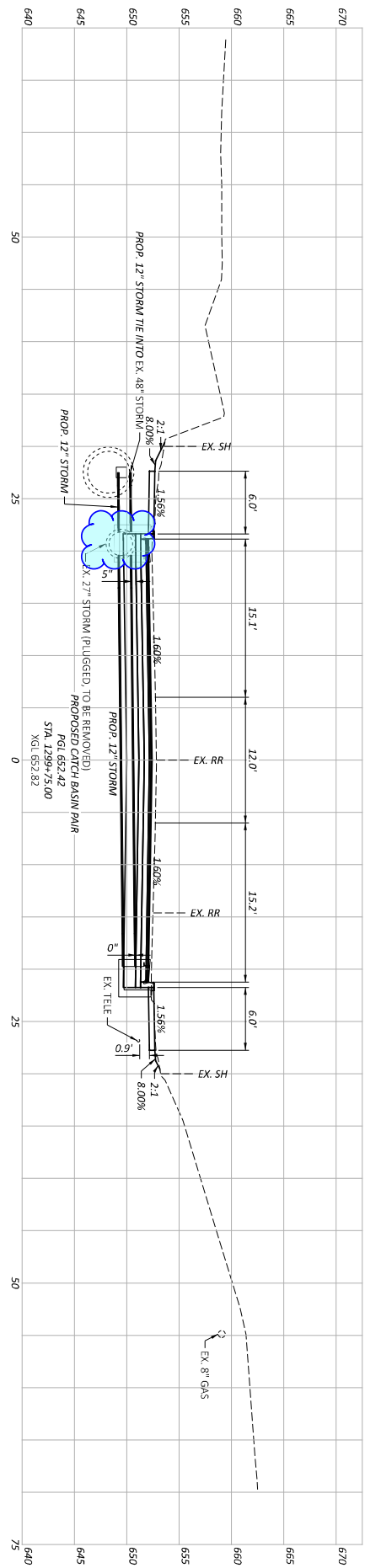

SHEET: P.3 / TOTAL: 3	PROJECT ID: 117275	SUBMITTED: CVWP 04-29-2024	DESIGNER: SAF	CHAGRIN VALLEY ENGINEERING, LTD. — DESIGN AGENCY

CROSS SECTIONS - SR 4 - 14.5' CLEARANCE
STA. 1299+75.00

BUT IR 75/VAR/5.22/VAR

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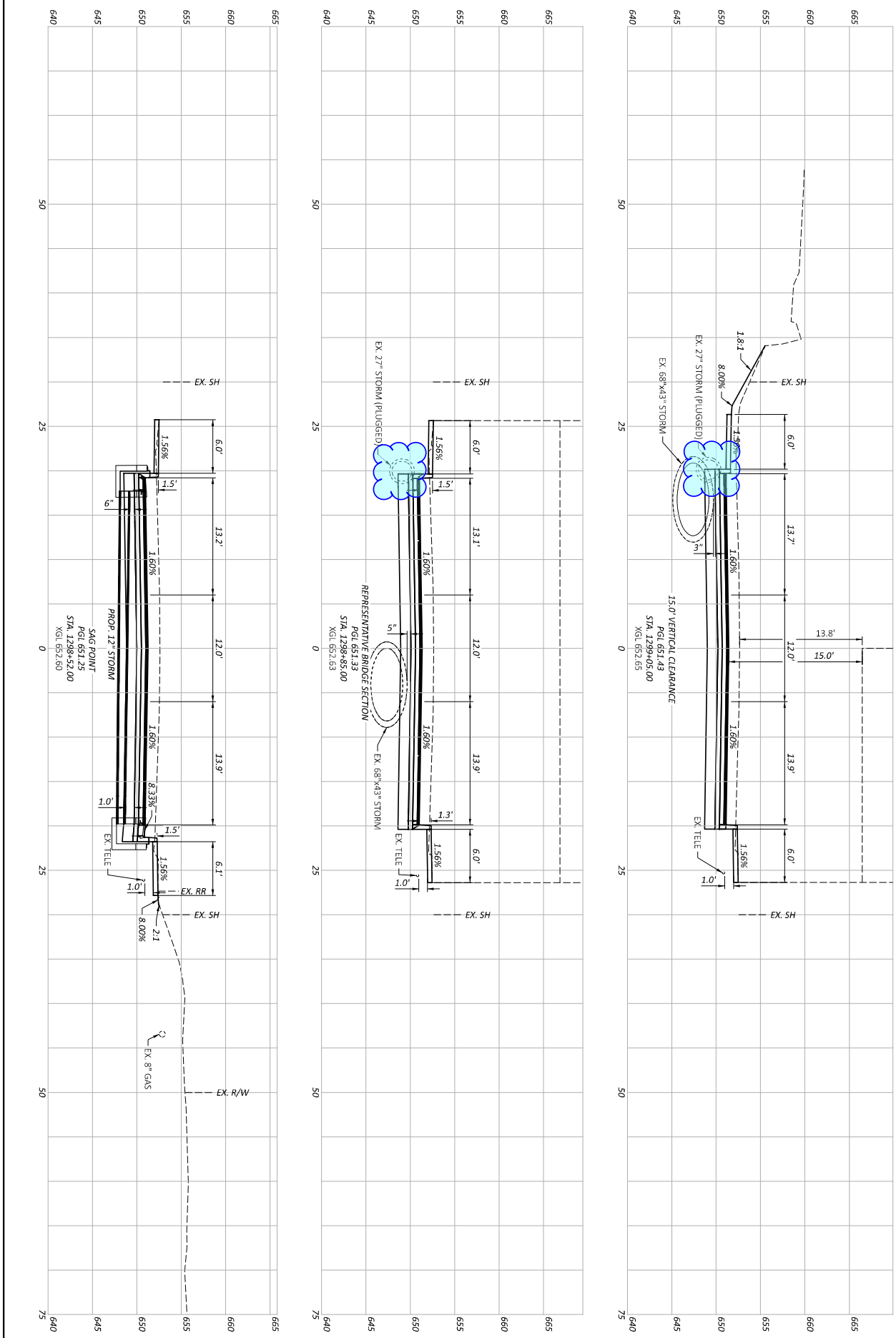

CROSS SECTIONS - SR 4 - 15.0' CLEARANCE
STA. 1298+52.00, STA. 1298+85.00 AND STA. 1299+05.00

SHEET	P.1
TOTAL	3
PROJECT ID	117275
SUBMITTED	CVWP 04-29-2024
DESIGNER	SAF
DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.

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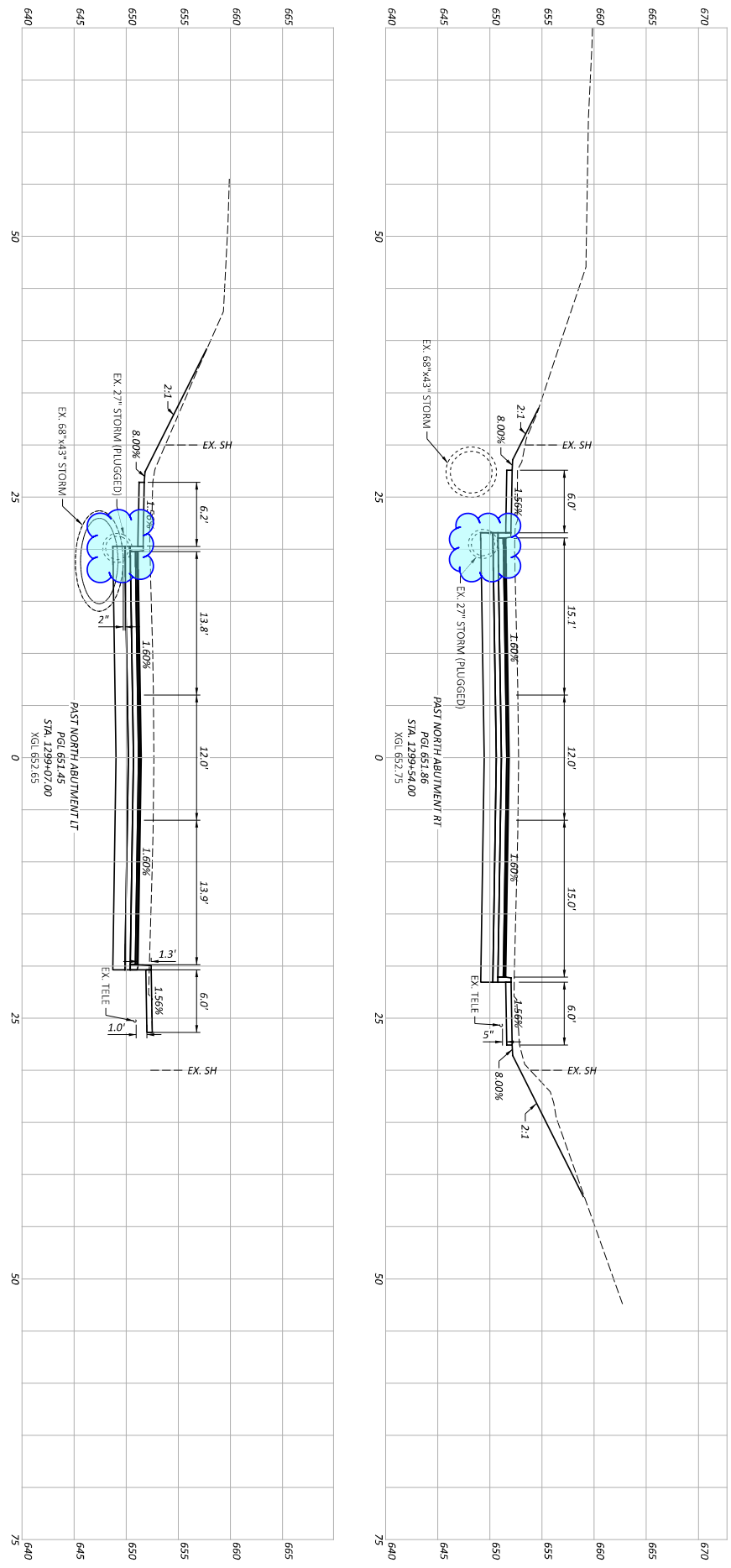

CROSS SECTIONS - SR 4 - 15.0' CLEARANCE
STA. 1299+07.00 AND STA. 1299+54.00

SHEET	P.2
TOTAL	3
PROJECT ID	117275
SUBMITTED	CVP 04-29-2024
DESIGNED	SAF
DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.

BUT IR 75/VAR/5.22/VAR

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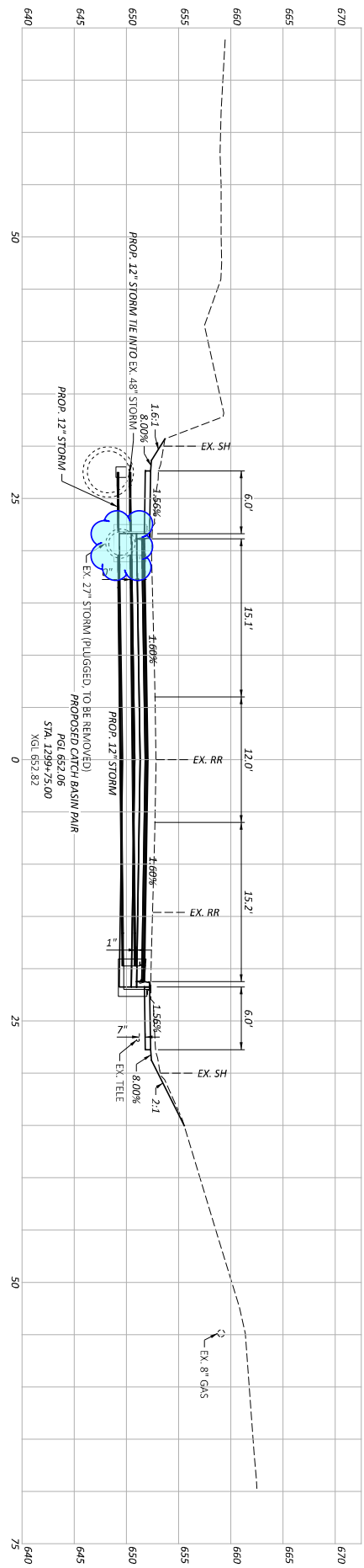
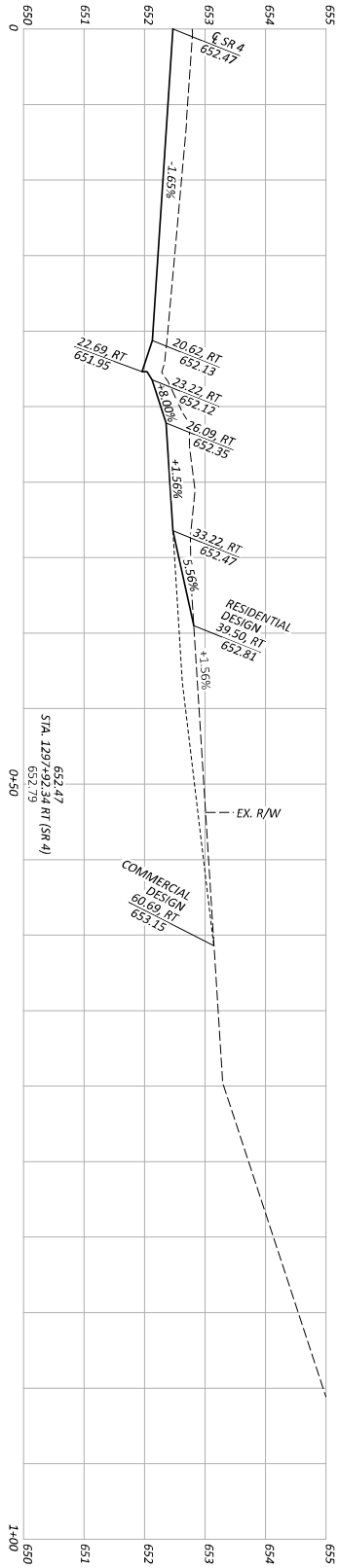


CROSS SECTIONS - SR 4 - 15.0' CLEARANCE
STA. 1299+75.00

SHEET	P.3
TOTAL	3
PROJECT ID	117275
SUBMITTED	CVP 04-29-2024
DESIGNED	SAF
DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.

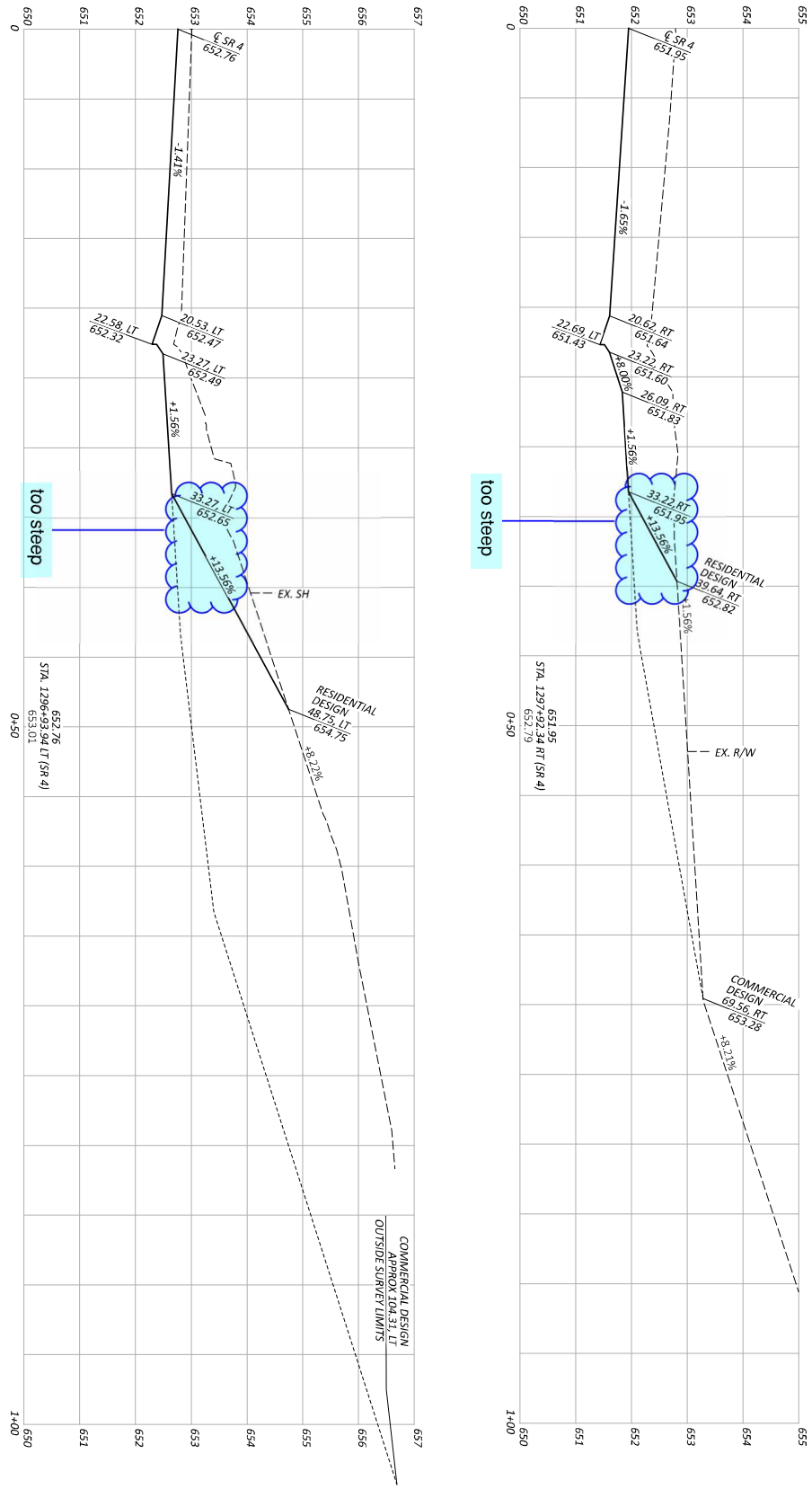
Appendix F

BUT-4 Drive Profiles



DRIVE PROFILES - SR 4
14.0' ALTERNATIVE

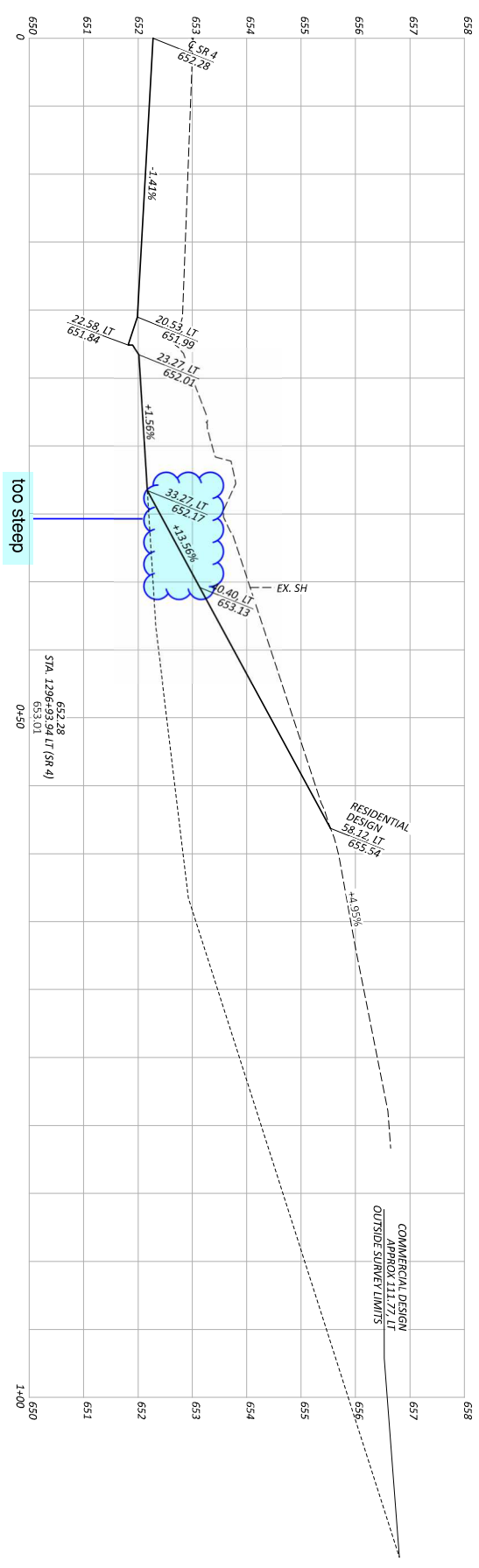
DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER	SAF
SUBMITTED	CVP 04-29-2024
PROJECT ID	117275
SHEET	P.1 | TOTAL 4

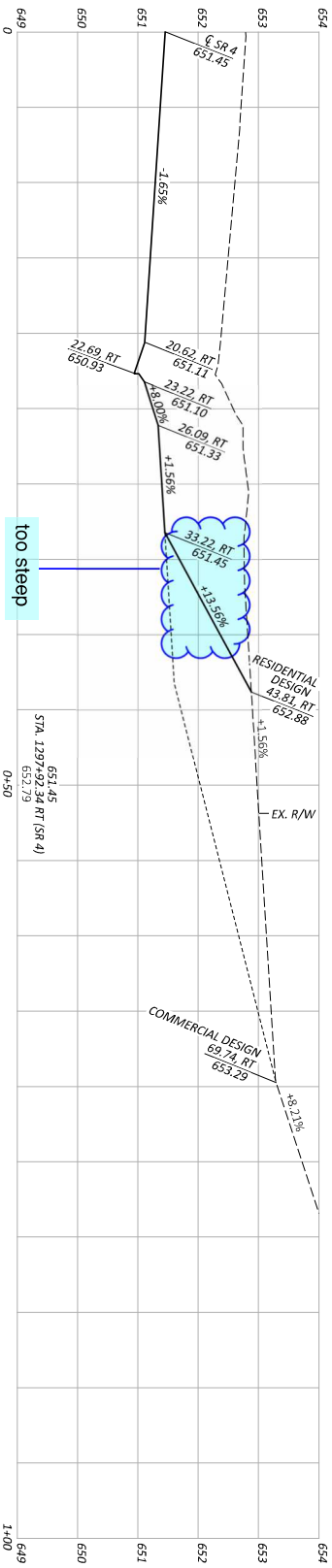


DRIVE PROFILES - SR 4
14.5' ALTERNATIVE

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: SAF
SUBMITTED: CVP 04-29-2024
PROJECT ID: 117275
SHEET: P.2 | TOTAL: 4

MODEL: 15 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 2:51:27 PM USER: flis
P:\23365 - ODOT - BUT-75-5.22\117275\400-Engineering\Roadway\Sheets\117275_GD205.dgn





DRIVE PROFILES - SR 4
15.0' ALTERNATIVE

DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER	SAF
SUBMITTED	CVP 04-29-2024
PROJECT ID	117275
SHEET	P.3 | TOTAL 4

MODEL: 15 [Sheet 2] PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 2:51:27 PM USER: flis
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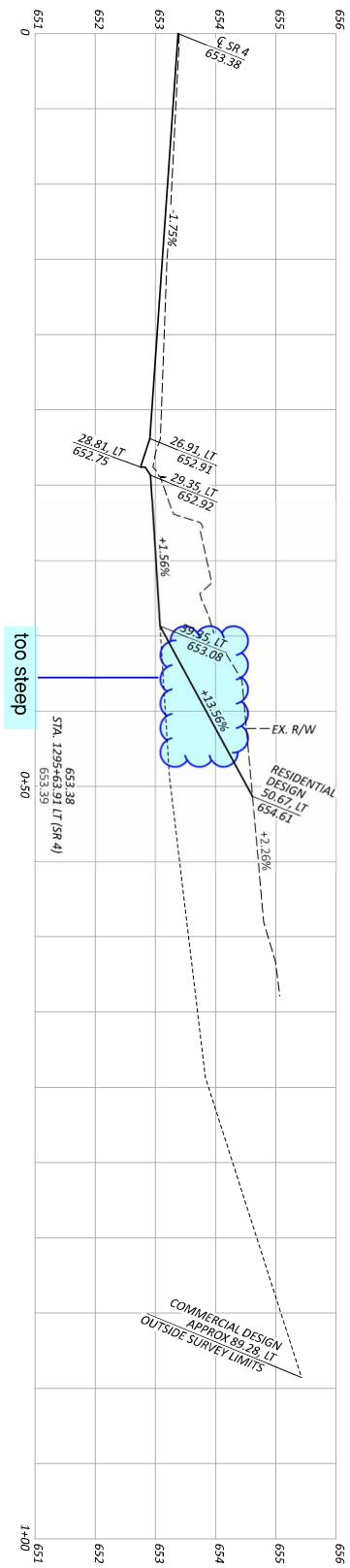

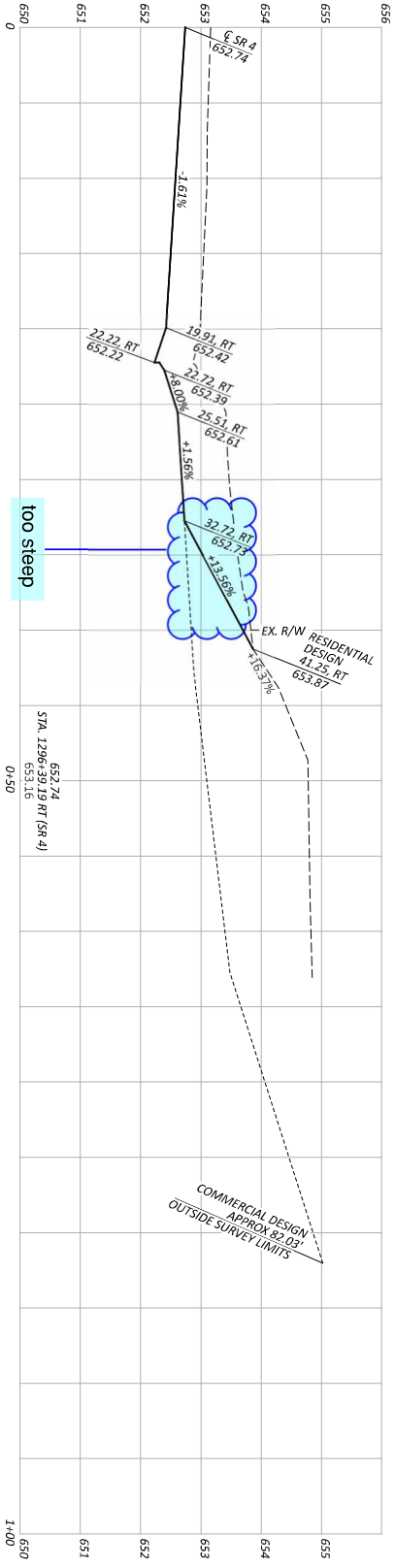

DRIVE PROFILES - SR 4
15.0' ALTERNATIVE

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: SAF
SUBMITTED: CVP 04-29-2024
PROJECT ID: 117275
SHEET: P.4 | TOTAL: 4

Appendix G

BUT-4 Maintenance of Traffic Schematic, Typical Sections, Detour Routes, Detour Road User Costs, Capacity Analysis, and MOT Delay & Cost Comparison

MODEL: CLP_SR4 14.5 FT2 - Plan 1 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 9:09:31 AM USER: cdunlap
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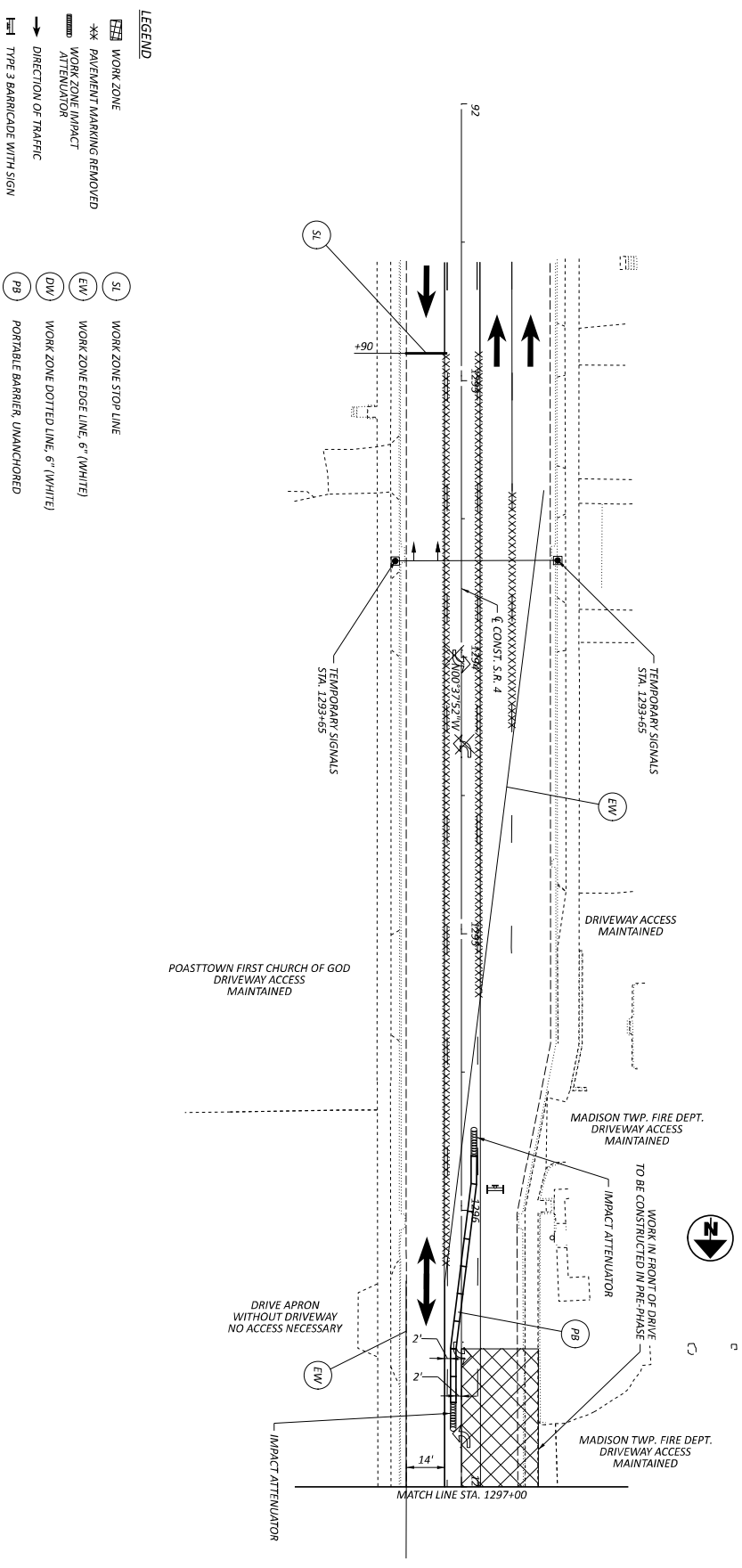


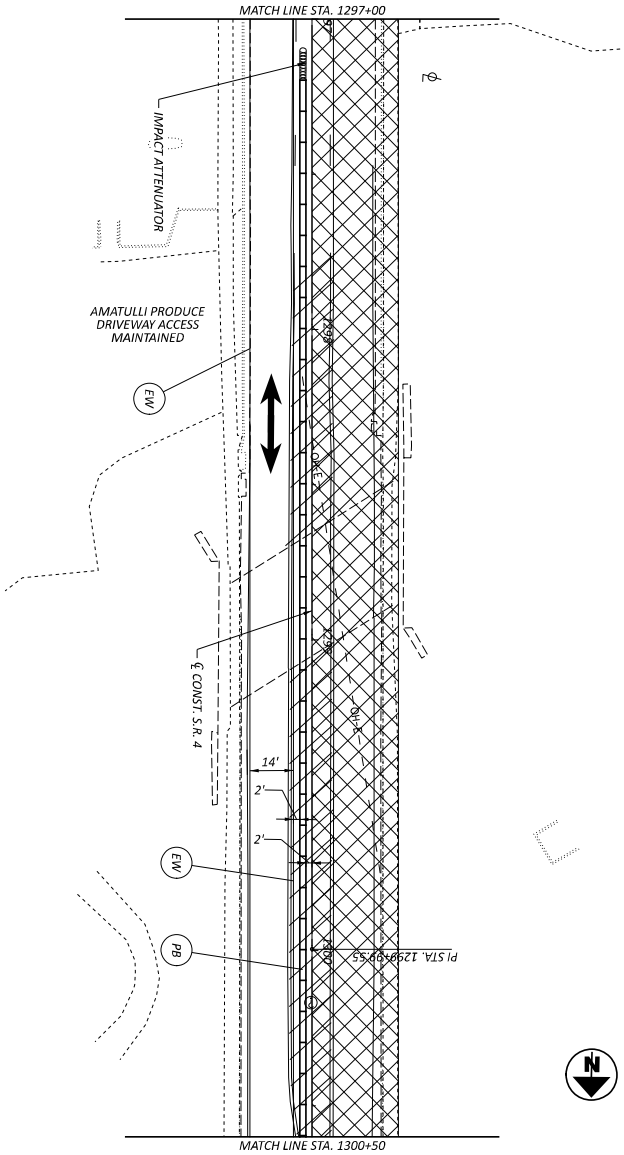
SHEET P.1 TOTAL 3	PROJECT ID 117275	REVIEWER CWP 05-01-24	DESIGNER CJD	DESIGN AGENCY CHAGRIN VALLEY ENGINEERING, LTD.	MAINTENANCE OF TRAFFIC - STAGE 1, PHASE 1 (14.5' VC OPTION) S.R. 4 - BEGIN TO STA. 1297+00

HORIZONTAL SCALE IN FEET
0 20
10 40

MODEL: CLP_SR4 14.5 FT2 - Plan 2 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 9:09:32 AM USER: cdunlap
P:\23365 - ODOT - BUT-75-5.22\117275\400-Engineering\MOT\Sheets\117275_MP201.dgn

LEGEND

- WORK ZONE
- PAVEMENT MARKING REMOVED
- WORK ZONE IMPACT ATTENUATOR
- DIRECTION OF TRAFFIC
- TYPE 3 BARRICADE WITH SIGN
- SL — WORK ZONE STOP LINE
- EW — WORK ZONE EDGE LINE, 6" (WHITE)
- DW — WORK ZONE DOTTED LINE, 6" (WHITE)
- PB — PORTABLE BARRIER, UNANCHORED



MAINTENANCE OF TRAFFIC - STAGE 1, PHASE 1 (14.5' VC OPTION)
S.R. 4 - STA. 1297+00 TO STA. 1300+50

HORIZONTAL SCALE IN FEET
0 20
10 40

SHEET	TOTAL
P.2	3

PROJECT ID: 117275
REVIEWER: CWP 05-01-24
DESIGNER: CJD
DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.

MODEL: CLP_SR4 14.5 FT2 - Plan 3 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 9:09:32 AM USER: cdunlap
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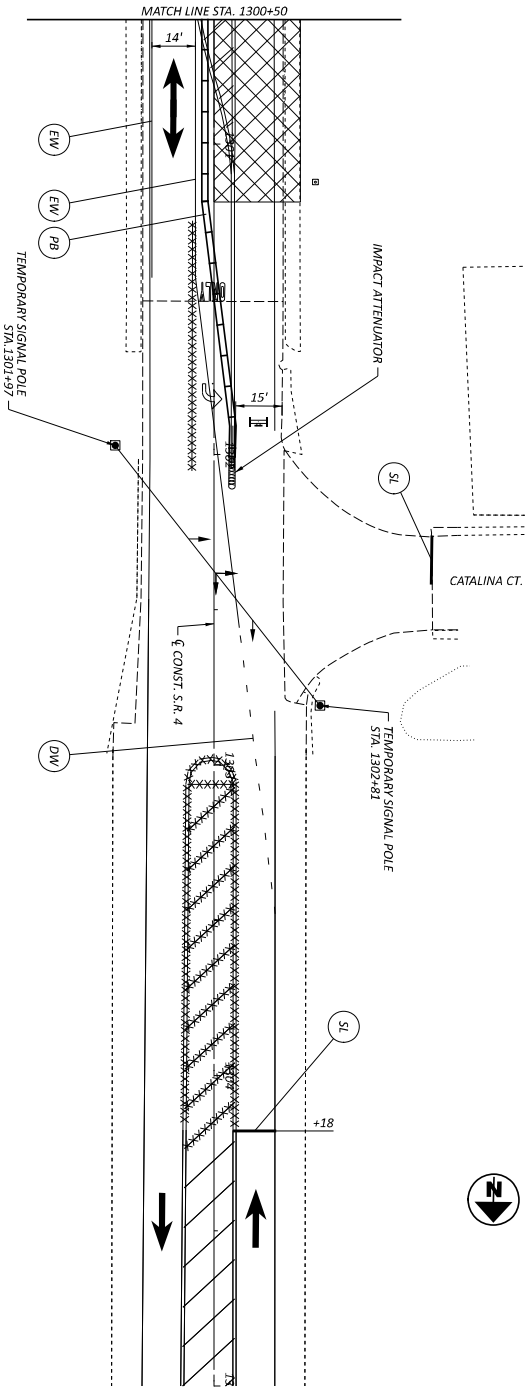
LEGEND

- WORK ZONE
- PAVEMENT MARKING REMOVED
- WORK ZONE IMPACT ATTENUATOR
- DIRECTION OF TRAFFIC
- TYPE 3 BARRICADE WITH SIGN
- SL — WORK ZONE STOP LINE
- EW — WORK ZONE EDGE LINE, 6" (WHITE)
- DW — WORK ZONE DOTTED LINE, 6" (WHITE)
- PB — PORTABLE BARRIER, UNANCHORED



MAINTENANCE OF TRAFFIC - STAGE 1, PHASE 1 (14.5' VC OPTION)
S.R. 4 - STA. 1300+50 TO END

HORIZONTAL SCALE IN FEET
0 20
10 40

SHEET	TOTAL
P.3	3

PROJECT ID 117275
REVIEWER CWP 05-01-24
DESIGNER CJD
DESIGN AGENCY CHAGRIN VALLEY ENGINEERING, LTD.

MODEL: CLP_SR4 14.5 FT2 - Plan 1 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 9:09:47 AM USER: cdunlap
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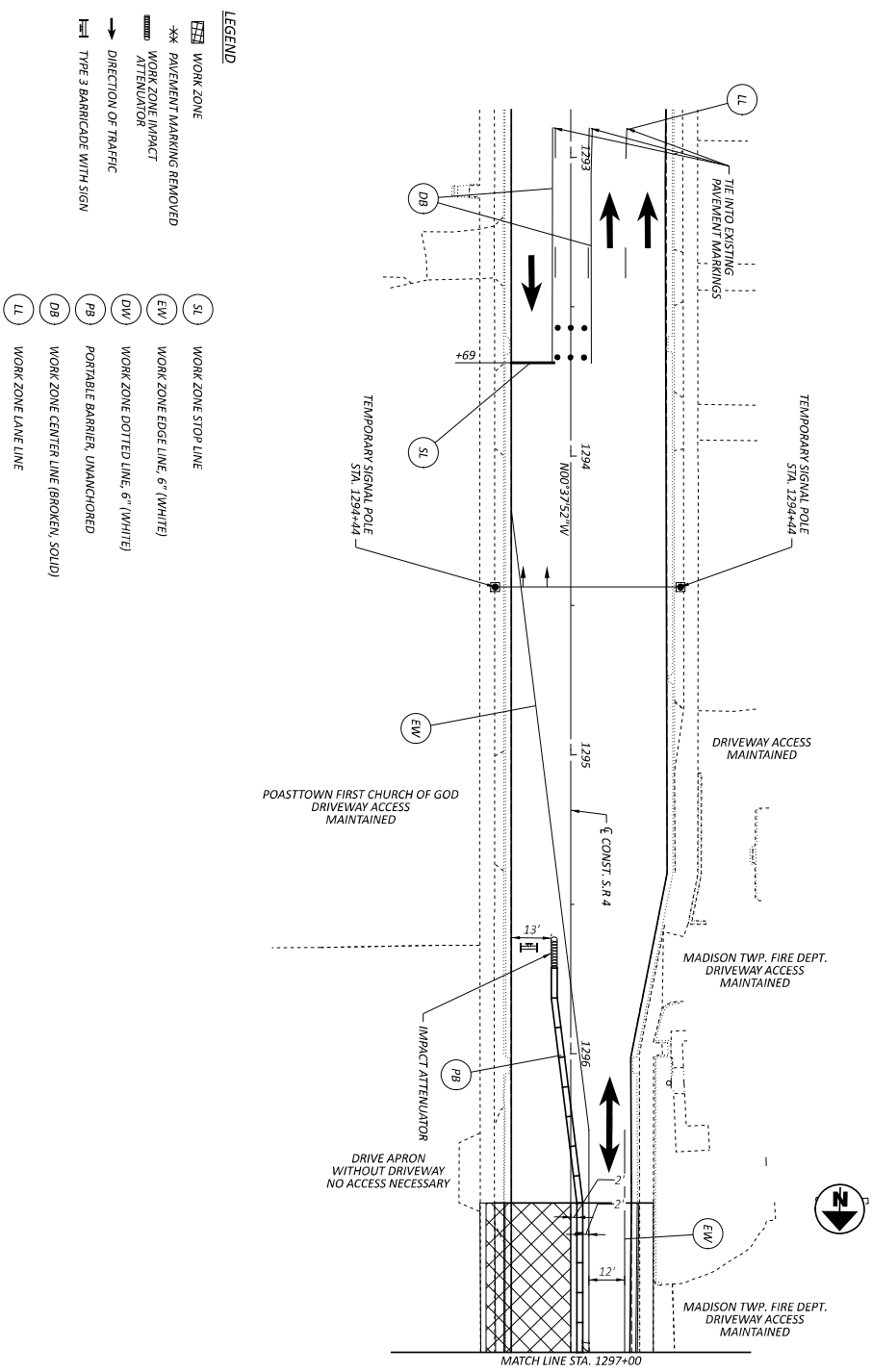

SHEET P.1 / TOTAL 3	PROJECT ID 117275	REVIEWER CWP 05-01-24	DESIGNER CJD	DESIGN AGENCY CHAGRIN VALLEY ENGINEERING, LTD.	HORIZONTAL SCALE IN FEET 0 20 10 40

MAINTENANCE OF TRAFFIC - STAGE 1, PHASE 2 (14.5' VC OPTION)
S.R. 4 - BEGIN TO STA. 1297+00

MODEL: CLP_SR4 14.5 FT2 - Plan 2 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 9:09:48 AM USER: cdunlap
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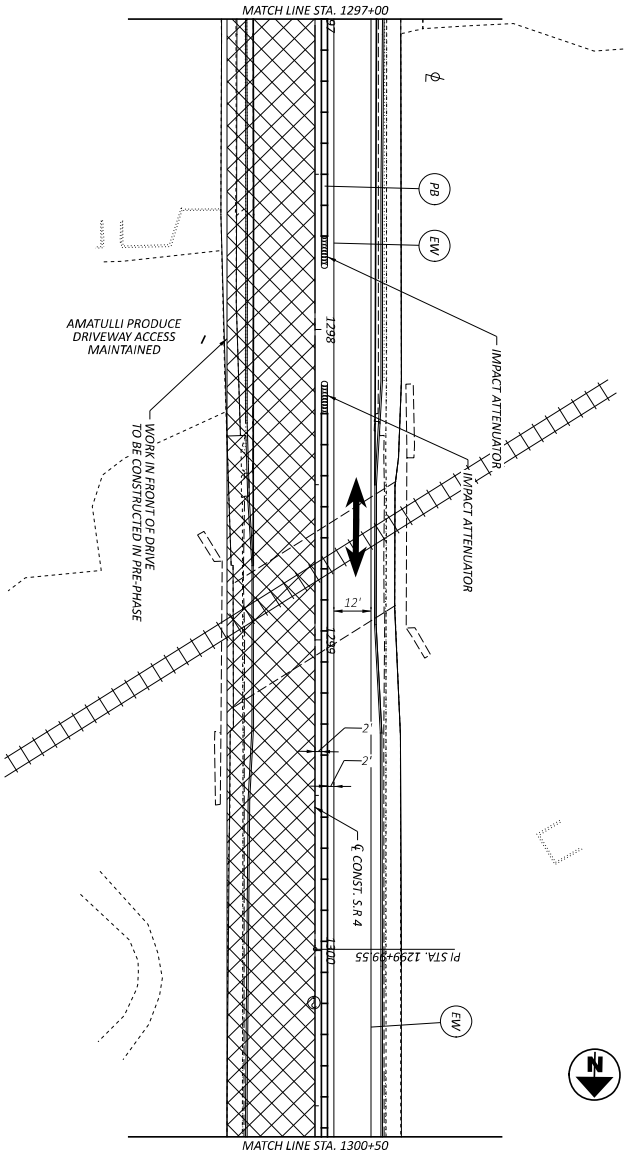
LEGEND

- WORK ZONE
- PAVEMENT MARKING REMOVED
- WORK ZONE IMPACT ATTENUATOR
- DIRECTION OF TRAFFIC
- TYPE 3 BARRICADE WITH SIGN
- (SL) WORK ZONE STOP LINE
- (EW) WORK ZONE EDGE LINE, 6" (WHITE)
- (DW) WORK ZONE DOTTED LINE, 6" (WHITE)
- (PB) PORTABLE BARRIER, UNANCHORED
- (DB) WORK ZONE CENTER LINE (BROKEN, SOLID)
- (LL) WORK ZONE LANE LINE



MAINTENANCE OF TRAFFIC - STAGE 1, PHASE 2 (14.5' VC OPTION)
S.R. 4 - STA. 1297+00 TO STA. 1300+50

HORIZONTAL SCALE IN FEET
0 20
10 40

SHEET	TOTAL
P.2	3

PROJECT ID: 117275
REVIEWER: CWP 05-01-24
DESIGNER: CJD
DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.

MODEL: CLP_SR4 14.5 FT2 - Plan 3 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 9:09:49 AM USER: cdunlap
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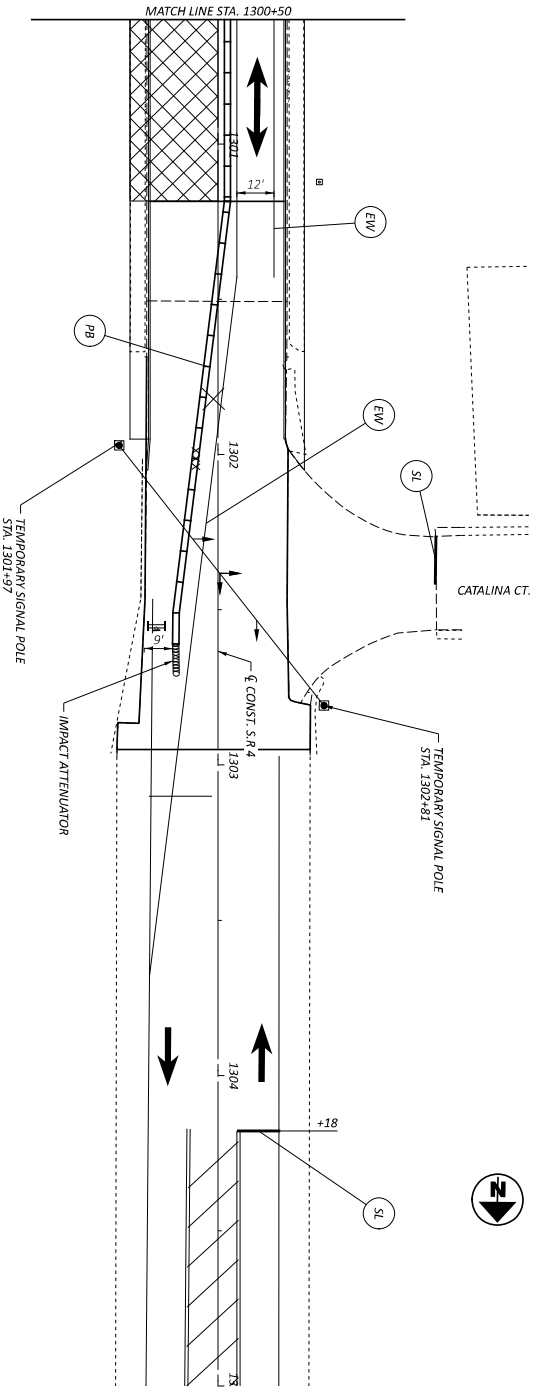
LEGEND

- WORK ZONE
- PAVEMENT MARKING REMOVED
- WORK ZONE IMPACT ATTENUATOR
- DIRECTION OF TRAFFIC
- TYPE 3 BARRICADE WITH SIGN
- SL — WORK ZONE STOP LINE
- EW — WORK ZONE EDGE LINE, 6" (WHITE)
- DW — WORK ZONE DOTTED LINE, 6" (WHITE)
- PB — PORTABLE BARRIER, UNANCHORED
- DB — WORK ZONE CENTER LINE (BROKEN, SOLID)
- LL — WORK ZONE LANE LINE



MAINTENANCE OF TRAFFIC - STAGE 1, PHASE 2 (14.5' VC OPTION)
S.R. 4 - STA. 1300+50 TO END

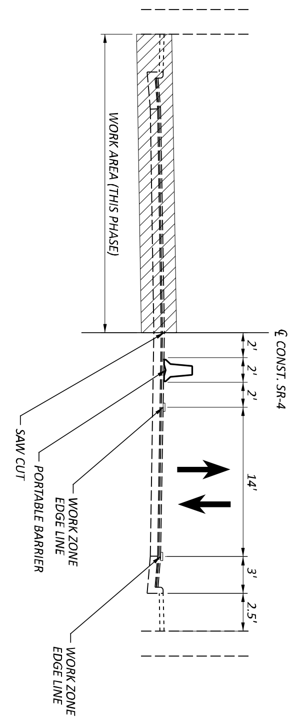
HORIZONTAL SCALE IN FEET
0 20
10 40

SHEET	TOTAL
P.3	3

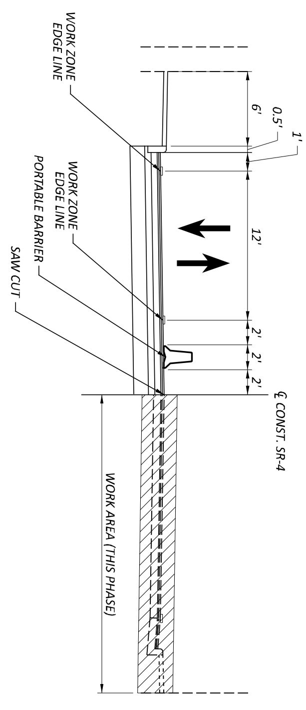
PROJECT ID 117275
REVIEWER CWP 05-01-24
DESIGNER CJD
DESIGN AGENCY CHAGRIN VALLEY ENGINEERING, LTD.

LEGEND

- WORK AREA



STAGE 1, PHASE 1 - SR-4
SECTION UNDER BRIDGE



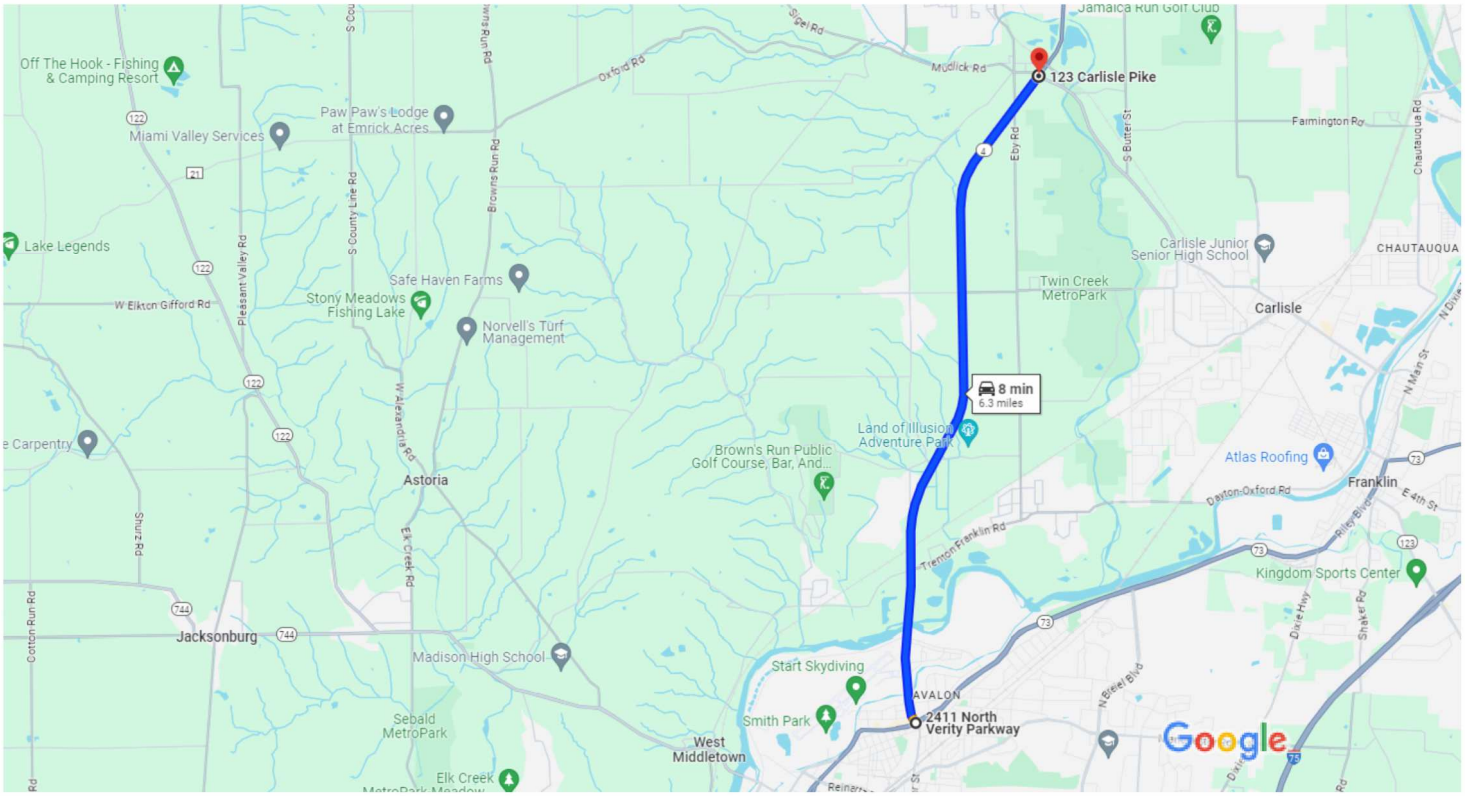
STAGE 1, PHASE 2 - SR-4
SECTION UNDER BRIDGE

MAINTENANCE OF TRAFFIC - TYPICAL SECTIONS - SR-4

DESIGN AGENCY	DESIGNER	REVIEWER	PROJECT ID	SHEET	TOTAL
CHAGRIN VALLEY ENGINEERING, LTD.	CJD	CVP 05-01-24	117275	P.1	1

Google Maps Northbound Time to Drive Normal Route Drive 6.3 miles, 8 min

BUT-004-23.90-Normal Route-NB-TYP



Map data ©2024 1 mi

2411 N Verity Pkwy
Middletown, OH 45042

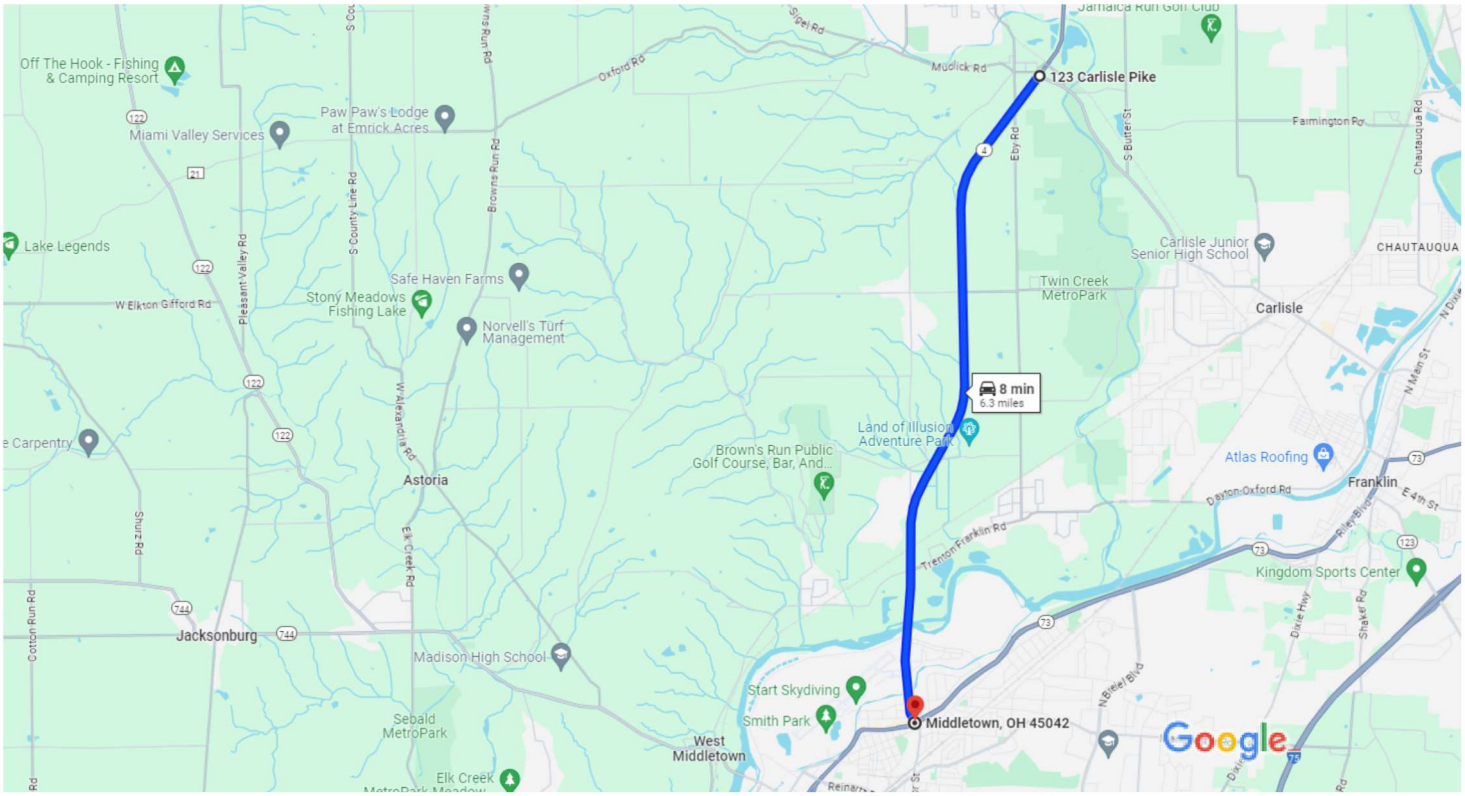
1. Head northwest on OH-4 N/Germantown Rd toward Avalon Dr
   Continue to follow OH-4 N

6.3 mi

123 Carlisle Pike
Germantown, OH 45327

Google Maps Southbound Time to Drive Normal Route Drive 6.3 miles, 8 min

BUT-004-23.90-Normal Route-SB-TYP



Map data ©2024 1 mi

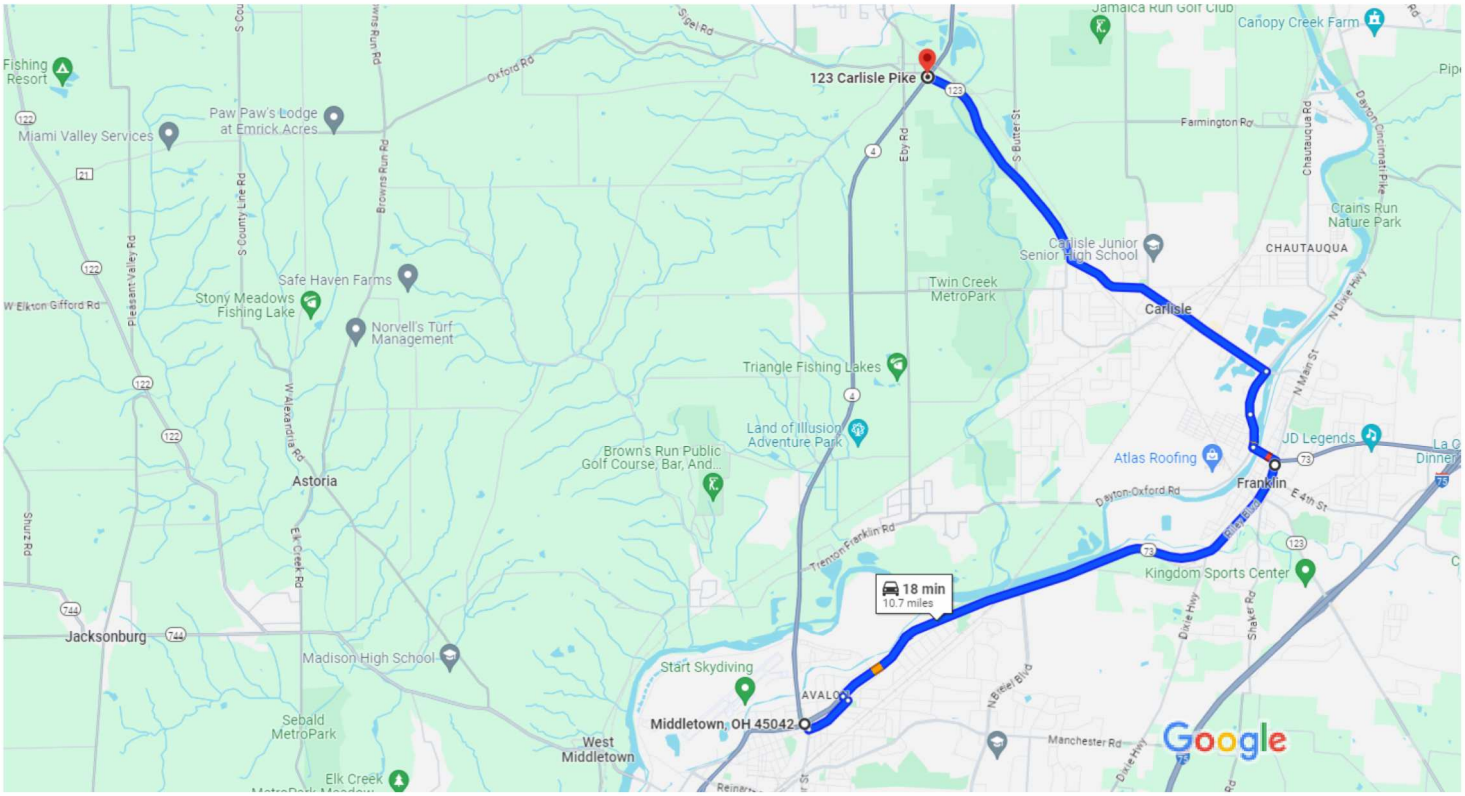
123 Carlisle Pike
Germantown, OH 45327

1. Head southwest on OH-4 S toward OH-123 S
   6.3 mi

Middletown
Ohio 45042

Google Maps Northbound Time to Drive Detour Route Drive 10.7 miles, 18 min

BUT-004-23.90-Detour 1-NB-TYP-State Route Option



Middletown
Ohio 45042

1. Head south on Germantown Rd toward Germantown Rd

404 ft

2. Turn left onto Tytus Ave

0.5 mi

3. Turn left onto Eldora Dr

325 ft

4. Turn right onto OH-73 E/N Verity Pkwy
   Continue to follow OH-73 E

4.8 mi

5. Turn left onto E 2nd St

0.2 mi

6. Turn right onto Miami Ave

0.3 mi

7. Continue onto Dayton-Oxford Rd

0.4 mi

8. Turn left onto OH-123 N/Central Ave

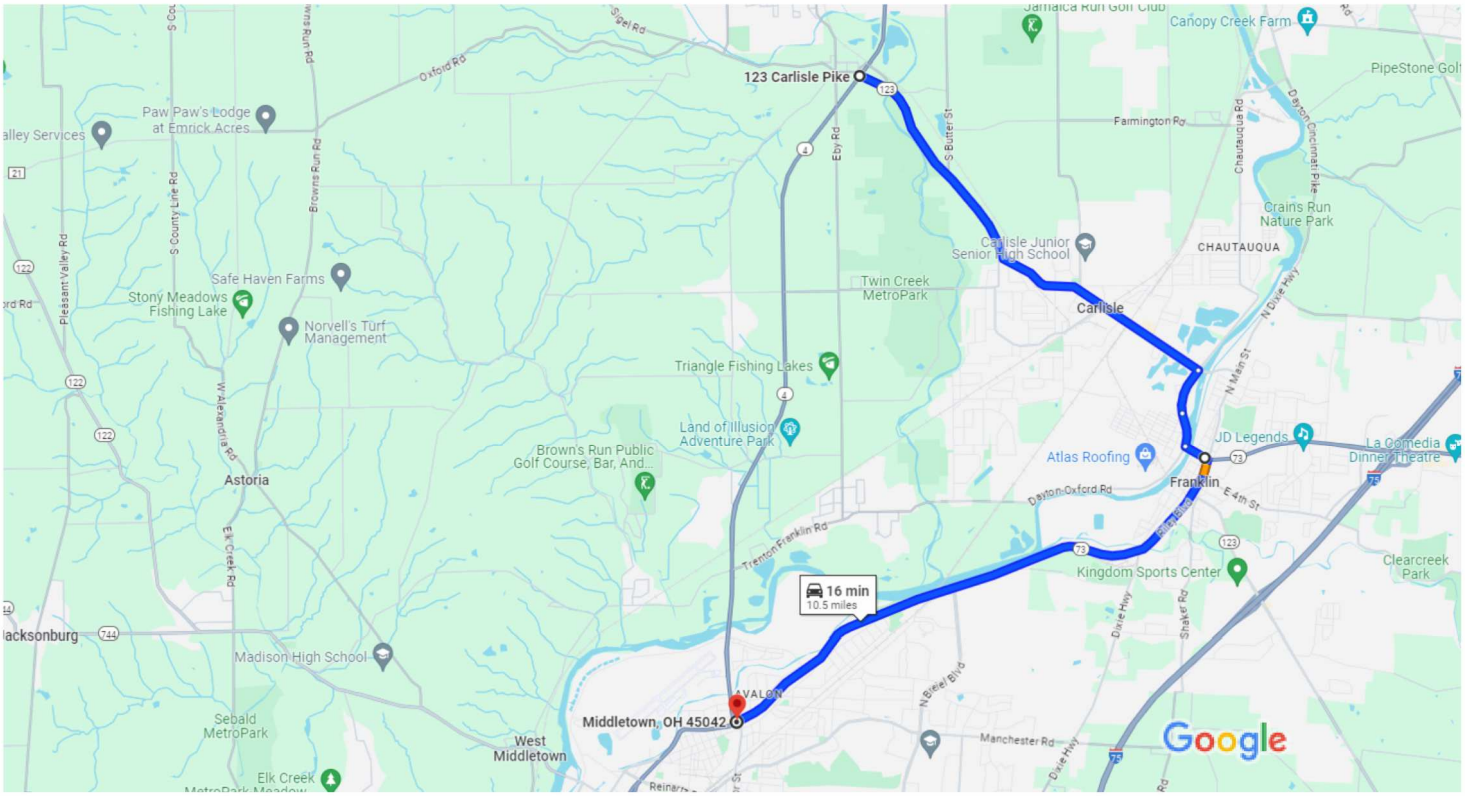
Continue to follow OH-123 N

4.3 mi

123 Carlisle Pike
Germantown, OH 45327

Google Maps Southbound Time to Drive Detour Route Drive 10.5 miles, 16 min

BUT-004-23.90-Detour 1-SB-TYP-State Route Option



Map data ©2024 1 mi

123 Carlisle Pike
Germantown, OH 45327

1. Head southeast on OH-123 S toward Sugar St — 4.3 mi
2. Turn right onto Dayton-Oxford Rd — 0.4 mi
3. Continue onto Miami Ave — 0.3 mi
4. Turn left onto W 2nd St — 0.2 mi
   Pass by Subway (on the left)
5. Turn right onto OH-73 W/Riley Blvd — 5.2 mi
   Continue to follow OH-73 W

Middletown
Ohio 45042

Work Zone User Cost Calculations

Detour (Using Actual Drive Time)

Project ID:	**117275**	
County-Route-Section:	**BUT-004-23.90-D1-NB-Typ**	
User Input:		
Construction Calendar Year:	**2023**	
	Car	**B/C Truck**
ADT of Detoured Section:	**5,690**	**237**
Time to Drive Normal Route (Min):	**8**	**8**
Time to Drive Detour Route (Min):	**18**	**18**
Duration of Closure (Days):	**60**	
Calculated Values:		
User Cost per Vehicle per Hour:	$26.13	$70.52
Delay (Min):	10	10
Delay (Hours):	0.167	0.167
Delay Cost per Vehicle:	$4.35	$11.75
Delay Cost per Day:	$24,775.38	$2,785.50
Delay Cost for Closure Duration:	$1,486,523	$167,130
Total Delay Cost for Closure Duration:	**$1,653,653**	
Average Delay Cost per Day:	**$27,561**	

Notes ***(description, detour route, project phase reference, etc, as applicable)*** **:**
******TIP: Alt+Enter for a line break in the box below.******

Detour 1 - Northbound - Typical Hour - State Route 1
ADT volumes from ODOT AADT with ODOT seasonal adjustment factors applied

Form Version Date: 2/27/2024

Fill in all highlighted cells.

The Average Delay Cost per Day is the MAXIMUM that may be used as incentive / disincentive.

Date Calculated: 5/1/2024

Work Zone User Cost Calculations		
Detour (Using Actual Drive Time)		
Project ID:	**117275**	
County-Route-Section:	**BUT-004-23.90-D1-SB-Typ**	
User Input:		
Construction Calendar Year:	**2023**	
	Car	B/C Truck
ADT of Detoured Section:	**5,541**	**238**
Time to Drive Normal Route (Min):	**8**	**8**
Time to Drive Detour Route (Min):	**16**	**16**
Duration of Closure (Days):	**60**	
Calculated Values:		
User Cost per Vehicle per Hour:	$26.13	$70.52
Delay (Min):	8	8
Delay (Hours):	0.133	0.133
Delay Cost per Vehicle:	$3.48	$9.40
Delay Cost per Day:	$19,301.28	$2,237.80
Delay Cost for Closure Duration:	$1,158,077	$134,268
Total Delay Cost for Closure Duration:	**$1,292,345**	
Average Delay Cost per Day:	**$21,539**	

Notes ***(description, detour route, project phase reference, etc, as applicable)*** **:**
******TIP: Alt+Enter for a line break in the box below.******

Detour 1 - Southbound - Typical Hour - State Route 1
ADT volumes from ODOT AADT with ODOT seasonal adjustment factors applied

Form Version Date: 2/27/2024

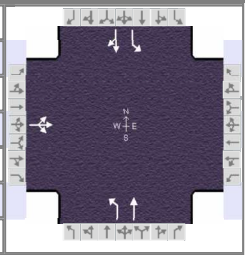
Fill in all highlighted cells.

The Average Delay Cost per Day is the MAXIMUM that may be used as incentive / disincentive.

Date Calculated: 2024-05-01

HCS Signalized Intersection Results Summary

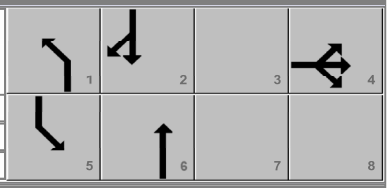
General Information				Intersection Information	
Agency	CVE			Duration, h	0.250
Analyst	ALM	Analysis Date	Apr 26, 2024	Area Type	Other
Jurisdiction	ODOT	Time Period	AM Peak	PHF	0.91
Urban Street	BUT-4	Analysis Year	2024	Analysis Period	1> 7:00
Intersection	Catalina & BUT-4	File Name	117275-BUT-4-23.90-WZ-AM.xus		
Project Description	BUT-004-23.90 Feasibility AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	12	0	11				1	361		0	310	10

Signal Information			
Cycle, s	150.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off

Green	34.0	31.0	10.0	0.0	0.0	0.0	
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
Red	22.0	22.0	19.0	0.0	0.0	0.0	



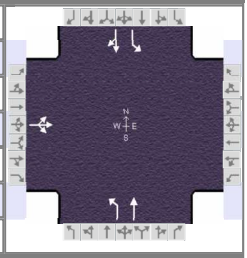
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			1	6	5	2
Case Number		12.0			2.0	4.0	2.0	4.0
Phase Duration, s		33.0			60.0	60.0	57.0	57.0
Change Period, ($Y+R_c$), s		23.0			26.0	26.0	26.0	26.0
Max Allow Headway (*MAH*), s		2.9			2.8	2.7	0.0	2.7
Queue Clearance Time (g_s), s		4.3			2.1	36.0		33.0
Green Extension Time (g_e), s		0.0			0.0	0.0	0.0	0.0
Phase Call Probability		1.00			1.00	1.00		1.00
Max Out Probability		0.00			0.00	1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14				1	6		5	2	12
Adjusted Flow Rate (*v*), veh/h		25					1	397		0	352	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1573					1667	1702		1667	1693	
Queue Service Time (g_s), s		2.3					0.1	34.0		0.0	31.0	
Cycle Queue Clearance Time (g_c), s		2.3					0.1	34.0		0.0	31.0	
Green Ratio (*g/C*)		0.07					0.23	0.23		0.21	0.21	
Capacity (*c*), veh/h		105					378	386		344	350	
Volume-to-Capacity Ratio (*X*)		0.241					0.003	1.028		0.000	1.005	
Back of Queue (*Q*), ft/ln (95 th percentile)		42					2	722		0	644	
Back of Queue (*Q*), veh/ln (95 th percentile)		1.7					0.1	28.2		0.0	25.1	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.04					0.00	0.72		0.00	0.64	
Uniform Delay (d_1), s/veh		66.4					44.9	58.0		0.0	59.5	
Incremental Delay (d_2), s/veh		0.4					0.0	53.2		0.0	49.4	
Initial Queue Delay (d_3), s/veh		0.0					0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		66.8					44.9	111.2		0.0	108.9	
Level of Service (LOS)		E					D	F			F	
Approach Delay, s/veh / LOS	66.8	E		0.0			111.0	F		108.9	F	
Intersection Delay, s/veh / LOS	108.6						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.97	B	1.97	B	1.44	A	1.73	B
Bicycle LOS Score / LOS	0.53	A			1.14	A	1.07	A

HCS Signalized Intersection Results Summary

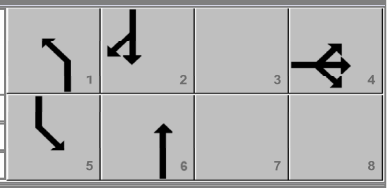
General Information				Intersection Information	
Agency	CVE			Duration, h	0.250
Analyst	ALM	Analysis Date	Apr 26, 2024	Area Type	Other
Jurisdiction	ODOT	Time Period	PM Peak	PHF	0.92
Urban Street	BUT-4	Analysis Year	2024	Analysis Period	1> 7:00
Intersection	Catalina & BUT-4	File Name	117275-BUT-4-23.90-WZ-PM.xus		
Project Description	BUT-004-23.90 Feasibility PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	13	0	14				1	521		0	570	17

Signal Information			
Cycle, s	150.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off

Green	30.5	34.5	10.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	22.0	22.0	19.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			1	6	5	2
Case Number		12.0			2.0	4.0	2.0	4.0
Phase Duration, s		33.0			56.5	56.5	60.5	60.5
Change Period, (*Y+R c*), s		23.0			26.0	26.0	26.0	26.0
Max Allow Headway (*MAH*), s		2.9			2.8	2.7	0.0	2.7
Queue Clearance Time (*g s*), s		4.7			2.1	32.5		36.5
Green Extension Time (*g e*), s		0.0			0.0	0.0	0.0	0.0
Phase Call Probability		1.00			1.00	1.00		1.00
Max Out Probability		0.01			0.00	1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14				1	6		5	2	12
Adjusted Flow Rate (*v*), veh/h		29					1	566		0	638	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1566					1667	1716		1667	1707	
Queue Service Time (*g s*), s		2.7					0.1	30.5		0.0	34.5	
Cycle Queue Clearance Time (*g c*), s		2.7					0.1	30.5		0.0	34.5	
Green Ratio (*g/C*)		0.07					0.20	0.20		0.23	0.23	
Capacity (*c*), veh/h		104					339	349		383	393	
Volume-to-Capacity Ratio (*X*)		0.281					0.003	1.623		0.000	1.625	
Back of Queue (*Q*), ft/ln (95 th percentile)		49					2	1629		0	1827	
Back of Queue (*Q*), veh/ln (95 th percentile)		2.0					0.1	64.1		0.0	71.9	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.05					0.00	1.63		0.00	1.83	
Uniform Delay (*d 1*), s/veh		66.6					47.6	59.8		0.0	57.8	
Incremental Delay (*d 2*), s/veh		0.5					0.0	293.3		0.0	292.8	
Initial Queue Delay (*d 3*), s/veh		0.0					0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		67.1					47.6	353.0		0.0	350.5	
Level of Service (LOS)		E					D	F			F	
Approach Delay, s/veh / LOS	67.1	E		0.0			352.5	F		350.5	F	
Intersection Delay, s/veh / LOS	344.7						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.97	B	1.97	B	1.43	A	1.72	B
Bicycle LOS Score / LOS	0.54	A			1.42	A	1.54	B

Standard Delay Calculation

BUT-4-23.90

Urban Principal Arterial Other

	Hour	Total		Delay (sec) per vehicle NB	SB	Wtd Avg	# veh	adjusted total delay **per vehicle** (s)	**(min)**	(hr)	Total delay (**per day**) (s)	(min)	**(hr)**
	0	381539	0.4%										
	1	209414	0.2%										
	2	205634	0.2%										
	3	305070	0.3%										
	4	752663	0.7%										
	5	2169597	2.0%										
	6	4532997	4.3%										
7:15 - 8:15	7	6961304	6.6%	111.2	108.9	110.1	681						
	8	6735787	6.3%										
	9	5835601	5.5%										
	10	5695212	5.4%										
	11	6280389	5.9%										
	12	6720306	6.3%										
	13	6761167	6.4%										
	14	7552831	7.1%										
	15	8566672	8.1%										
4:30 - 5:30	16	9116646	8.6%	353	350.5	351.7	1108						
	17	8767295	8.3%										
	18	6213536	5.9%										
	19	4371985	4.1%										
	20	3244956	3.1%										
	21	2289937	2.2%										
	22	1490170	1.4%										
	23	932973	0.9%										
		106093681	1.00	128	126	127	11805	123	**2.0**	0.03	1,401,455	23,357.6	**389.29**
						254	**11415**						

Urban Local

Hour	Total		EB	# veh	total delay
0	1862	0.6%			
1	688	0.2%			
2	589	0.2%			
3	740	0.2%			
4	1683	0.5%			
5	4301	1.4%			
6	10421	3.3%			
7	21067	6.7%	66.8	23	
8	23116	7.3%			
9	17144	5.4%			
10	16035	5.1%			
11	19365	6.1%			
12	20434	6.5%			
13	19797	6.3%			
14	23074	7.3%			
15	26274	8.3%			
16	26959	8.6%	67.1	27	
17	26924	8.5%			
18	17712	5.6%			
19	13272	4.2%			
20	9830	3.1%			
21	6380	2.0%			
22	4570	1.4%			
23	3069	1.0%			
	315306	1.00			

SAF 0.975
(U03 Mon, June)

	NB	SB
AADT	5779	5635
ADT	5927	5779

NB veh / day	Calc	5820.05956
	MS2 ADT	**5927**
SB veh / day	Calc	5985.02724
	MS2 ADT	**5779**

	NB	SB
MS2 % Cars	96%	96%
MS2 % Trucks	4%	4%

ODOT RUC User cost per Vehicle per hour
Cars $ 26.13
Trucks $ 70.52

NB

adjusted total delay **per vehicle** (s)	**(min)**	(hr)	Total delay (**per day**) (s)	(min)	**(hr)**
130	2.2	0.036	770,363	12,839	213.99

Vehicles by type (**per day**) Total	Cars	Trucks	Total User Cost (**per day**) Cars	Trucks	Total
5927	5690	237	$ 5,367.96	$ 603.42	**$ 5,971.38**

SB

adjusted total delay **per vehicle** (s)	**(min)**	(hr)	Total delay (**per day**) (s)	(min)	**(hr)**
122	2.0	0.034	704,819	11,747	195.78

Vehicles by type (**per day**) Total	Cars	Trucks	Total User Cost (**per day**) Cars	Trucks	Total
5779	5541	238	$ 4,905.13	$ 568.61	**$ 5,473.73**

Appendix H

BUT-4 Preliminary Cost Estimate

BUT-4-23.90; PID 117275
Preliminary Estimate of Probable Costs For Feasibility Study

Items	Unit	Unit Cost $ (2023)	Quantity	Total $
Construction Costs - BUT-4-23.90 - Alternate 1 (13.8' Vertical Clearance)				
Roadway				
Clearing and Grubbing	Lump	$10,000	1	$10,000
Walk Removed	Sq Ft	$4	3986	$15,944
Curb Removed	Ft	$7.25	899	$6,518
Curb and Gutter Removed	Ft	$11.50	261	$3,002
Excavation	Cu Yd	$18	131	$2,358
Excavation, As Per Plan (Retention Pond)	Cu Yd	$25	433	$10,825
Subgrade Compaction	Sq Yd	$3	899	$2,697
Excavation of Subgrade	Cu Yd	$26	352	$9,152
Granular Material, Type C, As Per Plan	Cu Yd	$65	352	$22,880
Proof Rolling	Hour	$325	1	$325
Geotextile Fabric	Sq Yd	$2	899	$1,798
4" Concrete Walk	Sq Ft	$8.50	5160	$43,860
Curb Ramp	Sq Ft	$18.50	144	$2,664
Erosion Control				
Seeding and Mulching	Sq Yd	$2	318	$636
Erosion Control	Each	$1	27457	$27,457
Drainage				
Special - Fill and Plug Existing Conduit	Ft	$30	24	$720
Pipe Removed, 24" and Under	Ft	$22	43	$946
Pipe Removed, Over 24"	Ft	$35	67	$2,345
Catch Basin Removed	Each	$425	5	$2,125
Special - Pipe Cleanout, 24" and Under	Ft	$22	304	$6,688
Special - Pipe Cleanout, 27" to 48"	Ft	$34	257	$8,738
Special - Pipe Cleanout, Over 48"	Ft	$33	321	$10,593
6" Shallow Pipe Underdrains with Geotextile Fabric	Ft	$12	726	$8,712
6" Conduit, Type F for Underdrain Outlets	Ft	$25	40	$1,000
12" Conduit, Type B	Ft	$110	140	$15,400
Catch Basin, No. 3	Each	$4,500	7	$31,500
Catch Basin, No. 3A	Each	$3,500	1	$3,500
Manhole, No. 3	Each	$5,500	2	$11,000
Manhole Adjusted to Grade	Each	$900	13	$11,700
Flap Gate	Lump	$110,000	1	$110,000
Drainage Misc.	Lump	$40,000	1	$40,000
Pavement				
Pavement Removed	Sq Yd	$12	899	$10,788
Full Depth Pavement Sawing	Ft	$3.50	683	$2,391
Pavement Planing, Asphalt Concrete	Sq Yd	$2	21920	$43,840
Asphalt Concrete Base, PG64-22, (449)	Cu Yd	$200	131	$26,200
Aggregate Base	Cu Yd	$70	131	$9,170
1.25" Asphalt Concrete Surface Course, Type 1, (448), PG64-22	Cu Yd	$210	802	$168,420
1.75" Asphalt Concrete Intermediate Course, Type 2, (448)	Cu Yd	$255	1120	$285,600
Non-Tracking Tack Coat	Gal	$4	1416	$5,664
Tack Coat, 702.13	Gal	$4	1460	$5,840
Combination Curb and Gutter, Type 2	Ft	$30	287	$8,610
Curb, Type 6	Ft	$28	674	$18,872
Traffic Control				
RPM	Each	$40	55	$2,200
Edge Line, 6"	Mile	$4,200	1.79	$7,518
Lane Line, 6"	Mile	$3,400	0.99	$3,366
Center Line	Mile	$5,000	0.65	$3,250
Channelizing Line, 8"	Ft	$3	569	$1,707
Stop Line	Ft	$14	74	$1,036
Transverse/Diagonal Line	Ft	$11	636	$6,996
Island Marking	Sf	$8	170	$1,360
Lane Arrow	Each	$200	17	$3,400
Signing Misc.	Lump	$2,000	1	$2,000
Traffic Signals				
Detector Loop	Each	$1,850	4	$7,400
Maintenance of Traffic				
Law Enforcement Officer with Patrol Car for Assistance	Hour	$82	32	$2,624
Special - Work Zone Traffic Signal	Each	$25,000	1	$25,000
Increased Barrier Delineation	Ft	$2	621	$1,242
Work Zone Impact Attenuator, 24" Wide Hazards, (Bidirectional)	Each	$2,300	8	$18,400
Detour Signing	Lump	$15,000	1	$15,000
Work Zone Lighting System	Each	$13,000	1	$13,000
Barrier Reflector, Type 1, Bidirectional	Each	$12	17	$204
Object Marker, Two Way	Each	$19	17	$323
Work Zone Lane Line, Class I, 642 Paint	Mile	$700	0.01	$10
Work Zone Center Line, Class I, 642 Paint	Mile	$1,500	0.03	$45
Work Zone Edge Line, Class I, 6", 642 Paint	Mile	$1,000	0.27	$273
Work Zone Edge Line, Class I, 6", 740.06, Type I	Mile	$10,300	0.07	$687
Work Zone Dotted Line, Class I, 6", 642 Paint	Ft	$1	93	$93
Work Zone Stop Line, Class I, 740.06, Type I	Ft	$20	56	$1,120
Portable Barrier, Unanchored	Ft	$15	621	$9,315
Removal of Pavement Marking	Ft	$2	1121	$2,242
Removal of Pavement Marking	Each	$225	2	$450
Primary Cost Drivers Subtotal				**$1,140,737**
Incidentals				
Railroad Insurance	Lump		1	$12,500
Maintenance of Traffic (MOT)	Lump		1	$34,222
Construction Layout Stakes	Lump		1	$8,556
Field Office, Type B	Month	$2,200	8	$17,600
Mobilization	Lump		1	$22,815
Contingencies for items not included (30%)	Lump		1	$342,221
R/W				
CSX Railroad Construction Agreement	Lump			$10,000
Summary of Probable Construction Costs 2024				**$1,589,000**
Probable Construction Costs Including 18.9% for 2027				**$1,890,000**
Right-of-Way Acquisition Costs				**$0**
TOTAL ESTIMATED PROJECT COST				**$1,890,000**

BUT-4-23.90; PID 117275
Preliminary Estimate of Probable Costs For Feasibility Study

Items	Unit	Unit Cost $ (2023)	Quantity	Total $
Construction Costs - BUT-4-23.90 - Alternate 2 (14.0' Vertical Clearance)				
Roadway				
Clearing and Grubbing	Lump	$15,000	1	$15,000
Walk Removed	Sq Ft	$4	3986	$15,944
Curb Removed	Ft	$7.25	612	$4,437
Curb and Gutter Removed	Ft	$11.50	316	$3,634
Excavation	Cu Yd	$18	285	$5,130
Excavation, As Per Plan (Retention Pond)	Cu Yd	$25	517	$12,925
Subgrade Compaction	Sq Yd	$3	1682	$5,046
Excavation of Subgrade	Cu Yd	$26	629	$16,354
Granular Material, Type C, As Per Plan	Cu Yd	$65	629	$40,885
Proof Rolling	Hour	$325	1	$325
Geotextile Fabric	Sq Yd	$2	1682	$3,364
4" Concrete Walk	Sq Ft	$8.50	5160	$43,860
Curb Ramp	Sq Ft	$18.50	144	$2,664
Erosion Control				
Seeding and Mulching	Sq Yd	$2	530	$1,060
Erosion Control	Each	$1	27932	$27,932
Drainage				
Special - Fill and Plug Existing Conduit	Ft	$30	24	$720
Pipe Removed, 24" and Under	Ft	$22	43	$946
Pipe Removed, Over 24"	Ft	$35	67	$2,345
Catch Basin Removed	Each	$425	5	$2,125
Special - Pipe Cleanout, 24" and Under	Ft	$22	304	$6,688
Special - Pipe Cleanout, 27" to 48"	Ft	$34	257	$8,738
Special - Pipe Cleanout, Over 48"	Ft	$33	321	$10,593
6" Shallow Pipe Underdrains with Geotextile Fabric	Ft	$12	726	$8,712
6" Conduit, Type F for Underdrain Outlets	Ft	$25	40	$1,000
12" Conduit, Type B	Ft	$110	140	$15,400
Catch Basin, No. 3	Each	$4,500	7	$31,500
Catch Basin, No. 3A	Each	$3,500	1	$3,500
Manhole, No. 3	Each	$5,500	2	$11,000
Manhole Adjusted to Grade	Each	$900	13	$11,700
Flap Gate	Lump	$110,000	1	$110,000
Drainage Misc.	Lump	$40,000	1	$40,000
Pavement				
Pavement Removed	Sq Yd	$12	1629	$19,548
Full Depth Pavement Sawing	Ft	$3.50	90	$315
Pavement Planing, Asphalt Concrete	Sq Yd	$2	21662	$43,324
Asphalt Concrete Base, PG64-22, (449)	Cu Yd	$200	273	$54,600
Aggregate Base	Cu Yd	$70	273	$19,110
1.25" Asphalt Concrete Surface Course, Type 1, (448), PG64-22	Cu Yd	$210	816	$171,360
1.75" Asphalt Concrete Intermediate Course, Type 2, (448)	Cu Yd	$255	1141	$290,955
Non-Tracking Tack Coat	Gal	$4	1591	$6,364
Tack Coat, 702.13	Gal	$4	1430	$5,720
Combination Curb and Gutter, Type 2	Ft	$30	316	$9,480
Curb, Type 6	Ft	$28	674	$18,872
8" Non-Reinforced Concrete Pavement, Class QC MS (Drives)	Sq Yd	$100	72	$7,200
Traffic Control				
RPM	Each	$40	55	$2,200
Edge Line, 6"	Mile	$4,200	1.82	$7,644
Lane Line, 6"	Mile	$3,400	0.99	$3,366
Center Line	Mile	$5,000	0.69	$3,450
Channelizing Line, 8"	Ft	$3	569	$1,707
Stop Line	Ft	$14	74	$1,036
Transverse/Diagonal Line	Ft	$11	724	$7,964
Island Marking	Sf	$8	255	$2,040
Lane Arrow	Each	$200	17	$3,400
Signing Misc.	Lump	$2,000	1	$2,000
Traffic Signals				
Detector Loop	Each	$1,850	4	$7,400
Maintenance of Traffic				
Law Enforcement Officer with Patrol Car for Assistance	Hour	$82	32	$2,624
Special - Work Zone Traffic Signal	Each	$25,000	1	$25,000
Increased Barrier Delineation	Ft	$2	989	$1,978
Work Zone Impact Attenuator, 24" Wide Hazards, (Bidirectional)	Each	$2,300	8	$18,400
Detour Signing	Lump	$15,000	1	$15,000
Work Zone Lighting System	Each	$13,000	1	$13,000
Barrier Reflector, Type 1, Bidirectional	Each	$12	24	$288
Object Marker, Two Way	Each	$19	24	$456
Work Zone Lane Line, Class I, 642 Paint	Mile	$700	0.01	$10
Work Zone Center Line, Class I, 642 Paint	Mile	$1,500	0.03	$45
Work Zone Edge Line, Class I, 6", 642 Paint	Mile	$1,000	0.34	$343
Work Zone Edge Line, Class I, 6", 740.06, Type I	Mile	$10,300	0.14	$1,405
Work Zone Dotted Line, Class I, 6", 642 Paint	Ft	$1	93	$93
Work Zone Stop Line, Class I, 740.06, Type I	Ft	$20	56	$1,120
Portable Barrier, Unanchored	Ft	$15	989	$14,835
Removal of Pavement Marking	Ft	$2	1121	$2,242
Removal of Pavement Marking	Each	$225	2	$450
Primary Cost Drivers Subtotal				**$1,249,871**
Incidentals				
Railroad Insurance	Lump		1	$12,500
Maintenance of Traffic (MOT)	Lump		1	$37,496
Construction Layout Stakes	Lump		1	$9,374
Field Office, Type B	Month	$2,200	8	$17,600
Mobilization	Lump		1	$24,997
Contingencies for items not included (30%)	Lump		1	$374,961
R/W				
CSX Railroad Construction Agreement	Lump			$10,000
Summary of Probable Construction Costs 2024				**$1,737,000**
Probable Construction Costs Including 18.9% for 2027				**$2,070,000**
Right-of-Way Acquisition Costs				**$0**
TOTAL ESTIMATED PROJECT COST				**$2,070,000**

BUT-4-23.90; PID 117275
Preliminary Estimate of Probable Costs For Feasibility Study

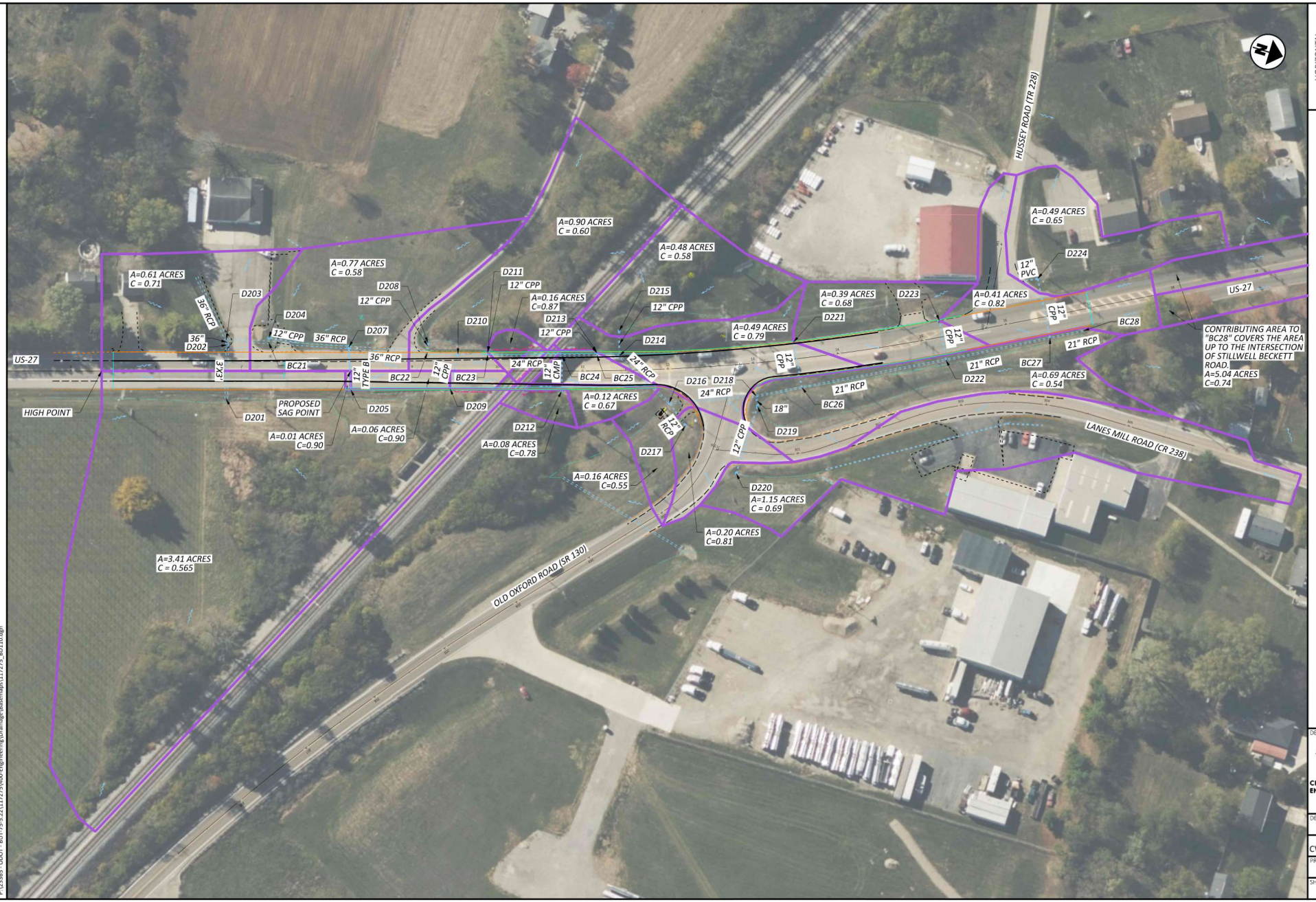
Items	Unit	Unit Cost $ (2023)	Quantity	Total $
Construction Costs - BUT-4-23.90 - Alternate 3 (14.5' Vertical Clearance)				
Roadway				
Clearing and Grubbing	Lump	$25,000	1	$25,000
Walk Removed	Sq Ft	$4	3986	$15,944
Curb Removed	Ft	$7.25	612	$4,437
Curb and Gutter Removed	Ft	$11.50	316	$3,634
Excavation	Cu Yd	$18	367	$6,606
Excavation, As Per Plan (Retention Pond)	Cu Yd	$25	782	$19,550
Subgrade Compaction	Sq Yd	$3	2243	$6,729
Excavation of Subgrade	Cu Yd	$26	823	$21,398
Granular Material, Type C, As Per Plan	Cu Yd	$65	823	$53,495
Proof Rolling	Hour	$325	2	$650
Geotextile Fabric	Sq Yd	$2	2243	$4,486
4" Concrete Walk	Sq Ft	$8.50	5160	$43,860
Curb Ramp	Sq Ft	$18.50	144	$2,664
Erosion Control				
Seeding and Mulching	Sq Yd	$2	800	$1,600
Erosion Control	Each	$1	28299	$28,299
Drainage				
Special - Fill and Plug Existing Conduit	Ft	$30	24	$720
Pipe Removed, 24" and Under	Ft	$22	43	$946
Pipe Removed, Over 24"	Ft	$35	67	$2,345
Catch Basin Removed	Each	$425	5	$2,125
Special - Pipe Cleanout, 24" and Under	Ft	$22	304	$6,688
Special - Pipe Cleanout, 27" to 48"	Ft	$34	257	$8,738
Special - Pipe Cleanout, Over 48"	Ft	$33	321	$10,593
6" Shallow Pipe Underdrains with Geotextile Fabric	Ft	$12	726	$8,712
6" Conduit, Type F for Underdrain Outlets	Ft	$25	40	$1,000
12" Conduit, Type B	Ft	$110	140	$15,400
Catch Basin, No. 3	Each	$4,500	7	$31,500
Catch Basin, No. 3A	Each	$3,500	1	$3,500
Manhole, No. 3	Each	$5,500	2	$11,000
Manhole Adjusted to Grade	Each	$900	13	$11,700
Flap Gate	Lump	$110,000	1	$110,000
Drainage Misc.	Lump	$40,000	1	$40,000
Pavement				
Pavement Removed	Sq Yd	$12	2190	$26,280
Full Depth Pavement Sawing	Ft	$3.50	90	$315
Pavement Planing, Asphalt Concrete	Sq Yd	$2	21502	$43,004
Asphalt Concrete Base, PG64-22, (449)	Cu Yd	$200	364	$72,800
Aggregate Base	Cu Yd	$70	355	$24,850
1.25" Asphalt Concrete Surface Course, Type 1, (448), PG64-22	Cu Yd	$210	829	$174,090
1.75" Asphalt Concrete Intermediate Course, Type 2, (448)	Cu Yd	$255	1160	$295,800
Non-Tracking Tack Coat	Gal	$4	1634	$6,536
Tack Coat, 702.13	Gal	$4	1449	$5,796
Combination Curb and Gutter, Type 2	Ft	$30	316	$9,480
Curb, Type 6	Ft	$28	674	$18,872
8" Non-Reinforced Concrete Pavement, Class QC MS (Drives)	Sq Yd	$100	72	$7,200
Traffic Control				
RPM	Each	$40	55	$2,200
Edge Line, 6"	Mile	$4,200	1.84	$7,728
Lane Line, 6"	Mile	$3,400	0.99	$3,366
Center Line	Mile	$5,000	0.70	$3,500
Channelizing Line, 8"	Ft	$3	569	$1,707
Stop Line	Ft	$14	74	$1,036
Transverse/Diagonal Line	Ft	$11	834	$9,174
Island Marking	Sf	$8	255	$2,040
Lane Arrow	Each	$200	17	$3,400
Signing Misc.	Lump	$2,000	1	$2,000
Traffic Signals				
Detector Loop	Each	$1,850	4	$7,400
Maintenance of Traffic				
Law Enforcement Officer with Patrol Car for Assistance	Hour	$82	32	$2,624
Special - Work Zone Traffic Signal	Each	$25,000	1	$25,000
Increased Barrier Delineation	Ft	$2	1207	$2,414
Work Zone Impact Attenuator, 24" Wide Hazards, (Bidirectional)	Each	$2,300	8	$18,400
Detour Signing	Lump	$15,000	1	$15,000
Work Zone Lighting System	Each	$13,000	1	$13,000
Barrier Reflector, Type 1, Bidirectional	Each	$12	29	$348
Object Marker, Two Way	Each	$19	29	$551
Work Zone Lane Line, Class I, 642 Paint	Mile	$700	0.01	$10
Work Zone Center Line, Class I, 642 Paint	Mile	$1,500	0.03	$45
Work Zone Edge Line, Class I, 6", 642 Paint	Mile	$1,000	0.38	$384
Work Zone Edge Line, Class I, 6", 740.06, Type I	Mile	$10,300	0.18	$1,830
Work Zone Dotted Line, Class I, 6", 642 Paint	Ft	$1	93	$93
Work Zone Stop Line, Class I, 740.06, Type I	Ft	$20	56	$1,120
Portable Barrier, Unanchored	Ft	$15	1207	$18,105
Removal of Pavement Marking	Ft	$2	1121	$2,242
Removal of Pavement Marking	Each	$225	2	$450
Primary Cost Drivers Subtotal				**$1,333,509**
Incidentals				
Railroad Insurance	Lump		1	$12,500
Maintenance of Traffic (MOT)	Lump		1	$40,005
Construction Layout Stakes	Lump		1	$10,001
Field Office, Type B	Month	$2,200	8	$17,600
Mobilization	Lump		1	$26,670
Contingencies for items not included (30%)	Lump		1	$400,053
R/W				
CSX Railroad Construction Agreement	Lump			$10,000
Summary of Probable Construction Costs 2024				**$1,851,000**
Probable Construction Costs Including 18.9% for 2027				**$2,210,000**
Right-of-Way Acquisition Costs				**$0**
TOTAL ESTIMATED PROJECT COST				**$2,210,000**

BUT-4-23.90; PID 117275
Preliminary Estimate of Probable Costs For Feasibility Study

Items	Unit	Unit Cost $ (2023)	Quantity	Total $
Construction Costs - BUT-4-23.90 - Alternate 4 (15.0' Vertical Clearance)				
Roadway				
Clearing and Grubbing	Lump	$30,000	1	$30,000
Walk Removed	Sq Ft	$4	3986	$15,944
Curb Removed	Ft	$7.25	612	$4,437
Curb and Gutter Removed	Ft	$11.50	316	$3,634
Excavation	Cu Yd	$18	435	$7,830
Excavation, As Per Plan (Retention Pond)	Cu Yd	$25	1111	$27,775
Subgrade Compaction	Sq Yd	$3	2712	$8,136
Excavation of Subgrade	Cu Yd	$26	978	$25,428
Granular Material, Type C, As Per Plan	Cu Yd	$65	978	$63,570
Proof Rolling	Hour	$325	2	$650
Geotextile Fabric	Sq Yd	$2	2712	$5,424
4" Concrete Walk	Sq Ft	$8.50	5160	$43,860
Curb Ramp	Sq Ft	$18.50	144	$2,664
Erosion Control				
Seeding and Mulching	Sq Yd	$2	925	$1,850
Erosion Control	Each	$1	83311	$83,311
Drainage				
Special - Fill and Plug Existing Conduit	Ft	$30	24	$720
Pipe Removed, 24" and Under	Ft	$22	43	$946
Pipe Removed, Over 24"	Ft	$35	67	$2,345
Catch Basin Removed	Each	$425	5	$2,125
Special - Pipe Cleanout, 24" and Under	Ft	$22	304	$6,688
Special - Pipe Cleanout, 27" to 48"	Ft	$34	257	$8,738
Special - Pipe Cleanout, Over 48"	Ft	$33	321	$10,593
6" Shallow Pipe Underdrains with Geotextile Fabric	Ft	$12	726	$8,712
6" Conduit, Type F for Underdrain Outlets	Ft	$25	40	$1,000
12" Conduit, Type B	Ft	$110	140	$15,400
Catch Basin, No. 3	Each	$4,500	7	$31,500
Catch Basin, No. 3A	Each	$3,500	1	$3,500
Catch Basin Adjusted to Grade	Each	$1,050	2	$2,100
Manhole, No. 3	Each	$5,500	2	$11,000
Manhole Adjusted to Grade	Each	$900	14	$12,600
Flap Gate	Lump	$110,000	1	$110,000
Drainage Misc.	Lump	$40,000	1	$40,000
Pavement				
Pavement Removed	Sq Yd	$12	2659	$31,908
Full Depth Pavement Sawing	Ft	$3.50	94	$329
Pavement Planing, Asphalt Concrete	Sq Yd	$2	21084	$42,168
Asphalt Concrete Base, PG64-22, (449)	Cu Yd	$200	443	$88,600
Aggregate Base	Cu Yd	$70	423	$29,610
1.25" Asphalt Concrete Surface Course, Type 1, (448), PG64-22	Cu Yd	$210	828	$173,880
1.75" Asphalt Concrete Intermediate Course, Type 2, (448)	Cu Yd	$255	1159	$295,545
Non-Tracking Tack Coat	Gal	$4	1714	$6,856
Tack Coat, 702.13	Gal	$4	1447	$5,788
Combination Curb and Gutter, Type 2	Ft	$30	316	$9,480
Curb, Type 6	Ft	$28	674	$18,872
8" Non-Reinforced Concrete Pavement, Class QC MS (Drives)	Sq Yd	$100	72	$7,200
Traffic Control				
RPM	Each	$40	55	$2,200
Edge Line, 6"	Mile	$4,200	1.84	$7,728
Lane Line, 6"	Mile	$3,400	0.99	$3,366
Center Line	Mile	$5,000	0.70	$3,500
Channelizing Line, 8"	Ft	$3	569	$1,707
Stop Line	Ft	$14	74	$1,036
Transverse/Diagonal Line	Ft	$11	834	$9,174
Island Marking	Sf	$8	255	$2,040
Lane Arrow	Each	$200	17	$3,400
Signing Misc.	Lump	$2,000	1	$2,000
Traffic Signals				
Detector Loop	Each	$1,850	4	$7,400
Maintenance of Traffic				
Law Enforcement Officer with Patrol Car for Assistance	Hour	$82	32	$2,624
Special - Work Zone Traffic Signal	Each	$25,000	1	$25,000
Increased Barrier Delineation	Ft	$2	1387	$2,774
Work Zone Impact Attenuator, 24" Wide Hazards, (Bidirectional)	Each	$2,300	8	$18,400
Detour Signing	Lump	$15,000	1	$15,000
Work Zone Lighting System	Each	$13,000	1	$13,000
Barrier Reflector, Type 1, Bidirectional	Each	$12	32	$384
Object Marker, Two Way	Each	$19	32	$608
Work Zone Lane Line, Class I, 642 Paint	Mile	$700	0.01	$10
Work Zone Center Line, Class I, 642 Paint	Mile	$1,500	0.03	$45
Work Zone Edge Line, Class I, 6", 642 Paint	Mile	$1,000	0.42	$418
Work Zone Edge Line, Class I, 6", 740.06, Type I	Mile	$10,300	0.21	$2,181
Work Zone Dotted Line, Class I, 6", 642 Paint	Ft	$1	93	$93
Work Zone Stop Line, Class I, 740.06, Type I	Ft	$20	56	$1,120
Portable Barrier, Unanchored	Ft	$15	1387	$20,805
Removal of Pavement Marking	Ft	$2	1121	$2,242
Removal of Pavement Marking	Each	$225	2	$450
Primary Cost Drivers Subtotal				**$1,451,421**
Incidentals				
Railroad Insurance	Lump		1	$12,500
Maintenance of Traffic (MOT)	Lump		1	$43,543
Construction Layout Stakes	Lump		1	$10,886
Field Office, Type B	Month	$2,200	8	$17,600
Mobilization	Lump		1	$29,028
Contingencies for items not included (30%)	Lump		1	$435,426
R/W				
CSX Railroad Construction Agreement	Lump			$10,000
Temporary R/W Acquisition (PPN E2250091000004)	Acre	$42,200	0.003	$127
Summary of Probable Construction Costs 2024				**$2,011,000**
Probable Construction Costs Including 18.9% for 2027				**$2,400,000**
Right-of-Way Acquisition Costs				**$14,765**
TOTAL ESTIMATED PROJECT COST				**$2,420,000**

Appendix I

BUT-27 Drainage Area Map, Conduit Inventory and Calculations



BUT IR 75/VAR 5.22/VAR

MODEL: Design PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 9:46:12 AM USER: stan
P:\23365 - ODOT - BUT-75-5.22\117275\ODOT Engineering\Drainage\Basemaps\117275_B0110.dgn

DRAINAGE AREA MAP
BUT-27

DESIGN AGENCY
CHAGRIN VALLEY ENGINEERING, LTD.

DESIGNER	SDK
REVIEWER	CWP 04-29-2024
PROJECT ID	117275
SHEET	P.1
TOTAL	1

INLET SPACING DESIGN

PID : 117275 **Date :** 04/24/2024 **Project :** BUT IR 75/VAR/5.22/VAR **Location :** US-27

Description : Pavement Spread at Right Sag - STA 8+28.23 **Designer :** SDK

Rainfall Area: C **Storm Frequency (yr.) :** 5 **Total Allow. Spread (ft.) :** 4.00* **Allowable Depth (ft.)** 0.42

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
11+91	Begin																		
9+45	CB-3A	218.31	0.67	0.12	10.00	1.96	11.96	0.0131	0.0833	0.0160	2.00	0.0000	4.46	0.36	0.00	0.36	0.155	1.87	*5.38' SHOULDER
8+28	CB-3	116.39	0.90	0.06	10.00	2.21	12.22	0.0025	0.0833	0.0160	2.00	0.0000	4.42	******	******	0.24	0.182	2.94	Sag *7.50' SHOULDER
8+22	Begin																		
8+28	CB-3	292.02	0.90	0.01	10.00	8.94	18.94	0.0025	0.0833	0.0160	2.00	0.0000	3.54	******	******	0.03	0.086	1.03	End *7.50' SHOULDER

SUMP DATA

Total Flow (cfs) : 0.27 **Ponded Depth (ft.) :** 0.008 **Spread on Pavement (ft.) :** 1.50

* 4.0' spread allowed in through lane, add gutter and/or varying shoulder widths through limits.

INLET SPACING DESIGN

PID : 117275 **Date :** 04/24/2024 **Project :** BUT IR 75/VAR/5.22/VAR **Location :** US-27

Description : Pavement Spread at Left Sag - STA 8+28.23 **Designer :** SDK

Rainfall Area: C **Storm Frequency (yr.) :** 5 **Total Allow. Spread (ft.) :** 4.00* **Allowable Depth (ft.)** 0.42

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
22+50	Begin**																		
20+96	CB-3	154.04	0.78	0.13	10.00	2.19	12.19	0.0100	0.0160	0.0160	0.00	0.0420	4.42	0.39	0.06	0.45	0.096	5.99***	
17+78	CB-3	317.58	0.79	0.26	10.00	2.83	12.83	0.0210	0.0160	0.0160	0.00	0.0420	4.32	0.67	0.28	0.95	0.110	6.89*****	
15+25	CB-3	253.72	0.82	0.41	10.00	1.38	11.38	0.0340	0.0291	0.0291	0.00	0.0420	4.56	1.34	0.47	1.81	0.161	5.53***	
13+50	CB-3	173.39	0.68	0.39	10.00	0.65	10.66	0.0514	0.0833	0.0460	2.00	0.0000	4.69	1.66	0.05	1.71	0.215	3.06	
11+17	CB-6	230.63	0.79	0.49	10.00	1.23	11.23	0.0232	0.0833	0.0328	2.00	0.0000	4.59	1.69	0.14	1.83	0.250	4.54	*4.28' SHOULDER
9+89	CB-6	128.01	0.87	0.16	10.00	0.91	10.93	0.0176	0.0833	0.0160	2.00	0.0000	4.64	******	******	0.79	0.196	3.81 End	*4.58' SHOULDER

*4.0' spread allowed in through lane, add gutter and/or varying shoulder widths through limits.
**Not true high point, beginning of CDSS analysis is 2 upstream structures outside of survey limits to account for Bypass Flow onto project limits.
***2 ft was added to spread limit since a 14' lane is proposed.
****Note that the allowable spread is exceeded however this catch basins falls outside of the project limits.

STORM SEWER SYSTEM

PID : 117275 **Date :** 04/24/2024 **Project :** BUT IR 75/VAR/5.22/VAR **Location :** US-27

Description :US-27 Drainage Network **Designer :** SDK

Rainfall Area: C **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 12.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
BC28	BC27	17+75		5.04	3.73	35.00	2.78	3.22	10.4	12.0	21	39.9	0.0133	906.41	7.01	17.02	0.0077	907.71	908.16	0.45	0.00	MH 3
begin		16+48		5.04	3.73									905.88				907.40	907.63			0.015
D224	BC27	16+47		0.49	0.32	15.00	4.47	5.07	1.4	1.6	12	70.9	0.0490	909.72	6.85	7.35	0.0027	910.05	911.91	1.86	1.19	CB 2-2B
begin		16+48		5.53	4.05									906.25				907.02	907.25			0.015
BC27	D222	16+48		0.00	0.00	35.09	2.78	3.21	11.2	13.0	21	123.0	0.0226	905.88	8.77	22.21	0.0089	906.89	907.63	0.74	0.00	MH BC
		15+23		5.53	4.05									903.10				904.65	912.15			0.015
D223	D222	15+24		0.41	0.34	10.00	5.32	5.98	1.8	2.0	12	46.4	0.0192	907.00	5.20	4.60	0.0043	907.48	911.08	3.60	3.08	CB 3
begin		15+23		5.94	4.39									906.11				906.91	912.15			0.015
D222	BC26	15+23		0.00	0.00	35.33	2.76	3.19	12.1	14.0	21	171.9	0.0255	903.25	9.35	23.58	0.0104	904.27	912.15	7.88	7.15	MH 3
		13+54		5.94	4.39									898.87				900.44	900.62			0.015
D221	BC26	13+50		0.39	0.27	10.00	5.32	5.95	1.4	1.6	12	53.7	0.0071	899.62	3.38	2.79	0.0026	900.19	903.91	3.72	3.29	CB 3
begin		13+54		6.33	4.65									899.24				900.01	900.24			0.015
BC26	D218	13+54		0.00	0.00	35.64	2.75	3.19	12.8	14.8	21	54.4	0.0335	898.87	10.49	27.02	0.0116	899.84	900.62	0.78	0.00	MH BC
		13+00		6.33	4.65									897.05				898.64	903.03			0.015
D220	D219	300+30		1.15	0.79	25.00	3.42	3.92	2.7	3.1	12	82.8	0.0164	899.10	5.43	4.26	0.0100	899.77	902.67	2.90	2.57	CB 2-2B
begin		13+00		7.48	5.44									897.74				898.62	900.43			0.015

BC = BLIND CONNECTION

STORM SEWER SYSTEM

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
D219	D218	200+40		0.69	0.37	25.25	3.40	3.91	4.0	4.6	18	11.7	0.0264	897.28	7.09	15.91	0.0025	898.16	900.43	2.27	1.65	CB 2-2B
		13+00		8.17	5.82									896.97				898.13	903.03			0.015
D218	D216	13+00		0.00	0.00	35.72	2.75	3.18	16.0	18.5	24	102.4	0.0325	896.97	10.97	38.03	0.0089	898.00	903.03	5.03	4.06	MH 3
		12+00		8.17	5.82									893.64				895.41	897.76			0.015
D217	D216	200+84		0.20	0.16	15.00	4.47	5.08	0.7	0.8	12	32.4	0.0782	897.12	6.74	9.29	0.0007	897.33	899.16	1.83	1.04	CB 2-2B
begin		12+00		8.37	5.98									894.59				895.28	897.76			0.015
D216	D214	12+00		0.16	0.09	35.88	2.74	3.17	16.6	19.2	24	80.5	0.0309	893.50	10.89	37.10	0.0096	894.57	897.76	3.19	2.26	CB 2-2B
		11+43		8.53	6.07									891.01				892.80	895.72			0.015
D215	D214	11+44		0.48	0.28	15.00	4.47	5.09	1.2	1.4	12	29.2	0.2904	900.29	12.39	17.90	0.0021	900.49	903.38	2.89	2.09	CB 2-2B
begin		11+43		9.01	6.34									891.82				892.57	895.72			0.015
D214	BC25	11+43		0.00	0.00	36.00	2.73	3.17	17.3	20.1	24	26.1	0.0283	890.72	10.62	35.50	0.0105	892.06	895.72	3.66	3.00	MH 3
		11+17		9.01	6.34									889.98				891.79	891.98			0.015
D213	BC25	11+17		0.49	0.39	10.00	5.32	3.16	2.1	1.2	12	3.3	0.1958	890.63	12.57	14.70	0.0016	891.71	894.71	3.00	3.08	CB 3
begin		11+17		9.50	6.73									889.98				891.71	890.98			0.015
BC25	BC24	11+17		0.00	0.00	36.04	2.73	3.16	18.4	21.3	24	40.8	0.0142	889.98	8.24	25.14	0.0118	891.71	891.98	0.27	0.00	MH BC
		10+76		9.50	6.73									889.40				891.23	891.40			0.015
D212	BC24	10+76		0.08	0.06	15.00	4.47	5.06	0.3	0.3	12	41.8	0.0217	890.93	3.22	4.90	0.0001	891.11	894.39	3.28	2.46	CB 2-2B
begin		10+76		9.58	6.80									890.02				890.64	891.02			0.015
BC24	BC23	10+76		0.00	0.00	36.12	2.73	3.09	18.5	21.0	24	87.2	0.0350	889.40	11.69	39.45	0.0114	890.48	891.40	0.92	0.00	MH BC
		9+89		9.58	6.80									886.35				888.26	888.35			0.015
D211	BC23	9+89		0.16	0.14	10.00	5.32	3.09	0.7	0.4	12	2.5	0.4675	887.50	12.71	22.71	0.0002	888.26	891.45	3.19	2.95	CB 6
begin		9+89		9.74	6.94									886.35				888.26	887.35			0.015

BC = BLIND CONNECTION

Great job on your documentation on the drainage printouts. Thank you for your efforts!!

STORM SEWER SYSTEM

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
BC23	D210	9+89	9+54	0.00 9.74	0.00 6.94	36.25	2.72	3.09	18.9	21.4	24	34.9	0.0284	886.35 885.36	10.86	35.55	0.0119	888.26 887.85	888.35 890.94	0.09	0.00	MH BC 0.015
D209	D210	9+45		0.12	0.08	10.00	5.32	3.09	0.4	0.2	12	38.5	0.0457	887.94	4.69	7.10	0.0001	888.07	890.79	2.72	1.85	CB 6
begin		9+54		9.86	7.02									886.18				887.85	890.94			0.015
D210	BC22	9+54		0.00	0.00	36.30	2.72	3.09	19.1	21.6	36	35.9	0.0014	884.81	3.45	23.22	0.0014	887.85	890.94	3.09	3.13	MH 3
		9+18		9.86	7.02									884.76				887.80	887.76			0.015
D208	BC22	9+19		0.90	0.54	20.00	3.87	3.09	2.1	1.7	12	9.9	0.0031	884.78	2.65	1.86	0.0029	887.82	888.87	1.05	3.09	CB 2-2B
begin		9+18		10.76	7.55						Warning*			884.75				887.80	885.75			0.015
BC22	D207	9+18		0.00	0.00	36.48	2.71	3.09	20.5	23.3	36	90.1	0.0014	884.75	3.43	22.88	0.0016	887.80	887.75	-0.05**	0.00	MH BC
		8+28		10.76	7.55									884.63				887.65	889.25			0.015
D205	D207	8+28		0.07	0.06	10.00	5.32	3.09	0.3	0.2	12	49.4	0.0150	885.37	2.95	4.06	0.0000	887.65	889.79	2.14	3.42	CB 3
begin		8+28		10.83	7.62									884.63				887.65	889.25			0.015
D207	BC21	8+28		0.00	0.00	36.91	2.69	3.09	20.5	23.5	36	96.5	0.0014	884.63	3.49	23.34	0.0017	887.65	889.25	1.60	1.62	MH 3
		7+32		10.83	7.62									884.49				887.49	887.49			0.015
D204	BC21	7+32		0.77	0.45	20.00	3.87	3.09	1.7	1.4	12	4.4	0.2603	885.63	13.14	16.95	0.0020	887.50	888.87	1.37	2.24	CB 2-2B
begin		7+32		11.60	8.06									884.49				887.49	885.49			0.015
BC21	D203	7+32		0.00	0.00	37.37	2.67	3.09	21.5	24.9	36	49.7	0.0014	884.49	3.50	23.34	0.0018	887.49	887.49	0.00	0.00	MH BC
		6+82		11.60	8.06									884.42				886.72	889.53			0.015
D201	D202	6+82		3.41	1.93	30.00	3.06	3.54	5.9	6.8	39***	62.2	0.0257	886.11	7.28	123.45	0.0001	886.65	889.11	2.46	-0.25	HW Half He
begin		6+84		15.01	9.99									884.51				886.54	889.39			0.015
D202	D203	6+84		0.61	0.43	30.14	3.06	3.53	7.2	8.3	36	3.2	0.0444	884.51	9.43	131.09	0.0002	886.33	889.39	3.06	1.88	CB 2-4
		6+82		15.62	10.42						Warning****			884.37				886.33	889.53			0.015

BC = BLIND CONNECTION

* EXISTING PIPE CANNOT HANDLE 10 YEAR JUST FULL CAPACITY, BUT DOES NOT DISCHARGE OUT THE CASTING.

** HY GR IS ABOVE PIPE BUT BELOW GROUND.

*** PIPE IS 3X3 CULVERT, A 39" DIAMETER PIPE IS AN EQUIVALENT DIAMETER FOR FLUID FLOW.

**** WARNING MESSAGE BECAUSE 36" CONTINUES FROM 39" (3X3 CULVERT). THESE ARE EXISTING CONDITIONS AND CAN BE IGNORED.

STORM SEWER SYSTEM

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
D203	OUT	6+82		0.00	0.00	37.61	2.65	3.08	27.7	32.1	36	79.6	0.0139	884.42	9.15	73.44	0.0031	885.97	889.53	3.56	2.11	MH 3
final		0+00		15.62	10.42									883.31				885.73	886.31			0.015

BC = BLIND CONNECTION

\\cvelimited.com\data\Projects\23365 - ODOT - BUT-75-5.22\117275\400-Engineering\Drainage\EngData\US-27\BUT-27 Drainage Inventory

CRS	CFN	Inlet Station	Inlet Offset	Outlet Station	Outlet Offset	Side	Inlet Structure	Inlet Survey Point #	Outlet Structure	Outlet Survey Point #	Size	Length	Pipe Material	GA	Inventory Comments	Inspection Comments	ODOT Scope Disposition	Profile Work
BUT-27-10.536	1833530	16+46.86	45.33' LT			Both	Catch Basin	SV5272	Other	N/A	12	72	PVC	7	yard drain c/b - 20' north of hussy rd.	culvert has minor joint seperation and culvert misalignment. Slight deflection throughout culvert.culvert tee' into 24" mainline.	No work	No work
BUT-27-10.514	1832925	15+24.55	19.45' LT	15+23.33	27.26' RT	Both	Catch Basin	SV5158	Manhole	SV1673	12	46	PVC	8	c/b to m/h	Null	No work	No work
BUT-27-10.474	1832924	13+49.68	20.26' LT			Both	Catch Basin	SV1632	Other	N/A	12	54	PVC	7	pipe tee's into 24" mainline on rt. side behind curb	Minor misalignment, pipe Ts into a ditch pipe	No work	Adjust catch basin to grade
BUT-27-10.437	1832923	11+99.78	40.07' RT	11+43.29	16.97' LT	Both	Catch Basin	SV1172	Manhole	SV1057	24	78	Corrugated Steel Spiral Rib	7	m/h in sb lane south of sr. 130 north of railway	Minor rust along invert	No work	Adjust manhole to grade
BUT-27-10.424	1832922	10+75.56	23.70' RT			Both	Catch Basin	SV5307	Other	N/A	12	45	PVC	7	north of the railway. c/b behind gr	this culvert was not on our invertory. c/b is behind gr on rt. at the end of fwd. abut.	No work	Adjust catch basin to grade
BUT-27-10.404	1832921	9+44.61	20.84' RT	9+53.96	19.39' LT	Both	Catch Basin	SV924	Manhole	SV940	12	39	PVC	7	south of the railway	Null	No work	Adjust catch basin and manhole to grade
BUT-27-10.354	1821668	6+82.00	30.48' RT	6+84.00	30.55' LT	Both	Third Height Concrete Headwall	SV5288	Catch Basin	SV540	3'x3'	63	Concrete	7	box is 47' to c/b.16' of 36" concrete pipe	Leakage at joints with stalactites, abutments have some honeycomb from construction,	No work	No work

Appendix J

BUT-27 Preliminary Plan and Profile Sheets

MODEL: CLX_3 - Plan 1 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 5/6/2024 TIME: 2:48:30 PM USER: thomas
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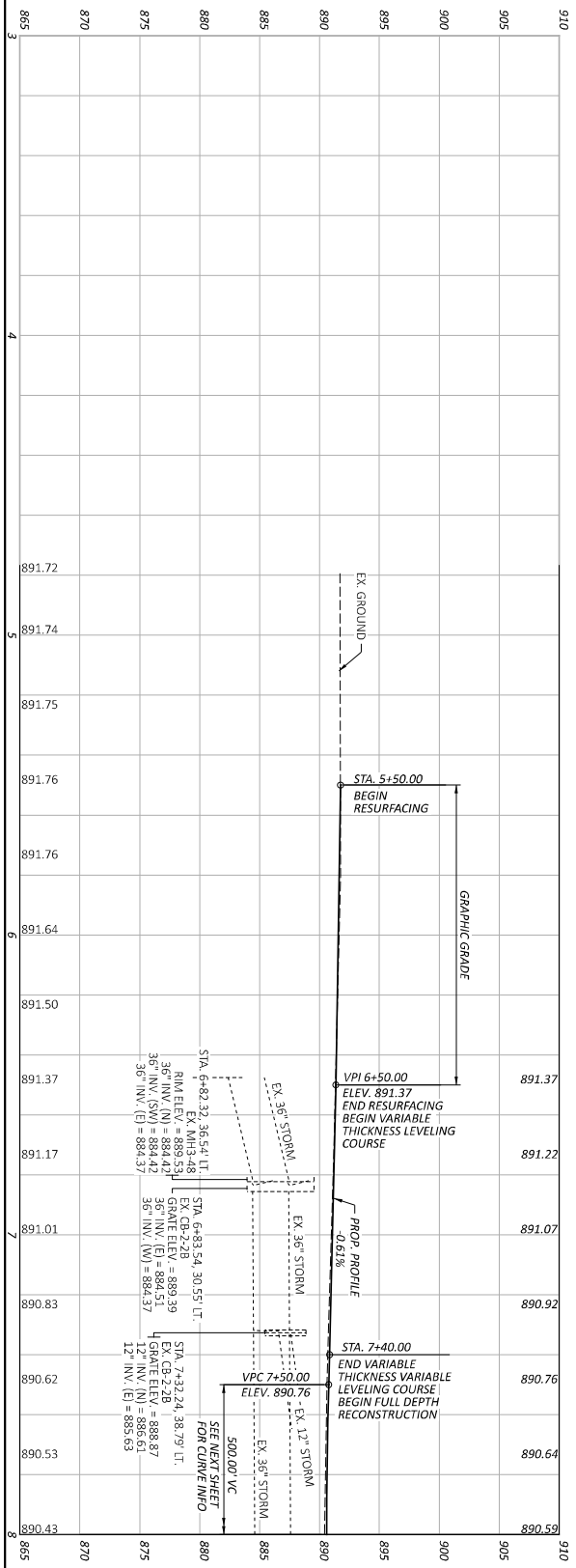
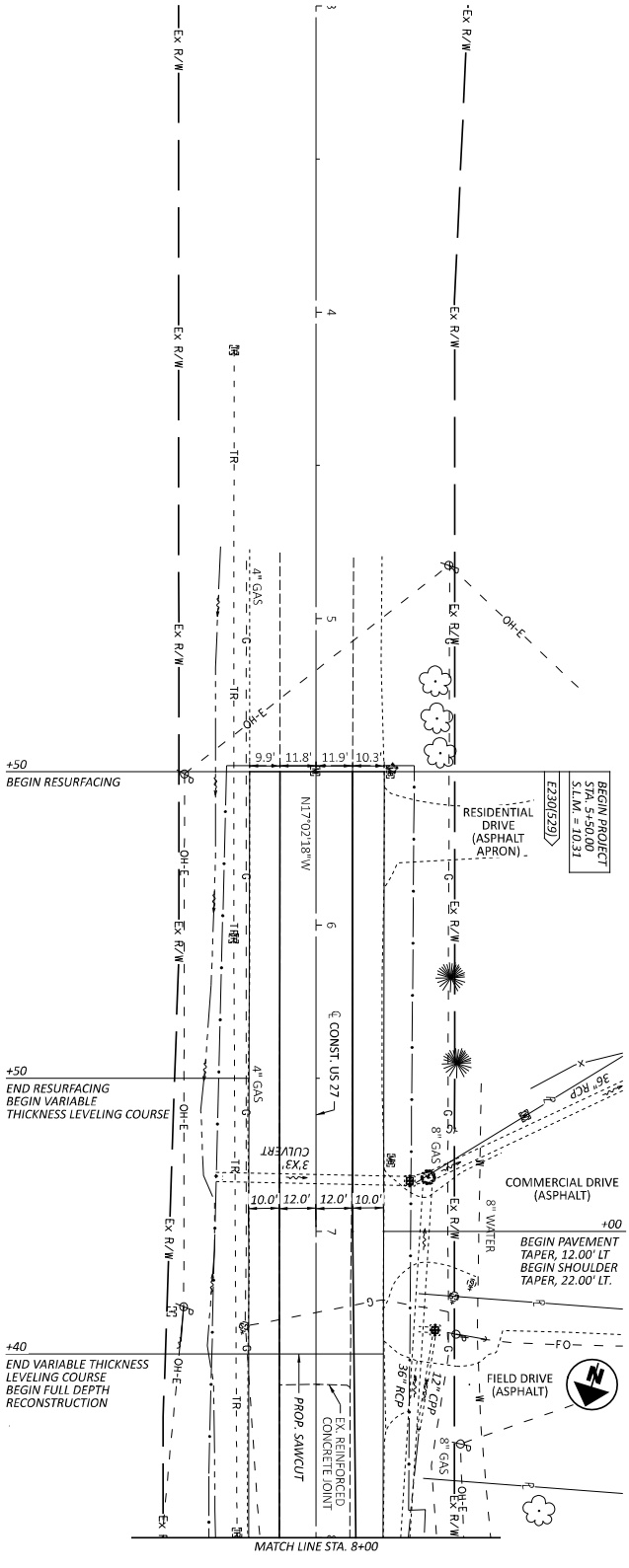
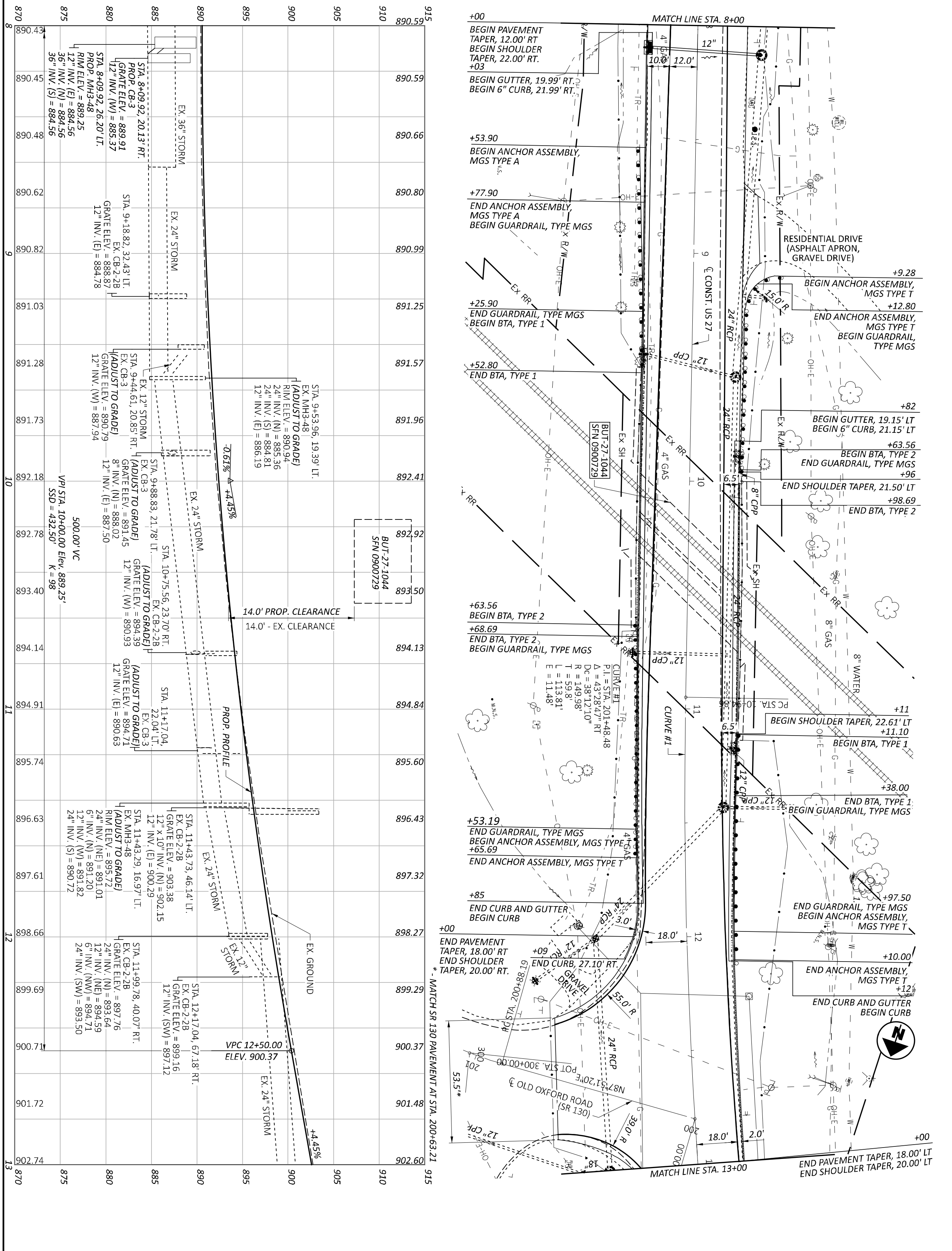




SHEET P.1 TOTAL 3	PROJECT ID 117275	REVIEWED CWP 04-29-24	DESIGNED SHT	DESIGN AGENCY CHAGRIN VALLEY ENGINEERING, LTD.	PLAN AND PROFILE - 14.0' VERTICAL CLEARANCE US-27 - BEGIN TO STA. 8+00

HORIZONTAL SCALE IN FEET
0 20
10 40



DESIGN AGENCY

CHAGRIN VALLEY ENGINEERING, LTD.

DESIGNER	REVIEWER	PROJECT ID	SHEET	TOTAL
SHT	CWP 04-29-24	117275	P.2	3

PLAN AND PROFILE - 14.0' VERTICAL CLEARANCE
US-27 - STA. 8+00 TO STA. 13+00

HORIZONTAL SCALE IN FEET

0 10 20 40

BUT IR 75/VAR/5.22/VAR

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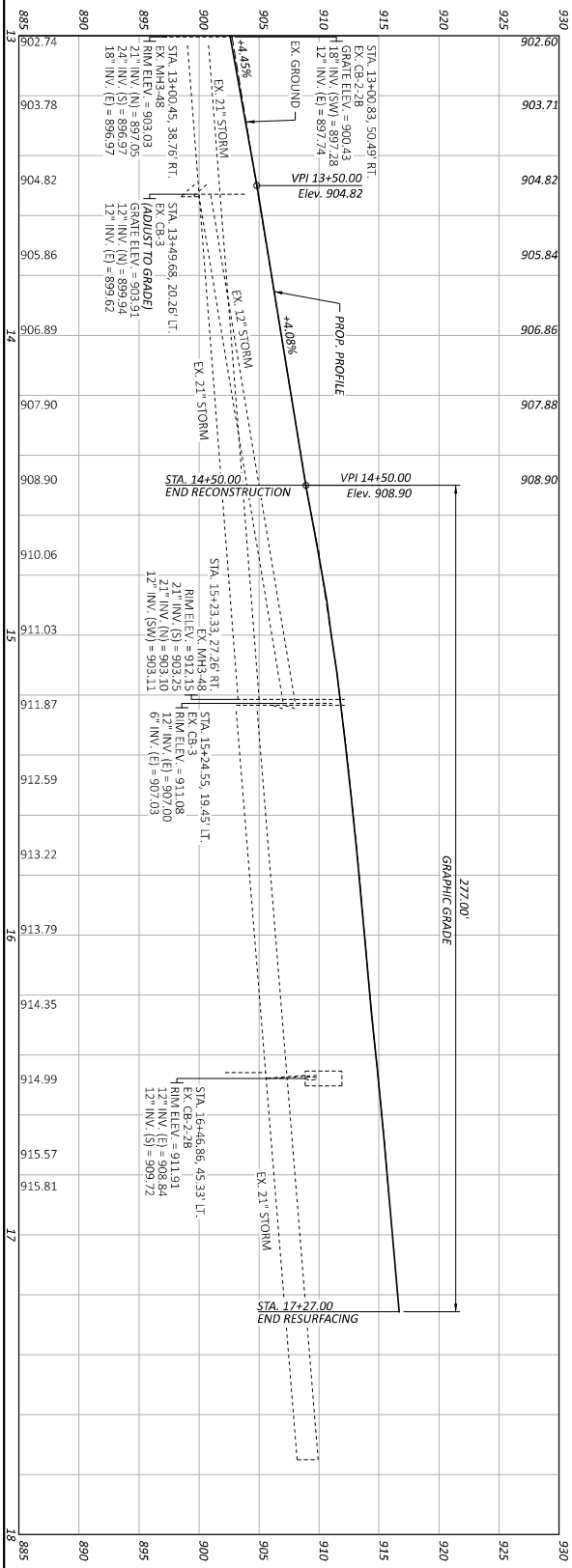

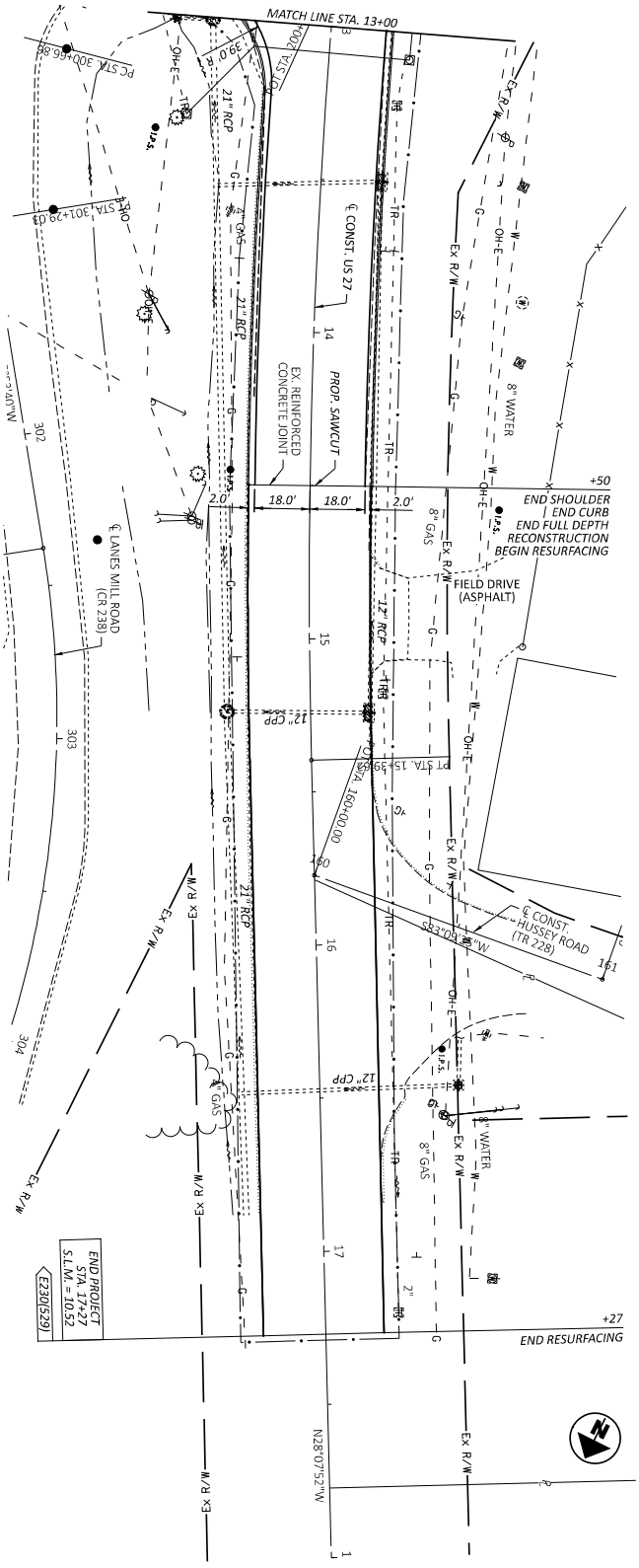

PLAN AND PROFILE - 14.0' VERTICAL CLEARANCE
US-27 - STA. 8+00 TO END

HORIZONTAL SCALE IN FEET
0 20
10 40

SHEET	TOTAL
P.3	3

PROJECT ID: 117275
REVIEWED: CWP 04-29-24
DESIGNED: SHT
DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.

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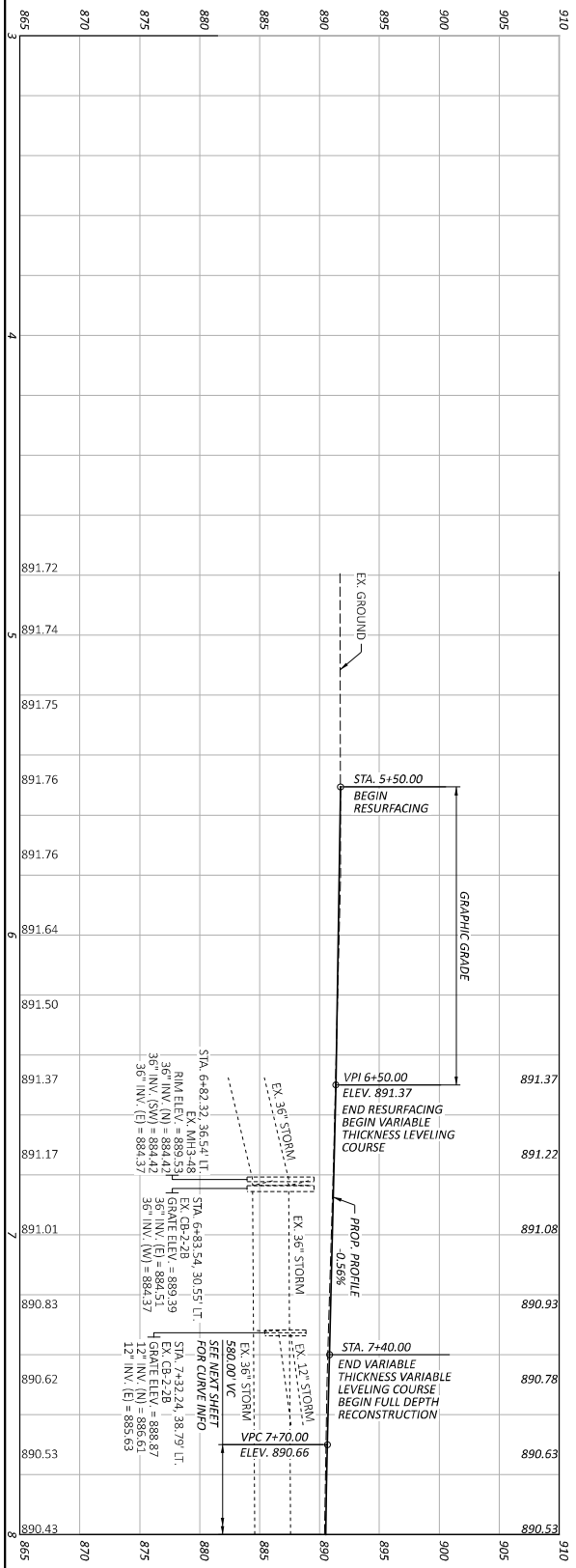

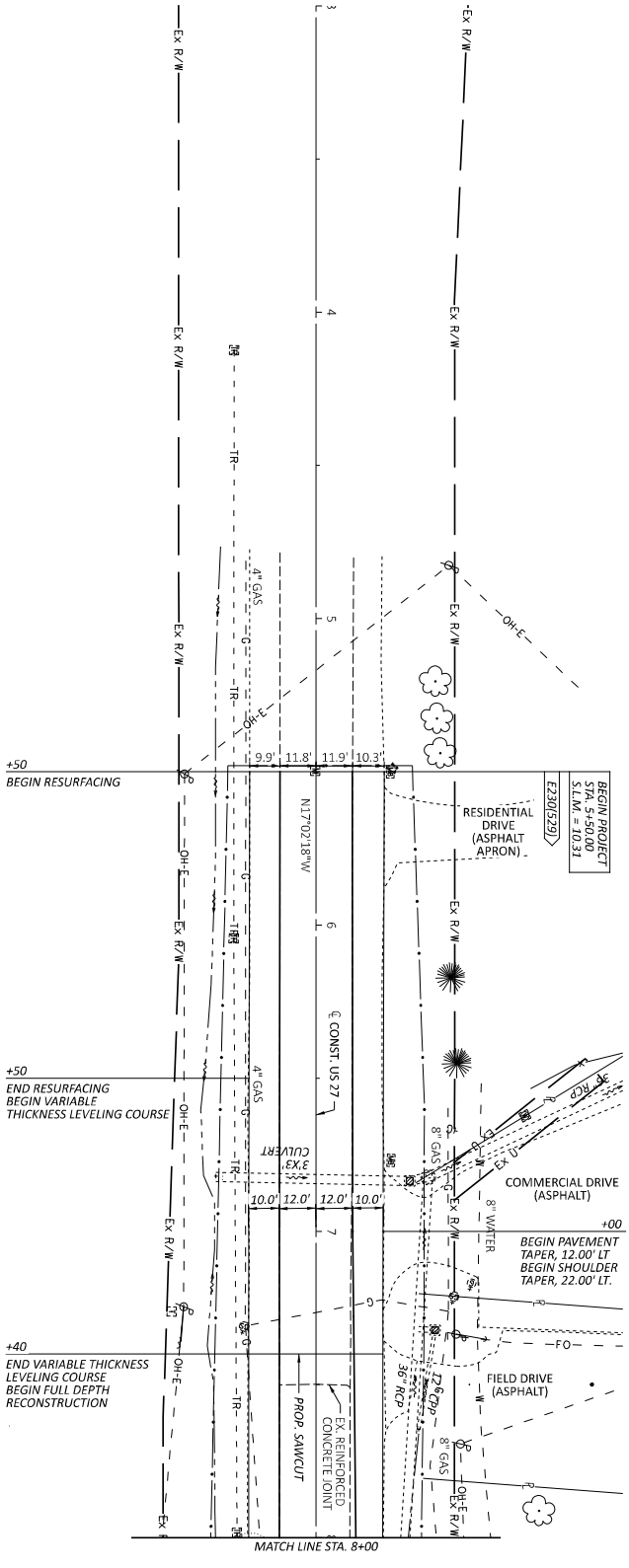

SHEET P.1 TOTAL 3	PROJECT ID 117275	REVIEWED CWP 04-29-24	DESIGNED SHT	CHAGRIN VALLEY ENGINEERING, LTD.	DESIGN AGENCY

PLAN AND PROFILE - 14.5' VERTICAL CLEARANCE
US-27 - BEGIN TO STA. 8+00

HORIZONTAL SCALE IN FEET
0 20
10 40

BUT IR 75/VAR/5.22/VAR

MODEL: CLX_3 - Plan 2 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 5/6/2024 TIME: 2:48:25 PM USER: thomas
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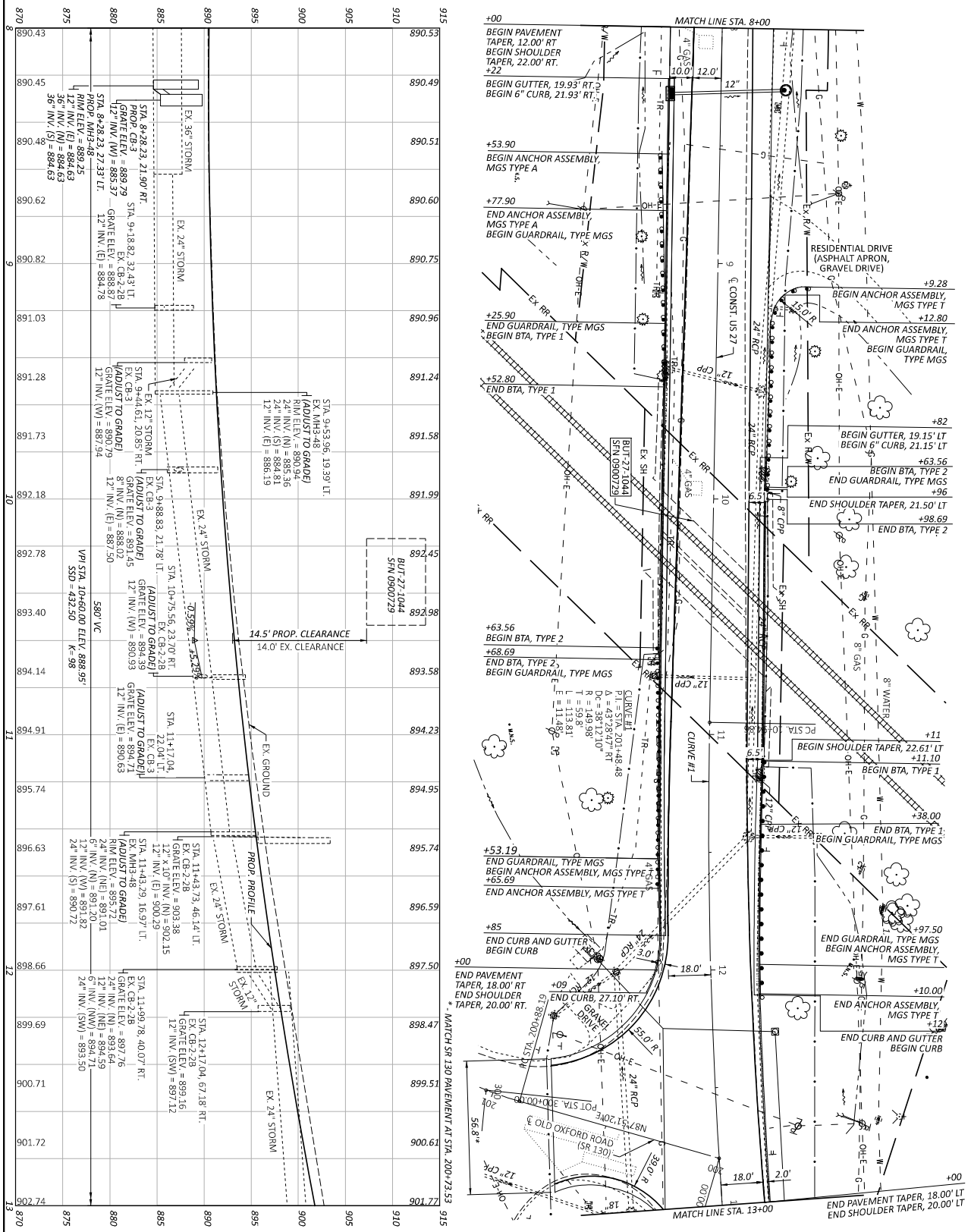

SHEET	PROJECT ID	DESIGNED	DESIGN AGENCY	PLAN AND PROFILE - 14.5' VERTICAL CLEARANCE US-27 - STA. 8+00 TO STA. 13+00	HORIZONTAL SCALE IN FEET
P.2 / 3 TOTAL	117275	SHT	CHAGRIN VALLEY ENGINEERING, LTD.		0 20 10 40
	CWP 04-29-24	REVIEWED			

BUT IR 75/VAR/5.22/VAR

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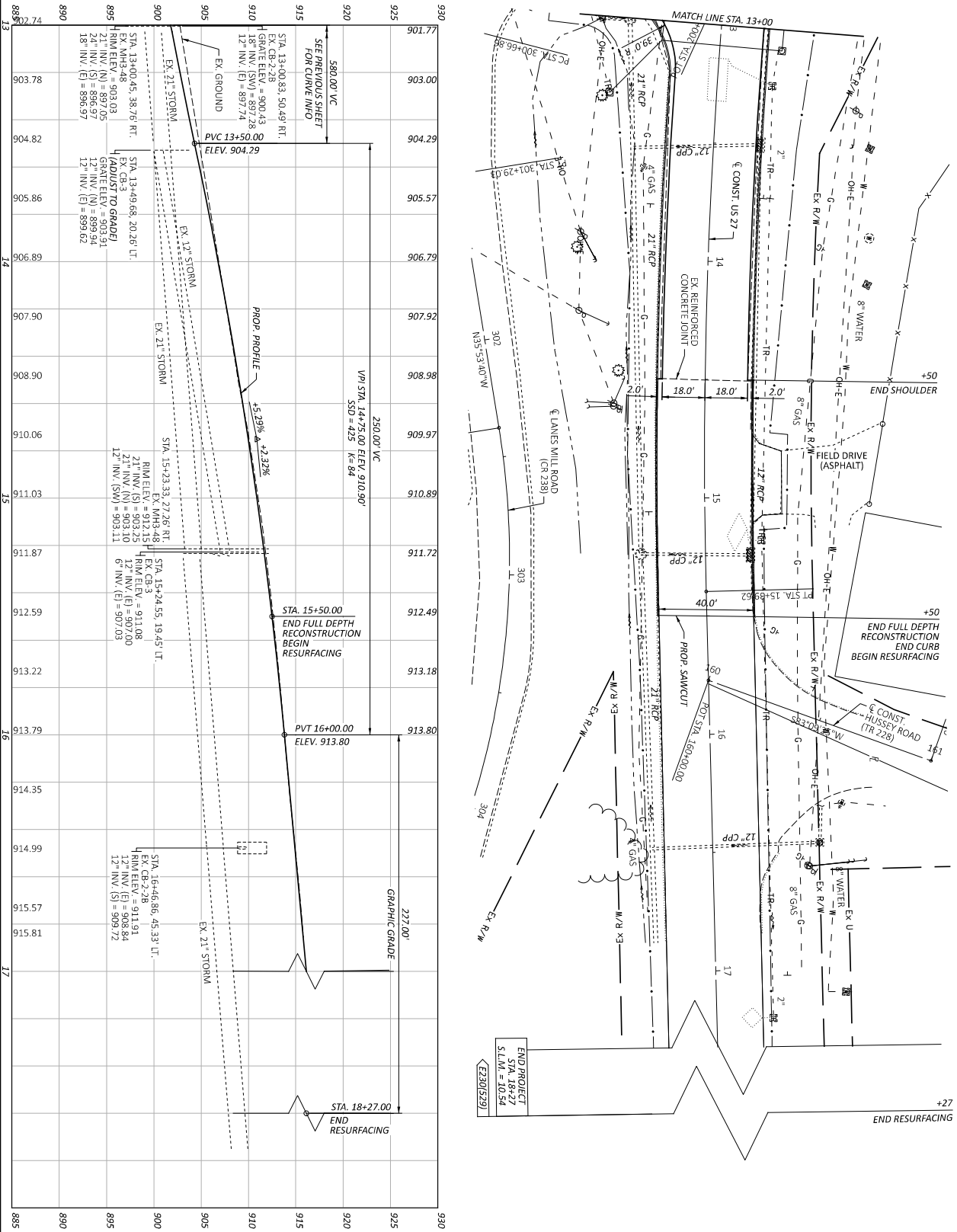


PLAN AND PROFILE - 14.5' VERTICAL CLEARANCE
US-27 - STA. 8+00 TO END

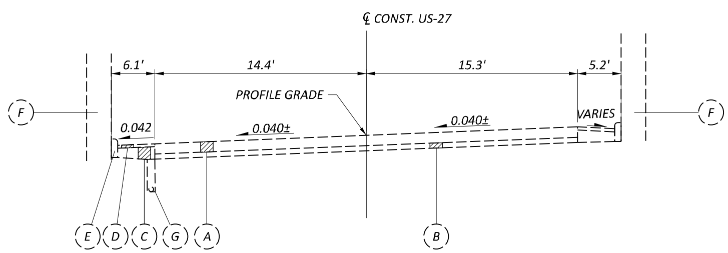
HORIZONTAL SCALE IN FEET
0 20
10 40

SHEET	TOTAL
P.3	3

PROJECT ID: 117275
REVIEWED: CWP 04-29-24
DESIGNED: SHT
DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.

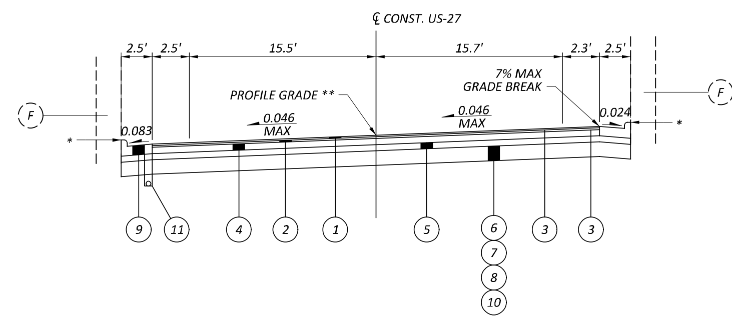
Appendix K

BUT-27 Representative Typical Sections



EXISTING REPRESENTATIVE (SUPERELEVATED) SECTION: US-27

STA. 10+45.37 (UNDER RAILROAD BRIDGE)



PROPOSED REPRESENTATIVE (SUPERELEVATED) SECTION: US-27

STA. 10+45.37 (UNDER RAILROAD BRIDGE)

EXISTING LEGEND

- (A) 10" REINFORCED CONCRETE PAVEMENT
- (B) 5" BITUMINOUS AGGREGATE BASE, AC-20
- (C) AGGREGATE BASE, VARIABLE DEPTH
- (D) 3" ASPHALT CONCRETE
- (E) CURB, TYPE 6
- (F) EX. BRIDGE ABUTMENT
- (G) EX. 6" SHALLOW PIPE UNDERDRAIN

PROPOSED LEGEND

- (1) ITEM 441 - 1.25" ASPHALT CONCRETE SURFACE COURSE, TYPE 1 (448), PG64-22
- (2) ITEM 441 - 1.75" ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE 2, (448)
- (3) ITEM 407 - NON-TRACKING TACK COAT (0.055 GAL/SY)
- (4) ITEM 301 - 6" ASPHALT CONCRETE BASE, PG64-22 (449)
- (5) ITEM 304 - 6" AGGREGATE BASE
- (6) ITEM 204 - 14" EXCAVATION OF SUBGRADE
- (7) ITEM 204 - 14" GRANULAR MATERIAL, TYPE C, AS PER PLAN
- (8) ITEM 204 - GEOTEXTILE FABRIC
- (9) ITEM 609 - COMBINATION CURB AND GUTTER, TYPE 2
- (10) ITEM 204 - PROOF ROLLING
- (11) ITEM 605 - 6" SHALLOW PIPE UNDERDRAINS WITH GEOTEXTILE FABRIC

* MATCH EXISTING TOP OF CURB ELEVATION

** PROPOSED IS 0.1' HIGHER THAN EXISTING IN 14.0' OPTION AND 0.4' LOWER THAN EXISTING IN 14.5' OPTION

REPRESENTATIVE TYPICAL SECTIONS -US-27

DESIGN AGENCY
CHAGRIN VALLEY ENGINEERING, LTD.

DESIGNER: CJD
REVIEWER: CWP 05-01-24
PROJECT ID: 117275
SHEET: P.1 TOTAL: 1

Appendix L

BUT-27 Critical Cross Sections

BUT IR 75/VAR 5.22/VAR

MODEL: CLX_4 - 8+09.92 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 5/6/2024 TIME: 2:48:39 PM USER: thomas
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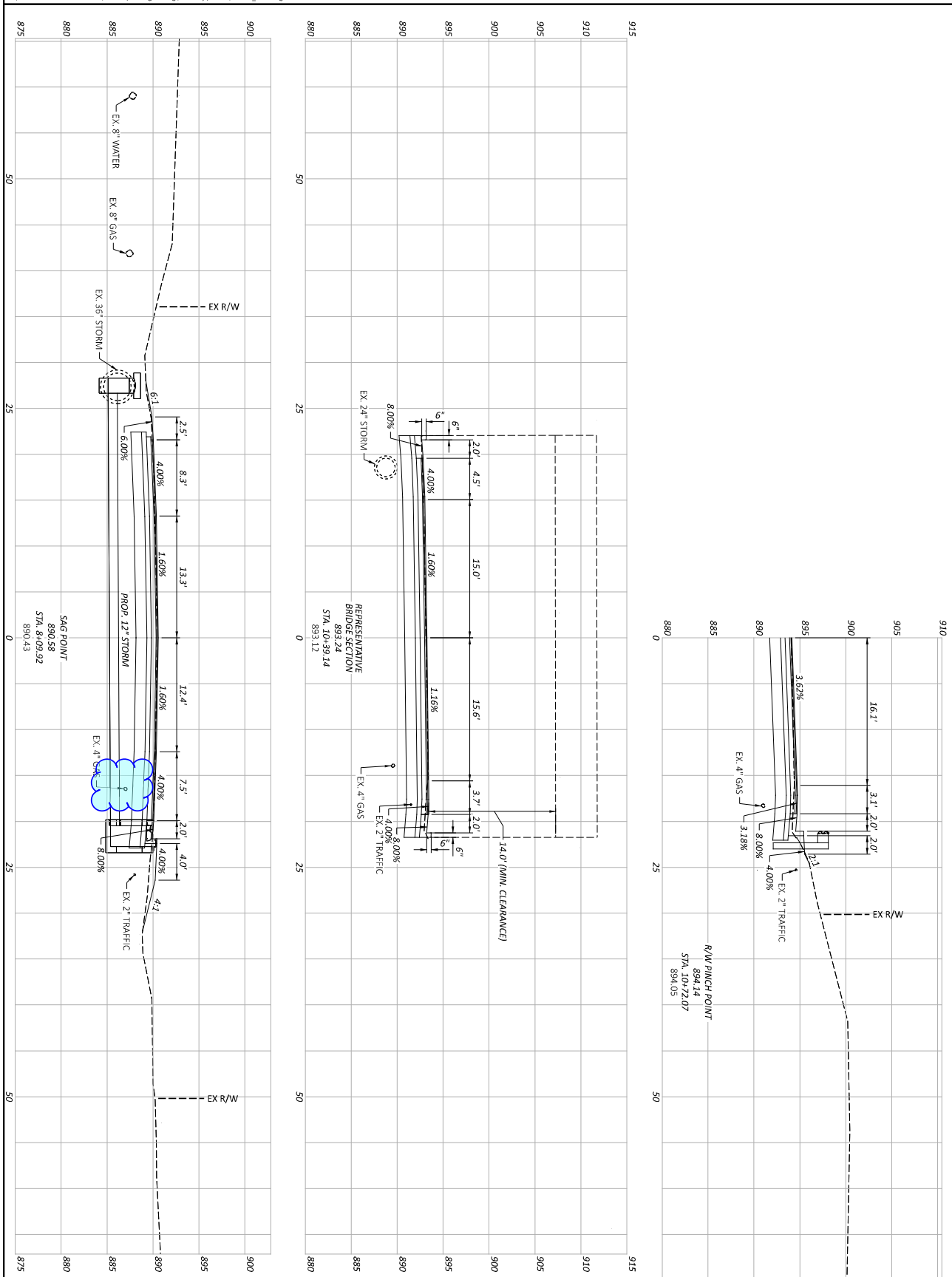

CROSS SECTIONS - BUT 27 -14.0' CLEARANCE
STA. 8+09.92 TO STA. 10+72.07

DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER	SHT
REVIEWER	CWP 04-26-24
PROJECT ID	117275
SHEET	P.1
TOTAL	2

MODEL: CLX_6 - 11+60.82 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 5/6/2024 TIME: 2:48:41 PM USER: thomas
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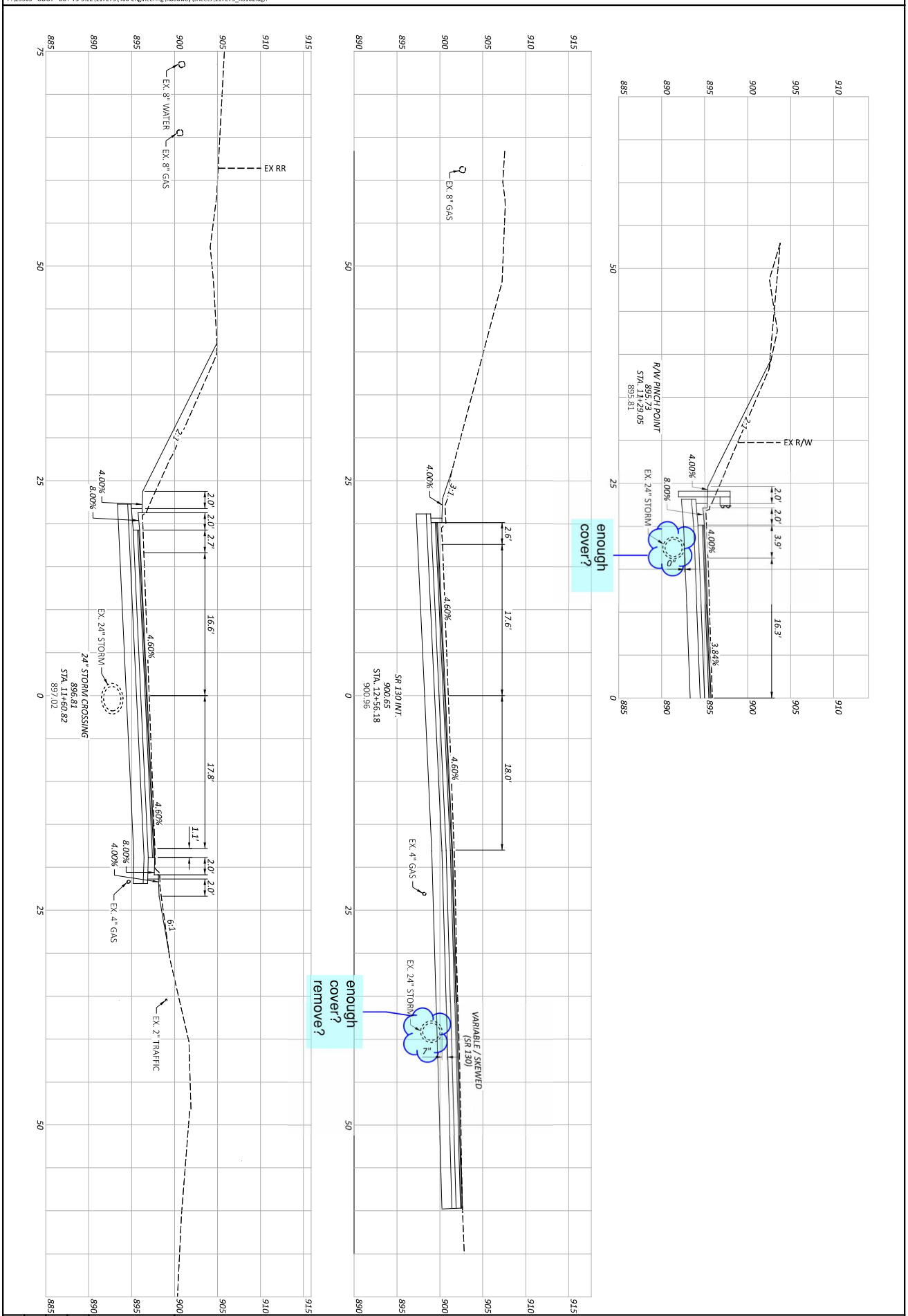

CROSS SECTIONS - BUT-27 - 14.0' CLEARANCE
STA. 11+29.05 TO STA. 12+56.18

DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER	SHT
REVIEWER	CWP 04-26-24
PROJECT ID	117275
SHEET	P.2
TOTAL	2

BUT IR 75/VAR 5.22/VAR

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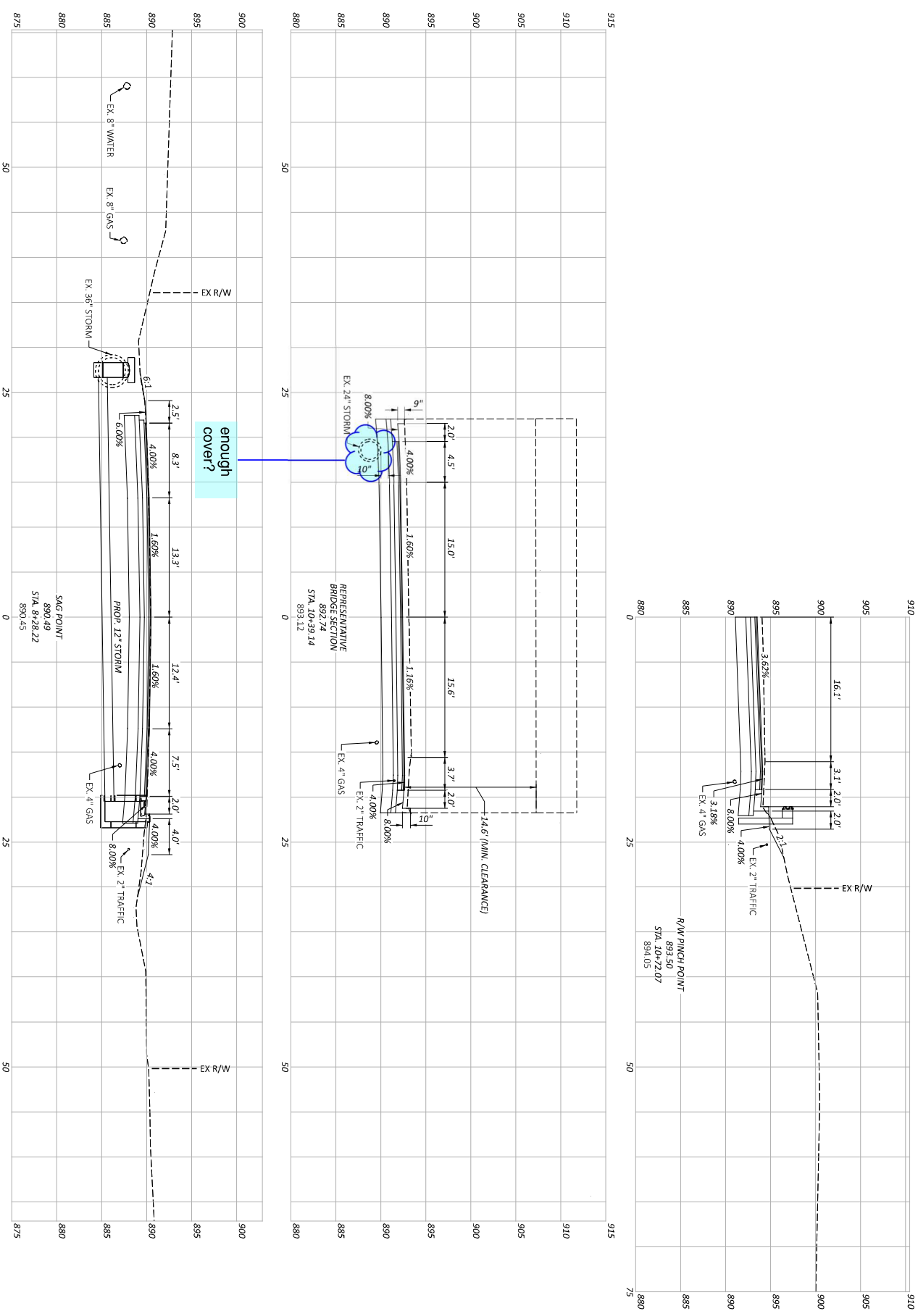

CROSS SECTIONS - BUT 27 - 14.5' CLEARANCE
STA. 8+28.22 TO STA. 10+72.07

DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER	SHT
REVIEWER	CWP 04-26-24
PROJECT ID	117275
SHEET	P.1
TOTAL	2

BUT IR 75/VAR 5.22/VAR

MODEL: CLX_6 - 11+60.82 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 5/6/2024 TIME: 2:48:37 PM USER: thomas
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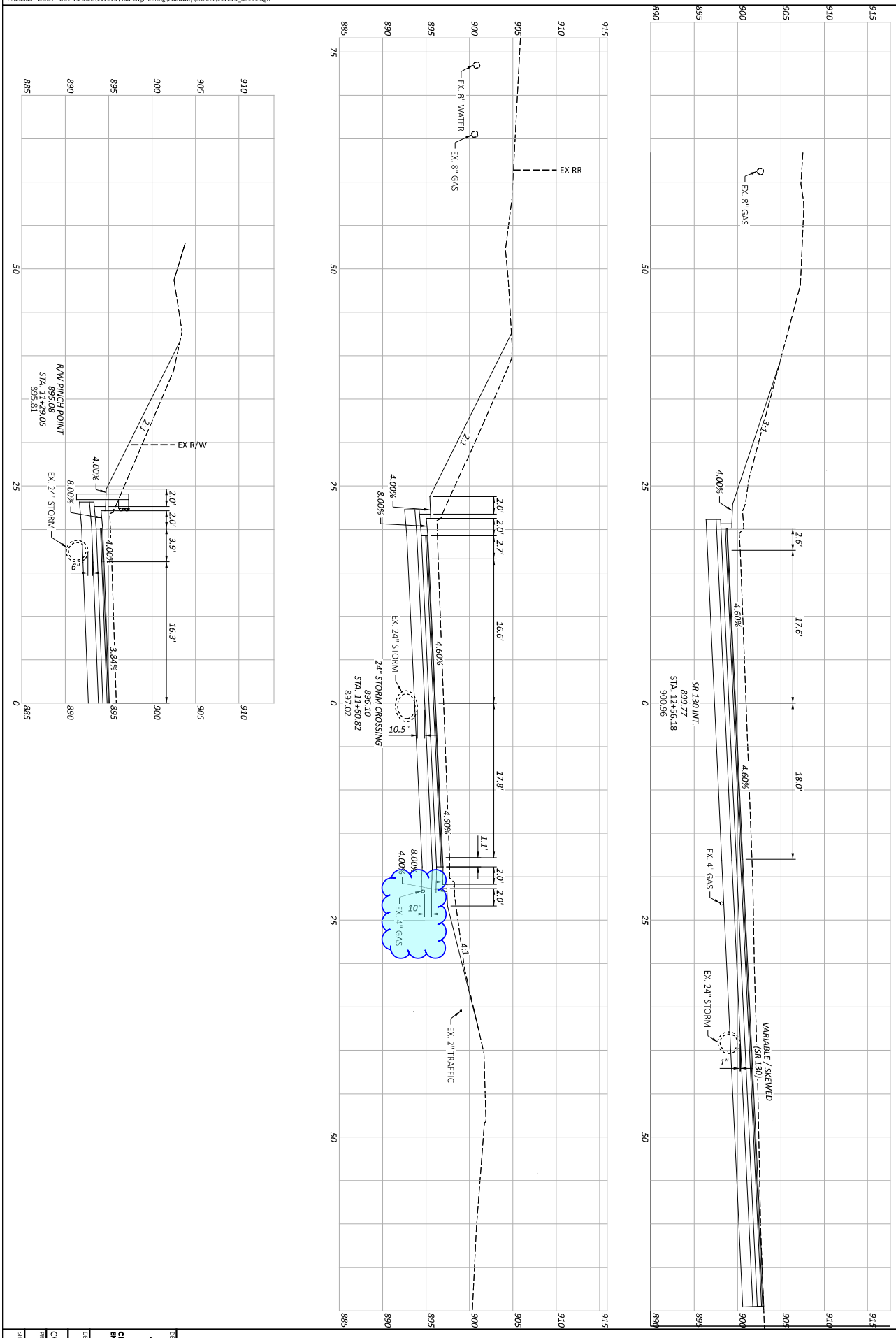

CROSS SECTIONS - BUT 27 - 14.5' CLEARANCE
STA. 11+29.05 TO STA. 12+56.18

DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER	SHT
REVIEWER	CWP 4-26-24
PROJECT ID	117275
SHEET	P.2 of 2

Appendix M

BUT-27 Drive Profiles

MODEL: STA 5+71.51 - STA 5+71.51 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 4/29/2024 TIME: 7:46:41 AM USER: thomas
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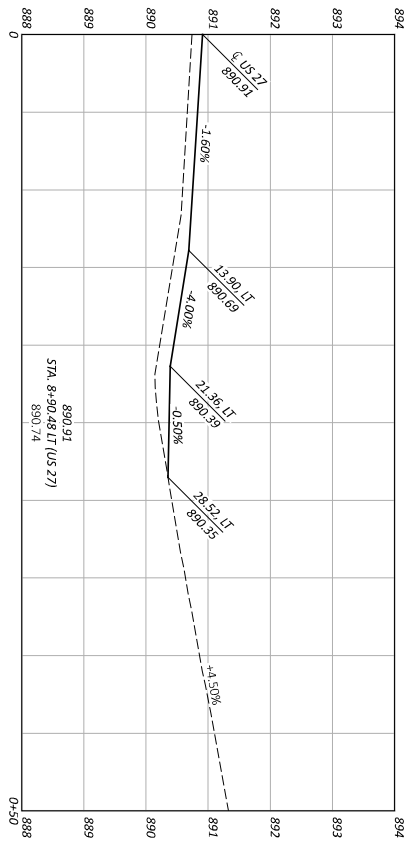
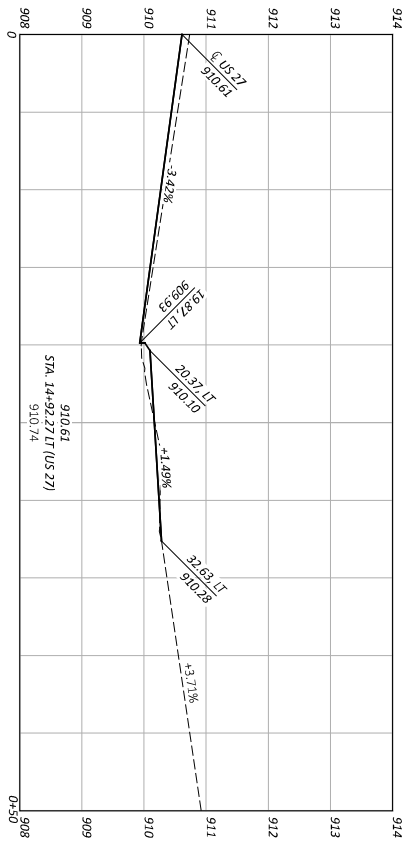


DRIVE PROFILES - US 27
14.0' ALTERNATIVE

DESIGN AGENCY	DESIGNER	REVIEWER	PROJECT ID	SHEET	TOTAL
CHAGRIN VALLEY ENGINEERING, LTD.	SHT	CWP 04-29-24	117275	P.1	1



DRIVE PROFILES - US 27
14.5' ALTERNATIVE

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: SHT
REVIEWER: CWP 04-29-24
PROJECT ID: 117275
SHEET: P.1 | TOTAL: 1

Appendix N

BUT-27 Maintenance of Traffic Schematic, Typical Sections, Capacity Analysis, Detour Routes, Detour Road User Costs and MOT Delay & Cost Comparison

MODEL: CLX_3 - Plan 1-1 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 9:08:24 AM USER: cdunlap
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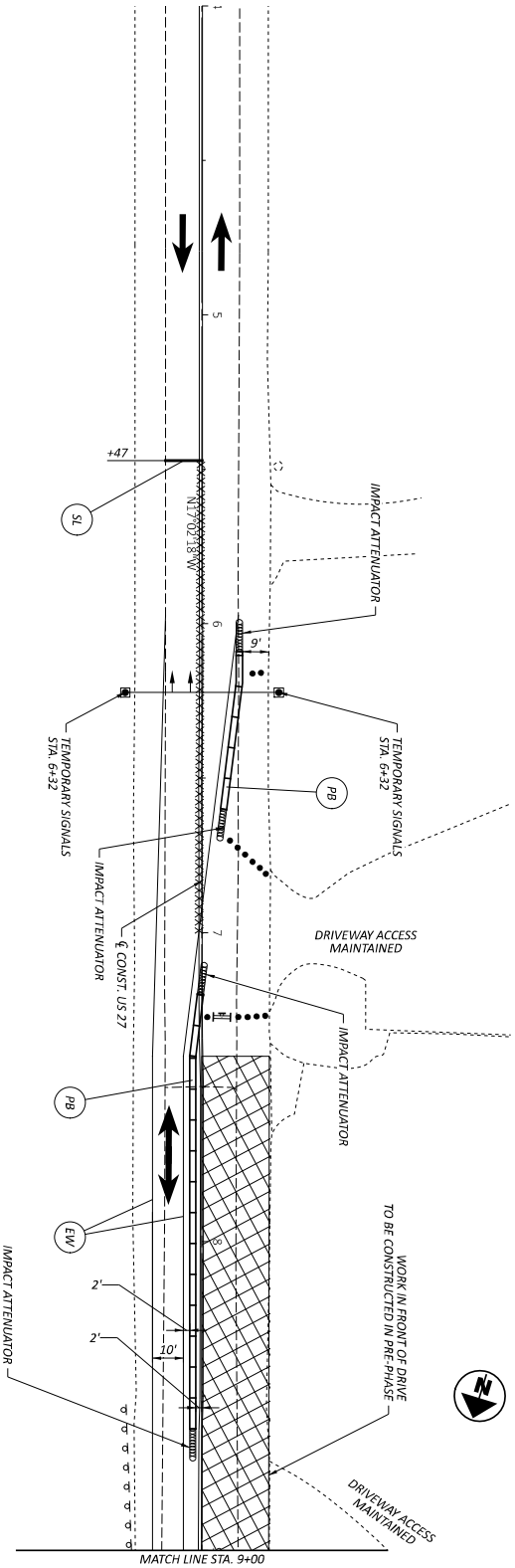
LEGEND

- WORK ZONE
- PAVEMENT MARKING REMOVED
- WORK ZONE IMPACT ATTENUATOR
- DIRECTION OF TRAFFIC
- TYPE 3 BARRICADE WITH SIGN
- (SL) WORK ZONE STOP LINE
- (EW) WORK ZONE EDGE LINE, 6" (WHITE)
- (DW) WORK ZONE DOTTED LINE, 6" (WHITE)
- (PB) PORTABLE BARRIER, UNANCHORED



MAINTENANCE OF TRAFFIC - PHASE 1 (14.5' VC OPTION)
US-27 - BEGIN TO STA. 9+00

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: CJD
REVIEWER: CWP 05-01-24
PROJECT ID: 117275
SHEET: P.1 | TOTAL: 3

HORIZONTAL SCALE IN FEET
0 20
10 40

MODEL: CLX_3 - Plan 2 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 9:08:31 AM USER: cdunlap
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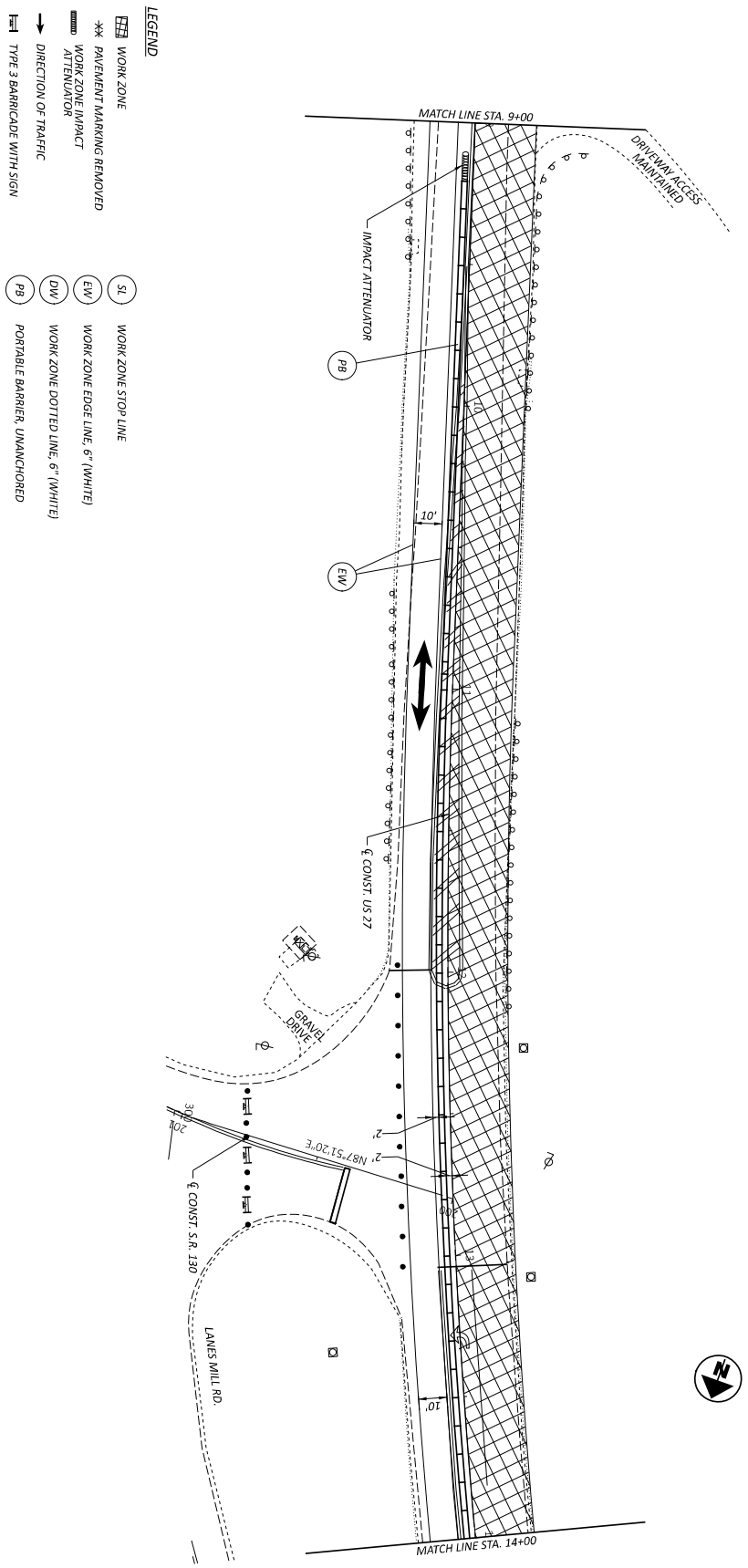

MAINTENANCE OF TRAFFIC - PHASE 1 (14.5' VC OPTION)
US-27 - STA. 9+00 TO STA. 14+00

HORIZONTAL SCALE IN FEET
0 20
10 40

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: CJD
REVIEWER: CWP 05-01-24
PROJECT ID: 117275
SHEET: P.2 | TOTAL: 3

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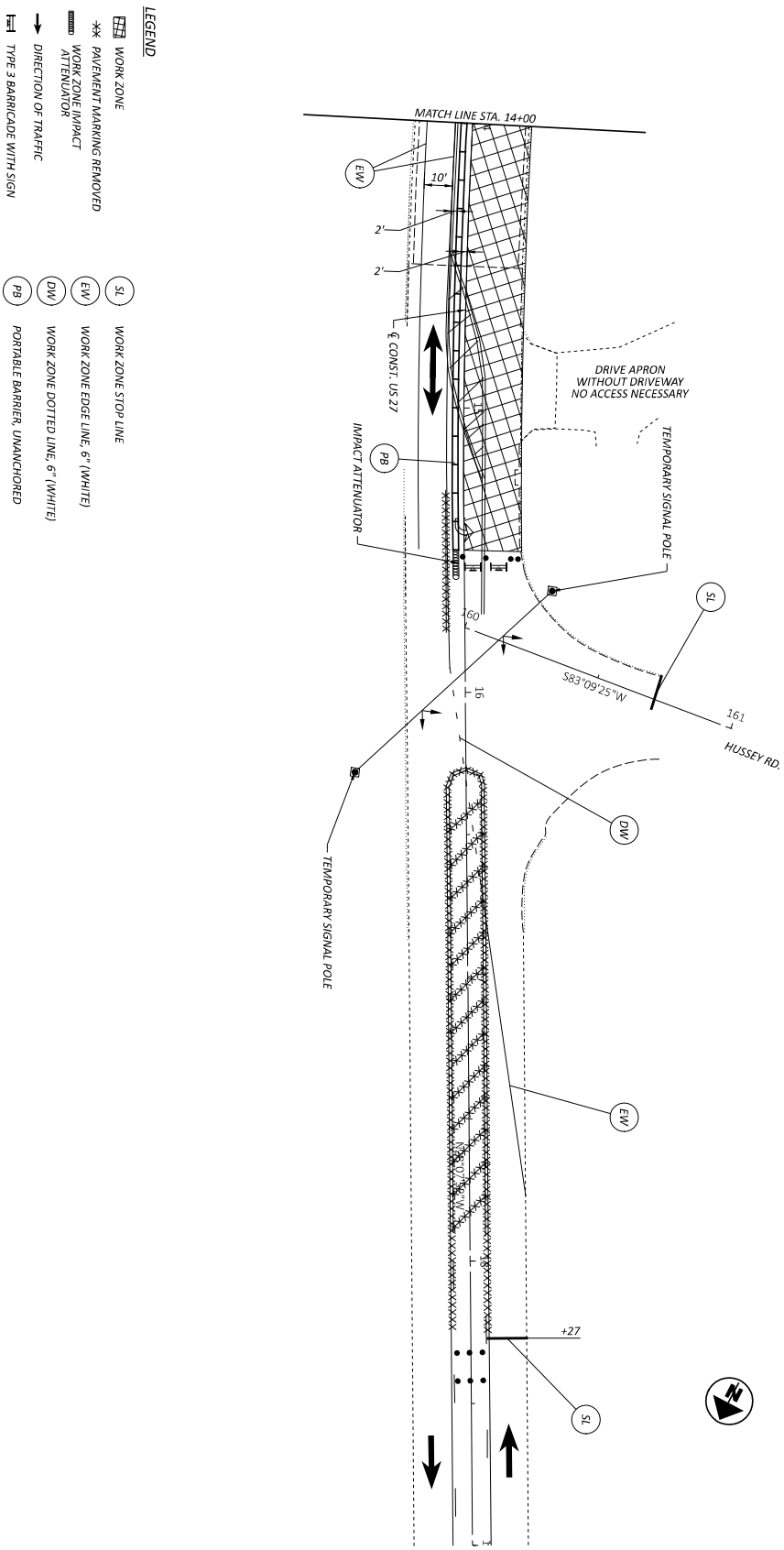

SHEET P.3 TOTAL 3	PROJECT ID 117275	REVIEWED CWP 05-01-24	DESIGNER CJD	CHAGRIN VALLEY ENGINEERING, LTD.	DESIGN AGENCY

MAINTENANCE OF TRAFFIC - PHASE 1 (14.5' VC OPTION)
US-27 - STA. 14+00 TO END

HORIZONTAL SCALE IN FEET
0 20
10 40

MODEL: CLX_3 - Plan 1-1 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 9:09:16 AM USER: cdunlap
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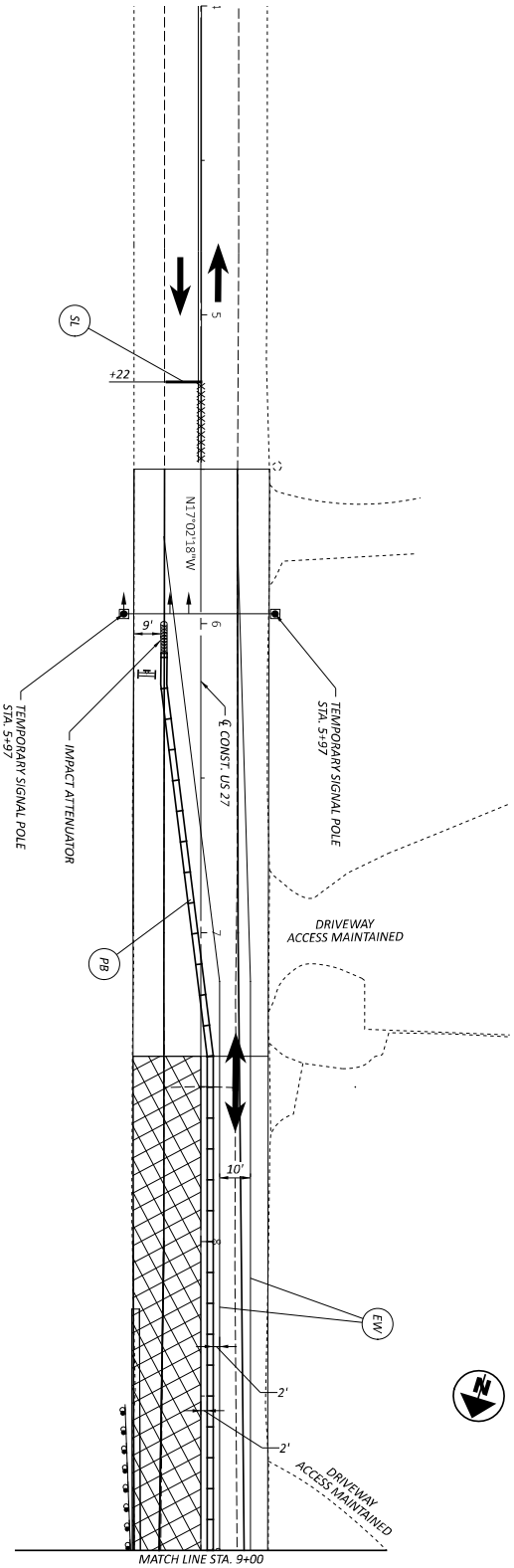
LEGEND

- WORK ZONE
- PAVEMENT MARKING REMOVED
- WORK ZONE IMPACT ATTENUATOR
- DIRECTION OF TRAFFIC
- TYPE 3 BARRICADE WITH SIGN
- (SL) WORK ZONE STOP LINE
- (EW) WORK ZONE EDGE LINE, 6" (WHITE)
- (DW) WORK ZONE DOTTED LINE, 6" (WHITE)
- (PB) PORTABLE BARRIER, UNANCHORED



MAINTENANCE OF TRAFFIC - PHASE 2 (14.5' VC OPTION)
US-27 - BEGIN TO STA. 9+00

DESIGN AGENCY: CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER: CJD
REVIEWER: CWP 05-01-24
PROJECT ID: 117275
SHEET: P.1 | TOTAL: 3

HORIZONTAL SCALE IN FEET
0 20
10 40

MODEL: CLX_3 - Plan 2 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 9:09:17 AM USER: cdunlap
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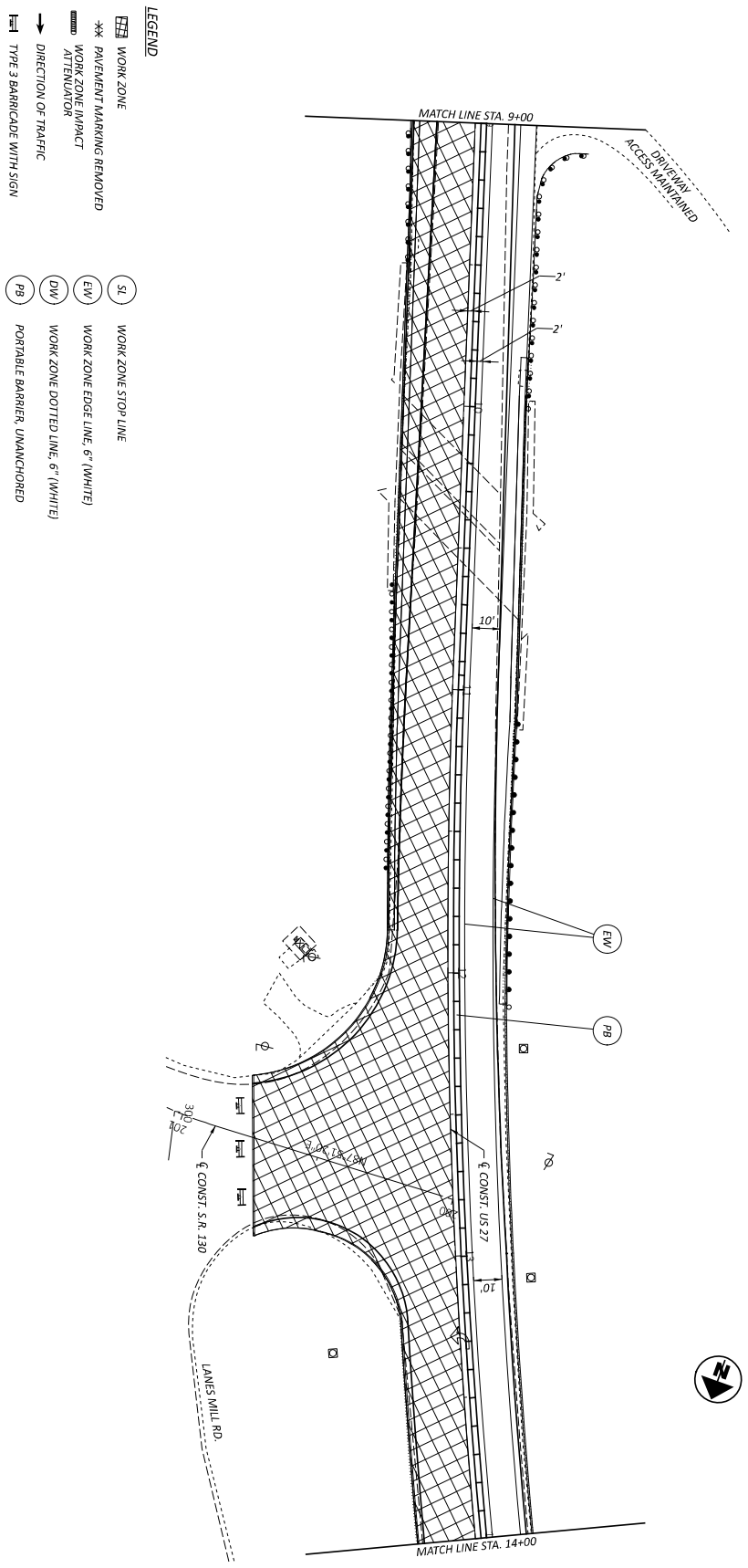


MAINTENANCE OF TRAFFIC - PHASE 2 (14.5' VC OPTION)
US-27 - STA. 9+00 TO STA. 14.00

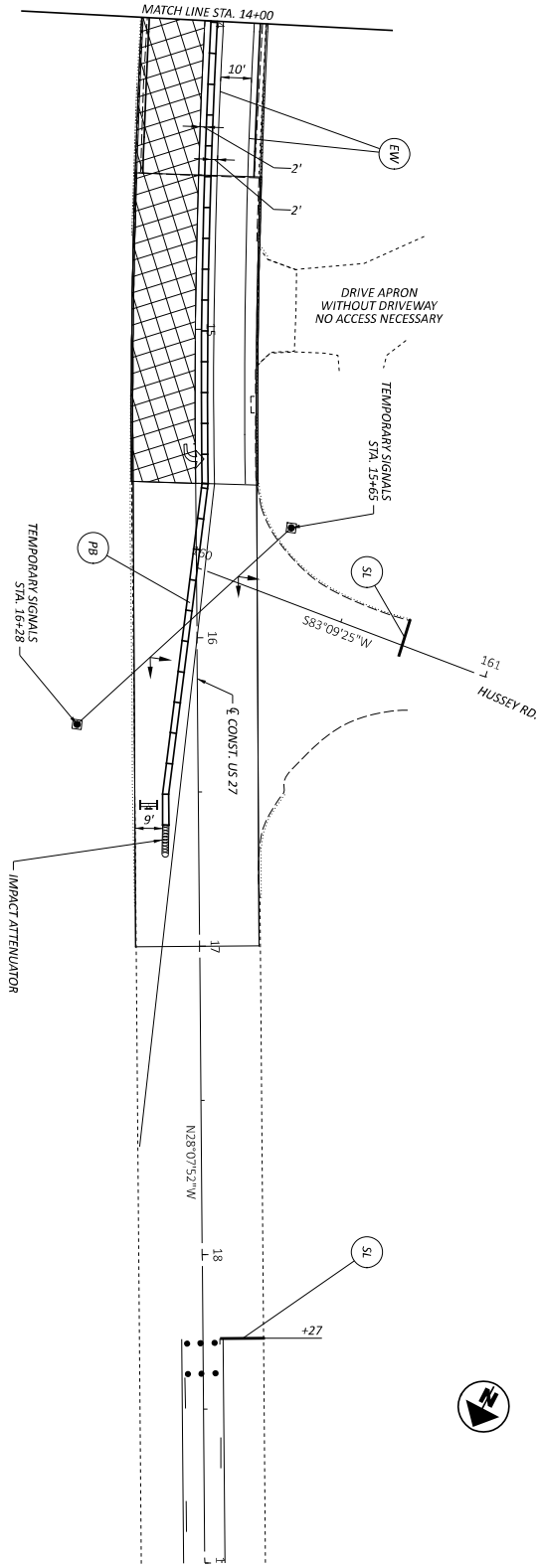
HORIZONTAL SCALE IN FEET
0 20
10 40

SHEET	P.2 | TOTAL 3
PROJECT ID	117275
REVIEWED	CWP 05-01-24
DESIGNER	CJD
DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.

MODEL: CLX_3 - Plan 3-1 [Sheet] PAPERSIZE: 17x11 (in.) DATE: 4/30/2024 TIME: 9:09:17 AM USER: cdunlap
P:\23365 - ODOT - BUT-75-5.22\117275\400-Engineering\MOT\Sheets\117275_MP102.dgn

LEGEND

- WORK ZONE
- PAVEMENT MARKING REMOVED
- WORK ZONE IMPACT ATTENUATOR
- DIRECTION OF TRAFFIC
- TYPE 3 BARRICADE WITH SIGN
- (SL) WORK ZONE STOP LINE
- (EW) WORK ZONE EDGE LINE, 6" (WHITE)
- (DW) WORK ZONE DOTTED LINE, 6" (WHITE)
- (PB) PORTABLE BARRIER, UNANCHORED



MAINTENANCE OF TRAFFIC - PHASE 2 (14.5' VC OPTION)
US-27 - STA. 14+00 TO END

HORIZONTAL SCALE IN FEET
0 20
10 40

SHEET	TOTAL
P.3	3

PROJECT ID 117275
REVIEWED CWP 05-01-24
DESIGNED CJD
DESIGN AGENCY CHAGRIN VALLEY ENGINEERING, LTD.

BUT IR 75/VAR/5.22/VAR

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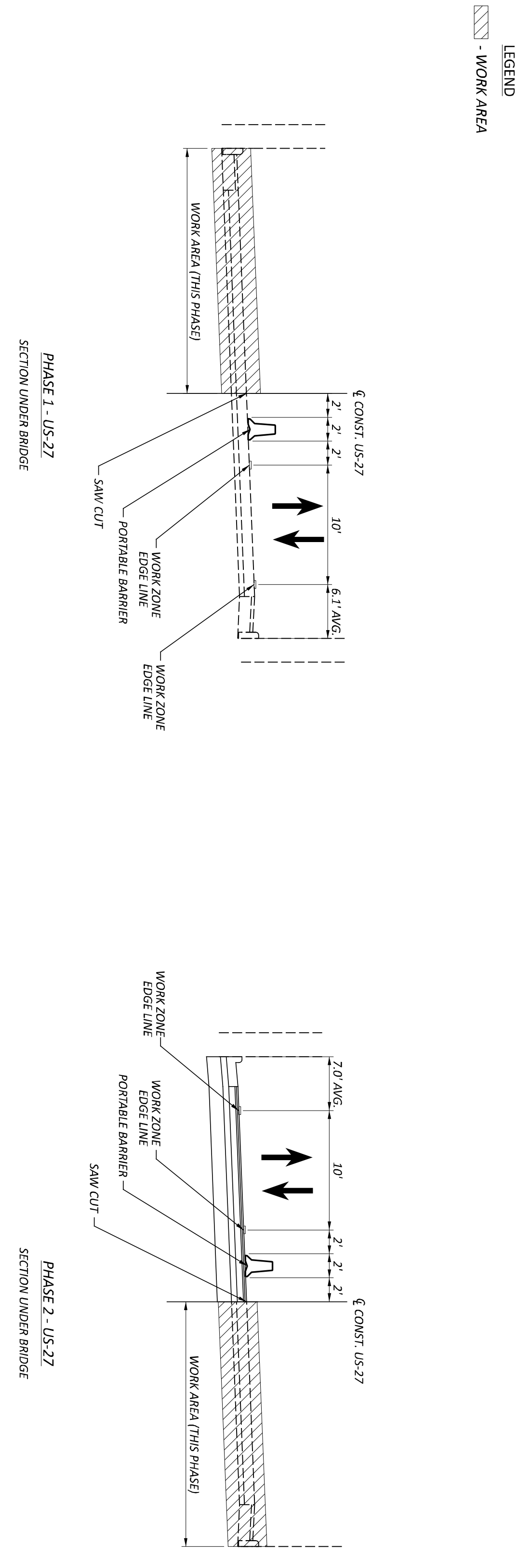
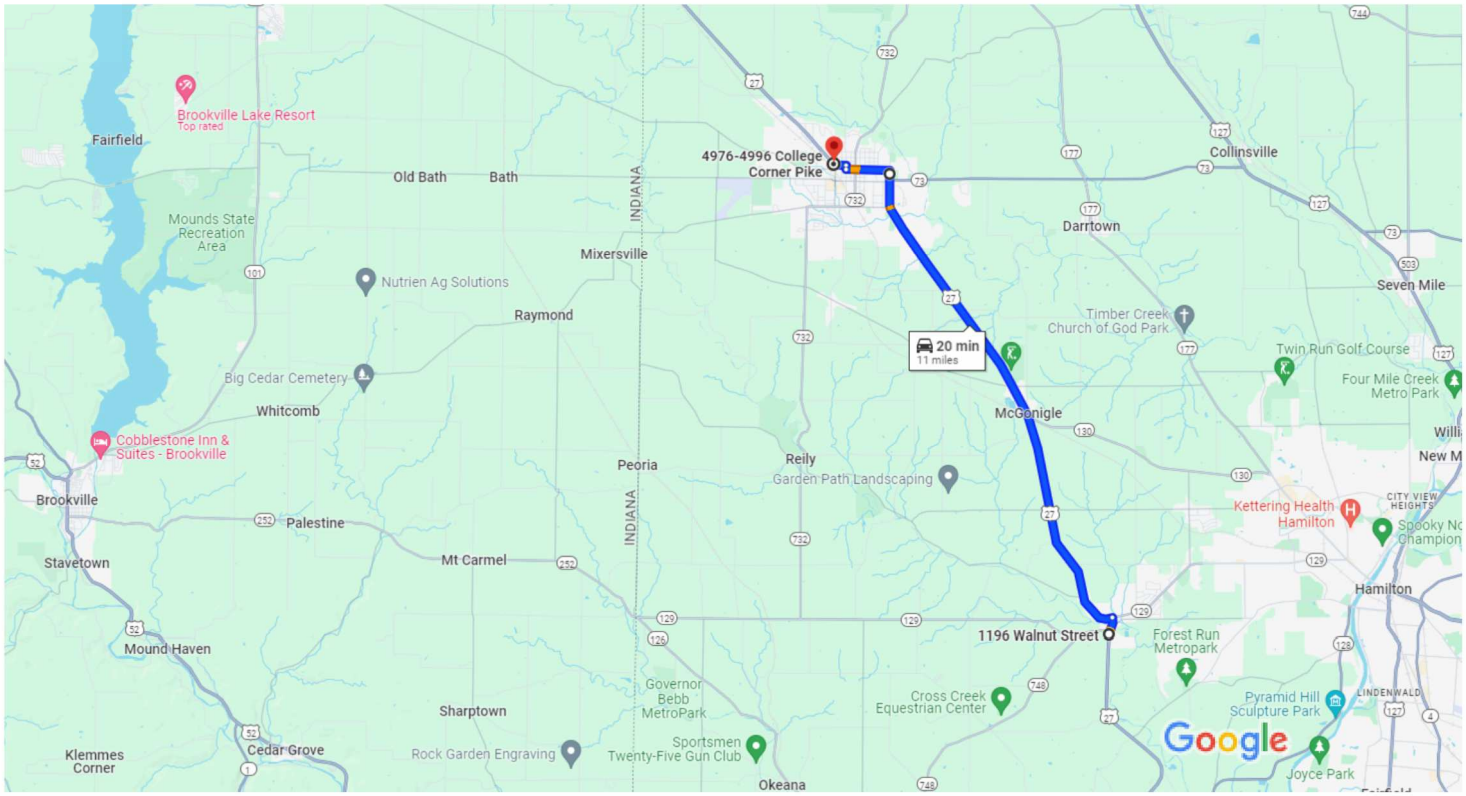


MAINTENANCE OF TRAFFIC - TYPICAL SECTIONS - US-27

DESIGN AGENCY	CHAGRIN VALLEY ENGINEERING, LTD.
DESIGNER	CJD
REVIEWER	CVP 05-01-24
PROJECT ID	117275
SHEET	P.1
TOTAL	1

Google Maps Northbound Time to Drive Normal Route Drive 11.0 miles, 20 min

BUT-027-10.83-Normal Route-NB-TYP



Map data ©2024 Google 2 mi

1196 Walnut St
Hamilton, OH 45013

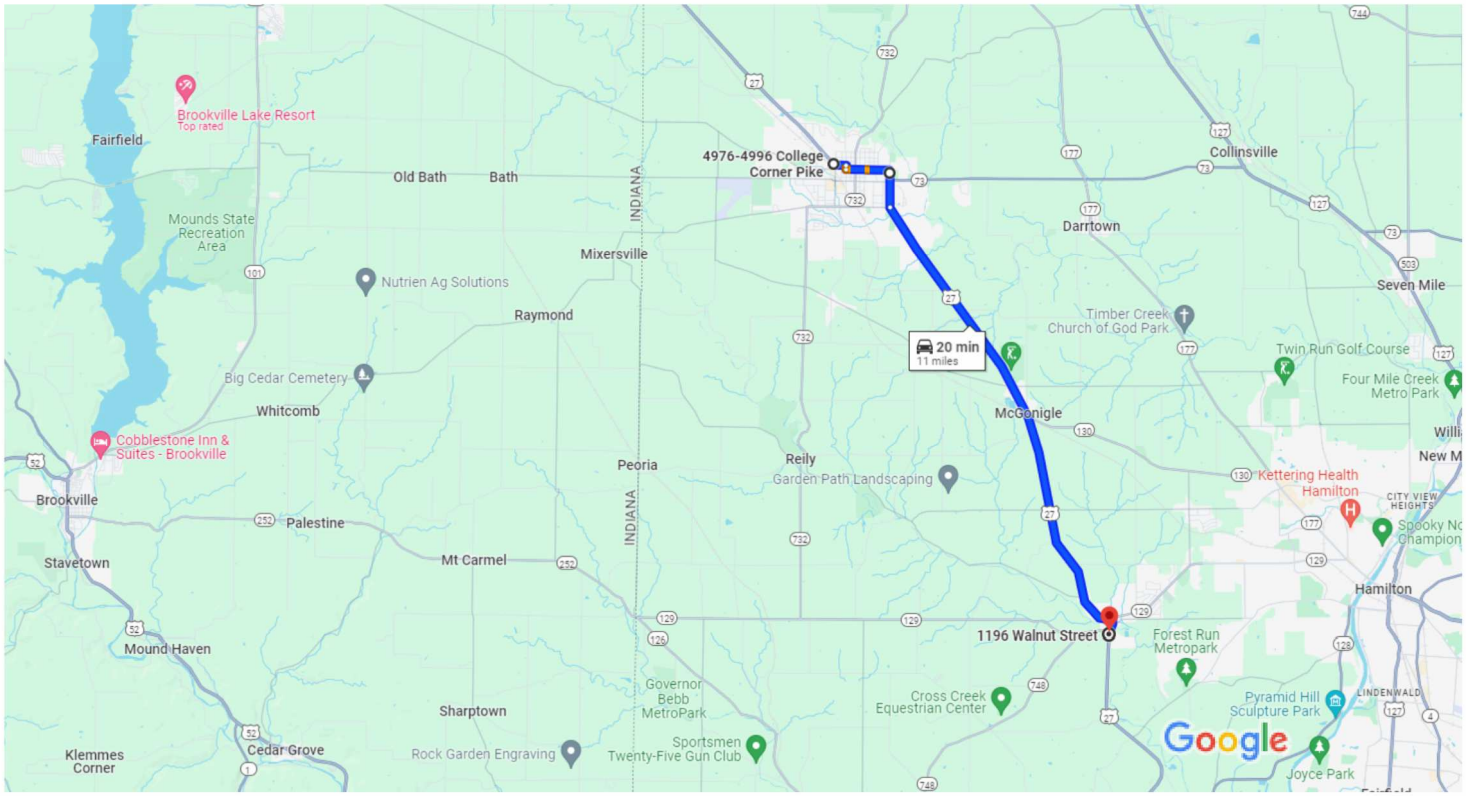
1. Head north on Walnut St toward High St
   0.3 mi
2. Turn left onto Millville Oxford Rd/US Hwy 27 N
   Continue to follow US Hwy 27 N
   9.5 mi
3. Turn left onto E High St
   0.8 mi
4. Turn right onto N College Ave
   381 ft
5. Turn left at the 1st cross street onto W Church St
   0.2 mi
6. Continue onto College Corner Pike
   246 ft

4976-4996 College Corner Pike

Oxford, OH 45056

Google Maps Southbound Time to Drive Normal Route Drive 11.0 miles, 20 min

BUT-027-10.83-Normal Route-SB-TYP



Map data ©2024 Google 2 mi

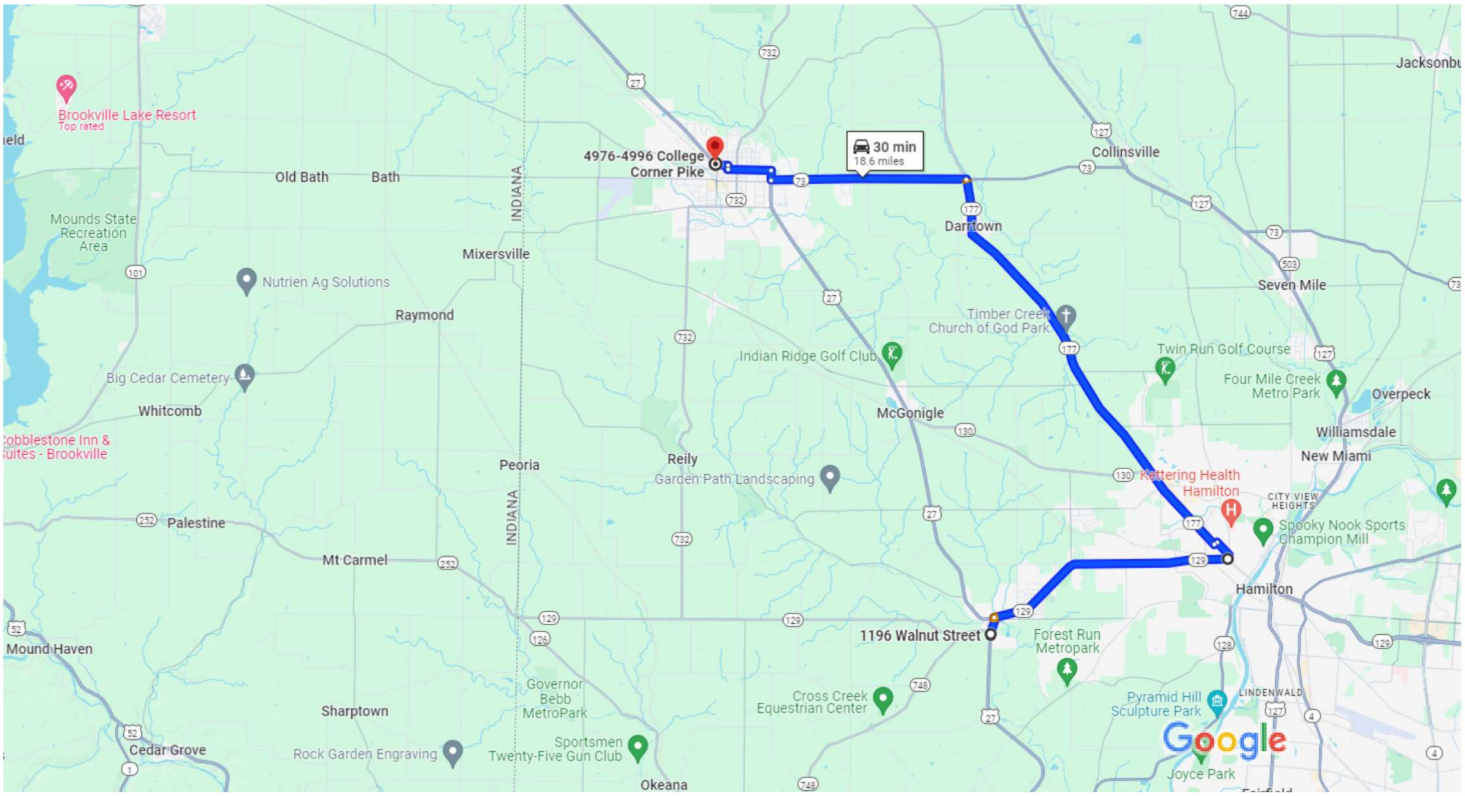
4976-4996 College Corner Pike
Oxford, OH 45056

1. Head southeast on College Corner Pike
   246 ft
2. Continue onto W Church St
   0.2 mi
3. Turn right onto N College Ave
   381 ft
4. Turn left at the 1st cross street onto W High St
   0.8 mi
5. Turn right onto S Patterson Ave
   0.7 mi
6. Continue onto Millville Oxford Rd/Oxford Millville Rd/US Hwy 27 S
   Continue to follow Millville Oxford Rd/US Hwy 27 S
   8.9 mi
7. Turn right onto Walnut St
   0.3 mi

1196 Walnut St
Hamilton, OH 45013

Google Maps Northbound Time to Drive Detour Route Drive 18.6 miles, 30 min

BUT-027-10.83-Detour 1-NB-TYP-State Route Option 1



1196 Walnut St
Hamilton, OH 45013

1. Head north on Walnut St toward High St
   0.3 mi
2. Turn right onto OH-129 E/Millville Ave
   4.6 mi
3. Continue straight onto Eaton Ave
   449 ft
4. Turn left onto Park Ave
   0.3 mi
5. Turn left onto Beal Ave
   367 ft
6. Turn right onto OH-177 N/Hamilton Richmond Rd/Main St
   Continue to follow OH-177 N/Hamilton Richmond Rd
   Pass by KeyBank (on the right in 1.4 mi)
   8.3 mi

7. Turn left onto OH-73 W/Trenton Oxford Rd

3.6 mi

8. Turn right onto S Patterson Ave

0.2 mi

9. Turn left onto E High St

0.8 mi

10. Turn right onto N College Ave

381 ft

11. Turn left at the 1st cross street onto W Church St

0.2 mi

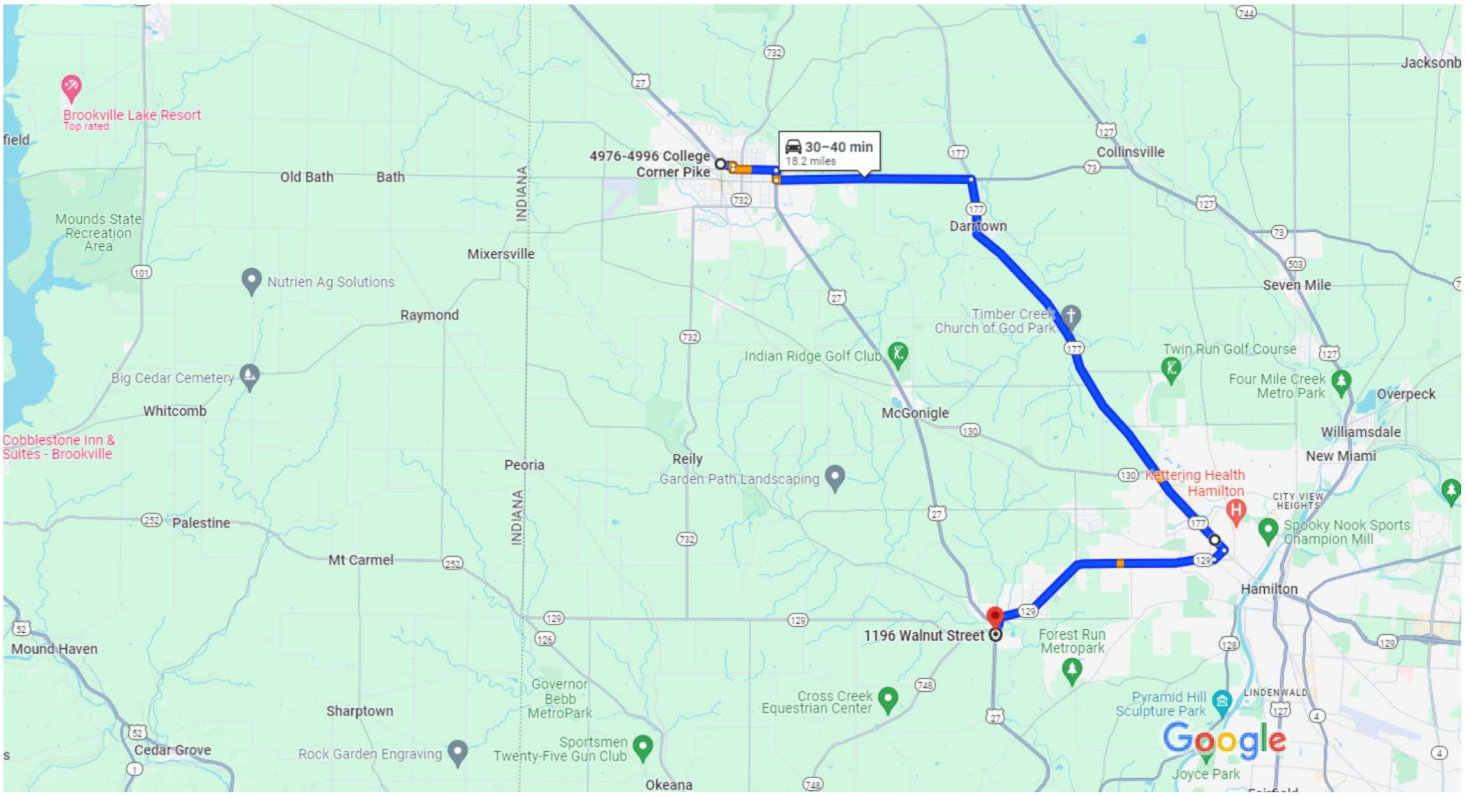
12. Continue onto College Corner Pike

246 ft

4976-4996 College Corner Pike
Oxford, OH 45056

Google Maps Southbound Time to Drive Detour Route Drive 18.2 miles, 30–40 min

BUT-027-10.83-Detour 1-SB-TYP-State Route Option1



Map data ©2024 Google 2 mi

4976-4996 College Corner Pike
Oxford, OH 45056

1. Head southeast on College Corner Pike — 246 ft
2. Continue onto W Church St — 0.2 mi
3. Turn right onto N College Ave — 381 ft
4. Turn left at the 1st cross street onto W High St — 0.8 mi
5. Turn right onto S Patterson Ave — 0.2 mi
6. Turn left onto OH-73 E/Trenton Oxford Rd — 3.6 mi
7. Turn right onto OH-177 S/Hamilton Richmond Rd — 8.4 mi
   Pass by Burger King (on the left in 7 mi)

8. Turn right onto S Edgewood Ave

0.3 mi

9. Turn right onto OH-129 W/Millville Ave

Pass by McDonald's (on the right in 1.6 mi)

4.3 mi

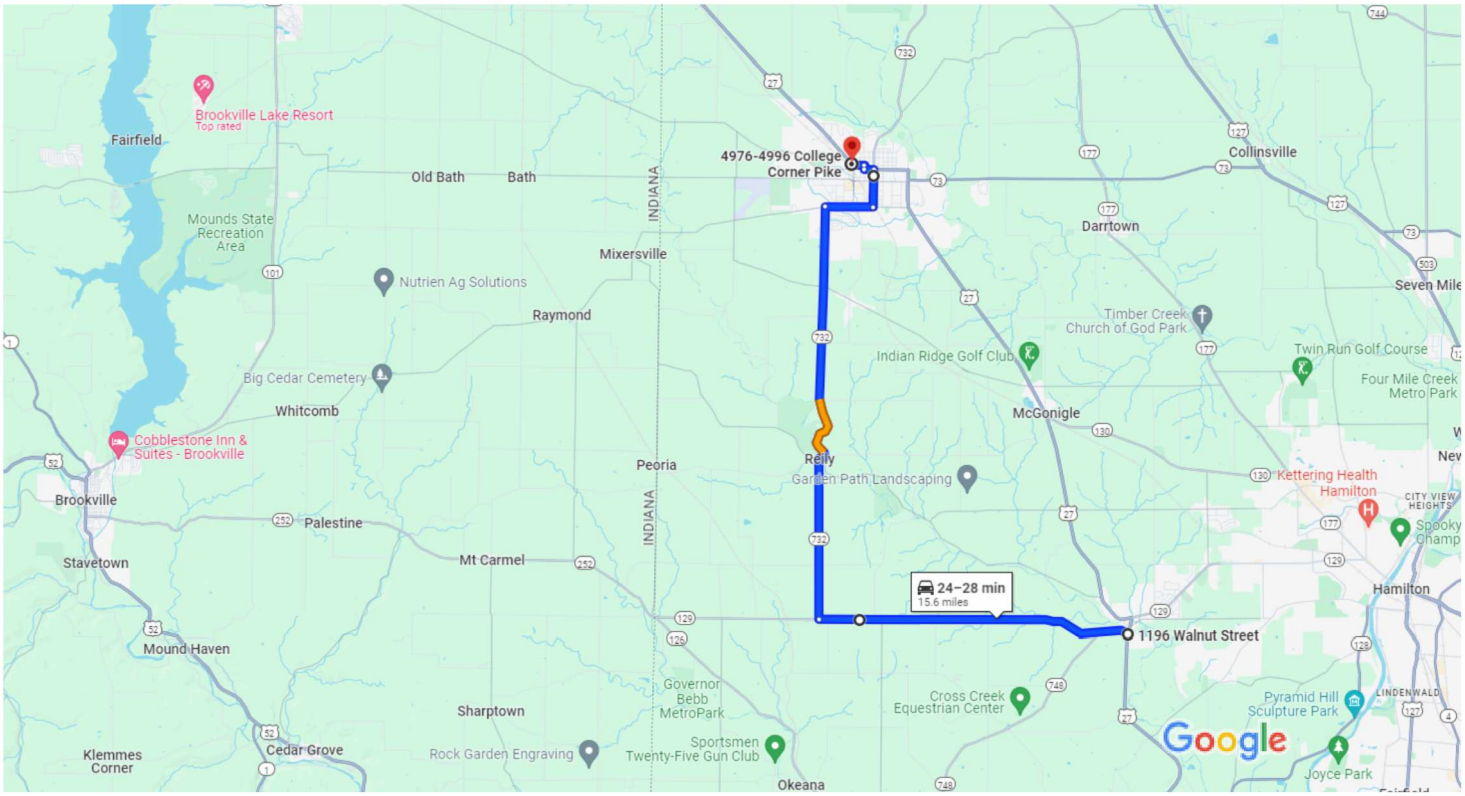
10. Turn left onto Walnut St

0.3 mi

1196 Walnut St
Hamilton, OH 45013

Google Maps Northbound Time to Drive Detour Route Drive 15.6 miles, 24–28 min

BUT-027-10.83-Detour 2-NB-TYP-State Route Option 2



Map data ©2024 Google 2 mi

1196 Walnut St
Hamilton, OH 45013

1. Head north on Walnut St toward High St

2 sec (52 ft)

Continue on OH-129 W. Take OH-732 N to W High St in Oxford

22 min (15.1 mi)

2. Turn left onto OH-129 W/High St
   Continue to follow OH-129 W

5.7 mi

3. Turn right onto OH-732 N

7.8 mi

4. Turn right onto W Chestnut St

0.9 mi

5. Turn left onto S Main St

0.7 mi

Continue on W High St. Take W Church St to College Corner Pike

3 min (0.5 mi)

6. Turn left onto W High St

0.2 mi

7. Turn right onto N College Ave

381 ft

8. Turn left at the 1st cross street onto W Church St

0.2 mi

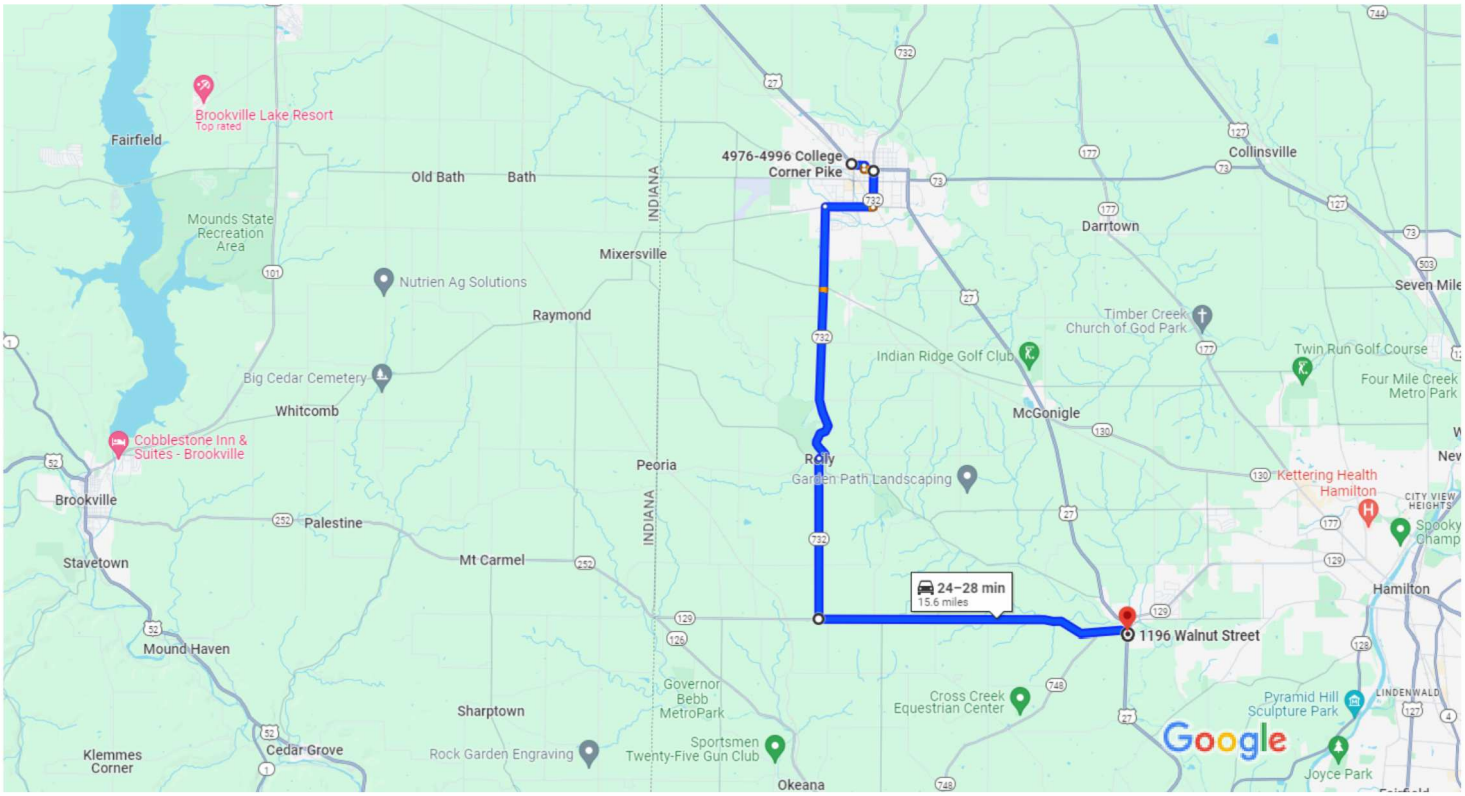
9. Continue onto College Corner Pike

246 ft

4976-4996 College Corner Pike
Oxford, OH 45056

Google Maps Southbound Time to Drive Detour Route Drive 15.6 miles, 24–28 min

BUT-027-10.83-Detour 2-SB-TYP-State Route Option 2



Map data ©2024 Google 2 mi

4976-4996 College Corner Pike
Oxford, OH 45056

Take W Church St and W High St to S Main St

3 min (0.5 mi)

1. Head southeast on College Corner Pike

246 ft

2. Continue onto W Church St

0.2 mi

3. Turn right onto N College Ave

381 ft

4. Turn left at the 1st cross street onto W High St

0.2 mi

Take OH-732 S and OH-129 E to Walnut St in Millville

23 min (15.1 mi)

5. Turn right onto S Main St

0.7 mi

6. Turn right onto W Chestnut St

0.9 mi

7. Turn left onto OH-732 S/Oxford Reily Rd

Continue to follow OH-732 S

4.9 mi

8. Turn left to stay on OH-732 S

2.9 mi

9. Turn left onto OH-129 E

5.7 mi

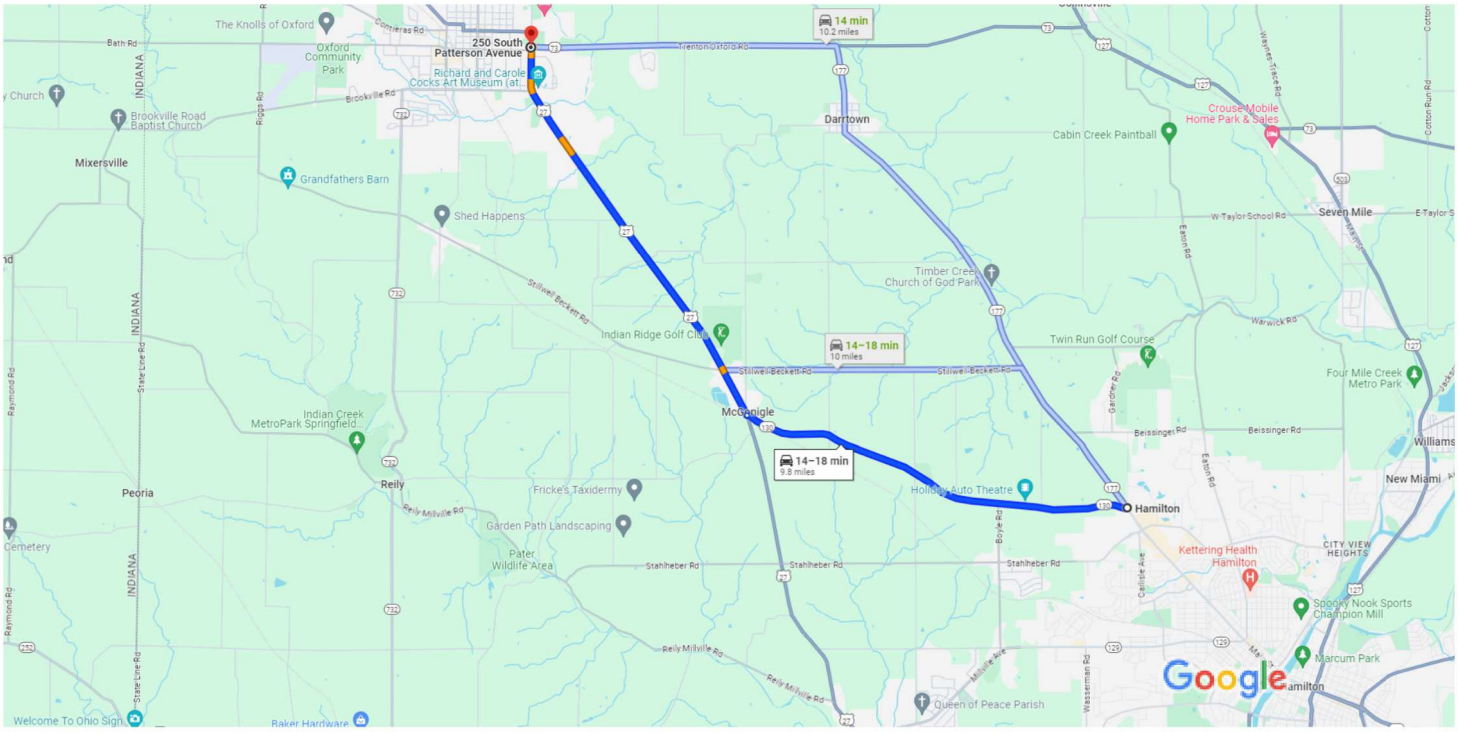
10. Turn right onto Walnut St

4 sec (52 ft)

1196 Walnut St
Hamilton, OH 45013

Google Maps Westbound Time to Drive Normal Route Drive 9.8 miles, 14–18 min

BUT-027-10.83-OH-130-Normal Route-WB-TYP



Map data ©2024 1 mi

Hamilton
Ohio

1. Head southwest on OH-130 W toward Serenity Hill Ln

4.7 mi

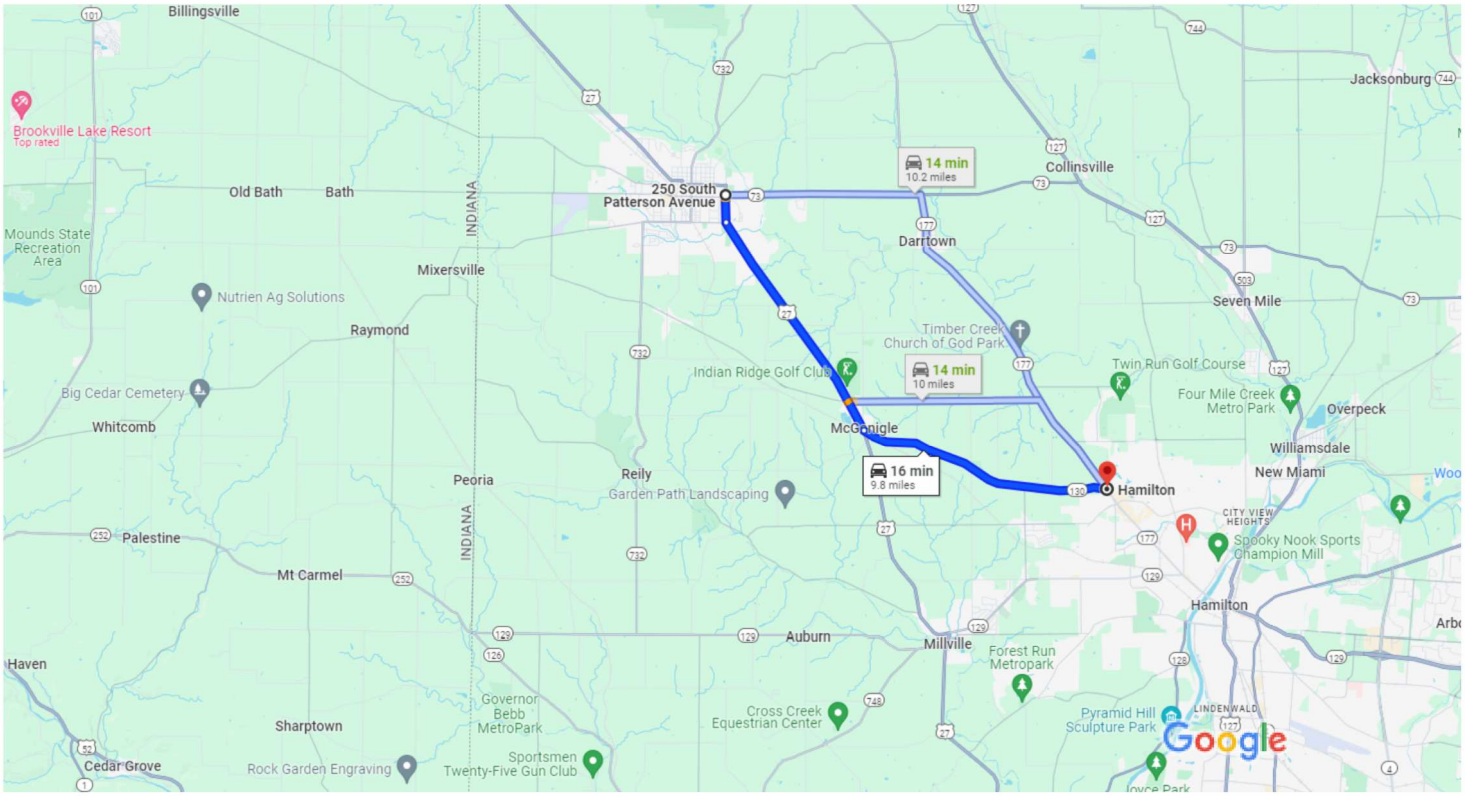
2. Turn right onto US Hwy 27 N
Destination will be on the left

5.1 mi

250 S Patterson Ave
Oxford, OH 45056

Google Maps Eastbound Time to Drive Normal Route Drive 9.8 miles, 16 min

BUT-027-10.83-OH130-Normal Route-EB-TYP



Map data ©2024 2 mi

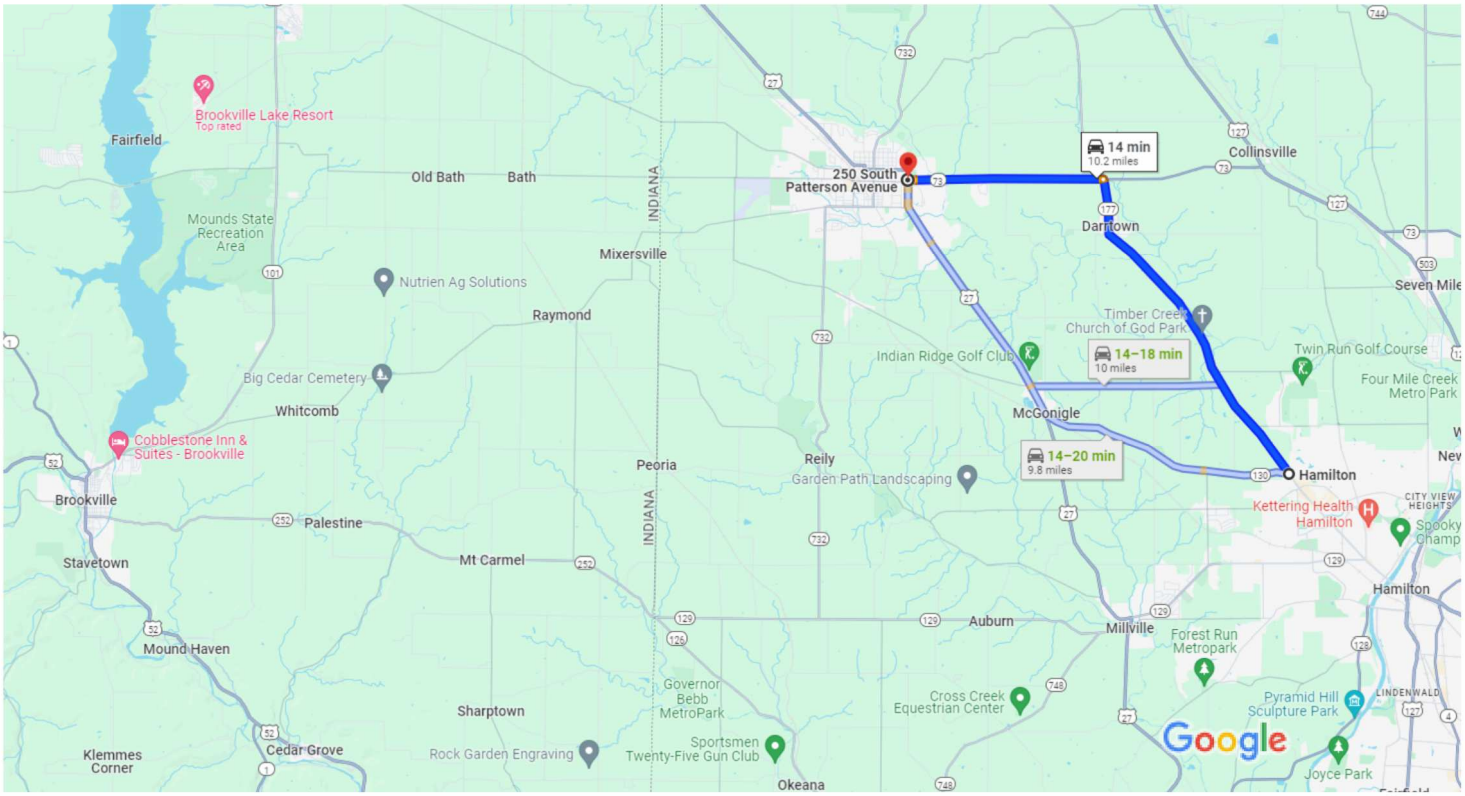
250 S Patterson Ave
Oxford, OH 45056

1. Head south on S Patterson Ave toward E Spring St
   0.5 mi
2. Continue onto Millville Oxford Rd/Oxford Millville Rd/US Hwy 27 S
   Continue to follow Millville Oxford Rd/US Hwy 27 S
   4.6 mi
3. Turn left onto OH-130 E
   4.7 mi

Hamilton
Ohio

Google Maps Westbound Time to Drive Detour Route Drive 10.2 miles, 14 min

BUT-027-10.83-OH-130-Detour A-WB-TYP



Map data ©2024 Google 2 mi

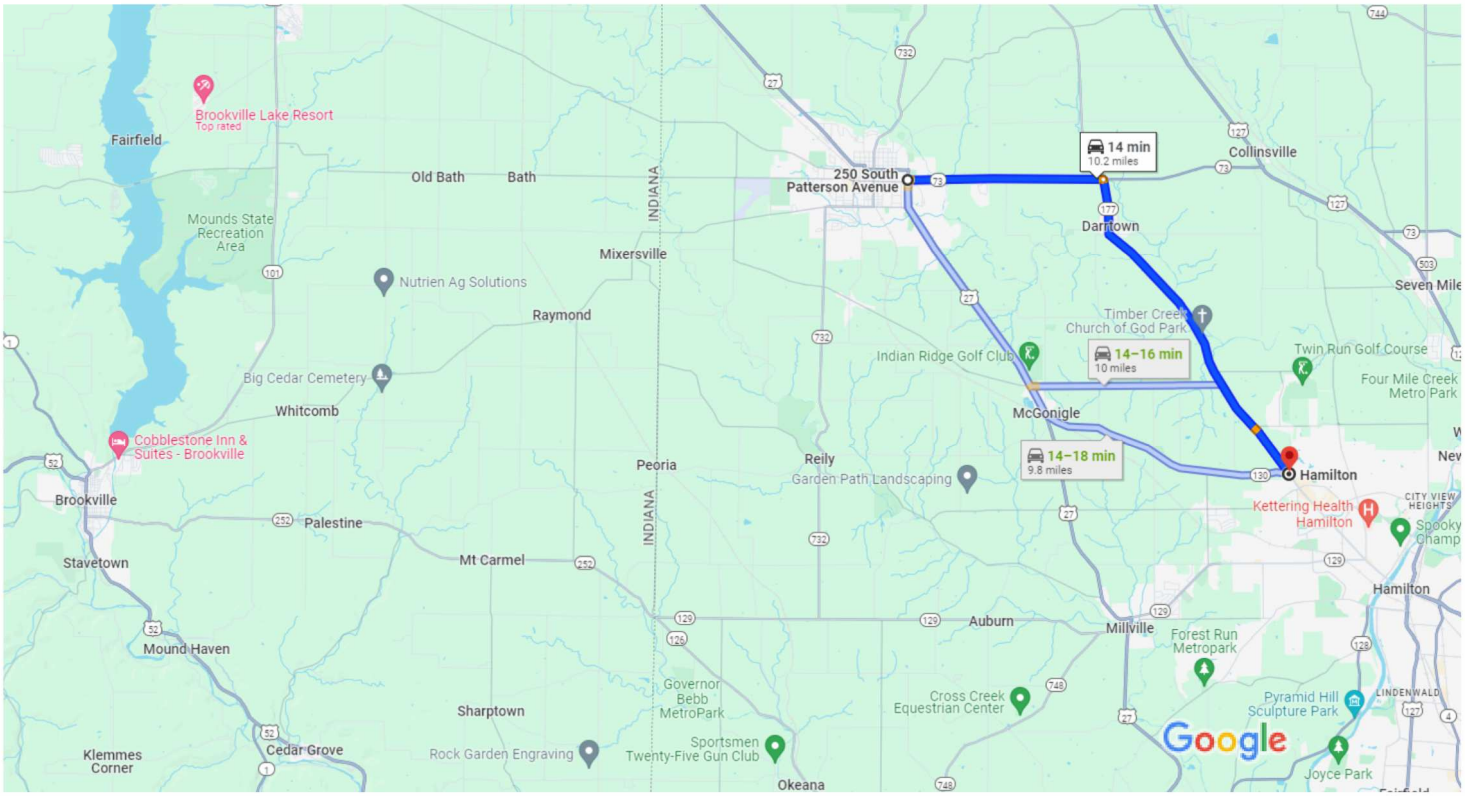
Hamilton
Ohio

1. Head northeast on OH-130 E toward OH-177 N
   7 ft
2. Turn left onto OH-177 N/Hamilton Richmond Rd
   6.6 mi
3. Turn left onto OH-73 W/Trenton Oxford Rd
   3.6 mi

250 S Patterson Ave
Oxford, OH 45056

Google Maps Eastbound Time to Drive Detour Route, Drive 10.2 miles, 14 min

BUT-027-10.83-OH-130-Detour A-EB-TYP



Map data ©2024 Google 2 mi

250 S Patterson Ave
Oxford, OH 45056

1. Head east on OH-73 E/Trenton Oxford Rd — 3.6 mi
2. Turn right onto OH-177 S/Hamilton Richmond Rd — 6.6 mi
3. Turn right onto OH-130 W — 7 ft

Hamilton
Ohio

Work Zone User Cost Calculations		
Detour (Using Actual Drive Time)		
Project ID:	**117275**	
County-Route-Section:	**BUT-027-10.83-D1-NB-Typ**	
User Input:		
Construction Calendar Year:	**2023**	
	Car	**B/C Truck**
ADT of Detoured Section:	**3,680**	**228**
Time to Drive Normal Route (Min):	**20**	**20**
Time to Drive Detour Route (Min):	**30**	**30**
Duration of Closure (Days):	**60**	
Calculated Values:		
User Cost per Vehicle per Hour:	$26.13	$70.52
Delay (Min):	10	10
Delay (Hours):	0.167	0.167
Delay Cost per Vehicle:	$4.35	$11.75
Delay Cost per Day:	$16,023.44	$2,679.72
Delay Cost for Closure Duration:	$961,407	$160,783
Total Delay Cost for Closure Duration:	**$1,122,190**	
Average Delay Cost per Day:	**$18,703**	

Notes ***(description, detour route, project phase reference, etc, as applicable)*** **:**
******TIP: Alt+Enter for a line break in the box below.******

Detour 1 - Northbound - Typical Hour - State Route 1
ADT volumes from ODOT AADT with ODOT seasonal adjustment factors applied

Form Version Date: 2/27/2024

Fill in all highlighted cells.

The Average Delay Cost per Day is the MAXIMUM that may be used as incentive / disincentive.

Date Calculated: 2024-05-01

Work Zone User Cost Calculations		
Detour (Using Actual Drive Time)		
Project ID:	**117275**	
County-Route-Section:	**BUT-027-10.83-D1-SB-Typ**	
User Input:		
Construction Calendar Year:	**2023**	
	Car	B/C Truck
ADT of Detoured Section:	**3,888**	**196**
Time to Drive Normal Route (Min):	**20**	**20**
Time to Drive Detour Route (Min):	**35**	**35**
Duration of Closure (Days):	**60**	
Calculated Values:		
User Cost per Vehicle per Hour:	$26.13	$70.52
Delay (Min):	15	15
Delay (Hours):	0.250	0.250
Delay Cost per Vehicle:	$6.53	$17.63
Delay Cost per Day:	$25,393.67	$3,455.43
Delay Cost for Closure Duration:	$1,523,620	$207,326
Total Delay Cost for Closure Duration:	**$1,730,946**	
Average Delay Cost per Day:	**$28,849**	

Notes ***(description, detour route, project phase reference, etc, as applicable)*** **:**
******TIP: Alt+Enter for a line break in the box below.******

Detour 1 - Southbound - Typical Hour - State Route 1
ADT volumes from ODOT AADT with ODOT seasonal adjustment factors applied

Form Version Date: 2/27/2024

Fill in all highlighted cells.

The Average Delay Cost per Day is the MAXIMUM that may be used as incentive / disincentive.

Date Calculated: 2024-05-01

Work Zone User Cost Calculations		
Detour (Using Actual Drive Time)		
Project ID:	**117275**	
County-Route-Section:	**BUT-027-10.83-D2-NB-Typ**	
User Input:		
Construction Calendar Year:	**2023**	
	Car	**B/C Truck**
ADT of Detoured Section:	**3,680**	**228**
Time to Drive Normal Route (Min):	**20**	**20**
Time to Drive Detour Route (Min):	**26**	**26**
Duration of Closure (Days):	**60**	
Calculated Values:		
User Cost per Vehicle per Hour:	$26.13	$70.52
Delay (Min):	6	6
Delay (Hours):	0.100	0.100
Delay Cost per Vehicle:	$2.61	$7.05
Delay Cost per Day:	$9,614.07	$1,607.83
Delay Cost for Closure Duration:	$576,844	$96,470
Total Delay Cost for Closure Duration:	**$673,314**	
Average Delay Cost per Day:	**$11,222**	

Notes ***(description, detour route, project phase reference, etc, as applicable)*** **:**
******TIP: Alt+Enter for a line break in the box below.******

Detour 2 - Northbound - Typical Hour - State Route 2
ADT volumes from ODOT AADT with ODOT seasonal adjustment factors applied

Form Version Date: 2/27/2024

Fill in all highlighted cells.

The Average Delay Cost per Day is the MAXIMUM that may be used as incentive / disincentive.

Date Calculated: 2024-05-01

Work Zone User Cost Calculations

Detour (Using Actual Drive Time)

Project ID:	**117275**	
County-Route-Section:	**BUT-027-10.83-D2-SB-Typ**	
User Input:		
Construction Calendar Year:	**2023**	
	Car	**B/C Truck**
ADT of Detoured Section:	**3,888**	**196**
Time to Drive Normal Route (Min):	**20**	**20**
Time to Drive Detour Route (Min):	**26**	**26**
Duration of Closure (Days):	**60**	
Calculated Values:		
User Cost per Vehicle per Hour:	$26.13	$70.52
Delay (Min):	6	6
Delay (Hours):	0.100	0.100
Delay Cost per Vehicle:	$2.61	$7.05
Delay Cost per Day:	$10,157.47	$1,382.17
Delay Cost for Closure Duration:	$609,448	$82,930
Total Delay Cost for Closure Duration:	**$692,378**	
Average Delay Cost per Day:	**$11,540**	

Notes ***(description, detour route, project phase reference, etc, as applicable)*** **:**
******TIP: Alt+Enter for a line break in the box below.******

Detour 2 - Southbound - Typical Hour - State Route 2
ADT volumes from ODOT AADT with ODOT seasonal adjustment factors applied

Form Version Date: 2/27/2024

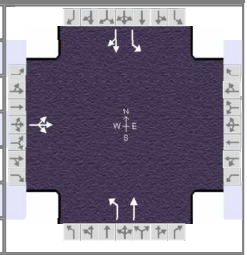
Fill in all highlighted cells.

The Average Delay Cost per Day is the MAXIMUM that may be used as incentive / disincentive.

Date Calculated: 2024-05-01

HCS Signalized Intersection Results Summary

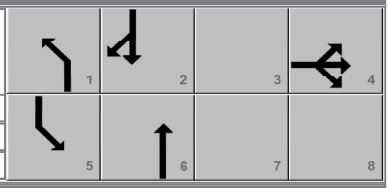
General Information				Intersection Information	
Agency	CVE			Duration, h	0.250
Analyst	ALM	Analysis Date	Apr 26, 2024	Area Type	Other
Jurisdiction	ODOT	Time Period	AM Peak	PHF	0.98
Urban Street	BUT-27	Analysis Year	2024	Analysis Period	1> 7:00
Intersection	Hussey & BUT-27	File Name	117275-BUT-27-10.83-WZ-AM.xus		
Project Description	BUT-027-10.83 Feasibility AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	0	13				1	243		0	297	12

Signal Information			
Cycle, s	150.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off

Green	27.5	33.0	10.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	23.5	23.5	20.5	0.0	0.0	0.0



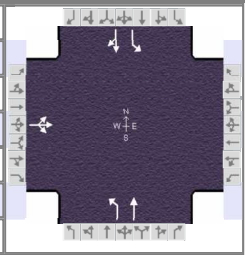
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			1	6	5	2
Case Number		12.0			2.0	4.0	2.0	4.0
Phase Duration, s		34.5			55.0	55.0	60.5	60.5
Change Period, ($Y+R_c$), s		24.5			27.5	27.5	27.5	27.5
Max Allow Headway (*MAH*), s		3.0			2.8	2.7	0.0	2.7
Queue Clearance Time (g_s), s		4.1			2.1	23.1		28.8
Green Extension Time (g_e), s		0.0			0.0	0.1	0.0	0.2
Phase Call Probability		1.00			1.00	1.00		1.00
Max Out Probability		0.00			0.00	0.16		0.25

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14				1	6		5	2	12
Adjusted Flow Rate (*v*), veh/h		23					1	248		0	315	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1558					1667	1689		1667	1690	
Queue Service Time (g_s), s		2.1					0.1	21.1		0.0	26.8	
Cycle Queue Clearance Time (g_c), s		2.1					0.1	21.1		0.0	26.8	
Green Ratio (*g/C*)		0.07					0.18	0.18		0.22	0.22	
Capacity (*c*), veh/h		104					306	310		367	372	
Volume-to-Capacity Ratio (*X*)		0.226					0.003	0.801		0.000	0.848	
Back of Queue (*Q*), ft/ln (95 th percentile)		39					2	397		0	487	
Back of Queue (*Q*), veh/ln (95 th percentile)		1.6					0.1	15.4		0.0	19.0	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.04					0.00	0.40		0.00	0.49	
Uniform Delay (d_1), s/veh		66.3					50.1	58.6		0.0	56.1	
Incremental Delay (d_2), s/veh		0.4					0.0	13.0		0.0	15.8	
Initial Queue Delay (d_3), s/veh		0.0					0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		66.7					50.1	71.6		0.0	71.9	
Level of Service (LOS)		E					D	E			E	
Approach Delay, s/veh / LOS	66.7	E		0.0			71.5	E		71.9	E	
Intersection Delay, s/veh / LOS	71.5						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.97	B	1.97	B	1.43	A	1.73	B
Bicycle LOS Score / LOS	0.53	A			0.90	A	1.01	A

HCS Signalized Intersection Results Summary

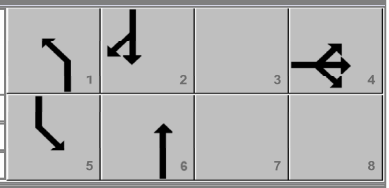
General Information				Intersection Information	
Agency	CVE			Duration, h	0.250
Analyst	ALM	Analysis Date	Apr 26, 2024	Area Type	Other
Jurisdiction	ODOT	Time Period	PM Peak	PHF	0.93
Urban Street	BUT-27	Analysis Year	2024	Analysis Period	1> 7:00
Intersection	Hussey & BUT-27	File Name	117275-BUT-27-10.83-WZ-PM.xus		
Project Description	BUT-027-10.83 Feasibility PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	15	0	12				1	404		0	304	14

Signal Information			
Cycle, s	150.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off

Green	33.5	27.0	10.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	23.5	23.5	20.5	0.0	0.0	0.0



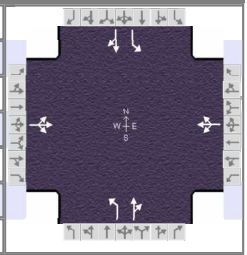
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			1	6	5	2
Case Number		12.0			2.0	4.0	2.0	4.0
Phase Duration, s		34.5			61.0	61.0	54.5	54.5
Change Period, ($Y+R_c$), s		24.5			27.5	27.5	27.5	27.5
Max Allow Headway (*MAH*), s		2.9			2.8	2.7	0.0	2.7
Queue Clearance Time (g_s), s		4.6			2.1	35.5		29.0
Green Extension Time (g_e), s		0.0			0.0	0.0	0.0	0.0
Phase Call Probability		1.00			1.00	1.00		1.00
Max Out Probability		0.01			0.00	1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14				1	6		5	2	12
Adjusted Flow Rate (*v*), veh/h		29					1	434		0	342	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1580					1667	1702		1667	1702	
Queue Service Time (g_s), s		2.6					0.1	33.5		0.0	27.0	
Cycle Queue Clearance Time (g_c), s		2.6					0.1	33.5		0.0	27.0	
Green Ratio (*g/C*)		0.07					0.22	0.22		0.18	0.18	
Capacity (*c*), veh/h		105					372	380		300	306	
Volume-to-Capacity Ratio (*X*)		0.276					0.003	1.143		0.000	1.116	
Back of Queue (*Q*), ft/ln (95 th percentile)		49					2	884		0	704	
Back of Queue (*Q*), veh/ln (95 th percentile)		1.9					0.1	34.5		0.0	27.7	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.05					0.00	0.88		0.00	0.70	
Uniform Delay (d_1), s/veh		66.6					45.3	58.3		0.0	61.5	
Incremental Delay (d_2), s/veh		0.5					0.0	91.0		0.0	86.3	
Initial Queue Delay (d_3), s/veh		0.0					0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		67.1					45.3	149.2		0.0	147.8	
Level of Service (LOS)		E					D	F			F	
Approach Delay, s/veh / LOS	67.1	E		0.0			149.0	F		147.8	F	
Intersection Delay, s/veh / LOS	145.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.97	B	1.97	B	1.44	A	1.73	B
Bicycle LOS Score / LOS	0.54	A			1.21	A	1.05	A

HCS Signalized Intersection Results Summary

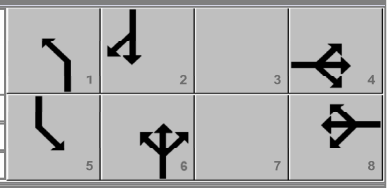
General Information				Intersection Information	
Agency	CVE			Duration, h	0.250
Analyst	ALM	Analysis Date	Apr 26, 2024	Area Type	Other
Jurisdiction	ODOT	Time Period	AM Peak	PHF	0.98
Urban Street	BUT-27	Analysis Year	2024	Analysis Period	1> 7:00
Intersection	Hussey/SR-130 & BUT-27	File Name	117275-BUT-27-10.83-SR-130-WZ-AM.xus		
Project Description	BUT-027-10.83 Feasibility AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	0	13	43	0	34	1	200	43	0	297	12

Signal Information			
Cycle, s	180.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off

Green	27.1	32.5	10.0	10.4	0.0	0.0
Yellow	4.0	4.0	4.0	4.0	0.0	0.0
Red	23.5	23.5	20.5	16.5	0.0	0.0



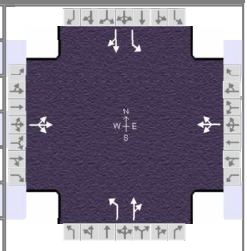
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	1	6	5	2
Case Number		12.0		12.0	1.2	4.0	2.0	4.0
Phase Duration, s		34.5		30.9	54.6	54.6	60.0	60.0
Change Period, ($Y+R_c$), s		24.5		20.5	27.5	27.5	27.5	27.5
Max Allow Headway (*MAH*), s		3.0		2.9	2.8	2.8	0.0	2.7
Queue Clearance Time (g_s), s		4.6		10.9	2.1	29.1		34.5
Green Extension Time (g_e), s		0.0		0.0	0.0	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00	1.00		1.00
Max Out Probability		0.01		1.00	0.00	1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	1	6	16	5	2	12
Adjusted Flow Rate (*v*), veh/h		23			79		1	248		0	315	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1558			1580		1667	1636		1667	1690	
Queue Service Time (g_s), s		2.6			8.9		0.1	27.1		0.0	32.5	
Cycle Queue Clearance Time (g_c), s		2.6			8.9		0.1	27.1		0.0	32.5	
Green Ratio (*g/C*)		0.06			0.06		0.15	0.15		0.18	0.18	
Capacity (*c*), veh/h		87			91		291	246		301	305	
Volume-to-Capacity Ratio (*X*)		0.271			0.861		0.004	1.006		0.000	1.033	
Back of Queue (*Q*), ft/ln (95 th percentile)		48			214		2	569		0	691	
Back of Queue (*Q*), veh/ln (95 th percentile)		1.9			8.6		0.1	22.1		0.0	27.0	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.05			0.00		0.00	0.57		0.00	0.69	
Uniform Delay (d_1), s/veh		81.5			84.1		64.9	76.5		0.0	73.8	
Incremental Delay (d_2), s/veh		0.6			50.2		0.0	59.0		0.0	60.3	
Initial Queue Delay (d_3), s/veh		0.0			0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		82.1			134.3		64.9	135.4		0.0	134.1	
Level of Service (LOS)		F			F		E	F			F	
Approach Delay, s/veh / LOS	82.1	F		134.3	F		135.1	F		134.1	F	
Intersection Delay, s/veh / LOS	132.7						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.98	B	1.98	B	1.74	B	1.74	B
Bicycle LOS Score / LOS	0.53	A	0.62	A	0.90	A	1.01	A

HCS Signalized Intersection Results Summary

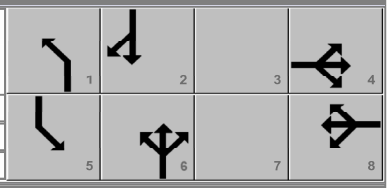
General Information				Intersection Information	
Agency	CVE			Duration, h	0.250
Analyst	ALM	Analysis Date	Apr 26, 2024	Area Type	Other
Jurisdiction	ODOT	Time Period	PM Peak	PHF	0.93
Urban Street	BUT-27	Analysis Year	2024	Analysis Period	1> 7:00
Intersection	Hussey/SR-130 & BUT-27	File Name	117275-BUT-27-10.83-SR-130-WZ-PM.xus		
Project Description	BUT-027-10.83 Feasibility PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	15	0	12	68	0	87	1	336	68	0	304	14

Signal Information			
Cycle, s	180.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off

Green	31.5	25.0	10.0	13.5	0.0	0.0
Yellow	4.0	4.0	4.0	4.0	0.0	0.0
Red	23.5	23.5	20.5	16.5	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	1	6	5	2
Case Number		12.0		12.0	1.2	4.0	2.0	4.0
Phase Duration, s		34.5		34.0	59.0	59.0	52.5	52.5
Change Period, ($Y+R_c$), s		24.5		20.5	27.5	27.5	27.5	27.5
Max Allow Headway (*MAH*), s		2.9		3.0	2.8	2.8	0.0	2.7
Queue Clearance Time (g_s), s		5.2		15.5	2.1	33.5		27.0
Green Extension Time (g_e), s		0.0		0.0	0.0	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00	1.00		1.00
Max Out Probability		0.02		1.00	0.00	1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	1	6	16	5	2	12
Adjusted Flow Rate (*v*), veh/h		29			167		1	434		0	342	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1580			1558		1667	1652		1667	1702	
Queue Service Time (g_s), s		3.2			13.5		0.1	31.5		0.0	25.0	
Cycle Queue Clearance Time (g_c), s		3.2			13.5		0.1	31.5		0.0	25.0	
Green Ratio (*g/C*)		0.06			0.08		0.18	0.18		0.14	0.14	
Capacity (*c*), veh/h		88			117		332	289		231	236	
Volume-to-Capacity Ratio (*X*)		0.331			1.426		0.003	1.502		0.000	1.446	
Back of Queue (*Q*), ft/ln (95 th percentile)		60			529		2	1289		0	999	
Back of Queue (*Q*), veh/ln (95 th percentile)		2.4			21.2		0.1	50.4		0.0	39.3	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.06			0.00		0.00	1.29		0.00	1.00	
Uniform Delay (d_1), s/veh		81.8			83.3		61.2	74.3		0.0	77.5	
Incremental Delay (d_2), s/veh		0.8			233.9		0.0	243.4		0.0	223.0	
Initial Queue Delay (d_3), s/veh		0.0			0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		82.6			317.2		61.2	317.6		0.0	300.5	
Level of Service (LOS)		F			F		E	F			F	
Approach Delay, s/veh / LOS	82.6	F		317.2	F		317.0	F		300.5	F	
Intersection Delay, s/veh / LOS	304.2						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.97	B	1.98	B	1.74	B	1.74	B
Bicycle LOS Score / LOS	0.54	A	0.76	A	1.21	A	1.05	A

Standard Delay Calculation - OH 130 Closed

BUT-27-10.83

Rural Principal Arterial Other

	Hour	Total		Delay (sec) per vehicle NB	SB	Wtd Avg	# veh	adjusted total delay **per vehicle** (s)	**(min)**	(hr)	Total delay (**per day**) (s)	(min)	**(hr)**
	0	294875	0.6%										
	1	215170	0.4%										
	2	200896	0.4%										
	3	281407	0.5%										
	4	644231	1.2%										
	5	1517013	2.9%										
	6	2639080	5.1%										
7:15 - 8:15	7	3242804	6.2%	71.6	71.9	71.8	552						
	8	2935280	5.6%										
	9	2863084	5.5%										
	10	2941020	5.6%										
	11	3051448	5.8%										
	12	3185569	6.1%										
	13	3304284	6.3%										
	14	3589343	6.9%										
	15	4056399	7.8%										
4:00 - 5:00	16	4258351	8.2%	149.2	147.8	148.6	722						
	17	3952528	7.6%										
	18	2819406	5.4%										
	19	2031364	3.9%										
	20	1591746	3.1%										
	21	1194084	2.3%										
	22	821520	1.6%										
	23	552526	1.1%										
		52183428	1.00										
				64	64	64	8863	58	**0.96**	0.016	463363	7722.714721	**128.71**
							8019						

Rural Local

Hour	Total		EB
0	14	0.2%	
1	2	0.0%	
2	4	0.1%	
3	6	0.1%	
4	10	0.1%	
5	102	1.5%	
6	264	3.8%	
7	531	7.7%	
8	474	6.8%	
9	375	5.4%	
10	392	5.7%	
11	410	5.9%	
12	409	5.9%	
13	405	5.8%	
14	456	6.6%	
15	683	9.9%	
16	597	8.6%	
17	687	9.9%	
18	440	6.4%	
19	262	3.8%	
20	247	3.6%	
21	89	1.3%	
22	50	0.7%	
23	15	0.2%	
	6924	1.00	

SAF 0.925

(R03 Tues/Wed, June)

	NB	SB
AADT	3615	3778
ADT	3908	4084

NB veh / day	Calc	4501
	MS2 ADT	**3908**
SB veh / day	Calc	4362
	MS2 ADT	**4084**

	NB	SB
MS2 % Cars	94%	95%
MS2 % Trucks	6%	5%

ODOT RUC User cost per Vehicle per hour

Cars	$	26.13
Trucks	$	70.52

NB BUT-27

adjusted total delay **per vehicle** (s)	**(min)**	(hr)	Total delay (**per day**) (s)	(min)	**(hr)**
56	0.9	0.015	217,166	3,619	60.32

Vehicles by type (**per day**) Total	Cars	Trucks	Total User Cost (**per day**) Cars	Trucks	Total
3908	3680	228	$ 1,484.30	$ 248.19	**$ 1,732.49**

SB BUT-27

adjusted total delay **per vehicle** (s)	**(min)**	(hr)	Total delay (**per day**) (s)	(min)	**(hr)**
60	1.0	0.017	243,513	4,059	67.64

Vehicles by type (**per day**) Total	Cars	Trucks	Total User Cost (**per day**) Cars	Trucks	Total
4084	3888	196	$ 1,682.67	$ 228.93	**$ 1,911.60**

Standard Delay Calculation - OH 130 Open

BUT-27-10.83

Rural Principal Arterial Other

	Hour	Total		Delay (sec) per vehicle NB	SB	Wtd Avg	# veh	adjusted total delay **per vehicle** (s)	**(min)**	(hr)	Total delay (**per day**) (s)	(min)	**(hr)**
	0	294875	0.6%										
	1	215170	0.4%										
	2	200896	0.4%										
	3	281407	0.5%										
	4	644231	1.2%										
	5	1517013	2.9%										
	6	2639080	5.1%										
7:15 - 8:15	7	3242804	6.2%	135.4	134.1	134.7	552						
	8	2935280	5.6%										
	9	2863084	5.5%										
	10	2941020	5.6%										
	11	3051448	5.8%										
	12	3185569	6.1%										
	13	3304284	6.3%										
	14	3589343	6.9%										
	15	4056399	7.8%										
4:00 - 5:00	16	4258351	8.2%	317.6	300.5	310.1	722						
	17	3952528	7.6%										
	18	2819406	5.4%										
	19	2031364	3.9%										
	20	1591746	3.1%										
	21	1194084	2.3%										
	22	821520	1.6%										
	23	552526	1.1%										
		52183428	1.00										
				131	126	129	8863	117	**1.9**	0.03	935217	15586.95	**259.78**
							8019						

SR-130

Rural Major Collector

Hour	Total		EB	# veh
0	6148	0.1%		
1	4169	0.1%		
2	4326	0.1%		
3	7181	0.1%		
4	32074	0.5%		
5	138913	2.3%		
6	305312	4.9%		
7	466734	7.6%	134.3	77
8	368415	6.0%		
9	329145	5.3%		
10	341506	5.5%		
11	368919	6.0%		
12	385402	6.2%		
13	401145	6.5%		
14	483452	7.8%		
15	578419	9.4%		
16	621756	10.1%	317.2	155
17	527389	8.5%		
18	323390	5.2%		
19	206025	3.3%		
20	140551	2.3%		
21	76073	1.2%		
22	34465	0.6%		
23	17889	0.3%		
	6168798	1.00		
			107	1315
				3401

SAF 0.925

(R03 Tues/Wed, June)

	NB	SB
AADT	3615	3778
ADT	3908	4084

NB veh / day	Calc	4501
	MS2 ADT	**3908**
SB veh / day	Calc	4362
	MS2 ADT	**4084**

	NB	SB
MS2 % Cars	94%	95%
MS2 % Trucks	6%	5%

ODOT RUC User cost per Vehicle per hour

Cars	$ 26.13
Trucks	$ 70.52

NB BUT-27

adjusted total delay **per vehicle** (s)	**(min)**	(hr)	Total delay (**per day**) (s)	(min)	**(hr)**
114	1.9	0.032	445,545	7,426	123.76

Vehicles by type (**per day**) Total	Cars	Trucks	Total User Cost (**per day**) Cars	Trucks	Total
3908	3680	228	$ 3,045.24	$ 509.19	**$ 3,554.44**

SB BUT-27

adjusted total delay **per vehicle** (s)	**(min)**	(hr)	Total delay (**per day**) (s)	(min)	**(hr)**
118	2.0	0.033	481,706	8,028	133.81

Vehicles by type (**per day**) Total	Cars	Trucks	Total User Cost (**per day**) Cars	Trucks	Total
4084	3888	196	$ 3,328.59	$ 452.86	**$ 3,781.44**

Appendix O

BUT-27 Preliminary Cost Estimate

BUT-27-10.38; PID 117275
Preliminary Estimate of Probable Costs For Feasibility Study

Items	Unit	Unit Cost $ (2023)	Quantity	Total $
Construction Costs - BUT-27-10.38 - Alternate 1 (14.0' Vertical Clearance)				
Roadway				
Clearing and Grubbing	Lump	$20,000	1	$20,000
Curb Removed	Ft	$7.25	1057	$7,663
Guardrail Removed	Ft	$3	325	$975
Anchor Assembly Removed	Each	$150	4	$600
Bridge Terminal Assembly Removed	Each	$800	4	$3,200
Excavation	Cu Yd	$18	1340	$24,120
Subgrade Compaction	Sq Yd	$3	3924	$11,772
Excavation of Subgrade	Cu Yd	$26	1518	$39,468
Granular Material, Type C, As Per Plan	Cu Yd	$65	1518	$98,670
Proof Rolling	Hour	$325	2	$650
Geotextile Fabric	Sq Yd	$2	3924	$7,848
Guardrail, Type MGS	Ft	$19	325	$6,175
Flared End Section	Each	$75	1	$75
Anchor Assembly, MGS Type A	Each	$1,300	3	$3,900
Anchor Assembly, MGS Type T	Each	$1,300	1	$1,300
MGS Bridge Terminal Assembly, Type 1	Each	$2,500	4	$10,000
Monument Box Adjusted to Grade	Each	$800	1	$800
Erosion Control				
Seeding and Mulching	Sq Yd	$2	1650	$3,300
Erosion Control	Each	$1	31560	$31,560
Drainage				
6" Shallow Pipe Underdrains with Geotextile Fabric	Ft	$12	1030	$12,360
6" Conduit, Type F for Underdrain Outlets	Ft	$25	70	$1,750
12" Conduit, Type B	Ft	$110	44	$4,840
Catch Basin, No. 3	Each	$4,500	1	$4,500
Catch Basin Adjusted to Grade	Each	$1,050	4	$4,200
Manhole, No. 3	Each	$5,500	1	$5,500
Manhole Adjusted to Grade	Each	$900	3	$2,700
Drainage Misc.	Lump	$20,000	1	$20,000
Pavement				
Pavement Removed	Sq Yd	$12	3942	$47,304
Full Depth Pavement Sawing	Ft	$3.50	133	$466
Pavement Planing, Asphalt Concrete	Sq Yd	$2	2161	$4,322
Asphalt Concrete Base, PG64-22, (449)	Cu Yd	$200	634	$126,800
Asphalt Concrete Base, PG64-22, (449), Driveways	Cu Yd	$335	3	$1,005
Aggregate Base	Cu Yd	$70	654	$45,780
1.25" Asphalt Concrete Surface Course, Type 1, (448), PG64-22	Cu Yd	$210	126	$26,460
1.75" Asphalt Concrete Intermediate Course, Type 2, (448)	Cu Yd	$255	293	$74,715
1.25" Asphalt Concrete Surface Course, Type 1, (449), Driveways	Cu Yd	$500	1	$500
Non-Tracking Tack Coat	Gal	$4	334	$1,336
Tack Coat, 702.13	Gal	$4	421	$1,684
Combination Curb and Gutter, Type 2	Ft	$30	585	$17,550
Curb, Type 6	Ft	$28	590	$16,520
Traffic Control				
RPM	Each	$40	38	$1,520
Edge Line, 6"	Mile	$4,200	0.38	$1,596
Center Line	Mile	$5,000	0.32	$1,600
Channelizing Line, 8"	Ft	$3	195	$585
Stop Line	Ft	$14	58	$812
Transverse/Diagonal Line	Ft	$11	360	$3,960
Island Marking	Sf	$8	114	$912
Lane Arrow	Each	$200	4	$800
Signing Misc.	Lump	$2,000	1	$2,000
Traffic Signals				
Detector Loop	Each	$1,850	6	$11,100
Maintenance of Traffic				
Law Enforcement Officer with Patrol Car for Assistance	Hour	$82	32	$2,624
Special - Work Zone Traffic Signal	Each	$25,000	1	$25,000
Increased Barrier Delineation	Ft	$2	1876	$3,752
Work Zone Impact Attenuator, 24" Wide Hazards, (Bidirectional)	Each	$2,300	8	$18,400
Detour Signing	Lump	$15,000	1	$15,000
Work Zone Lighting System	Each	$13,000	1	$13,000
Barrier Reflector, Type 1, Bidirectional	Each	$12	42	$504
Object Marker, Two Way	Each	$19	42	$798
Work Zone Edge Line, Class I, 6", 642 Paint	Mile	$1,000	0.50	$496
Work Zone Edge Line, Class I, 6", 740.06, Type I	Mile	$10,300	0.31	$3,152
Work Zone Dotted Line, Class I, 6", 642 Paint	Ft	$1	75	$75
Work Zone Stop Line, Class I, 740.06, Type I	Ft	$20	50	$1,000
Portable Barrier, Unanchored	Ft	$15	1876	$28,140
Removal of Pavement Marking	Ft	$2	821	$1,642
Primary Cost Drivers Subtotal				**$830,836**
Incidentals				
Railroad Insurance	Lump		1	$12,500
Maintenance of Traffic (MOT)	Lump		1	$8,308
Construction Layout Stakes	Lump		1	$8,308
Field Office, Type B	Month	$2,200	8	$17,600
Mobilization	Lump		1	$16,617
Contingencies for items not included (30%)	Lump		1	$249,251
R/W				
CSX Railroad Construction Agreement	Lump			$10,000
Summary of Probable Construction Costs 2024				**$1,154,000**
Probable Construction Costs Including 18.9% for 2027				**$1,380,000**
Right-of-Way Acquisition Costs				**$14,765**
TOTAL ESTIMATED PROJECT COST				**$1,400,000**

BUT-27-10.38; PID 117275
Preliminary Estimate of Probable Costs For Feasibility Study

Items	Unit	Unit Cost $ (2023)	Quantity	Total $
Construction Costs - BUT-27-10.38 - Alternate 2 (14.5' Vertical Clearance)				
Roadway				
Clearing and Grubbing	Lump	$30,000	1	$30,000
Curb Removed	Ft	$7.25	1057	$7,663
Guardrail Removed	Ft	$3	325	$975
Anchor Assembly Removed	Each	$150	4	$600
Bridge Terminal Assembly Removed	Each	$800	4	$3,200
Excavation	Cu Yd	$18	1580	$28,440
Subgrade Compaction	Sq Yd	$3	4224	$12,672
Excavation of Subgrade	Cu Yd	$26	1628	$42,328
Granular Material, Type C, As Per Plan	Cu Yd	$65	1628	$105,820
Proof Rolling	Hour	$325	3	$975
Geotextile Fabric	Sq Yd	$2	4224	$8,448
Guardrail, Type MGS	Ft	$19	325	$6,175
Flared End Section	Each	$75	1	$75
Anchor Assembly, MGS Type A	Each	$1,300	3	$3,900
Anchor Assembly, MGS Type T	Each	$1,300	1	$1,300
MGS Bridge Terminal Assembly, Type 1	Each	$2,500	4	$10,000
Monument Box Adjusted to Grade	Each	$800	1	$800
Erosion Control				
Seeding and Mulching	Sq Yd	$2	2500	$5,000
Erosion Control	Each	$1	31560	$31,560
Drainage				
6" Shallow Pipe Underdrains with Geotextile Fabric	Ft	$12	1105	$13,260
6" Conduit, Type F for Underdrain Outlets	Ft	$25	70	$1,750
12" Conduit, Type B	Ft	$110	44	$4,840
Catch Basin, No. 3	Each	$4,500	1	$4,500
Catch Basin Adjusted to Grade	Each	$1,050	5	$5,250
Manhole, No. 3	Each	$5,500	1	$5,500
Manhole Adjusted to Grade	Each	$900	3	$2,700
Drainage Misc.	Lump	$20,000	1	$20,000
Pavement				
Pavement Removed	Sq Yd	$12	4242	$50,904
Full Depth Pavement Sawing	Ft	$3,50	133	$466
Pavement Planing, Asphalt Concrete	Sq Yd	$2	2161	$4,322
Asphalt Concrete Base, PG64-22, (449)	Cu Yd	$200	679	$135,800
Aggregate Base	Cu Yd	$70	702	$49,140
1.25" Asphalt Concrete Surface Course, Type 1, (448), PG64-22	Cu Yd	$210	129	$27,090
1.75" Asphalt Concrete Intermediate Course, Type 2, (448)	Cu Yd	$255	306	$78,030
Non-Tracking Tack Coat	Gal	$4	348	$1,392
Tack Coat, 702.13	Gal	$4	441	$1,764
Combination Curb and Gutter, Type 2	Ft	$30	585	$17,550
Curb, Type 6	Ft	$28	590	$16,520
8" Non-Reinforced Concrete Pavement, Class QC MS (Drives)	Sq Yd	$100	43	$4,300
Traffic Control				
RPM	Each	$40	41	$1,640
Edge Line, 6"	Mile	$4,200	0.38	$1,596
Center Line	Mile	$5,000	0.36	$1,800
Channelizing Line, 8"	Ft	$3	195	$585
Stop Line	Ft	$14	58	$812
Transverse/Diagonal Line	Ft	$11	435	$4,785
Island Marking	Sf	$8	114	$912
Lane Arrow	Each	$200	4	$800
Signing Misc.	Lump	$2,000	1	$2,000
Traffic Signals				
Detector Loop	Each	$1,850	6	$11,100
Maintenance of Traffic				
Law Enforcement Officer with Patrol Car for Assistance	Hour	$82	32	$2,624
Special - Work Zone Traffic Signal	Each	$25,000	1	$25,000
Increased Barrier Delineation	Ft	$2	1876	$3,752
Work Zone Impact Attenuator, 24" Wide Hazards, (Bidirectional)	Each	$2,300	8	$18,400
Detour Signing	Lump	$15,000	1	$15,000
Work Zone Lighting System	Each	$13,000	1	$13,000
Barrier Reflector, Type 1, Bidirectional	Each	$12	42	$504
Object Marker, Two Way	Each	$19	42	$798
Work Zone Edge Line, Class I, 6", 642 Paint	Mile	$1,000	0.50	$496
Work Zone Edge Line, Class I, 6", 740.06, Type I	Mile	$10,300	0.31	$3,152
Work Zone Dotted Line, Class I, 6", 642 Paint	Ft	$1	75	$75
Work Zone Stop Line, Class I, 740.06, Type I	Ft	$20	50	$1,000
Portable Barrier, Unanchored	Ft	$15	1876	$28,140
Removal of Pavement Marking	Ft	$2	821	$1,642
Primary Cost Drivers Subtotal				**$884,622**
Incidentals				
Railroad Insurance	Lump		1	$12,500
Maintenance of Traffic (MOT)	Lump		1	$8,846
Construction Layout Stakes	Lump		1	$8,846
Field Office, Type B	Month	$2,200	8	$17,600
Mobilization	Lump		1	$17,692
Contingencies for items not included (30%)	Lump		1	$265,387
R/W				
CSX Railroad Construction Agreement	Lump			$10,000
Summary of Probable Construction Costs 2024				**$1,226,000**
Probable Construction Costs Including 18.9% for 2027				**$1,460,000**
Right-of-Way Acquisition Costs				**$14,765**
TOTAL ESTIMATED PROJECT COST				**$1,480,000**

Appendix P

Business Plan Inflation Calculator

CY 2024-2028 Business Plan Inflation Calculator:

Not sure if you have the latest calculator? Click here.

Last Modified: 1/26/2024

Today's Date:
April 26, 2024

Please Enter Values in the Yellow Areas Only:

Estimation Start Date:
Less than or Equal to Today's Date
(mm/dd/yyyy)

4/26/2024
Start Date:

Enter Construction Mid-Point Date:
(cannot exceed 04/26/2049)
(mm/dd/yyyy)

7/15/2027
Construction Mid-Point Date:

Present-Day Estimated Cost:

$1,000.00
Estimated Dollar Amount:

Estimate Start Date to Construction Mid-Point Date: **39** **Months**

Inflation - Start to Mid-Point of Construction:

(compounded growth rate)

Business Plan **18.9%**

Inflated Dollar Amount:

$1,189.46

Estimator's Name: Chagrin Valley Engineering

County - Route - Section: BUT-75/VAR 5.22/VAR

PID: 117275

Estimator's Notes: begin construction - April 1, 2027, end construction - November 1, 2027
midpoint construction - July 15, 2027