Preliminary Engineering Phase – Supplementary Report

Interlachen Park Street & Utility Improvements Edge Treatment Alternatives Review

City of Hopkins

City Project No. 2019-010

BMI Project No. T19.118342

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Certification

Edge Treatment Alternatives Review

For

Interlachen Park Street & Utility Improvements

City of Hopkins
Hopkins, MN
City Project 2019-010
BMI T19.118342

October, 2019

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

By: Mike Waltman

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License No. 48696

Date: 10/11/19

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I. Background

A. Proposed 2020-2021 Interlachen Park Street & Utility Improvements

The City of Hopkins, MN is planning improvements to the public infrastructure located within the Interlachen Park neighborhood in southeast Hopkins. The feasibility report was prepared for compliance with the MN Chapter 429 process for special assessments. To that end, the report identifies the project location, existing conditions, proposed improvements, estimated project costs, and proposed funding including special assessments to individual properties as identified in the report. The report was presented to the Hopkins City Council on September 17, 2019 and the required public improvement hearing was conducted at that time.

Testimony at the public improvement hearing was received by the City Council. Following receipt of the testimony, the City Council requested additional information related to the proposed installation of concrete curb and gutter as well as associated alternatives considered. This report has been compiled to identify and quantify alternatives to concrete curb and gutter installation and the associated impacts of each alternative.

This 2020-2021 project has been proposed for over 5 years in the City's Capital Improvement Planning process. The reconstruction of streets and utilities in the Interlachen Park neighborhood has been identified as a need for nearly 20 years, however. Over the same period, City considerations to edge treatments have been routinely made and internally critiqued to develop best management practices toward street and utility reconstructions in the most cost-effective manner based on industry standard practices and sound engineering principles. This report summarizes such considerations made in evaluating roadway edge treatment alternatives for the Interlachen Park Improvements project as well as what has been considered over time on the subject.

B. Local road design fundamentals

1. *Aggregate Subbase*

A pavement subbase is commonly used where existing soils in the roadbed are poor draining and/or unsuitable for roadway construction. Most commonly on local roadways throughout Minnesota and the City of Hopkins, a 'clean' sand is used to retain a well draining structure. The subbase of a roadway is a significant investment as its installation requires significant excavation and hauling efforts. Preventing water from reaching the subbase enhances its ability to support the overlying structure without weakening it due to freeze/thaw related influences.

2. *Aggregate Base*

Aggregate base material is installed to provide a stable and firm layer upon which surface pavement can be installed.

During construction of road sections where bituminous pavement is installed atop aggregate base, the suitable compaction and stability of the aggregate base is particularly important. Aggregate base instability is caused by its saturation as a result of improper drainage or other causes that introduce water to this layer.

3. *Surface Pavement*

The pavement driving surface is effectively the cap on the pavement system. For local roadways containing utilities, bituminous pavement is almost always used. Bituminous pavement is comprised of coarse and fine aggregates which are adhered to each other with a bituminous oil. It is a flexible pavement, as opposed to a rigid pavement, and is intended to flex and rebound while supporting vehicle loads. Much of the vehicle load is transferred to the underlying aggregate base layer(s) during this process.

The pavement driving surface layer serves the function of conveying surface runoff to its edges. The surface is typically crowned, meaning it sheds water from centerline to each edge, or fully tipped toward one edge.

4. *Managing Surface Runoff and Moisture in a Pavement System*

While many environmental factors help to deteriorate a pavement system, excess moisture is the primary cause of deterioration and is responsible for reduced strength in the system. Any water entering the pavement layers ultimately fall victim to Minnesota freeze/thaw cycles in addition to other weaknesses produced in the pavement by excess moisture. Numerous publications, including the MnDOT Pavement Design Manual and supporting studies completed at the MnROAD Test Facility, indicate that a pavement's service life is greatly impacted by the pavement system's ability to prevent water from entering the aggregate base layer and its ability to drain of any water that reaches it[1].

Roadway edges designed for managing stormwater runoff are typically classified as one of two roadway types:

- Urban roadway sections which are almost always comprised of a curbed edge to direct water to the inlets of an underground storm sewer system; or
- Rural roadway sections which are comprised of ditches that receive water off of the roadway edge.

Both systems convey water away from the bituminous edge. Once off the bituminous edge, the water is then conveyed via the storm sewer system or ditches and culverts. This is a necessary pavement function for heavy rainfall events.

[1] Drainage and Pavement Performance, Roger Olson of MnDOT, December 2006

C. Industry Design Standards and Best Practices

1. *MnDOT Studies & Related Research*

The Minnesota Department of Transportation (MnDOT) has produced a variety of studies based on research performed at its Minnesota Road Research (Mn/ROAD) test site. Mn/ROAD is one of the most, if not the most, ambitious test tracks in the world in its continuous collection of environmental data[2]. The facility is equipped with multiple continuous lanes of active vehicle traffic over a variety of sensors and gauges. In particular, these measurements have aided the Civil Engineering field with collection of empirical evidence for improved understanding and quantification of drainage through and under pavements.

With respect to this analysis, managing water runoff that is being directed to the roadway edge is an important design consideration for a long-lasting pavement structure. In 2003 MnDOT completed an analysis on the effect of an unsealed pavement edge joint (such as may be seen without curb or with curb but no sealant) versus a sealed pavement edge joint. The study found an 95% reduction in water entering a pavement system during a low intensity rain event and an 83% reduction during a high intensity event.[3]

The 2003 MnDOT study also analyzed the effectiveness of an edge drain under an unsealed joint, but found that "the edge drain is not draining the pavement system but rather is draining the edge joint."[4] This study found that the assumption that edge drains provide positive drainage to be erroneous.[5] This result has been confirmed by other analyses.[6] Similarly, one study found that moisture from an edge joint located several feet away can result in increased moisture within the pavement aggregate base layer under the outer wheelpath.[7]

2. *Standards in adjacent communities*

The following adjacent communities have a standard of installation concrete curb and gutter with local street reconstruction projects:

a. City of Edina

b. City of Minnetonka

c. City of St. Louis Park

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[2] Drainage and Pavement Performance, Roger Olson of MnDOT, December 2006
[3] Olson, R. and R. Roberson, *2003-26 Final Report; Edge-Joint Sealing as a Preventative Maintenance Practice*, Minnesota Department of Transportation Office of Materials and Road Research, 2003
[4] Olson, R., *Drainage and Pavement Performance*, Minnesota Department of Transportation, 2006
[5] Olson, R. and R. Roberson, *2003-26 Final Report; Edge-Joint Sealing as a Preventative Maintenance Practice*, Minnesota Department of Transportation Office of Materials and Road Research, 2003
[6] Ahmed, Z., T.D. White, and T. Kuczek. Comparative Field Performance of Subdrainage Systems. Journal of Irrigation and Drainage Engineering, May/June 1997.
[7] Birgisson, B. and R. Roberson. *Drainage of Pavement Base Material*: Design and Construction Issues. Transportation Research Board, Washington, D.C., 2000

d. City of Golden Valley

e. City of Eden Prairie

f. City of Plymouth

g. City of Minneapolis

No adjacent cities were found to have standards which did not involve installation of concrete curb and gutter.

3. Preventing Infiltration with Edge Joint Sealants

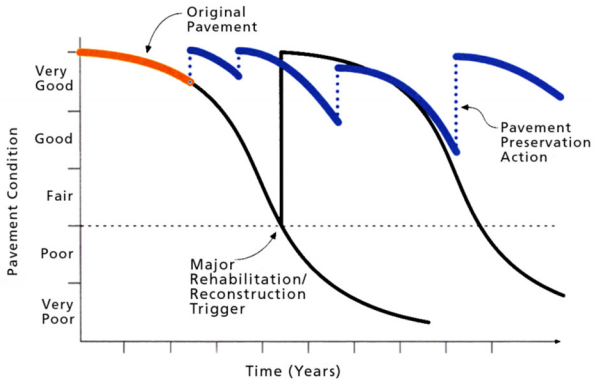
All concrete edge treatment alternatives evaluated in this report would receive a bituminous joint adhesive / sealant material to prevent water infiltration from occurring through the bituminous/concrete interface joint. Infiltration without this sealant commonly occurs during the spring freeze/thaw period when bituminous pavements are contracted inward due to colder temperatures, causing the bituminous to pull away from the adjacent concrete edges. The City of Hopkins began this joint sealing practice in 2015 and has continued it with success.

The use of a concrete edge treatment on roadways carries several benefits when properly implemented. Bituminous pavement installation is improved through the presence of a confined edge to pave against. The bituminous is placed up to the installed concrete gutter pan edge and then rolled for compaction. The roller can compact the bituminous, essentially squeezing it up against the concrete, to greater density as the material is compressed within that confined volume. The improved bituminous density yields numerous benefits, including its resistance to freeze/thaw degradation, resilience, and other factors that ultimately add to its service life. For this reason, MnDOT specifications allow density testing to occur up to confined edges as such density requirements can still reasonably be expected to be met by contractors at confined edges. Conversely, at unconfined edges such as would exist with other alternatives described in this comparative analysis, MnDOT specifications do not require density requirements be met within 1 horizontal foot of the roadway edge as these requirements cannot be reasonably expected to be met in such areas. While one could deviate from a MnDOT specification for a specific project, if not met and subsequently challenged by a contractor, the deficiencies and specification would likely not be upheld and associated damages for failure to meet the unrealistic specification would be void.

D. Pavement Management

1. *Pavement Management Principles*

A pavement management system is a numerical based rating system which treats infrastructure segments as assets which depreciate over time. After rating the current condition of each asset and applying industry standard depreciation curves to each, forecasts can be made on each segments remaining service life of pavements. Pavement management systems therefore enable forecasting of the appropriate timing for major maintenance practices (mill and overlay, reclamation and resurface, etc.) or full reconstruction. By forecasting the timing of major maintenance, which typically comes at a significant discount as compared to the costs of reconstruction, budgeting can be completed to coincide with maintenance needs before the window for their effectiveness closes. The figure included in this section illustrates graphically the concept of depreciating pavement condition over time coupled with various maintenance activities to improve pavement conditions throughout their life.



There are limits to how much pavement maintenance work can be completed during the life cycle of a street. For example, the process of completing a mill and overlay involves removing (by way of milling) about half of the pavement depth and replacing the upper half with a new pavement surface. The underlying original bottom half of pavement remains in place and will continue to deteriorate, and cracks will reflect through the new pavement layer to the surface. Therefore, a roadway can typically only be milled and overlaid one or two times during its life cycle while remaining cost effective. Typical pavement life cycles are about 50 to 60 years on average. Best practices for major maintenance activities have changed over time. Current typical practices include the following minor and major maintenance activities over a pavement's life span:

- Reconstruction begins a pavement's life cycle at year 0
- Mill and overlay at approximately age 20 and potentially at age 40
- Crack sealing approximately every 7 to 10 years, beginning at about age 3 to 5
- Seal coating approximately every 7 to 10 years, beginning at about age 3 to 5
- Reconstruction or, if utility conditions are acceptable, major reclamation/resurfacing at age 60 effectively restarting the life cycle.

2. *Historic Maintenance Activities in the Interlachen Park Neighborhood*

   The maintenance history of documented activities in the Interlachen Park Neighborhood was compiled upon the request of some area residents. Documentation on some activities could not be located, as additional activities were known to occur based on current observations. The list of activities found in Appendix E detail what is currently available to the City.

E. Interlachen Park Street & Utility Improvements - Project Constraints

During the preliminary design process, the following key design constraints and goals were identified as a result of public input, design team investigations, City staff identification of issues, and other means. The following list is not an exhaustive list of all project design constraints and goals. Rather, this list is intended to highlight the key issues which influence broad consideration of roadway edge alternatives described herein. Some key issues and goals for the project include:

1. Correcting nuisance drainage issues, which necessitate a combination of installing new storm sewer and modifying longitudinal street slopes/grades to alleviate locations of nuisance standing water or “bird baths”.
2. Compliance with stormwater management requirements set by the Minnehaha Creek Watershed District (MCWD) and National Pollution Discharge Elimination System (NPDES) permitting requirements for this project.
3. Replacement of old, outdated, and poor condition buried utility lines.
4. Replacement of the failed bituminous pavements with new roadways of consistent widths meeting the City standards and public needs.
5. Remaining within the project budgetary constraints.
6. Retaining public roadway improvements within the established public right-of-way.
7. Minimizing impacts to healthy, mature trees that add to the character of the neighborhood. The City and Interlachen Park residents have expressed a desire to minimize impacts. In response, the project design team has developed and implemented an intensive tree protection and coordination process. This process will be primarily implemented over the upcoming 6 months from the drafting of this report, but will continue throughout the construction process as care is taken to protect all trees except those that must be removed to meet other project goals.

The process for identifying and communicating proposed tree removals for the project is as follows:

a. Document a tree inventory, completed by a professional arborist / forester, of all trees within the public right-of-way. The inventory is to include the tree diameter, condition, species, and location. This process is currently underway.

b. Review preliminary removals based on condition and species against the inventory to confirm removal or protection is appropriate. Adjustment will be made to the list of proposed tree impacts as necessary.

c. For trees identified in conflict with utility construction, implement procedures for trenchless construction of privately-owned utility service lines under trees or re-routed open-cut construction around trees.

1) Coordination process with property owner and city-secured plumber for verifying feasibility of trenchless option under trees. A letter is sent requesting input on the property owner's interest in a trenchless alternative at increased cost and if interest exists, scheduling subsequent televised inspection of the sewer service line.

2) Following televised inspection:

a. If trenchless replacement is infeasible, conduct a coordination process with property owner for re-routing around trees by a property owner secured plumber.

b. If trenchless replacement is feasible, conduct a coordination process with the property owner for trenchless replacement by a city secured plumber (at property owner cost) or a property owner secured plumber.

d. Develop and maintain a booklet with a photo, location by address, condition, species, and diameter of each tree that may be removed and its proposed designation for subsequent coordination:

1) Removal proposed due to undesirable species (list species in parenthesis)

2) Removal proposed due to poor condition

3) Removal proposed due to utility service construction

4) Removal proposed due to street construction or grading. (also include a narrative on street construction impact to the tree and design consideration made to avoid impact)

e. Outreach is completed with the property owner consistent with standard processes for past Hopkins projects. A letter is sent to each property owner containing the following information:

1) Identify proposed tree to be removed and reason (utility, condition, species, street, grading, etc.)

2) If applicable for utility service lines, include information regarding televising and potential subsequent steps for trenchless replacement and associated costs

3) Review of the City's tree replacement policy. Removed trees will be replaced at a 1:1 basis from a diverse list of approved species to enhance the neighborhood's tree biodiversity.

4) Request input on tree replacement for removal as appropriate based on point in process

Similar coordination will be completed near the conclusion of final design for impacts to landscaping, retaining walls, driveways with special paving materials within the public right-of-way, and unique water service connections at the dead-end streets or off Blake Road

F. Curb Design Standard

Chapter VIII of the City of Hopkins' Legislative Policy relates to reconstruction of local streets. The policy addresses the City standard practice of improvements to be completed when reconstructing local streets. The policy states that new and reconstructed local streets are to have concrete curb and gutter installed. The function of this policy is to:

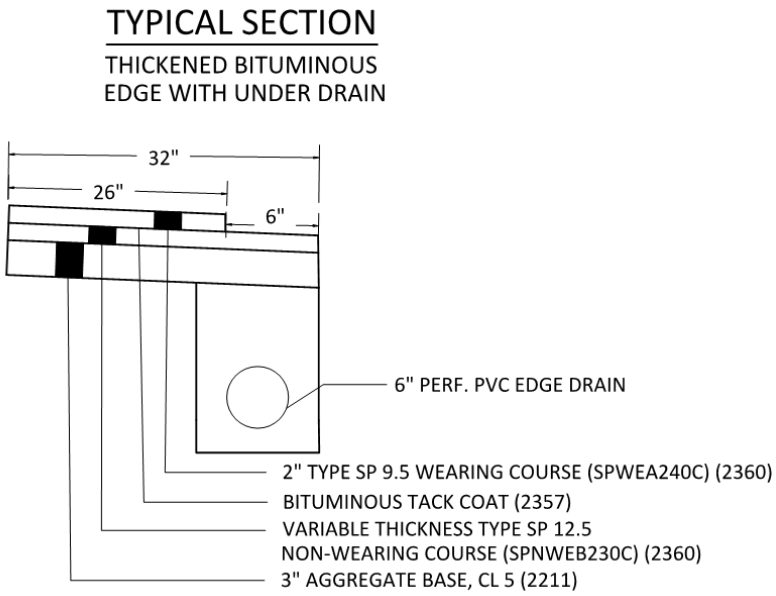
1. Reconstruct streets in a cost-effective manner for all Hopkins taxpayers and residents.
2. Position the public infrastructure for cost-effective application of future major maintenance projects.
3. Provide uniformity and consistency in the street product provided.
4. Effect a standard for which routine maintenance operations could be applied.
5. Effectively convey stormwater runoff to storm sewer.
6. Provide a vertical barrier for motor vehicles from lawns and sidewalks.

II. Edge Treatment Alternatives

A. Thickened bituminous edge with underdrain

In 1998 improvements were completed to relatively (in comparison to the magnitude of the neighborhood area) short portions of Holly Road and Preston Lane within the Interlachen Park neighborhood. During development of the proposed improvements, objections were made to the use of concrete curb and gutter edge treatments. After much discussion, a thickened bituminous edge treatment with underdrain was implemented.

The thickened bituminous edge was equipped with a tapered bituminous non-wear thickness from centerline to roadway edge, which involves a 1.5” thicker pavement at roadway edge than centerline. This yields on average an additional 0.75” of bituminous pavement and associated excavation across the full roadway surface. A detail for this alternative at the roadway edge is as follows:

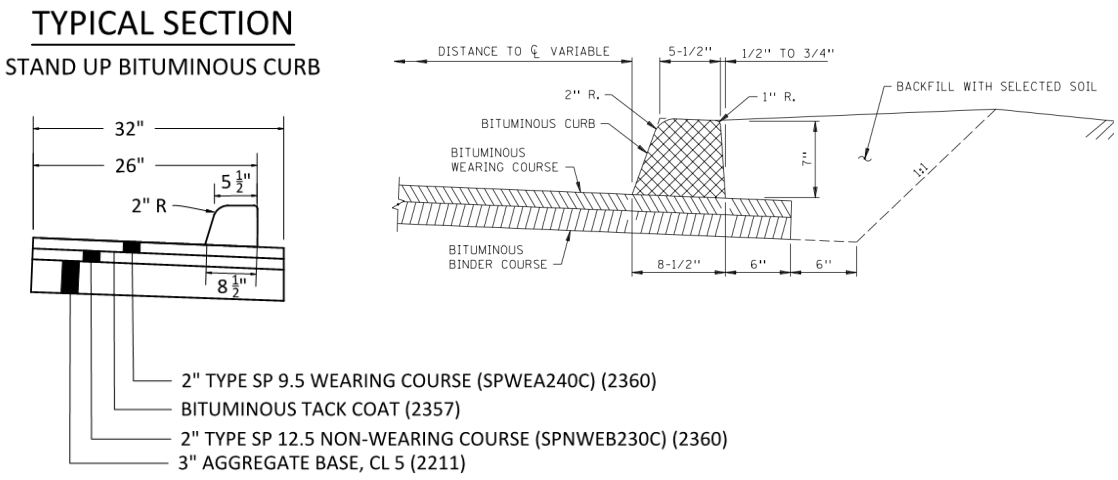


At catch basin inlets, bituminous curb was used on the 1998 project in some cases. From review of the catch basin inlets, there appear to be some which have sustained snowplow damage where the castings protrude from the bituminous pavement. If raised grates were not provided to avoid such damage, the inlets would more susceptible to clogging due to leaves, other debris, or snow/ice. As a result, some amount of curb at inlets would be required for compatibility with storm drainage inlets.

B. Standup Bituminous Curb

Bituminous curbing is commonly used as a temporary installation on reconstruction projects where roadway edge or alignment shifts are anticipated in the relatively near future. Historically this roadway edge treatment was perceived as a cost savings measure, however continued use of the product over time has shown that initial costs are only slightly lower but ongoing maintenance costs are much higher. Bituminous curb has less resistance to damage caused by impacts of snowplows and vehicles due to its small structural size and weight as compared to concrete curb and gutter. Below are photos of its use along Hopkins Crossroad (CSAH 73) in northwest Hopkins. The curb in that location routinely (annually or biannually) requires spot replacement of large segments damaged by routine snow plowing operations or vehicle impacts. Additionally, bituminous curbing lacks a gutter pan to convey stormwater that is separate from the roadway pavement.

A typical section and of the bituminous curbing alternative is as shown below. Drain tile is also planned for some areas of the project as shown in the feasibility report. Associated costs for underdrains were includes in this alternative cost calculation as well as the subsequent alternatives discussed in this report.

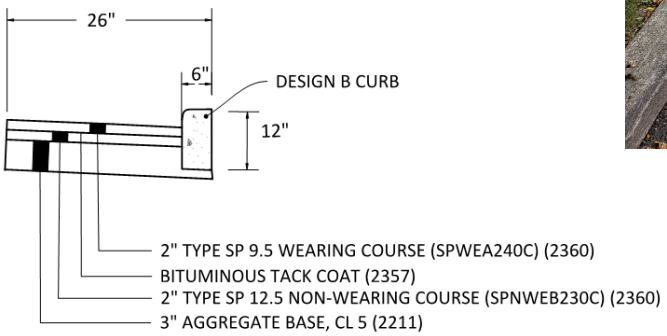


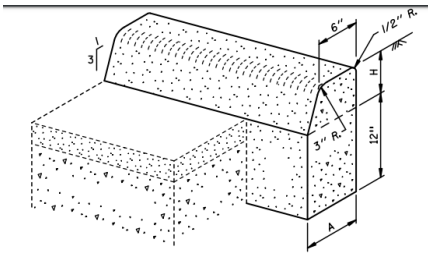
C. Gutter-less concrete curb (B-style or similar)

A gutter-less curb alternative consists of a concrete barrier style curb but without a concrete gutter pan as shown in the detailed drawings below. The bituminous street pavement directly abuts the face of the curb. To achieve more rigidity and integrity, concrete barrier curb is typically installed with its base one foot beneath the pavement surface. Without a gutter pan, water then flows along the shallow channel that is created at the bituminous/concrete interface. This joint can be initially sealed to help reduce the amount of infiltrating water, though in areas where the sealant fails channelized water would flow into this joint. From a long-term performance perspective, concrete barrier curb typically leans toward or away from the roadway given how slender it is shaped vertically. Below is a photo of it along 14th Avenue in Hopkins. Concrete barrier curb was commonly used in Hopkins in the 1950s into the 1960s but has been getting replaced on recent street and utility reconstruction projects over the past 20 years with more modernly used concrete curb and gutter.

TYPICAL SECTION

GUTTER-LESS CONCRETE CURB
(B - STYLE OR SIMILAR)





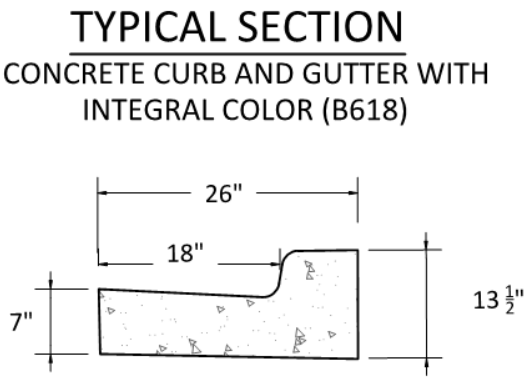
DESIGN NO.	CURB WIDTH A	CURB HEIGHT H	CONCRETE	
			CU. YDS. PER LIN. FT.	LIN. FT. PER CU. YD.
B4	7-3/8"	4"	0.0294	34.0
B6	8"	6"	0.0352	28.4
B8	8-5/8"	8"	0.0414	24.2
B9	9"	9"	0.0449	22.3
B10	9-3/8"	10"	0.0485	20.6

DESIGN B

D. Concrete curb with integral color

It is feasible to install all of the concrete alternatives discussed herein with a colored concrete mixture. The use of colored concrete is most often applied in walks or street pavements on streetscaping projects where placemaking is of great importance, in privately owned driveways or patios, or in median sidewalk pavements of collector roadways for added aesthetic value within commercial areas. Colored concrete is typically about two times the cost of its initial installation cost. Value is still achieved commonly in the typical applications discussed above, but there are some long-term considerations that occur with decision making related to its use, including:

- The color within colored concrete fades over time. Therefore, its aesthetic value gained as compared to traditional uncolored concrete is diminished over time.
- Darker colors tend to fade more quickly than lighter colors and have a higher material cost.
- With the color fading over time, the color future spot replacements (where necessary for utility repairs, failed concrete, or other reasons) will not perfectly match the in-place concrete color.
- The availability of exact/specific colors provided by suppliers has not remained consistent over time. Therefore, future continuity aspects need to be considered.

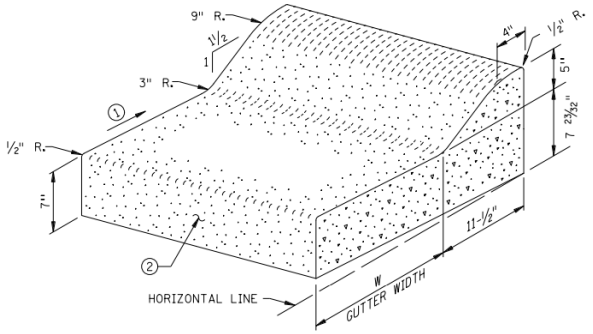


Functionally with respect to the pavement system, a colored concrete's performance would be consistent with other concrete edge alternatives. The alternative proposed for this analysis is a colored B618 concrete curb and gutter with the precise color to be determined.

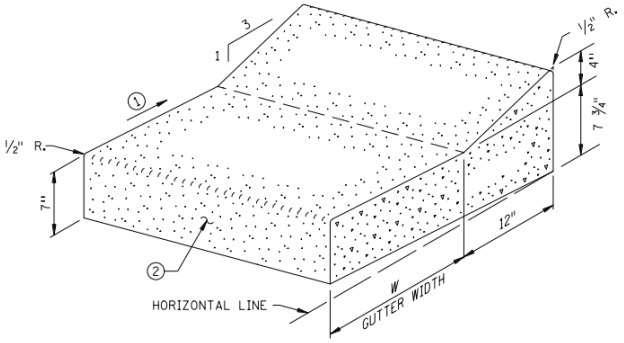
E. Mountable concrete curb and gutter

Details and images for mountable concrete curb and gutter are below. In Minnesota mountable curb types are most commonly used in new residential developments. With costs similar to B618 or B612 curb and gutter, this curb type is preferred for residential new developments by developers because it allows home builders flexibility in locating a new driveway as custom homes are requested by prospective buyers.

Functional performance of mountable concrete curb and gutter has several similarities to traditional 6" tall concrete curb and gutter. Runoff water is provided a gutter pan, the joint of which with bituminous pavement can be sealed, to convey it to storm water inlets. There are some limitations to its functional performance as compared to barrier style curb however, which lead most cities to not use it for street reconstruction efforts:



DESIGN S



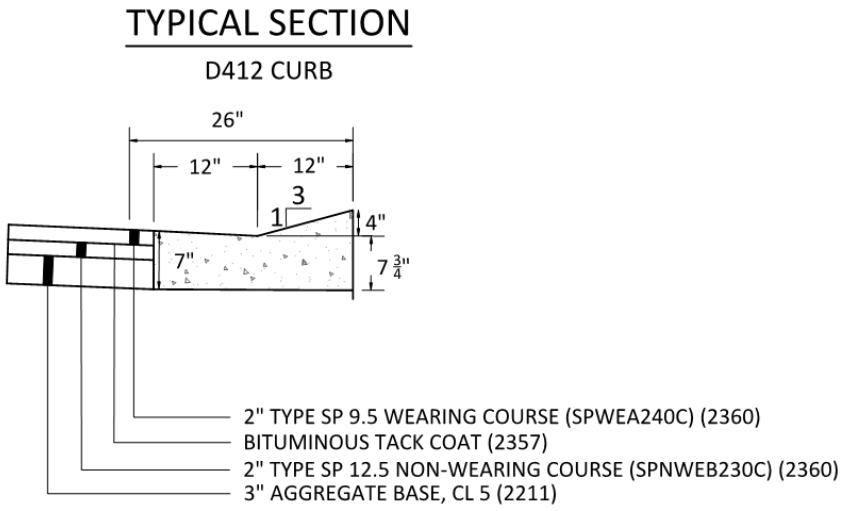
DESIGN D

- Mountable curbing typically has a 4" height as measured from top/back of curb to bottom of gutter pan. This is a smaller capacity for conveyance of stormwater than traditional 6" tall barrier style curb. The impact of this difference is additional storm water inlets are required to meet roadway design requirements for removal of runoff from the street ('spread calculations').
- At catch basin inlets transition to 6" B-style concrete curb and gutter is still recommended to match drainage inlet casting shapes. Thus, if surmountable concrete curbing is desired for aesthetic reasons it should be understood that some B-style curb would still be utilized.
- At intersection corners transition to 6" B-style concrete curb and gutter is still recommended to provide a barrier to better prevent vehicle tracking over adjacent turf areas. Most concrete curb and gutter is installed using a slip form paving machine and can be used at intersection corners depending on the corner radius and contractor's desired means/methods for efficiency purposes. A slip form option for contractors at these corners would be eliminated if transition to a different curb style is required, such as from mountable to barrier style curbing.

This is a less significant issue where mountable curb is used new developments where common modern designs have winding roadways without as many intersections as in a grid/block style street network.

- Mountable curb can be driven over more easily than 6" curb when motorists are attempting to park vehicles along street corridors. Additionally, the curb style is not as compatible with snow plowing operations as the blade of plows can gouge the face of the surmountable curb or even inadvertently ride up the curb face to turf areas behind the curb. There is therefore some increase in potential for damage to areas behind the curb as opposed to similar risks for barrier style curb.
- Mountable curbing is in place in a handful of areas in Hopkins. Its most recent use on a similar street and utility reconstruction project was in 2006 when 18th Ave S, 19th Ave S, and 20th Ave S were reconstructed between Mainstreet and Excelsior Boulevard. A D412 concrete curb and gutter was used. During construction of the project, some concern was expressed by residents at the time over the 'bump' associated with driving over the mountable curb style into driveways. Unmodified, this bump is more greatly felt on mountable curb styles due to the maintained 4" height (or 3" height if further stormwater capacity decreases are acceptable) through driveways. On barrier style curb types, the height of curb back at driveways is typically 1.5" which yields a lesser bump for residents accessing their driveway.

A typical section for a mountable curb and gutter edge treatment alternative is as follows:



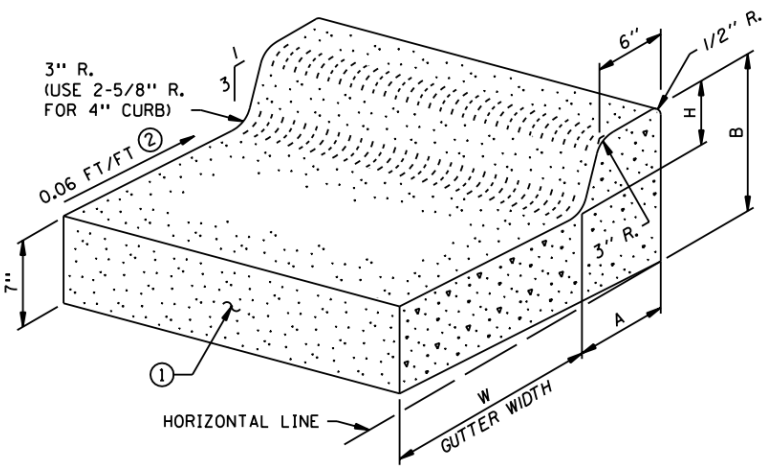
F. Concrete curb and gutter – B612

For this comparison of alternatives, B612 is proposed as an alternative with reduced gutter pan width which may or may not provide some improved aesthetic value depending on the viewer. B612 concrete curb and gutter is commonly used as a standard in some nearby communities, including the City of Minnetonka, though B618 is more commonly used in the state. Its cost of installation is quite similar to B618 when all factors are considered. B612 curb has slightly less integrity due to its smaller size and slightly less stormwater capacity, though these differences are not major in comparison to the benefits gained associated with have a defined concrete curb edge.

G. Concrete curb and gutter – B618

B618 concrete curb and gutter is the standard for use on street reconstruction projects in the City of Hopkins.

Barrier style curb and gutter ("Design B" per MnDOT) is the most commonly used roadway edge treatment in Minnesota for local roadway reconstruction projects. The proposed edge treatment for the Interlachen Park street and utility improvements project is a B618 concrete curb and gutter. Within that name:



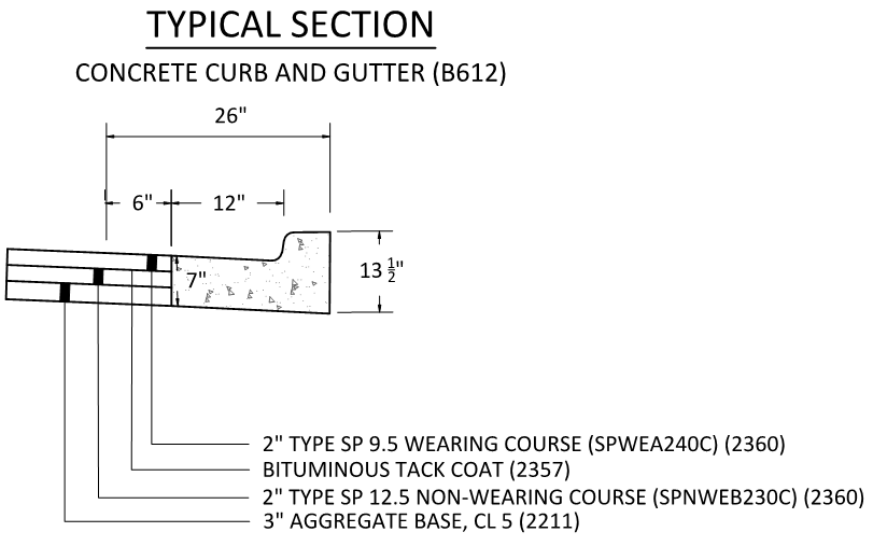
DESIGN B

- "B" describes the design style of the curb
- "6" is the height of the curb backing (H in the figure above) as vertically measured in inches from its top/back to its gutter line
- "18" is the width of the gutter pan ("W" in the figure above) as horizontally measured in inches from the curb face to the bituminous/concrete interface joint

While a designer could specify effectively an infinite variety of barrier style curb types with different dimensions for the curb height and gutter pan width, there are industry standard types that are most commonly used, including:

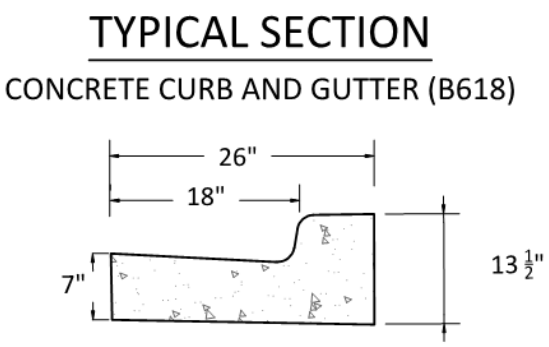
- B612, B618, and B624 for low speed urban roadway edges
- B418 and B424 for higher speed urban roadway edges – the lower curb height has been found to better perform from a safety perspective at higher motor vehicle speed

- B660 (or other wide gutter pan widths) for bicycle lanes



Deviation from these typical styles can and has been done in the area for project specific reasons, however contractors typically would need to manufacture a new slip form 'shoe' for their installation equipment or would need to hand form custom specified dimensions. These deviations therefore typically incur some labor related cost increase and most communities therefore maintain consistency with the industry standards.

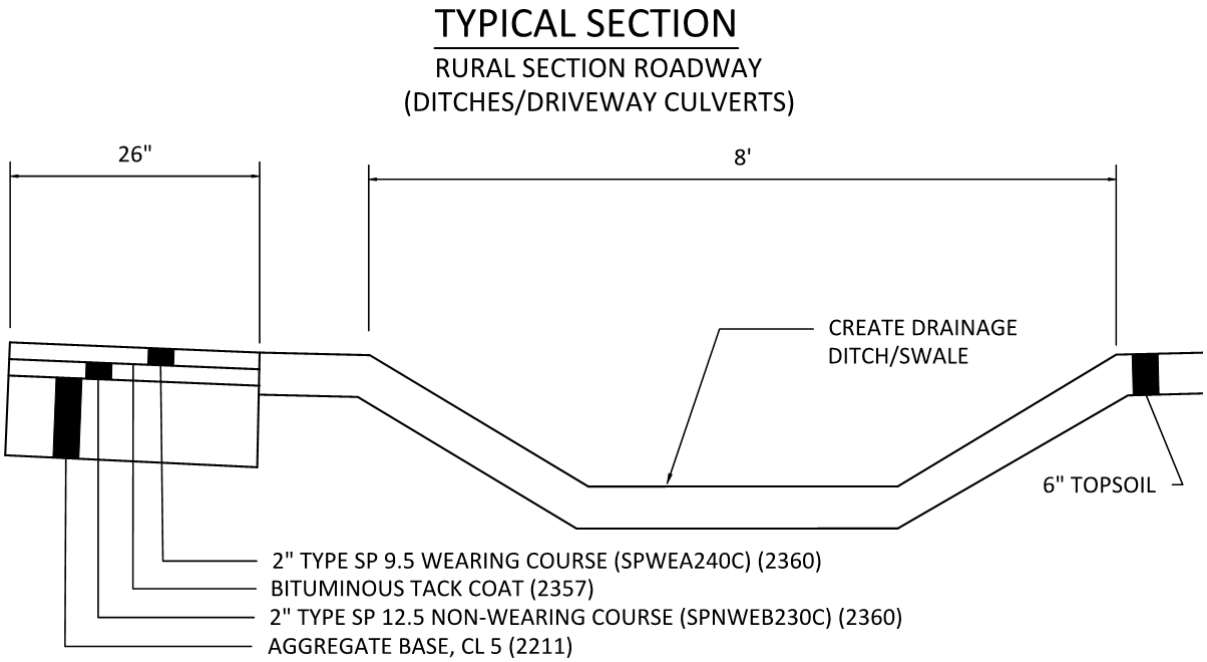
An aesthetic modification to this style of curb could also be implemented involving application of a clear curing compound after its installation. All concrete lightens in color as it cures. To retain water in the concrete without loss to evaporation, within 1 hour of concrete placement a curing compound (a modified linseed oil) is sprayed onto the concrete. Standard curing compounds are pigmented so the applicator can identify where they have sprayed against the gray concrete. A white color is chosen because white closely matches the color of cured concrete but still contrasts visually with the fresh concrete. To minimize the white/black color contrast between concrete/bituminous pavement interface, a clear curing compound could be used at no noticeable additional cost to yield a light gray/black color contrast at the interface.



H. Rural section roadway (ditches / driveway culverts)

Rural section roadways convey water with ditch sections rather than curb and gutter as is typically done in an urban roadway section. Rural section roadways receive their name because they are typically implemented within unincorporated areas or more rural communities where land use density is not as high and more space therefore exists for ditch installations.

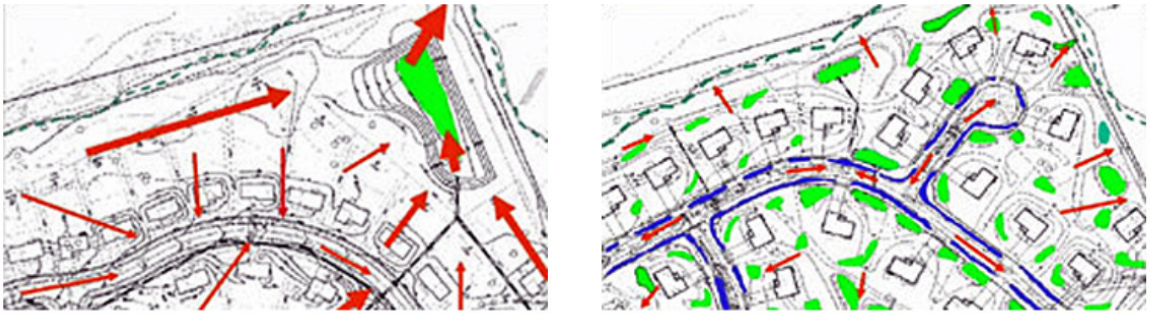
Rural section roadways do not typically have a concrete edge treatment to convey runoff water to storm sewer. Instead, the runoff is shed away from the pavement edge to adjacent ditches which vary in width and depth. Across driveways and roadway connections, culverts are used to convey water from ditch to ditch. A typical cross section for what this edge treatment alternative entails is approximately as follows:



I. Low Impact Development (LID)

The term low impact development (LID) refers to systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration or use of stormwater in order to protect water quality and associated aquatic habitat.[8] In the context of the Interlachen Park Project, interest has been expressed in eliminating concrete curb and gutter in exchange for a LID design. The project team understands this to imply runoff be routed away from a bituminous edge to various basins along the roadway edges rather than through a concrete curb and gutter type system.

LID design often centers around the concept of decentralizing stormwater management systems into numerous basins. As shown in the example below[9], a developer may propose numerous small basins (shown in green) rather than one relatively large basin. This enables stormwater management requirements to be met while maximizing available space for sellable lots and associated profit.

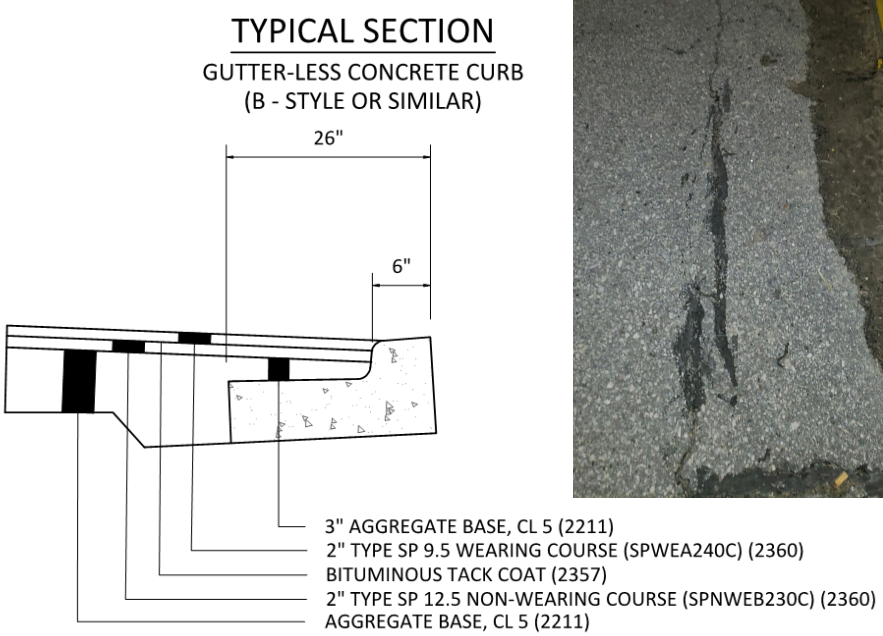


In the Interlachen Park Neighborhood, this design would entail the installation of basins outside the roadway in the yards of adjacent residences, redirecting stormwater to such basins in lieu of the existing storm sewer system, and incorporating bypass flow measures to get runoff from extreme rainfall events to the storm sewer system. There are no stormwater management requirements (ponding, etc.) that must be met based on the project as proposed, thus the benefits of this alternative are limited compared to its typical application.

[8] https://www.epa.gov/nps/urban-runoff-low-impact-development
[9] Whole Building Design Guide (WBDG), National Institute of Building Sciences, https://www.wbdg.org/resources/low-impact-development-technologies

J. Invisible curb

Some residents of the Interlachen Park Neighborhood have expressed interest in what they call an 'invisible curb'. Images shared with the project team showed a typical section/detail generally similar to the following:



This curb alternative is not commonly installed as part of reconstruction efforts. This curb alternative is effectively created in some situations when major maintenance activities are undertaken to overlay a roadway without milling. On such projects where the existing condition is a standard B618 concrete curb and gutter set at typical elevations next to the roadway, occasionally conditions are such that rather than milling out the interior pavements, an overlay is conducted over the full width of the pavement and gutter pan. The results are commonly as shown in the photo above, where the crack forms in the overlying bituminous pavement over the underlying bituminous/concrete interface.

K. Mixture of alternatives

Some residents of Interlachen park have expressed interest in a mixture of roadway edge treatment alternatives based upon aesthetic preferences of the adjacent property owners. If this approach were considered, one which bases the roadway edge treatment decision making process on a democratic vote-bases system, the City may wish to conduct additional outreach to determine the neighborhood preferences on a block-by-block basis.

For purposes of this report, this alternative assumes a blend of thickened bituminous edge alternative coupled with the proposed B618 concrete curb and gutter alternative. The exact mixture on a block by block basis is not known.

III. Analysis

A. Screening of Alternatives

A screening process was first conducted as part of this analysis and documentation process. In terms of their application and feasibility within the Interlachen Park neighborhood, two alternatives appear impractical, infeasible, and inconsistent with the project goals, constraints, and requirements:

- *Rural section roadway*

  The widening of the footprint of the roadway to create ditch sections through the Interlachen Park neighborhood would result in heavy tree losses, likely not have sufficient space in all areas to remain within the existing public right-of-way, would not be supported by Hopkins Public Works for maintenance reasons, and would not be supported by the public for a variety of reasons, particularly including more significant and less desirable tree loss. This alternative was considered but found to be infeasible.

- *Low Impact Development*

  This design strategy is incompatible with the project design constraints and project requirements. Low Impact Development based design is a common practice implemented by developers with the goal of minimizing stormwater management costs/space, while meeting project stormwater management requirements and maximizing developable area. The introduction of stormwater management features can be implemented as desired with any other alternative discussed herein but would be above and beyond project requirements. If such features are desired to be implemented as a practice to exceed project requirements, it is recommended those features be woven into the chosen design rather than used as the initial fundamental basis for design. For example, it would not be prudent to locate a number of small ponds within the project area and then design around them; Rather, one could design the improvements and fit rain gardens or water quality treatment structures to the infrastructure design as desired.

These two alternatives remain within the evaluation matrix included in Appendix A for comparison. However, estimated costs were not further evaluated for these alternatives.

B. Initial Cost of Installation

The Interlachen Park project consists of a variety of components which generate project cost, including full-width street pavement reconstruction, watermain and sanitary sewer replacement, storm sewer construction, etc. An initial installation cost estimate has been developed for each alternative and is provided in **Appendix B**.

The initial cost estimates described herein include the costs for infrastructure located along the roadway edge. The original proposed roadway edge treatment included a B618 concrete curb and gutter, which is 26-inches in width as measured from back of curb to

the end of the gutter pan at the bituminous/concrete joint. Therefore, the initial installation cost estimates provided function to demonstrate comparative costs between alternatives, and in essence, a comparison between B618 concrete curb and gutter as originally proposed against what it may be replaced with.

Based on the results of the screening process above, initial installation costs for alternatives 10) Rural Section Roadway and 11) Low Impact Development have not been quantified as these alternatives appear incompatible with the project constraints. The initial installation cost for alternative 9) Mixture of Alternatives has also not been directly quantified as this would require further definition as to which areas are to receive a specified alternative treatment. Initial installation costs for 9) Mixture of Alternatives have been indirectly quantified however, if provided a percentage of neighborhood for each desired alternative one could determine a proportion-based comparative initial installation cost for the provided mixture.

Of interest to neighborhood residents were the quantification of excavation costs between alternatives. Estimated excavation volumes (and associated costs) were determined for two primary alternatives to gauge the impact of each. A design for the surface profile and associated topography was developed for Ashley Road, from its southerly limit to Excelsior Boulevard, for an alternative design with B618 concrete curb and gutter as well as an alternative design with no raised curbing. A cross sectional analysis was performed at 25' intervals for both alternatives, as shown in figures located in **Appendix D**. The design centerline profile for each alternative, as well as the resultant roadway edge profile, varies between the two alternatives. Constraints controlling the design centerline profile primarily include:

- Maintaining acceptable driveway slopes approaching the roadway edge. An acceptable driveway slope is between 1% and 10%. If existing driveways are steeper than 10%, the new driveway will be a similar slope or flatter. If existing driveways have slopes away from the roadway, attempts will be made to have the driveway slope towards the road where feasible.
- Maintaining acceptable boulevard / front yard slopes approaching the roadway edge. Positive drainage towards the roadway at a minimum and 4:1 (H:V) maximum slopes were used for tie-in slopes on turf areas.
- Maintaining or creating acceptable longitudinal slopes. For alternatives with curbing, a longitudinal slope as low as 0.50% is considered acceptable as concrete can be formed and installed within reasonable tolerances to achieve positive drainage at this specified slope. The alternative without a concrete edging was designed with the understanding that bituminous alone cannot be reasonably relied upon at longitudinal slopes flatter than approximately 1.0% without acceptance of some 'bird bath' non-draining areas. The concrete curbing alternative therefore has more flexibility in longitudinal design to match adjacent driveways/boulevards, and thereby allowing more flexibility/opportunity to reduce excavation volumes through effective iterative design.

- Maintaining a 2% crowned cross slope on the pavement. Typical sections used for the analysis are provided in the appendix. The curbless alternative was developed to accurately account for the additional volume of excavation for additional pavement thickness tapered toward the roadway edge as well as the underdrain pipe.

The excavation volume analysis found that excavation volumes will vary from block to block between the two alternatives. The cross section figures in **Appendix D** illustrate the difference in volume (excavation or fill) between the existing ground surface and finished ground surface. Similar, essentially equal, excavation will occur beneath the ground surface to make room for pavement, aggregate base, and subbase for each alternative (i.e. excavation for 8" aggregate base will be consistent for each alternative). These volumes do not represent the total excavation for either alternative, which would require a comparison between the existing ground surface and the proposed bottom of excavation limits. The total volume is not necessary for this exercise because all of the alternatives will have similar pavement thicknesses and result in similar excavations. The primary difference in the excavation between alternatives, besides any thickened bituminous or additional drain tile, is the change in grading which is best compared when reviewing the surface, not the bottom of the excavation. Results were as follows:

Alternative	Cut Volume (CY)	Fill Volume (CY)	Overall Excavation (CY)
Curb	380.65	194.96	185.04
No Curb	536.62	93.32	443.30

The overall excavation is the difference between cut and fill volume and the material hauled off site.

In terms of overall impact on project cost, the excavation costs for the curbless alternative is more than double the excavation costs for curb alternative. The curbless alternative produced an excavation of 0.24 CY per foot of roadway, while the curb alternative produced and excavation of 0.10 CY per foot of roadway. In addition to the difference in cut vs. fill as described above, the curbless alternative also accounted for the additional excavation for the thickened bituminous and the additional drain tile, while the curb alternative accounted for the volume of the back of curb.

C. Life Cycle Cost Analysis

A life cycle cost estimate has been developed for each alternative and is provided in **Appendix C.** The life cycle cost estimate has been based on a variety of factors, which can be summarized as:

- Initial cost of installation
- Cost of ongoing major maintenance operations specific to each alternative including:
    - Crack Sealing & Seal Coating

  - Cleaning Underdrains
  - Mill & Overlay with Associated Preparations (patching, spot curb replacement, etc.)

- Estimated service life of each alternative

The life cycle cost for each alternative is expressed in an estimated total cost (inclusive of initial and ongoing maintenance) per year of service life.

As described and referenced earlier in this report, one major factor affecting a pavement's service life is whether it is saturated. Some alternatives, such as the "Thickened Bituminous Edge with Underdrain" and "Invisible Curb" do not provide a sealed roadway edge but instead rely upon an underdrain system to eliminate water which infiltrates to the pavement surface and aggregate base. Studies completed at the MnROAD test facility have noted that sealing a pavement edge can reduce the volume of water entering the pavement system by as much as 85%. The Minnesota Local Road Research Board (LRRB) report titled "Subsurface Drainage Manual for Pavements in Minnesota" notes it is predicted that a reduction of 50% in the pavement service life if a pavement base is saturated as little as 10% of the time.

The practice of sealing roadway edges and preventing water infiltration is therefore directly correlated with increased pavement service life. The actual saturation of the pavement system, and associated service life impacts, will vary across the Interlachen Park neighborhood depending on a variety of factors including changing underlying/adjacent soil conditions, adjacent drainage area (i.e. front and backyards draining toward street versus only front yards toward street, etc.), pavement cross slope / flow direction, pavement surface area / street width, etc. The effect on a pavement service life impact will therefore also vary anywhere between 0% to 50% reduction in service life depending on drainage conditions.

- Alternatives 1 and 8 (as numbered in the evaluation matrix), which lack the opportunity for a sealed pavement edge treatment, had life cycle cost estimates prepared based on a 20% reduction in service life.
- Alternatives 2 and 3, which lack a gutter pan and therefore rely exclusively on the sealed joint to convey stormwater runoff, had life cycle cost estimates prepared based on a 10% reduction in service life.
- Other alternatives had life cycle cost estimates prepared based on a standard 60-year pavement service life with proper maintenance activities.

D. Evaluation Matrix for Comparison of Alternatives

The overarching function of this document is to document the evaluation of several alternative roadway edge treatments and their associated benefits and detriments. Roadway edge treatment considerations can be made on a wide variety of factors. Additionally, the weight of one criterion versus another may vary from individual to individual. To provide this information in a consolidated, digestible form for decision makers and the public, an "Evaluation Matrix for Roadway Edge Treatment Alternatives"

was developed and is provided in **Appendix A**. The matrix describes how each alternative addresses the criteria as follows:

Green: Best alternative / exceeds project requirements / best meets project goals and constraints

Yellow: Meets project requirements / acceptably addresses project goals and constraints

Red: Worst alternative / does not meet project requirements / worst addresses project goals and meets project constraints

Components of the Evaluation Matrix considerations are summarized as follows:

1. *Tree Loss Due to Roadway Edge Construction*

   Streets within the Interlachen Park Neighborhood have been assigned proposed widths as documented in the Feasibility Report. The proposed width of each roadway was based on a variety of factors, most notably:

   - Existing roadway width
   - Available space with consideration given to minimizing impacts to significant trees and other prominent surface features
   - Consistent roadway width from corridor to corridor
   - Not increasing total impervious surface area by more than 10,000 square feet for the full project area.

   In large part, with exception to alternatives considered that require additional facilities such as ditches or basins outside the roadway, there is no difference between alternatives with respect to tree impacts.

2. *Tree Loss Due to Utility Impacts, Poor / Dying / Dead Condition, and Undesirable Species (Ash)*

   Evaluations of tree losses for these reasons has been completed on a preliminary basis and the process for confirming final proposed tree removals is underway. Proposed tree removals identified due to underlying utility replacement needs, due to trees in poor condition are dying or are dead, and of undesirable species are not related to roadway edge treatments (i.e. curb versus other alternatives). Each alternative will therefore involve the same number of unrelated tree removals, and all alternatives are consistently ranked within the evaluation matrix.

3. *Initial Installation Cost of the Roadway Edge Treatment*

   This component of the evaluation matrix is taken directly from the estimated costs of each alternative provided in Appendix B. The following range was used for cell coloring:

   Green: Under $1,250,000

Yellow: $1,250,000 to $1,500,000

Red: Over $1,500,000

4. *Ability to Keep Moisture Out of Pavement Base & Subgrade*

   A pavement's ability to keep water out of the underlying layers is a primary function serving its longevity. This criterion evaluates how each alternative addresses moisture / drainage of the pavement.

5. *Life cycle cost of Roadway Edge Treatment Portion*

   This component of the evaluation matrix is taken directly from the estimated costs of each alternative provided in Appendix B. The following range was used for cell coloring:

   Green: Under $30,000

   Yellow: $30,000 to $40,000

   Red: Over $40,000

6. *Turf Impacts*

   During the preliminary engineering and associated public engagement process, some residents expressed interest in having a vertical barrier to prevent vehicles and snow plows from disrupting lawns. In some instances, property owners have taken to placing fixed objects (reflective markers, stones, landscaping, etc.) along the roadway edge to delineate it and prevent damage.

   Some alternatives propose temporary storage or conveyance of stormwater through turf areas adjacent to the roadway. Form past experience on similar projects, it is known to the project team and City that storage of public stormwater runoff in lawns, even if in the public right-of-way, is not well-received by adjacent property owners. This is particularly poorly received in late winter / early spring months when frozen ground conditions and lingering snowbanks prohibit proper drainage from lawns and therefore prohibit the enjoyment and use of lawns by adjacent owners.

This criterion evaluates the ability of each option to address these concerns and project constraints related to turf areas adjacent to the roadway edge.

7. *Stormwater Conveyance Capacity & Continuity with Drainage Inlet Castings*

Roadways are almost always 'crowned' meaning the center of the roadway is higher than the roadway edges. It is therefore the duty of the roadway edges to convey/transport water from the street to either a ditch system or a storm sewer inlet.

The storm sewer inlets selected by the City of Hopkins (and almost all other roadway authorities) involve a slotted grate typically located in a concrete gutter pan as well as a hooded opening above the gutter for high flows or in the event the grate becomes clogged. The alternatives vary in their compatibility with this type of structure.

This criterion evaluates the stormwater conveyance functionality of each alternative as it relates to the edge treatment's ability to get water to its intended destination in a reliable fashion.

8. *Consistency with similar projects constructed in other communities – contractor risks*

Project cost estimates provided in this analysis are based on historically observed unit prices as bid by contractors on similar projects. Similarly, estimates for time of construction are based on observations of work completed on past similar projects. In some cases, particularly where innovative / atypical designs are completed, actual costs of work and the associated duration to complete the work may significantly increase as a result of contractor uncertainty / contractor risk aversion. Contractors are often hesitant to complete work which they are inexperienced with, particularly when they are required to provide a two-year warranty as is the City of Hopkins standard. In response to that risk, contractors typically either extend the schedule for the work or, as is more often, increase the associated price bid to account for risk.

Contractors will be required to provide a two-year warranty for the project, but given certain conditions, may make claims of a warranty being voided if a product design is inadequate. For example, with respect to edge treatment alternatives; if the invisible curb alternative were chosen and if cracking consistently develop along it as is anticipated, a contractor may argue that the warranty of the cracked pavement and associated pavement infrastructure is void. The contractor's argument would be strengthened if it could be proven such cracking should have been anticipated during the project design process and is therefore outside the contractor's control.

This criterion was established to compare the consistency of the alternative to what work is being commonly completed in other communities, thereby providing reference as to how it may be perceived by contractors and the associated risks to the project.

9. *Stormwater management*

Each alternative meets the project stormwater management requirements. Stormwater pond, rain garden, or other permanent stormwater management construction is not required for any alternative as conceptualized. The "Low Impact Development" alternative however, proposes to implement permanent stormwater management features in the lawns of adjacent properties for stormwater quality and rate control benefits.

This criterion evaluates how each alternative address project stormwater management requirements.

10. *Aesthetics*

The public has expressed an interest in considering the aesthetics of the roadway improvements.

- A petition has been circulated to neighborhood residents demanding alternatives to concrete curb and gutter be considered. From discussions with those leading the effort to circulate this petition, the project team was informed the primary objection to B618 concrete curb and gutter is their dissatisfaction with the aesthetics of a raised curb along the roadway edge, regardless of raised height and gutter pan presence/width. This testimony is in conflict with Alternatives 2, 3, 4, 6, and 7 (as numbered/labeled in **Appendix A**).
- Input has been received from other residents noting their dissatisfaction with the existing roadway edge treatments (without raised curb) from an aesthetic perspective, as vehicles may park on lawns and snowplow impacts can be encountered. Some also feel that roadways with concrete curbing looks more finished and traditional. This testimony is in conflict with Alternatives 1, 5, 8, and 9.
- Input has been received that the preservation of trees is of utmost aesthetic importance. This testimony is in conflict with alternatives 10 and 11 which would involve heavy losses of significant trees.

Aesthetic testimony has been received in conflict with every alternative. The conflicting / subjective opinions on what is aesthetically pleasing therefore cannot be objectively differentiated based on this input. Without clarity on a collective aesthetic consensus, all alternatives were provided a consistent 'yellow' ranking. Individual users of the evaluation matrix may desire to consider this criterion based on their individual opinion of the roadway aesthetics.

11. *Disruption / Temporary Construction Impacts*

This criterion was included for evaluation of the duration and magnitude of temporary construction impacts.

For example, the installation of concrete requires approximately 5 to 7 days to adequately cure or harden to sufficiently support vehicles. During that time, as is typical with street and utility construction, access to residential driveways is restricted and residents will be required to park on the roadway adjacent to their home.

The installation of concrete as part of the roadway edge treatment (as opposed to bituminous or gravel edging) may or may not result in an overall increased construction duration. While the concrete curb and gutter cures to support vehicle weights, depending on whether the contractor is ahead of or lagging on its schedule as compared to contractual deadlines, the contractor may continue to complete the following street and utility construction efforts:

- Completion of concrete curbing at catch basins, intersection radii, or other locations within the project area.
- The addition of aggregate base to the roadway in preparation for bituminous street paving.
- Backfill of concrete curbing outside the roadway in preparation for placement of topsoil borrow.

It is not anticipated that the deletion of concrete edging will reduce the total duration of the neighborhood construction. It is anticipated that the contractors working on the project will allocate staffing and equipment resources necessary to meet project deadlines. The roadway edge treatment is a relatively small component of the project in comparison to the construction effort associated with the other roadway and utility components of the project, and therefore a substantive reduction in project deadlines would not be recommended.

Evaluation of each alternative was completed in consideration of these factors related to temporary impacts.

12. *Continuity with Routine City of Hopkins Maintenance Practices*

The Hopkins Public Works Department is responsible for ongoing maintenance operations for the Interlachen Park neighborhood streets following completion of the project. The quality and costs of maintenance are benefitted by having a consistent set of infrastructure components throughout the community that can be matched with staff training and equipment ideally suited for community-wide maintenance activities.

The City of Hopkins has completed significant street and utility reconstruction projects for over 20 years utilizing similar concrete curb and gutter edge treatments which require similar maintenance routines and programming.

Significant deviation from past practices in favor of a unique edge treatment (the loss of continuity with the rest of the community) in the Interlachen Park neighborhood would be a detriment to the quality and cost of ongoing maintenance activities and programming.

As one example, Hopkins Public Works is not equipped or have programs in place to routinely replace large segments of bituminous curb damaged plowing operations, which is a common occurrence with bituminous curbing. In such cases, the duration that defective bituminous curb were to remain in place would increase, thereby demonstrating a detriment to the quality of maintenance operations that should be anticipated with the bituminous curb alternative 2.

The following input was provided by the City's Streets Superintendent:

- Curb defines the street edge for the plow so plows can move over to the edge of the street, feel the curb, and plow the street to full width. You can't do that without curb or you'll roll up sod so plows will plow less than full width if there is no curb.
- Having a curb edge allows the plows to get closer to the edge when wrapping corners so the snow in the corners gets off the street which can improve visibility, drivability, and drainage. Again, without curbs we'd roll up sod on the corners trying to reach the street edge.
- With a straight plowed street edge, against a curb, thawed snow and ice have a better opportunity to drain away in the curb line and there is less refreezing in the street. This can be especially helpful at driveway ends. The refreezing at driveway ends can damage the blacktop in front of the driveway over time.
- Sod creeps into the street over time because we cannot run the street sweeper along the true edge of the street or we will pull up sod with the broom. The street becomes narrowed over time and narrower when the plows have to stay away from the edge.

This criterion was used for evaluation of continuity from an ongoing maintenance perspective.

IV. Recommendations

The typical decision-making process for determining which edge treatment is most appropriate has become largely based on industry standards which were developed through decades of collective experience across numerous agencies. The function of this exercise was to provide reference to industry standards, alternative considerations made prior to and during development of this project, estimates of initial installation cost, and estimates of long-term life cycle costs for each edge treatment alternative.

The evaluation matrix provides a consolidated review of the proposed alternatives. The following aspects were most notable from this evaluation:

1. There is no anticipated difference in number of trees lost due to either alternative. Tree losses proposed are primarily due to utility impacts, poor/dead/dying tree condition, or undesirable tree species; none of which are influenced by roadway edge alternative chosen.
2. Industry accepted research has completed along similar roadway joints located within the region documenting the benefits to pavement systems resulting from having adequate control of subgrade moisture causes. The most effective results are anticipated from having a concrete curb with gutter and a sealed bituminous/concrete interface.
3. The City of Hopkins standard is for installation of concrete curb and gutter during street reconstruction. The concrete curb and gutter alternatives have the lowest life cycle cost of all alternatives quantified, primarily due to:
    - A relatively low installation cost.
    - Ability to lengthen the life of the pavement by providing a confined concrete edge
    - An opportunity for a sealed bituminous/concrete joint with a continuous gutter pan, as is routinely completed on Hopkins projects.
    - Less costly future major maintenance efforts.
4. B612 concrete curb and gutter alternative provided similar life cycle cost estimates within three percent ($36,000 over 60 years) of the B618 alternative.
5. The mountable curb and gutter alternative also provided similar life cycle cost estimates, but at slightly higher life cycle cost of about five percent higher ($66,000 over 60 years) than the B618 concrete curb and gutter alternative.
6. The ‘no-curb’ thickened bituminous edge alternative was found to be 40% more costly on an annual basis ($440,000 over 48 years) than the B618 concrete curb and gutter alternative.
7. It is recognized that a petition has circulated regarding opposition to the initial proposal of concrete curb and gutter installation. Through discussions between City Staff and organizers of the petition, City Staff has learned the petition organizers’ preference on edge treatment is based in aesthetics. A definitive, comprehensive aesthetic preference held by all project stakeholders could not be identified based on all input received.

8. A concrete curb and gutter system is preferred by Hopkins Public Works for routine maintenance operations. A B6 style curb would best support those efforts.

A concrete curb and gutter alternative is recommended for the Interlachen Park Street & Utility Improvements Project. The following are two recommended alternatives in consideration of the findings of this report:

- B618 concrete curb and gutter
- B612 concrete curb and gutter if a narrower gutter pan is desired for aesthetic purposes. Modifications to the curb style could be made at catch basin inlets for compatibility with City Standards at those locations.

The two recommended alternatives are within three percent in terms of estimated life cycle cost. The actual cost of installation and long-term maintenance will be based on a variety of economic factors impacting contractors. The three percent difference in life cycle cost is negligible over the anticipated 60-year life cycle. A B612 alternative, with its narrower footprint, may also yield some aesthetic benefits over B618 which has received more vocal aesthetic criticism.

Additionally, if desired for aesthetic purposes, a clear curing compound could be used to lessen the color contrast between concrete edge treatment and bituminous surfacing.

Appendix A: Evaluation Matrix for Roadway Edge Treatment Alternatives

BOLTON & MENK

Roadway Edge Alternative
Evaluation Matrix

	Initial installation cost of roadway edge treatment	Tree loss due to roadway edge construction	Tree loss due to utility impacts, poor condition, and undesirable species	Ability to keep moisture out of pavement base and subgrade	Turf impacts	Stormwater conveyance capacity and continuity with drainage inlet castings	Consistency with similar projects constructed in other communities -Contractor costs, installation risk	Stormwater management	Aesthetics	Disruption/temporary construction impacts	Continuity with routine city of Hopkins maintenance practices	Life cycle cost of roadway edge treatment portion
1. Thickened bituminous edge with underdrain (no curb)	✓ $1,060,000	✓	●	✗	✗	✗	✗	●	●	✓	✗	● $32,000
2. Standup bituminous curb	● $1,350,000	✓	●	✗	✗	●	●	●	●	✓	✗	✗ $51,900
3. Gutter-less concrete curb (B-style or similar)	● $1,380,000	✓	●	●	✓	●	●	●	●	●	●	● $37,700
4. Concrete curb with integral color	✗ $1,970,000	✓	●	✓	✓	✓	✗	●	●	●	●	✗ $46,400
5. Mountable concrete curb	✓ $1,150,000	✓	●	✓	●	●	✓	●	●	●	●	✓ $23,900
6. Concrete curb and gutter--B612, clear curing compound sub-option	✓ $1,040,000	✓	●	✓	✓	✓	✓	●	●	●	✓	✓ $23,400
7. Concrete curb and gutter--B618, clear curing compound sub-option	✓ $1,080,000	✓	●	✓	✓	✓	✓	●	●	●	✓	✓ $22,800
8. Invisible curb	● $1,440,000	✓	●	✗	✗	✗	✗	●	●	●	✗	✗ $42,400
9. Mixture of alternatives	● Varies	✓	●	●	●	●	●	●	●	●	●	● Varies
10. Rural section roadway (ditches/ driveway culverts)	✓ NA	✗	●	●	✗	✗	●	●	●	●	✗	✓ NA
11. Low-impact development (rain gardens/basins/storm sewer/culverts)	✗ NA	●	●	●	✗	✗	✗	✓	●	●	✗	✗ NA

LEGEND

✗ Worst alternative/does not meet project requirements/does not address project goals and meets project constraints

● Meets project requirements/ acceptably addresses project goals and contraints

✓ Best alternative/exceeds project requirements/best meets project goals and constraints

Appendix B: Estimates of Comparative Initial Installation Costs

Estimates of Comparative Initial Costs: Edge Treatment Portion of Roadway

INTERLACHEN PARK STREET & UTILITY IMPROVEMENTS
CITY OF HOPKINS, MN
BMI PROJECT NO. T19.118342

Estimates of Comparative Initial Installation Costs			Thickened Bituminous Edge w/ Underdrain		Standup Bituminous Curb		Gutter-less Concrete Curb		Concrete Curb w/ Integral Color		Mountable Concrete Curb & Gutter	
Item	**Unit**	**Unit Price**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**
COMMON EXCAVATION	CU YD	$ 24.00	9459	$ 227,016	5110	$ 122,640	4624	$ 110,976	4624	$ 110,976	4624	$ 110,976
CLASS 5 AGGREGATE BASE	TON	$ 18.00	1836	$ 33,048	1836	$ 33,048	1033	$ 18,594		$ -		$ -
BITUMINOUS WEARING COURSE (SPWEA240C)	TON	$ 85.00	1131	$ 96,135	1412	$ 120,020	782	$ 66,470		$ -	180	$ 15,300
BITUMINOUS NON-WEARING COURSE (SPNWB230C)	TON	$ 75.00	3978	$ 298,350	1412	$ 105,900	782	$ 58,650		$ -	180	$ 13,500
BITUMINOUS MATERIAL FOR TACK COAT	GAL	$ 3.50	492	$ 1,722	600	$ 2,100	340	$ 1,190		$ -	40	$ 140
6" PERF PIPE DRAIN	LIN FT	$ 10.00	40801	$ 408,010	23132	$ 231,320	23132	$ 231,320	23132	$ 231,320	23132	$ 231,320
BITUMINOUS CURB	LIN FT	$ 18.00		$ -	40801	$ 734,418		$ -		$ -		$ -
B8 GUTTERLESS CURB	LIN FT	$ 22.00		$ -		$ -	40801	$ 897,622		$ -		$ -
COLORED CONCRETE CURB & GUTTER	LIN FT	$ 40.00		$ -		$ -		$ -	40801	$ 1,632,040		$ -
D412 CONCRETE CURB & GUTTER	LIN FT	$ 19.00		$ -		$ -		$ -		$ -	40801	$ 775,219
B612 CONCRETE CURB & GUTTER	LIN FT	$ 16.00		$ -		$ -		$ -		$ -		$ -
B618 CONCRETE CURB & GUTTER	LIN FT	$ 18.00		$ -		$ -		$ -		$ -		$ -
TOTAL				**$ 1,060,000**		**$ 1,350,000**		**$ 1,380,000**		**$ 1,970,000**		**$ 1,150,000**

Estimates of Comparative Initial Costs: Edge

INTERLACHEN PARK STREET & UTILITY IMPROVEMENTS
CITY OF HOPKINS, MN
BMI PROJECT NO. T19.118342

Estimates of Comparative Initial Installation Costs			B612 Concrete Curb & Gutter		B618 Concrete Curb & Gutter		Invisible Concrete Curb	
Item	**Unit**	**Unit Price**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**
COMMON EXCAVATION	CU YD	$ 24.00	4624	$ 110,976	4624	$ 110,976	6261	$ 150,264
CLASS 5 AGGREGATE BASE	TON	$ 18.00	344	$ 6,192		$ -	567	$ 10,206
BITUMINOUS WEARING COURSE (SPWEA240C)	TON	$ 85.00	261	$ 22,185		$ -	869	$ 73,865
BITUMINOUS NON-WEARING COURSE (SPNWB230C)	TON	$ 75.00	261	$ 19,575		$ -	869	$ 65,175
BITUMINOUS MATERIAL FOR TACK COAT	GAL	$ 3.50	113	$ 396		$ -	110	$ 385
6" PERF PIPE DRAIN	LIN FT	$ 10.00	23132	$ 231,320	23132	$ 231,320	40801	$ 408,010
BITUMINOUS CURB	LIN FT	$ 18.00		$ -		$ -		$ -
B8 GUTTERLESS CURB	LIN FT	$ 22.00		$ -		$ -		$ -
COLORED CONCRETE CURB & GUTTER	LIN FT	$ 40.00		$ -		$ -		$ -
D412 CONCRETE CURB & GUTTER	LIN FT	$ 19.00		$ -		$ -		$ -
B612 CONCRETE CURB & GUTTER	LIN FT	$ 16.00	40801	$ 652,816		$ -		$ -
B618 CONCRETE CURB & GUTTER	LIN FT	$ 18.00		$ -	40801	$ 734,418	40801	$ 734,418
TOTAL				**$ 1,040,000**		**$ 1,080,000**		**$ 1,440,000**

Appendix C: Estimates of Comparative Life Cycle Costs

Estimates of Comparative Life Cycle Costs: Edge Treatment Portion of Roadway

INTERLACHEN PARK STREET & UTILITY IMPROVEMENTS

CITY OF HOPKINS, MN

BMI PROJECT NO. T19.118342

Life Span Ratio of Bit Edge vs. Conc. Curb: **80%**

Life Span Ratio of Bit Curb vs. Conc. Curb: **90%**

Thickened Bituminous Edge w/ Underdrain			Standup Bituminous Curb			Gutter-less Concrete Curb			Concrete Curb w/ Integral Color		
Year	**Maintenance**	**Cost**	**Year**	**Maintenance**	**Cost**	**Year**	**Maintenance**	**Cost**	**Year**	**Maintenance**	**Cost**
0	Reconstruction	$ 1,060,000	0	Reconstruction	$ 1,350,000	0	Reconstruction	$ 1,380,000	0	Reconstruction	$ 1,970,000
4	Crack Seal & Seal Coat	$ 19,911	4	Crack Seal & Seal Coat	$ 11,200	4	Crack Seal & Seal Coat	$ 11,200	4	Crack Seal & Seal Coat	$ -
10	Crack Seal & Seal Coat	$ 19,911	11	Crack Seal & Seal Coat	$ 11,200	11	Crack Seal & Seal Coat	$ 11,200	12	Crack Seal & Seal Coat	$ -
16	Mill & Overlay	$ 177,200	18	Mill & Overlay	$ 691,275	18	Mill & Overlay	$ 293,475	20	Mill & Overlay	$ 408,000
20	Crack Seal & Seal Coat	$ 19,911	22	Crack Seal & Seal Coat	$ 11,200	22	Crack Seal & Seal Coat	$ 11,200	24	Crack Seal & Seal Coat	$ -
26	Crack Seal & Seal Coat	$ 19,911	29	Crack Seal & Seal Coat	$ 11,200	29	Crack Seal & Seal Coat	$ 11,200	32	Crack Seal & Seal Coat	$ -
32	Mill & Overlay	$ 177,200	36	Mill & Overlay	$ 691,275	36	Mill & Overlay	$ 293,475	40	Mill & Overlay	$ 408,000
36	Crack Seal & Seal Coat	$ 19,911	40	Crack Seal & Seal Coat	$ 11,200	40	Crack Seal & Seal Coat	$ 11,200	44	Crack Seal & Seal Coat	$ -
42	Crack Seal & Seal Coat	$ 19,911	47	Crack Seal & Seal Coat	$ 11,200	47	Crack Seal & Seal Coat	$ 11,200	52	Crack Seal & Seal Coat	$ -
48	Reconstruction	TBD	54	Reconstruction	TBD	54	Reconstruction	TBD	60	Reconstruction	TBD
	Total Costs before 2nd Reconstruction	$ 1,534,000		Total Costs before 2nd Reconstruction	$ 2,800,000		Total Costs before 2nd Reconstruction	$ 2,034,000		Total Costs before 2nd Reconstruction	$ 2,786,000
	Cost per Year	$ 32,000		**Cost per Year**	$ 51,900		**Cost per Year**	$ 37,700		**Cost per Year**	$ 46,400

Estimates of Comparative Life Cycle Costs

INTERLACHEN PARK STREET & UTILITY IMPROVEMENTS

CITY OF HOPKINS, MN

BMI PROJECT NO. T19.118342

Life Span Ratio of Bit Edge vs. Conc. Curb: **80%**

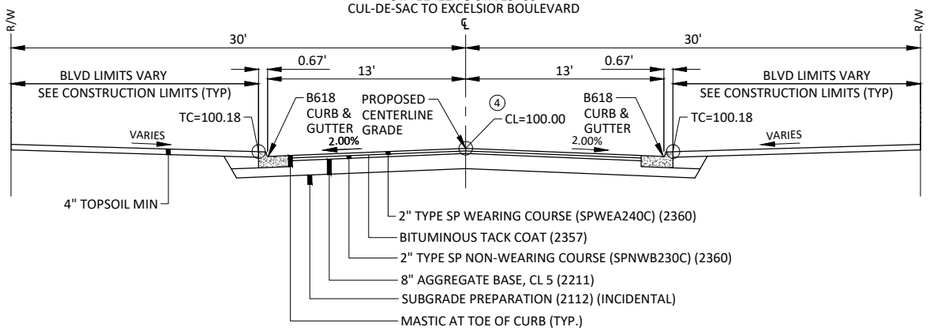
Life Span Ratio of Bit Curb vs. Conc. Curb: **90%**

Mountable Concrete Curb & Gutter			B618 Concrete Curb & Gutter			B612 Concrete Curb & Gutter			Invisible Concrete Curb		
Year	**Maintenance**	**Cost**	**Year**	**Maintenance**	**Cost**	**Year**	**Maintenance**	**Cost**	**Year**	**Maintenance**	**Cost**
0	Reconstruction	$ 1,150,000	0	Reconstruction	$ 1,080,000	0	Reconstruction	$ 1,040,000	0	Reconstruction	$ 1,440,000
4	Crack Seal & Seal Coat	$ -	4	Crack Seal & Seal Coat	$ -	4	Crack Seal & Seal Coat	$ 3,733	4	Crack Seal & Seal Coat	$ 11,200
12	Crack Seal & Seal Coat	$ -	12	Crack Seal & Seal Coat	$ -	12	Crack Seal & Seal Coat	$ 3,733	10	Crack Seal & Seal Coat	$ 11,200
20	Mill & Overlay	$ 142,800	20	Mill & Overlay	$ 142,800	20	Mill & Overlay	$ 169,225	16	Mill & Overlay	$ 262,875
24	Crack Seal & Seal Coat	$ -	24	Crack Seal & Seal Coat	$ -	24	Crack Seal & Seal Coat	$ 3,733	20	Crack Seal & Seal Coat	$ 11,200
32	Crack Seal & Seal Coat	$ -	32	Crack Seal & Seal Coat	$ -	32	Crack Seal & Seal Coat	$ 3,733	26	Crack Seal & Seal Coat	$ 11,200
40	Mill & Overlay	$ 142,800	40	Mill & Overlay	$ 142,800	40	Mill & Overlay	$ 169,225	32	Mill & Overlay	$ 262,875
44	Crack Seal & Seal Coat	$ -	44	Crack Seal & Seal Coat	$ -	44	Crack Seal & Seal Coat	$ 3,733	36	Crack Seal & Seal Coat	$ 11,200
52	Crack Seal & Seal Coat	$ -	52	Crack Seal & Seal Coat	$ -	52	Crack Seal & Seal Coat	$ 3,733	42	Crack Seal & Seal Coat	$ 11,200
60	Reconstruction	TBD	60	Reconstruction	TBD	60	Reconstruction	TBD	48	Reconstruction	TBD
	Total Costs before 2nd Reconstruction	$ 1,436,000		Total Costs before 2nd Reconstruction	$ 1,366,000		Total Costs before 2nd Reconstruction	$ 1,401,000		Total Costs before 2nd Reconstruction	$ 2,033,000
	Cost per Year	$ 23,900		**Cost per Year**	$ 22,800		**Cost per Year**	$ 23,400		**Cost per Year**	$ 42,400

Appendix D: Cross Sectional Analysis for Evaluation of Roadway Excavation Depth Due to Curbing

TYPICAL SECTION - ASHLEY ROAD

STA 11+22 TO STA 29+00
CUL-DE-SAC TO EXCELSIOR BOULEVARD



TYPICAL SECTIONS ARE NOT TO SCALE

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NICHOLAS J. AMATUCCIO
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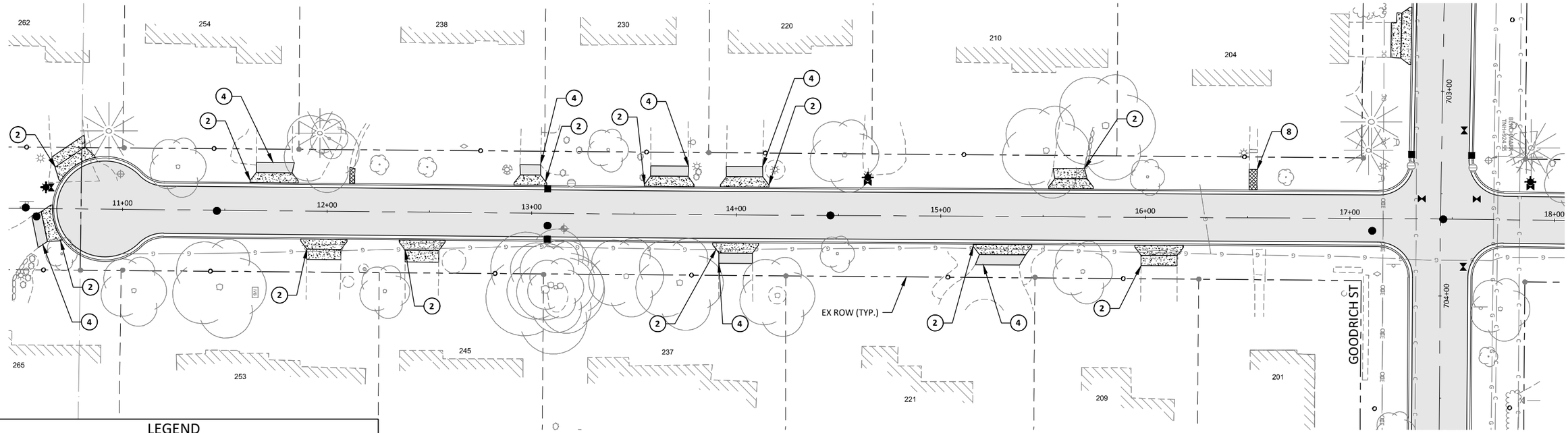
CHECKED	NA/MW
CLIENT PROJ. NO.	T19.118342

NO.	ISSUED FOR	DATE

HOPKINS, MINNESOTA
INTERLACHEN PARK STREET & UTILITY IMPROVEMENTS
ASHLEY RD EXHIBITS

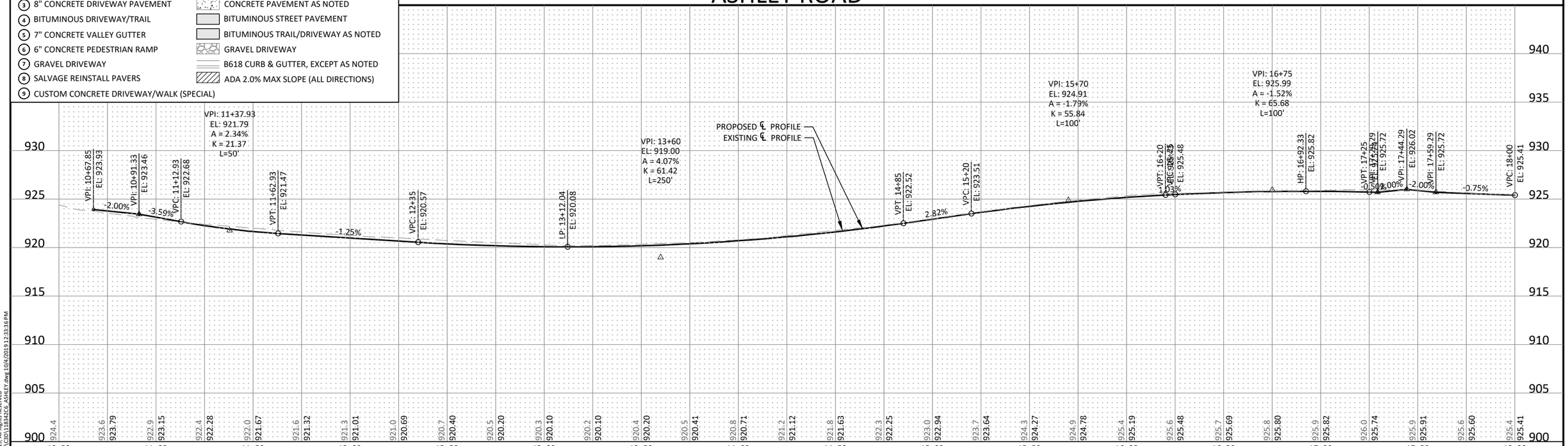
SHEET
C1.01



LEGEND

1 4" CONCRETE WALK	10 R-1733 CASTING
2 6" CONCRETE DRIVEWAY PAVEMENT	11 R-3067-V CASTING
3 8" CONCRETE DRIVEWAY PAVEMENT	CONCRETE PAVEMENT AS NOTED
4 BITUMINOUS DRIVEWAY/TRAIL	BITUMINOUS STREET PAVEMENT
5 7" CONCRETE VALLEY GUTTER	BITUMINOUS TRAIL/DRIVEWAY AS NOTED
6 6" CONCRETE PEDESTRIAN RAMP	GRAVEL DRIVEWAY
7 GRAVEL DRIVEWAY	B618 CURB & GUTTER, EXCEPT AS NOTED
8 SALVAGE REINSTALL PAVERS	ADA 2.0% MAX SLOPE (ALL DIRECTIONS)
9 CUSTOM CONCRETE DRIVEWAY/WALK (SPECIAL)	

ASHLEY ROAD



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VERT. SCALE 0 5 10 FEET

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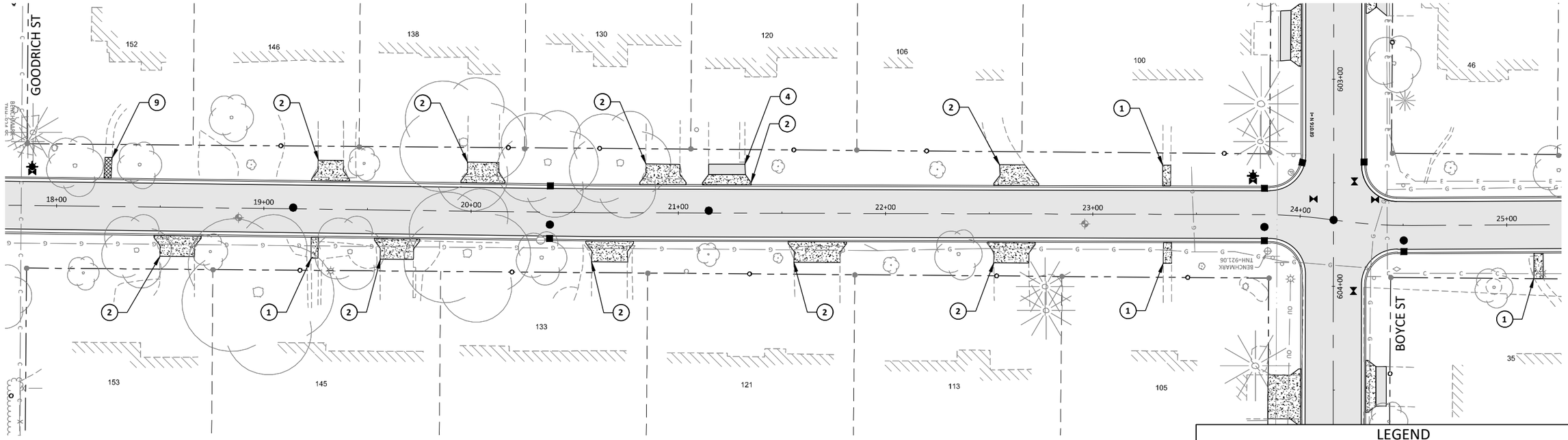
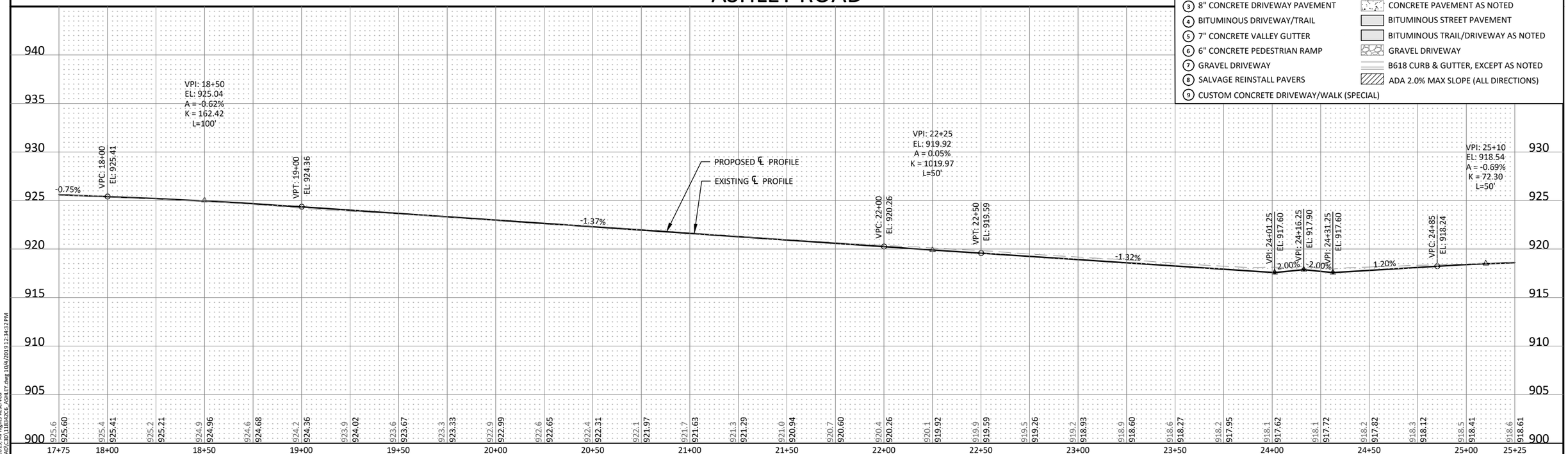
STREET PLAN & PROFILE
ASHLEY ROAD

SHEET C6.03



ASHLEY ROAD



LEGEND

1. 4" CONCRETE WALK
2. 6" CONCRETE DRIVEWAY PAVEMENT
3. 8" CONCRETE DRIVEWAY PAVEMENT
4. BITUMINOUS DRIVEWAY/TRAIL
5. 7" CONCRETE VALLEY GUTTER
6. 6" CONCRETE PEDESTRIAN RAMP
7. GRAVEL DRIVEWAY
8. SALVAGE REINSTALL PAVERS
9. CUSTOM CONCRETE DRIVEWAY/WALK (SPECIAL)
10. R-1733 CASTING
11. R-3067-V CASTING

CONCRETE PAVEMENT AS NOTED
BITUMINOUS STREET PAVEMENT
BITUMINOUS TRAIL/DRIVEWAY AS NOTED
GRAVEL DRIVEWAY
B618 CURB & GUTTER, EXCEPT AS NOTED
ADA 2.0% MAX SLOPE (ALL DIRECTIONS)

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VERT. 0 5 10 SCALE FEET

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STREET PLAN & PROFILE
ASHLEY ROAD

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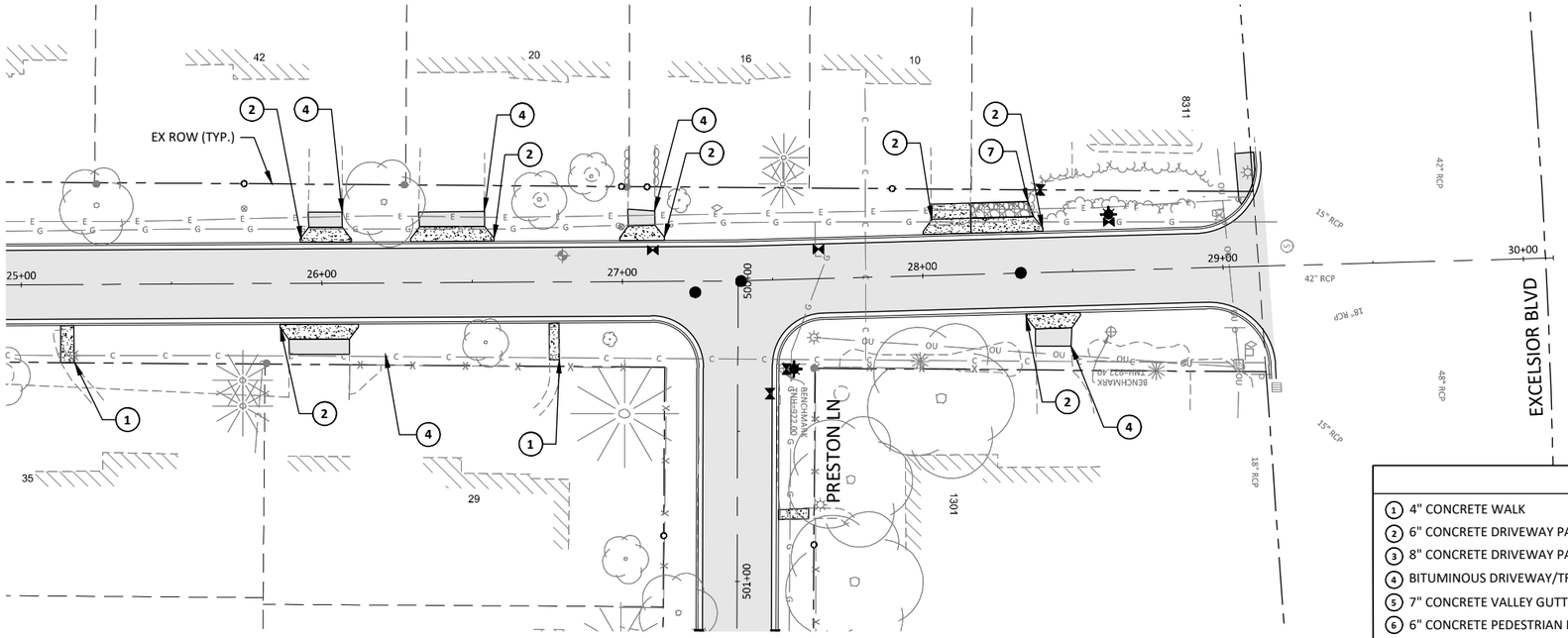

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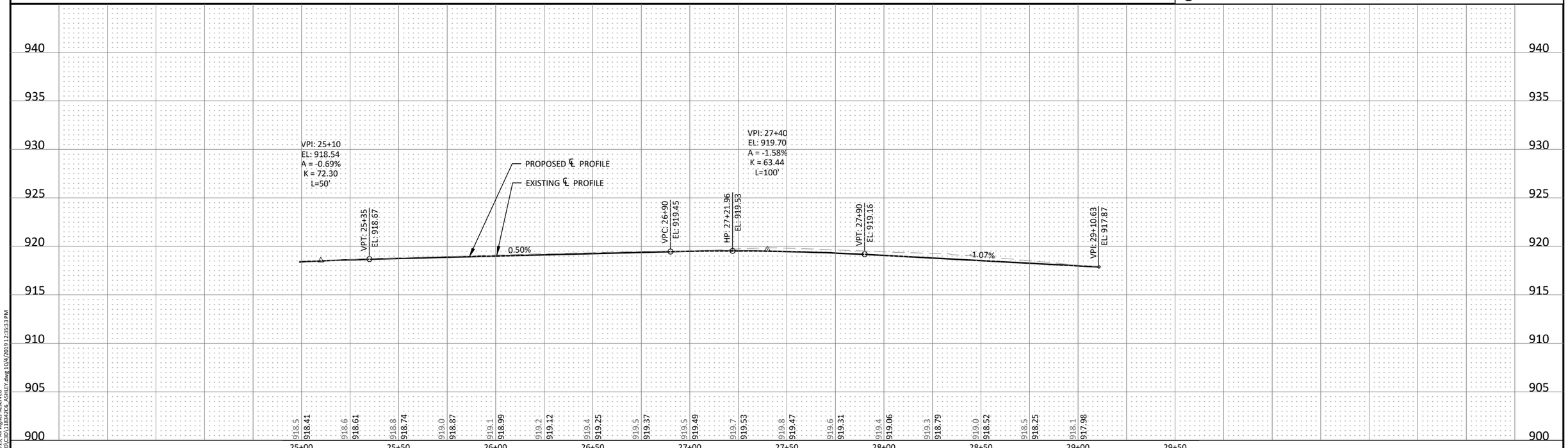
6 6" CONCRETE PEDESTRIAN RAMP	GRAVEL DRIVEWAY
7 GRAVEL DRIVEWAY	B618 CURB & GUTTER, EXCEPT AS NOTED
8 SALVAGE REINSTALL PAVERS	ADA 2.0% MAX SLOPE (ALL DIRECTIONS)
9 CUSTOM CONCRETE DRIVEWAY/WALK (SPECIAL)	



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VERT. 0 5 10 SCALE FEET

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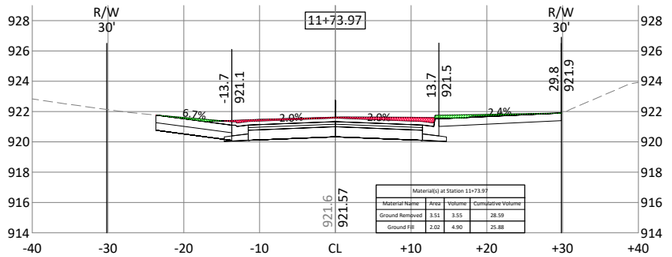
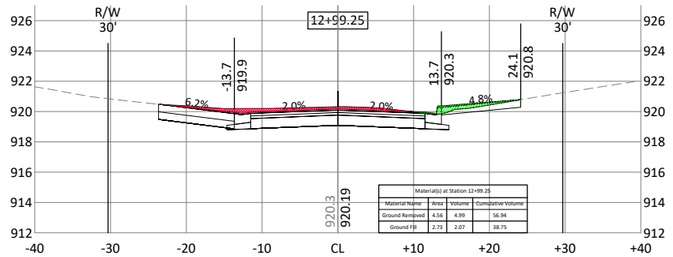
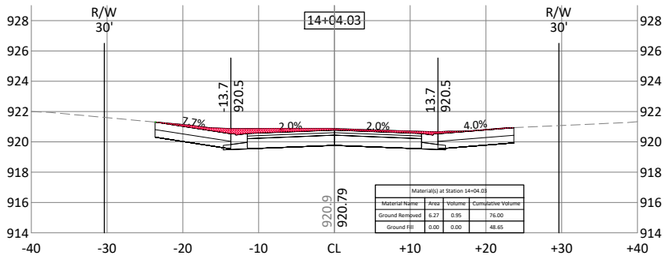
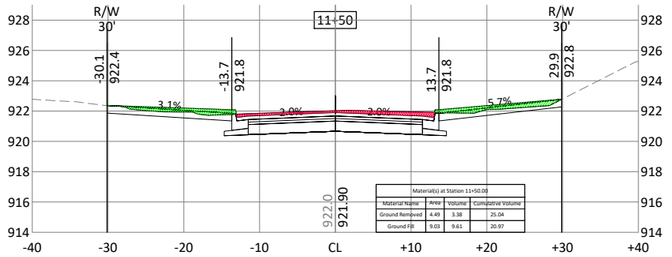
STREET PLAN & PROFILE
ASHLEY ROAD

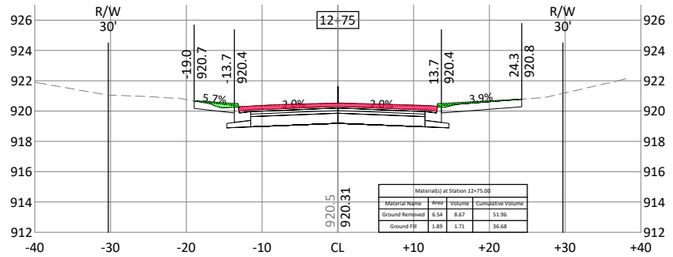
SHEET C6.05

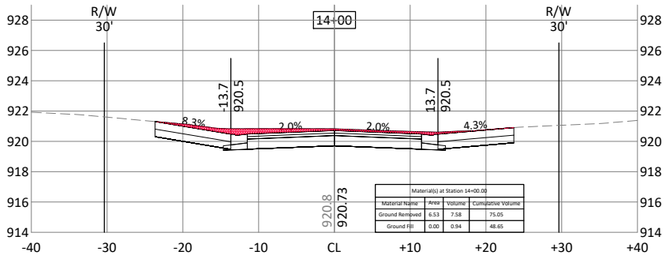


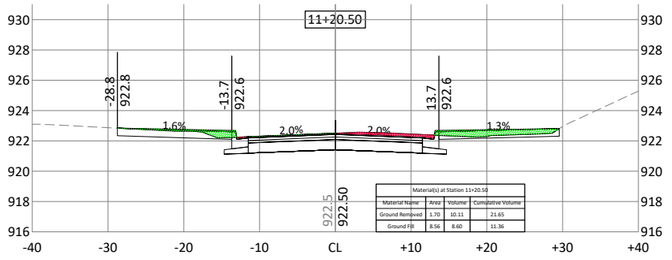


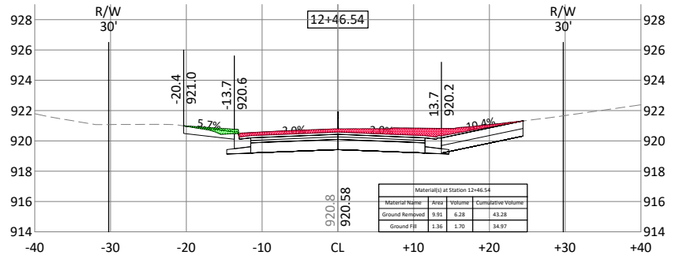


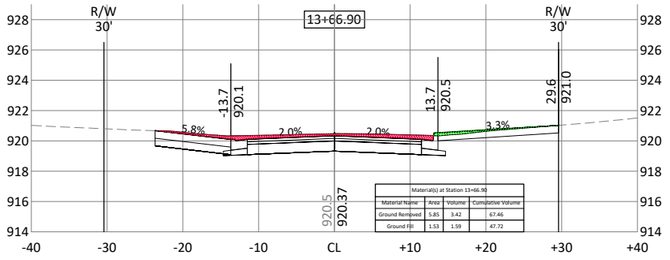


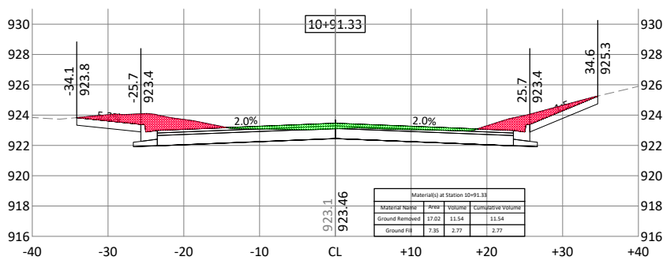


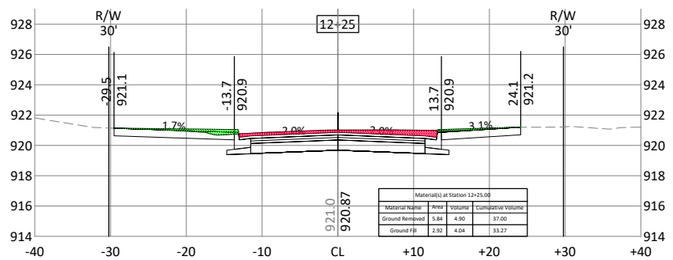


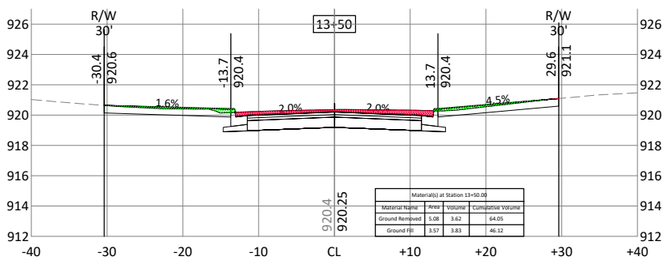


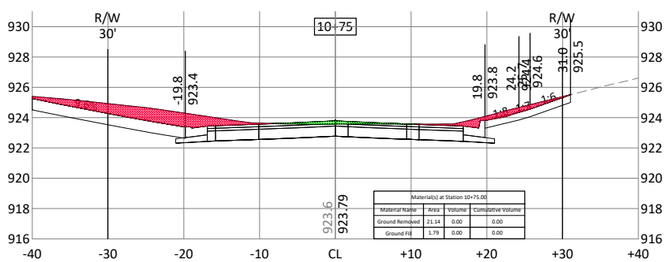


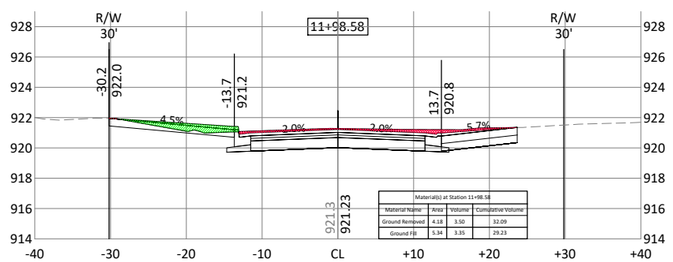


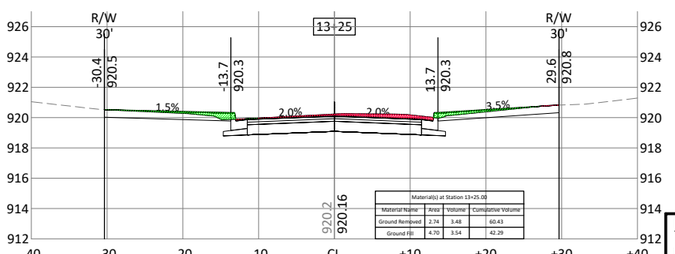












LEGEND:
= CUT VOLUME
= FILL VOLUME

HORZ. 0 10 20 SCALE FEET
VERT. 0 5 10 SCALE FEET

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LIC. NO. 53639 DATE MM/DD/YYYY

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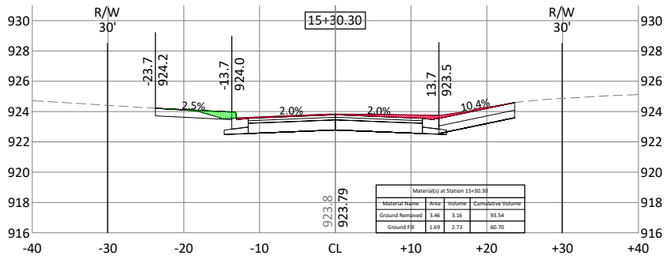
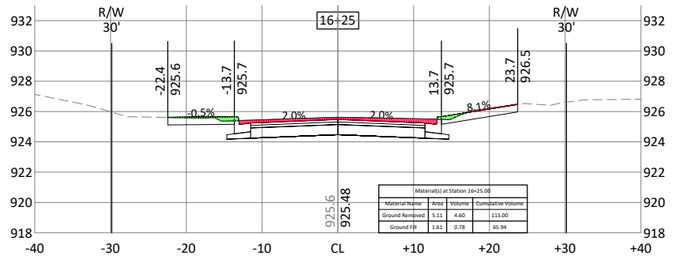
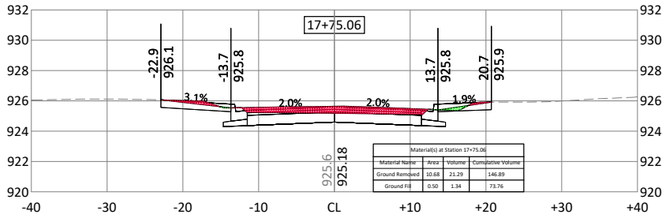
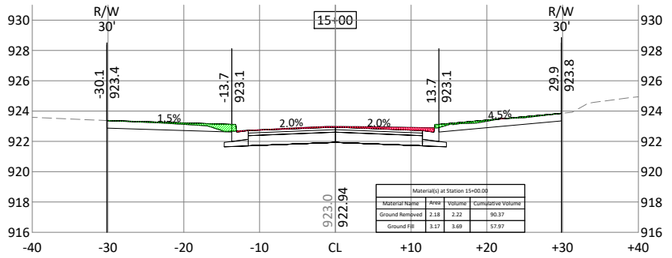
ASHLEY ROAD

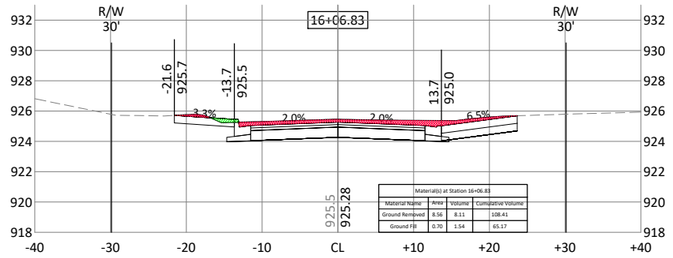
SHEET C9.07

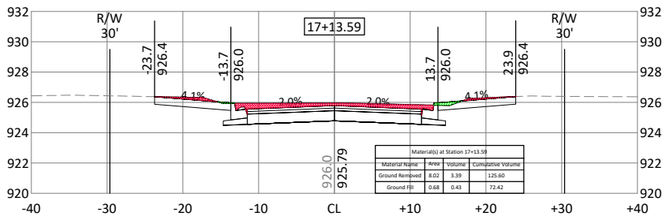


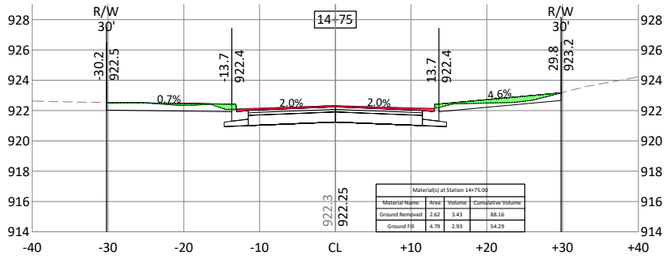


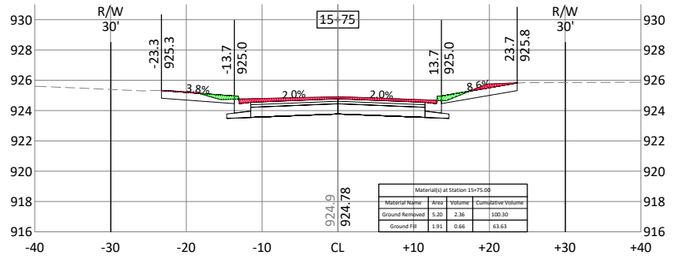


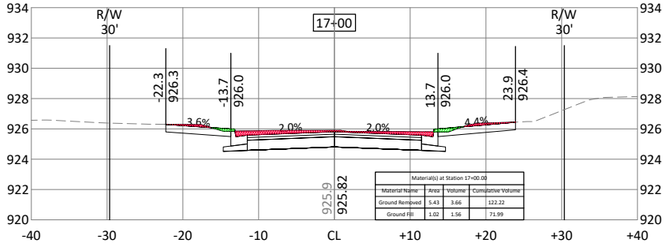


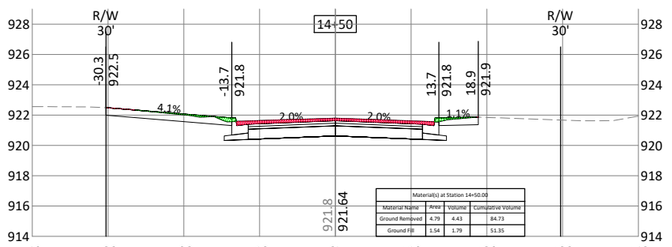


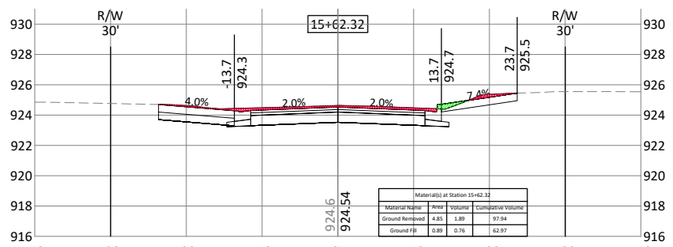


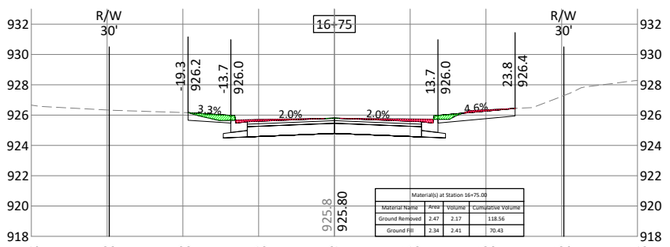


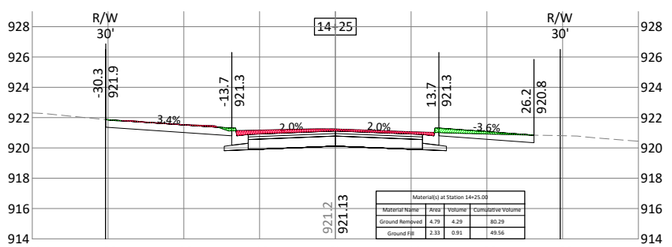


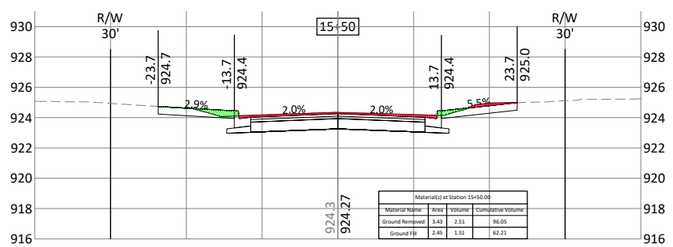


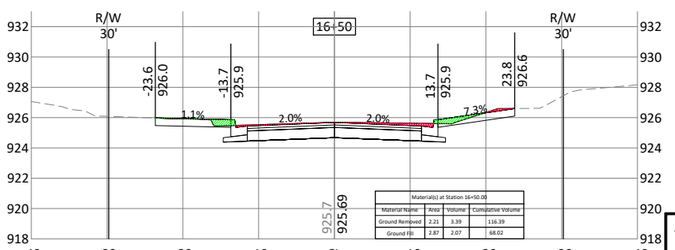












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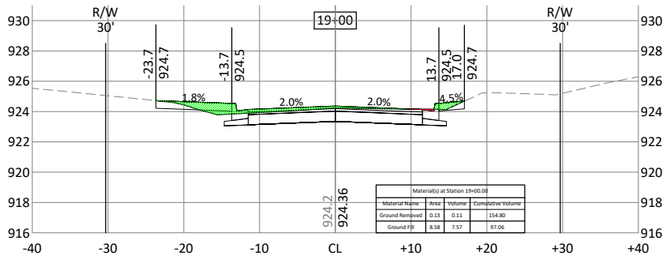
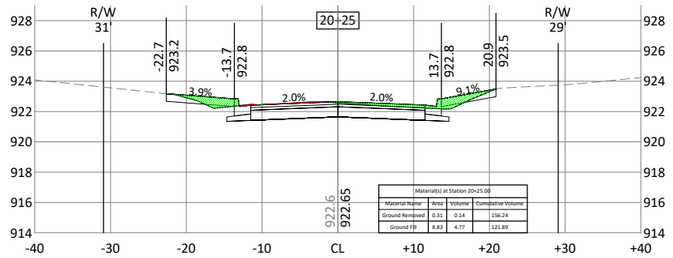
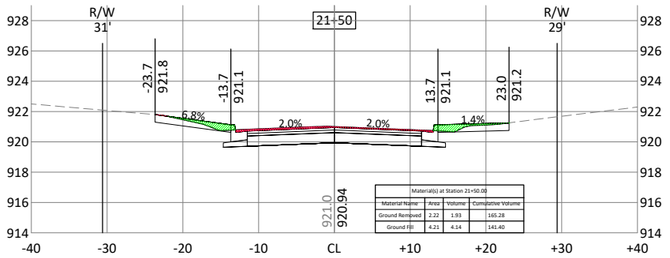
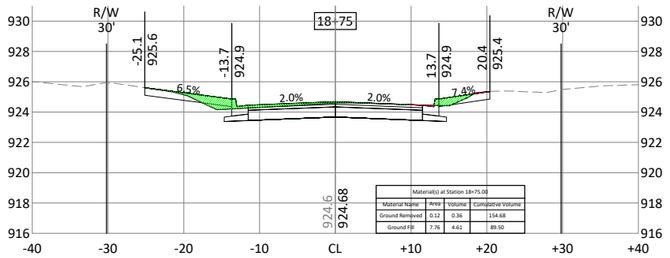
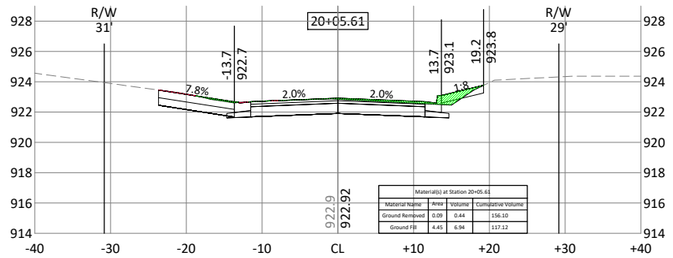
SHEET C9.08

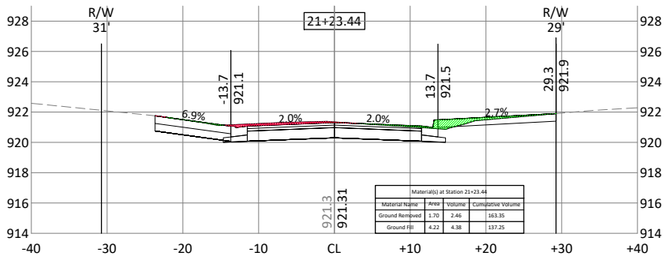


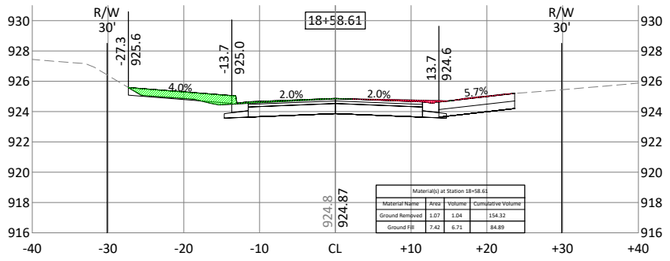


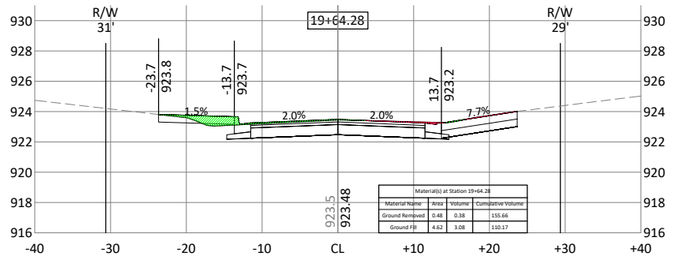


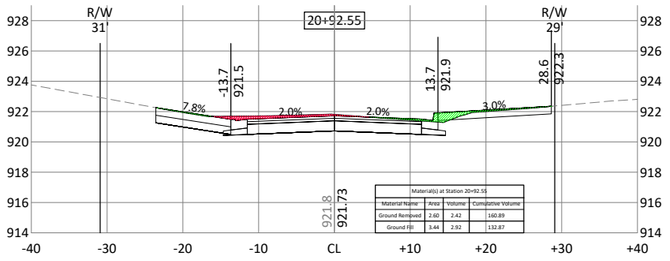


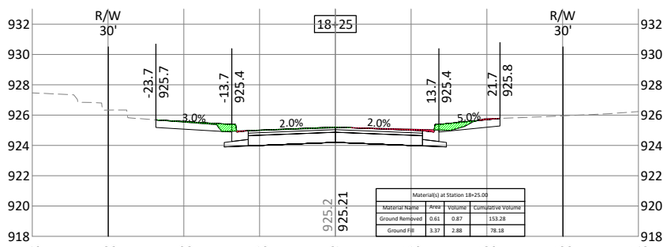


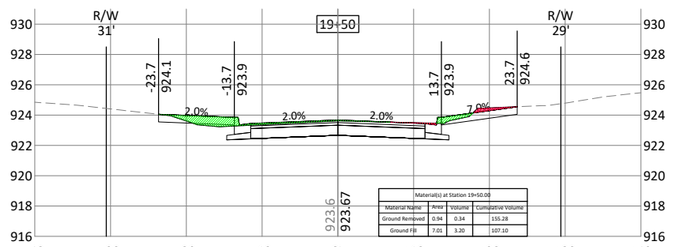


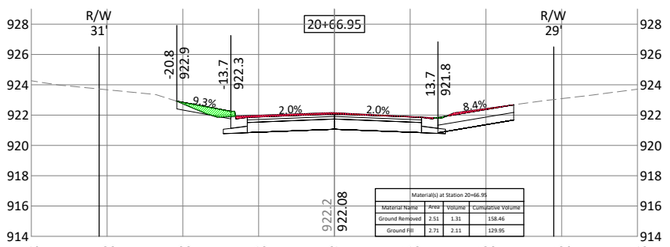


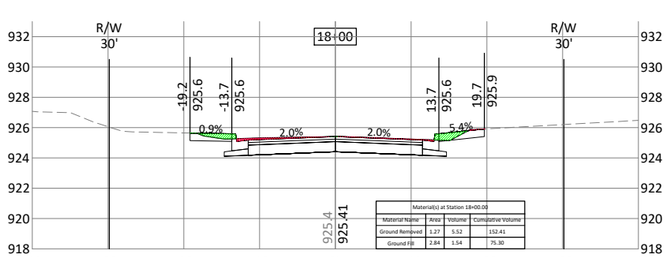


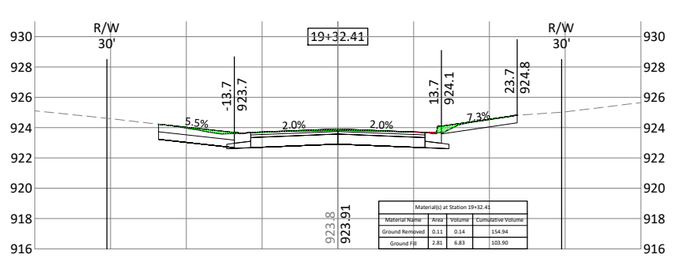


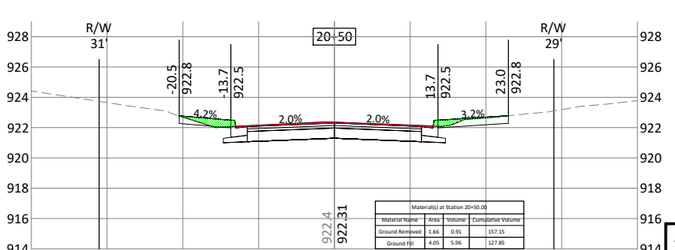












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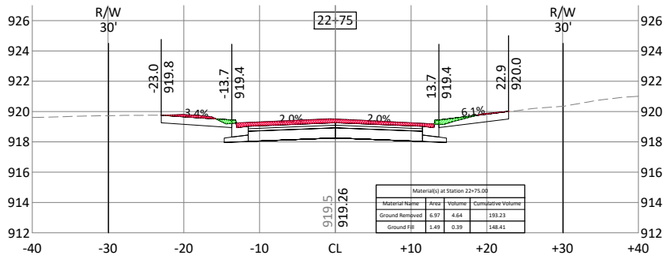

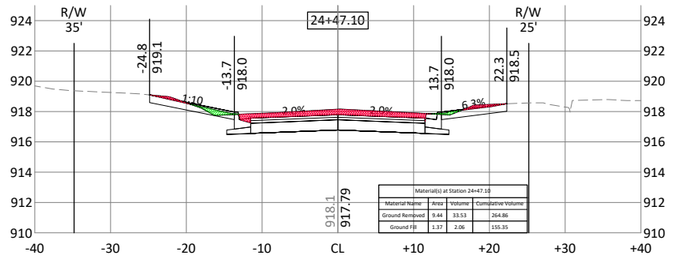

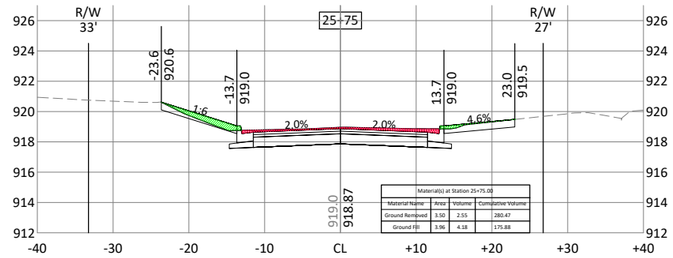

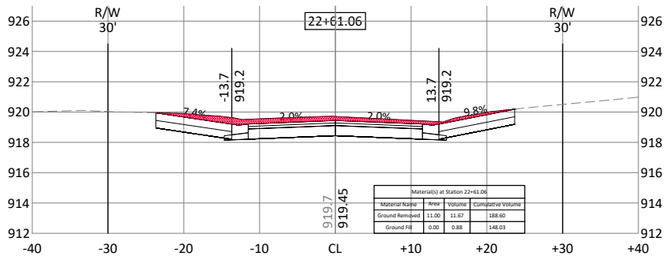

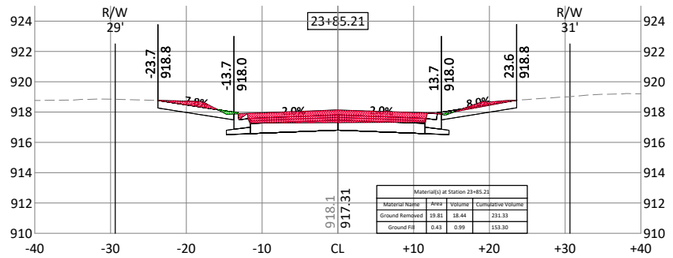

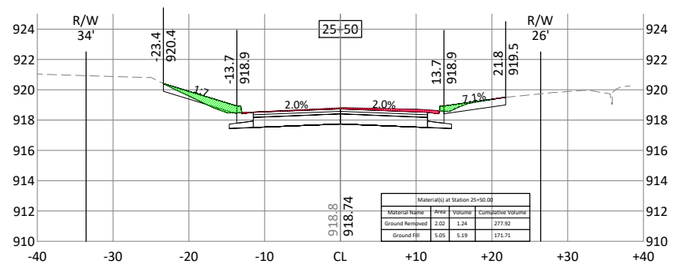

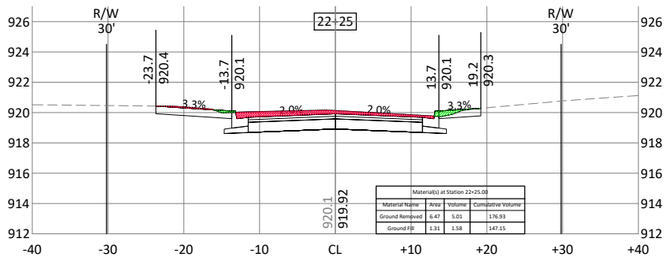

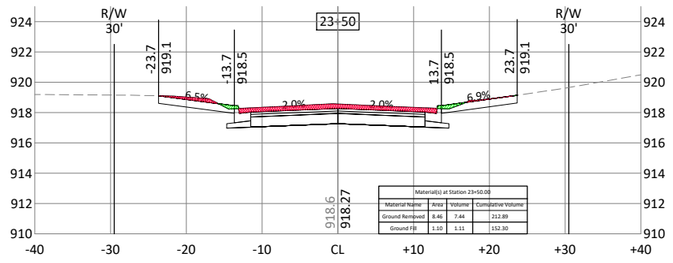

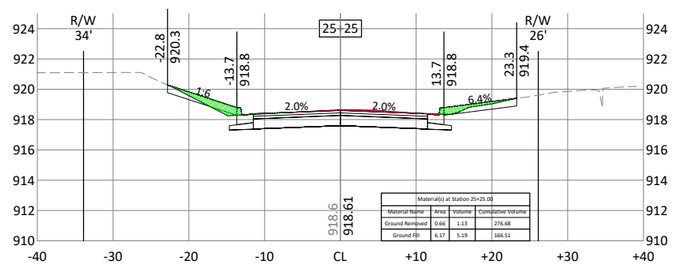

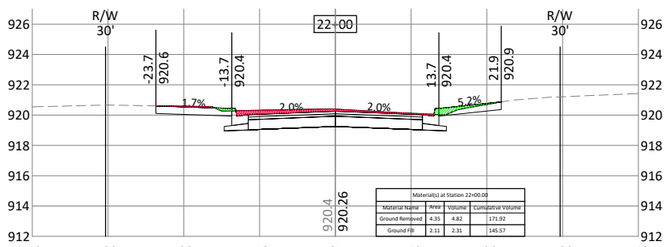

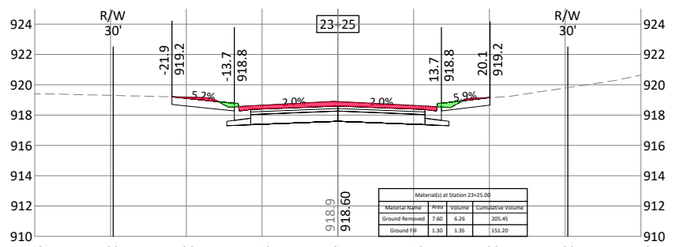

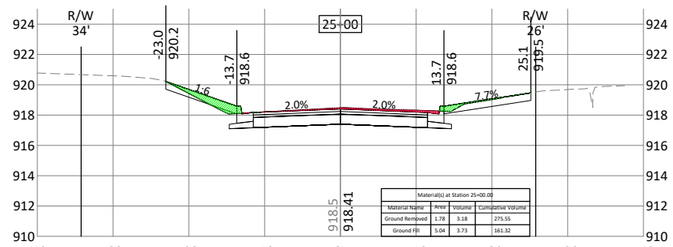

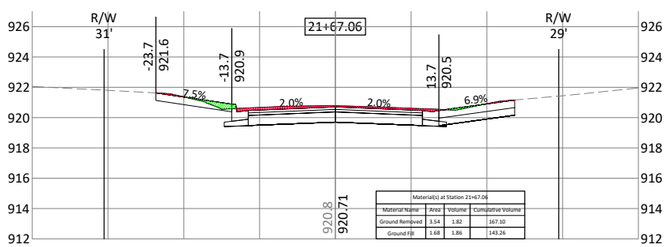

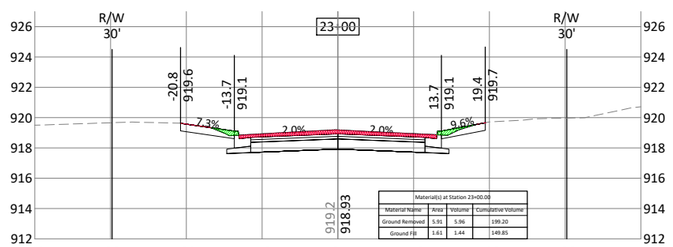

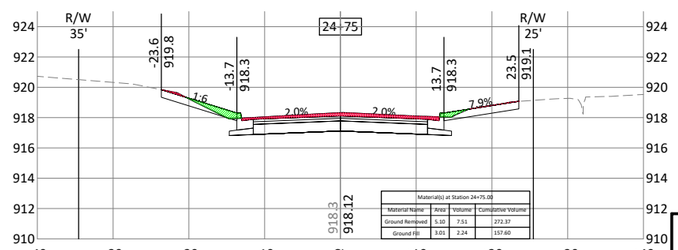

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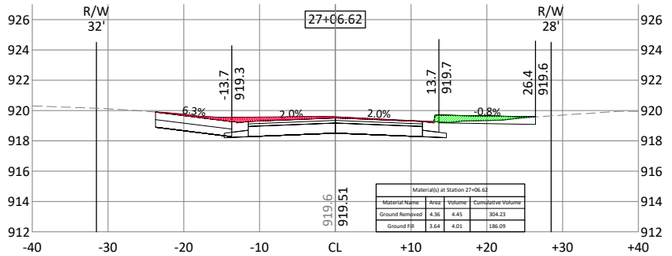
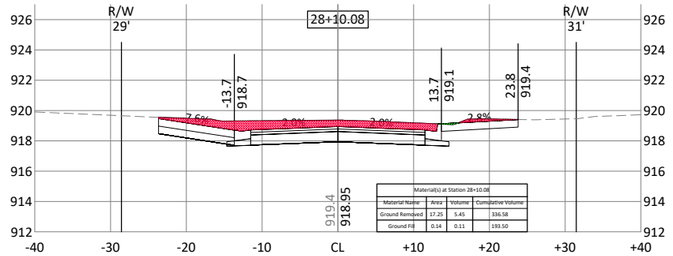
DESIGNED MH/CB/LW
DRAWN JB/JW
CHECKED NA/MW
CLIENT PROJ. NO. T19.118342

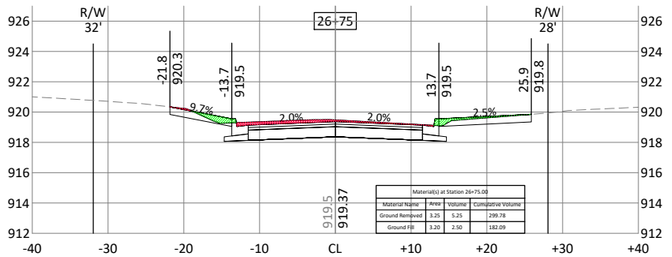
NO.	ISSUED FOR	DATE

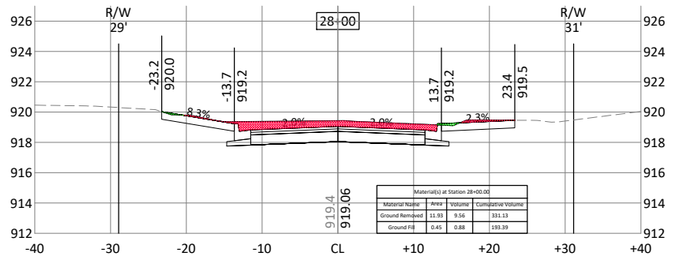
HOPKINS, MINNESOTA
INTERLACHEN PARK STREET & UTILITY IMPROVEMENTS
CROSS SECTIONS
ASHLEY ROAD

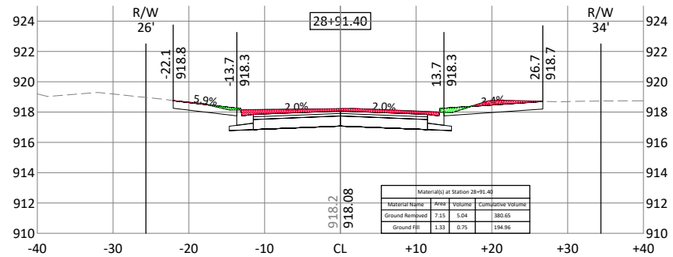
SHEET C9.10

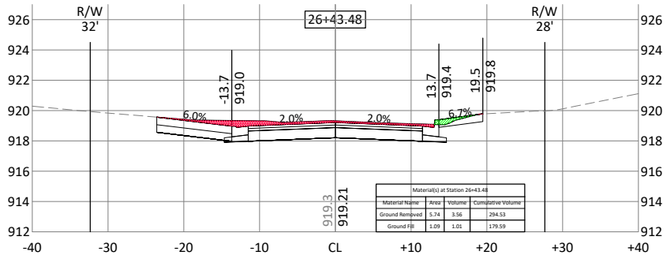


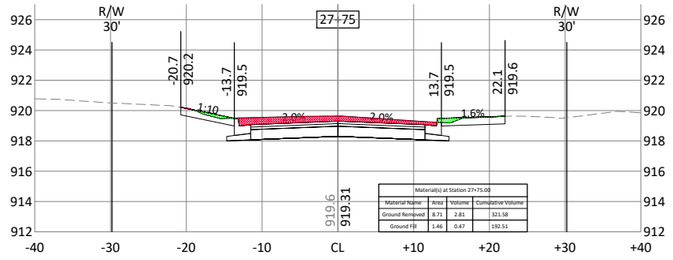


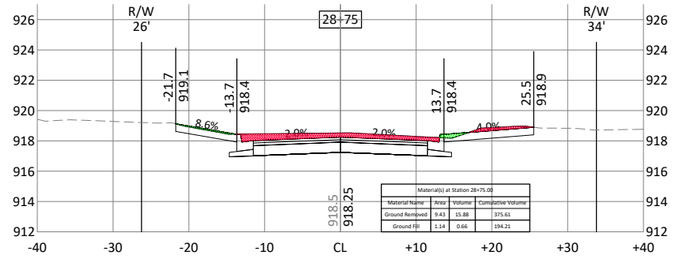


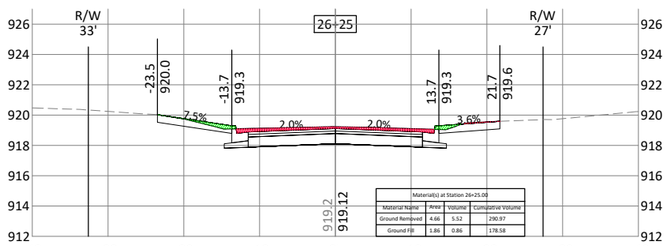


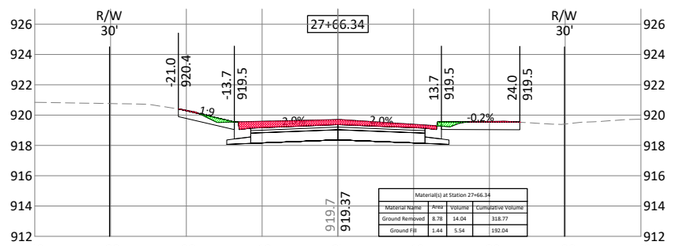


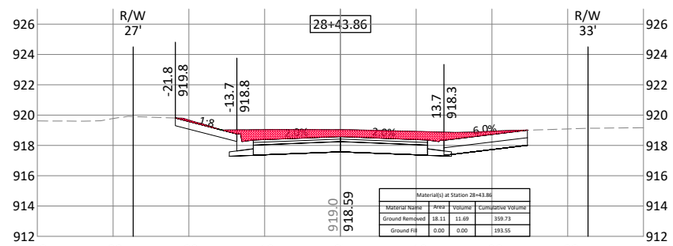


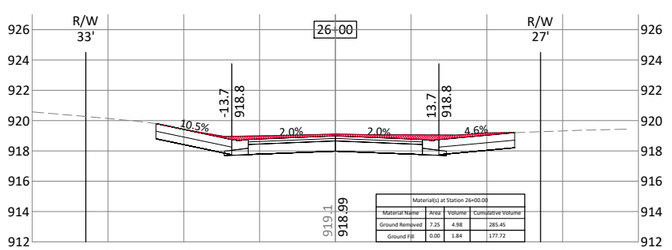


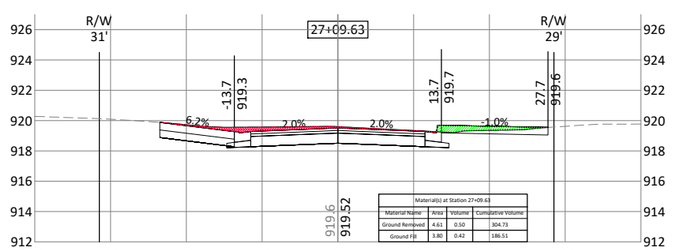


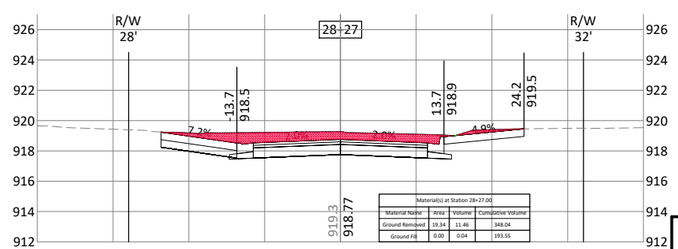












LEGEND:
= CUT VOLUME
= FILL VOLUME

HORZ. 0 10 20 SCALE FEET
VERT. 0 5 10 SCALE FEET

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

NICHOLAS J. AMATUCCIO
LIC. NO. 53639 DATE MM/DD/YYYY

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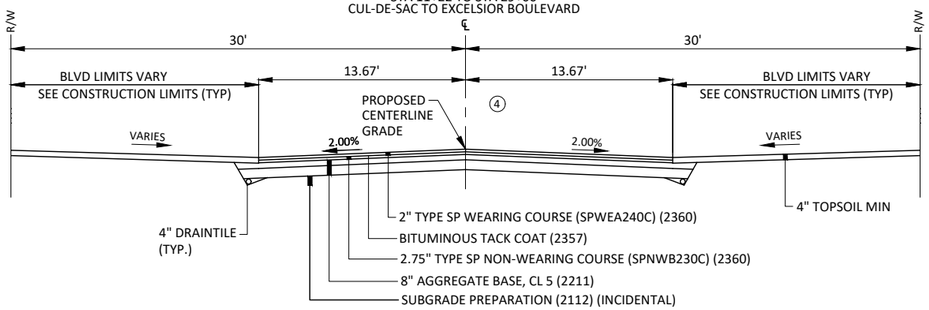
HOPKINS, MINNESOTA
INTERLACHEN PARK STREET & UTILITY IMPROVEMENTS
CROSS SECTIONS
ASHLEY ROAD

SHEET C9.11

TYPICAL SECTION - ASHLEY ROAD - NO CURB

STA 11+22 TO STA 29+00
CUL-DE-SAC TO EXCELSIOR BOULEVARD



TYPICAL SECTIONS ARE NOT TO SCALE

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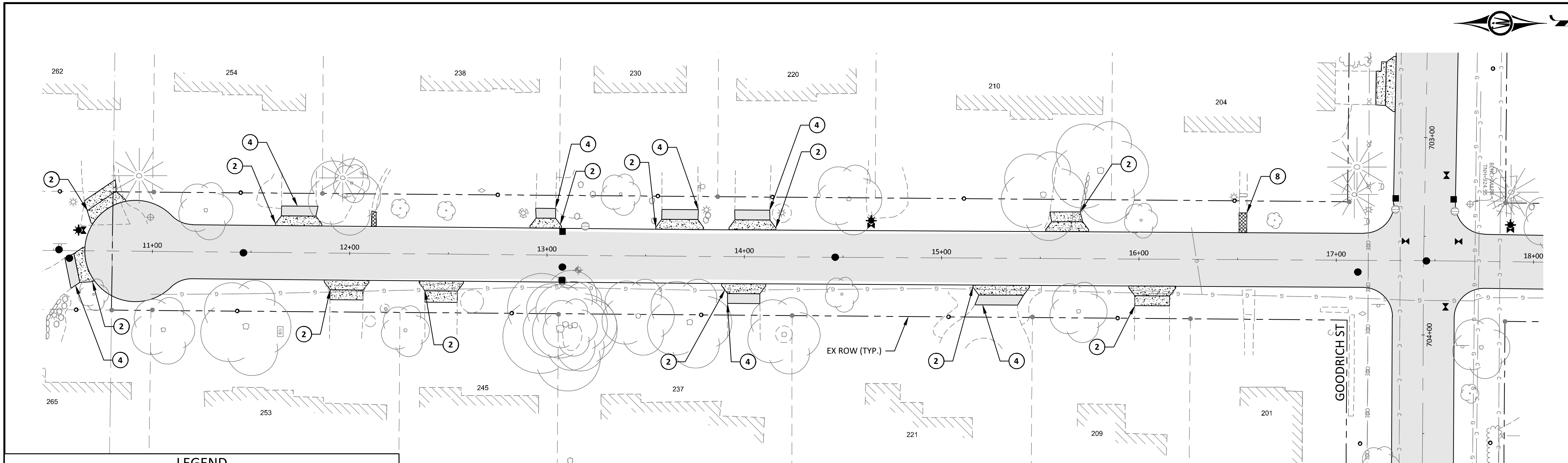
HOPKINS, MINNESOTA
INTERLACHEN PARK STREET & UTILITY IMPROVEMENTS
TYPICAL SECTION ASHLEY ROAD - NO CURB

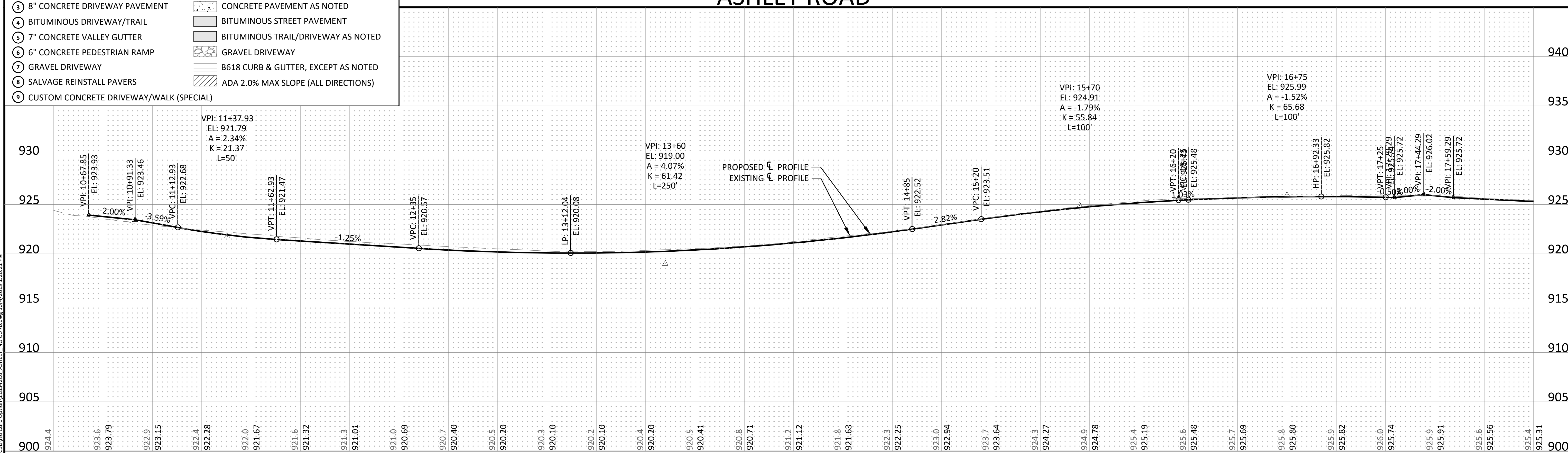
SHEET
C1.01



LEGEND

(1) 4" CONCRETE WALK	(10) R-1733 CASTING
(2) 6" CONCRETE DRIVEWAY PAVEMENT	(11) R-3067-V CASTING
(3) 8" CONCRETE DRIVEWAY PAVEMENT	CONCRETE PAVEMENT AS NOTED
(4) BITUMINOUS DRIVEWAY/TRAIL	BITUMINOUS STREET PAVEMENT
(5) 7" CONCRETE VALLEY GUTTER	BITUMINOUS TRAIL/DRIVEWAY AS NOTED
(6) 6" CONCRETE PEDESTRIAN RAMP	GRAVEL DRIVEWAY
(7) GRAVEL DRIVEWAY	B618 CURB & GUTTER, EXCEPT AS NOTED
(8) SALVAGE REINSTALL PAVERS	ADA 2.0% MAX SLOPE (ALL DIRECTIONS)
(9) CUSTOM CONCRETE DRIVEWAY/WALK (SPECIAL)	

ASHLEY ROAD



HORZ. SCALE 0 25 50 FEET

VERT. SCALE 0 5 10 FEET

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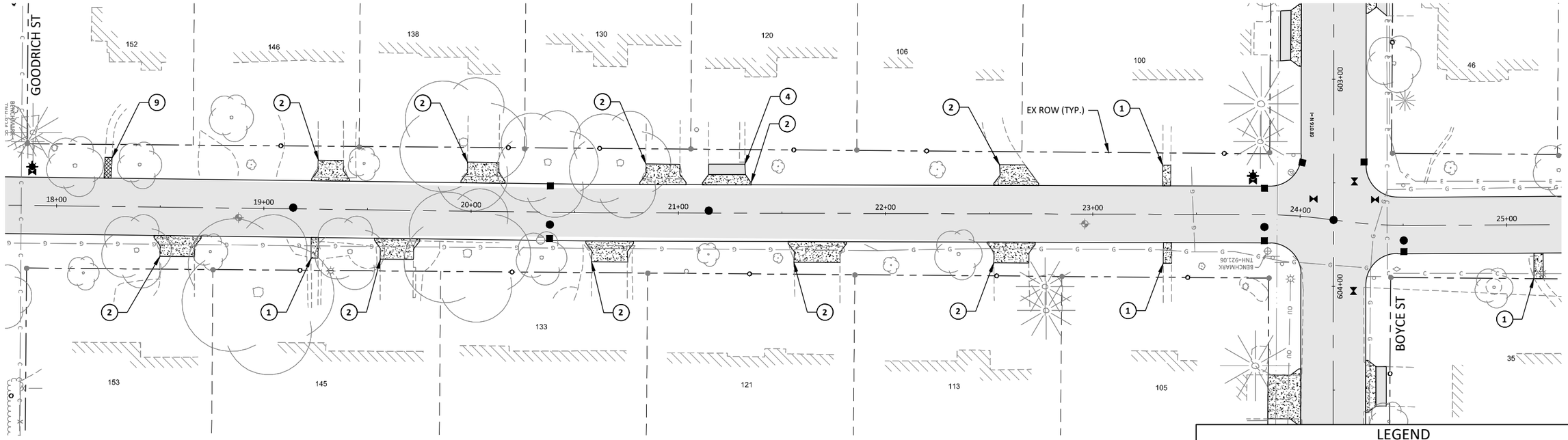
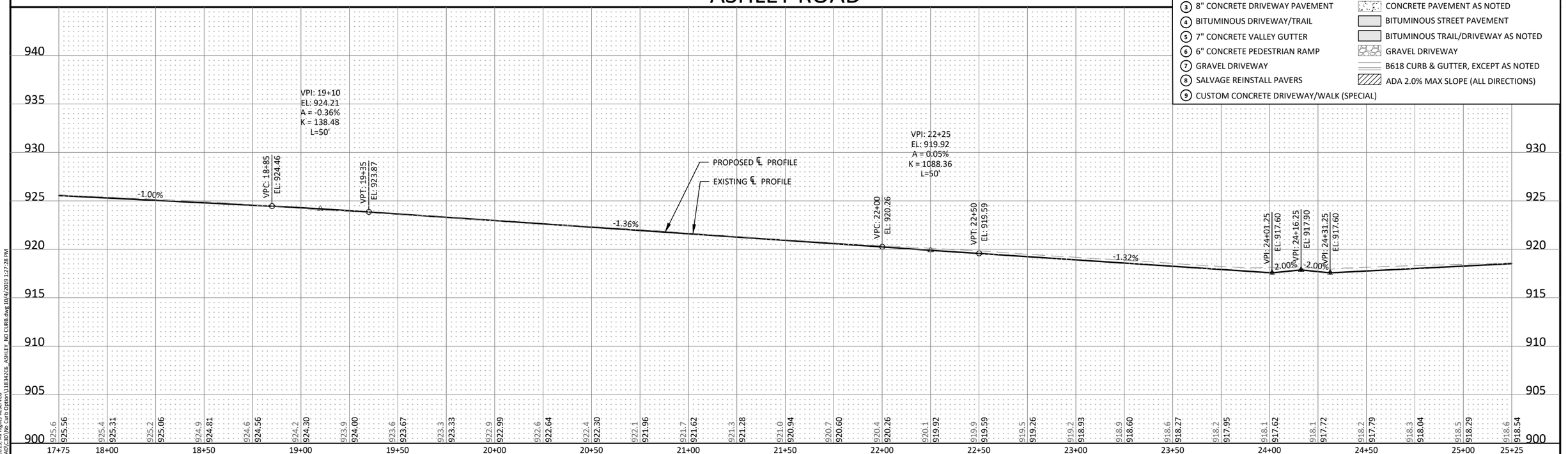
ASHLEY RD EXHIBITS
ASHLEY ROAD - NO CURB

SHEET C6.03



ASHLEY ROAD



LEGEND

(1) 4" CONCRETE WALK	(10) R-1733 CASTING
(2) 6" CONCRETE DRIVEWAY PAVEMENT	(11) R-3067-V CASTING
(3) 8" CONCRETE DRIVEWAY PAVEMENT	CONCRETE PAVEMENT AS NOTED
(4) BITUMINOUS DRIVEWAY/TRAIL	BITUMINOUS STREET PAVEMENT
(5) 7" CONCRETE VALLEY GUTTER	BITUMINOUS TRAIL/DRIVEWAY AS NOTED
(6) 6" CONCRETE PEDESTRIAN RAMP	GRAVEL DRIVEWAY
(7) GRAVEL DRIVEWAY	B618 CURB & GUTTER, EXCEPT AS NOTED
(8) SALVAGE REINSTALL PAVERS	ADA 2.0% MAX SLOPE (ALL DIRECTIONS)
(9) CUSTOM CONCRETE DRIVEWAY/WALK (SPECIAL)	

HORZ. 0 25 50 SCALE FEET

VERT. 0 5 10 SCALE FEET

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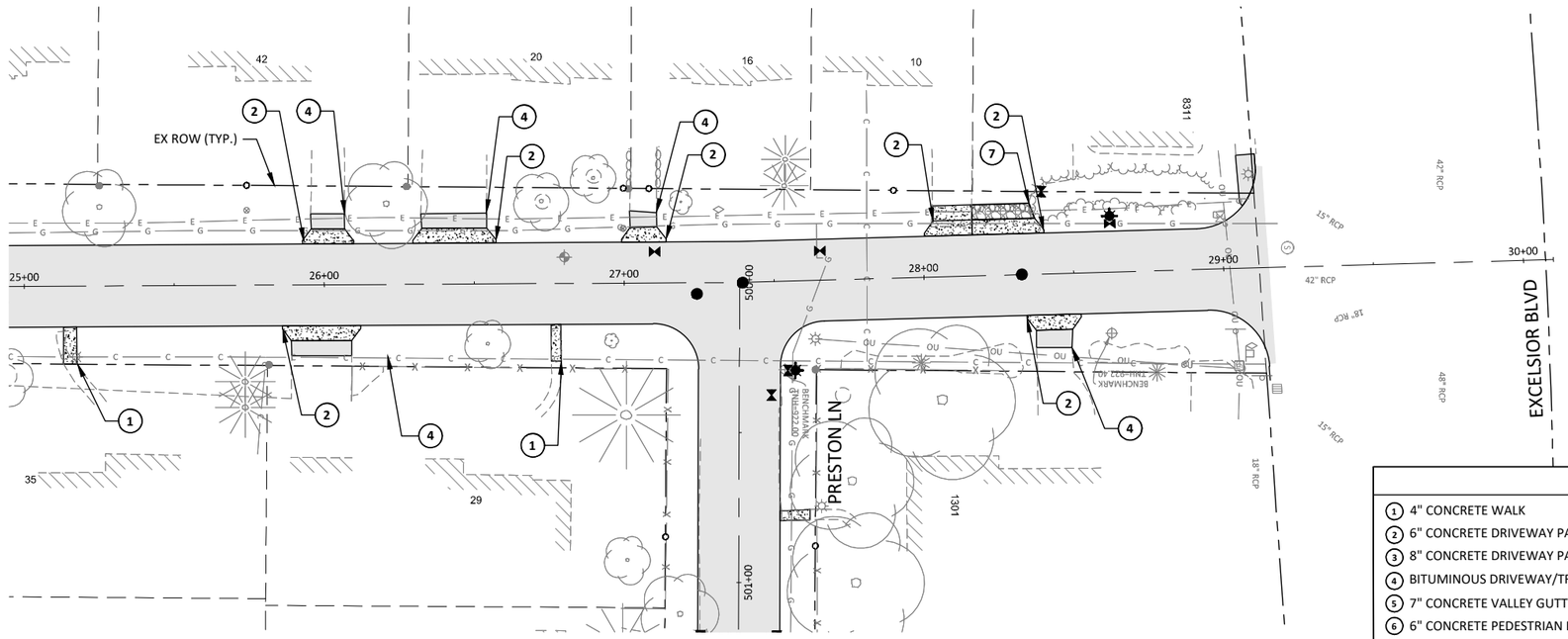
ASHLEY RD EXHIBITS
ASHLEY ROAD - NO CURB

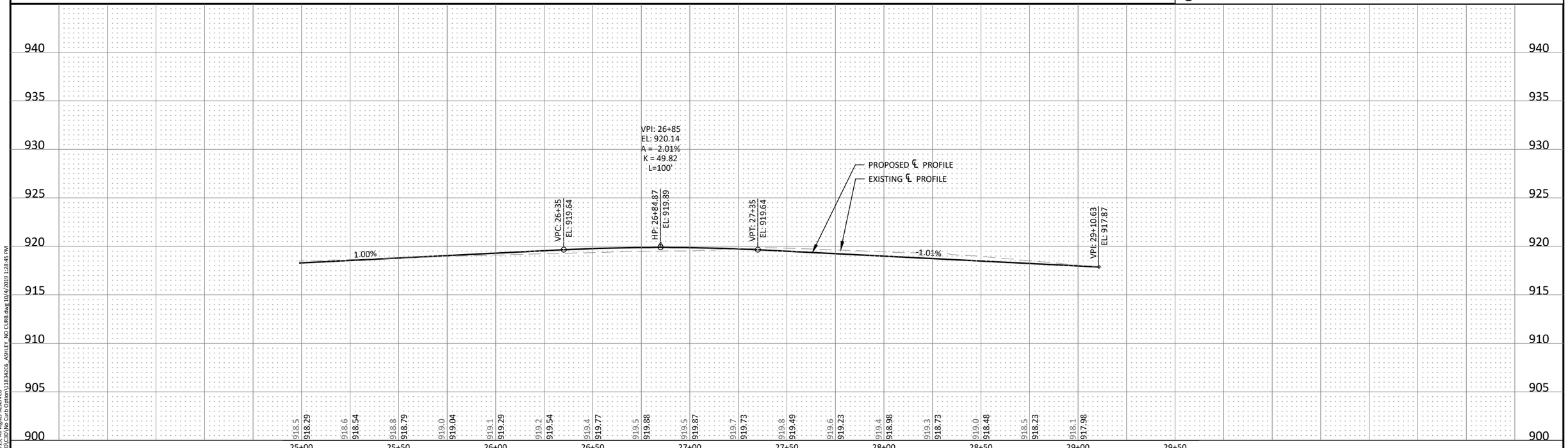
SHEET C6.04



ASHLEY ROAD

LEGEND

1 4" CONCRETE WALK	10 R-1733 CASTING
2 6" CONCRETE DRIVEWAY PAVEMENT	11 R-3067-V CASTING
3 8" CONCRETE DRIVEWAY PAVEMENT	CONCRETE PAVEMENT AS NOTED
4 BITUMINOUS DRIVEWAY/TRAIL	BITUMINOUS STREET PAVEMENT
5 7" CONCRETE VALLEY GUTTER	BITUMINOUS TRAIL/DRIVEWAY AS NOTED
6 6" CONCRETE PEDESTRIAN RAMP	GRAVEL DRIVEWAY
7 GRAVEL DRIVEWAY	B618 CURB & GUTTER, EXCEPT AS NOTED
8 SALVAGE REINSTALL PAVERS	ADA 2.0% MAX SLOPE (ALL DIRECTIONS)
9 CUSTOM CONCRETE DRIVEWAY/WALK (SPECIAL)	



HORZ. 0 25 50 SCALE FEET

VERT. 0 5 10 SCALE FEET

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ASHLEY RD EXHIBITS
ASHLEY ROAD - NO CURB

SHEET C6.05

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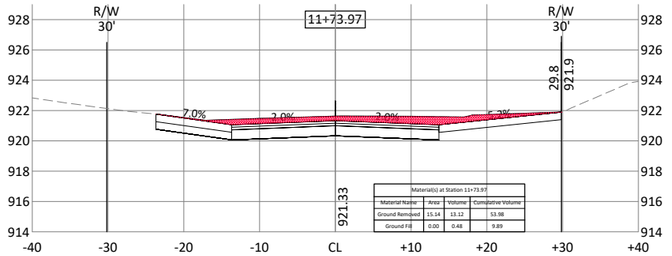

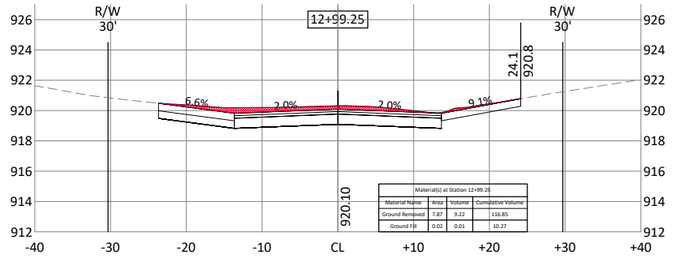

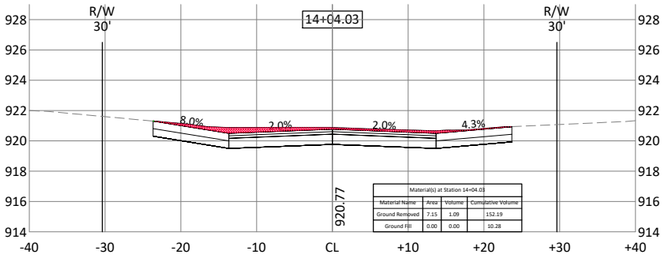

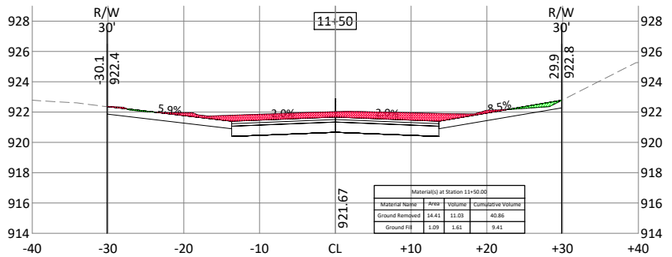

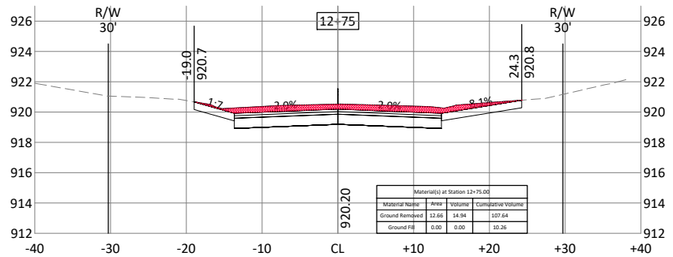

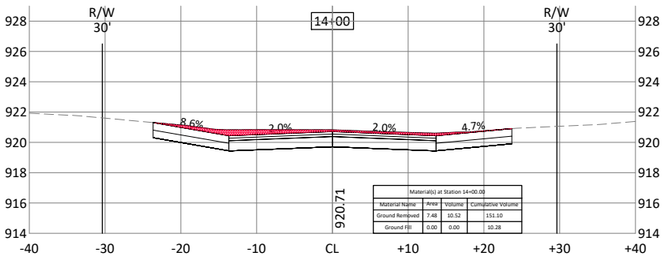

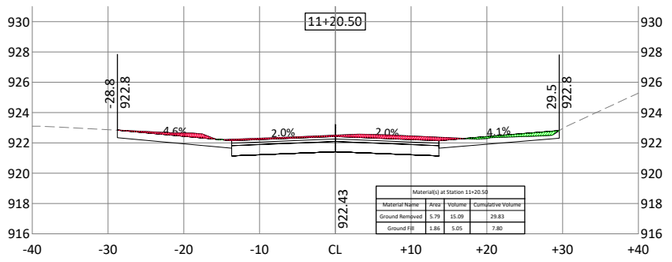

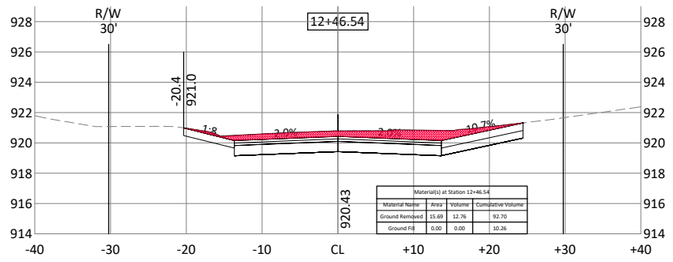

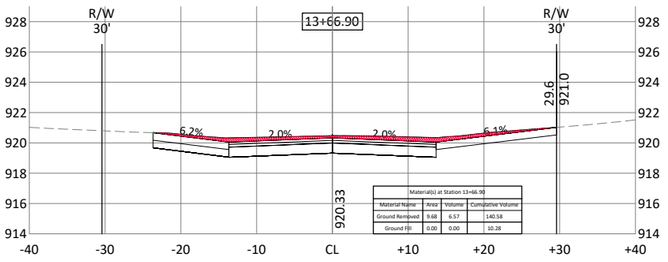

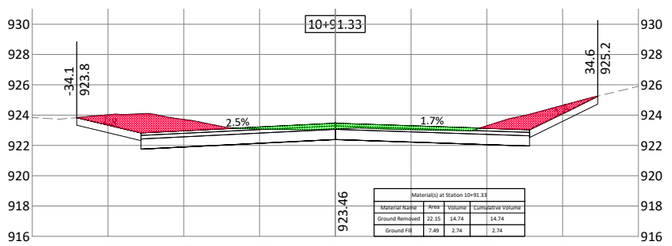

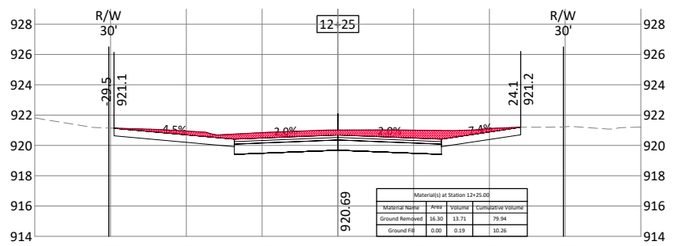

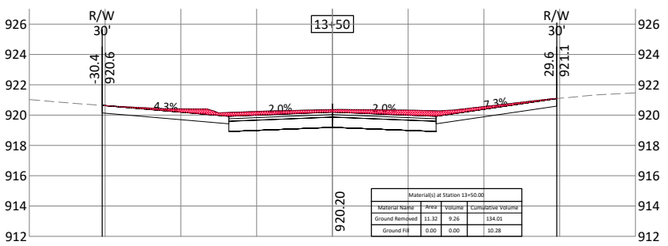

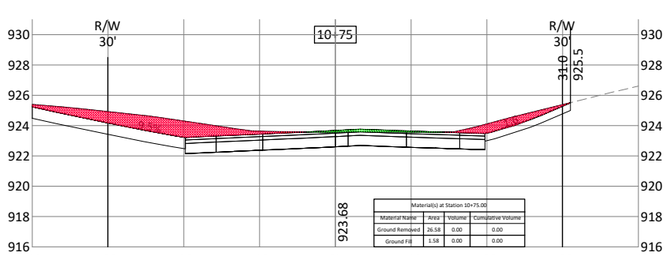

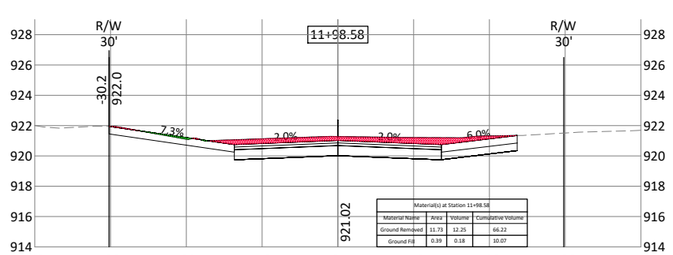

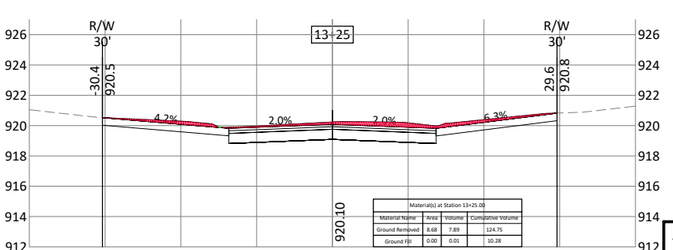

LEGEND:
= CUT VOLUME
= FILL VOLUME

HORZ. 0 10 20 SCALE FEET
VERT. 0 5 10 SCALE FEET

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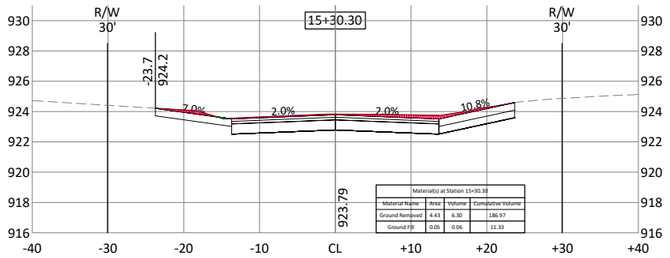
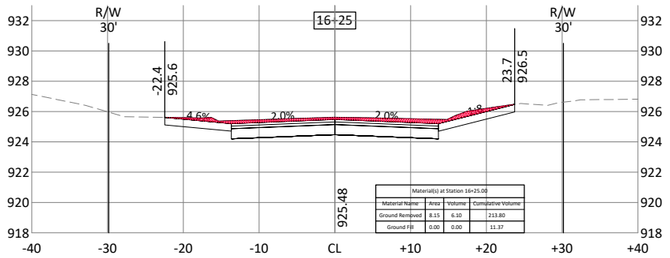
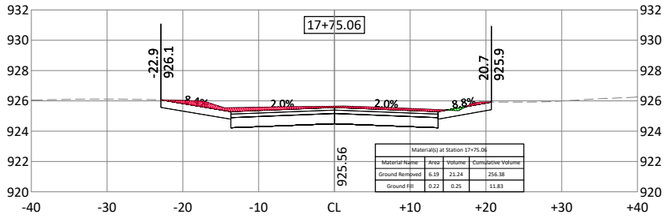
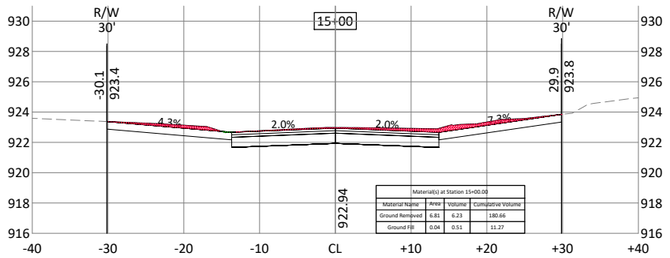
ASHLEY RD EXHIBITS
ASHLEY ROAD - NO CURB

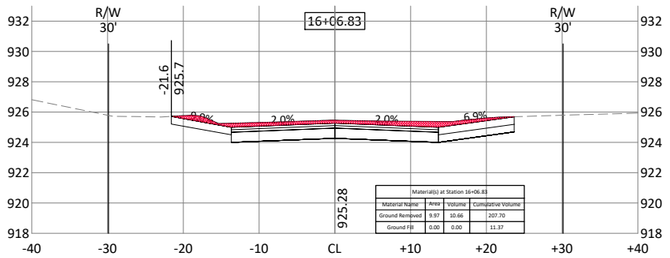
SHEET C9.07

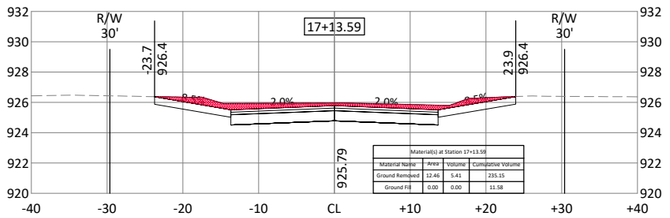


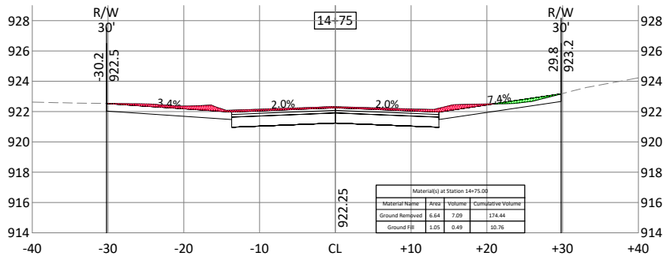


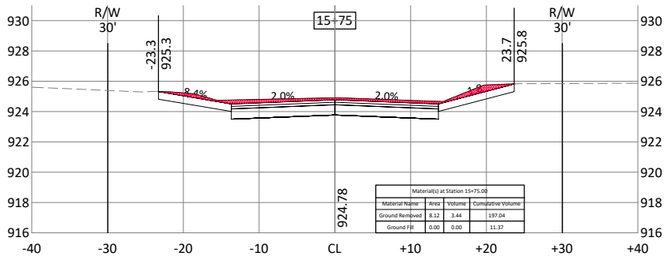


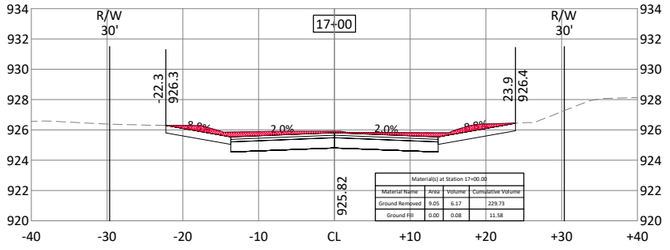


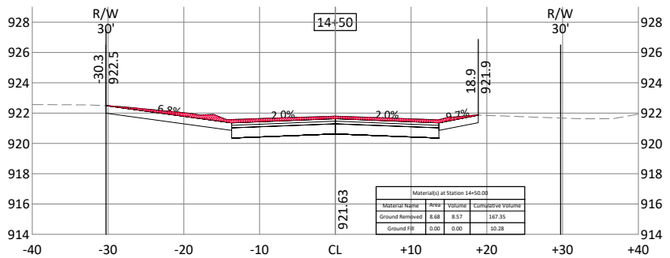


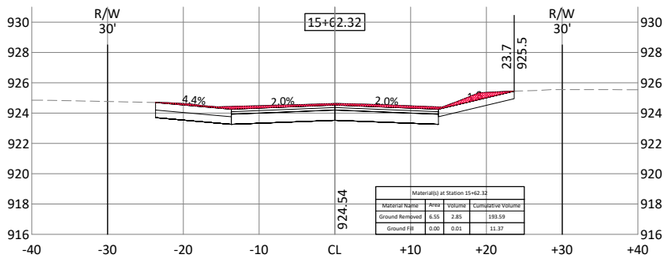


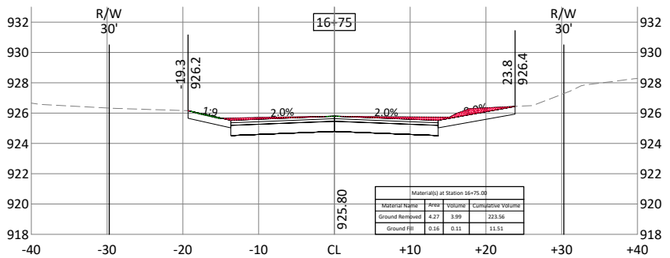


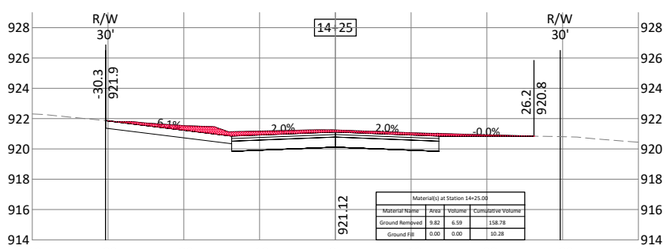


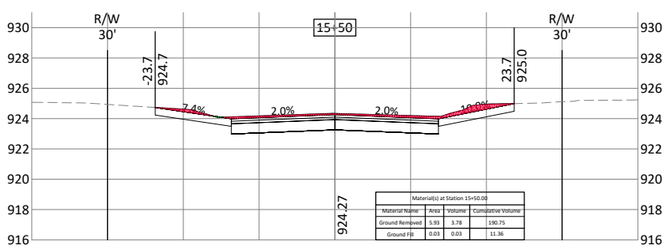


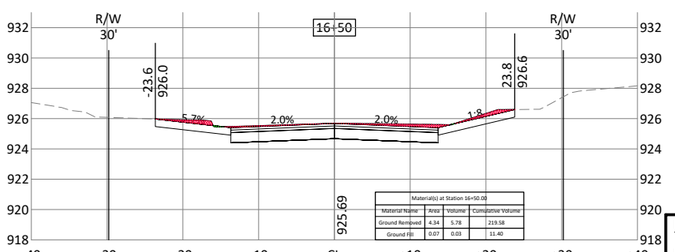












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= FILL VOLUME

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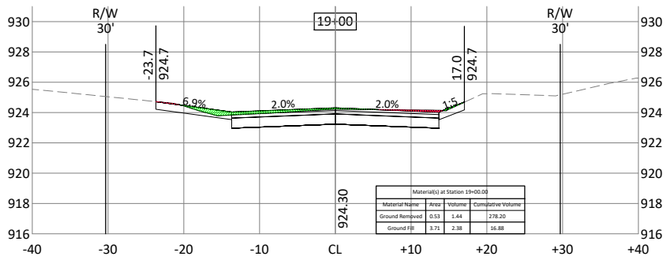
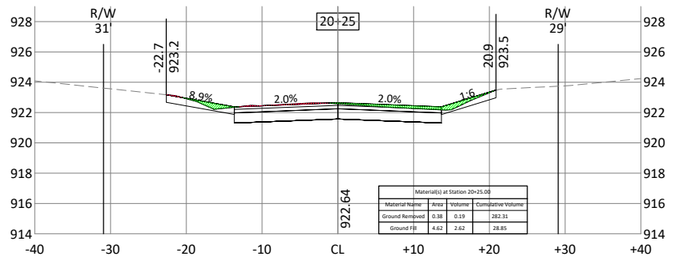
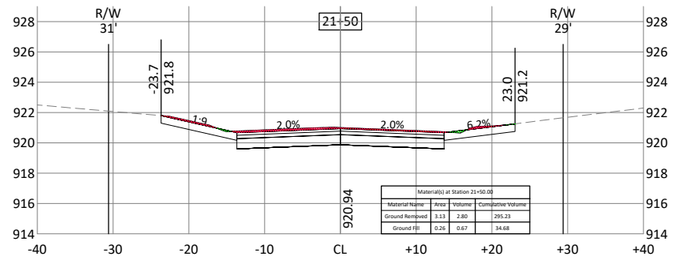
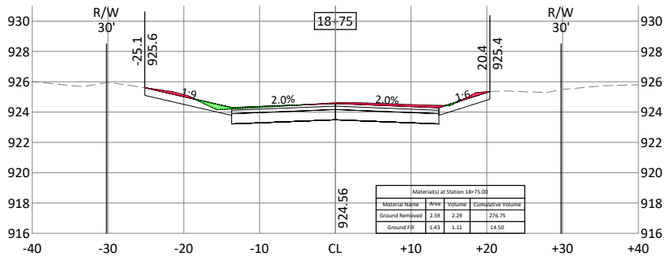
ASHLEY RD EXHIBITS
ASHLEY ROAD - NO CURB

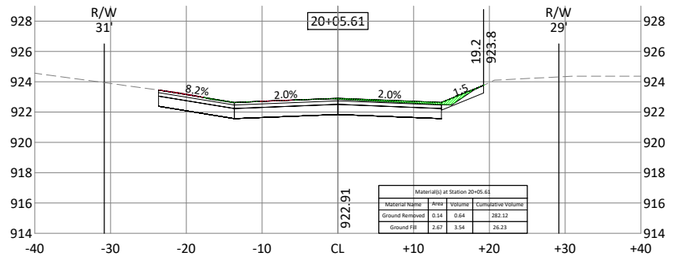
SHEET C9.08

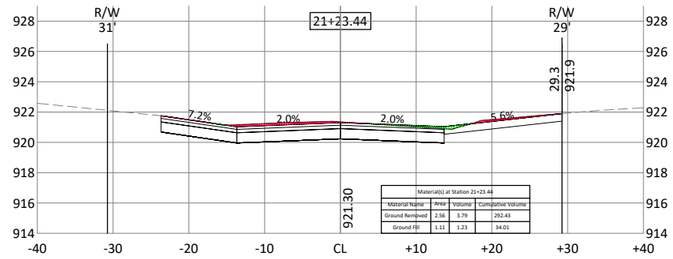


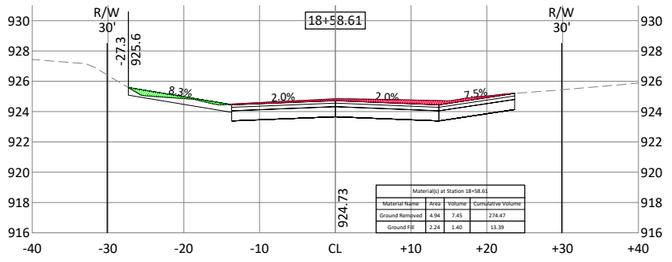


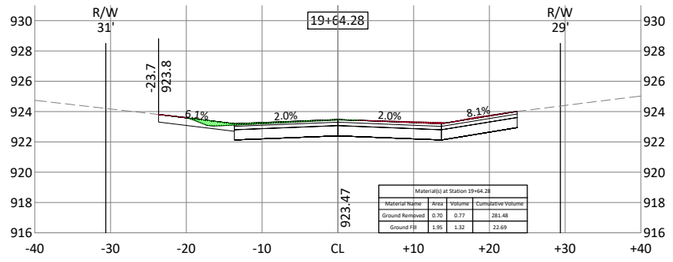


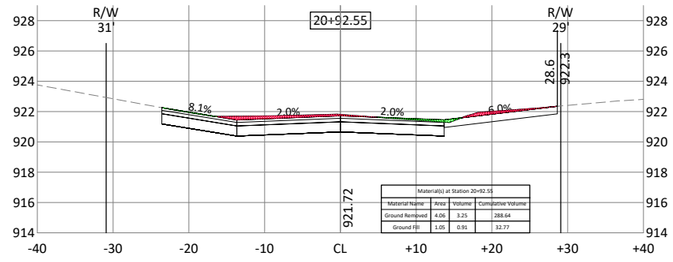


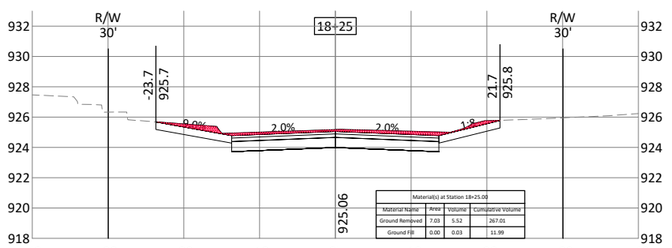


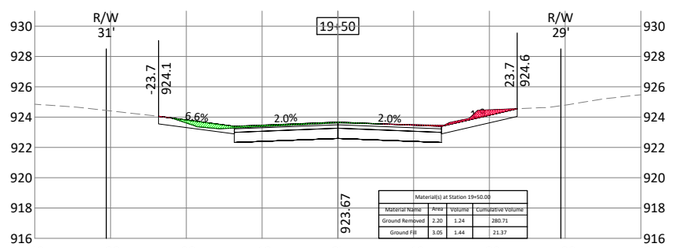


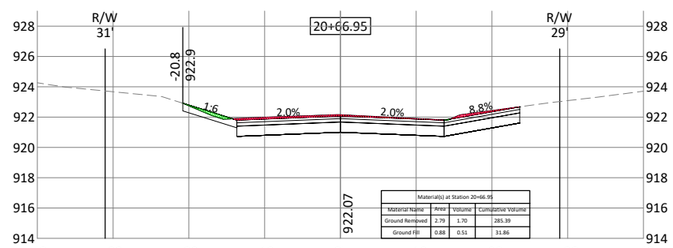


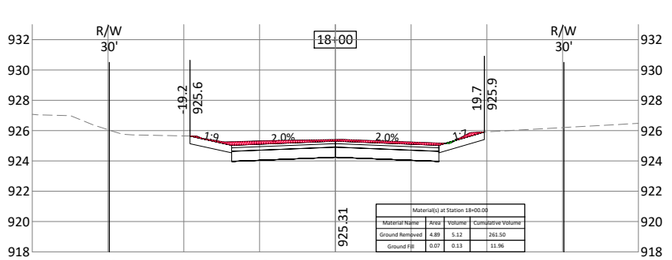


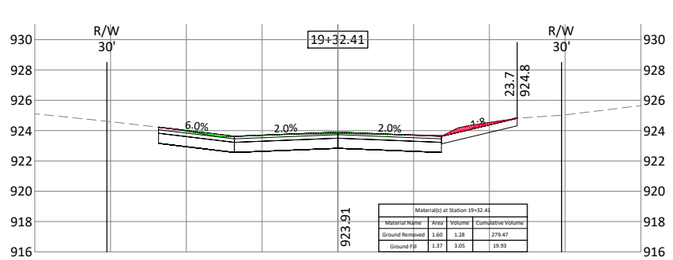


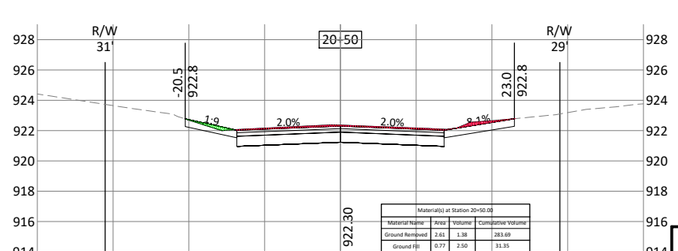












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= FILL VOLUME

HORZ. 0 10 20 SCALE FEET
VERT. 0 5 10 SCALE FEET

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LIC. NO. 53639 DATE MM/DD/YYYY

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DRAWN	JB/JW
CHECKED	NA/MW
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NO.	ISSUED FOR	DATE

HOPKINS, MINNESOTA
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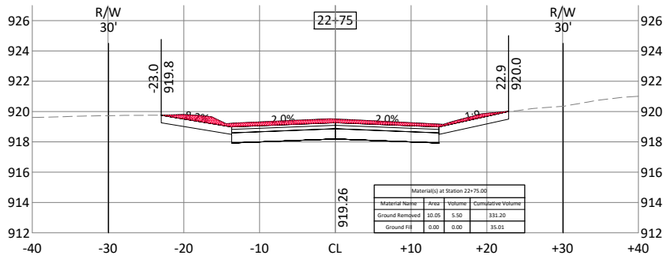
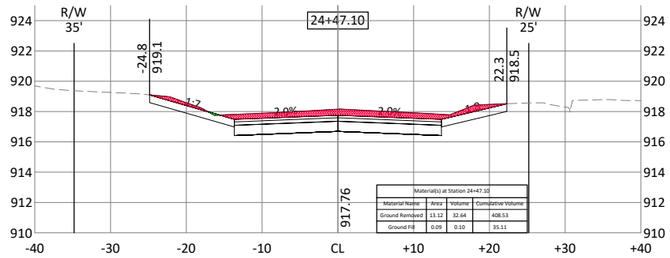
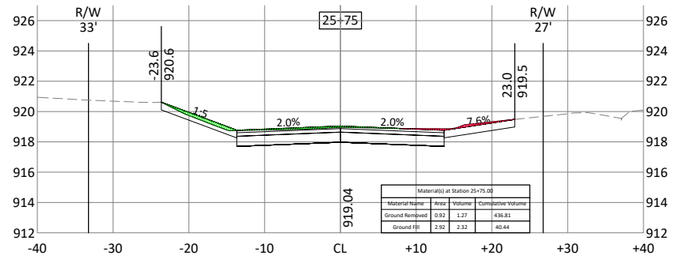
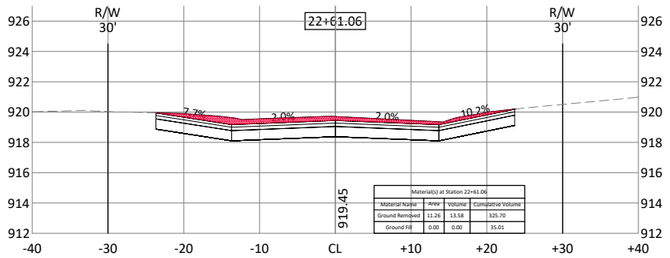
ASHLEY RD EXHIBITS
ASHLEY ROAD - NO CURB

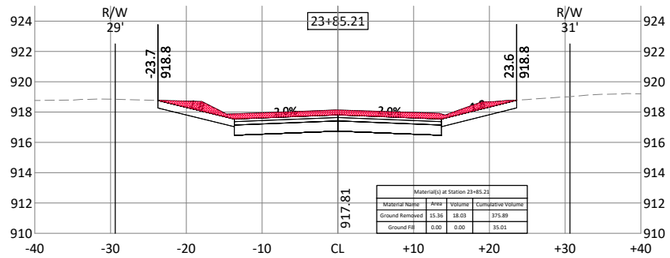
SHEET C9.09

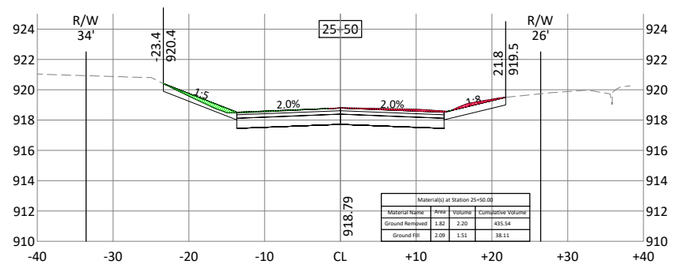


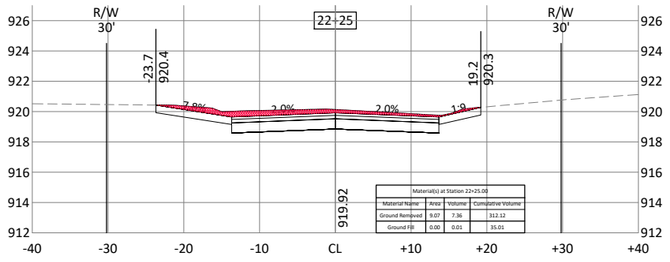


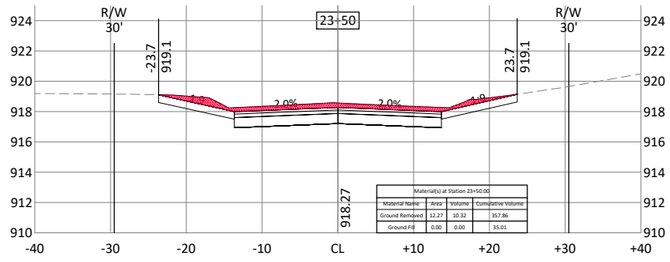


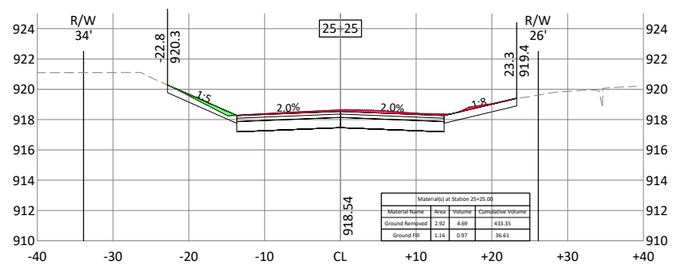


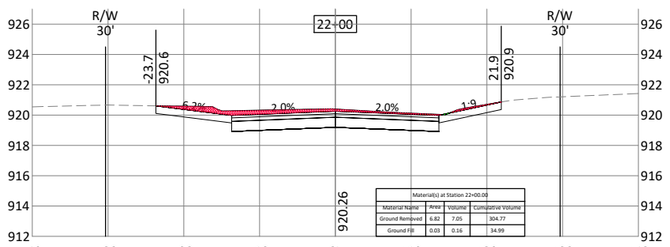


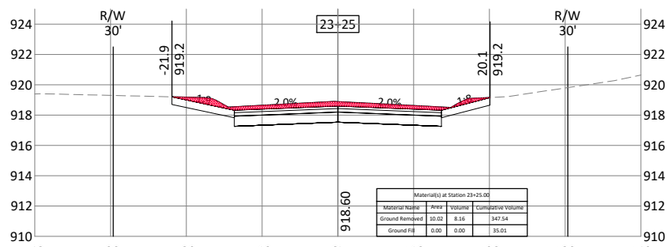


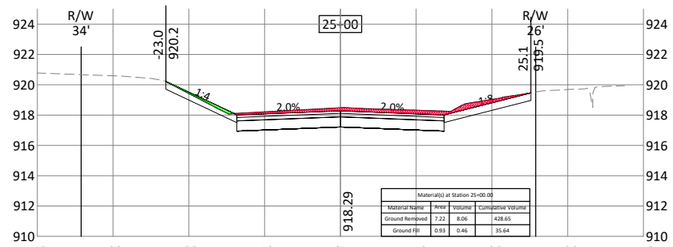


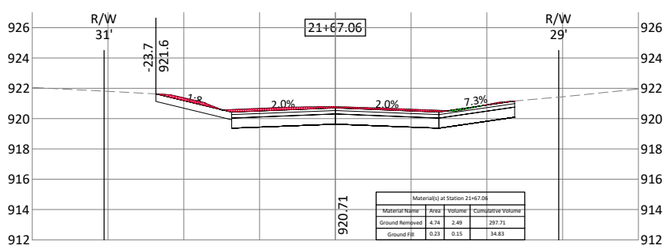


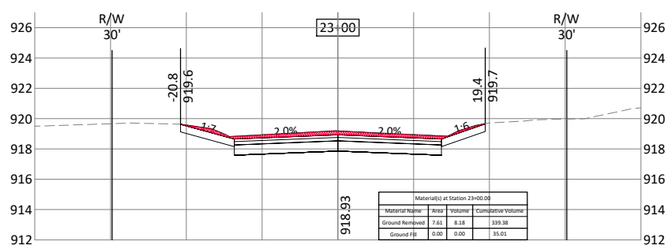


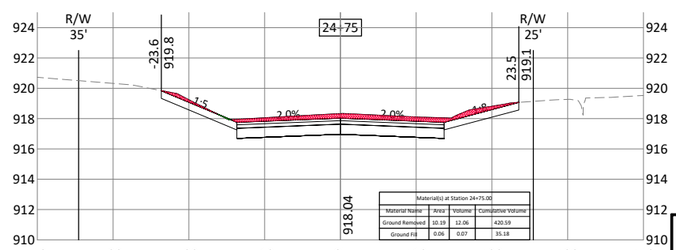












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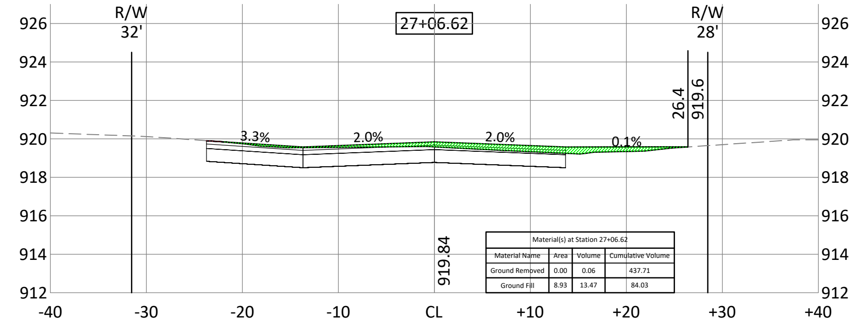
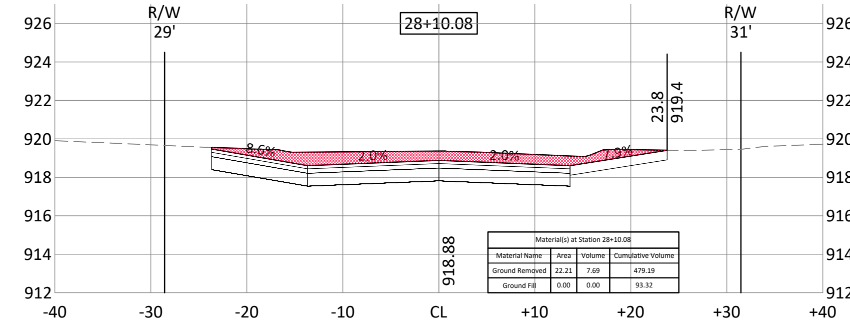
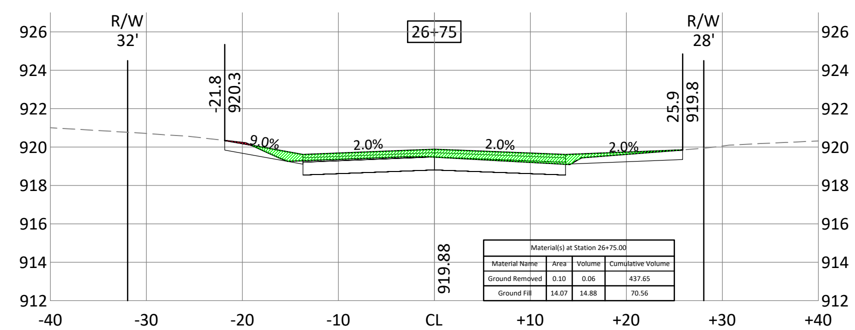
SHEET C9.10



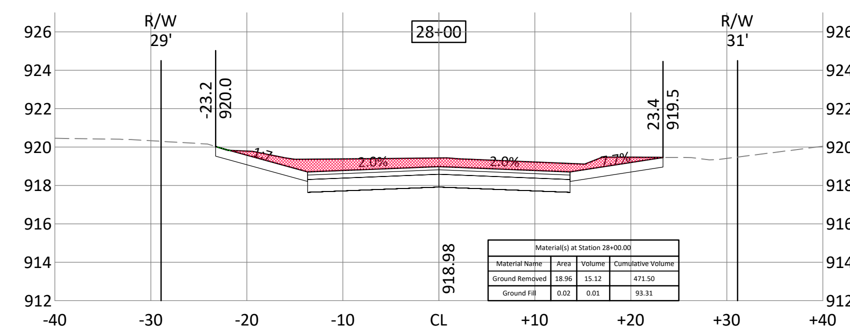
Material(s) at Station 27+06.62			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	0.00	0.06	437.71
Ground Fill	8.93	13.47	84.03



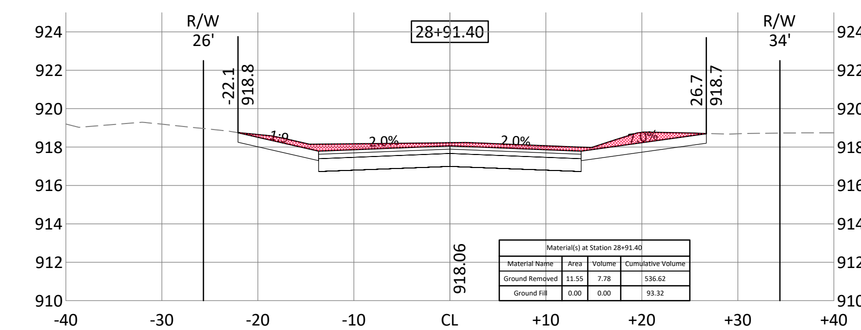
Material(s) at Station 28+10.08			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	22.21	7.69	479.19
Ground Fill	0.00	0.00	93.32



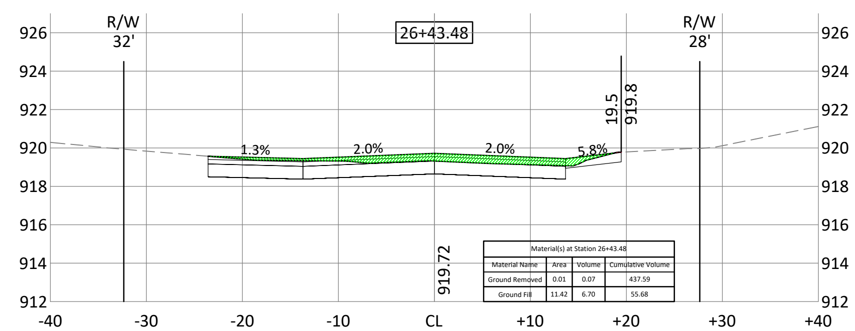
Material(s) at Station 26+75.00			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	0.10	0.06	437.65
Ground Fill	14.07	14.88	70.56



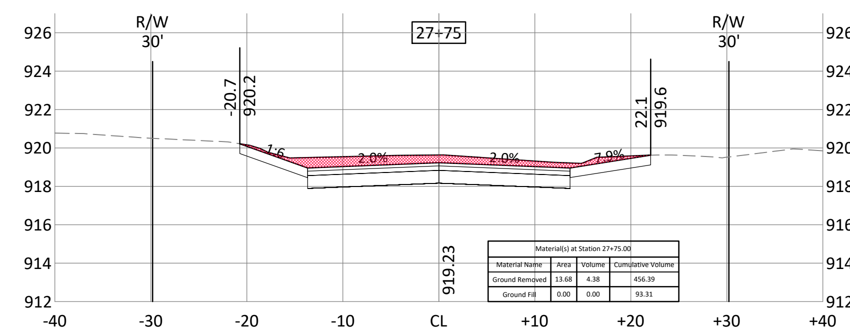
Material(s) at Station 28+00.00			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	18.96	15.12	471.50
Ground Fill	0.02	0.01	93.31



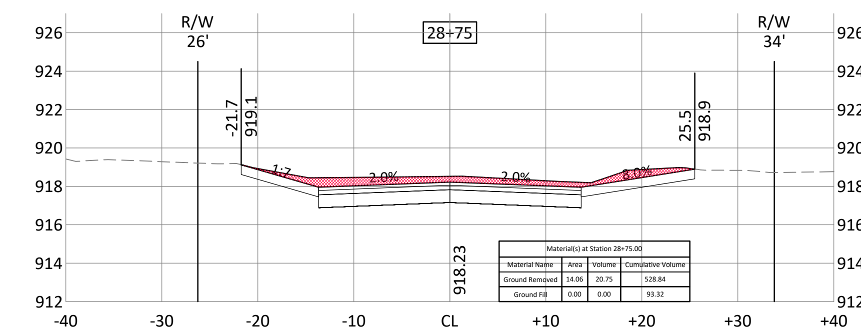
Material(s) at Station 28+91.40			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	11.55	7.78	536.62
Ground Fill	0.00	0.00	93.32



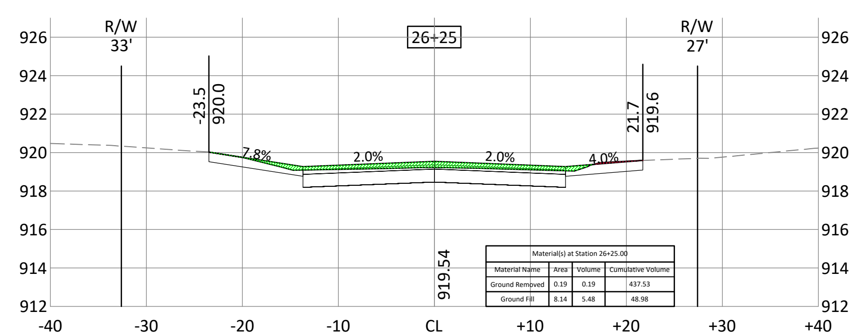
Material(s) at Station 26+43.48			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	0.01	0.07	437.59
Ground Fill	11.42	6.70	55.68



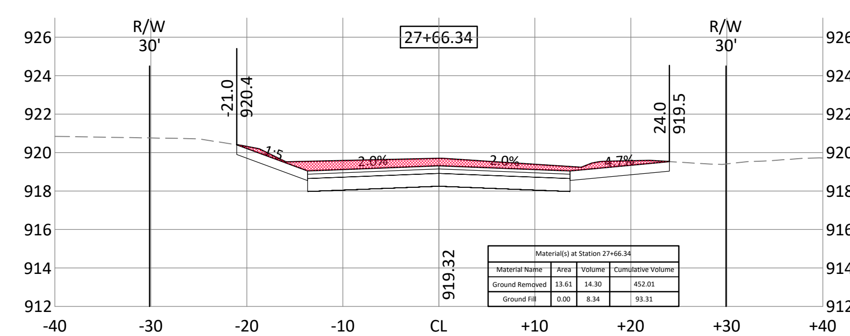
Material(s) at Station 27+75.00			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	13.68	4.38	456.39
Ground Fill	0.00	0.00	93.31



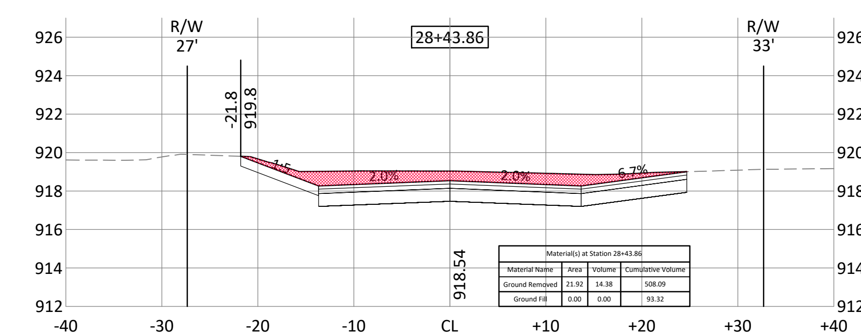
Material(s) at Station 28+75.00			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	14.06	20.75	528.84
Ground Fill	0.00	0.00	93.32



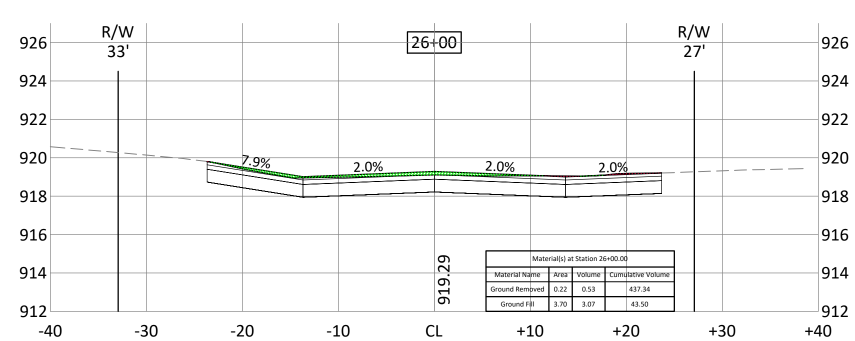
Material(s) at Station 26+25.00			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	0.19	0.19	437.53
Ground Fill	8.14	5.48	48.98



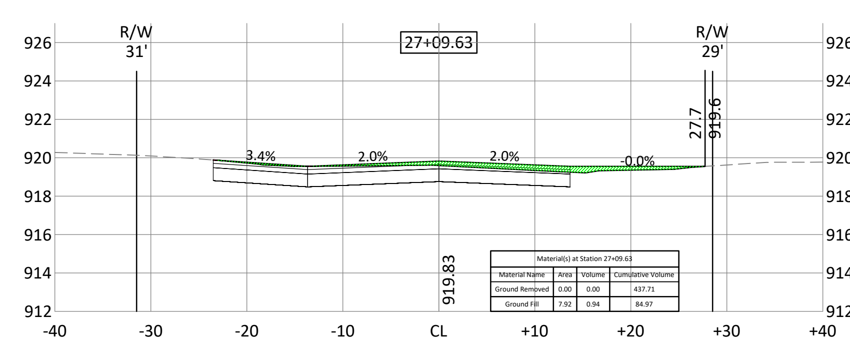
Material(s) at Station 27+66.34			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	13.61	14.30	452.01
Ground Fill	0.00	8.34	93.31



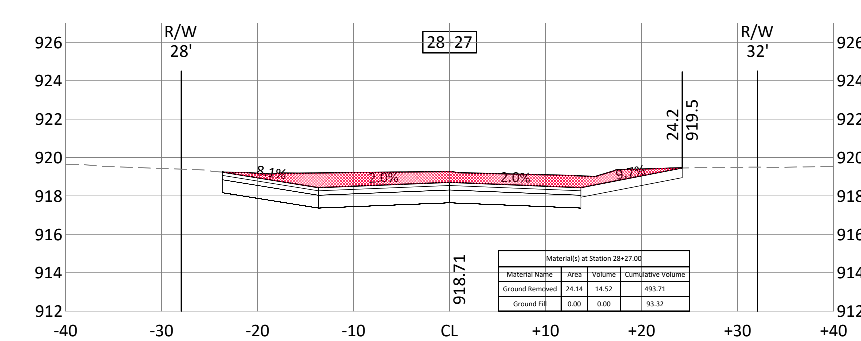
Material(s) at Station 28+43.86			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	21.92	14.38	508.09
Ground Fill	0.00	0.00	93.32



Material(s) at Station 26+00.00			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	0.22	0.53	437.34
Ground Fill	3.70	3.07	43.50



Material(s) at Station 27+09.63			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	0.00	0.00	437.71
Ground Fill	7.92	0.94	84.97



Material(s) at Station 28+27.00			
Material Name	Area	Volume	Cumulative Volume
Ground Removed	24.14	14.52	493.71
Ground Fill	0.00	0.00	93.32

LEGEND:
- = CUT VOLUME
- = FILL VOLUME

HORZ. SCALE 0 10 20 FEET

VERT. SCALE 0 5 10 FEET

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

NICHOLAS J. AMATUCCIO

LIC. NO. 53639 DATE MM/DD/YYYY

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www.bolton-menk.com

DESIGNED MH/CB/LW
DRAWN JB/JW
CHECKED NA/MW
CLIENT PROJ. NO. T19.118342

NO.	ISSUED FOR	DATE

HOPKINS, MINNESOTA

INTERLACHEN PARK STREET & UTILITY IMPROVEMENTS

ASHLEY RD EXHIBITS

ASHLEY ROAD - NO CURB

SHEET C9.11

Appendix E: Interlachen Park Maintenance History

INTERLACHEN MAINTENANCE HISTORY

INTERLACHEN PARK STREET & UTILITY IMPROVEMENTS
CITY OF HOPKINS, MN
BMI PROJECT NO. T19.118342

	STREET & MAINTENANCE TYPE										
YEAR	ASHLEY RD	BOYCE ST	GOODRICH ST	HAWTHORNE RD	HOLLY RD	HOMEDALE RD	INTERLACHEN RD	MAPLE HILL RD	MEADOWBROOK RD	OAKWOOD RD	PRESTON LN
1977	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT
1978					OVERLAY						
1979										OVERLAY	
1980											OVERLAY
1981											
1982											
1983	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT
1984						OVERLAY			OVERLAY		
1985		OVERLAY					OVERLAY	OVERLAY			
1986											
1987			OVERLAY								
1988											
1989	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT & OVERLAY	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT
1990											
1991											
1992									FULL DEPTH PATCH		
1993											
1994											
1995											
1996		SEAL COAT	SEAL COAT	SEAL COAT		SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	
1997											
1998											
1999	OVERLAY				OVERLAY						OVERLAY & REHABILITATION
2000	CRACK SEAL										
2001											
2002	CRACK SEAL										CRACK SEAL
2003											
2004											
2005											
2006	CRACK SEAL & SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT	CRACK SEAL & SEAL COAT	SEAL COAT	SEAL COAT	SEAL COAT			CRACK SEAL & SEAL COAT
2007									SEAL COAT	SEAL COAT	
2008											
2009											
2010											
2011	CRACK SEAL				CRACK SEAL						CRACK SEAL

Services Provided:

Civil and Municipal Engineering
Water and Wastewater Engineering
Traffic and Transportation Engineering
Aviation Planning and Engineering
Water Resources Engineering
Coatings Inspection Services
Landscape Architecture Services
Surveying and Mapping
Geographic Information System Services

Funding Assistance

www.bolton-menk.com