

Cilent

Village of Lake Orion

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Geotechnical / Structural Engineer

G2 Consulting Group  
1866 Woodslee Street,  
Troy, Michigan 48083

Tel. (248) 680-0400  
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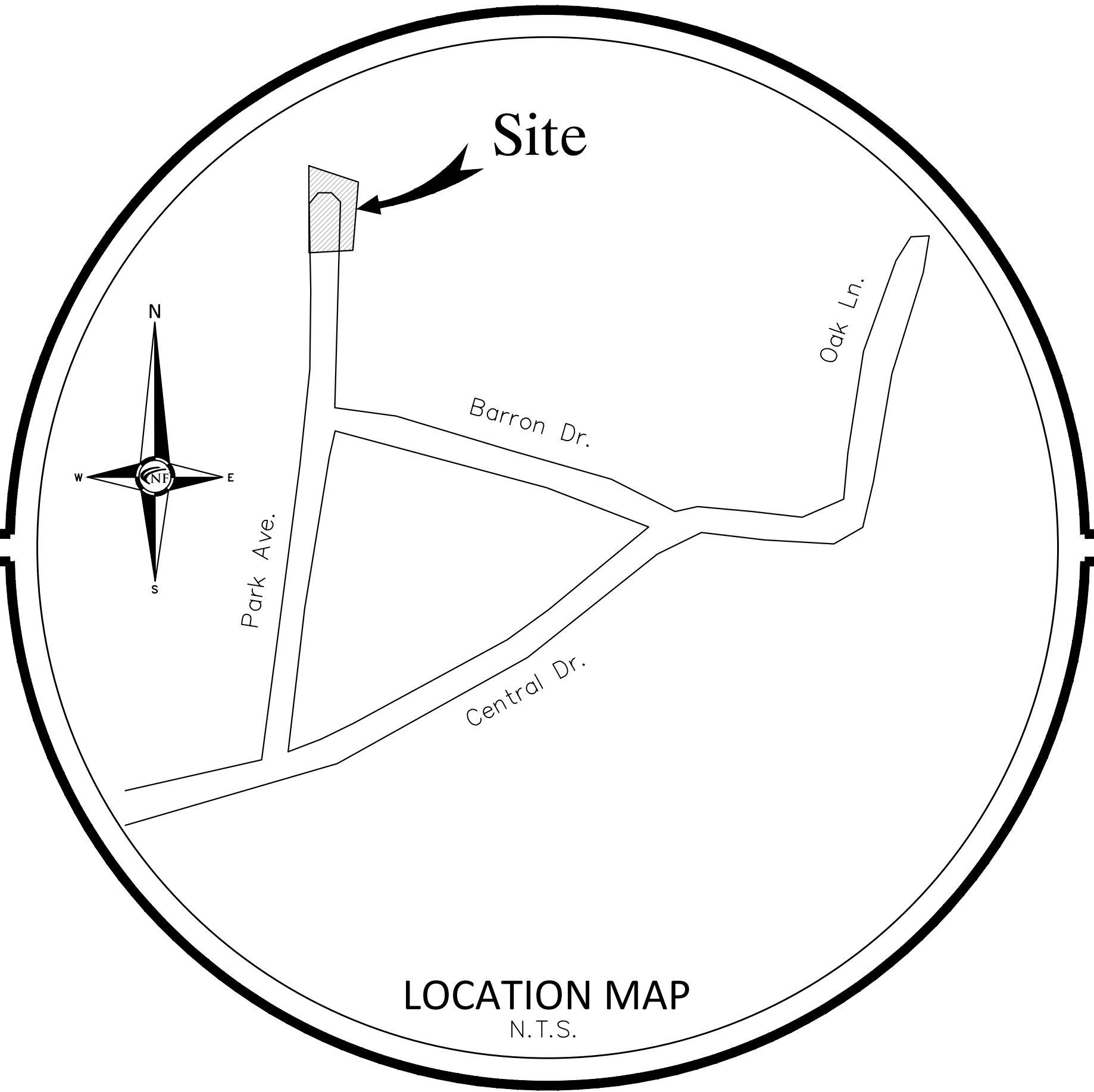
Civil Engineer

Nowak & Fraus Engineers  
48680 Van Dyke, Suite 200  
Shelby Twp., MI 48317

Tel. (586) 739-0939

Village of Lake Orion,  
CONSTRUCTION DOCUMENTS

PART OF THE SE 1/4 OF SECTION 3, T.4N, R.10E  
VILLAGE OF LAKE ORION,  
OAKLAND COUNTY, MICHIGAN



LEGAL DESCRIPTION

PROPERTY BOUNDARY SURVEY REQUIRED

NOWAK AND FRAUS, PLLC HAS COMPLETED A TOPOGRAPHICAL SURVEY FOR THE DESIGN OF THIS PROJECT. A BOUNDARY SURVEY IS REQUIRED PRIOR TO RELEASE FOR CONSTRUCTION TO IDENTIFY PROPERTY BOUNDARY AND R.O.W. LIMITS SO APPROVAL FOR CONSTRUCTION ON PRIVATE PROPERTY CAN BE ACQUIRED

ESTIMATED QUANTITIES

PAVING

DESCRIPTION	QUANTITY	UNITS
4" ASPHALT ON 6" 21AA AGGREGATE BASE	55	SY
GUARDRAIL	39	LF

STORM SEWER

DESCRIPTION	QUANTITY	UNITS
4" PERFORATED UNDERDRAIN (EXCLUDING RETAINING WALL UNDERDRAIN)	13	LF
NYLOPLAST DRAIN BASIN	1	EA
POP UP	1	EA

ALTERNATE PAVING

DESCRIPTION	QUANTITY	UNITS
COLD MILL HMA SURFACE	52	SY
HMA 5EML	52	SY
SUBGRADE UNDERCUT	2	CY

SHEET INDEX

C0	Cover Sheet
C1	Topographic
C2	Paving & Grading Plan
C3	Demolition Plan

G2 Consulting Group Plans:

1	Plan View
2	Elevation
3	Sections
4	Notes
5	Notes
6	Notes

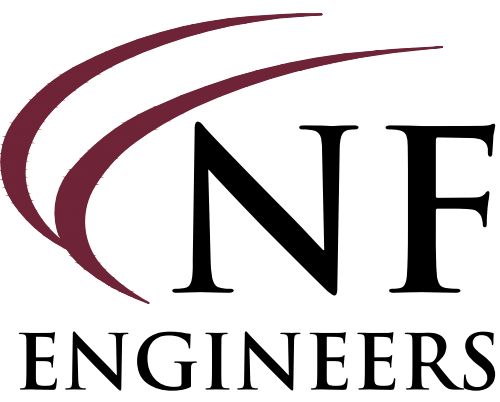
REVISIONS:

06-03-2024 ADDITIONAL GUARDRAIL  
07-05-2024 ALTERNATE PAVING - MILL AND RESURFACE  
07-08-2024 ISSUE FOR BID

Park Avenue Retaining  
Wall Replacement



N & F JOB #M718

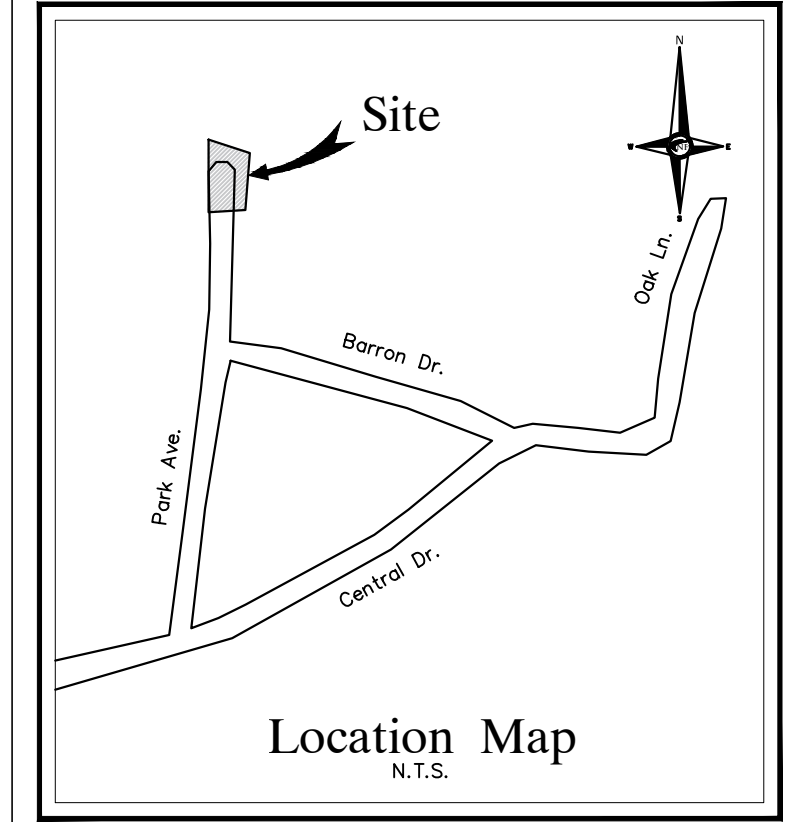
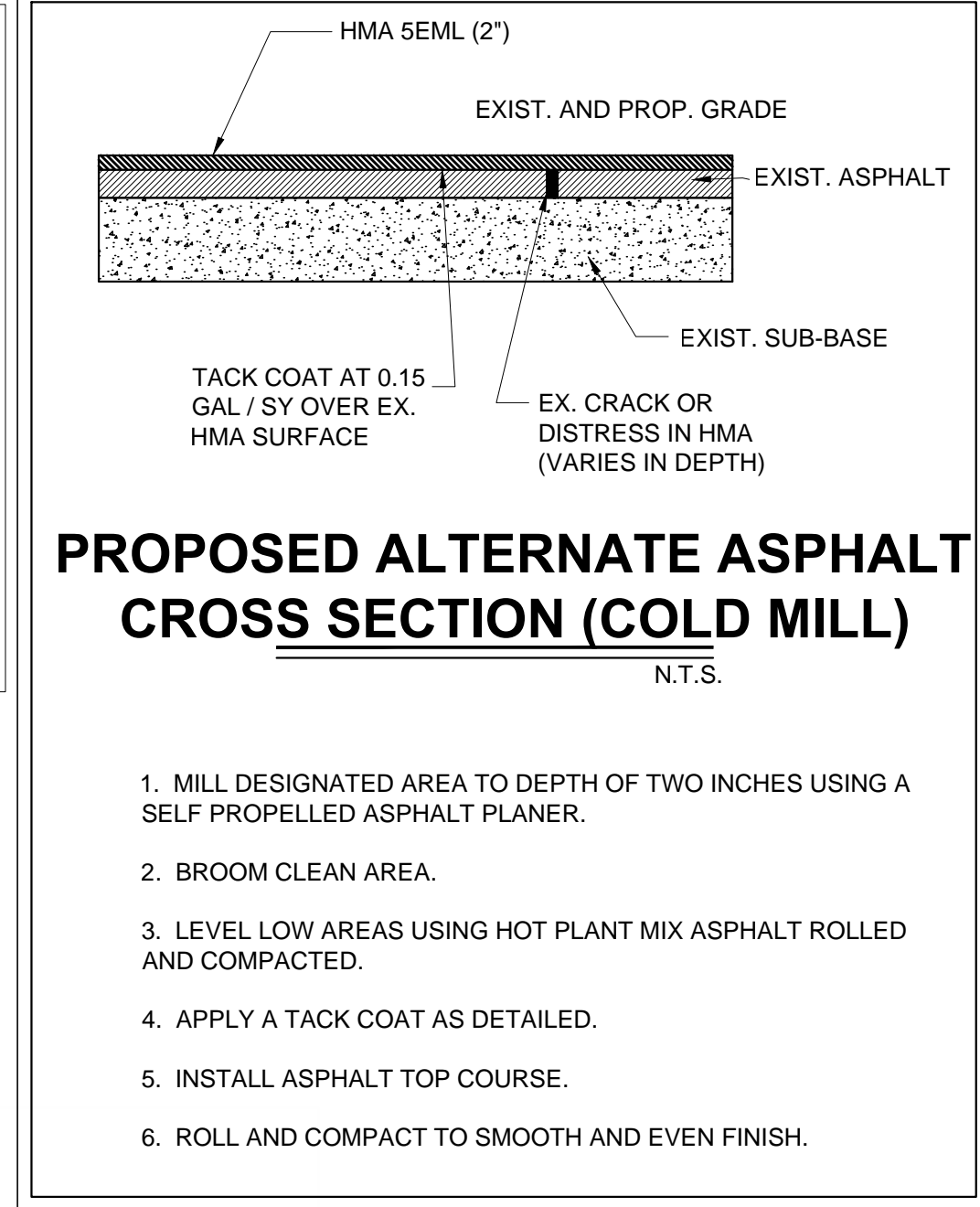
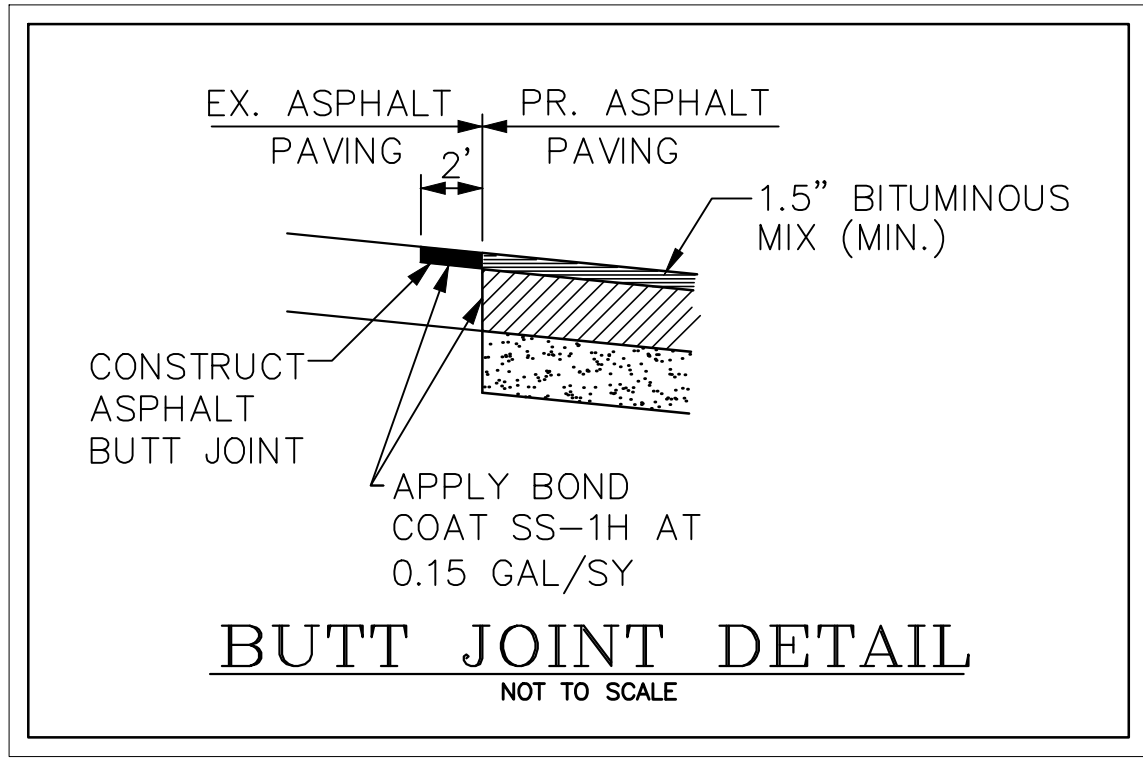
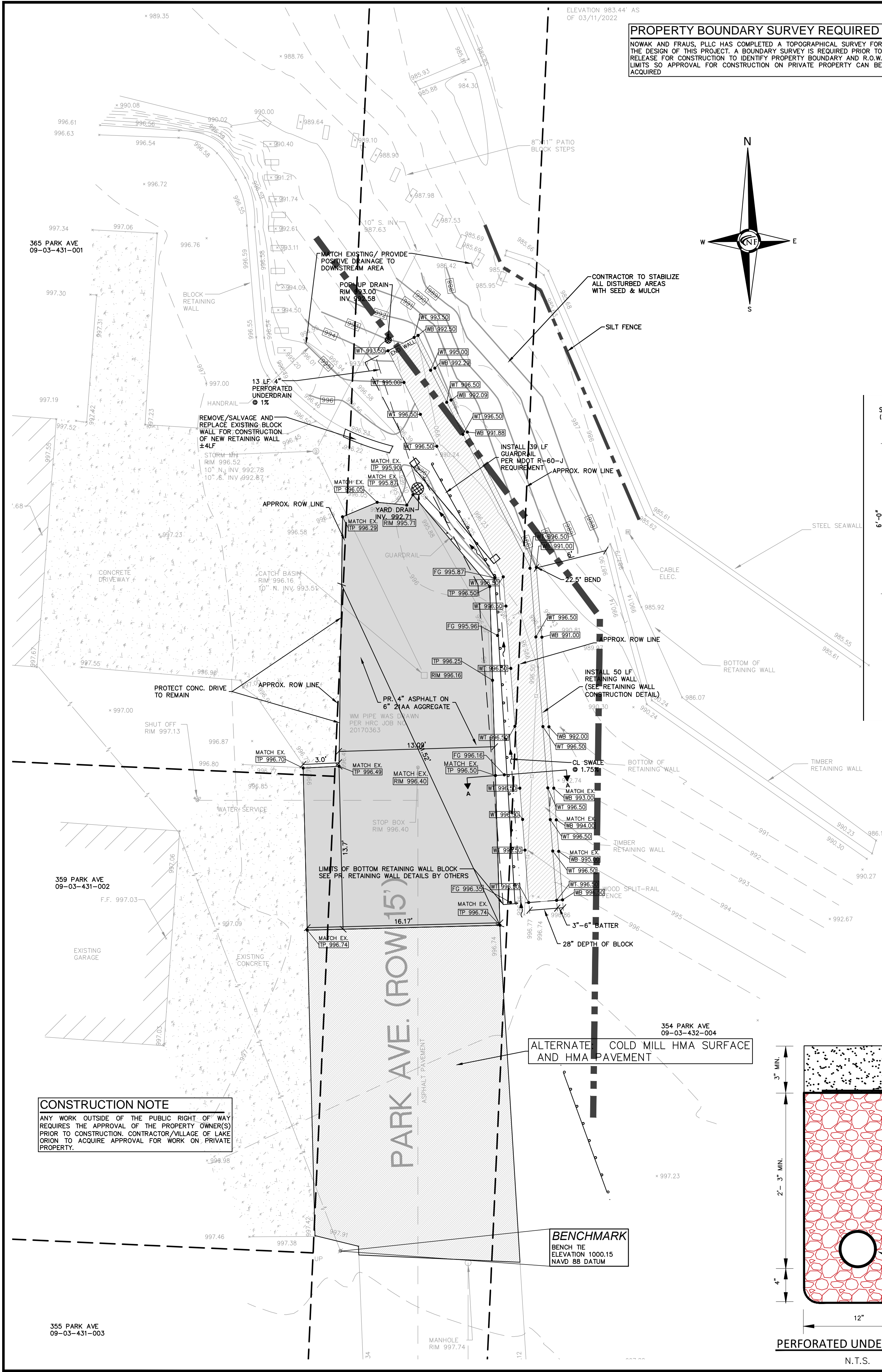


CIVIL ENGINEERS  
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LAND PLANNERS

NOWAK & FRAUS ENGINEERS  
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**NF ENGINEERS**

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SEAL

PROJECT  
Park Avenue Retaining Wall Replacement

CLIENT  
Village of Lake Orion

Darwin McClary  
Ph-248-693-8391

PROJECT LOCATION  
Part of the SE 1/4 of Section 3  
T.4N, R.10E  
Lake Orion, Oakland, Michigan

SHEET  
Paving & Grading Plan

**811**

Know what's below  
Call before you dig.

DATE ISSUED/REVISED  
05-20-2024 ADDITIONAL GUARDRAIL  
07-05-2024 ALTERNATE PAVING  
07-08-2024 ISSUE FOR BID

DRAWN BY:  
C. Michals

DESIGNED BY:  
C. Michals

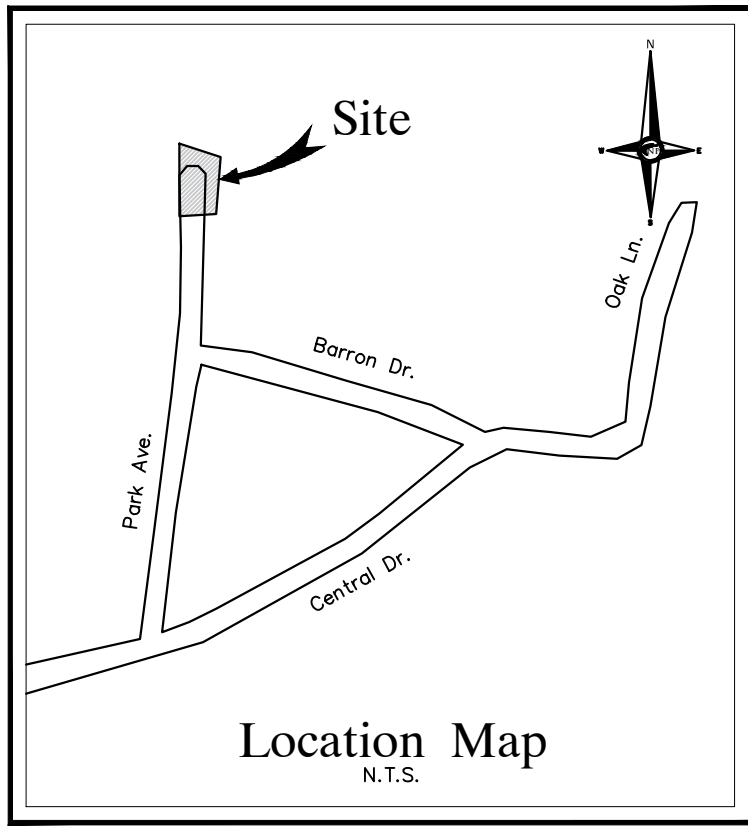
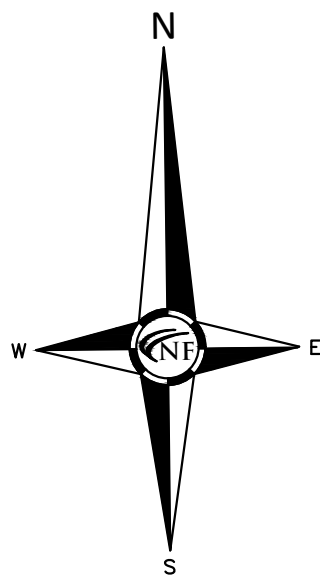
APPROVED BY:  
C. Thurber

DATE:  
06-19-2023

SCALE: 1" = 5'

NFE JOB NO. **M718** SHEET NO. **C2**





**NF**  
**ENGINEERS**  
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SEAL

PROJECT  
Park Avenue Retaining  
Wall Replacement

CLIENT  
Village of Lake Orion

Darwin McClary  
Ph-248-693-8391

PROJECT LOCATION  
Part of the SE 1/4  
of Section 3  
T.4N, R.10E  
Lake Orion, Oakland,  
Michigan

SHEET  
Demolition Plan



Know what's below  
Call before you dig.

**MISS DIG / UTILITY DISCLAIMER NOTE**

A MISS DIG TICKET NUMBER 202203080244, PURSUANT TO MICHIGAN PUBLIC ACT 174 WAS ENTERED FOR THE SURVEYED PROPERTY. DUE TO THE EXTENDED REPORTING PERIOD FOR UNDERGROUND FACILITY OWNERS TO PROVIDE THEIR RECORDS, THE SURVEY MAY NOT REFLECT ALL THE UTILITIES AT THE TIME THE SURVEY WAS ISSUED ON 03/08/2022. THE SURVEY ONLY REFLECTS THOSE UTILITIES WHICH COULD BE OBSERVED BY THE SURVEYOR IN THE FIELD OR AS DEPICTED BY THE UTILITY COMPANY RECORDS FURNISH PRIOR TO THE DATE THIS SURVEY WAS ISSUED. THE CLIENT AND/OR THEIR AUTHORIZED AGENT SHALL VERIFY WITH THE FACILITY OWNERS AND/OR THEIR AUTHORIZED AGENTS, THE COMPLETENESS AND EXACTNESS OF THE UTILITIES LOCATION.

**SNOW NOTE**

THIS SURVEY WAS PERFORMED UNDER EXTREME SNOW CONDITIONS, DUE TO THE DEPTH OF SNOW & SNOW PILES CAUSED BY SNOW REMOVAL. THE LOCATION OF ALL SURFACE STRUCTURES SUCH AS CURBS, MANHOLES, EDGES OF PAVEMENT & PARKING STRIPES MAY NOT BE SHOWN.

**LEGAL DESCRIPTION**

LOT 76; ORION SUMMER HOME CO.'S. SUBDIVISION, OF PART OF SECTIONS 2 & 3, T.4 N., R.10 E., TOWNSHIP OF ORION (NOW VILLAGE OF LAKE ORION), OAKLAND COUNTY, MICHIGAN, AS RECORDED IN LIBER 4 OF PLATS, PAGE 27 OF OAKLAND COUNTY RECORDS.

**TOPOGRAPHIC SURVEY NOTES**

ALL ELEVATIONS ARE EXISTING ELEVATIONS, UNLESS OTHERWISE NOTED.

UTILITY LOCATIONS WERE OBTAINED FROM MUNICIPAL OFFICIALS AND RECORDS OF UTILITY COMPANIES, AND NO GUARANTEE CAN BE MADE TO THE COMPLETENESS, OR EXACTNESS OF LOCATION.

THIS SURVEY MAY NOT SHOW ALL EASEMENTS OF RECORD UNLESS AN UPDATED TITLE POLICY IS FURNISHED TO THE SURVEYOR BY THE OWNER.

LEGEND	
	MANHOLE
	HYDRANT
	GATE VALVE
	MANHOLE CATCH BASIN
	UTILITY POLE
	GUY POLE
	GUY WIRE
	OVERHEAD LINES
	LIGHT POLE
	SIGN
	EXISTING GAS MAIN
	EXISTING UTILITY TO BE REMOVED
	EXISTING UTILITY TO BE ABANDONED
	12" MAPLE
	INDICATES EXISTING TREE TO BE REMOVED
	INDICATES AREAS OF PAVEMENT, BUILDINGS, ETC. TO BE REMOVED

DATE ISSUED/REVISED

07-05-2024 ALTERNATE PAVING

07-08-2024 ISSUE FOR BID

DRAWN BY:

M. Hani

DESIGNED BY:

M. Hani

APPROVED BY:

C. Thurber

DATE:

06-19-2023

SCALE: 1" = 5'

5 2.5 0 2.5 5 7.5

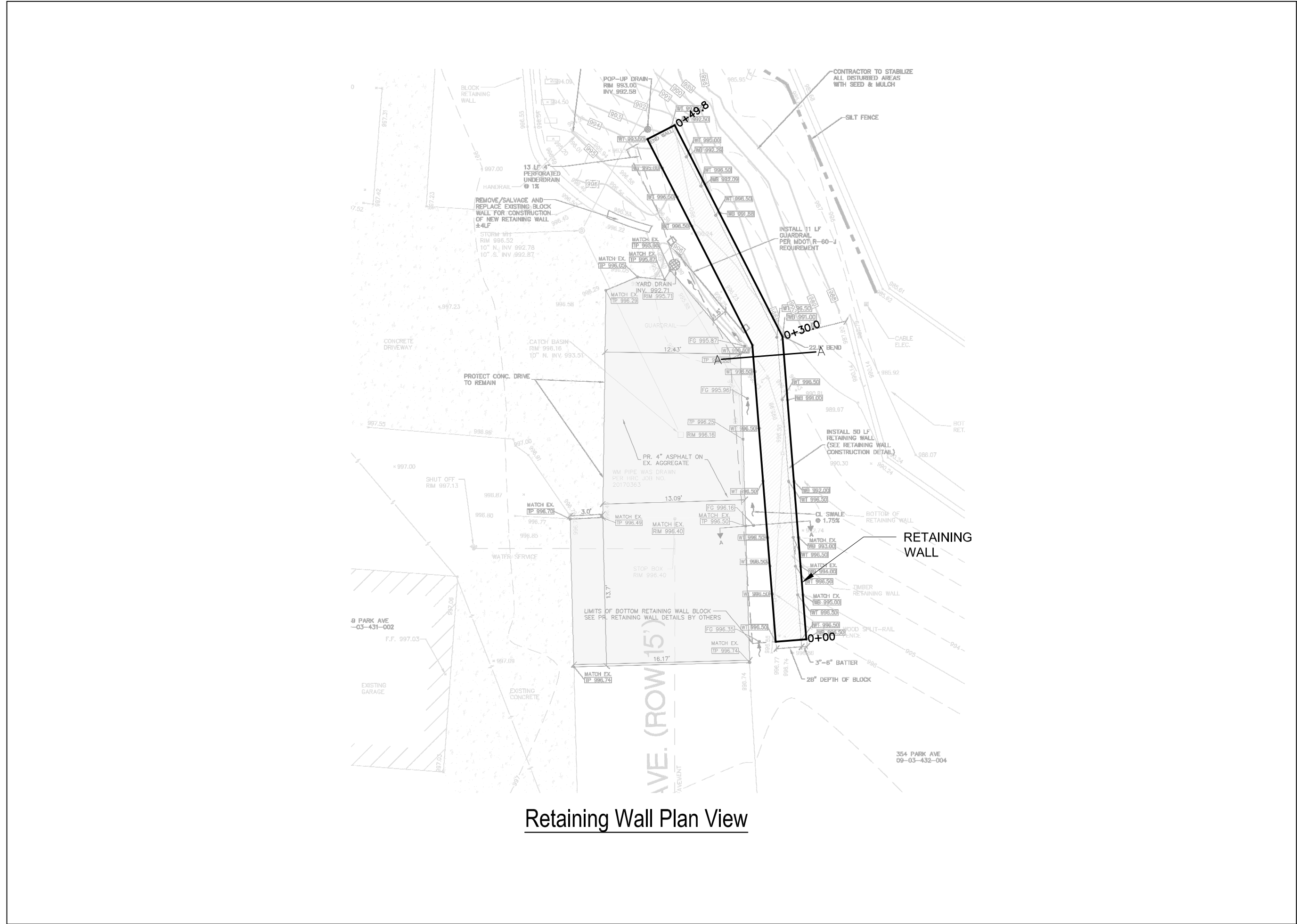
NFE JOB NO.

M718

SHEET NO.

C3





Retaining Wall Plan View

Scaled for 11" x 17" sheet

2

CONSULTING GROUP

1866 Woodsee Street  
Troy, Michigan 48083  
(248) 680-0400  
fax (248) 680-9745

PROJECT NO: 213502

DATE: 9-6-2022

DRAWN BY: MLE

CHECKED BY: --

DATE:	6/7/23					
REVISION DESCRIPTION	REVISED WALL LOCATION					
NO.:	1					

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PROJECT NAME:

Park Ave Retaining Wall

LOCATION:

Park Avenue  
Lake Orion, MI

SHEET TITLE

Plan View

SHEET NUMBER

1





1866 Woodsee Street  
Troy, Michigan 48083  
(248) 680-0400  
fax (248) 680-9745

PROJECT NO: 213502

DATE: 9-6-2022

DRAWN BY: MLE

CHECKED BY: --

DATE:	6/7/23						
REVISION/DESCRIPTION	REVISED WALL LOCATION						
NO.:	1						

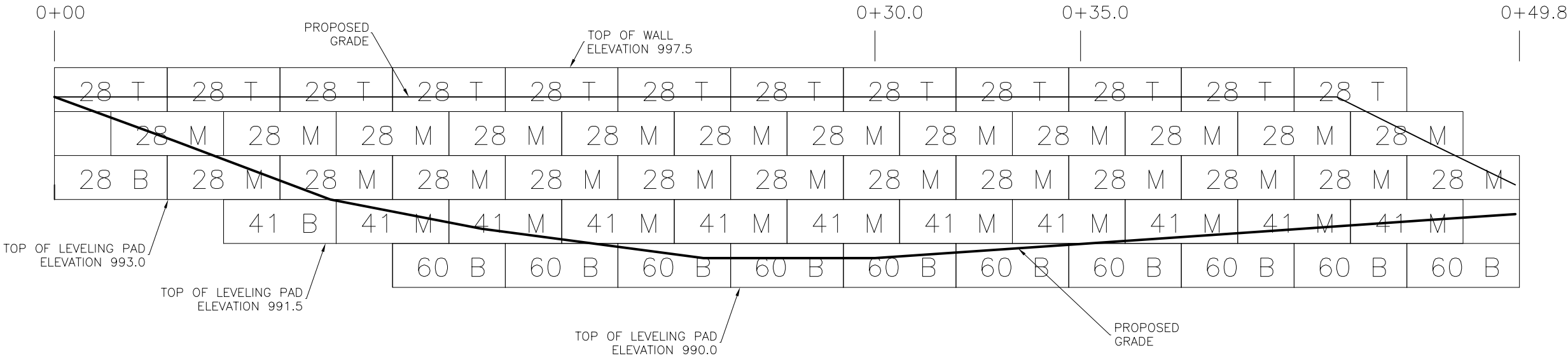
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PROJECT NAME:  
Park Ave Retaining Wall

LOCATION:  
Park Ave  
Lake Orion, MI

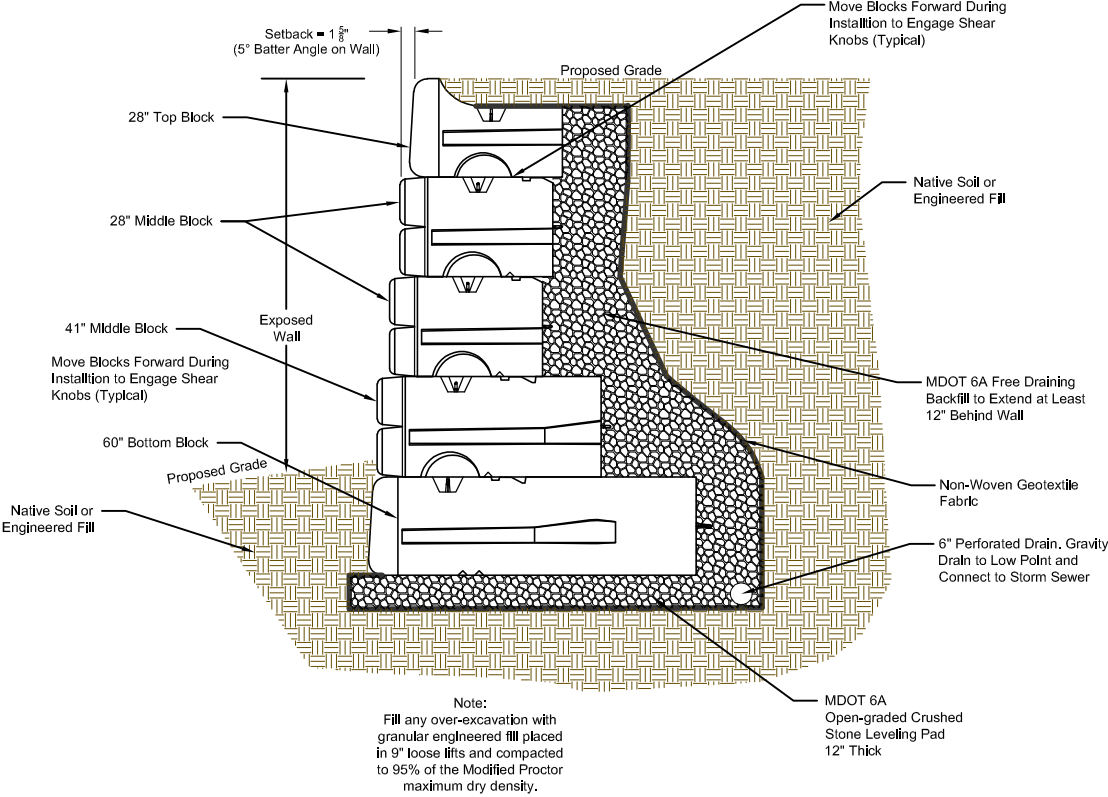
SHEET TITLE  
Elevation

SHEET NUMBER  
2



Retaining Wall Elevation





**Section A-A**  
SCALE : N.T.S.

Scaled for 11" x 17" sheet

2

CONSULTING GROUP

1866 Woodslee Street  
Troy, Michigan 48083  
(248) 680-0400  
fax (248) 680-9745

PROJECT NO: 213502

DATE: 9-6-2022

DRAWN BY: MLE

CHECKED BY: --

DATE:	6/7/23						
REVISION/DESCRIPTION	REVISED WALL LOCATION						
NO.:	1						

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PROJECT NAME:  
Park Ave Retaining Wall

LOCATION:  
Park Avenue  
Lake Orion, MI

SHEET TITLE  
Sections

SHEET NUMBER  
3



PRECAST MODULAR BLOCK RETAINING WALL

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes furnishing all materials and labor required for the construction of a precast concrete modular block (PMB) retaining wall without geosynthetic reinforcement. Precast modular block retaining wall blocks under this section shall be cast utilizing a wet-cast concrete mix and exhibit a final handling weight in excess of 1,000 pounds (450 kilograms) per unit.
- B. Scope of Work: The work shall consist of furnishing materials, labor, equipment, and supervision for the construction of a precast modular block (PMB) retaining wall structure in accordance with the requirements of this section and in acceptable conformity with the lines, grades, design, and dimensions shown in the project site plans.

1.02 REFERENCES

- A. Where the specification and reference documents conflict, the Owner's designated representative will make the final determination of the applicable document.
- B. Definitions:
- Precast Modular Block (PMB) Unit - machine-placed, wet-cast concrete modular block retaining wall facing unit.
  - Geotextile - a geosynthetic fabric manufactured for use as a separation and filtration medium between dissimilar soil materials.
  - Drainage Aggregate - clean, crushed stone placed within and immediately behind the precast modular block units to facilitate drainage and reduce compaction requirements immediately adjacent to and behind the precast modular block units.
  - Unit Core Fill - clean, crushed stone placed within the hollow vertical core of a precast modular block unit. Typically, the same material used for drainage aggregate as defined above.
  - Foundation Zone - soil zone immediately beneath the leveling pad and the reinforced zone.
  - Retained Zone - soil zone immediately behind the drainage aggregate and wall infill for wall sections designed as modular gravity structures.
  - Leveling Pad - hard, flat surface upon which the bottom course of precast modular blocks are placed. The leveling pad shall be constructed with crushed stone or dense-graded aggregate as indicated on the drawings. A leveling pad is not a structural footing.
  - Wall Infill - the fill material placed and compacted between the drainage aggregate and the excavated soil face in retaining wall sections designed as modular gravity structures.
- C. Reference Standards
- Design
    - AASHTO LRFD Bridge Design Specifications, 8th Edition, 2017.
    - Minimum Design Loads for Buildings and Other Structures - ASCE/SEI 7-16.
    - International Building Code, 2021 Edition.
    - FHWA-NHI-10-024 Volume I and GEC 11 Design of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes.
    - FHWA-NHI-10-025 Volume II and GEC 11 Design of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes.
  - Precast Modular Block Units
    - ASTM C94 - Standard Specification for Ready-Mixed Concrete.
    - ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
    - ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
    - ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
    - ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
    - ASTM C666 - Standard Test Method for Concrete Resistance to Rapid Freezing and Thawing.
    - ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
    - ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete.
    - ASTM C1611 - Standard Test Method for Slump Flow of Self-Consolidating Concrete.
    - ASTM D6638 - Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks).
    - ASTM D6916 - Standard Test Method for Determining Shear Strength Between Segmental Concrete Units (Modular Concrete Blocks).
  - Geosynthetics
    - AASHTO M 288 - Geotextile Specification for Highway Applications.
    - ASTM D3786 - Standard Test Method for Bursting Strength of Textile Fabrics Diaphragm Bursting Strength Tester Method.
    - ASTM D4354 - Standard Practice for Sampling of Geosynthetics for Testing.

- ASTM D4355 - Standard Test Method for Deterioration of Geotextiles
- ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
- ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
- ASTM D4595 - Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
- ASTM D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
- ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile.
- ASTM D4759 - Standard Practice for Determining Specification Conformance of Geosynthetics.
- ASTM D4833 - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
- ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
- ASTM D5262 - Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics.
- ASTM D5321 - Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
- ASTM D5818 - Standard Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics.
- ASTM D6241 - Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.
- ASTM D6637 - Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method.
- ASTM D6706 - Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil.
- ASTM D6992 - Standard Test Method for Accelerated Tensile Creep and Creep-Rupture of Geosynthetic Materials Based on Time-Temperature Superposition Using the Stepped Isothermal Method.

4. Soils
- AASHTO M 145 - AASHTO Soil Classification System.
  - AASHTO T 104 - Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
  - AASHTO T 267 - Standard Method of Test for Determination of Organic Content in Soils by Loss of Ignition.
  - ASTM C33 - Standard Specification for Concrete Aggregates.
  - ASTM D422 - Standard Test Method for Particle-Size Analysis of Soils.
  - ASTM D448 - Standard Classification for Sizes of Aggregates for Road and Bridge Construction.
  - ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort. (12,400 ft-lbf/ft (2,700 kN-m/m)).
  - ASTM D1241 - Standard Specification for Materials for Soil-Aggregate Subbase, Base and Surface Courses.
  - ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
  - ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort. (56,000 ft-lbf/ft (2,700 kN-m/m)).
  - ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
  - ASTM D2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
  - ASTM D3080 - Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions.
  - ASTM D4254 - Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
  - ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
  - ASTM D4767- Test Method for Consolidated-Undrained Triaxial Compression Test for Cohesive Soils.
  - ASTM D4972 - Standard Test Method for pH of Soils.
  - ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Aggregate by Nuclear Methods (Shallow Depth).
  - ASTM G51 - Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing.
  - ASTM G57 - Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method.

5. Drainage Pipe
- ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  - ASTM F2648 - Standard Specification for 2 to 60 inch [50 to 1500 mm] Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preconstruction Meeting. As directed by the Owner, the General Contractor shall schedule a preconstruction meeting at the project site prior to commencement of retaining wall construction. Participation in the preconstruction meeting shall be required of the General Contractor, Retaining Wall Design Engineer, Retaining Wall Installation Contractor, Grading Contractor, and Inspection Engineer. The General Contractor shall provide notification to all parties at least 10 calendar days prior to the meeting.
- Preconstruction Meeting Agenda:
    - The Retaining Wall Design Engineer shall explain all aspects of the retaining wall construction drawings.
    - The Retaining Wall Design Engineer shall explain the required bearing capacity of soil below the retaining wall structure and the shear strength of in-situ soils assumed in the retaining wall design to the Inspection Engineer.
    - The Retaining Wall Design Engineer shall explain the required shear strength of fill soil in the retained, and foundation zones of the retaining wall to the Inspection Engineer.
    - The Retaining Wall Design Engineer shall explain any measures required for coordination of the installation of utilities or other obstructions in the retained fill zones of the retaining wall.
    - The Retaining Wall Installation Contractor shall explain all excavation needs, site access, and material staging area requirements to the General Contractor and Grading Contractor.

1.04 SUBMITTALS

- A. Product Data. At least 14 days prior to construction, the General Contractor shall submit a minimum of four (4) copies of the retaining wall product submittal package to the Owner's Representative for review and approval. The submittal package shall include technical specifications and product data from the manufacturer for the following:
- Precast Modular Block System brochure
  - Precast Modular Block concrete test results specified in paragraph 2.01, subparagraph B of this section as follows:
    - 28-day compressive strength
    - Air content
    - Slump or Slump Flow (as applicable)
  - Drainage Pipe
  - Geotextile

- B. Installer Qualification Data. At least 14 days prior to construction, the General Contractor shall submit the qualifications of the business entity responsible for installation of the retaining wall, the Retaining Wall Installation Contractor, per paragraph 1.06, subparagraph A of this section.

1.05 QUALITY ASSURANCE

- A. Retaining Wall Installation Contractor Qualifications. In order to demonstrate basic competence in the construction of precast modular block walls, the Retaining Wall Installation Contractor shall document compliance with the following:
- Experience.
    - Construction experience with a minimum of 30,000 square feet (2,787 square meters) of the proposed precast modular block retaining wall system.
    - Construction of at least ten (10) precast modular block (large block) retaining wall structures within the past three (3) years.
    - Construction of at least 50,000 square feet (4,645 square meters) of precast modular block (large block) retaining walls within the past three (3) years.
  - Retaining Wall Installation Contractor experience documentation for each qualifying project shall include:
    - Project name and location
    - Date (month and year) of construction completion
    - Contact information of Owner or General Contractor
    - Type (trade name) of precast modular block system built
    - Maximum height of the wall constructed
    - Face area of the wall constructed
  - In lieu of the requirements set forth in items 1 and 2 above, the Retaining Wall Installation Contractor must be a certified Precast Modular Block Retaining Wall Installation Contractor as demonstrated by satisfactory completion of a certified precast modular block retaining wall installation training program administered by the precast modular block manufacturer.

1.06 QUALITY CONTROL

- A. The Owner's Representative shall review all submittals for materials and the Retaining Wall Installation Contractor qualifications.
- B. The General Contractor shall retain the services of an Inspection Engineer who is experienced with the construction of precast modular block retaining wall structures to perform inspection and testing. The cost of inspection shall be the responsibility of the General Contractor. Inspection shall be continuous throughout the construction of the retaining walls.

Scaled for 11" x 17" sheet



PROJECT NO: 213502
DATE: 9-6-2022
DRAWN BY: MLE
CHECKED BY: --

REVISION DESCRIPTION	REVISED WALL LOCATION	DATE:	6/7/23						
NO.:	1								

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PROJECT NAME:
Park Ave Retaining Wall

LOCATION:
Park Avenue Lake Orion, MI

SHEET TITLE
Notes

SHEET NUMBER
4



- C. The Inspection Engineer shall perform the following duties:
- Inspect the construction of the precast modular block structure for conformance with construction shop drawings and the requirements of this specification.
  - Verify that soil or aggregate fill placed and compacted in the retained, and foundation zones of the retaining wall conforms with the project specifications and exhibits the shear strength parameters specified by the Retaining Wall Design Engineer.
  - Verify that the shear strength of the in-situ soil assumed by the Retaining Wall Design Engineer is appropriate.
  - Inspect and document soil compaction in accordance with these specifications:
    - Required dry unit weight
    - Actual dry unit weight
    - Allowable moisture content
    - Actual moisture content
    - Pass/fail assessment
    - Test location - wall station number
    - Test elevation
    - Distance of test location behind the wall face
  - Notify the Retaining Wall Installation Contractor of any deficiencies in the retaining wall construction and provide the Retaining Wall Installation Contractor a reasonable opportunity to correct the deficiency.
  - Notify the General Contractor, Owner, and Retaining Wall Design Engineer of any construction deficiencies that have not been corrected in a timely fashion.
  - Document all inspection results.
  - Test compacted density and moisture content of the retained backfill with the following frequency:
    - At least once every 1,000 square feet (93 square meters) (in plan) per 9-inch (229 millimeter) vertical lift, and
    - At least once per every 18 inches (457 millimeter) of vertical wall construction.

- D. The General Contractor's engagement of the Inspection Engineer does not relieve the Retaining Wall Installation Contractor of responsibility to construct the proposed retaining wall in accordance with the approved construction shop drawings and these specifications.
- E. The Retaining Wall Installation Contractor shall inspect the on-site grades and excavations prior to construction and notify the Retaining Wall Design Engineer and General Contractor if on-site conditions differ from the elevations and grading conditions depicted in the retaining wall construction shop drawings.

1.07 DELIVERY, STORAGE AND HANDLING

- A. The Retaining Wall Installation Contractor shall inspect the materials upon delivery to ensure that the proper type, grade, and color of materials have been delivered.
- B. The Retaining Wall Installation Contractor shall store and handle all materials in accordance with the manufacturer's recommendations as specified herein and in a manner that prevents deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, UV exposure, or other causes. Damaged materials shall not be incorporated into the work.

C. Geosynthetics

- All geosynthetic materials shall be handled in accordance with ASTM D4873. The materials should be stored off the ground and protected from precipitation, sunlight, dirt, and physical damage.

D. Precast Modular Blocks

- Precast modular blocks shall be stored in an area with positive drainage away from the blocks. Be careful to protect the block from mud and excessive chipping and breakage. Precast modular blocks shall not be stacked more than three (3) units high in the storage area.

E. Drainage Aggregate and Backfill Stockpiles

- Drainage aggregate or backfill material shall not be piled over unstable slopes or areas of the project site with buried utilities.
- Drainage aggregate and/or reinforced fill material shall not be staged where it may become mixed with or contaminated by poor draining fine-grained soils such as clay or silt.

PART 2 - MATERIALS

2.01 PRECAST MODULAR BLOCK RETAINING WALL UNITS

- A. All units for the project shall be obtained from the same manufacturer. The manufacturer shall be licensed and authorized to produce the retaining wall units by the precast modular block system patent holder/licensor and shall document compliance with the published quality control standards of the proprietary precast modular block system licensor for the previous three (3) years.
- B. Concrete used in the production of the precast modular block units shall be first-purpose, fresh concrete. It shall not consist of returned, reconstituted, surplus, or waste concrete. It shall be an original production mix meeting the requirements of ASTM C94 and exhibit the following:
- Minimum 28-day compressive strength of 4,000 psi (27.6 MPa).

- Shall be free of water soluble chlorides and chloride based accelerator admixtures.
- 6% ± 1½% air-entrainment in conformance ASTM C94.
- Maximum slump of 5 inches ± 1½ inches (127 millimeter ± 38 millimeter) per ASTM C143 for conventional concrete mix designs.
- Slump Flow for Self-Consolidating Concrete (SCC) mix designs shall be between 18 inches and 32 inches (457 millimeter and 813 millimeter) as tested in accordance with ASTM C1611.

C. Each concrete block shall be cast in a single continuous pour without cold joints. With the exception of half-block units, corner units, and other special application units, the precast modular block units shall conform to the nominal dimensions listed in the table below and be produced to the dimensional tolerances shown.

Block Type	Dimension	Nominal Value	Tolerance
28" (710 mm) Block	Height	18" (457 mm)	±3/16" (5 mm)
	Length	46-1/8" (1172 mm)	±1/2" (13 mm)
	Width*	28" (710 mm)	±1/2" (13 mm)
41" (1030 mm) Block	Height	18" (457 mm)	±3/16" (5 mm)
	Length	46-1/8" (1172 mm)	±1/2" (13 mm)
	Width*	40-1/2" (1030 mm)	±1/2" (13 mm)
60" (1520 mm) Block	Height	18" (457 mm)	±3/16" (5 mm)
	Length	46-1/8" (1172 mm)	±1/2" (13 mm)
	Width*	60" (1520 mm)	±1/2" (13 mm)

\* Excluding Variable Face Texture

D. Individual block units shall have a nominal height of 18 inches (457 millimeters).

E. With the exception of half-block units, corner units, and other special application units, the precast modular block units shall have two (2) circular dome shear knobs that are 10 inches (254 millimeters) maximum in diameter and 4 inches (102 millimeters) maximum in height. The shear knobs shall fully index into a continuous semi-cylindrical shear channel in the bottom of the block course above. Peak interlock shear between any two (2) vertically stacked precast modular block units measured in accordance with ASTM D6916 shall exceed 6,500 lb/ft (95 kN/m) at a minimum normal load of 500 lb/ft (7kN/m), as well as an ultimate peak interface shear capacity in excess of 11,000 lb/ft (160 kN/m). Test specimen blocks tested under ASTM D6916 shall be actual, full-scale production blocks of known compressive strength. The interface shear capacity reported shall be corrected for a 4,000 psi (27.6 MPa) concrete compressive strength. Regardless of precast modular block configuration, interface shear testing shall be completed without the inclusion of unit core infill aggregate.

F. Without field cutting or special modification, the precast modular block units shall be capable of achieving a minimum radius of 14 foot 6 inch (4.42 meters).

G. The precast modular block units shall be manufactured with integrally cast shear knobs that establish a standard horizontal set-back for subsequent block courses. The precast modular block system shall be available in the four (4) standard horizontal setback facing batter options listed below:

Horizontal Setback/Block Course	Max. Facing Batter
3/8"(10 mm)	1.2°
1-5/8"(41 mm)	5.2°
9-3/8"(238 mm)	27.5°
16-5/8"(422 mm)	42.7°

The precast modular block units shall be furnished with the required shear knobs that provide the facing batter required in the construction shop drawings.

H. The precast modular block unit face texture shall be selected by the owner from the available range of textures available from the precast modular block manufacturer. Each textured block facing unit shall be a minimum of 5.75 square feet (0.54 square meters) with a unique texture pattern that repeats with a maximum frequency of once in any 20 square feet (1.87 square meters) of wall face.

I. The block color shall be selected by the owner from the available range of colors available from the precast modular block manufacturer.

J. All precast modular block units shall be sound and free of cracks or other defects that would interfere with the proper installation of the unit, impair the strength or performance of the constructed wall. PMB units to be used in exposed wall construction shall not exhibit chips or cracks in the exposed face or faces of the unit that are not otherwise permitted. Chips smaller than 1.5 inches (38 millimeters) in its largest dimension and cracks not wider than 0.012 inch (0.3 millimeter) and not longer than 25% of the nominal height of the PMB unit shall be permitted. PMB units with bug holes in the exposed architectural face smaller than 0.75 inch (19 millimeter) in its largest dimension shall be permitted. Bug holes, water marks, and color variation on non-architectural faces are acceptable. PMB units that exhibit cracks that are continuous through any solid element of the PMB unit shall not be incorporated in the work regardless of the width or length of the crack.

K. Preapproved Manufacturers.

- Manufacturers of Redi-Rock Retaining Wall Systems as licensed by Redi-Rock International, LLC, 05481 US 31 South, Charlevoix, MI 49720 USA; telephone (866) 222-8400; website **redi-rock.com**.

M. Substitutions. Technical information demonstrating conformance with the requirements of this specification for an alternative precast modular block retaining wall system must be submitted for preapproval at least 14 calendar days prior to the bid date. Acceptable alternative PMB retaining wall systems, otherwise found to be in conformance with this specification, shall be approved in writing by the owner seven (7) days prior to the bid date. The Owner's Representative reserves the right to provide no response to submissions made out of the time requirements of this section or to submissions of block retaining wall systems that are determined to be unacceptable to the owner.

2.02 GEOTEXTILE

A. Nonwoven geotextile fabric shall be placed as indicated on the retaining wall construction shop drawings. Additionally, the nonwoven geotextile fabric shall be placed in the v-shaped joint between adjacent block units on the same course. The nonwoven geotextile fabric shall meet the requirements Class 3 construction survivability in accordance with AASHTO M 288.

B. Preapproved Nonwoven Geotextile Products

- Mirafi 140N
- Propex Geotex 451
- Skaps GT-142
- Thrace-Linq 140EX
- Carthage Mills FX-40HS
- Stratatex ST 142

2.03 DRAINAGE AGGREGATE

A. Drainage aggregate shall consist of MDOT 6A crushed stone.

2.04 LEVELING PAD

A. The precast modular block units shall be placed on a leveling pad constructed from MDOT 6A crushed stone. The leveling pad shall be constructed to the dimensions and limits shown on the retaining wall design drawings prepared by the Retaining Wall Design Engineer.

2.05 DRAINAGE

A. Drainage Pipe

- Drainage collection pipe shall be at least a 6-inch (102-millimeter) diameter, 3-hole perforated, HDPE pipe with a minimum pipe stiffness of 22 psi (152 kPa) per ASTM D2412.
- The drainage pipe shall be manufactured in accordance with ASTM D1248 for HDPE pipe and fittings.

B. Preapproved Drainage Pipe Products

- ADS 3000 Triple Wall pipe as manufactured by Advanced Drainage Systems.

PART 3 - EXECUTION

3.01 GENERAL

- A. All work shall be performed in accordance with OSHA safety standards, state and local building codes, and manufacturer's requirements.
- B. The General Contractor is responsible for the location and protection of all existing underground utilities. Any new utilities proposed for installation in the vicinity of the retaining wall shall be installed concurrent with retaining wall construction. The General Contractor shall coordinate the work of subcontractors affected by this requirement.
- C. New utilities installed below the retaining wall shall be backfilled and compacted to a minimum of 95% maximum dry density per ASTM D1557 modified Proctor.
- D. The General Contractor is responsible to ensure that safe excavations and embankments are maintained throughout the course of the project.
- E. All work shall be inspected by the Inspection Engineer as directed by the Owner.

3.02 EXAMINATION

A. Prior to construction, the General Contractor, Grading Contractor, Retaining Wall Installation Contractor, and Inspection Engineer shall examine the areas in which the retaining wall will be constructed to evaluate compliance with the requirements for installation tolerances, worker safety, and any site conditions affecting performance of the completed structure. Installation shall proceed only after unsatisfactory conditions have been corrected.

3.03 PREPARATION

A. Fill Soil.

- The Inspection Engineer shall verify that any fill soil installed in the foundation and retained soil zones of the retaining wall satisfies the specification of the Retaining Wall Design Engineer as shown on the construction drawings.

Scaled for 11" x 17" sheet



PROJECT NO: 213502
DATE: 9-6-2022
DRAWN BY: MLE
CHECKED BY: --

DATE:	6/7/23						
REVISION DESCRIPTION	REVISED WALL LOCATION						
NO.:	1						

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PROJECT NAME:
Park Ave Retaining Wall

LOCATION:
Park Avenue Lake Orion, MI

SHEET TITLE
Notes

SHEET NUMBER
5



B. Excavation.

1. The Grading Contractor shall excavate to the lines and grades required for construction of the precast modular block retaining wall as shown on the construction drawings. The Grading Contractor shall minimize over-excavation. Excavation support, if required, shall be the responsibility of the Grading Contractor.
2. Over-excavated soil shall be replaced with engineered fill as directed by the project Geotechnical Engineer.
3. Embankment excavations shall be bench cut as directed by the project Geotechnical Engineer and inspected by the Inspection Engineer for compliance.

C.Foundation Preparation.

1. Prior to construction of the precast modular block retaining wall, the leveling pad area, and undercut zone (if applicable) shall be cleared and grubbed. All topsoil, brush, frozen soil, and organic material shall be removed. Additional foundation soils found to be unsatisfactory beyond the specified undercut limits shall be undercut and replaced with approved fill as directed by the project Geotechnical Engineer. The Inspection Engineer shall ensure that the undercut limits are consistent with the requirements of the project Geotechnical Engineer and that all soil fill material is properly compacted according project specifications. The Inspection Engineer shall document the volume of undercut and replacement.
2. Following excavation for the leveling pad and undercut zone (if applicable), the Inspection Engineer shall evaluate the in-situ soil in the foundation and retained soil zones.
  - a. The Inspection Engineer shall verify that the shear strength of the in-situ soil assumed by the Retaining Wall Design Engineer is appropriate. The Inspection Engineer shall immediately stop work and notify the Owner if the in-situ shear strength is found to be inconsistent with the retaining wall design assumptions.
  - b. The Inspection Engineer shall verify that the foundation soil exhibits sufficient ultimate bearing capacity to satisfy the requirements indicated on the retaining wall construction shop drawings.

D. Leveling Pad.

1. The leveling pad shall be constructed to provide a level, hard surface on which to place the first course of precast modular block units. The leveling pad shall be placed in the dimensions shown on the retaining wall construction drawings and extend to the limits indicated.
2. MDOT 6A Crushed Stone Leveling Pad. Crushed stone shall be placed in uniform maximum lifts of 6 inches (150 millimeter). The crushed stone shall be compacted by a minimum of three (3) passes of a vibratory compactor capable of exerting 2,000 lb (8.9 kN) of centrifugal force and to the satisfaction of the Inspection Engineer.

3.04 PRECAST MODULAR BLOCK WALL SYSTEM INSTALLATION

- A. The precast modular block structure shall be constructed in accordance with the construction drawings, these specifications, and the recommendations of the retaining wall system component manufacturers. Where conflicts exist between the manufacturer's recommendations and these specifications, these specifications shall prevail.
- B. Drainage components. Pipe, geotextile, and drainage aggregate shall be installed as shown on the construction shop drawings.
- C.Precast Modular Block Installation.
  1. The first course of block units shall be placed with the front face edges tightly abutted together on the prepared leveling pad at the locations and elevations shown on the construction drawings. The Retaining Wall Installation Contractor shall take special care to ensure that the bottom course of block units are in full contact with the leveling pad, are set level and true, and are properly aligned according to the locations shown on the construction drawings.
  2. Backfill shall be placed in front of the bottom course of blocks prior to placement of subsequent block courses. Nonwoven geotextile fabric shall be placed in the V-shaped joints between adjacent blocks. Drainage aggregate shall be placed in the V-shaped joints between adjacent blocks to a minimum distance of 12 inches (305 millimeters) behind the block unit.
  3. Drainage aggregate shall be placed in 9 inch (229 millimeter) maximum lifts and compacted by a minimum of three (3) passes of a vibratory plate compactor capable exerting a minimum of 2,000 lb (8.9 kN) of centrifugal force.
  4. Unit core fill shall be placed in the precast modular block unit vertical core slot. The core fill shall completely fill the slot to the level of the top of the block unit. The top of the block unit shall be broom-cleaned prior to placement of subsequent block courses. No additional courses of precast modular blocks may be stacked before the unit core fill is installed in the blocks on the course below. The core fill is required for blocks both with and without the geogrid reinforcement (install geogrid before core fill).
  5. Base course blocks for gravity wall designs (without geosynthetic soil reinforcement) may be furnished without vertical core slots. If so, disregard item 4 above for the base course blocks in this application.
  6. Nonwoven geotextile fabric shall be placed between the drainage aggregate and the retained soil as required on the retaining wall construction drawings.
  7. Subsequent courses of block units shall be installed with a running bond (half block horizontal course-to-course offset). With the exception of 90 degree corner units; the shear channel of the upper block shall be fully engaged with the shear knobs of the block course below. The upper block course shall be

- pushed forward to fully engage the interface shear key between the blocks and to ensure consistent face batter and wall alignment. Drainage aggregate, unit core fill, geotextile, and properly compacted backfill shall be complete and in-place for each course of block units before the next course of blocks is stacked.
8. If included as part of the precast modular block wall design, cap units shall be secured with an adhesive in accordance with the precast modular block manufacturer's recommendation.

D. Construction Tolerance. Allowable construction tolerance of the retaining wall shall be as follows:

1. Deviation from the design batter and horizontal alignment, when measured along a 10 foot (3 meter) straight wall section, shall not exceed 3/4 inch (19 millimeter).
2. Deviation from the overall design batter shall not exceed 1/2 inch (13 millimeter) per 10 foot (3 meter) of wall height.
3. The maximum allowable offset (horizontal bulge) of the face in any precast modular block joint shall be 1/2 inch (13 millimeter).
4. The base of the precast modular block wall excavation shall be within 2 inches (51 millimeter) of the staked elevations, unless otherwise approved by the Inspection Engineer.
5. Differential vertical settlement of the face shall not exceed 1 foot (305 millimeter) along any 200 feet (61 meters) of wall length.
6. The maximum allowable vertical displacement of the face in any precast modular block joint shall be 1/2 inch (13 millimeter).
7. The wall face shall be placed within 2 inches (51 millimeters) of the horizontal location staked.

3.06 OBSTRUCTIONS IN THE INFILL ZONE

- A. The Retaining Wall Installation Contractor shall make all required allowances for obstructions behind and through the wall face in accordance with the approved construction shop drawings.
- B. Should unplanned obstructions become apparent for which the approved construction shop drawings do not account, the effected portion of the wall shall not be constructed until the Retaining Wall Design Engineer can appropriately address the required procedures for construction of the wall section in question.

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PROJECT NO: 213502

DATE: 9-6-2022

DRAWN BY: MLE

CHECKED BY: --

DATE:	6/7/23						
REVISION/DESCRIPTION	REVISED WALL LOCATION						
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PROJECT NAME:

Park Ave Retaining Wall

LOCATION:

Park Avenue  
Lake Orion, MI

SHEET TITLE

Notes

SHEET NUMBER

6