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ADDENDUM No. ONE

Date: June 11, 2024

Project: Flemington Road Improvements, MES No. 2023-80

Engineer: M.E. Sack Engineering 
Hinesville, Georgia

The original plans, specifications, and bid documents are amended to include the following:

Plan Set:

- Replace previous Sheets C201 – C300 with enclosed of the same. Note the Engineer has decided to add rumble strips and raised pavement markers for vehicular safety, given that the existing measures will be removed during construction.

Table of Contents:

- Replace the previous Table of Contents with the enclosed of the same. Note Section 919 – Raised Pavement Markers was added to Section V-D: Georgia Department of Transportation (GDOT) Specifications.

Bid Form:

- Replace the previous Bid Form with the enclosed of the same. Note the bid items now include line items for both thermoplastic and paint and bead pavement markings, as well as rumble strips, transverse rumble strips, and raised pavement markings.

Technical Specifications:

- Replace the previous Section 01150 – Measurement and Payment with the enclosed of the same. Note that Pavement Markings have been revised to include both thermoplastic and paint and bead pavement markings, and that

Rumble Strips, Transverse Rumble Strips, and Raised Pavement Markers have also been added.

GDOT Specifications:

- Add the enclosed Section 919 – Raised Pavement Markers to Section V-D: GDOT Specifications.

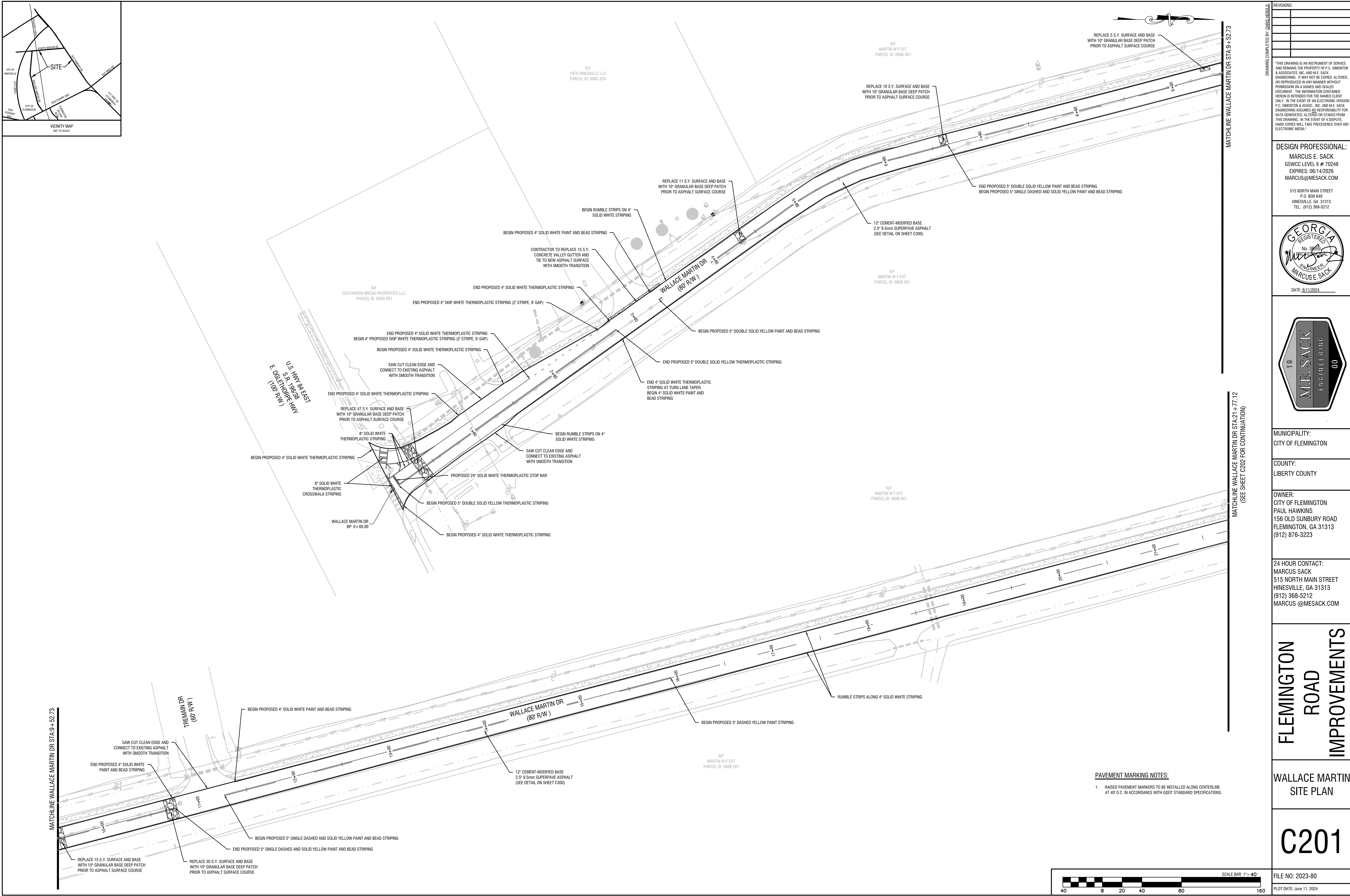
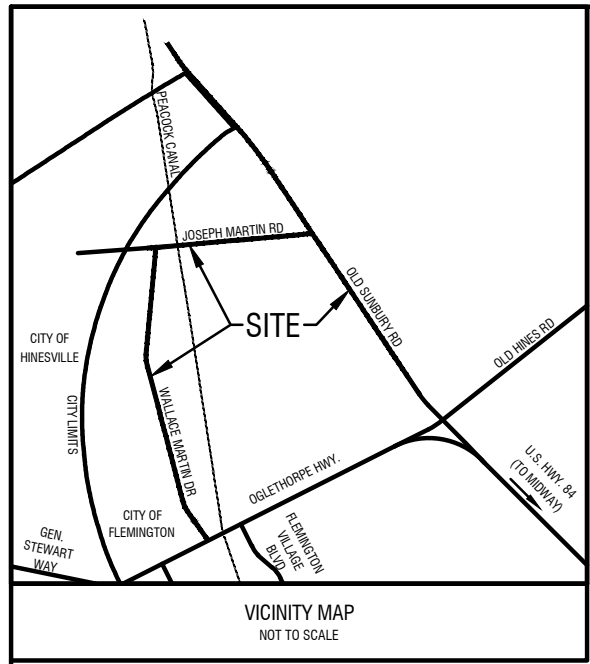
The following clarifications are offered for questions received:

- 1. What is the depth for the Full-Depth Roadway Pulverization as well as the Cement Stabilized Base?*
 - Recommended depth for cement-stabilized base is 12". The depth of pulverization will need to be 14.5" to allow for 2.5" of asphalt surface course to match the elevation and grade of the existing road. Please refer to the Bid Document Section V-E: "Geotechnical Engineering Report"; see page 7 under "Pavement Recommendations".
- 2. What is the recommended rate for Portland Cement to be added to the Pulverized Base? Also, I believe that there should be 2 bid items for the "Recycling Agent (Stabilization) for Base Course" per Specification Section 301.5, items B & D, as there is no way of knowing what the application rate of Portland Cement will be prior to a mix design being done.*
 - Recommended rate of cement additive is 5% by weight. Please refer to the Bid Document Section V-E: "Geotechnical Engineering Report"; see page 7 for mix design under "Pavement Recommendations".
- 3. On plan sheet C300, the pavement detail for the "Full Depth Reclamation" is confusing without the subsequent layers being labelled. Also, is the intent for the Full Depth Reclamation to match the existing pavement grade or for the final asphalt layer to match the existing pavement grade?*
 - The detail on plan sheet C300 is meant to provide a cross section of the final base and paving depth, which shall be constructed to match the existing grade and elevations of the existing road.
- 4. If the intent is for the Full Depth Reclamation to match the existing road elevation, the finish grade would be 2.5" above where it is now and require the shoulders to be built up 2.5" to match the new pavement grade. In this case, there would need to be an additional bid item for shoulder construction to bring in dirt fill. Also, there would be issues tying into the existing curb & gutter and the sidewalk sections tying into the existing asphalt pavement on Wallace Martin Dr.*
 - As described in response to #3, the intention is for the surface course of the new roadway to match the grade and elevations of the existing roadway.

5. *The maximum lift thickness for 9.5 mm Superpave is 2" per GDOT Specification section 400. Will the Contractor be required to place the asphalt mix in (2) lifts?*
- Please see page 1 of the Geotechnical Report under "Overview Statement", next to "Pavement Recommendations", which states that asphalt is to be placed in accordance with GDOT specifications. We recommend two (2) lifts of 1.25" 9.5 mm asphalt.
6. *The Measurement and Payment section (01150), item # 2.09 Pavement Markings, says that all pavement markings should be Thermoplastic, but the Construction Plans call out "Paint Striping" for all markings except for the Stop Bars which aren't specified either way. Which is correct?*
- Please use thermoplastic markings up to the 2nd driveway to the north (plan right) roughly to STA 3+00, and paint with glass beads in all other areas. This will encompass the turn lane/connection of Wallace Martin to the GDOT HWY 84 R/W. We have updated the Bid Document to better differentiate thermoplastic and paint and bead pavement markings.

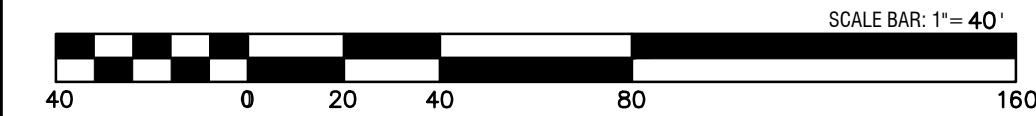
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PAVEMENT MARKING NOTES:

1. RAISED PAVEMENT MARKERS TO BE INSTALLED ALONG CENTERLINE AT 40' O.C. IN ACCORDANCE WITH GOOT STANDARD SPECIFICATIONS.



REVISIONS:

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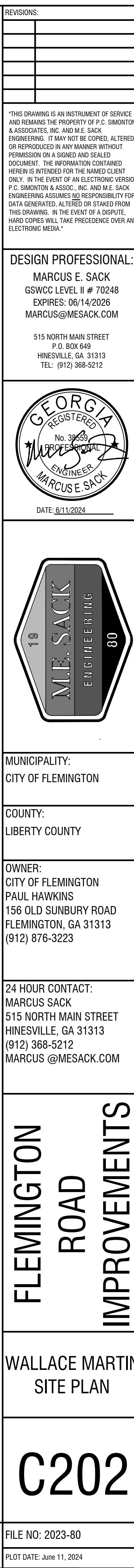
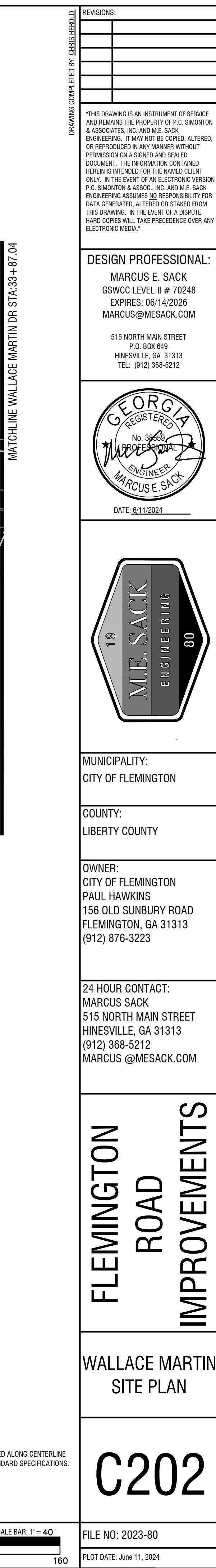
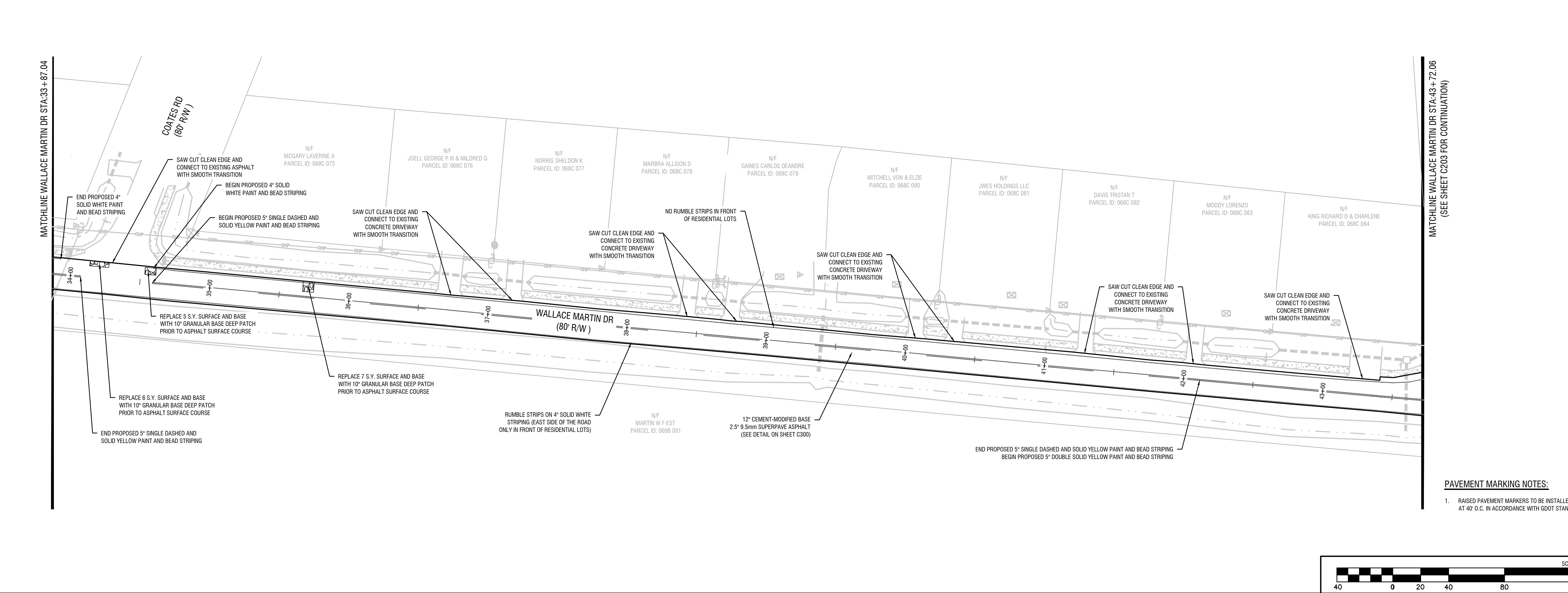
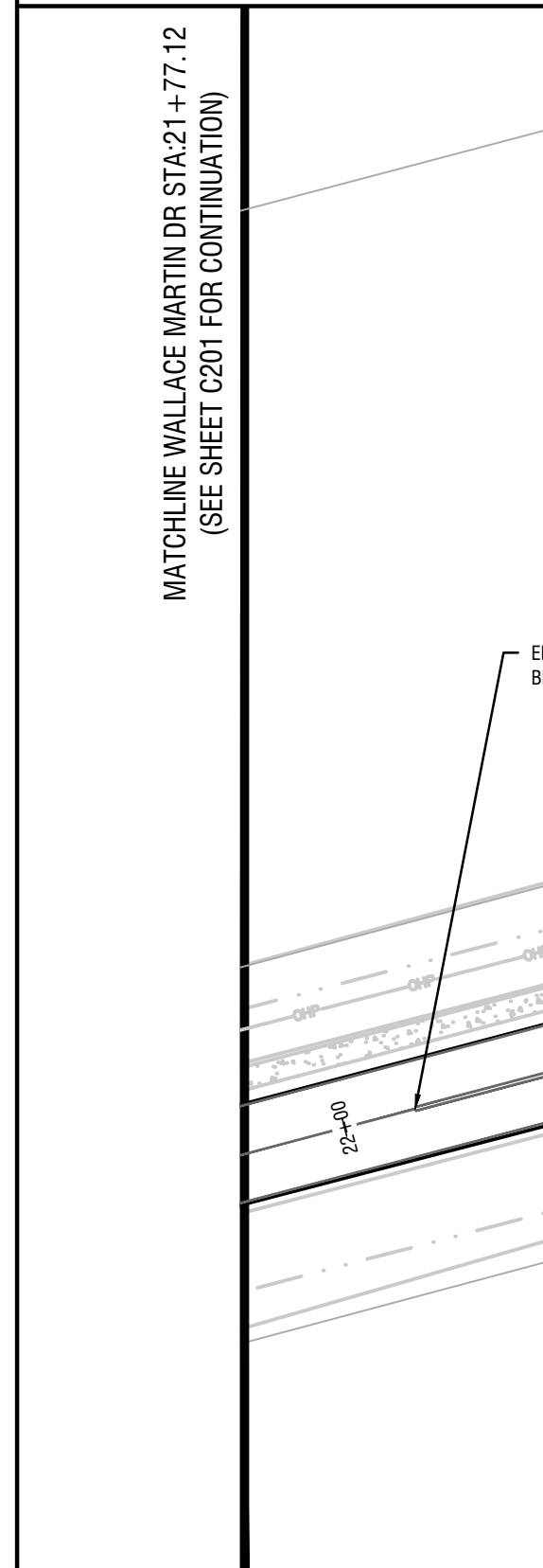
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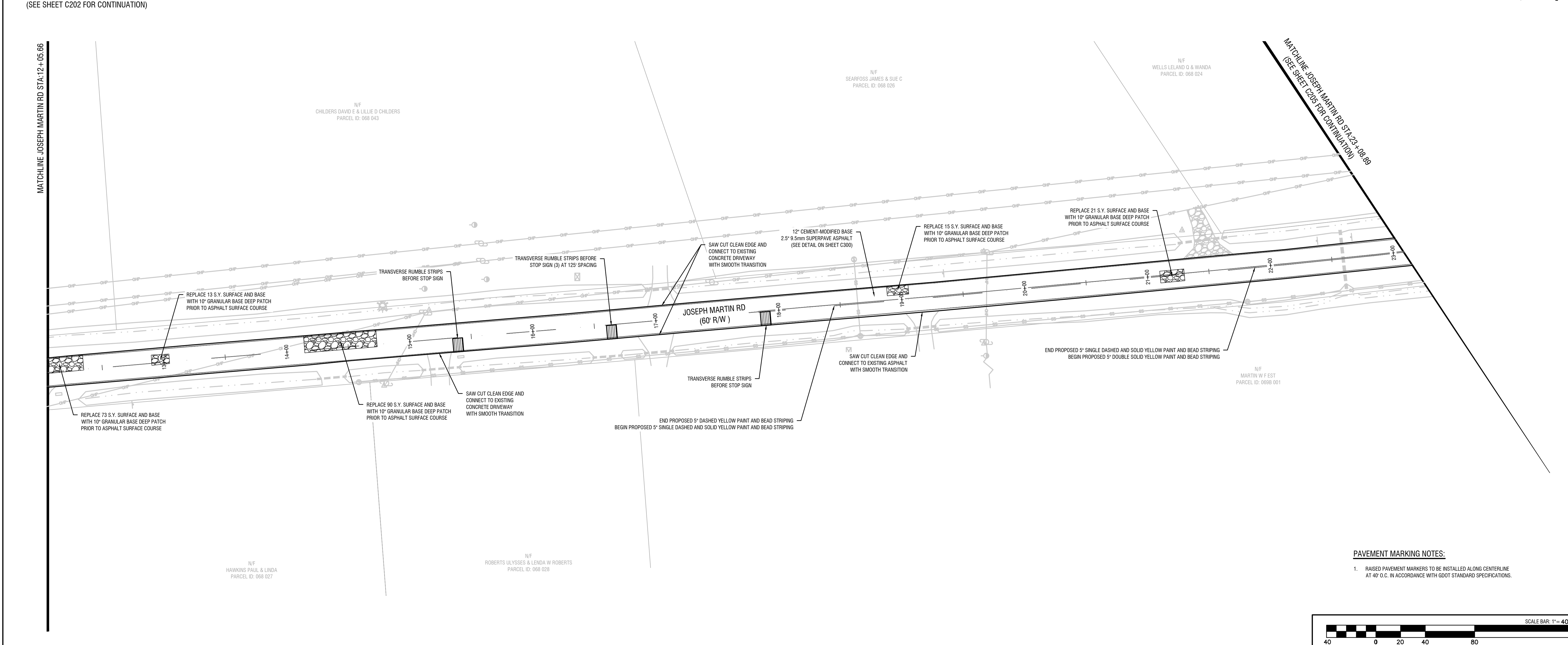
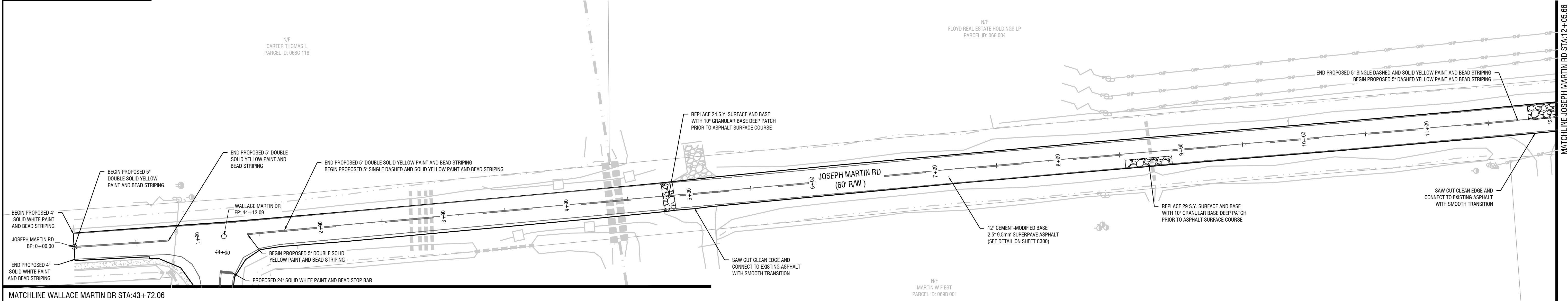
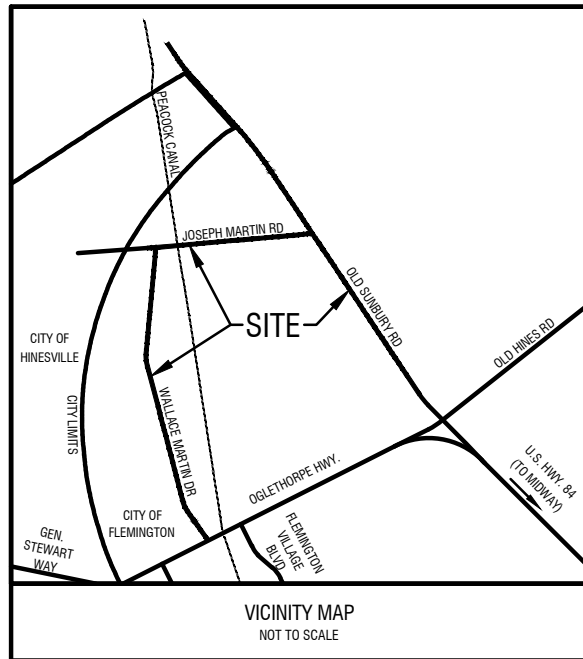
FLEMINGTON
ROAD
IMPROVEMENTS

WALLACE MARTIN
SITE PLAN

C201

FILE NO: 2023-80
PLOT DATE: June 11, 2024





PAVEMENT MARKING NOTES:

1. RAISED PAVEMENT MARKERS TO BE INSTALLED ALONG CENTERLINE AT 40' O.C. IN ACCORDANCE WITH GDOT STANDARD SPECIFICATIONS.



DRAWING COMPLETED BY: QUBS.HESLO

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ROAD

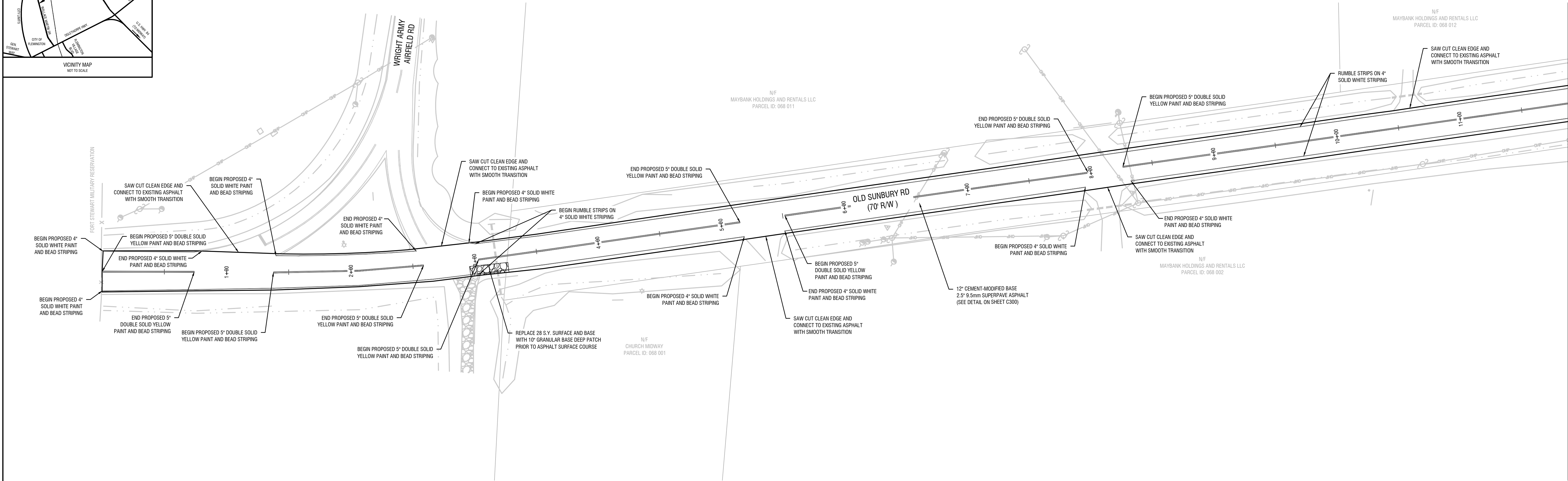
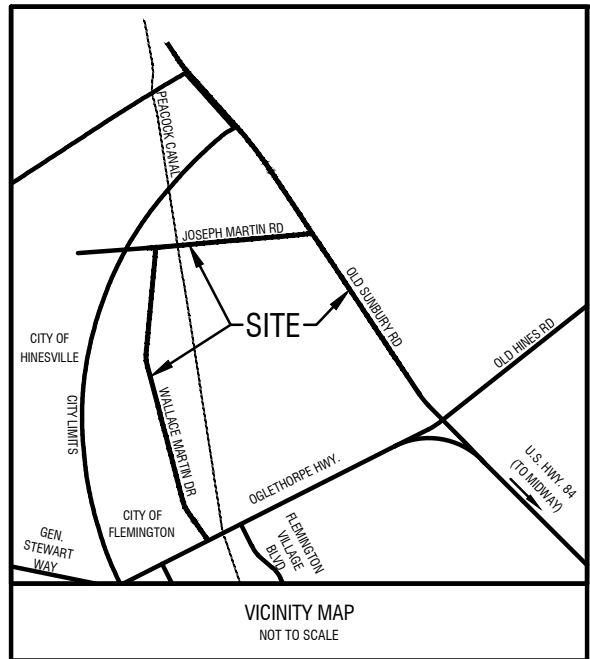
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JOSEPH MARTIN SITE PLAN

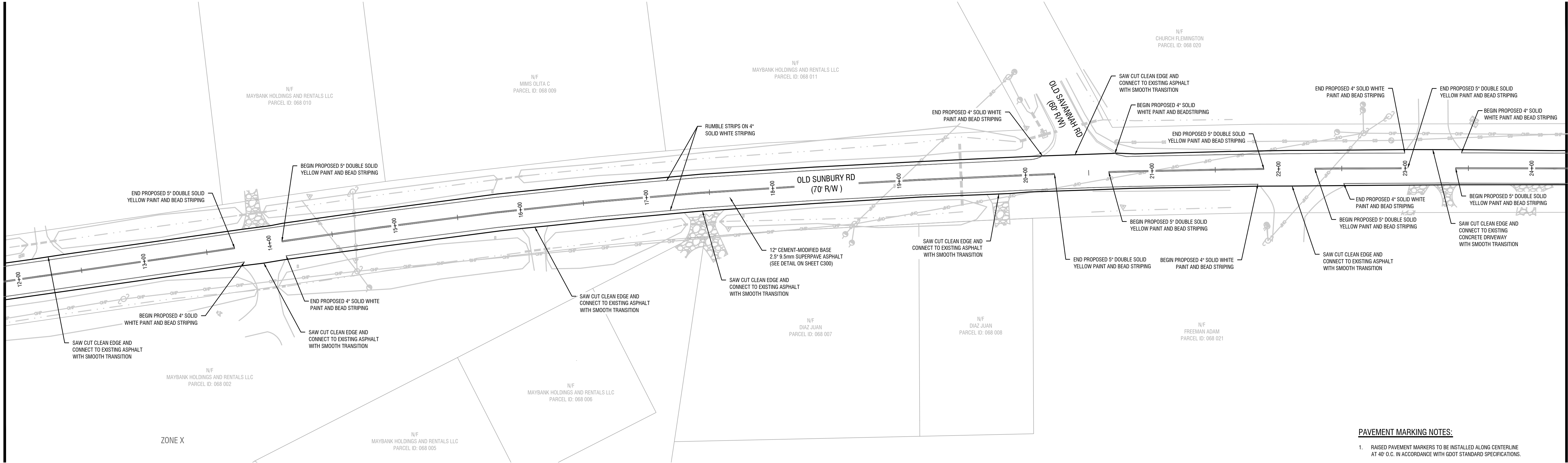
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FILE NO: 2023-80

PLOT DATE: June 11, 2024



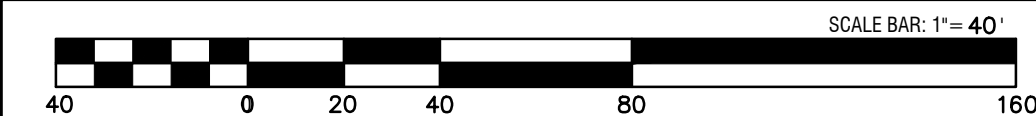
MATCHLINE OLD SUNBURY RD STA:11+88.59



MATCHLINE OLD SUNBURY RD STA:24+27.61
(SEE SHEET C205 FOR CONTINUATION)

PAVEMENT MARKING NOTES:

1. RAISED PAVEMENT MARKERS TO BE INSTALLED ALONG CENTERLINE AT 40' O.C. IN ACCORDANCE WITH GDOT STANDARD SPECIFICATIONS.



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FLEMINGTON
ROAD
IMPROVEMENTS

OLD SUNBURY
SITE PLAN

C204

FILE NO: 2023-80
PLOT DATE: June 11, 2024

STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA.			

REVERSIBLE LANE SIGN OR SIGNAL SYSTEM REQUIRED
TWO-WAY TRAFFIC WITH A REVERSIBLE CENTER LANE

DIVIDED HIGHWAY WITH RAISED MEDIAN

TWO-WAY TRAFFIC WHERE MOTORISTS IN A SINGLE LANE ARE PERMITTED TO PASS

TYPICAL LOCATION OF CROSSWALKS AND STOP BARS

MULTI-LANE, TWO-WAY TRAFFIC WITH SINGLE LANE, TWO-WAY LEFT TURN CHANNELIZATION

ONE-WAY TRAFFIC WITH ADDED TURN LANES

CROSSWALK DETAIL

* USE WHERE THE LANE WIDTH EXCEEDS 12' OR WHERE LANE LINES HAVE BEEN OMITTED

GENERAL NOTES:

1. SPACING BETWEEN DOUBLE LINES SHALL BE EQUAL TO THE LINE WIDTH.
2. EDGE LINES SHALL BE PLACED A MINIMUM OF 4 INCHES FROM THE NORMAL EDGE OF PAVEMENT.
3. CONTRAST MARKINGS FOR SKIP STRIPING SHALL BE AS SHOWN IN DETAIL T-11B.

DEPARTMENT OF TRANSPORTATION STATE OF GEORGIA		CONSTRUCTION DETAILS PAVEMENT MARKING PLACEMENT NON-LIMITED ACCESS ROADWAY	
		NO SCALE	
DATE DESIGNED DRAWN CHECKED	3-15-00 REVISION	JANUARY 2000 NUMBER T-11A	
	ADDED GENERAL NOTE 3		
	COR.		

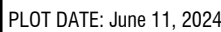


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B. BID FORM

Bid Item	Quantity	Units	Description	Unit Price	Cost
1	35	SY	Concrete Pavement Removal	\$	\$
2	640	SY	Full-Depth Roadway Removal	\$	\$
3	675	SY	10" Granular Roadway Base	\$	\$
4	35,525	SY	Full-Depth Roadway Pulverization	\$	\$
5	1	LS	Shoulder Scrapping & Grubbing	-	\$
6	35,525	SY	Recycling Agent (Stabilization) for Base Course	\$	\$
7	36,200	SY	2.5" 9.5mm Asphalt Paving	\$	\$
8	15	SY	Concrete Valley Gutter	\$	\$
9	1	LS	Shoulder Grassing	-	\$
10	11	LF	24" Thermoplastic Stop Bar	\$	\$
11	280	LF	8" Thermoplastic Crosswalk Striping	\$	\$
12	635	LF	4" Thermoplastic Solid White Line Striping	\$	\$
13	270	LF	5" Thermoplastic Double Solid Yellow Line Striping	\$	\$
14	24	LF	24" Paint & Bead Stop Bar	\$	\$
15	25,465	LF	4" Paint & Bead Solid White Line Striping	\$	\$
16	6,330	LF	5" Paint & Bead Double Solid Yellow Line Striping	\$	\$
17	1,240	LF	5" Paint & Bead Dashed Yellow Line Striping	\$	\$
18	4,100	LF	5" Paint & Bead Dashed/Solid Yellow Line Striping	\$	\$
19	20,150	LF	Rumble Strips on 4" White Striping	\$	\$
20	3	EA	Transverse Rumble Strips before Stop Sign	\$	\$
21	12,700	LF	Raised Pavement Markers	\$	\$
22	1	LS	Traffic Control	-	\$
23	1	LS	Mobilization (5% Max)	-	\$
				SUBTOTAL	\$
Alternative A					
24.A	36,200	SY	4" Granular Roadway Base	\$	\$
Alternative B					
24.B	36,235	SY	1.5" Open Graded Crack Relief Interlayer	\$	\$
				TOTAL BID	\$

**SECTION 01150
MEASUREMENT AND PAYMENT**

PART 1 - GENERAL

1.01 QUANTITIES

- A. Quantities: Quantities listed in the Proposal are approximate only and are intended to serve as a guide in comparing bids, and may be increased or decreased without invalidating the unit price bid.
- B. Payment: Contractor shall be paid for actual in place quantities as determined by the Engineer field measurements.
- C. Discrepancies: In case of discrepancies between the figures shown in the unit prices and totals, the unit prices shall apply and the totals shall be corrected to agree with the unit price.

PART 2 - MEASUREMENT AND PAYMENT

2.01 CONCRETE PAVEMENT REMOVAL

- A. Measurement: Measurement shall be made on the basis of the number of square yards of graded aggregate base applied to the roadway at the specified thickness as shown on the construction plans. Irregular areas such as turnouts, filler strips, and intersections will be measured to the closest square yard.
- B. Payment: Payment will be made on the basis of the number of square yards of granular crusher run (graded aggregated) base at the specified thickness applied to the roadway at the unit price state in the bid. The price shall include all labor, equipment, and material to complete the task. The task shall include, but not be limited to, furnishing, hauling, placing and compaction of the crusher run base in order to bring the base to the lines, grades, and cross sections shown of the construction plans or established by the Engineer.

2.02 FULL-DEPTH ROADWAY RECLAMATION

- A. Measurement: Measurement shall be made on the basis of each square yard of pavement to undergo full-depth reclamation in accordance with the plans, specifications, and bid documents.
- B. Payment: Payment will be made on the basis of the unit price stated in the bid. The unit price shall include furnishing all labor, materials, and equipment necessary to complete this item of work. Work shall include, but not be limited to, pulverization of roadway and base material, addition of chemical stabilizers, compaction of new base mix, and curing of mix.

2.03 GRANULAR ROADWAY BASE

- A. Measurement: Measurement shall be made on the basis of the number of square yards of graded aggregate base applied to the roadway at the specified thickness as shown on the construction plans. Irregular areas such as turnouts, filler strips, and intersections will be measured to the closest square yard.

- B. Payment: Payment will be made on the basis of the number of square yards of granite crusher run (graded aggregated) base at the specified thickness applied to the roadway at the unit price stated in the bid. The price shall include all labor, equipment, and material to complete the task. Work shall include, but not be limited to, the furnishing, hauling, placing, and compaction of the crusher run base in order to bring the base to the lines, grades, and cross sections shown on the construction plans or established by the Engineer.

2.04 SHOULDER SCRAPING & GRUBBING

- A. Measurement: Measurement shall be made on the basis of the percentage complete of the task in accordance with the plans and specifications.
- B. Payment: Payment will be made at the lump sum stated in the bid. The price bid shall include furnishing all labor, materials, and equipment necessary to complete this item. Work shall include, but is not limited to, removal of all trees, shrubs, grass, soil, sand, and undergrowth that presently exist along the shoulder, preventing the construction of this project. All material removed including vegetation, roots and organic mat shall be removed from the site and disposed of at a permitted site. The contractor shall take special care not to disturb the roots of trees that are marked to remain. Trees to be saved shall be marked and approved by the engineer prior. Trees to be saved shall have the appropriate tree protection installed.

2.05 ASPHALT PAVING OVERLAY/CRACK PROOF INTERLAYER

- A. Measurement: Measurement will be made on the basis of each square yard of asphalt in place, in accordance with the plans and specifications and accepted by the Engineer.
- B. Payment: Payment will be made on the basis of the number of square yards of asphalt in place, in accordance with the unit price bid as stated in contract. Work shall include, but is not limited to, the furnishing, hauling, placing, and compaction of the asphalt and aggregate in order to bring the pavement to the lines, grades and cross sections as designated on the construction plans. The unit price shall also include all surface cleaning, prime, tack, and pavement markings. All striping shall be in accordance with the current MUTCD and local specifications.

2.06 ADJUSTING TO GRADE OF MISCELLANEOUS ROADWAY STRUCTURES

- A. Measurement: Measurement will be made on the basis of adjusting each structure to grade, to determine the unit or units of each type completed and accepted, in accordance with the plans and specifications and accepted by the engineer. Structure tops to be raised or lowered 2 ft. (600 mm) or less are considered "Adjust to Grade."
- B. Payment: Payment will be made on the basis of each structure adjusted to grade. The unit price bid shall include all labor, materials and equipment necessary, including, but not limited to, excavation, shoring and sheeting, dewatering, gravel bedding, castings, backfill, compaction and complete surface restoration. Payment is full compensation for adjusting to grade the structures as specified in this Specification.

2.07 CURB AND GUTTER, VALLEY GUTTER, AND CONCRETE BANDS

- A. Measurement: Measurement will be made on the basis of each linear foot of curb and gutter installed to the lines and grades shown on the plan. The size of the curb and gutter will be shown on the plans and indicated on the bid documents.
- B. Payment: Payment shall be made on the basis of the unit price stated in the bid. The price bid shall include all materials, labor, and equipment necessary to complete the work. Work shall include, but is not limited to, all excavation, forming, grade staking, compaction, curb and gutter installation, dewatering, form wrecking, cleanup, and surface restoration

2.08 GRASSING

- A. Measurement: Measurement shall be made on the basis of the completed item in accordance with the construction plans and bid items.
- B. Payment: Payment will be made in accordance with the price stated in the bid. The unit price shall include, but is not limited to, furnishing all labor, materials, and equipment necessary for the satisfactory growth of grass on all disturbed areas in accordance with plans and specifications. Work shall include, but not be limited to, furnishing all materials, fertilizer, soil samples, grass seed, raking, leveling, watering, maintenance, and final surface restoration. Final payment will not occur until permanent grass is established.

2.09 THERMOPLASTIC PAVEMENT MARKING

- A. Measurement: Measurement shall be made on the basis of each linear foot of pavement markings in place in accordance with the plans and specifications.
- B. Payment: Payment shall be made at the linear footage stated in the bid. The unit price bid shall include all labor, materials, and equipment necessary to complete the task. The task shall include, but is not limited to, supplying and installing all thermoplastic pavement markings to replace existing in accordance with construction plans, surface restoration, and cleanup.

2.10 PAINT AND BEAD PAVEMENT MARKING

- A. Measurement: Measurement shall be made on the basis of each linear foot of pavement markings in place in accordance with the plans and specifications.
- B. Payment: Payment shall be made at the linear footage stated in the bid. The unit price bid shall include all labor, materials, and equipment necessary to complete the task. The task shall include, but is not limited to, supplying and installing all paint and bead pavement markings to replace existing in accordance with construction plans, surface restoration, and cleanup.

2.11 RUMBLE STRIPS ON SHOULDER

- A. Measurement: Measurement shall be made on the basis of each linear foot of rumble strips in place in accordance with the plans and specifications.

- B. Payment: Payment shall be made at the linear footage stated in the bid. The unit price bid shall include all labor, materials, and equipment necessary to complete the task. The task shall include, but is not limited to, installing all rumble strips to replace existing in accordance with construction plans, surface restoration, and cleanup.

2.12 TRANSVERSE RUMBLE STRIPS BEFORE STOP SIGN

- A. Measurement: Measurement shall be made on the basis of each transverse rumble strip in place in accordance with the plans and specifications.
- B. Payment: Payment shall be made at the unit price stated in the bid. The unit price bid shall include all labor, materials, and equipment necessary to complete the task. The task shall include, but is not limited to, installing all rumble strips to replace existing in accordance with construction plans, surface restoration, and cleanup.

2.13 RAISED PAVEMENT MARKERS

- A. Measurement: Measurement shall be made on the basis of each linear foot of raised pavement markers in place in accordance with the plans and specifications.
- B. Payment: Payment shall be made at the linear footage stated in the bid. The unit price bid shall include all labor, materials, and equipment necessary to complete the task. The task shall include, but is not limited to, installing all raised pavement markers in accordance with construction plans, surface restoration, and cleanup.

2.14 TRAFFIC CONTROL

- A. Measurement: Measurement shall be made on the basis of the percentage complete of the lump sum bid in accordance with the construction plans and bid items.
- B. Payment: Payment shall be made on the basis of the percentage complete of the lump sum price stated in the bid as determined by the project engineer. The lump sum shall include furnishing all labor, materials, and equipment necessary to complete the task. The task shall include, but is not limited to, the placing, moving, and maintenance of all signage, barricades, cones, barrels, flagging, flag men, and guide vehicles throughout the construction process to safely reroute traffic from existing traffic patterns. Traffic control shall be done in a manner to safely warn, reroute, and lead vehicles to their destination. Additional signage will be required if the engineer deems that the traffic control in place does not fully meet the required intent of the task. Changing of existing traffic patterns shall be communicated with the engineer no less than 48 hours prior to.

2.15 MOBILIZATION

- A. Payment will be made for the price as stated in the Contract once the Contractor has established his construction yard, and met the requirements established in the Contract Documents. Mobilization will be recognized complete once the Contractor has provided a construction schedule and moved his equipment and a substantial amount of material to the job site. Construction must be underway and progressing. Payment for mobilization will be limited to a maximum amount not to exceed 5% of the bid price.

END OF SECTION

Section 919—Raised Pavement Markers

919.1 General Description

This section includes the requirements for raised pavement marker materials for use in reflective, ceramic, and channel markers.

919.1.01 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

ASTM C 424

ASTM C 373

ASTM D 2240

ASTM D 4280

Federal Method TT-T-141, Method 4252

919.2 Materials

A. Requirements

Do not use any marker materials until the laboratory approves it.

1. Use raised pavement marker sources as listed in [QPL 76](#).
2. Use raised pavement markers of the type shown in the Plans or specified in the proposal. This Specification references markers as follows:

Type	Description
1	One-way, one-color, 4 x 2 in (100 mm x 50 mm), reflective
2	Two-way, one-color, 4 x 2 in (100 mm x 50 mm), reflective
3	Two-way, two color, 4 x 2 in (100 mm x 50 mm), reflective
4	Round white, yellow or black ceramic, non reflective
5	Oval white, yellow or black ceramic, non-reflective
6	Oval white or yellow ceramic, reflective
7	White or yellow ceramic jiggle bar, non-reflective
8	White or yellow ceramic jiggle bar, reflective
9	White or yellow channel, non-reflective
10	White or yellow channel, reflective
11	Two-way, one-color, 4 x 4 in (100 mm x 100 mm), reflective
12	One-way, one color, 4 x 4 in (100 mm x 100 mm), reflective
13	Two-way, two color, 4 x 4 in (100 mm x 100 mm), reflective

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14	Two-way, one color, flexible reflective
15	One-way, one color, flexible reflective

3. Definitions

- Angle of Incidence: Formed by a ray from the light source to the marker, and the normal to the leading edge of the marker face.
- Angle of Divergence: Formed by a ray from the light source to the marker and the return ray from the marker to the measuring receptor.
- Specific Intensity: The mean candela of the reflected light at a given incidence and divergence angle for each lux at the reflector on a plane perpendicular to the incident light.

4. Sampling

The Department will select at random the required number of markers for initial tests for each shipment or lot, as follows:

Reflective Markers	Ceramic Markers	Channel Markers
50	25	5

5. Certification

Submit a certification to the Engineer from the manufacturer showing the physical properties of the markers and their conformance to this Specification.

6. Packaging

Pack shipments in containers that are acceptable to common carriers.

- Pack the containers to ensure delivery in perfect condition.
- Clearly mark each package of pavement markers with the size, color, type, and lot number.
- You are liable to replace any damaged shipments.

7. Acceptance

The Department will give conditional approval to raised pavement markers evaluated by the National Transportation Product Evaluation Program (NTPEP), the Georgia Department of Transportation, or other Department-approved test facilities and place them on [QPL 76](#).

All white raised pavement markers must meet the requirements of this Specification and the following field performance requirements.

- Conditional [QPL](#) Placement: The Department may add markers on a conditional basis to [QPL 76](#). These markers must maintain an average Coefficient of Retroreflected Luminous Intensity of 1.5 candles per footcandle (cd/fc)* after a one-year field evaluation period through at least one of the test facilities specified above.
- Final Acceptance or Rejection: The Department will accept or reject markers based on the marker maintaining an average Coefficient of Retroreflected Luminous Intensity of 0.5 candles per footcandle (cd/fc)* after a two-year field evaluation period through at least one of the test facilities specified above.

NOTE: Measure the coefficient of retroreflected luminous intensity at the 0 degree incident angle and 0.2 degree divergence angle.

919.2.01 Reflective Pavement Markers

A. Requirements

Plastic reflective pavement markers are types 1, 2, 3, 11, 12, and 13 (rigid plastic reflective) and types 14 and 15 (flexible reflective).

1. Rigid Plastic Reflective Markers

- a. Use prismatic markers made with a methyl methacrylate or acrylonitrile butadiene styrene, a high-impact plastic shell filled with a mixture of inert thermosetting compound and filler material.
 - 1) Ensure that the exterior shell surface is smooth and contains one or two prismatic faces, molded to reflect incident light from a single direction or from opposite directions.
 - 2) Ensure that the shell is one color or a combination of two colors that will be the same as reflective elements and shall match the size and shape in the Plans.
- b. Use two basic sizes—a standard (a base of 4 x 4 in [100 mm x 100 mm]) or a low-profile (a base of 4 x 2 in [100 mm x 50 mm]).
 - 1) Ensure that reflective raised pavement markers have one or two lens surfaces that meet the requirements of ASTM D 4280, designation H—a marker with a hard, abrasion-resistant lens surface.
 - 2) Ensure the marker base is clean and has no gloss or substance that may reduce the adhesive's bond. The Department will reject the marker if it has a soft or resin-rich film on the base.

2. Flexible Reflective Markers (Type 14 and 15)

Use markers manufactured by extruding plastic into an “L” shape, with nominal dimensions of 4 in (100 mm) long x 2 in (50 mm) high (vertical face) x 1 in (25 mm) wide (base leg). Ensure that the markers have the following:

- A pressure-sensitive adhesive with a paper release liner to the bottom of the base leg.
- Strips of metallized acrylic reflective sheeting on either one or both sides of the vertical face.
- A clear plastic cover to protect the reflective strip. Ensure that the cover withstands a chip-seal operation and is easily removed after the operation.

3. Color

Use clear, yellow, or red raised reflective pavement markers, as required.

If the reflection is off-color, the Department will reject the markers.

4. Specific Intensity

Ensure that the specific intensity of each reflective surface, when tested at 0.2 degree angle of divergence, has at least these values:

Incidence Angle	Clear	Yellow	Red
0°	3.0	1.50	0.75

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20°	1.2	0.60	0.30
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Calculate the intensity as follows:

$$SI = (R_L \times D^2) \div I_L$$

Where:

SI = Specific Intensity

I_L = Incident Light

R_L = Reflected Light

D = Test Distance

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will accept markers based on the results of the physical tests and on the manufacturer's certification showing the physical properties of the markers and their conformance to this Specification.

The Department will conduct the following tests:

- Specific Intensity
- Compressive Strength
- Impact
- Temperature Cycle
- Shore A Hardness (Type 14 and 15 only)

1. Specific Intensity

- Place markers so the center of the reflecting face is 5 ft (1.5 m) from a uniformly bright light source. Use a source with an effective diameter of 0.21 in (5 mm).
If using a test distance other than 5 ft (1.5 m), modify the source and receptor in the same proportion as the test distance.
- Use a photocell receptor 0.5 in (13 mm) wide. Shield it to eliminate stray light.
- Place the center of the light source aperture 0.2 in (5 mm) from the center of the photocell.
- Use the following table to determine if the markers pass the tests (except the strength test), unless otherwise specified.

Markers that Pass	Department Action
48 of 50	Accept the lot.
44 or less of 50	Reject whole lot; no retest allowed.
45-47 of 50	Contractor can request a retest on 100 markers. The Department will pass each marker through all tests except the strength test.
96 of 100 retested	Accept the whole shipment
95 or less of 100 retested	Reject the whole shipment

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2. Compressive Strength

Test for compressive strength as follows:

Standard Raised Markers 4 x 4 in (100 x 100 mm)	Low-Profile Markers 4 x 2 in (100 x 50 mm)
1. Select three random markers for the test.	
2. Center the base of the marker over the open end of a hollow, vertically positioned metal cylinder (1 in (25 mm) high, internal diameter of 3 in (75 mm), wall thickness of 0.25 in (6 mm)).	2. Position the marker on its base at the center of a flat, steel plate that has a minimum thickness of 0.5 in (13 mm).
3. Apply a load to the top center of the marker with a 1 in (25 mm) diameter solid steel plug at a rate of	
0.2 in (5 mm) per minute.	0.03 in (0.75 mm) per minute.
4. The marker fails if it breaks or deforms at a load less than	
2,000 lbs (8.9 kN)	4,000 lbs (17.8 kN)
Or if the shell and the filler material significantly delaminate, regardless of the load required to break the marker.	
5.If any of the 3 samples fail, the Department will test 6 additional samples.	
6.If any of the 6 additional samples fail, the Department will reject the entire lot.	

3. Impact Test

- Condition all prismatic reflective faces that meet the requirements of ASTM D 4280, designation H, before the impact test.
- Choose at random 20 markers for each test.
- Condition the markers in an oven at 130 °F (54° C) for one hour.
- While at this temperature, drop a 0.42 lb (0.2 kg) dart fitted with a 0.25 in (6 mm) radius spherical head from 18 in (450 mm) above the reflective face.
- Drop the dart perpendicularly onto the center of the reflective surface. The cracks in the impact area shall appear generally concentric.
- The Department will reject the marker if more than two radial cracks longer than 0.25 in (6 mm) appear, or if radial cracks extend to the edge of the reflective face.
- Use the following table to determine if the markers pass the tests.

Markers that Pass	Department Action
18 of 20	Accept the lot.
16 of 20	Reject the lot.
17 of 20	The Contractor may request a retest. The Department will test 20 additional lenses.
19 or less of 20 retested	Reject the lot.

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4. Temperature Cycle

- a. Subject the same markers used for impact testing to 3 cycles of 140 °F (60 °C) for 4 hours followed by 20 °F (–7 °C) for 4 hours.
- b. The Department will reject the markers if they crack or delaminate after this test.
- c. Use the following table to determine if the markers pass the tests.

Markers That Pass	Department Action
18 of 20	Accept the lot.
16 of 20	Reject the lot.
17 of 20	The Contractor may request a retest. The Department will test 20 additional lenses.
19 or less of 20 retested	Reject the lot.

5. Hardness (Type 14 or 15 only)

- a. Select five random markers.
- b. Use ASTM D 2240 to determine the Shore A hardness.
- c. Measure the hardness. The Department will reject markers whose body and clear protective cover hardness is less than 80.

D. Materials Warranty

General Provisions 101 through 150.

919.2.02 Ceramic Pavement Markers

A. Requirements

Ceramic pavement markers are types 4, 5, 6, 7, and 8.

1. Use ceramic pavement markers made from a heat-fired, white, vitreous, ceramic base and a heat fired, opaque, glazed surface to produce the properties required in these Specifications.
 - a. Do not place glaze on the marker bottom where it connects to the road surface.
 - b. Thoroughly and evenly mature the markers. Ensure that they have no defects that affect appearance and serviceability.
 - c. Use reflective ceramic markers that meet the specific intensity of each reflective surface according to [Subsection 919.2.01.A.4.](#)
 - d. Ensure that the mean thickness of the glazed surface is at least 0.005 in (0.13 mm) when measured at least 0.25 in (6 mm) from the edge of the marker.
 - e. Ensure that the water absorption of the ceramic markers does not exceed 2 percent of the original dry weight when tested according to ASTM C 373.
 - f. Ensure that the glazed surface does not craze, spoil, or peel when passed through one cycle of the Autoclave test at 250 psi (1724 kPa) (ASTM C 424).

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2. Use the designated colors for the white and yellow markers.
 - a. Ensure that the colors are uniform.
 - b. Ensure that black matches Federal Color No. 595-27038.
 - c. Determine the color by visually comparing each marker with calibrated standards having CIE Chromaticity Coordinate limits. Determine the limits with Federal methods of test TT-T-141, Method 4252, using a rectangle with the following corner points:

	1		2		3		4		(90MGO)
White	.290	.316	.310	.296	.330	.320	.310	.344	80 min.
Yellow	.435	.485	.445	.435	.544	.456	.516	.484	50 min.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

1. Use a random sample of five markers for each of the required tests in [Subsection 919.2.01.C.3](#) to [Subsection 919.2.01.C.4](#), and [Subsection 919.2.01.C.5](#). Use the Compressive Strength Test in [Subsection 919.2.02.C.3](#).
2. Use the following table to determine if the markers pass the tests.

Markers that Pass	Department Action
5 of 5	Accept the lot.
3 or less of 5	Reject the lot; no resample allowed.
4 of 5	The Contractor may request a retest. The Department will retest an additional 25 random markers in the test or tests where the original sample failed.
20 of 25 retested	Accept the lot.
19 or less of 25 retested	Reject the lot; no resample allowed.

3. Compressive Strength Test
 - a. Center the markers with the base down over the open end of a vertically positioned hollow metal cylinder. Use a cylinder 1 in (25 mm) high with an internal diameter of 3 in (75 mm) and a wall thickness of 0.25 in (6 mm).
 - b. Apply a load at 0.2 in (5 mm) per minute to the top of the markers through a 1 in (25 mm) diameter solid metal cylinder centered on the top of the markers.
 - c. Apply the load until the marker breaks.
 - d. The markers pass if the average compressive load of all five markers is at least 1,500 psi (6.7 kN). No individual marker shall be less than 1,200 psi (5.3 kN).

D. Materials Warranty

General Provisions 101 through 150.

919.2.03 Channel Pavement Markers

A. Requirements

Channel pavement markers are type 9 and 10 markers only.

1. Use channel pavement markers made of either a heat-fired, white, vitreous, ceramic base with a heat-fired, opaque, glazed surface, or a 9 gauge (3.9 mm) steel body with a heat-fired porcelain finish.
 - a. Ensure both ceramic and steel channel markers have no defects that affect appearance and serviceability.
 - b. Ensure that the mean thickness of the glazed surface of ceramic channel markers is at least 0.005 in (0.13 mm) when measured at least 0.25 in (6 mm) from the edge of the marker.
 - c. Ensure that mean thickness of the porcelain finish on the steel channel markers is at least 0.030 in (0.76 mm).
 - d. Ensure that the water absorption of the ceramic markers does not exceed 2.0 percent of the original dry weight when tested according to ASTM C 373.
 - e. Ensure that the surface of the markers do not craze, spoil, or peel when passed through one cycle of the Autoclave test at 250 psi (1724 kPa) (ASTM C 424).
2. Use the designated colors for the white and yellow markers.
 - a. Ensure that the colors are uniform.
 - b. Determine the color by visually comparing them with calibrated standards having CIE Chromaticity Coordinate limits. Determine the limits with Federal methods of test TT-T-141, Method 4252, using a rectangle with the following corner points:

	1		2		3		4		(90MGO)
White	.290	.316	.310	.296	.330	.320	.310	.344	80 min.
Yellow	.435	.485	.445	.435	.544	.456	.516	.484	50 min.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

1. Ensure that Type 10 markers meet the specific intensity of each reflective surface according to [Subsection 919.2.01.A.4](#)
2. Use a random sample of five markers for each of the required tests in [Subsection 919.2.01.C.2](#), [Subsection 919.2.01.C.3](#), [Subsection 919.2.01.C.4](#), and [Subsection 919.2.01.C.5](#).
3. Select two of the five markers and subject them to all the required tests.
4. Use the following table to determine if the markers pass the tests.

Markers that Pass	Department Action
2 of 2	Accept the lot.
0 of 2	Reject the lot; no resample allowed.

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1 of 2	Retest the three remaining markers.
3 of 3 retested	Accept the lot.
2 or less of 3 retested	Reject the lot; no resample allowed

D. Materials Warranty

General Provisions 101 through 150.