

# PROJECT SPECIFICATIONS

**CITY OF HARRISON**  
**CLARE COUNTY, MI**

**2ND STREET PARKING LOT**

**August 2024**  
**866510**



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## SECTION 31 20 00

### EARTHWORK

#### PART 1 - GENERAL

##### 1.01 SUMMARY:

- A. This Section includes earthwork for foundations, floor slabs, miscellaneous exterior concrete, concrete and asphalt pavements, yard piping and rough site grading.

##### 1.02 REFERENCES:

- A. MDOT - Michigan Department of Transportation, "*2020 Standard Specifications for Construction*".
- B. ASTM - American Society of Testing Materials, latest edition.

##### 1.03 DEFINITIONS:

- A. Maximum Density: Maximum unit weight per volume for an established material.
- B. Optimum Moisture: Percentage of water at maximum density.
- C. Borrow: Material required for earthwork construction in excess of the quantity of suitable material available from required excavation grading or cutting. Borrow may be necessary even though not shown on the plans.
- D. Suitable Excavated Material: Mineral (inorganic) soil free of cinders, refuse, sod boulders, rocks, pavement soft or plastic clays, vegetable or other organic material capable of being compacted as specified. Moisture content has bearing on the suitability of materials to be used.
- E. Granular Material: Coarse grained materials having no cohesion, which derive their resistance to displacement from internal stability.
- F. Cohesive Material: Fine grained material which produces resistance to displacement by mutual attraction between particles. Clays are cohesive.
- G. Rough Grade: Earth grade before placing structure or landscaping.
- H. Subgrade: Earth grade upon which a pavement structure is to be placed.
- I. Rock Excavation: Boulders or rock weighing 4,000 pounds (approximately one cubic yard) or more and all solid or ledge rock, slate, shale, sandstone and other hard materials that require continuous use of pneumatic tools, heavy rippers or continuous drilling and blasting for removal. Pavements are not included.
- J. Proof Rolling: Applying test loads over the rough grade or subgrade surface by means of a heavy pneumatic tire roller or other approved means, to locate and permit timely correction of deficiencies likely to adversely affect performance of the pavement structure.

1.04 JOB CONDITIONS:

- A. If, during progress of the work, testing indicates that materials do not meet specified requirements, remove defective work and replace at no cost.
- B. Protect and preserve all public and private property including existing vegetation, landscape features, monuments within, along and adjacent to the work area.
- C. Moisture content has bearing on the suitability of material to be used.
  - 1. The moisture content of a material may be such that its use will require extensive manipulation to achieve required compaction.
  - 2. It is the Contractor's responsibility to determine the economics of using or disposing and replacing of such materials.
  - 3. Materials determined by the Contractor to be uneconomical for use may be disposed on-site in areas approved by the Engineer and shall be replaced with other material at no additional cost to the Owner.

**PART 2 - PRODUCTS**

2.01 MATERIALS:

- A. Fill:
  - 1. Granular Material shall be MDOT 902.07, Table 902-3, Class III limited to 1.0-inch maximum size.
  - 2. Select Granular Material shall be MDOT 902.07, Table 902-3, Class II or IIA limited to 1.0-inch maximum size.
  - 3. Suitable Excavated Material: ARTICLE 1.03 DEFINITIONS.
  - 4. Clay Liner Material: Unified Classification CL, CH, ML, MH.
- B. Topsoil: Surface soils containing organic matters and productive of plant life.
- C. Pipe Bedding: Compact granular material.

**PART 3 - EXECUTION**

3.01 PREPARATION:

- A. Clearing and Grubbing: MDOT Sections 201 and 202.
  - 1. Remove trees and shrubs as required, unless otherwise indicated.
  - 2. Grub out all stumps and roots:
    - a. To a minimum depth of 4 feet below finished grade within roadways.
    - b. To a minimum depth of 2 feet below finished grade in other locations.
  - 3. Remove all debris from site resulting from clearing and grubbing.
- B. Remove topsoil from all areas of new construction and stockpile on site in designated areas.
- C. Utilities:
  - 1. Before starting excavation, establish location and extent of underground utilities in work area.
  - 2. Notify utility companies to remove and relocate lines which are in conflict with the proposed utility.
- D. Protect Plantings and other features to remain as part of final landscaping.

### 3.02 EXCAVATION:

- A. Excavate as required for construction of the work. Utilize or dispose of excavated materials as required.
  - 1. Protect excavation by shoring, bracing, sheet piling or other methods as required.
  - 2. Remove unsuitable material to firm underlying soils beneath footings, pipelines, floor slabs, paved areas and walks.
- B. Preparation of Subgrade:
  - 1. Compact top 12 inches of subgrade under footings, slabs, pavement structure areas and walks to ninety-five percent (95%) maximum density unless otherwise specified.
  - 2. Compact top 12 inches under landscaped areas to eighty-five percent (85%) maximum density.
- C. Utilities:
  - 1. Maintain, reroute or extend existing utility lines to remain in excavation area, as required.
  - 2. Protect utility services uncovered by excavation.
  - 3. Cap off, plug or seal discontinued utility services and remove from site within excavated areas.

### 3.03 FILL:

- A. Under Floor Slabs and Exterior Slabs: Place select granular material in layers maximum 9 inches deep compacted to ninety-five percent (95%) maximum density.
- B. Under Roadways and within a 1 on 1 influence of the roadway edges: Place suitable excavated material or granular material in layers maximum 9.0 inches deep compacted to ninety-five percent (95%) maximum density.
- C. Under Foundations: Place select granular material in layers maximum 9.0 inches deep compacted to ninety-five percent (95%) maximum density.
- D. Clay Liner: Place clay liner material in layers 9.0 inches deep compacted to minimum ninety-five percent (95%) Maximum Density.
- E. Landscape Areas: Place suitable excavated material or granular material in layers maximum 12 inches deep compacted to eighty-five percent (85%) maximum density.

### 3.04 ROUGH GRADING:

- A. Rough grade to levels, profiles, contours and elevations required for finished grades and surface treatment.
- B. Maintain the following rough grades:
  - 1. Sidewalk: 4 inches below finished grade.
  - 2. Floor slabs, exterior slabs and sidewalk at driveways: 6 inches below finished grade.
  - 3. Pavement surfaces: As shown on drawings.
  - 4. Landscape areas: 4 inches below finished grade to receive topsoil.

3.05 PROOF ROLL SUBGRADE SURFACE:

- A. Perform two complete passes over area to receive pavement structure.
- B. Correct deficiencies identified during proof rolling:
  - 1. Fill depressions with compacted material similar to subgrade soil.
  - 2. Undercut areas not providing satisfactory support for pavement structure:
    - a. Fill with compact granular material.
    - b. Place geotextile fabric when soil below undercut will not satisfactorily support construction equipment.

3.06 DEWATERING:

- A. Provide dry excavations until structures have been placed and fill is complete.
- B. Provide and maintain slopes, crowns, ditches and ponds to ensure satisfactory surface drainage at all times.
  - 1. Construct ditches and other drainage facilities necessary to remove ponded water as soon as practical to provide dry work areas for progression of the work.
  - 2. Interruption of surface drainage or underdrainage: Provide temporary drainage facilities until permanent drainage work complete.

3.07 COMPACTION:

- A. Place and compact all required materials and provide proper control of moisture content of the material and other details necessary to obtain satisfactory results.
  - 1. Remove materials that cannot be compacted with manipulation and moisture control.
  - 2. Replace with suitable excavated material or granular material at no additional cost.
- B. Correct any deficiencies resulting from insufficient or improper compaction. Retest if required.
- C. Provide equipment and personnel for access to test locations.
- D. Moisture - Density Relationship:
  - 1. Cohesive (Clays) or Granular (Sands) Soils: ASTM D1557 (Modified Proctor).
- E. Testing will be by ENGINEER or OWNER approved independent laboratory.

3.08 SURPLUS MATERIALS:

- A. Surplus excavated or unsuitable excavated material shall become the property of the Contractor.
- B. Dispose of surplus or unsuitable materials off-site.
- C. Disposal On-Site: In accordance with MDOT 201.03.A.4.

**END OF SECTION**

## SECTION 31 23 33

### TRENCHING, EXCAVATING, BACKFILLING AND COMPACTING

#### PART 1 - GENERAL

##### 1.01 SUMMARY:

- A. This Section includes the work required for trenching, excavating and backfilling, special pipe foundations and special work below grade.

##### 1.02 DEFINITIONS:

- A. Maximum Density: Maximum dry weight in pounds per cubic foot of a specific material.
- B. Optimum Moisture: Percentage of water at maximum density.
- C. Rock Excavation: Includes all boulders or rock weighing 4,000 pounds (approximately one cubic yard) or more and all solid or ledge rock, slate, shale, sandstone and other hard materials that require continuous use of pneumatic tools, heavy rippers or continuous drilling and blasting for removal. Pavements are not included.
- D. Suitable Excavated Material: Mineral (inorganic) soil free of cinders, refuse, sod, boulders, rocks, pavement, soft or plastic clays, vegetable or other organic material, and capable of being compacted as specified. Moisture content has bearing on the suitability of materials to be used.
- E. Granular Material: Coarse grained materials having no cohesion, which derives its resistance to displacement from internal stability.
- F. Cohesive Material: Fine grained material which derives its resistance to displacement by manual attraction between particles of the mass, involving forces of molecular origin (i.e. Clays are considered cohesive).
- G. Grade Terminology: In accordance with the detail.

##### 1.03 REFERENCES:

- A. MDOT - Michigan Department of Transportation, *"2020 Standard Specifications for Construction"*.
- B. ASTM - American Society of Testing Materials, latest edition.

##### 1.04 JOB CONDITIONS:

- A. Obtain and comply with construction permits from agencies having jurisdiction over the work.
- B. Scheduling: Clean up promptly following utility installation backfilling.
- C. Dust Control: Broom or apply dust palliatives as needed.

- D. Driveway Closing: Eight (8) hour maximum with prior notification to resident. Maintain emergency access to all properties during construction.
- E. Signs, mailboxes and other movable surface features:
  - 1. Witness location prior to removal. Relocate to accessible location and maintain during construction.
  - 2. Upon completion of construction, replace to original position and condition.
  - 3. Replace regulatory traffic control signs immediately after utilities are placed and backfilled.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS:**

- A. Trench Backfill:
  - 1. Trench backfill shall not contain frozen soil.
  - 2. Granular Material shall be MDOT 902.07, Table 902-3, Class III limited to 1.0-inch maximum size.
  - 3. Select Granular Material shall be MDOT 902.07, Table 902-3, Class II or IIA limited to 1.0-inch maximum size.
  - 4. Concrete Grade 3000 per MDOT Section 1004.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION:**

- A. Clearing and Grubbing:
  - 1. Save and protect all trees and vegetation not identified to be removed.
  - 2. Repair or replace trees, shrubs and other vegetation damaged by CONTRACTOR's operation at no additional charge.
- B. Conflicting Underground Facilities:
  - 1. Before starting work, establish location and extent of existing underground facilities in work area.
  - 2. Establish potential conflict areas prior to construction.
  - 3. Excavate and expose existing underground facilities presenting potential conflict to determine their exact location and elevation.
  - 4. Advise Engineer of conflicts and obtain instructions on how to proceed.
  - 5. Make adjustments in proposed utility location at no additional cost.
  - 6. Make arrangements with owner of existing underground facilities for relocation, if necessary.
  - 7. Schedule work accordingly.

### **3.02 EXCAVATION:**

- A. General:
  - 1. Dispose of surplus and unsuitable excavated material.
  - 2. Remove, salvage and stockpile topsoil.
  - 3. Unsuitable material encountered in subgrade or below payment line: obtain instruction on how to proceed.
- B. Trenches:
  - 1. Depth: Provide a uniform and continuous bearing and support for proposed utility on solid and undisturbed or compact granular material.



2. Minimum Width: Allow space for jointing and bedding. Meet requirements of AWWA C600 or C605, as applicable, for water main.
  3. Maximum Width: The following limitations shall apply at utility crown:
    - a. 6 inch through 10-inch diameter: 30 inches.
    - b. 12 inch through 30-inch diameter: Outside diameter plus 24 inches.
    - c. 30 inch and over diameter: Outside diameter plus 36 inches.
    - d. Elliptical: Outside pipe width plus 36 inches.
- C. Blasting:
1. Not allowed unless otherwise indicated.
  2. If allowed, obtain and comply with required permits.
  3. If allowed, perform only during hours approved by Owner.
- D. Length of Open Trench shall be 200 feet maximum.
- E. Damage to Existing Underground Utilities:
1. Report all damage to Engineer and utility owner.
  2. Repair to utility owner's standard.

### 3.03 BACKFILLING:

- A. Pipe bedding area: Compact granular material to ninety percent (90%) of maximum density according to the Modified Proctor Method or to ninety-five percent (95%) of maximum density using the Michigan Cone Test.
- B. Trench Backfill Area:
1. Under permanent pavement, shoulder areas and areas within a one on one slope from the shoulder edge:
    - a. Compact suitable excavated material or granular material in 9.0-inch layers to ninety percent (90%) of maximum density according to the Modified Proctor Method or to ninety-five percent (95%) of maximum density using the Michigan Cone Test.
  2. Under nonpermanent pavement: Same as permanent pavement.
  3. Under unimproved right-of-way areas: Compact suitable excavated material to eighty-five percent (85%) of maximum density.
  4. Under landscaped and unimproved areas: Compact suitable excavated material to eighty percent (80%) of maximum density.
  5. Under undercut existing structure: Place concrete.
- C. Structures:
1. Density requirements: Same as Trenches.
  2. Concrete structure: Place backfill only after seventy-five percent (75%) of concrete design strength has been reached.

### 3.04 TRENCH UNDERCUTTING AND BACKFILL:

- A. Excavation: Perform to Owner or Owner's Representative instructions.
- B. Backfill: Provide with granular material compacted in place.

### 3.05 COMPACTION, TESTING AND INSPECTION:

- A. Surplus excavated and unsuitable excavated material shall become the property of the Contractor.

- B. Dispose of surplus excavated or unsuitable excavated materials off-site.
- C. Performance and test equipment will be provided by Owner or Owner's Representative approved independent laboratory.
- D. Moisture - Density relationships:
  - 1. Cohesive (clays) soils: ASTM D 1557 (Modified Proctor).
  - 2. Granular (sands) soils: Michigan Cone Test.
- E. Field Density: ASTM D-2922 (Nuclear).
- F. Furnish equipment and personnel to provide access to test location and depth. Density tests will be performed at various levels, during or after backfilling operation.
- G. Correct any deficiencies resulting from insufficient or improper compaction. Retesting of density in areas of failed tests shall be performed by Owner or Owner's Representative at the Contractor's expense.

**END OF SECTION**

## SECTION 32 12 16

### HOT MIXED ASPHALT PAVING – MARSHALL MIXTURES

#### PART 1 - GENERAL

##### 1.01 SUMMARY:

- A. This Section includes construction of new hot mixed asphalt (HMA) pavements and reconstruction of existing pavements with hot mixed asphalt pavement and related work.
- B. Definitions:
  - 1. Pavement structure: Any combination of subbase, aggregate base, base course, leveling course and surface course, including shoulders, placed on subgrade.
  - 2. Permanent pavement: All improved pavement surfaces above the quality of treated or untreated gravel.
  - 3. Subgrade: That portion of the earth grade upon which the pavement structure is to be placed.
  - 4. Subbase: The layer of specified material of designed thickness placed on the subgrade as a part of the pavement structure.
  - 5. Base course: The layer of specified or selected material of designed thickness placed on a subbase or a subgrade to support leveling and surface courses.
  - 6. Leveling course: Layer of specified material placed on the base course in preparation for the surface course.
  - 7. Surface course: The top layer of a pavement structure.
  - 8. Bond Coat: Asphalt emulsion used to enhance the adhesion between HMA courses.
  - 9. Maximum Specific Gravity of Asphalt (Gmm): The ratio of the weight in air of a unit volume of an un-compacted asphalt mixture to the weight of an equal volume of gas free distilled water at a given standard temperature.
  - 10. Maximum density (soils): Maximum unit weight of soil material according to Modified Proctor Method ASTM D1557.
  - 11. Density Control Target: Target density of an HMA mixture determined by multiplying the Gmm times the density of water (62.4lb/ft<sup>3</sup>).

##### 1.02 REFERENCES:

- A. MDOT - Michigan Department of Transportation, *"2020 Standard Specifications for Construction"*.
- B. ASTM - American Society of Testing Materials, latest edition.
- C. MTM – Michigan Test Methods, latest edition.

##### 1.03 SUBMITTALS:

- A. Pre-Construction:
  - 1. Job-mix formulas (JMF):
    - a. Provide a job-mix formula (JMF) for each HMA mix prepared by independent lab or approved by MDOT submittals two weeks prior to paving. The job-mix formula shall include, at a minimum, the Gmm, Gmb, Gb, Gse, Gsb and parameters listed in Tables 1 & 2 of this specification.
  - 2. Material Certifications:
    - a. Provide certifications of quality by producer for the following:
      - 1) Aggregates.
      - 2) Asphalt cement.

- 3) Prime coat.
- 4) Bond coat.
- 5) Pavement marking materials.

1.04 JOB CONDITIONS:

- A. Seasonal Limitations:
  1. Removal of permanent pavement: Unless otherwise specified, execute during the period from March 15 to October 15.
  2. Restoration of permanent pavement: MDOT 501.03.I.1.
- B. Clean up promptly following pavement installation.
- C. Maintenance of Temporary Surfaces: Maintain temporary surfaces until permanent pavement installation is completed.
- D. Driveway Closing: Twenty-four (24) hour maximum. Provide proper notice to property owner.
- E. Allow access to the hot mixed asphalt plant for verification of mix proportions, aggregate gradations and temperatures.

**PART 2 - PRODUCTS**

2.01 MATERIALS:

- A. Subbase: Granular material Class II, MDOT 902.07, Table 902-3.
- B. Aggregate Base: Aggregate 22A, MDOT 302.02 and 902.05.
- C. Aggregate Surface:
  1. Use Aggregate 22A when the aggregate surface will receive a hot mixed asphalt surface at a later date. MDOT 306.02 and 902.05.
  2. Use Aggregate 23A when the aggregate surface will not receive a hot mixed asphalt surface. MDOT 306.02 and 902.05.
- D. Aggregate Shoulders and Approaches:
  1. Use Aggregate 22A for construction of Class I shoulders and approaches. MDOT 307.02 and 902.05.
  2. Use Aggregate 23A for construction of Class II shoulders and approaches. MDOT 307.02 and 902.05.
  3. Use salvaged aggregate or Aggregate 23A for construction of Class III shoulders and approaches. MDOT 307.02 and 902.05.
- E. Maintenance Gravel:
  1. Aggregate 21A, 21AA, 22A, 23A.
  2. Salvaged aggregate or HMA millings.
- F. Hot Mix Asphalt (HMA) Base Course:
  1. MDOT 501.02, HMA 13A.
  2. MDOT 904.03, Asphalt binder 58-28.
- G. Hot Mix Asphalt (HMA) Surface Course:
  1. MDOT 501.02, HMA 36A.
  2. MDOT 904.03, Asphalt binder 58-28.

H. Bond Coat: Asphalt material SS-1h. MDOT 501.02 and 904.03.C.

2.02 MIXTURES:

- A. Furnish hot mixed asphalt mixture designed using Marshall mixture design methods.
- B. The mix design shall be developed using a 50 blow Marshall hammer.
- C. Reclaimed Asphalt Pavement (RAP) may be substituted for up to 27% RAP binder by weight of the new material required to produce the HMA mixture. Greater than 27% RAP binder by weight (MDOT Tier 3) is not allowed.
- D. If greater than 17% RAP binder by weight of the total binder is proposed for the mixture, the selected binder grade shall be adjusted to compensate for the stiffness of the asphalt binder in the RAP. The Contractor shall supply blending chart and RAP test data used to determine the binder selection.
- E. The following Table 1 shall be used to determine the mix design criteria and volumetric properties of the specified mixture.

**Table 1: Mix Design Criteria and Volumetric Properties**

|  | Mixture No. |       |       |       |       |
|--|-------------|-------|-------|-------|-------|
|  | 2C          | 3C    | 4C    | 13A   | 36A   |
| Target Air Void, % (a)   | 3.00        | 4.00  | 4.00  | 4.00  | 4.00  |
| VMA (min) (b)  | 11.00       | 13.00 | 14.00 | 14.00 | 15.00 |
| VFA  | 65-78       | 65-78 | 65-78 | 65-78 | 65-78 |
| Fines to Binder Ratio (max) (c)  | 1.2         | 1.2   | 1.2   | 1.2   | 1.2   |
| Flow (0.01 inch)   | 8-16        | 8-16  | 8-16  | 8-16  | 8-16  |
| Stability (min), lbs   | 1200        | 1200  | 1200  | 900   | 900   |
| a. Lower target air voids by 1.00% if used in a separate shoulder paving operation. Consider reducing air void targets to 3.00% for lower traffic volume roadways when designing 13A and 36A mixtures.<br>b. VMA calculated using Gsb of the combined aggregates.<br>c. Ratio of the weight of aggregate passing the No. 200 sieve to total asphalt binder content by weight; including fines and binder contributed by RAP. |             |       |       |       |       |

- F. The following Table 2 shall be used to determine the aggregate properties of the specified mixture.

**Table 2: Aggregate Properties**

|  | Mixture No.                                       |         |         |       |        |
|--|---|---------|---------|-------|--------|
|  | 2C  | 3C      | 4C      | 13A   | 36A    |
|  | Percent Passing Indicated Sieve or Property Limit |         |         |       |        |
| 1 ½ inch   | 100   |         |         |       |        |
| 1 inch   | 91-100  | 100     |         |       |        |
| ¾ inch   | 90 max.   | 91-100  | 100     | 100   |        |
| ½ inch   | 78 max.   | 90 max. | 91-100  | 75-95 | 100    |
| ⅜ inch   | 70 max.   | 77 max. | 90 max. | 60-90 | 92-100 |
| No. 4  | 52 max.   | 57 max. | 67 max. | 45-80 | 65-90  |
| No. 8  | 15-40   | 15-45   | 15-52   | 30-65 | 55-75  |
| No. 16   | 30 max.   | 33 max. | 37 max. | 20-50 |        |
| No. 30   | 22 max.   | 25 max. | 27 max. | 15-40 | 25-45  |
| No. 50   | 17 max.   | 19 max. | 20 max. | 10-25 |        |
| No. 100  | 15 max.   | 15 max. | 15 max. | 5-15  |        |
| No. 200  | 3-6   | 3-6     | 3-6     | 3-6   | 3-10   |
| Crushed (min), % (MTM 117)   | 90  | 90      | 90      | 25    | 60     |
| Soft Particle (max), % (a)   | 12.0  | 12.0    | 8.0     | 8.0   | 8.0    |
| Angularity Index (min) (b)   | 4.0   | 4.0     | 4.0     | 2.5   | 3.0    |
| L.A. Abrasion (max), % loss (c)  | 40  | 40      | 40      | 40    | 40     |
| Sand Ratio (max) (d)   | -   | -       | -       | 50    | 50     |
| <p>a. The sum of the shale, siltstone, structurally weak, and clay-ironstone particles must not exceed 8.0 percent for aggregates used in top course. The sum of the shale, siltstone, structurally weak, and clay-ironstone particles must not exceed 12.0 percent for aggregates used in base and leveling courses.</p> <p>b. The fine aggregate angularity of blended aggregates, determined by MTM 118, must meet the minimum requirement. In mixtures containing RAP, the required minimum fine aggregate angularity must be met by the virgin material. NAA fine aggregate angularity must be reported for information only and must include the fine material contributed by RAP if present in the mixture.</p> <p>c. Los Angeles abrasion maximum loss must be met for the composite mixture; however, each individual aggregate must be less and 50.</p> <p>d. Sand ratio for 13A and 36A no more than 50% of the material passing the No. 4 sieve is allowed to pass the No. 30 Sieve.</p> |   |         |         |       |        |

### PART 3 - EXECUTION

#### 3.01 PREPARATION:

- A. Removal: Remove all existing pavement structure required, as shown on the drawings.
  1. Pavement remnant limit: Remove pavement, curb, gutter, curb and gutter, sidewalk or similar structures to existing joint, where dimension is less than 3 feet.
  2. Provide saw cut joint full depth at removal limit.
  3. Butt joint: Provide on overlay projects where new pavement meets existing pavement. MDOT 501.03.C.3.
  4. Restore existing permanent pavement disturbed by construction equipment at no additional cost to Owner.
- B. Dispose of all material removed during the construction.
- C. Crushing and shaping: MDOT 305.
- D. Cold-milling existing HMA surface: MDOT 501.

- E. Subgrade:
  - 1. Obtain approval prior to placing the subbase or aggregate base course.
  - 2. Construct to the required line, grade and cross section. MDOT 205.03.N.
    - a. Tolerance if subbase is required: Trim within 1 inch of design grade.
    - b. Tolerance if subbase is not required: Trim within  $\frac{3}{4}$  inch of design grade.
  - 3. Compaction:
    - a. Compact to not less than ninety percent (90%) of the maximum density according to the Modified Proctor Method ASTM D1557.
    - b. Compact to not less than ninety-five percent (95%) of the maximum density using the Michigan Cone Test.
- F. Excavation: Conform to MDOT 205.03.G.
- G. Embankment: Conform to MDOT 205.03.H and 205.03.I.

### 3.02 PERFORMANCE:

- A. Subbase:
  - 1. Thickness: Conform to design cross section.
  - 2. Construction method:
    - a. Place in equal layers not exceeding 15 inches loose measure.
    - b. Spread evenly and compact to not less than ninety-five percent (95%) maximum density according to Michigan Sand Cone Test.
  - 3. Tolerance: Construct sub-base to plan grade within a tolerance of  $\pm 0.5$  inch.
- B. Aggregate Base:
  - 1. Thickness: Conform to design cross section.
  - 2. Construction Method: MDOT 302.03.
  - 3. Tolerances:
    - a. Curbed streets: Shape the aggregate base course to the design grade and cross section within a tolerance of  $\pm \frac{1}{4}$  inch.
    - b. Other: Shape within a tolerance of  $\pm \frac{1}{2}$  inch of the design grade and cross section.
    - c. Check and correct grades and cross section prior to HMA placement if traffic use is allowed.
- C. Aggregate Surface:
  - 1. Thickness: Provide 8 inches compacted in place in two (2) equal courses, unless otherwise specified.
  - 2. Construction Method: MDOT 306.03.
- D. Shoulder (aggregate):
  - 1. Thickness: Provide 4 inches of compacted aggregate shoulder on an aggregate base, unless otherwise noted.
  - 2. Construction Method: MDOT 307.03.
- E. Shoulder (other than aggregate):
  - 1. Thickness: Provide 4 inches of compacted soil or topsoil on an aggregate base, unless otherwise noted.
- F. Hot Mixed Asphalt Base:
  - 1. Construction Methods: Conform placement of the hot mixed asphalt base mixture not exceeding lifts of 3 inches in accordance with MDOT 501.03.
  - 2. Tolerances:
    - a. Curbed streets: Shape the hot mixed asphalt base course to the design grade and cross section, within a tolerance of  $\pm \frac{3}{8}$  inch.

- b. Other: Unless otherwise specified, shape within  $\pm 3/4$  inch of the design grade and cross section.
- G. Bond Coat:
- 1. Construction Method: MDOT 501.03.D.
  - 2. Application Rate: Provide 0.15 gallon per square yard.
- H. Hot Mixed Asphalt Leveling and Surface:
- 1. Cutting: Saw vertically in straight lines parallel or perpendicular to pavement centerline.
  - 2. Thickness: Do not place hot mixed asphalt surface course mixture in lifts exceeding 2 inches unless otherwise approved. Provide design thickness.
  - 3. Construction Methods:
    - a. Paving: Conform method of paving to MDOT 501.03.
    - b. Prior to placement of hot mixed asphalt surface, verify crowns and grades of roadway for positive drainage. Any deficiencies in grade or crown shall be corrected prior to placement of surface course.
  - 4. Tolerances: Hot mixed asphalt surface on streets with new curbs shall have a finish elevation of  $1/4$  inch above curb.
  - 5. Asphalt Yield: The design asphalt yield has been based on 110 lbs./syd per inch of thickness. Construction asphalt yield in excess of 15% of the plan yield shall not be paid.
- I. Hot Mixed Asphalt Drive Approach:
- 1. Preparation: Construct drive approach on prepared subgrade or embankment as required to meet plan grades.
  - 2. Aggregate Base: Provide 6-inches of Aggregate 22A compacted in place.
  - 3. HMA Mixture: Provide 3-inches of HMA 36A.
- J. Hot Mixed Asphalt Patching:
- 1. Preparation: Saw cut vertically in straight lines parallel or perpendicular to pavement centerlines. Minimum dimension of area to be patched shall be 2 feet for placement and compaction of materials.
  - 2. Aggregate Base: Provide a minimum of 6 inches of Aggregate 22A compacted in place.
  - 3. HMA Mixture: Match existing pavement thickness (minimum 3 inches).

### 3.03 STRUCTURE COVER ADJUSTMENT:

- A. Construction Method: MDOT 403.03.C.
- 1. Adjust structure castings to finish grade or to a maximum of  $1/4$  inch below finish grade of all manholes, catch basins and valve boxes.
    - a. Set grades of castings and valve boxes from street grades with castings tilted where necessary to meet proposed street grades and crown.
    - b. All castings, when adjusted to finish grade, shall be placed in a bed of hot mixed asphalt mix placed in entire area disturbed for casting adjustment. Mixture shall be compacted in place.
  - 2. Adjust castings to finish grade after the leveling course is complete.
    - a. Castings shall be kept below grade or flush with the proposed sand subgrade so as not to conflict with grading operations or conflict with placement of leveling course.
    - b. HMA removed from area for casting adjustment shall be saw cut square around the casting.
  - 3. Adjustment of new structures will not be a pay item.



3.04 PAVEMENT MARKINGS

- A. Construction Method: MDOT 811.03
- B. Contractor shall layout all proposed markings in accordance with the MMUTCD and MDOT Standards and as shown on the Drawings prior to placement for Owner or Owner's representative review.

3.05 TESTING AND INSPECTION:

- A. Observation: By the designated authorized representative.
- B. Aggregates:
  - 1. Sampling and Analysis: Michigan Testing Methods, Series 100.
  - 2. Exception: Provide certification of approved stockpiled material.
- C. Hot Mixed Asphalt Pavement Density:
  - 1. Density acceptance of HMA mixtures will be measured with a nuclear density gauge using the Gmm from the approved Job-Mix Formula for the density control target. The required in place density of the HMA mixture shall be 92.0-96.0% of the density control target.
  - 2. The Contractor is responsible for determining Quality Control Density and establishing a rolling pattern that will achieve the required in place density.
- D. Hot Mixed Asphalt Mix Composition:
  - 1. Sampling:
    - a. Acceptance sampling shall include a minimum of two samples per mix type for each day of production with no less than three samples for each mix type per project.
    - b. Method of sampling per MDOT Standard Specifications for Construction requirements.
  - 2. Extraction: ASTM D2172
  - 3. Sieve Analysis: ASTM C117 and ASTM C136
  - 4. Tolerance: Acceptance tolerances for HMA parameters are detailed in the following Table.

**Table 3: Uniformity Tolerance Limits for HMA Mixtures**

| PARAMETER   | Surface & Leveling Course | Base Course |
|---|---------------------------|-------------|
|   | Range                     | Range       |
| Binder Content  | + 0.50                    | + 0.50      |
| % Passing #8 and Larger Sieves  | + 8.0                     | + 9.0       |
| % Passing #30 Sieve   | + 6.0                     | + 9.0       |
| % Passing #200 Sieve  | + 2.0                     | + 3.0       |
| 1. The mixture shall be proportioned to test as closely as possible to the Job-Mix-Formula.<br>2. The crushed particle content of the aggregate shall not be more than 10 percentage points above or below the crush particle content listed in the approved JMF. |                           |             |

- 5. Acceptance: If for any one mixture, two consecutive aggregate gradations on one sieve, or binder contents exceed the uniformity tolerance or do not meet the minimum requirements for crushed particle content the mixture will be rejected.

**END OF SECTION**

## SECTION 32 16 13

### CONCRETE CURBS & GUTTERS

#### PART 1 - GENERAL

##### 1.01 SUMMARY:

- A. This Section includes work required for concrete curbs and gutters.

##### 1.02 REFERENCES:

- A. MDOT – Michigan Department of Transportation, “*2020 Standard Specifications for Construction*”.
- B. ASTM – American Society of Testing Materials, latest edition.

##### 1.03 SUBMITTALS:

###### A. Pre-Construction:

###### 1. Concrete Mix Designs:

- a. Provide a concrete mix design submittals for each mix of concrete meeting the requirements of MDOT Division 10, prepared by independent lab, two weeks prior to paving. Contractor may submit concrete mix designs previously approved by MDOT.

###### 2. Material Certifications:

- a. Provide certifications of quality by producer for the following:
  - 1) Cement.
  - 2) Aggregates.
  - 3) Admixtures.
  - 4) Curing Compound.
  - 5) Steel Reinforcement.
  - 6) Pavement marking materials.

###### 3. Batch Tickets:

- a. In accordance with MDOT 1001.03.A.4.

###### B. Post-Construction:

###### 1. Concrete Test Specimens:

- a. Contractor shall deliver acceptance cylinders to the place of inspection and testing.

##### 1.04 JOB CONDITIONS:

###### A. Weather and Temperature Limitations:

- 1. Protect the concrete from being damaged by rain.
- 2. Protect the concrete from freezing until it has attained a minimum compressive strength of 1,000 psi.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS:**

- A. Concrete:
  - 1. Use Concrete Grade 3500 per MDOT Section 1004.
  - 2. Use Concrete Grade P-NC per MDOT Section 1006 where indicated on the drawings to achieve early compressive strength.
- B. Steel Reinforcement: MDOT Section 905, epoxy coated.
- C. Joint Filler: MDOT Section 914.
- D. Lane Ties: MDOT Section 914.09.
- E. Curing Compound: MDOT Section 903.06, white membrane curing compound.
- F. Chemical Admixtures: MDOT Section 903.
  - 1. Use of calcium chloride is not allowed.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION:**

- A. Removal: Remove all existing pavement structure required, as shown on the drawings. MDOT 204.03.A.2.
- B. Dispose of all material removed during construction.
- C. Subgrade: Prepare base per MDOT 602.03.B.
  - 1. Obtain approval prior to placing sub-base and forms.
  - 2. Construct to the required line, grade and cross-section per MDOT 205.03.N.
  - 3. Compaction: Compact to not less than ninety-five percent (95%) of the maximum density using the Michigan Cone Test.
- D. Contractor shall notify Owner or Owner's representative of plans to pour concrete a minimum of 24-hours in advance the concrete pour. The Contractor shall provide a minimum of 2 hours between forming and pouring to allow for review. Failure to provide notice will be considered cause to reject the work.

### **3.02 PERFORMANCE:**

- A. Subbase:
  - 1. Thickness: Conform to design cross section.
  - 2. Construction to the required line, grade and cross section.
  - 3. Compaction: Compact to not less than ninety-five percent (95%) of the maximum density using the Michigan Cone Test.
- B. Concrete Curb and Gutter:
  - 1. Place concrete on moist base.
  - 2. Construct curbing mechanically using slip forms or place with fixed forms including face forms.
  - 3. Epoxy coated steel reinforcement:
    - a. Place in accordance with Owner's standard and per the drawings.

- b. Reinforcement shall be spliced by lapping at least 10 inches and securing with two (2) ties per splice.
- c. Lane ties, where required, shall be placed in the correct position and spaced in accordance with the drawings.
- d. At locations where proposed concrete abuts existing concrete, two #4 epoxy coated steel reinforcing bars shall be epoxy anchored into the existing concrete.
- 4. Concrete shall be consolidated during placement using a spade or vibration.
- 5. Finishing:
  - a. Round all exposed edges to a radius of approximately ¼ inch including transverse joints.
  - b. Do not add water to the concrete surface to aid finishing.
  - c. Apply broom finish.
- 6. After removing forms and before applying curing compound, repair all honeycombed areas or voids with Type R-2 mortar. Excessive voids or honeycomb will require removal and replacement.
- 7. Joints:
  - a. Contraction joints shall be spaced evenly on 10-foot centers.
  - b. Expansion joints shall be full depth and located as follows:
    - 1) 10 foot each side of curb castings
    - 2) At the spring points of curb radius
    - 3) Every 250 feet
- 8. Curing and Protection: Concrete shall be cured and protected as specified under MDOT Section 602.03.M and 602.03.T. Curing compound shall be applied immediately following finishing operations.

### 3.03 STRUCTURE COVER ADJUSTMENT:

- A. MDOT 403.03.C:
  - 1. Adjust structure cover to finish grade with top of curb and pavement edge set to the proposed grade.
  - 2. Tilt casting towards back of curb a maximum of 1 inch and transition gutter line of concrete curb to gutter line of casting.
  - 3. Set casting in a bed of concrete or mortar prior to pouring curb.
  - 4. Concrete or mortar bed inside of casting shall be troweled smooth and shall be free of voids.

### 3.04 TESTING AND INSPECTION:

- A. Observation: By designated authorized representative.
- B. Acceptance Testing:
  - 1. If initial testing indicates failed or nonconformance to specification, perform additional test. If further testing verifies nonconformance, additional testing shall be paid by Contractor. Replace nonconforming material at no additional cost to Owner.
- C. Tolerance: Gutter and top of curb shall be finished within 3/16 inch in 10 feet when checked with a 10-foot straight edge.

**END OF SECTION**

## SECTION 32 92 00

### SURFACE PROTECTION, RESTORATION AND TURF ESTABLISHMENT

#### PART 1 - GENERAL

##### 1.01 SUMMARY:

- A. Work included in this specification consists of the establishment of a durable, permanent, weed free, mature, perennial turf and protection and restoration of site improvements.
- B. Definition of Site Improvements: Fences, mailboxes, street signs, sheds, playground equipment, landscaping stones and decorations, underground lawn irrigation systems, retaining walls, parking appurtenances, and yard accessories.

##### 1.02 REFERENCES:

- A. MDOT - Michigan Department of Transportation, *"2020 Standard Specifications for Construction"*.
- B. MDOT – Michigan Department of Transportation, "Materials Source Guide" current edition.
- C. ASTM – American Society of Testing Materials, latest edition.

##### 1.03 SUBMITTALS:

- A. Pre-Construction:
  - 1. Topsoil test results.
  - 2. Seed mixture.
  - 3. Fertilizer product.
- B. Post Construction:
  - 1. Contractor's Daily Reports

##### 1.04 JOB REQUIREMENTS:

- A. Surface Areas Disturbed by Construction Operation:
  - 1. Restoration and Turf Establishment:
    - a. Fine grade to 4 inches below finished grade.
    - b. Remove all stones and debris greater than 1-inch diameter.
    - c. Place 4 inches of topsoil.
    - d. Rake smooth to finished grade, seed, fertilize and mulch, or place mulch blanket pegged in place, where specified or required for slope stability.
- B. Site Improvements:
  - 1. Protect all items not indicated for removal.
  - 2. Where Site Improvements impact proposed construction, remove the item carefully, store and protect the item and reinstall the item upon completion of construction.
- C. Scheduling:
  - 1. Restoration of lawns and other surface features:

- a. As soon as possible after final grading of the areas designated for turf establishment but no later than the maximum time frames stated in MDOT 208.03 or as required by project soil erosion control permit.
- 2. Clean up: Promptly following restoration.
- D. Seasonal Limitations:
  - 1. MDOT 816.03.C.4.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS:**

- A. Topsoil:
  - 1. Topsoil may be salvaged and reinstalled from the project site or imported to the site:
    - a. Salvaged topsoil:
      - 1) Must be segregated during construction and kept free of intermingling with other soils.
      - 2) The acceptance of salvaged topsoil is subject to its ability to establish turf. The salvaged topsoil must be acceptable to the Owner and property owner after turf is established. The existing topsoil may or may not be acceptable in its existing condition.
    - 2. Material:
      - a. Salvaged and imported topsoil:
        - 1) Shall be screened and amended either on-site or off-site.
        - 2) Shall be loose, friable, and free of refuse and foreign material.
        - 3) 20% minimum organic material by test method ASTM D2974.
        - 4) pH of 6.8 to 7.5 by test method ASTM D4972.
        - 5) Gradation:
          - a) 100% passing the ½" sieve.
          - b) 98% minimum passing the ¼" sieve.
          - c) 30% maximum passing the #200 sieve.
    - 3. Before placing topsoil on the site, the Contractor shall have the topsoil tested by an independent soil-testing laboratory. Topsoil test results from the testing laboratory shall be submitted for review and acceptance. Tests shall include:
      - a. Organic material content; ASTM D2974
      - b. pH; ASTM D4972
      - c. Sieve gradation analysis
- B. Grass Seed Mixture:
  - 1. Stormwater Retention Basin – Michigan Wildflower Farm, Detention Basin Mix.
  - 2. All other disturbed areas shall be comprised of at least four of the below species and each species selected shall be 5% to 25% of the grass seed mixture by weight. At least two species selected shall be salt tolerant.
    - a. Kentucky Bluegrass.
    - b. Perennial Ryegrass.
    - c. Hard Fescue.
    - d. Creeping Red Fescue.
    - e. Chewings Fescue.
    - f. Turf-type Tall Fescue.
    - g. Buffalo grass.
    - h. Alkaligrass-Fults Puccinellia distans.

- C. Chemical Fertilizer: MDOT 917.09, Class A.
  - 1. Phosphorus can only be used at the time of planting or when soil conditions require.
- D. Hydro-mulch: MDOT 917, Recycled newsprint or wood fiber.
- E. Co-polymer Gel: Finn Hydro Gel B, or equal.
- F. Water:
  - 1. Water shall be furnished and applied from an approved source. Do not draw water from any waterway (i.e. river, ditch, creek, lake, etc.)
- G. Mulch Blanket:
  - 1. MDOT 917.14, Excelsior or straw mulch blanket listed on the current Qualified Products List in the MDOT Materials Source Guide.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION:**

- A. Prior to construction, provide advance notice to property owners of privately-owned surface features within the project area to allow the property owner time to remove or relocate them.
- B. Prior to placing topsoil, shape, compact and assure all areas to be seeded are debris and weed free. Place topsoil to a minimum depth of 4 inches and to meet proposed finished grade. If the area being restored requires more than the minimum depth of topsoil to meet finished grade, this additional depth shall be filled using topsoil. Furnishing and placing this additional material will not be paid separately.

#### **3.02 TREES AND SHRUBS:**

- A. Protect all trees and shrubs during construction.
- B. Where existing trees and shrubs will be impacted by construction, Contractor shall prune or trim branches in accordance with industry standard horticulture practice.
- C. Tree limbs inadvertently damaged during construction shall be trimmed to remove the damaged portion within 5 days. Contractor shall notify the property owner and Owner or Owner's representative of the inadvertent damage caused and the remedy.

#### **3.03 IRRIGATION SYSTEMS:**

- A. Contractor shall make every effort to protect existing irrigation systems adjacent to the project area.
- B. Irrigation repair is the responsibility of the Contractor. Where existing irrigation systems are encountered during construction the Contractor shall temporarily relocate or remove as required to place the proposed improvements and repair the irrigation system promptly following construction of the improvements. This work may require cutting and capping of the existing sprinkler lines and salvaging of the existing sprinkler heads for reuse during replacement. Where lines are cut Contractor shall take measures to prevent dirt or debris from entering the existing sprinkler lines or heads. Damaged irrigation heads shall be replaced in-kind. Acceptance of the repair subject to the approval of the property owner.

3.04 TOPSOIL:

- A. Place 4 inches of topsoil in preparation of seeding.
- B. Construction methods:
  - 1. MDOT 816.03.A.

3.05 HYDROSEEDING, FERTILIZING AND MULCHING:

- A. Construction methods: Hydro-seed with mixture of seed, fertilizer, and mulch, and co-polymer gel with the following minimum rates:
  - 1. Seed:
    - a. 220 pounds per acre.
  - 2. Fertilizer:
    - a. 228 pounds per acre.
  - 3. Mulch:
    - a. 1,200 pounds per acre of recycled newsprint or 2,000 pounds per acre of wood fiber.
  - 4. Co-polymer gel:
    - a. 10 pounds per acre between June 1 and September 1.
    - b. Zero at other times of the year.

3.06 MULCH BLANKET:

- A. Construction Methods:
  - 1. MDOT 816.

3.07 MAINTENANCE

- A. Repair:
  - 1. The Contractor is responsible, at no additional cost, for the repair of turf establishment work occasioned by storm events up to 3 inches of rain in a 24-hour period as documented by local meteorological data.
  - 2. Repairs made to damaged turf establishment areas as a result of a documented storm by a local meteorological data resulting in rainfall amounts of more than 3 inches in a 24 hr period will be paid for as an increase to the turf restoration quantity.
- B. Inspections:
  - 1. The Contractor is responsible for all inspection of turf establishment work. Provide notification to Owner or Owner's representative of upcoming inspections or maintenance work.
  - 2. Provide a Contractor's Daily Report to report inspections made and to document turf establishment work performed on this project.
  - 3. Complete and submit a Contractor's Daily Report when any work performed is in progress.
  - 4. Include all necessary materials documentation including tests slips, certifications, etc. with the associated Contractor's Daily Report.



### 3.08 ACCEPTANCE

#### A. Final Acceptance:

1. Before final acceptance of the turf establishment work there must be no exposed bare soil and the turf must be fully germinated, erosion free, weed free, disease free, dark green in color and in a vigorous growing condition.
2. Once growth of weed-free grass has been achieved the Contractor's responsibility in this matter shall have ended. However, it is to be clearly understood that any failure on the part of the property owner to properly care for the restored lawn area prior to achieving a good growth of weed-free grass shall in no way relieve the Contractor of his responsibility as set forth above.

**END OF SECTION**

## SECTION 33 41 00

### STORM SEWERS

#### PART 1 - GENERAL

##### 1.01 SUMMARY:

- A. This Section includes work required for storm sewers, culverts, structures, under drains, drain excavation/cleanout and related work.

##### 1.02 REFERENCES:

- A. MDOT - Michigan Department of Transportation, "2020 Standard Specifications for Construction".
- B. ASTM - American Society of Testing Materials, latest edition.

##### 1.03 SUBMITTALS:

- A. Pre-Construction:
  - 1. Individual Drainage Structure Build Sheets:
    - a. Top, bottom and invert elevations.
    - b. Pipe orientation.
    - c. Individual precast concrete section dimensions.
    - d. Prefabricated rubber boot material & manufacturer.
  - 2. Castings:
    - a. Manufacturer & model numbers.
  - 3. Pipe & Fittings:
    - a. Manufacturer, material & ASTM designation.
    - b. Joint construction details.
  - 4. Geotextile Fabric:
    - a. Manufacturer, material & ASTM designation.
- B. Post Construction:
  - 1. Witnesses:
    - a. Three witness measurements to blind taps and lateral ends from permanent fixtures such as building corners.
    - b. Invert elevation at end of each lateral.

##### 1.04 JOB CONDITIONS:

- A. Maintain existing storm sewer operational.
- B. Install service lines, catch basins and inlet leads as pipe laying progresses and within maximum of 600 feet of mainline sewer installation.
- C. Clean up promptly following pipe installation and within maximum of 400 feet behind pipe laying operation. Clean-up includes backfill and rough grade.

## PART 2 - PRODUCTS

### 2.01 PIPE:

#### A. Concrete Pipe Classification Table:

| Type<br>& Size                      | Design Depth (feet)       |                           |                          |
|-------------------------------------|---------------------------|---------------------------|--------------------------|
|                                     | <u>0' - 10'</u>           | <u>10' - 19'</u>          | <u>Over 19'</u>          |
| Reinforced<br>Concrete<br>12" - 54" | ASTM<br>C-76<br>Class III | ASTM<br>C-76<br>Class III | ASTM<br>C-76<br>Class IV |
| Reinforced<br>Concrete<br>60" - 90" | ASTM<br>C-76<br>Class II  | ASTM<br>C-76<br>Class III | ASTM<br>C-76<br>Class IV |

### 2.02 PREMIUM JOINTS:

A. Concrete: ASTM C443, modified to include "O" rings on grooved pipe ends.

B. Plastic: Rubber O-Rings.

### 2.03 MANHOLES, CATCH BASINS AND INLETS:

A. Precast Units: ASTM C478.

1. Joints: Cement mortar preformed bituminous rope or "O" ring gaskets.
2. Pipe openings: Pipe diameter plus 6 inches, maximum.

B. Concrete Radial Units: ASTM C139.

C. Grade Rings: ASTM C478 with "O" ring gaskets or ASTM D4976 HDPE adjusting rings with butyl sealant manufactured by Ladtech, Inc. or equal.

D. Manhole Steps:

1. Polypropylene encapsulated steel.
2. Dimensions: 10-inches wide, 4-inch minimum clear tread depth, spaced 16 inches apart.
3. Steps shall be in accordance with:
  - a. ASTM C 478
  - b. ASTM D 4101 (polypropylene)
  - c. ASTM A 615 (steel)

E. Manhole Castings: East Jordan 1045Z1, B cover or Neenah R-1733, vented lid.

F. Catch Basin and Inlet Castings: East Jordan 7030 T1/T3 or Neenah Grate R-3246.

### 2.04 END SECTIONS:

A. End Section material shall match that of the adjoining pipe unless otherwise specified.

1. Concrete: MDOT 909.04.E, ASTM C 76 Class II and AASHTO M 170 Class II.

### 2.05 RIPRAP:

A. Riprap: MDOT 916.01.C.

B. Geotextile Fabric: MDOT 910.03.B and Table 910-1.

## PART 3 - EXECUTION

### 3.01 PREPARATION:

- A. Alignment and Grade:
  - 1. Deviations: Notify Engineer and obtain instructions to proceed where there is a grade discrepancy, or an obstruction not shown on the drawings.
  - 2. Expose existing utilities at crossings of proposed storm sewer in advance of laying pipe to verify existing depth. Advise Engineer of conflicts in grade and provide adjustments in grade of storm sewer at no additional cost.
- B. Laser Beam Control:
  - 1. Check grade at set-up point, 25-foot, 50-foot, 100 foot and 200-foot points thereafter to the next set-up point.
  - 2. Projector advancement: Reset at each manhole.
- C. Bedding:
  - 1. See *Methods of Bedding Gravity Pipe* detail.
  - 2. Provide bedding area backfill as specified elsewhere.
  - 3. Provide continuous bearing by supporting entire length of pipe barrel evenly. Excavate for bells of pipe joints.

### 3.02 INSTALLATION:

- A. Laying pipe:
  - 1. Direction shall be upstream with spigot or tongue end downstream and bell end upstream.
  - 2. Joints shall be smooth and clean.
  - 3. Place pipe length and bedding as a unit in a frost free, dry trench.
  - 4. Install reinforced concrete pipe in accordance with ASTM D 1479 except as exceeded by these specifications.
  - 5. Footing drains and under drains shall have 4'-0" minimum cover.
- B. Jointing:
  - 1. Premium:
    - a. Solvents, adhesives, and lubricants shall be furnished by Manufacturer.
    - b. Seating: Fully.
    - c. Gasket position: Check.
- C. Manhole, Catch Basins, and Inlets:
  - 1. Base bedding: Provide 4-inch pea stone with full and even bearing in impervious or wet conditions. Otherwise provide on undisturbed frost-free dry subgrade.
  - 2. Precast: Fill joint space completely and trowel.
  - 3. Block: Set in full bed of mortar with key slots filled, joints maximum ½ inch at inside face and wipe joints. Plaster coat complete interior of structure with ½ inch coat of cement mortar.
  - 4. Provide manhole casting grade setting as follows:
    - a. Existing pavement: Finish grade.
    - b. Gravel or lawn grade: 4 inches below.
    - c. Unpaved areas: Finished grade.
  - 5. Provide catch basin casting grade setting as follows:
    - a. Gutter grade: ½ inch below.
    - b. Unpaved areas: 6 inches below finished grade.
  - 6. Manhole casting adjustment: Concrete ring between leveling and top course of bituminous. Match cross slope of top of casting to cross slope of pavement.
    - a. HDPE adjusting rings:
      - 1) Install per manufacturer's recommendations.

- 2) Seal to manhole structure, casting and to one another by means of an approved butyl sealant.
  - 3) Adjustment for matching road grade and/or cross slope shall be made utilizing a molded and indexed slope ring.
7. Flow Channels:
    - a. Not Required.
- D. Riprap: MDOT 813.03.E.
- E. Connections:
1. Expose existing storm sewer and structures to which the work is to be connected to confirm condition, location, and elevation.
  2. Connect to existing storm manhole by coring or jack hammering opening adequate to insert pipe and secure circumference of pipe with non-shrink cement mortar.
    - a. Relay and repoint loose blocks and bricks on existing block and brick structures.
    - b. Rechannel flowlines and benches with concrete, trowel smooth.
  3. Future Storm Sewer:
    - a. Plug: Pipe 4 inch through 21 inches with standard disc.
    - b. Bulkhead: Pipe 24 inch and larger with brick and mortar, ½ inch plaster outside.
      - 1) 24 inch - 36 inch: 4 inches thick.
      - 2) 42 inch - 60 inch: 8 inches thick.
      - 3) 60 inch and larger: 12 inches thick.

### 3.03 TESTING AND INSPECTION:

- A. General:
1. Observation: By Owner or Owner's representative.
  2. Completion: Before connecting to active system.
  3. Notification: Clean and arrange for inspection.
- B. Line and Grade: Allowable drift between structures from proposed alignment will be as follows:
1. Line:
    - a. Through 36 inches: 0.40 foot.
    - b. Over 36 inches: 0.80 foot.
  2. Grade:
    - a. Through 36 inches: 0.05 foot.
    - b. Over 36 inches: 0.10 foot.

### 3.04 ADJUST AND CLEAN:

- A. General:
1. Keep pipe and structures clean as work progresses.

**END OF SECTION**

**APPENDIX A – SOILS INVESTIGATION REPORTS / SOIL BORING LOGS**

Geotechnical Investigation

July 2, 2024

*via electronic mail*

Mr. Brian T. Sinnott, PE  
FLEIS & VANDENBRINK ENGINEERING, INC.  
2960 Lucerne Drive SE, Grand Rapids, MI 49546

**Re: Geotechnical Pavement Recommendations  
Proposed Pavement Area  
West Norway Street and North 2nd Street, Harrison, Michigan  
D&A Project No. 2440478.3A**

Dear Mr. Sinnott:

Driesenga & Associates, Inc. (D&A) is pleased to submit the following geotechnical exploration report and recommendations for the proposed pavement area at the southeast corner of West Norway Street and North 2<sup>nd</sup> Street in Harrison. This work was performed in accordance with Amendment No. 27 the Master Subconsultant Agreement with Fleis & Vandenbrink, Inc. (F&V) and D&A proposal dated April 12, 2024, authorized by Brian T. Sinnott of F&V on May 22, 2024.

### **FIELD EXPLORATION AND LABORATORY PROCEDURES**

One (1) soil boring, designated SB-1, was performed at the selected location on June 21, 2024, as shown on the attached Soil Boring Location Map. The soil boring was advanced with solid-stem augers to a depth of 15 feet below the ground surface. During sampling, soil samples were collected from split-spoon sampling via standard penetration testing (ASTM method D 1586) at intervals of 2.5 feet to a depth of 10 feet and at 5 feet thereafter.

Upon completion, the boreholes were backfilled with soil cuttings and the surface was repaired approximating previous conditions. The collected samples from the split-spoon sampler were transported to our laboratory and characterized in general accordance with the Unified Soil Classification System (USCS). The estimated group symbol is shown on the boring logs, just before the soil description.

### **SITE, SOIL, AND GROUNDWATER CONDITIONS**

The area of the proposed pavement expansion is generally covered with maintained grass. Surface materials encountered at the site consisted of 4 inches of topsoil at the boring position. Native soils consisted of loose to medium dense fine to medium grained sand to the end of the borings.

Groundwater was not encountered to the explored depth of the soil borings. Hydrostatic groundwater levels and the elevations and volumes of groundwater should be expected to fluctuate throughout the year, based on variations in precipitation, evaporation, run-off, and other factors. The groundwater levels (or lack thereof) indicated by the soil borings and presented in this section represent conditions at the time the readings were taken. The actual groundwater levels at the time of construction may vary.



## ANALYSIS AND RECOMMENDATIONS

The topsoil encountered at soil borings SB-1, and present within the pavement areas, should be completely removed to native sand. Once the stripped subgrade is achieved, a comprehensive proofroll should be performed over the entire area to identify any unstable surfaces. Any areas that are found to exhibit excessive pumping or rutting or if unsuitable soils are encountered should be undercut and replaced with compacted engineered fill to design subgrade elevation. Compaction of the exposed surface and any backfill soils should be to a minimum of 95% of Modified Proctor maximum dry density MDD, or 98% of MDD as determined by the Michigan Cone Method.

The following Design Inputs were used in our evaluation:

- Estimated Native Subgrade CBR = 4 to 6 percent
- Design Subgrade Resilient Modulus (MR) = 4,500 to 6,500 psi
- Reliability = 85% flexible
- Standard Deviation = 0.49 flexible
- Initial Serviceability Index = 4.2
- Terminal Serviceability Index = 2.0

Above the subgrade, the sand subbase should be constructed using a minimum of 12 inches of Michigan Department of Transportation (MDOT) Class II Fine Aggregate fill (MDOT Division 3, Section 301 “2012 Standard Specifications for Construction”, April 1, 2011) compacted to a minimum of 95% of the material’s MDD as determined by Modified Proctor. The existing native sand may be suitable for subbase, however additional testing would be required to make that determination.

The aggregate base for pavement areas should follow MDOT Dense-Graded Aggregate Base Course Materials – Division 3, Section 302 and Division 9, Section 902, using 21AA (Grading Requirements per MDOT Table 902-1) Dense-Graded Aggregate material with a minimum compacted thickness of 8 inches. This gravel base may be placed in one (1) lift and should be compacted to a minimum of 95% of the material’s MDD as determined by Modified Proctor.

The following pavement sections are recommended:

| Light to Medium Duty (50,000 ESAL's) |                               |           |                              |                      |                   |
|--------------------------------------|-------------------------------|-----------|------------------------------|----------------------|-------------------|
| Layer                                | Material                      | Thickness | Structural Layer Coefficient | Drainage Coefficient | Structural Number |
| Surface Course                       | MDOT 13A or Similar           | 1.5       | 0.42                         | 1                    | 0.63              |
| Leveling Course                      | MDOT 13A or Similar           | 1.5       | 0.42                         | 1                    | 0.63              |
| Aggregate Base                       | MDOT 21AA (Crushed Limestone) | 6         | 0.14                         | 0.75                 | 0.84              |
| Total Structural Number (SN)         |                               |           |                              |                      | 2.10              |





| <b>Heavy Duty (100,000 ESAL's)</b>  |                               |           |                              |                      |                   |
|-------------------------------------|-------------------------------|-----------|------------------------------|----------------------|-------------------|
| Layer                               | Material                      | Thickness | Structural Layer Coefficient | Drainage Coefficient | Structural Number |
| Surface Course                      | MDOT 13A or Similar           | 2         | 0.42                         | 1                    | 0.84              |
| Leveling Course                     | MDOT 13A or Similar           | 2         | 0.42                         | 1                    | 0.84              |
| Aggregate Base                      | MDOT 21AA (Crushed Limestone) | 8         | 0.14                         | 0.75                 | 1.12              |
| <b>Total Structural Number (SN)</b> |                               |           |                              |                      | <b>2.80</b>       |

Compaction of asphalt courses should range between 92% and 96% of the Theoretical Maximum Density (TMD).

Construction traffic should be minimized on the new pavement. If excessive construction traffic is anticipated on the pavement structure, the initial asphalt lift thickness could be increased and placement of the final lift could be delayed until the majority of the construction activities have been completed. This action will allow repair of localized failure, if any does occur, as well as reduce load damage on the pavement system.

A bond coat of emulsion should be used between the base course and wearing course when more than 48 hours have elapsed between placement of the courses, or the surface of the base course has been contaminated by soil or dust. Performance grade asphalt cement should be used in the production of all bituminous mixtures. After the pavement is complete, we recommend instituting a regular maintenance program that includes sealing of cracks and patching of distressed areas. This should reduce the effect of water infiltration and associated frost action.

In areas where the durability of Portland cement concrete (PCC) is desired over bituminous pavement (i.e., loading areas, dumpster pads) a rigid pavement is recommended. Concrete pavement should be constructed on a base layer of at least 6 inches of Michigan Department of Transportation (MDOT) Class II sand subbase (Division 9, Section 902, Grading Requirements per Table 902-3). The concrete slab should consist of a minimum of 6 inches of 4,000 psi, air entrained concrete (MDOT Division 6, Section 601 – PCC Pavement and Division 9, Section 901 – Cement and Lime); however, actual design of the slab including reinforcement type and spacing should be performed by the Project Structural Engineer.

These recommendations assume typical conditions during the June through September construction season. Any substitution of materials or deviation from these stated assumptions should be reviewed to assess potential impact on the recommended design.



## GENERAL COMMENTS

This report and any future reports or addenda performed for this site should be supplied to potential bidders prior to them submitting their proposals. We also recommend the construction contract include provisions for dealing with differing conditions. Contingency funds should be reserved for potential problems during earthwork and pavement construction.

This report has been prepared solely for the use of the client for the project specifically described in this report. This report cannot be relied upon by other parties not involved in this project, unless written permission is granted by Driesenga & Associates, Inc. If this report or any of its contents are utilized by parties other than our original client and the project team members, Driesenga & Associates, Inc. cannot be held responsible for the suitability of the field exploration, scope of services, or recommendations made for the new project. Driesenga & Associates, Inc. also is not responsible for the interpretation of our soil boring logs and the recommendations provided herein by other parties.

We appreciate the opportunity to be of service to you. If you have any questions, or if we can be of further service as design and construction progresses, please contact our office.

Sincerely,  
**DRIESENKA & ASSOCIATES, INC.**

Michael Stork  
Senior Project Geologist

Musana Nabil  
Senior Project Engineer

Randy Pail, P.E.  
Director of Geotechnical Engineering

cc: James Henning, P.E. – Driesenga & Associates, Inc.

Attachments - Soil Boring Location Map  
Soil Boring Logs  
Soil Classification Sheets



**Figure Number: 1**

Site Location

**Project Name**

New Pavements – West  
Norway Street

**Project Number**

2440478.3A

**Project Location**

SE Corner of West Norway  
Street & 2<sup>nd</sup> Street,  
Harrison, Michigan







**Figure Number: 2**

Boring Locations

**Project Name**

New Pavements – West  
Norway Street

**Project Number**

2440478.3A

**Project Location**

SE Corner of West Norway  
Street & 2<sup>nd</sup> Street,  
Harrison, Michigan





Project Name: New Pavements - Harrison  
SE Corner of West Norway & 2nd Street  
Harrison, Michigan  
Project No. 2440478.3A  
Client: Fleis & VandenBrink

Date Started : June 21, 2024  
Date Completed : June 21, 2024  
Hole Diameter : 6-inches  
Drilling Method : Solid Stem Auger  
Sampling Method : Split-Spoon Sampler

Drilling Company : Great Lakes Drilling  
Field Sampling : J. Cook  
Reviewed By : S. Ellison  
GW Encountered : Dry  
GW Completion :

| Depth in Feet | Surf. Elev. | USCS | GRAPHIC | Water Levels   |                    | Standard Hammer Used for SPT | Samples | Blow Count | N Value | Pocket Pen (tsf) | Water Level | Moisture Content % |
|---------------|-------------|------|---------|--|--------------------|------------------------------|---------|------------|---------|------------------|-------------|--------------------|
|               |             |      |         | ▼ During Drilling  | ▽ After Completion |                              |         |            |         |                  |             |                    |
| DESCRIPTION   |             |      |         |  |                    |                              |         |            |         |                  |             |                    |
| 0             |             |      |         | TOPSOIL - 4 inches   |                    |                              |         |            |         |                  |             |                    |
|               |             |      |         | SAND, loose to medium dense, light brown, fine to medium grained, trace gravel, moist. |                    |                              | 1       | 3          | 5       |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 2          |         |                  |             |                    |
|               |             |      |         |  |                    |                              | 2       | 4          | 6       |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 3          |         |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 3          | 6       |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 3          |         |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 4          |         |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 3          | 7       |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 4          |         |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 4          |         |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 7          |         |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 7          | 13      |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 6          |         |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 4          |         |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 4          | 8       |                  |             |                    |
|               |             |      |         |  |                    |                              |         | 4          |         |                  |             |                    |
| 15            |             |      |         | E.O.B. @15'  |                    |                              |         |            |         |                  |             |                    |

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

**Per ASTM D 2487—00  
(Based on Unified Soil Classification System)**

Soil Description: Secondary Soil Type BASIC SOIL TYPE, Consistency/Relative Density, Color, Supplemental Soil Type, Moisture, Miscellaneous comments.

Ex. Silty SAND, loose, brown, fine to medium, trace gravel, moist.

Secondary Soil Type – adjective for the BASIC SOIL TYPE describing material making up greater than 12% but less than 50% of the primary soil type by weight. For sands this also includes a description of grain size (fine, medium or coarse).

BASIC SOIL TYPE – primary constituent of sample; material making up greater than 50% of the sample by weight. Material is classified by grain size and material properties.

Consistency/Relative Density – a measurement of in-situ consistency or density of cohesive or cohesionless soils, respectively, based upon Standard Penetration Testing blow counts (N) per ASTM D 1586.

Color – visual inspection of soil appearance.

Supplementary Soil Type – a description of any other material that may be mixed with the BASIC SOIL TYPE. Qualifying terms are based on the percentage of the supplementary soil type in the sample by weight.

Moisture – description of the in-situ moisture content of the sample (dry, moist or wet).

Miscellaneous Comments – anything observed in the sample or in the field that does not fit into the above categories but should be noted (odor, etc.).

| CALIBRATED AUTO HAMMER CONSISTENCY/RELATIVE DENSITY |                          |                |                      |                     |
|---|--------------------------|----------------|----------------------|---------------------|
| COHESIONLESS SOILS                                  |                          | COHESIVE SOILS |                      |                     |
| SPT N-VALUES  | IN-SITU RELATIVE DENSITY | SPT N-VALUES   | SHEAR STRENGTH (PSF) | IN-SITU CONSISTENCY |
| 0-3   | VERY LOOSE               | 0-1            | BELOW 250            | VERY SOFT           |
| 4-8   | LOOSE                    | 2-3            | 250 - 500            | SOFT                |
| 9-23  | MEDIUM DENSE             | 4-6            | 500 - 1,000          | MEDIUM STIFF        |
| 24-38   | DENSE                    | 7-12           | 1,000 - 2,000        | STIFF               |
| >38   | VERY DENSE               | 13-25          | 2,000 - 4,000        | VERY STIFF          |
|   |                          | >26            | OVER 4,000           | HARD                |

| STANDARD HAMMER CONSISTENCY/RELATIVE DENSITY |                          |                |                      |                     |
|--|--------------------------|----------------|----------------------|---------------------|
| COHESIONLESS SOILS                           |                          | COHESIVE SOILS |                      |                     |
| SPT N-VALUES                                 | IN-SITU RELATIVE DENSITY | SPT N-VALUES   | SHEAR STRENGTH (PSF) | IN-SITU CONSISTENCY |
| 0-4  | VERY LOOSE               | 0-2            | BELOW 250            | VERY SOFT           |
| 5-10   | LOOSE                    | 3-4            | 250 - 500            | SOFT                |
| 11-30  | MEDIUM DENSE             | 5-8            | 500 - 1,000          | MEDIUM STIFF        |
| 31-50  | DENSE                    | 9-16           | 1,000 - 2,000        | STIFF               |
| >50  | VERY DENSE               | 17-32          | 2,000 - 4,000        | VERY STIFF          |
|  |                          | >32            | OVER 4,000           | HARD                |

| SUPPLEMENTAL TEXTURE QUALIFYING TERMS |                      |
|---------------------------------------|----------------------|
| DESCRIPTOR                            | PERCENTAGE BY WEIGHT |
| TRACE                                 | 1-10%                |
| LITTLE                                | 10-20%               |
| SOME                                  | 20-35%               |
| AND                                   | 35-50%               |



## SOIL CLASSIFICATION CHART (Per ASTM D2487)

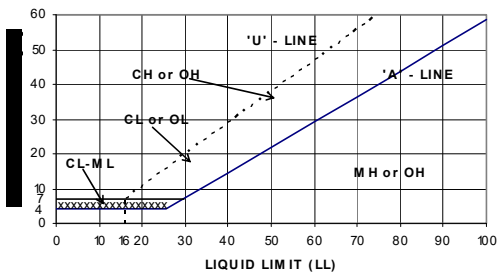
| Criteria for Assigning Symbols and Group Names Using Laboratory Tests <sup>A</sup> |   |  | Soil Classification                                     |            |                                   |
|--|---|--|---|------------|-----------------------------------|
|  |   |  | Group Symbol  | Group Name |                                   |
| COHESIONLESS SOILS<br>More than 50% retained on No. 200 sieve                      | Gravels<br>More than 50% of coarse fraction retained on No. 4 Sieve | Clean Gravels<br>Less than 5% fines <sup>C</sup>       | $Cu \geq 4$ and $1 \leq Cc \leq 3^E$                    | GW         | Well-graded gravel <sup>F</sup>   |
|  |   |  | $Cu < 4$ and/or $1 > Cc > 3^E$                          | GP         | Poorly graded gravel <sup>F</sup> |
|  |   | Gravels with Fines<br>More than 12% fines <sup>C</sup> | Fines classify as ML or MH                              | GM         | Silty gravel <sup>F,G,H</sup>     |
|  |   |  | Fines classify as CL or CH                              | GC         | Clayey gravel <sup>F,G,H</sup>    |
|  | Sands<br>More than 50% of coarse fraction retained on No. 4 Sieve   | Clean Sands<br>Less than 5% fines <sup>D</sup>         | $Cu \geq 6$ and $1 \leq Cc \leq 3^E$                    | SW         | Well-graded sand <sup>F</sup>     |
|  |   |  | $Cu < 6$ and/or $1 > Cc > 3^E$                          | SP         | Poorly graded sand <sup>F</sup>   |
|  |   | Sands with Fines<br>More than 12% fines <sup>D</sup>   | Fines classify as ML or MH                              | SM         | Silty sand <sup>G,H,I</sup>       |
|  |   |  | Fines classify as CL or CH                              | SC         | Clayey sand <sup>G,H,I</sup>      |
| COHESIVE SOILS<br>50% or more passes the No. 200 Sieve                             | Silt and Clays<br>Liquid limit less than 50                         | Inorganic  | $PI \geq 7$ and plots on or above 'A' line <sup>J</sup> | CL         | Lean clay <sup>K,L,M</sup>        |
|  |   |  | $PI < 4$ or plots below 'A' line <sup>J</sup>           | ML         | Silt <sup>K,L,M</sup>             |
|  |   | Organic  | Liquid limit - oven dried $< 0.75$                      | OL         | Organic clay <sup>K,L,M,N</sup>   |
|  |   |  | Liquid limit - not dried $< 0.75$                       |            | Organic silt <sup>K,L,M,O</sup>   |
|  | Silt and Clays<br>Liquid limit 50 or more                           | Inorganic  | PI plots on or above 'A' line                           | CH         | Fat clay <sup>K,L,M</sup>         |
|  |   |  | PI plots below 'A' line                                 | MH         | Elastic Silt <sup>K,L,M</sup>     |
|  |   | Organic  | Liquid limit - oven dried $< 0.75$                      | OH         | Organic Clay <sup>K,L,M,P</sup>   |
|  |   |  | Liquid limit - not dried $< 0.75$                       |            | Organic silt <sup>K,L,M,O</sup>   |
| HIGHLY ORGANIC SOILS   | Primarily organic matter, dark in color, and organic odor           |  | PT  | Peat       |                                   |

- A** Based on the material passing the 3-in. sieve
- B** If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name
- C** Gravels with 5 to 12% fines require dual symbols:  
 GW-GM well-graded gravel with silt  
 GW-GC well-graded gravel with clay  
 GP-GM poorly graded gravel with silt  
 GP-GC poorly graded gravel with clay
- D** Sands with 5 to 12% fines require dual symbols:  
 SW-SM well-graded sand with silt  
 SW-SC well-graded sand with clay  
 SP-SM poorly graded sand with silt  
 SP-SC poorly graded sand with clay

- E**  $Cu = D_{60}/D_{10}$   $Cc = (D_{30})^2/(D_{10} \cdot D_{60})$
- F** If soil contains  $\geq 15\%$  sand, add "with sand" to group name.
- G** If fines classify as CL-ML, use dual symbol GC-GM or SC-SM
- H** If fines are organic, add "with organic fines" to group name.
- I** If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.
- J** If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
- K** If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant
- L** If soil contains  $\geq 30\%$  plus No. 200, predominantly sand, add "sandy" to group name.

- M** If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name
- N**  $PI \geq 4$  and plots on or above 'A' line.
- O**  $PI < 4$  or plots below 'A' line.
- P**  $PI$  plots on or above 'A' line.
- Q**  $PI$  plots below 'A' line.

### For classification of fine-grained soils and fine-grained fraction of coarse-grained soils



### SIEVE ANALYSIS

