

SECTION 01650

MEASUREMENT AND PAYMENT PROCEDURES

PART 1 – Description.

All work completed under this Contract will be measured by the Engineering according to the bid items and to the construction drawings. Units of measurement and dimensions will be shown in these specifications.

1.01 Payment

A. Progress payments will be processed in accordance with the following schedule.

| <u>Cut-Off Date</u> | <u>Date of Submittal</u> |
|---------------------|--------------------------|
| November 26, 2020 | December 03, 2020 |
| December 23, 2020 | December 30, 2020 |
| January 26, 2021 | February 03, 2021 |
| February 28, 2020 | March 06, 2021 |
| March 18, 2021 | March 25, 2021 |

Submit pay requests to the City by the dates of submittal listed above.

- B. Owner will make progress payments as defined in Article 5 of the Agreement, on the forms provided by the Engineer.
- C. If the Contractor elects to enter into a joint account agreement, two (2) pay requests and vouchers must be submitted. One pay request and voucher for the appropriate progress payment amount, the other for the retained amount.

1.02 Measurement of Quantities

Quantities shown on the bid schedule are estimated and are to be considered approximate. Actual constructed quantities will vary. The Contractor will be compensated only for those items and materials actually installed and approved as part of the project. No additional pay will be granted for items or materials not installed.

- A. Payment will be made for the work completed and stored materials less retained amounts in accordance with provisions of the contract documents.
- B. Payment amounts will be based on the scheduled values and mutually agreed upon percentage of completion for each item.

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- B. Payment amounts will be based on the scheduled values and mutually agreed upon percentage of completion for each item.

1.03 Bid Item Descriptions

The cost of all material and labor required to complete this project as specified and shown on the drawings, but not specifically included as a pay item, shall be included in the bid price of its related bid item. No extra pay shall be granted for items that are reasonably foreseen as necessary for the proper installation of an item.

PART 3 Execution

3.01 Measurement and Payment of Bid Items

A. Construction stakes, lines, and grades

1. Measurement of this item shall be paid by lump sum (LS) of construction stakes furnished and installed in place and approved. This item shall include stakes and installation. Payment shall be made by the contract unit price per Lineal Foot (LF) in place.

B. Clearing & Grubbing

1. Measurement of this item shall be paid by lump sum (LS) for clearing and grubbing. This item shall include completing clearing and grubbing, hauling, and disposal of all debris resulting from clearing and grubbing as outlined in Plans and Specifications. Payment shall be made by the contract unit price per Lump Sum (LS).

C. Road & Drainage Excavation

1. Measurement of this item shall be paid by cubic yard (CY) for earthwork. This item shall include preparation of area, earthwork, compaction, removal of unsuitable soils, grading as outlined in Plans and Specifications. Payment shall be made by the contract unit price per cubic yard (CY)

D. Borrow Excavation

1. Measurement of this item shall be paid by cubic yard (CY) for earthwork. This item shall include excavation, placement of borrow and all other incidentals necessary to complete the work outlined in Plans and Specifications. Payment shall be made by the contract unit price per cubic yard (CY)

E. Water

1. Measurement of this item shall be paid by M.G. (1,000 gallons) for water. This item shall include the required water for compaction to complete the work outlined in the Plans and Specifications. Payment shall be made by the contract unit price per M.G. (1,000 gallons).

F. Sediment Removal

1. Measurement of this item shall be by the number of cubic yards (SY) of sediment are removed. This item shall include excavation, hauling and disposal of material. Quantities shall be verified and paid by the haul ticket. Payment shall be by the contract unit price per Cubic Yard (CY).

G. Temporary Silt Fence (with backing)

1. Measurement of this item shall be paid by lineal foot (LF) of silt fencing furnished and installed in place and approved. This item shall include silt fence, stakes and installation. Payment shall be made by the contract unit price per Lineal Foot (LF) in place.

H. Mineral aggregate, Type A base, grading D

1. Measurement of this item shall be by the number of tons (Tons) of mineral aggregate furnished and installed in place and approved. Quantities shall be verified and paid by haul ticket. This item include furnishing and installing granular base, and compaction. Payment shall be by the contract unit price per tons (Ton) in place.

I. Mineral Aggregate (size 57)

1. Measurement of this item shall be by the number of tons (Tons) of mineral aggregate furnished and installed in place and approved. Quantities shall be verified and paid by haul ticket. This item include furnishing and installing mineral aggregate, and compaction. Payment shall be by the contract unit price per tons (Ton) in place.

J. Install 18" crossdrain pipe culvert, Polypropylene Pipe

1. Measurement of this item shall be paid by lineal foot (LF) of each size corrugated smooth interior polypropylene pipe furnished and installed in place and approved. This item shall include PP pipe, excavation, placement of pipe, bedding, compaction, backfill, and all other incidentals necessary to complete the work. Payment shall be made by the contract unit price per Lineal Foot (LF) in place.

K. Install 24" crossdrain pipe culvert, Polypropylene Pipe

1. Measurement of this item shall be paid by lineal foot (LF) of each size corrugated smooth interior polypropylene pipe furnished and installed in place and approved. This item shall include PP pipe, excavation, placement of pipe, bedding, compaction, backfill, and all other incidentals necessary to complete the work. Payment shall be made by the contract unit price per Lineal Foot (LF) in place.

L. Install 30" crossdrain pipe culvert, Polypropylene Pipe

1. Measurement of this item shall be paid by lineal foot (LF) of each size corrugated smooth interior polypropylene pipe furnished and installed in place and approved. This item shall include PP pipe, excavation, placement of pipe, bedding, compaction, backfill, and all other incidentals necessary to complete the work. Payment shall be made by the contract unit price per Lineal Foot (LF) in place.

M. Install 36" crossdrain pipe culvert, Polypropylene Pipe

1. Measurement of this item shall be paid by lineal foot (LF) of each size corrugated smooth interior polypropylene pipe furnished and installed in place and approved. This item shall include PP pipe, excavation, placement of pipe, stream diversion, bedding, compaction, backfill, and all other incidentals necessary to complete the work. Payment shall be made by the contract unit price per Lineal Foot (LF) in place.

N. Install 48" crossdrain pipe culvert, Polypropylene Pipe

1. Measurement of this item shall be paid by lineal foot (LF) of each size corrugated smooth interior polypropylene pipe furnished and installed in place and approved. This item shall include PP pipe, excavation, placement of pipe, stream diversion, bedding, compaction, backfill, and all other incidentals necessary to complete the work. Payment shall be made by the contract unit price per Lineal Foot (LF) in place.

O. Machined Rip-Rap (Class A-3)

1. Measurement of this item shall be by the number of tons (Tons) of Class A-3 Rip Rap furnished and installed in place and approved. Quantities shall be verified and paid by haul ticket. This item includes excavation, disposal of existing material, geotextile, furnishing and installing granular material, and compaction. Payment shall be by the contract unit price per Ton (Ton) in place.

P. Machined Rip-Rap (Class A-1)

1. Measurement of this item shall be by the number of tons (Tons) of Class A-1 Rip Rap furnished and installed in place and approved. Quantities shall be verified and paid by haul ticket. This item includes excavation, disposal of existing material, furnishing, installing granular material, and compaction. Payment shall be by the contract unit price per Ton (Ton) in place.

Q. Mobilization

1. Measurement of this item shall be paid by lump sum (LS) for mobilization. This item shall include all costs for mobilization, including mobilization of equipment to the project site and property owner notifications in accordance with these specifications. Payment shall be by the contract unit price per Lump Sum (LS).

R. Geotextile (Type III) (Erosion Control)

1. Measurement of this item shall be paid by square yard (SY) of nonwoven geotextile furnished and installed in place and approved. This item shall include furnishing and placement of geotextile in excavated areas. Payment shall be made by the contract unit price per Square Yard (SY) in place

S. Geotextile (Type IV) (Stabilization)

1. Measurement of this item shall be paid by square yard (SY) of nonwoven geotextile furnished and installed in place and approved. This item shall include furnishing and placement of geotextile in excavated areas. Payment shall be made by the contract unit price per Square Yard (SY) in place

T. Temporary Sediment Tube 24 in

1. Measurement of this item shall be paid by lineal foot (LF) of sediment tube furnished and installed in place and approved. This item shall include 24 in temporary sediment tube, installation, removal, and disposal. Payment shall be made by the contract unit price per Lineal Foot (LF) in place.

U. Furnish and Install Construction Exit

1. Measurement of this item shall be paid by each (EA) construction exit furnished and installed in place and approved. This item shall include clearing, excavation, furnishing and placement of geo textile and granular material, and maintenance. Payment shall be made by the contract unit price per Each (EA).

END OF SECTION

SECTION 01750

CONTRACT CLOSEOUT

PART I Description

1.01 Summary

- A. Provide prerequisites to substantial completion.
 - 1. Punch list.
 - 2. Supporting documentation.
 - 3. Warranties.
 - 4. Certifications.

- B. Provide prerequisites to final acceptance.
 - 1. Final payment request with supporting affidavits.
 - 2. Completed punch list.
 - 3. Submit record documents: One set of drawings and project manual with all changes noted in red and Project Manual changes flagged with page tabs.
 - 4. Final clean-up.
 - 5. Removal of temporary facilities.

END OF SECTION

SECTION 01810

SPECIAL PROVISIONS

PART 1 Description

1.01 SUMMARY

- A. These "Special Provisions" supplement, clarify, or modify provisions of Specifications as they apply to this project.
- B. Requirements of Special Provisions, General and Supplemental Conditions apply to work performed under all sections of this project.
- C. Work of this contract shall include all work required to construct the entire Project as shown on the drawings and defined by the Specifications and other contract documents, unless specific exceptions are stated therein.
- D. DISCREPANCY BETWEEN SPECIAL PROVISIONS, SPECIFICATIONS, AND PLANS. In the event of discrepancy between Special Provisions and other sections of the Specifications, the Special Provisions will take precedence over the Specifications, the General Conditions, and the Supplemental Conditions. The Specifications will take precedence over the Plans.

1.02 LABOR PRACTICES

A. EIGHT-HOUR WORK DAY

The Contractor's attention is directed to, Limitation on work hours; overtime; exceptions. a) No person shall require laborers, workmen, or mechanics to work more than eight hours in any one calendar day or forty hours in any one week upon any public works of the state, or any of its political subdivisions, except as hereafter authorized. An employee may agree to work more than eight hours per day or more than forty hours in any week provided the employee shall be paid at the rate of one and one-half times the regularly established hourly rate for all work in excess of forty hours in any one week.

1.03 BACKFILL OBSERVATION

No work shall be covered before the Project Representative or Engineer has approved the work. If any piping or appurtenance is covered without the approval of the Engineer or Project Representative, at the discretion of the Engineer, the Contractor will be required to re-excavate to expose the covered materials. The cost of exposing those materials and then backfilling and compaction will be at the Contractor's expense, regardless of the condition of

the pipe and/or the materials under question.

1.04 CONSTRUCTION WATER

The Contractor is responsible for supplying water for construction purposes. If the Contractor wishes to use existing fire hydrants for water, he shall make the proper arrangements with the owner of the hydrant. The Contractor will be responsible for compliance with that owner's requirements as well as the payment of any fees for its use. Construction water is considered incidental to this project and no separate payment will be made to the Contractor for this item. If the Contractor wishes to use water from a resident, he shall obtain written permission from that resident to do so.

1.05 SAFETY

In accordance with generally accepted construction practices, the Contractor will be solely and completely responsible for safety conditions at and adjacent to the job site, including the safety of all persons and property during the performance of the work. The Contractor shall comply with all federal, state, and local safety laws and regulations. This requirement shall apply continuously, and shall not be limited to normal working operations. The Engineer's construction review of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures, in, on, or near the construction site. This paragraph shall be applicable to the Contractor and all of the Contractor's subcontractors.

In addition, the Contractor shall provide barriers, fences, signs, lights, etc. as necessary to control access to the site.

Contractor shall provide Owner a written copy of their confined spaced program, proof of record-keeping protocol and inventory of appropriate equipment such as monitors for atmospheric hazards and rescue equipment. These documents shall be submitted at the preconstruction conference.

1.07 DUST CONTROL

The Contractor shall be responsible for dust and erosion control, and for minimizing dust and erosion to the Owner's satisfaction. Dust and erosion control shall be deemed to be incidental and shall not be a pay item.

1.08 DISPOSAL OF WASTE MATERIALS

Excess, unsuitable, and waste materials from this project (including that from trench excavation, pavement removal, piping removal, and grading operations), shall be disposed of, offsite, by Contractor. Such disposal shall be considered incidental, and shall not be a pay item.

1.09 CODES AND STANDARDS

All materials and the completed installation shall comply with applicable standards promulgated pursuant to the State of Tennessee and City of Lakeland.

1.10 OPEN EXCAVATIONS

The Contractor shall completely backfill all excavations before stopping work for the day. No excavation (fenced or unfenced) shall be left open overnight, over a weekend, nor any period in which no work at that location is underway. The cost of reopening or re-excavation due to this provision will be borne by the Contractor.

1.11 CONSTRUCTION SURVEYING AND STAKING

In this project, lines and grades of replaced appurtenances shall match those existing. When new appurtenances such as drain lines, catch basins, curbswalks, and new roadway crowns are to be installed, the Contractor will provide construction surveying and staking, unless otherwise noted.

1.12 CLEANING AND FINISHING

After completion of all work all debris and foreign material will be removed by the contractor. The project area, including staging areas, shall be clean and functional. This will include the restoration of any disturbed landscaping in the work area.

1.13 TRAFFIC CONTROL

A traffic control plan is required for repairs in areas affecting traffic. The Contractor is responsible for furnishing a traffic control plan to the City Engineer at least one week prior to the start of construction. Excavations which traverse a street shall be limited to one-half the width of the street at any one time, unless an emergency situation exists which requires the entire width of the street be excavated. The City Engineer's approval is required prior to traversing an entire street. The closure should not exceed forty-eight (48) hours and proper signage shall be installed detouring traffic and warning of construction.

END OF SECTION

SECTION 02115

EROSION AND SEDIMENT CONTROL

PART 1 - Description

This work shall consist of providing erosion and sediment control during and upon completion of construction as specified herein and as shown on the Construction Drawings.

1.01 General

- A. The Contractor shall provide the Engineer a copy of the Storm Water Pollution Prevention Plan (SWPPP) as submitted to the Tennessee Department of Environment and Conservation.
- B. All erosion and sediment control plans shall be developed as per regulations outlined by the Tennessee Department of Environment and Conservation.
- C. All erosion and sediment control plans as outlined in the SWPPP shall be installed prior to any grading and land disturbance.
- D. All control measures shall be checked, and repaired as necessary, twice weekly in dry periods and within 24 hours after any rainfall of 0.5 inches (minimum). During prolonged rainfall daily checking and repairing is necessary. Maintain records of checks and repairs.
- E. A specific individual who is certified by a TDEC Certification Program or its equivalent shall be designated to be responsible for erosion and sediment control.

1.02 Related Sections

Section 02230 Clearing and Grubbing

Section 02315 Excavation, Embankment and Fill

Section 02335 Roadway Earthwork

Section 02340 Geotextiles

Section 02370 Storm Drain Outfall Protection

Section 02835 Topsoil, Seeding and Lawn Restoration

PART 2 – Materials

- A. The Contractor shall submit the following to the Engineer for inspection and acceptance all materials used for this Section.
- B. Silt Fence Materials shall be as follows:
 - 1. Silt Fence-See Section 02340 Geotextiles.
 - 2. Fence Post (for fabricated units): Steel posts will be a standard “T” and “U” sections weighting not less than 1.33 pounds per lineal foot with a minimum length 42 inches.
 - 3. Wire Fence (for fabricated units): Wire fencing shall be minimum 14-1/4 gage welded wire fabric with a maximum six inch mesh opening or as approved by the Owner.
- C. Stabilized Construction Entrance Materials shall be as follows:
 - 1. Aggregate shall be in accordance with Tennessee Department of Transportation (TDOT) #1 or #2 stone specifications (1.5 to 3.5 inch stone), washed and well graded. Refer to Tennessee Department of Environment and Conservation (TDEC) specification Riprap for aggregate size tables.
 - 2. Geotextile fabric shall meet the requirements of Section 02340 Geotextiles.

PART 3 - Execution

3.01 Silt Fencing

- A. Silt fence shall be constructed by securely fastening silt fence fabric and wire reinforcement to steel posts using wire ties. The silt fence fabric panels shall be installed loosely with adjacent panels overlapped a minimum of 12 inches. The top edge of the fabric shall be reinforced or shall have a one inch tuck.
- B. Accumulated silt and debris shall be removed by the Contractor behind the face of the silt fence when the silt deposits reach approximately one half the height of the fence. Clogged or damaged silt fence fabric or wire reinforcement shall be immediately replaced at no additional expense to the Owner.
- C. Refer to Silt Fence details on the construction drawing for additional details and general notes.

3.02 Erosion Control During Construction

- A. The Contractor shall take sufficient precautions during construction to minimize the run-off of polluting substances such as silt, clay, wastes, fuels, oils, bitumens, and calcium chloride into the water supplies and surface waters of the State. Special precautions shall be taken in the use of construction equipment to prevent operations which promote erosion.
- B. Disposal of drainage shall be in an area approved by the Owner. The Contractor shall prevent the flow or seepage of drainage back into the drainage areas. Drainage shall not be disposed of until silt and other sedimentary materials have been removed. Particular care shall be taken to prevent the discharge of unsuitable drainage to a water supply or surface water body.
- C. As a minimum, the following shall apply:
 - 1. Approved silt fencing shall be provided as points where drainage from the worksite leaves the site, to reduce the sediment content of the water.
 - 2. Drainage leaving the site shall flow to water courses in such a manner to prevent erosion.
- D. Measures for control of erosion must be adequate to assure that turbidity in receiving water will not be increased more than 10 standard turbidity units (s.t.u.) or as otherwise required by the State or other controlling body, in waters used for public water supply or fish unless limits have been established for the particular water. In surface water used for other purposes, the turbidity increases must not exceed 25 s.t.u. unless otherwise permitted.

3.03 Stabilized Construction Entrance

- A. Contractor shall install stabilized construction entrances in at least one main entry point to the construction site. Additional entrances shall be stabilized depending on the project size and use of entry points to the construction sites. Construct stabilized construction entrance as per dimensions shown on the construction.
- B. Geotextile Engineering fabric shall be installed prior to placement of aggregate. Fabric shall not be required for work on single family residential lot.
- C. Maintenance of stabilized construction entrance shall include periodic top dressing of entrance with additional stones as conditions demand to prevent tracking or flow of sediment onto public rights of way.

END OF SECTION

SECTION 02230

CLEARING AND GRUBBING

PART 1 - Description

This work shall consist of clearing, grubbing, scalping, removal of trees and stumps, and removing and disposing of all vegetation and debris within the limits of the work as described on the drawings, except such objects that are to remain or are to be removed in accordance with other sections of these specifications.

1.01 General

- A. The Engineer shall exercise control over clearing and grubbing and shall designate all trees, shrubs, plants, and other objects to be removed. This work shall also include the preservation from injury or defacement of all vegetation and objects to remain. Paint required for cut or scarred surfaces of trees or shrubs selected for retention shall be a suitable asphaltum base paint.
- B. Before the Contractor removes any tree or stump which the plans state is to be removed, the Engineer shall review the plan requirements with the Owner and Contractor and appropriately mark each tree or stump which is to be removed.
- C. Only such trees and stumps which have been marked for removal by the Engineer shall be removed.
- D. Limitations of areas of clearing and grubbing and earthwork operations shall be in accordance with the construction drawings

PART 2 – Materials (Not Used)

PART 3 - Execution

3.01 Clearing and Grubbing

- A. All surface objects, brush, roots, and other protruding obstructions, not designated to remain, and all trees and stumps marked for removal, shall be cleared and/or grubbed, including mowing, as required, except for special treatment as follows:
 - 1. In locations to be seeded, stumps shall be removed to a minimum of 150 mm (6 inches) below ground surface.
 - 2. In unseeded areas to be rounded at the top of backslopes, stumps shall be cut off flush with or below the surface of the final slope line.

3. Except in areas to be excavated, stump holes and other holes from which obstructions are removed, shall be backfilled with suitable material and compacted in accordance with other divisions within these specifications.
4. Materials and debris may be removed from the construction site and properly disposed of at locations off the project outside the limits of view from the right-of-way with the written permission of the property owner on whose property the materials and debris are placed. No burning of vegetation will be allowed. The Contractor shall make all necessary arrangements with property owners for obtaining suitable disposal locations.
5. Low hanging branches and unsound or unsightly branches on trees or shrubs designated to remain shall be removed as directed. Branches of trees extending over the roadbed shall be trimmed to give a clear height of 6 m (20 feet) above the roadbed surface.

3.02 Scalping

- A. The Contractor shall scalp all areas where excavation or embankment is to be made. Scalping shall include the removal of material such as roots, sod, grass, residue of agricultural crops, sawdust, and decayed vegetable matter from the surface of the ground.
- B. Sod and incidental topsoil removed in the scalping operation shall be salvaged and stockpiled for use as specified elsewhere. The stockpiles of scalplings shall be made in such a manner and at such locations that they will be well drained and will not impound water.
- C. The depth of scalping performed under this section is not intended to include topsoil.

END OF SECTION

SECTION 02315

EXCAVATION & EMBANKMENT FILL

PART 1 – Description

- A. This work consists of excavating and disposal of unsuitable material from roadbed excavations; and building controlled embankments and the sloping, shaping and dressing of all slopes including preparation of the areas upon which they are to be constructed by the placing and compacting of material in holes, pits, and other depressions within the embankment area, all in conformity with the lines, grades, and typical cross-sections shown on the Plans. Only approved materials shall be used in the construction of embankments.

PART 2 – Materials

All equipment for the satisfactory performance of excavation and hauling shall be on the project and approved by the Owner before the work will be permitted to begin.

2.01 Related Sections

Section 02335 Roadway Earthwork

PART 3 – Execution

3.01 General

- A. Prior to beginning excavation all necessary Clearing and Grubbing and Removal of Structures and Obstructions shall have been completed in the area in accordance with Sections 02220 and 02230 of these Specifications. The removal of unsuitable material and/or undercutting ordered by the Owner will not be considered contract items and these two operations will be included in either excavation (unclassified) or embankment (unclassified) respectively. Unsuitable material above subgrade or from undercutting in cuts shall be disposed of as directed by the Owner at no additional cost to the Owner. Any imbalance of material quantities caused by these operations or change in actual shrinkage factor shall be the Contractor's responsibility. The Owner's decision on the suitability of material or the need for undercutting shall be final.
- B. If approved by the Owner, gravel for undercut backfill or stabilization and Portland cement for stabilization will be used and paid for as separate items in the contract.
- C. When ordered by the Owner, water used for dust control will be paid for as a contract item.
- D. The Contractor shall provide for proper drainage of the project area to protect from ponding and erosion.

3.02 Excavation

- A. Excavation (unclassified) shall consist of the removal of all suitable or unsuitable material in cut sections to the lines, grades, and cross-sections shown on the Plans. All slopes, ditches and berms shall be neatly trimmed to the lines given. Excavation beyond given lines or to correct slides, regardless of the location, will be at the Contractor's expense, and the suitability of the material from slides for embankment construction will be determined by the Owner.
- B. Surplus excavated material, if determined to be suitable by the Owner, may be used to widen embankments or to flatten slopes or may be deposited in such other places and for such other purposes on the right-of-way as the Owner may approve. No payment to the Contractor shall be made for the placement of surplus excavated material. Materials unsuitable for construction of embankment or use as backfill shall be removed to off-site waste disposal areas. The Contractor shall secure waste disposal areas and dispose of surplus and unsuitable materials in such areas. It is the Contractor's responsibility to obtain written permission from the owners of all property(s) to be used for waste disposal areas prior to removal of material to disposal sites. The Contractor shall dispose of all materials on the sites to the satisfaction of the property owner(s).

3.03 Embankments

- A. Prior to beginning embankment operations all necessary Clearing and Grubbing and Removal of Structures and Obstructions shall have been completed in the area in accordance with Sections 02220 and 02230 of these Specifications. The removal of unsuitable material and/or undercutting ordered by the Owner will not be considered contract items and these two operations will be included in either excavation (unclassified) or embankment (unclassified) respectively. If there is insufficient suitable material from excavation on the project, it shall be the Contractor's responsibility to obtain the additional material off the project to complete embankments according to the lines, grades, and cross-sections on the Plans.
- B. When ordered by the Owner, water used for dust control will be paid for as a contract item.
- C. This work shall consist of constructing roadway or street embankments including the preparation of the area upon which they are to be constructed, the placing and compacting of approved materials where unsuitable material has been removed, and the placing and compaction of embankment material in holes, pits, and other depressions not filled in accordance with Sections 02220 and 02230. All work shall be in accordance with these Specifications and in conformity with the lines, grades, and cross-sections shown on the Plans. Only approved materials shall be used in the construction of embankments, which material shall come from excavation on the Project or from approved sources furnished by the Contractor.

- D. Any area upon which an embankment is to be constructed shall be plowed or scarified, all cleavage planes destroyed, and the area rolled thoroughly with a sheeps-foot roller before embankment construction is begun in the area. An area upon which an embankment is to be constructed having a slope steeper than 3 to 1 shall be benched with steps of not less than eight (8) inches rise before any embankment materials are placed thereon. Benching shall be of sufficient width to permit the operation of placing and compacting equipment. Each successive benching cut shall begin at the intersection of the original ground line and the vertical side of the previous cut. Material thus cut out shall be recomacted along with new material at the Contractor's expense.
- E. Embankment construction will not be permitted within fifty (50) feet of any structure or proposed structure until such structure is cured sufficiently to permit embankment formation against it. This requirement will be waived when an embankment or portion thereof is to form the foundation of a structure or part thereof. Embankment to be placed on both sides of a concrete wall, manhole, or box type structure shall be so constructed that the embankment is always approximately the same elevation on both sides of the structure. Embankments on only one side of abutments, wingwalls, or piers shall not be constructed until the superstructure is in place or final concrete design strength has been obtained.
- F. Where embankment is to be constructed across ground that will not support earth moving equipment, the fill shall be started with a uniformly distributed layer of a thickness not greater than necessary to support the hauling equipment while placing subsequent layers. In the construction of such a lift the density requirement will be waived but the moisture content of the material used shall not exceed the optimum moisture content for that material. Maximum thickness and minimum density requirements will apply to all succeeding layers of embankment construction. Each succeeding layer of embankment is to be constructed with a compacted thickness not to exceed six (6) inches and shall be approved before material for the next succeeding layer is placed.
- G. Embankments shall be so constructed that adequate surface drainage will be provided at all times. Roadway embankment materials shall be placed in horizontal layers not to exceed a depth which will produce a six (6) inch compacted layer. Each layer shall be compacted for the entire embankment width to a density no less than ninety-five (95) percent of maximum density as determined in accordance with the standard specification of compaction and density of soils, ASTM D-698. The moisture content of the embankment material shall be controlled in such a way that the material will be compacted with a moisture content ranging from two (2) percent below to two (2) percent above the optimum moisture content as determined from the above mentioned test and approved by the Owner. If the moisture content of the material in the embankment prior to compaction is greater than two (2) percent above the optimum moisture content, the material shall be aerated by disking, harrowing, plowing, or other means approved by the Owner, who shall be the sole judge as to when the required density has been obtained. For each layer of embankment material, the Contractor shall disk sufficiently to break down oversize clods, thoroughly mix any different materials, secure correct moisture content, ensure uniform density, and obtain proper compaction. Rolling with compacting equipment shall start longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half of the width of the tamping

roller. Tamping equipment shall be operated at a speed of no more than three (3) miles per hour.

- H. The Contractor shall be responsible until final acceptance for the stability of all embankments and shall replace at this own expense any portion which in the opinion of the Owner has become displaced or damaged due to carelessness, negligence, or by rainfall and weathering.
- I. The slopes of all embankments, ditches, channels, and such other appurtenances as may be indicated on the Plans shall be shaped and trimmed to the lines, grades, and cross-sections shown or as directed by the Owner. This work shall also include the satisfactory shaping of spoil banks, waste deposits, and any other areas deemed necessary by the Owner to prepare the project for final inspection and acceptance.
- J. Water for dust control when ordered by the Owner, whether to comply with local air pollution ordinances, safety, or good construction practices, shall be readily available along with adequate distribution equipment.

END OF SECTION

SECTION 02340

GEOTEXTILE FABRICS AND MEMBRANES

PART 1 - Description

This section covers furnishing and placing geotextiles as shown on the plans or directed, in accordance with these specifications. The geotextile usage will determine the applicable specifications and the corresponding pay item.

PART 2 - Materials

A. The geotextile shall consist only of woven or non-woven, long-chain polymeric filaments or yarns such as polyethylene, polyester, polypropylene, polyamide, or polyvinylidene chloride formed into a stable network such that the filaments or yarns retain their relative positions to each other.

B. Membrane Requirements

| Geotextile and Impermeable Plastic Membrane Specifications | | | | | | | | |
|--|-------------|-------------------------|-----------------|------------|----------------------------|-----------|---|------------------------------|
| Fabric and Membrane Property | Test Method | Drainage And Filtration | Erosion Control | Silt Fence | Separation & Stabilization | | Embankment & Retaining Wall Reinforcement | Impermeable Plastic Membrane |
| | | | | | Woven | Non-Woven | | |
| *EOS (mm) | ASTM D4751 | 40-70 | 40-100 | 40-100 | 30-50 | 40-100 | 30-70 | ---- |
| Thickness, Mils (mm) | ASTM D5199 | ---- | ---- | ---- | ---- | ---- | ---- | 12 (0.305) |
| Permittivity, cm/sec | ASTM D5199 | 1.0 | 1.0 | 0.1 | 0.05 | 1.0 | 0.05 | <10 ⁻⁷ cm/sec |
| Grab Tensile Strength | ASTM D4632 | 90 | 180 | 90 | 200 | 160 | 300 | 150 |
| Elongation at Failure% Min | ASTM D4533 | 40 | 40 | 50 | 15 | 40 | 15 | 20 |
| Trap Tear Strength, lbs | ASTM D4833 | 40 | 70 | 50 | 65 | 60 | 110 | 50 |
| Puncture Strength, lbs | ASTM D4632 | 50 | 90 | 60 | 90 | 80 | 110 | 60 |
| | | | | | | | | |
| | | | | | | | | |

*Equivalent or Apparent Opening Size, U.S. Standard Sieve (mm)

PART 3 – Execution for Stabilization Fabric

3.01 Equipment

- A. Equipment loads when placing and compacting the material placed over the stabilization geotextiles shall comply with the following:
1. Maximum wheel load shall be 9,945 pounds (4500 kg), or as specified.
 2. Maximum contact pressure shall be 60 psi (400kPa). The contact pressure is calculated from the applied wheel load in newtons and the resulting contact area in square meters.
 3. Rutting in excess of three inches (3”) (75mm) will not be allowed. Equipment loads are to be lightened if this occurs. Ruts shall be repaired by filling the ruts with additional material.

3.02 Construction Requirements.

- A. The geotextile shall be lapped at the ends and sides of adjoining sheets unless shown otherwise on the plans or described herein. Geotextile that is joined by sewing shall have strength properties at the seam equal to the specified strength requirements of the geotextile. All seams shall be exposed for ease of inspection. High-strength polyester, polypropylene or kevlar thread shall be used for sewn seams. Nylon threads shall not be used. Overlapping J seams and double sewing are required for field seams.
- B. Gravel, pit run base course, sand, or other specified material shall be placed on the geotextile so that it is not torn, punctured, or shifted. Maximum pile heights of materials shall be limited to prevent geotextile distortion. Any geotextile that is torn or punctured shall be repaired. The repair shall consist of a patch of the same type of geotextile placed over the ruptured area and overlapped a minimum of three feet (3') (1m) from the edge of any part of the rupture, or a sewn patch with the same requirements for seam strength as that of the geotextile being repaired.
- C. Pegs or pins, as approved by the Engineer, may be used to hold the geotextile for embankment erosion control in place until the specified cover material has been placed. Pegs or pins shall not be used for other types of geotextile installations without approval of the Engineer. If such approval is given, pegs or pins shall be used only at locations that are not detrimental to the finished product.
- D. When geotextile is used for foundation stabilization, the following criteria shall govern:
1. The cover material shall be placed over the geotextile in 1-foot (0.3m)+/- lifts.
 2. Equipment shall not be operated directly on the geotextile. The minimum left thickness shall be maintained at all times.

3. The cover material shall be compacted with a roller or other equipment as approved by the Engineer.
 4. Prior to the installation of geotextile, the subgrade shall be leveled and smoothed to remove ruts, depressions, or humps, which exceed four inches (4") (100mm). The surface also shall be free of rocks, stumps, roots, brush, limbs, or other objects that might tear or puncture the geotextile or result in geotextile wear.
- E. During periods of shipment and storage, the geotextile shall be enclosed in heavy duty wrapping to protect it from direct sunlight, ultraviolet rays, temperatures greater than 140°F (60°C), mud, dirt, dust, and debris. Any geotextile left unprotected shall be removed from the project.
- F. The product name, type of material and the lot or batch identification shall be clearly labeled on each roll.
- G. Except for geotextile used for erosion control and silt fence, the cover material shall be placed over the fabric within five (5) days.
- H. Test results, with a certification by the manufacturer showing the geotextile performance in regard to the material requirements of this specification, shall be submitted to the Engineer. At least two weeks before the use of any geotextile, a sample six feet (6') (2 m) in length by the full width of the roll shall be submitted to the Engineer. The sample shall be labeled with the product name, machine direction, the lot and batch number, date of sampling, project number, and certification of compliance with the material specifications. If sewing is specified, a seam sample also shall be submitted to the Engineer. The sample sewn section shall be six feet (6') (2 m) by three feet (3') (1 m) with the seam in the center and parallel to the six feet (6') (2 m) length.

3.03 Installation

- A. The geotextile shall be laid smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic. Adjacent geotextile rolls shall be overlapped, sewn, or joined as required in the plans. Overlaps shall be in the direction as shown on the plans. See table below for overlap requirements.

Stabilization Fabric

| Soil CBR | Method of Joining |
|----------------|------------------------------------|
| Greater than 3 | 300 - 450 mm (12 - 18 in) overlap |
| 1 - 3 | 600 - 1000 mm (24 - 40 in) overlap |
| 0.5 - 1 | 1000 mm (40 in) overlap or sewn |
| Less than 0.5 | Sewn |
| All roll ends | 1000 mm (40 in) overlap or sewn |

- B. On curves, the geotextile may be folded or cut to conform to the curves. The fold or overlap shall be in the direction of construction and held in place by pins, staples, or piles of fill or rock.
- C. Prior to covering, the geotextile shall be inspected by a certified inspector of the Engineer to ensure that the geotextile has not been damaged during installation. Damaged geotextiles, as identified by the Engineer, shall be repaired immediately. Cover the damaged area with a geotextile patch which extends an amount equal to the required overlap beyond the damaged area.
- D. The subbase shall be placed by end dumping onto the geotextile from the edge of the geotextile, or over previously placed subbase aggregate. On soils with $CBR > 3$, most rubber-tired vehicles can be driven at slow speeds, less than 10 mph (16 km/h) and in straight paths over the exposed geotextile without causing damage to the geotextile. Sudden braking and sharp turning should be avoided. Tracked construction equipment should not be operated directly upon the geotextile. A minimum fill soil thickness of 6 in (15cm) is required prior to operation of tracked vehicles over the geotextile. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geotextile. Turning of vehicles shall not be permitted on the first lift above the geotextile.
- E. On subgrades having a CBR value of less than 1, the subbase aggregate should be spread in its full thickness as soon as possible after dumping to minimize the potential of localized subgrade failure due to overloading of the subgrade.
- F. Any ruts occurring during construction shall be filled with additional subbase material, and compacted to the specified density.
- G. If placement of the backfill material causes damage to the geotextile, the damaged area shall be repaired as previously described above. The placement procedure shall then be modified to eliminate further damage from taking place.

END OF SECTION

SECTION 02370

STORM DRAIN OUTFALL PROTECTION

PART 1 – Description

Storm drain outfall projection shall consist of furnishing and setting or placing, stones or sacked sand cement or approved materials downstream of pipes, culverts, and other drainage structures. The outfall projection shall be constructed in conformity to the lines, grades, and cross-sections, and at the locations indicated on the Plans or as directed by the Owner and in accordance with the requirements and provisions of these Specifications.

PART 2 – Materials

2.01 Material

A. Stone

1. Stone shall be sound, dense and durable, free from cracks, pyrite intrusions and other structural defects and have a density of not less than 150 pounds per solid cubic foot. When tested by the Los Angeles method, the percent of wear shall not exceed 60.
2. When the stone is subjected to five alternations of the sodium sulfate soundness test, the weighted percentage of loss shall be not more than 15 percent.
3. Stone shall conform to one of the following gradations and shall be approximately rectangular in shape:

RIP-RAP GRADATIONS

Grade B

1,200 pound maximum weight

| Weight | Percent |
|------------------------|---------|
| 750 lbs. to 1,200 lbs. | 27% |
| 400 lbs. to 749 lbs. | 25% |
| 200 lbs. to 399 lbs. | 25% |
| 50 lbs. to 199 lbs. | 15% |
| 10 lbs. to 49 lbs. | 5% |
| Less than 10 lbs. | 3% |

Grade C
400 pound maximum weight

| Weight | Percent |
|----------------------|---------|
| 250 lbs. to 400 lbs. | 30% |
| 50 lbs. to 249 lbs. | 20% |
| 30 lbs. to 49 lbs. | 25% |
| 10 lbs. to 29 lbs. | 20% |
| Less than 10 lbs. | 5% |

Grade D
125 pound maximum weight

| Weight | Percent |
|---------------------|---------|
| 90 lbs. to 125 lbs. | 25% |
| 25 lbs. to 89 lbs. | 50% |
| 10 lbs. to 24 lbs. | 15% |
| Under 10 lbs. | 10% |

Grade E
(upper bank)

| Weight | Percent |
|---------------------|---------|
| 75 lbs. to 125 lbs. | 10% |
| 25 lbs. to 74 lbs. | 40-60% |
| 5 lbs. to 24 lbs. | 20-40% |
| Under 5 lbs. | 15% |

B. Filter Cloth and Fasteners.

1. The filter cloth material used as a base for rip-rap shall be pervious sheets of strong, rot proof plastic fabric meeting the following Specifications:

| PHYSICAL PROPERTY | TEST METHOD | ACCEPTABLE RESULTS |
|---|------------------------------|--------------------|
| Tensile Strength, wet, lbs | ASTM D-1682 | 200 (min) |
| Elongation, wet, % | ASTM D-1682 | 40 (min) |
| Coefficient of Water Permeability, cm/sec | Constant Head ASTM D-4491 | .03 (min) ≥0.80 |
| Puncture Strength, lbs. | ASTM D-751 | 100 (min) |
| Pore Size – EOS | Corps of Engineers | 40 (max) |
| U.S. Standard Sieve | CW-02215 | |

2. The filter cloth material used as a base for cellular concrete blocks shall meet the following minimum physical requirements

| PHYSICAL PROPERTY | TEST METHOD | ACCEPTABLE RESULTS |
|--|--------------|--|
| Grab Tensile Strength (Unaged Geotextile) | ASTM D4632 | 200 Lbs. (in any principal direction) |
| Breaking Elongation (Unaged Geotextile) | ASTM D4632 | 50% max. (in any principal direction) |
| Burst Strength | ASTM D3786 | 400 psi |
| Puncture Strength | ASTM D4833 | 115 lbs. |
| A.O.S., U.S. Std. Sieve | ASTM D4751 | See Design Manual |
| % Open Area | CWO-22125-86 | See Design Manual |
| Permittivity | ASTM D4491 | See Design Manual |

3. The geotextile fiber shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of propylene, ethylene, ester, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic, if necessary, to make the filaments resistant to deterioration due to ultraviolet and heat exposure. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile.
4. During all periods of shipment and storage, the filter fabric shall be protected from direct sunlight, ultraviolet rays and temperatures greater than 140 degrees Fahrenheit. To the extent possible, the fabric shall be maintained wrapped in its protective covering. The geotextile shall not be exposed to sunlight, ultraviolet rays until the installation process begins.
5. Final acceptance of the filtration geotextile by the Engineer shall be dependent upon the geotextile performance when tested in accordance with ASTM D5105, Standard Test Method for Measuring the Soil-Geotextile System Clogging by the Gradient Ratio test or the Hydraulic Conductivity Ratio test. Soil characteristics such as grain size distribution and plasticity shall be determined for every 200,000 square feet of geotextile installed or for each source of borrow material used during construction. Significant differences in soil characteristics shall require further performance testing by either the Gradient Ratio or the Hydraulic Conductivity Ratio tests at the discretion of the Engineer. The locations for which the material to be tested is extracted shall be approved by the Engineer. The Contractor shall provide the site-specific soil and modified proctor curves for the site-soil, at his own expense, to the manufacturer. Also, the contractor shall be responsible for the performance of the test by a certified independent laboratory experienced in performing such test. The test shall be performed under the actual field soil conditions or as otherwise required by the Engineer.
6. At the time of installation, the filter fabric shall be rejected if it has been removed from its protective cover for over 72 hours or has defects, tears, punctures, flow deterioration, or damage incurred during manufacture, transportation or storage. With the acceptance of the Engineer, placing a filter fabric patch over the damaged

area prior to placing the mats shall repair a torn or punctured section of fabric. The patch shall be large enough to overlap a minimum of three (3) feet in all directions.

7. In the event pre-assembled panels of fabric are required, the panels of filter fabric shall be sewn together at the manufacturer or another approved location.
8. The Contractor shall furnish a certified laboratory test report from an approved testing laboratory with each shipment of materials. Laboratory test reports shall include actual numerical test data obtained on this product.
9. Pins may be any commercially available pin 6 inches in length capable of retaining a washer.
10. Washers may be any commercially available washer 2 inches in diameter and compatible with the pin.
11. The pins and washers shall be manufactured from corrosion resistant metal material.

C. High-Density Polyethylene (HDPE) Plastic Transition Matting

1. Matting shall be 4 feet by 4 feet in size and ½ inch in thickness manufactured with High Density Polyethylene. Matting shall be manufactured by ScourStop or approved equal.
2. Anchor Straps. Anchor Straps shall be provided to tie HDPE matting to soil by manufacturer.

D. Cellular Concrete Blocks

1. Materials shall be manufactured by Contech or approved equal and conform to the following applicable ASTM specifications:

Portland Cements - Specification C 150, for Portland Cement

Blended Cements - Specification C 595, for Blended Hydraulic Cements

Hydrated Lime Types - Specification C 207, for Hydrated Lime Types

Pozzolans - Specification C 618, for Fly Ash and Raw or Calcined Natural Pozzolans for use in Portland Cement Concrete.

2. Aggregates shall conform to the following ASTM specifications, except that grading requirements shall not necessarily apply:

Normal Weight - Specification C 33, for Concrete Aggregates.

3. The concrete units shall be produced by a dry cast method. The dry cast units obtain strength in a shorter duration as well as an increase in the durability and overall quality of product.
4. At the time of delivery to the work site, the units shall conform to the physical requirements prescribed in Table 2 listed below.

| Compressive Strength Net Area | | Water Absorption | |
|-------------------------------|-----------------|--|-----------------|
| Min. psi (mPa) | | Max. lb/ft ³ (kg/m ³) | |
| Avg. of 3 units | Individual Unit | Avg. of 3 units | Individual Unit |
| 4,000 (27.6) | 3,500 (24.1) | 10 (160) | 12 (192) |

5. When applicable, the manufacturer shall meet all requirements pertaining to a concrete unit's durability pertaining to a freeze-thaw environment.
6. Units shall be sampled and tested in accordance with ASTM D 6684-04, Standard Specification for Materials and Manufacture of Articulating Concrete Block (ACB) Revetment Systems.
7. The cellular concrete blocks, cables and fittings shall be fabricated at the manufacturer or another approved location into mats with a width of up to eight (8) feet and a length up to forty (40) feet, which is approved by the Engineer.

E. Polyester Revetment Cable and Fittings

1. Revetment cable shall be constructed of high tenacity, low elongating, and continuous filament polyester fibers. Cable shall consist of a core construction comprised of parallel fibers contained within an outer jacket or cover. The weight of the parallel core shall be between 65% to 70% of the total weight of the cable. The revetment cable shall have the following physical properties:

| Nominal Cable Dia. (in.) | Approx. Ave. Strength | | Weight per Length | |
|--------------------------------|--------------------------|------|-------------------|--------|
| | (lbs) | (kN) | (lbs)/100ft | (kg/m) |
| 1/4 | 3,000 | 13.3 | 2.2 | 0.03 |
| 5/16 | 7,000 | 31.1 | 4.4 | 0.07 |
| 3/8 | 10,000 | 44.5 | 5.5 | 0.08 |
| 1/2 | 15,000 | 66.7 | 9.7 | 0.14 |

2. Elongation requirements specified below are based upon stabilized new, dry cable. Stabilization refers to a process in which the cable is cycled fifty (50) times between a load corresponding to 200D² and a load equal to 10%, 20% or 30% of the cable's approximate average breaking strength. Relevant elongation values are as shown in the table below. The tolerance on these values is $\pm 5\%$.

ELASTIC ELONGATION

(at Percentage of Break Strength)

| | | |
|-----|-----|-----|
| 10% | 20% | 30% |
| 0.6 | 1.4 | 2.2 |

3. The revetment cable shall exhibit resistance to most concentrated acids, alkalis and solvents. Cable shall be impervious to rot, mildew and degradation associated with marine organisms. The materials used in the construction of the cable shall not be affected by continuous immersion in fresh or salt water.
4. Selection of cable and fittings shall be made in a manner that insures a safe design factor for mats being lifted from both ends, thereby forming a catenary. Consideration shall be taken for the bending of the cables around hooks or pins during lifting. Revetment cable splicing fittings shall be selected so that the resultant splice shall provide a minimum of 60% of the minimum rated cable strength. Fittings such as sleeves and stops shall be aluminum and washers shall be galvanized steel unless otherwise shown on the Contract Drawings.

F. Galvanized Steel Revetment Cable and Fittings

1. Revetment cable shall be constructed of preformed galvanized aircraft cable. The cables shall be made from individual wires and strands that have been formed during the manufacture into the shape they have in finished cable.
2. Cable shall consist of a core construction comprised of seven (7) wires wrapped within seven (7) or nineteen (19) wire strands. The revetment cable shall have the following physical properties:

| Nominal Cable Dia. | Type | Approx. Ave. Strength | | Weight per Length | |
|-----------------------|------|--------------------------|------|-------------------|--------|
| (in.) | | (Lbs) | (kN) | (Lbs)/100ft | (kg/m) |
| 1/8 | 7x7 | 1,700 | 7.5 | 2.8 | 0.04 |
| 3/16 | 7x7 | 3,700 | 16.4 | 6.2 | 0.09 |
| 1/4 | 7x7 | 6,100 | 27.1 | 10.6 | 0.16 |
| 5/16 | 7x19 | 9,800 | 43.6 | 17.3 | 0.26 |
| 3/8 | 7x19 | 14,400 | 64.1 | 24.3 | 0.36 |

3. The revetment cable shall exhibit resistance to mild concentrations of acids, alkalis, and solvents. Fittings such as sleeves and stops shall be aluminum, and the washers shall be galvanized steel. Furthermore, depending on material availability, the cable type (7x7 or 7x19) can be interchanged while always ensuring the required factor of safety for the cable.

4. Selection of cable and fittings shall be made in a manner that insures a safe design factor for mats being lifted from both ends, thereby forming a catenary. Consideration shall be taken for the bending of the cables around hooks or pins during lifting. Revetment cable splicing fittings shall be selected so that the resultant splice shall provide a minimum of 75% of the minimum rated cable strength.

PART 3 – Execution

3.01 Sub-grade Preparation for Stone

- A. The area to be occupied by the rip-rap stabilization shall be cleared of all trees, roots, vegetation, and similar material. Immediately prior to the placement of rip-rap, the slopes or ground surface shall be trimmed in conformity to the lines and grades indicated on the Plans or as directed by the Owner and shall be thoroughly compacted by the use of hand or mechanical tamps. Unless otherwise specified herein make all fill with suitable materials excavated from site.
- B. All fills in dry areas shall be compacted to a maximum density of 90 percent as determined by ASTM D 698 (Standard Proctor). On slopes, the bottom of the rip-rap shall be placed at least 2 feet below the natural ground surface, unless otherwise directed.
- C. Surplus excavated material shall be removed from the site and disposed of as shown on the Plans or as directed by the Owner. Spoil material shall not be disposed of in a watercourse or on the banks of a watercourse.

3.02 Placing Filter Fabric

- A. Filter Fabric for Stone Rip-Rap
 1. Unless otherwise specified, filter fabric shall be placed on the prepared and compacted subgrade within the limits shown on the Plans for stone rip-rap. The filter fabric shall be laid loosely without wrinkles or creases.
 2. When more than one width or length of filter fabric is necessary, the joints shall be overlapped a minimum of 24 inches.
 3. Securing pins with washers shall be inserted through both strips of overlapped material and into the material beneath, until the washer bears against the fabric and secures it firmly to the base material. These securing pins shall be inserted through the overlapped fabric at no greater than 2 foot intervals along a line through the midpoint of the overlap.
 4. If the fabric is torn or damaged, a patch overlapping the edges of the damaged area by 2 feet shall be sewn securely to the fabric with a continuous, monofilament, rot-proof material.

B. Filter Fabric for ACB Revetment System

1. The filtration geotextile shall be placed directly on the prepared area, in intimate contact with the subgrade, and free of folds or wrinkles. The geotextile shall not be walked on or disturbed when the result is a loss of intimate contact between the cellular concrete block and the geotextile or between the geotextile and the subgrade. The geotextile filter fabric shall be placed so that the upstream strip of fabric overlaps the downstream strip.
2. The longitudinal and transverse joints shall be overlapped at least two (3) feet. The geotextile shall extend at least one foot beyond the top and bottom revetment termination points. If cellular concrete blocks are assembled and placed as large mattresses, the top lap edge of the geotextile should not occur in the same location as a space between cellular concrete mats unless the space is concrete filled.

3.03 Placement of Rip-Rap

A. Stone Rip-Rap

1. Stone rip-rap shall be constructed upon the prepared foundation by hand placing, so that the stones shall be as close together as is practicable in order to minimize void space.
2. When rip-rap is constructed in more than one layer, it shall be so placed that it will be thoroughly tied together with the larger stones protruding from one layer into the other.
3. Each stone shall be placed so that the depth will be perpendicular to the surface upon which it is set. The length shall be placed as directed by the Owner and each main stone shall be placed so that it will be against the adjoining stones. The stones shall be placed in such a manner as to stagger all joints as far as it is possible and practicable.
4. The main stones shall be thoroughly "chinked" and filled with the smaller stones by throwing them over the surface in any manner that is practicable for the smaller stones to fill the voids. This work shall continue with the progress of the construction. Tamping of the stones will not be required if the stones have been placed in a reasonable and satisfactory manner.
5. Knapping of the stones will not be required, except stones protruding more than 4 inches above the specified grade.

3.04 Depth of Rip-Rap

- A. The standard depth of stone rip-rap shall be 18 inches unless otherwise indicated or directed. The average depth for each 25 square feet of surface shall be not less than the depth indicated on the Plans or directed by the Owner, or the standard depth required in these Specifications.
- B. In no case shall any part of the finished depth of stone rip-rap vary more than 3 inches above or below the specified depth.

3.05 Placement of High-Density Polyethylene (HDPE) Transition Matting

- A. HDPE Matting shall not be installed over bare soil. Install HDPE matting in accordance with the dimensions shown on the plans and construction details. Optional soil covers shall be sod, turf reinforcement mats, and geotextiles. Soil covers shall extend beyond the limits of the HDPE transition matting. Install HDPE in accordance with installation instructions and with a qualified installer.
- B. All transition matting shall be in contact with sod, TRM or geotextile fabric. Soil anchors shall be driven at least 18 inches deep or deeper as need to secure HDPE matting. Anchors shall be provided by manufacturer. Anchors shall be installed in a 3 by 2 by 3 pattern.

3.06 Placement of Armortec Concrete Block (ACB) Revetment System

- A. The slope shall be graded to a smooth plane surface to ensure that intimate contact is achieved between the slope face and the geotextile (filter fabric), and between the geotextile and the entire bottom surface of the cellular concrete blocks. All slope deformities, roots, grade stakes, and stones which project normal to the local slope face must be re-graded or removed. No holes, "pockmarks", slope board teeth marks, footprints, or other voids greater than 1.0 inch in depth normal to the local slope face shall be permitted. No grooves or depressions greater than 0.5 inches in depth normal to the local slope face with a dimension exceeding 1.0 foot in any direction shall be permitted. Where such areas are evident, they shall be brought to grade by placing compacted homogeneous material. The slope and slope face shall be uniformly compacted, and the depth of layers, homogeneity of soil, and amount of compaction shall be as required by the Engineer.
- B. Excavation and preparation for anchor trenches, flanking trenches, and toe trenches or aprons shall be done in accordance to the lines, grades and dimensions shown in the Contract Drawings. The anchor trench hinge-point at the top of the slope shall be uniformly graded so that no dips or bumps greater than 0.5 inches over or under the local grade occur. The width of the anchor trench hinge-point shall also be graded uniformly to assure intimate contact between all cellular concrete blocks and the underlying grade at the hinge-point.
- C. The filtration geotextile shall be placed directly on the prepared area, in intimate contact with the subgrade, and free of folds or wrinkles. The geotextile shall not be walked on or disturbed when the result is a loss of intimate contact between the cellular concrete block and the geotextile or between the geotextile and the subgrade. The geotextile filter fabric shall be

placed so that the upstream strip of fabric overlaps the downstream strip. The longitudinal and transverse joints shall be overlapped at least two (3) feet. The geotextile shall extend at least one foot beyond the top and bottom revetment termination points. If cellular concrete blocks are assembled and placed as large mattresses, the top lap edge of the geotextile should not occur in the same location as a space between cellular concrete mats unless the space is concrete filled.

- D. The cellular concrete blocks shall be placed on the filter fabric in such a manner as to produce a smooth plane surface in intimate contact with the filter fabric. No individual block within the plane of placed cellular concrete blocks shall protrude more than one-half inch or as otherwise specified by the Engineer. To ensure that the cellular concrete blocks are flush and develop intimate contact with the subgrade, the blocks shall be "seated" with a roller or other means as approved by the Engineer.
- E. If assembled and placed as large mattresses, the cellular concrete mats shall be attached to a spreader bar or other approved device to aid in the lifting and placing of the mats in their proper position by the use of a crane or other approved equipment. The equipment used should have adequate capacity to place the mats without bumping, dragging, tearing or otherwise damaging the underlying fabric. The mats shall be placed side-by-side and/or end-to-end, so that the mats abut each other. Mat seams or openings between mats greater than two (2) inches shall be filled with 4000 p.s.i. non-shrink grout. Whether placed by hand or in large mattresses, distinct changes in grade that results in a discontinuous revetment surface in the direction of flow shall require a grout seam at the grade change location so as to produce a continuous surface.
- F. Anchor trenches and side trenches shall be backfilled and compacted flush with the top of the blocks. The integrity of the trench backfill must be maintained so as to ensure a surface that is flush with the top surface of the cellular concrete blocks for its entire service life. Toe trenches shall be backfilled as shown on the Contract Drawings. Backfilling and compaction of trenches shall be completed in a timely fashion. No more than 500 linear feet of placed cellular concrete blocks with non-completed anchor and/or toe trenches shall be permitted at any time.
- G. The cells or openings in the cellular concrete blocks shall be backfilled and compacted immediately with suitable material to assure there are no voids and so that material extends from the filter fabric to one-inch above the surface of the cellular concrete block. Backfilling and compaction shall be completed in a timely manner so that no more than 500 feet of exposed mats exist at any time.
- H. The cells or openings in the cellular concrete blocks shall be backfilled and compacted immediately with suitable material to assure there are no voids and so that material extends from the filter fabric to one-inch above the surface of the cellular concrete block. Backfilling and compaction shall be completed in a timely manner so that no more than 500 feet of exposed mats exist at any time.

END OF SECTION

SECTION 02632

STORM SEWERS AND CULVERTS

PART 1 - Description

This section covers storm sewer and culvert materials, excavation, trenching, and backfilling for storm sewers and appurtenances. Work shall consist of removal of all material of whatever description that may be encountered; removal and disposal of debris; handling and storage of materials; all necessary bracing, shoring, and protection; pumping and dewatering as necessary; all backfill preparation of subgrades; and final grading, dressing, and surface restoration cleanup of the site.

PART 2 - Materials

2.01 Submittals

Before the fabrication of the pipe and manholes is started, the contractor shall submit for review, drawings showing the pipe lengths, complete laying schedule, joint details, special sections, and other additional details, such as fittings. All pipe and manholes furnished shall be fabricated in accordance with the reviewed drawings. Manufacturer's certificates of compliance and installation recommendations shall be provided to the City prior to construction.

2.02 Materials

The materials furnished for the storm sewer pipe and culverts shall be equal to or shall exceed the following requirements.

A. Storm Sewer Pipe and Culverts

The materials furnished for the storm sewer pipe and culverts shall be equal to or shall exceed the following requirements.

1. Reinforced Concrete Pipe (RCP)

- a. All reinforced concrete pipe shall conform to the requirements of ASTM Standards for the specified diameter and strength class as follows:
 1. Circular Pipe – ASTM C76
 2. Horizontal and Vertical Elliptical Pipe – ASTM C507
 3. Arch Pipe – ASTM C506
- b. Minimum wall thickness shall be "Wall B" in referenced specifications C76 and C14 of ASTM.

- c. Strength class or classes shall be as required by the Plans or Contract Documents but in no case shall pipe of less than strength Class III be used. Portland Cement used in manufacturing reinforced concrete pipe shall be Type II, ASTM C150.
- d. Lifting holes will not be permitted in any of the pipe, except elliptical pipe and box sections.
- e. Joints for the reinforced concrete pipe shall be either tongue and groove or bell and spigot. Except for special pieces, each joint shall be at least seven and one-half feet (7'6") (2.3m) in length. Unless deleted elsewhere in the specifications, joints in reinforced concrete pipe shall conform to one of the following types:

Rubber Trapped "O" Ring Gasket type – ASTM C 443

Flexible Plastic Rope Gasket type – AASHTO M 198 – Type B

Flexible Butyl Rope Gasket type – AASHTO M 198 – Type A

Portland Cement Mortar Joint type

- f. Type D, Portland Cement Mortar Joint, may only be used on radial, elliptical, and arch pipe. The shape, dimensions, and tolerance of the bell and spigot or tongue and groove ends of the pipe shall be compatible with the type of joint used and shall conform to the above referenced specifications.
- g. Reinforced concrete pipe shall be manufactured in a plant that is certified by the American Concrete Pipe Association.
- h. In addition to the certifications and bearing test results, the contractor shall furnish the Owner with mill test reports for all cement used to manufacture proposed pipe. The owner reserves the right to sample and test any pipe after delivery and to reject all pipe represented by any sample which fails to comply with the specified requirements.

2. Polyvinyl Chloride Pipe (PVC)

- a. Polyvinyl chloride pipe (PVC) shall conform to ASTM D3034, SDR 26, for four inch (4") (100mm) through fifteen inch (15") (375mm) diameter and ASTM F679 for eighteen inch (18") (450mm) through thirty six inch (36") (914 mm) diameter. The pipe shall have bell and spigot joints with an approved gasketed joint.
- b. When special fittings such as wyes, tees, etc., are required, they shall be manufactured from the same material as the pipe and shall be made for use with PVC pipe. Connections to manholes and catch basins shall be made using O-ring gaskets whenever ground water is present; otherwise, catch basins and manholes may be grouted. Other suitable elastomeric boots may be used.

3. Corrugated Steel Pipe (CSP)

- a. Corrugated steel pipe, band couplers, and fittings, shall be manufactured in accordance with AASHTO M-36, latest edition, as revised in these specifications. All seams shall be joined in a manner that develops the full strength of the pipe and shall not affect the shape or nominal diameter of the pipe. The wall thickness of the steel shall be specified in the Special Provisions. Corrugated Steel pipe shall not be used unless shown on the construction drawings.
- b. The materials used to coat the steel sheets shall be specified in the Special Provisions and may be one or more of the following types:
 - i Zinc-coated (galvanized) steel sheets for annular pipe shall be coated in accordance with AASHTO M-218.
 - ii Aluminized coated (Type 2) steel sheets shall be coated by the hot dip process in accordance with AASHTO M-274, M-36, and M-274.
 - iii Precoated (Polymeric) galvanized steel sheets shall be coated in accordance with AASHTO M-246 and M-245. The precoated sheets shall be Type C with a polymeric coating in a thickness of 0.010 inch (3mm) minimum on each side and edge of the sheets.
- c. After the fabrication of the pipe, the manufacturer will coat the cut ends of each section of pipe with the specified coating before shipping. Exposed uncoated metal at the ends of the pipe may be reason for rejection of the pipe.
- d. The CSP shall be joined together with coupling bands manufactured in accordance with AASHTO M-36. If coatings of the CSP are specified, the couplings shall be coated with the same materials. Unless otherwise specified, the couplings shall make a watertight joint.
- e. All pipe shall be inspected when delivered to the job site and prior to the unloading of the pipe. Any pipe damaged during shipping and/or handling will be rejected and will not be installed. If the exterior bituminous coating is damaged during installation, the contractor shall repair the coating using approved methods and materials. If the concrete lining is damaged during installation, the contractor shall remove and replace the damaged pipe at no expense to the owner.
- f. The pipe supplier shall prepare and supply the contractor with a pipe-laying schedule, and the Contractor's supervisor and superintendent and the owner's representative shall have these laying schedules available on the job site.
- g. Connections for the laterals and catch basin leads may be shop fabricated or made in the field. In some instances, field connections shall be required. All field connections shall be

saw cut using a saber type saw and templates made for such use. Flame cutting shall not be allowed. After field cuts have been made, the exposed metal shall be coated with the specified coating. Coating materials shall be supplied by the pipe manufacturer. The connection shall be completed according to the manufacturer's recommendations.

- h. Installation of corrugated steel pipe is considered to be a flexible conduit and, therefore, special care must be taken during the bedding and backfilling operations. Installation and backfilling operations shall be in accordance with the recommended practices set forth in the "Handbook of Steel Drainage and Highway Construction Projects", published by the American Iron and Steel Institute.
 - i All pipe shall be bedded with an approved granular bedding material. The pipe shall be bedded true to line and grade with uniform and continuous support from a firm base. Blocking shall not be used to bring the pipe to grade.
 - ii The bedding material shall be placed evenly on both sides of the pipe to a point twelve inches (12") above the top of the pipe. Special care shall be taken to insure that all voids are filled beneath the pipe haunch and that the bedding material is properly placed and compacted to provide lateral restraint. The trench sidewall shall be adequately braced, shored, or sheeted as necessary to stabilize the trench walls. The trench shall not be any wider than necessary for proper installation, and pipe jointing. The bedding material shall be placed under haunches and around the pipe alternately in 6-inch layers on both sides of the pipe to permit thorough consolidation of the bedding material. This material is placed alternately to keep it at the same elevation on both sides of the pipe at all times.
 - iii Extreme care shall be taken in the removal of cribbing, shoring, sheeting, etc., so as not to disturb previously constructed foundation, bedding and initial backfill. If it was necessary to place or drive sheeting or other trench protection below the top of the pipe, the sheeting, shoring, etc., shall be cut off at a point one foot (1') above the pipe and the remaining material shall be left in place. Removal of this portion could seriously jeopardize the side support necessary for "flexible conduits" and create excessive lateral soils pressures and pipe deflections.
 - iv Excessive concentrated loads or heavy equipment on top of or along side of the pipe shall be avoided. Maximum supporting strength in flexible conduits does not develop until the fill consolidates.

4. Corrugated PVC Drainage Pipe

- a. Corrugated Polyvinyl Chloride (PVC) pipe shall conform to ASTM F794 and F949 for twelve inch (12") through thirty-six inch (36") diameter. Joints shall be an integral bell-gasketed joint. When the joint is assembled, it shall prevent misalignment of adjacent pipes and form either a soil tight joint (2psi) hydrostatic test per AASHTO Standard

Specification for Highway Bridges, Section 26.4.2.4 or a watertight joint (10.8) psi test per ASTM D3212.

- b. When special fittings such as wyes, tees, etc., are required, they shall be manufactured from the same material as the pipe and shall be made for use with Corrugated PVC Drainage pipe. Connections to manholes and catch basins shall be made using O-ring gaskets whenever ground water is present; otherwise, catch basins and manholes may be grouted. Other suitable elastomeric boots may be used.
5. High-Performance Polypropylene Storm Pipe (HP Storm)
- a. Nominal dimensions for the HP Storm pipe for use in gravity-flow storm drainage applications range from twelve through sixty inches (12" to 60") (300 to 1500 mm).
 - b. Pipes shall have a smooth interior and annular exterior corrugations while meeting ASTM F2881 and AASHTO M330 Standards.
 - c. Manning's "n" value for use in design shall be 0.012.
 - d. Pipe shall be joined with a gasketed integral bell & spigot joint meeting the requirements of ASTM F2881.
 - e. Pipe shall be watertight according to the requirements of ASTM D3212. Spigots shall have gaskets meeting the requirements of ASTM F477. Gasket shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during joint assembly.
 - f. HP Storm Pipes shall have an exterior bell wrap installed by the manufacturer
 - g. Fittings shall conform to ASTM F2881 and AASHTO M330. Bell and spigot connections shall utilize spun-on, welded or integral bell spigots with gaskets meeting ASTM F477. Bell & spigot fittings joint shall meet the watertight joint performance requirements of ASTM D3212. Corrugated couplings shall be split collar, engaging at least 2 full corrugations.
 - h. To assure watertightness, field performance verifications may be accomplished by testing in accordance with ASTM F1417 or F2487. Appropriate safety precautions must be used when field testing any pipe material. Contact the manufacturer for recommended leakage rates.
 - i. Polypropylene compound for pipe and fitting productions shall be impact modified copolymer meeting the material requirements of ASTM F2881, Section 5 and AASHTO M330, Section 6.1.

Installation shall be in accordance with ASTM D2321 and manufacturer's recommended guidelines, with the exception that minimum cover in traffic areas for twelve through forty-eight inch (12" to 48") (300 to 1200mm) diameters shall be one-foot (1') (0.3 m) and for sixty-inch (1500 mm) diameters, the minimum cover shall be two-feet (2') (0.6 m) in single run applications. Backfill for minimum cover situations shall consists of Class 1, Class 2 (minimum 90% SPD) or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level.

6. Reinforced Concrete Box Culverts

- a. Reinforced box culverts shall be precast or cast in place
- b. Precast concrete box culverts shall conform to the requirements of ASTM C1433, latest revision. Concrete box culverts shall be manufactured in a plant that is certified by the American Concrete Pipe Association.

B. Manholes

1. All manholes and other precast items shall be manufactured in a plant that is certified by the National Precast Concrete Association. Manufacturer's certificates of compliance and installation recommendations shall be provided to the Engineer and City prior to construction.
 - a. All manholes shall be constructed with concentric precast sections without steps unless otherwise approved. Precast concrete manhole sections shall be manufactured to standards at least equal to or greater than the requirements of the standard specifications for precast reinforced concrete manhole sections, ASTM designation C478. The minimum internal diameter for storm manholes shall be forty-eight inches (48") (1.2m) unless shown otherwise. Manholes shall conform to all requirements as shown on the detail drawings. Precast manhole joints shall be made water-tight with RAM-NEK material, or approved rubber gasket at each joint. The RAM-NEK and primer must be used in accordance with the manufacturer's instructions. Rubber gaskets used for precast manhole joints shall be designed in accordance with ASTM designation C443. All lifting holes must be grouted. All Portland cement for manholes shall be Type II.
 - b. The concrete base shall be cast-in-place or precast concrete of the size and depth shown on the drawings. Concrete used for bases shall have a twenty-eight (28) day compressive strength of at least four thousand pounds per square inch (4,000psi) (27,600 kPa). Approved precast concrete bases will be allowed if provided with an integral groove for barrel placement. Precast concrete bases shall conform to ASTM C478. Manholes with a monolithically poured base with bottom barrel are also acceptable and preferred.
 - c. Precast manhole inverts shall be constructed using a secondary invert forming system

designed to provide a finished invert that aligns precisely with the incoming pipelines, incorporating a finished flow depth of 0.8 to 1.0 diameter of the largest pipe. The completed precast invert shall include an alignment bench for each pipe, and provide for uniform horizontal and vertical transition through the manhole in accordance with drawings. Provide 0.1' (30mm) minimum fall between inlet and outlet. After the installation of the pipelines into the manhole, the interior annular space around the outside of the pipe shall be sealed with grout. The acceptable tolerances for manhole inverts are one-quarter inch (1/4") (6.25mm) in any dimension and within 2 degrees for alignment. The invert forming system shall be "a-lok tru contour", or approved equal.

- d. The manhole ring and cover shall be centered over the connection at the centerline of flow.
- e. For manholes with depths of six feet (6') (1.8m) or less, all of the precast manhole sections shall be of the specified diameter and shall have a flat, precast concrete top.
- f. For sewer manholes four (4) to six (6) feet in diameter and less than twenty (20) feet deep, precast reinforced manhole base sections shall be a minimum of 8 inches thick. For sewer manholes greater than six (6) feet in diameter or more than twenty (20) feet deep, precast reinforced concrete manhole base sections shall be a minimum of 12 inches thick. All precast manhole base sections shall be reinforced with #4 steel reinforcement bars placed 6 inches on center each way and at mid depth of the slab, unless shown otherwise on the plans.

C. Catch Basins.

1. All catch basins, inlet boxes, and other precast items shall be manufactured in a plant that is certified by the National Precast Concrete Association. Catch basins (storm inlets) shall be cast-in-place or precast concrete with dimensions as shown on the drawings or standard details.
 - a. Precast concrete catch basins shall comply with all the requirements of ASTM C858 and C857. Cast-in-place concrete basins shall be constructed of materials in accordance with Section 03050, Portland Cement Concrete.
 - b. The Contractor may elect to install pre-cast or cast-in-place catch basins.

D. Castings

1. Manhole frames and covers, and catch basins frames and grates shall meet the requirements of this Section unless specified otherwise in the Special Provisions or drawings.
2. Manhole frames and covers shall be heavy duty Neenah R 1643 or approved equal. Heavy-duty manhole ring and cover shall have a minimum depth of seven and half inches 1.5 inch

thick cover, and an inside clearance of 24 inches in diameter.

3. Acceptable grates shall be determined by the design, hydraulic efficiency, and placement required. Additionally, grates must be suitable for use in areas where it is possible for handicap persons and pedestrians to be present. The adoption of the Americans with Disabilities Act (ADA), the prominence of narrow-tired bicycles and concern for pedestrian safety dictates the design considerations of storm water installations.

Grate selection criteria should include a combination of capacity, and functionality for the specific location. Directional and/or vane grates are not recommended at the low points of vertical curves, and shall be used only when approved by the Engineer.

Catch basin frames and curb box shall be Neenah R-3067, D&L Supply I-3517, or equivalent. I-3516 is recommended for use in the lowpoint of vertical curves.

Grates shall be certified by the manufacturer as bicycle friendly, and the certification shall be submitted to the City prior to installation.

4. Cover and frame seat shall be machine finished to prevent any rocking of cover in its associated frame. Cover shall have the word "storm sewer" clearly cast on its surface.

When required, self-sealing, waterproof frames and covers meeting Neenah R-1916-F, or approved equal shall be used.

5. Flared end sections for culverts shall be manufactured of the same material as the culvert. End sections shall be fitted for a trash rack on both upstream and downstream ends, or as directed by the Engineer.

E. Granular Materials

1. Granular materials furnished for foundation, bedding, encasement or other purposes as may be specified, shall consist of any material or synthetic mineral aggregate such as sand, gravel, crushed rock, crushed stone or slag, that shall be so graded as to meet the gradation requirements specified herein for each particular use.
2. Granular materials furnished for use in foundation, bedding, or encasement recommended for use in construction are:

MATERIAL USE DESIGNATION

| Sieve Size | <u>Percent Passing</u> | |
|---------------|----------------------------------|---|
| | Foundation AASHTO M43 (No.57) | Bedding & Encasement AASHTO M43 (No. 67) |
| 1 inch (25mm) | 95-100 | 100 |

| | | |
|------------------|-------|--------|
| 3/4 inch (20mm) | - | 90-100 |
| 1/2 inch | 25-60 | - |
| 3/8 inch (9.5mm) | - | 20-55 |
| No. 4 (4.75mm) | 0-10 | 0-10 |
| No. 8 (0.075mm) | 0-5 | 0-5 |

3. Other approved material for bedding and encasement shall consist of sand, sandy gravel, or fine gravel having a maximum size of three-quarter inch (3/4") (20mm), uniformly graded and a maximum plasticity of 6 as determined by AASHTO T-89 and T-90. Other gradations may be used if written approved is obtained from the City.
4. Certified copies of all sieve analysis and plasticity analysis for the above materials shall be submitted to the City Engineer and approved before construction starts. Other sieve or plasticity analysis may be required during construction as directed by the City Engineer.
5. Granular materials provided for Foundation, Bedding, or Encasement use, shall be classified as to use in accordance with the following:
 - a. Granular Foundation: placed below and to the midpoint of the pipe as replacement for unsuitable or unstable soils, to achieve better foundation support.
 - b. Granular Bedding: placed from four inches (4") (100mm) to six inches (6")(150mm) below the pipe to the pipe midpoint, to facilitate proper shaping and achieve uniform pipe support. When foundation material is required, the granular bedding shall be of foundation material gradation.
 - c. Granular Encasement: placed below an elevation one foot (1') (300mm) above the top of pipe, after pipe installation, for protection of the pipe and to assure proper filling of voids or thorough consolidation of backfill. Granular encasement shall be provided for all flexible piping.
6. Granular encasement and bedding material shall meet the gradation requirements listed in herein. Other gradations may be used if written approval is obtained from the City Engineer. Gradations should meet the requirements of ASTM 2321. Guidelines for the maximum particle size for encasement material in relation to pipe type and diameter are shown below:

| <u>Pipe Type</u> | <u>Nominal Diameter Inches (mm)</u> | <u>Maximum Particle Size Inches (mm)</u> |
|--------------------|---|--|
| PVC, Other Plastic | 15" and greater | 3/4 (20) |
| PVC, Other Plastic | Less than 15" | 1/2 (12.5) |
| Concrete | 6.1 - 12.0 (155 - 300) | 1 (25) |
| Concrete | 12.1 (307) and greater | 1 (25) |

| | | |
|-----|------------------------|--------|
| CMP | 6.1 - 12.0 (155 - 300) | 1 (25) |
| CMP | 12.1 (307) and greater | 1 (25) |

7. Select Backfill

Job excavated and imported select backfill material shall be free from debris, organic material, and stones larger than three inches (3") (75mm) in diameter. Contractor shall be responsible, at his expense, for separating debris, organic material and stones larger than three inches (3") (75mm) in diameter. Select material that the Engineer directs to be used shall be the same gradation as the bedding and encasement material. No asphalt chunks or concrete may be used as select backfill.

8. Structural Fill Material

Structural fill shall consist of excavated or imported material, free of organic or deleterious material and particles larger than three inches (3") (75mm) in maximum dimension. Structural fill shall be well graded from coarse gravel to fine sand with less than 10% passing the No. 200 sieve. Structural fill material shall be within +2% of optimum moisture content when placed as determined by Proctor, and shall not exhibit pumping (horizontal or vertical displacement) after completion.

9. Groundwater Barriers

Low permeability ground water barriers may be used in areas designated by the City Engineer. Barrier material shall meet soil classification GC, SC, or CL per the Unified Soil Classification System and shall have a liquid limit less than 50. The barrier material shall be compacted to 95 percent of maximum density. Job excavated material meeting one of the above soil classifications and free from stones, organic matter and debris may be used.

10. Portland Cement Concrete shall be of the class and dimensions as shown on the Plans or as directed by the Owner. The classes of concrete for drainage facility construction are referred to as Class AS and Class C. Class AS concrete is intended principally for concrete structures designed for high strength. Class C concrete is intended principally for low strength concrete used primarily for foundation stabilization, pipe cradles and encasement and other general purposes. All Portland Cement Concrete shall meet the requirements of Division 3 of these specifications.

Part 3 - Execution.

3.01 Excavation for Pipe and Related Structures (General)

1. Complete all excavation regardless of the material encountered. If structures, utilities, or other objects are encountered that may be necessary for continued facility operation or may need

preservation, immediately notify the Engineer and protect said object.

2. When cutting into existing roads, streets, alleys, or other public rights-of-way, the Contractor, shall obtain the proper licenses, cut permits, etc., from the appropriate authority.
 - a. Where trench excavation requires the removal of curb and gutter, concrete sidewalks, or asphaltic or concrete pavement, the pavement or concrete shall be cut in a straight line parallel to the edge of the excavation by use of a concrete saw, or similar approved equipment to obtain a straight, square, clean break. Cuts shall be located at standard joint locations, when possible.
3. When crossing existing or prospective cultivated areas, gravel streets or other developed surfaces, the Contractor shall strip the cover material to full depth of the existing surfacing. This surfacing shall be stockpiled and placed back over the trench after backfilling to the extent that it is acceptable and usable for that purpose. New material shall be provided as necessary. Topsoil shall be removed to full depth of the topsoil, or to a maximum depth of twelve inches (12") (300mm), whichever is less.
4. The disturbed area from construction shall be confined within the construction limits.
 - a. The trench shall be dug only as far in advance of the pipeline as work can be reasonably completed that day. The sides of the trench shall be sloped and/or braced in accordance with the current OSHA Standards and the trench drained so that workers can work safely and efficiently. It is essential that the discharge of pumps when required, be laid to approved natural drainage channels or storm sewers
5. Pipe crossings under sidewalks or curbs may be made by tunneling only if approved by the Engineer. If the Contractor elects to remove a portion of the sidewalk or curb, he must use a concrete saw for making neat joints corresponding to existing joints, compact the backfill as specified, and pour a new concrete sidewalk or curb section in accordance with the applicable sections of these specifications.
6. During excavation, materials suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials shall be stored and retained at least two feet (2') (600mm) or more from the edge of the trench in accordance with Occupational Health and Safety Rules and Regulations for Construction. Excavated material must not be piled over nearby existing parallel trench lines unless adequate precautions are taken by the Contractor to prevent sidewall failure. Ready access to existing fire alarm boxes, fire hydrants, valves, manholes, and other appurtenances must be maintained.
 - a. When making excavations, the various materials excavated shall be piled separately. All concrete and bituminous materials, any soils, which cannot be properly compacted, and all other deleterious materials shall be immediately removed from the construction site and

properly disposed of in accordance with applicable laws.

- b. All excavated material shall be piled within the construction limits or in a location obtained by the Contractor and accepted by the Engineer in a manner that will not endanger the work and that will avoid obstructing sidewalks, driveways, and fire hydrants.
7. Surface drainage of adjoining areas shall be unobstructed. Grading shall be done as may be necessary to prevent surface water from flowing into excavations, and any other water accumulating therein shall be promptly removed. Under no circumstances shall water be permitted to rise in unbackfilled trenches until after the pipe has been placed, tested, and covered with backfill. Any pipe having its alignment or grade changed as a result of a flooded trench shall be reinstalled.
 - a. Gutters shall be kept clear or other satisfactory provisions made for street drainage at all times.
8. The bottom of the trenches shall be accurately graded to the line and grade shown on the drawings. Bedding material shall be added (four inches (4") (100mm) minimum) to provide uniform bearing and support for each section of pipe at every point along its length. Care must be taken to avoid over excavation. Unauthorized over-depths shall be backfilled with approved bedding material at the Contractor's expense. All bedding material added shall be moistened and compacted to the satisfaction of the City Engineer. The finished trench bedding beneath the pipe shall be prepared accurately by means of hand tools.
 - a. The bottom of all excavations shall be neat and clean, containing no abrupt changes in grade except as shown and shall be free from all slough. Suitable methods shall be used to produce an excavated surface without disturbance to the underlying material by compacting soil material to at least 95% Standard Proctor, ASTM D698.
 - b. If in its natural state the material at the bottom of the trench is soft and, in the opinion of the City Engineer, cannot support the pipe, a further depth and/or width shall be excavated as directed by the City Engineer and refilled with foundation material to the midpoint of the pipe. Other approved methods may be used to assure a firm foundation.
 - c. Foundation material used to dewater the trench or to replace a wet material shall be considered incidental to construction.
9. Blasting the excavation to remove rock, clay, or hardpan will not proceed until the Contractor has notified the City Engineer of the necessity to do so and obtained written approval. This notification shall in no manner relieve the Contractor of the hazard and liability contingent on blasting operations. The City Engineer shall fix the hours of blasting. The Contractor at his expense shall repair any damage caused by blasting. The Contractor's methods of procedure relative to blasting shall conform to local and state laws and municipal ordinances, and the necessary permits shall be obtained.

10. The width of the trench shall be such to provide adequate working room for workers to install the pipe in the specified manner. The trench in the pipe zone and to one foot (1') (300mm) above the pipe zone shall be adequate in width to allow for proper compaction but shall in no case be less than one and half times the outside pipe diameter plus one foot (1') (300mm).
11. Where the trench is not located near existing utilities, buildings, or other structures, and where water and other conditions permit, the Contractor may omit sheeting and bracing of the excavation. In this event, sides of the trench shall be sloped to protect the workers working within them in accordance with Occupational Health and Safety Rules and Regulations for Construction. However, the trench must stay within the construction limits.
12. The Contractor shall provide safety boxes or sheeting and bracing necessary to confine his work within the construction limits, to provide safe working conditions, to prevent damage and delay to the work, and to prevent the disturbing or settlement of adjacent road surfaces, foundations, structures, utility lines or railroad tracks. The Contractor shall be responsible for the strength and sufficiency of all sheeting and bracing.
13. Any damage to the work under this contract or to adjacent structures or property caused by settlement, water or earth pressures, slides, cave-ins, or other reasons due to failure or lack of sheeting and bracing, or improper bracing, or through negligence or fault of the Contractor in any manner, shall be repaired by the Contractor without delay and at his expense.
14. Bracing shall be so arranged as to provide ample working space, so as not to interfere with the work, and so as not to place any strain on the structures being constructed, until such structures are of sufficient strength to withstand such strain. No sheeting and bracing shall be removed until the construction has proceeded far enough to provide ample strength for its safe removal.
 - a. Sheeting or bracing may be left in place in the trench at the discretion of the City Engineer. Any sheeting or bracing left in place shall be cut off approximately three feet (3') (900mm) above the top of the pipe or two feet (2') (.6m) below finish grade, whichever is lower, and the cut-off portion removed. All sheeting or bracing left in place shall be accurately located and shown on the "Record Drawings"
15. The Contractor shall be responsible for enforcing safety and maintaining safe working conditions in all trenching, shoring, and blasting operations to conform to OSHA regulations.
16. Trenching and tunneling standards near and around trees.
 - a. Trenches should be routed outside the tree protection zone or critical root zone (CRZ). For trees less than 6" diameter at breast height (DBH), defined as 4.5 feet about average ground level, that are to be retained, no trenching should occur within the dripline or tree protection/critical root zone as defined by the City of Lakeland Tree Management

Ordinance. For trees 6" DBH and less than 20" DBH no trenching should occur within an area equal to 1' radius for every inch of DBH or within the tree protection/critical root zone as defined by the City of Lakeland Tree Management Ordinance. For trees 20" DBH and greater, no trenching should occur within an area equal to 1.5' of radius for every inch of DBH or within the tree protection/critical root zone as defined by the City of Lakeland Tree Management Ordinance.

- b. Soil removed from the trenches should be placed on the side away from the trees and replaced as soon as possible. The width of the trench should be minimized. The use of trench walls should be considered rather than sloping sides when working around trees.
 - c. Trenches should be backfilled with quality or native soil when inside of a tree protection zone or critical root zone. Gravel, slurry, stone, and concrete are not appropriate fill material within a tree protection zone, unless used as bedding material.
 - d. If placement of utilities or other infrastructure is unavoidable within the tree protection zone or critical root zone then specific measures should be applied to minimize root damage. Tunneling is recommended as soon as roots 1 inch diameter and greater are encountered. Minimum tunnel depth should be 24 inches. Launch and recovery pits should be located outside of tree protection zones and critical root zones. If tunneling is impossible due to specific soil restrictions, the trenching should be done by hand within the tree protection zone or critical root zone. If this required trenching will sever more than 25% of the tree protection/critical root zone then the trench should be re-directed at the center of the tree with the final section dug under the base of the tree.
 - e. Changes to the approved construction plans or methods for trenching and tunneling must be submitted to and receive approval by the City's Representative before proceeding.
17. Dewatering, if required by site conditions, shall be provided by the Contractor. The contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface water and groundwater entering the excavations, trenches, or other parts of the work.
18. All trench excavations which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level beneath such excavations twelve inches (12") (300mm) or more below the bottom of the excavation.
19. Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.
20. The Contractor shall be responsible for the conditions of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.

21. In areas where dewatering is required, the Contractor will comply with the following requirements.
 - a. All discharges from dewatering systems, including well points, dewatering wells, pumps in the bottoms of the trenches, etc. will require a permit from the Tennessee Department of Environment and Conservation (TDEC). Before starting any construction, the Contractor shall submit an application to discharge to the TDEC along with this proposed dewatering plan for review.
 - b. One copy of the initial application, dewatering plan, and of the permit authorizing the discharge must be provided to the City Engineering office with the application for an excavation permit. Copies of any revisions to the dewatering plan shall be immediately provided to the City Engineering office.

3.02 Disposal of Excess Material

1. Except as otherwise permitted, dispose of excess excavated materials in a legal manner.
2. When making excavations, the various materials excavated shall be piled separately. All concrete and bituminous materials, any soils which cannot be properly compacted, and all other deleterious materials shall be immediately removed from the construction site and properly disposed of in accordance with applicable laws.

3.03 Pipe and Structure Installation

1. The Contractor shall use laser beam equipment, surveying instruments, or other proven techniques to maintain accurate alignment and grade. Reasonable care shall be exercised in handling and laying the pipe and fittings. The interior of all pipe and fitting shall be kept free from dirt and foreign matter at all times, and cleaned out thoroughly before being lowered into the trench. Under no circumstances shall materials be dropped or thrown into the trench.
2. Materials shall be placed where they will not be subject to injury from vehicles or equipment. The contractor's facilities for lowering the pipe into the trench shall be such that neither the pipe nor trench will be damaged or disturbed. Pipe shall be lowered into the trench with rope slings, gin poles, dragline, or trench in such manner as to lay the pipe carefully into place and shall be lowered and laid with the bell end up grade. Holes shall be dug under the bells so that pipe is unsupported at the pipe connection. The laying of pipe in the finished trench shall be started at the lowest point and laid up grade. The Contractor shall clean and remove all sand, gravel, concrete, and cement grout that has entered the lines in the process of construction.
3. Any pipe which is broken, cracked, or otherwise unsuitable, as determined by the Engineer, shall be removed and replaced by the contractor at no additional cost to the owner. Any damage to pipe coatings shall be repaired with the same materials used for the original coating before laying the pipe.

4. The Contractor shall keep the pipe, manholes, catch basins, and other structures free from deposits of mud, sand, gravel, or other foreign matter, and in good working condition until the construction is completed and accepted. Upon completion of each line between manholes, a clear and unobstructed view of the whole bore of a pipe shall be obtained between manholes by use of a light or subreflector. If such view is not apparent an air-filled rubber ball, approved by the Engineer, having a diameter one-inch (1") (25mm) less than the tile to be tested, shall be flushed through the line between manholes. Any obstruction found in any line shall be removed by the contractor without cost to the owner. Any methods used by the contractor to remove deposits of mud, sand, gravel, or other foreign matter from the line shall be approved by the Engineer. Unless specified in the Special Provisions, a leakage test will not be required. However, this does not preclude the fact that obvious and concentrated leaks (such as open joints, pinched gaskets, cracked barrels or bells, etc.) will not be allowed.
5. Pipe shall not be laid on frozen ground, or when trench conditions are unsuitable for such work.
6. The upgrade end of pipelines not terminating in a structure shall be plugged with a cap or plug approved by the Engineer.
7. Fine grading to the bottom of the barrel shall proceed ahead of the pipe laying and, should any over-excavation exceeding two inches (2") (50mm) be encountered, the material added shall be moistened (95% of Standard Proctor) and compacted to the density of the existing subgrade or foundation material shall be added at the Contractor's expense.
8. Bell holes shall be dug for the pipe bells or couplings and the materials placed along the preceding pipe laid. The pipe shall be supported for the bottom 60 degrees and throughout its length (except for the minimum distance necessary at the bell holes). Bell holes shall be adequate to make the joint, but no larger than necessary so that maximum support on undisturbed ground or pipe zone material will be provided for the pipe. The remainder of the pipe shall be surrounded to at least its midpoint by granular bedding material, compacted in maximum six inch (6") (150mm) layers to completely fill all space under and adjacent to pipe.
9. Pipe laying should proceed upgrade with the spigot ends pointed in the direction of flow. No pipe shall be laid in water or when the trench conditions are unsuitable for such work, except by written permission of the Engineer. The Contractor shall make all connections of pipe to the manholes which have previously been constructed.
10. The Contractor shall connect all existing storm inlets and sewers to the new storm sewer as shown on the drawings. These connections shall be made as the storm sewer construction progresses which will require that each section of the new sewer be fully completed and ready for operation as the construction advances.
11. Open excavation shall be satisfactorily protected at all times. At the end of each day's work,

the open ends of all pipes shall be protected against the entrance of animals, children, earth, or debris, by bulkheads or stoppers. The bulkheads or stoppers shall be perforated to allow passage of water into the installed pipeline to prevent flotation of the pipeline. Any earth or other material that may find entrance into the main sewer or into any lateral sewer through any such open end of unplugged branch must be removed at the Contractor's expense.

12. Curved alignments shall be constructed with precast, beveled end concrete radius pipe which meet the same requirements as for straight pipe. Concrete radius pipe less than or equal to 36 inch diameter shall have a minimum centerline radius of 20 feet and all radius pipe greater than 36 inch diameter and less than 72 inch diameter shall have a minimum centerline radius of 30 feet.

3.04 Installation of Manholes

1. Excavation shall be to a depth and size to provide for construction of the manhole. Concrete bases shall be poured on undisturbed ground. Precast concrete bases shall be carefully lowered onto one of the following:
 - a. Six inches (6") (150mm) minimum layer of well-compacted granular material accurately laid to a smooth level surface using a straight edge and hand level.
 - b. Three inches (3") (75 mm) of concrete poured on undisturbed soil.
2. Walls shall be of precast concrete as shown in the standard drawings and shall be constructed to form a complete watertight structure.
3. The Contractor shall provide a minimum of two inches (2") (50mm) and a maximum of twelve inches (12") (300mm) in two-inch (2") (50mm) layers of precast reinforced concrete adjusting rings between the cast iron frame and the manhole top section. Each ring shall be set on a full bed of mortar and shall be made watertight in accordance to Drawing 602-2. Wood will not be allowed as spacers. Adjusting rings shall conform to the size and shape of the casting frame. Frames and covers shall be set to the designated elevation in a full mortar bed.
 - a. The minimum two-inch (2") (50 mm) concrete ring for grade is not needed if grade can be met with a six-inch (6") (150mm) flange on top of the cone section of the manhole.
 - b. If the number of adjusting rings exceeds the maximum twelve inches (12") (300) mm), the manhole shall be reexcavated and a manhole barrel section installed.
4. Manholes shall be set as shown on drawing details. All lifting holes must be grouted in after placement.

5. When manholes are to be constructed in new streets, manhole rings shall be set to the final grade before the street-wearing course is placed. Riser rings shall not be used to make adjustments for new construction. In gravel or unpaved roads, the manhole ring shall be kept four to six inches (4"-6") (100mm-150mm) below the road surface.
6. The invert of all manholes shall be smoothly shaped so as to allow a free, uninterrupted flow of storm water. The invert forming system shall be "A-Lok Tru Contour", or approved equal. Floor troughs shall be furnished for all storm sewers entering manholes. Inverts shall be U-shaped to the 1.0 diameter point before sloping at a 1 to 12 slope to the manhole walls.

3.05 Trench Backfilling.

A. Trench Backfilling

1. All excavation in trenches shall be backfilled to the original ground surface or to such grades as specified or as shown on the drawings. The backfill shall begin as soon as practical after the pipe has been placed and shall thereafter be carried on as rapidly as the protection of the balance of the work shall permit.
2. No pipe shall be covered before the Project Representative or the Engineer has observed and approved the pipe. If any piping or appurtenance is covered without the approval of the Engineer or Resident Project Representative, at the discretion of the Engineer, the Contractor shall be required to re-excavate to expose the covered materials. The cost of exposing those materials and then backfilling and recompacting will be at the Contractor's expense regardless of the condition of the pipe and/or the materials under question.
3. The Contractor shall completely backfill all excavations before stopping work at the end each day. Open excavations (fenced or unfenced) shall not be allowed overnight or on weekends at any site after work has stopped for the day unless approved by the City.
4. Complete cleanup shall proceed directly behind the backfilling operation to accommodate the return to normal conditions. Should the Contractor, in the City's opinion, fail to pursue diligently the backfilling and cleanup, the amount of work on which complete cleanup has not been accomplished shall be limited to one thousand lineal feet (1,000') (300m) for the entire job. The Contractor shall have sufficient equipment on the job to assure timely backfill and cleanup at all times.

B. Pipe Bedding.

1. Class A - Concrete Cradle

Class A bedding for storm sewers and culverts shall consist of a continuous concrete cradle up to springline constructed in conformity with the details shown on the Plans or as directed by the Engineer.

2. Class B - Granular Encasement Bedding

Class B bedding shall consist of a bed of granular material having a thickness of at least 150 mm (6 inches) below the bottom of the conduit. For conduits other than precast reinforced concrete box sections and corrugated aluminum and steel box culverts, the bedding shall extend up around the pipe for a depth of not less than 12 inches above the top of the pipe.

3. Class C - Granular Bedding

Class C bedding shall be constructed by bedding the drainage pipe on a bed of granular material shaped by a template to fit the lower part of the pipe exterior for at least 10 percent of its overall height (Minimum of 4 inches below the bell of the pipe). After pipe installation granular encasement material shall then be rammed and tamped in layers not over 6 inches in loose thickness around the pipe to the springline.

4. Class B bedding shall be provided for all piping unless otherwise shown on the drawings and authorized by the City Engineer.
5. Bedding material shall be placed as shown on the typical trench detail and described above. Spread bedding material to provide continuous and uniform support beneath pipe at all points between bell holes or pipe joints. Particular attention shall be given to the area from the base of the pipe or culvert to the centerline to ensure firm, uniform, and continuous support is obtained and to prevent any lateral movement upon subsequent backfilling or under service conditions. Bedding material shall be placed, prepared, and compacted simultaneously on both sides and lateral movement shall be prevented. Bedding material shall be moisture conditioned to +2% to -4% of optimum and compacted to 90% maximum density, as determined by ASTM D698. Class C bedding material shall be placed manually with shovels, and tamped in maximum 6" lifts and evenly placing the material on both sides of the pipe. Bedding material shall not exhibit pumping (horizontal or vertical displacement) after compaction. Encasement material will then be placed around and over the top of the pipe, but need not be hand placed. During conditions where flexible piping shall be buried in excess of 20 feet in depth, all bedding material shall be moisture conditioned to +2% to -4% of optimum and compacted to 95% maximum density, as determined by ASTM D698.
6. Trench Backfill above the Encasement Zone. Trench backfill above the encasement zone may consist of excavated material or select backfill material. Excavated material shall be used unless the minimum density requirements cannot be met. Select backfill material such as pit run shall be substituted for excavated material to meet compaction requirements. Backfill material shall be pushed onto the slope of the excavated trench and allowed to slide down into the trench. Backfill material shall not be permitted to free fall into the trench until at least one foot (1') (254mm) of cover is over the pipe or culvert. Moisture conditioning may be provided by water trucks or hoses. Excavated or select backfill material shall not exhibit pumping (horizontal or vertical displacement) after compaction.
7. Backfilling shall be done in lifts of uniform layers which will produce the required compaction

Each lift shall be completely compacted over the full width of the excavated area. Compacting shall continue until the specified relative compaction has been attained or until no more settlement occurs. Water jetting of backfill shall not be permitted.

8. In-place densities of compacted backfill material shall be determined by the Engineer using either ASTM standard test method D1556-82 (Sandcone) or ASTM standard test method D2922-81 (nuclear). The minimum and maximum dry density for non-cohesive materials such as clean sands and gravel shall be determined by ASTM D4253 and D4254. The maximum dry density for cohesive backfill materials, such as clays, silts, etc., shall be determined by ASTM D698.
 - a. Backfill above the encasement zone shall be compacted to the minimum densities and moisture conditions listed below. The densities listed below may only be modified through a geotechnical report.

| <u>Area</u> | <u>Cohesive</u> |
|--------------------------------|-----------------|
| Streets, highway, alleys | 95%, $\pm 2\%$ |
| Sidewalks, curbs, and driveway | 95%, $\pm 2\%$ |
| Lawns and cultivated areas | 90%, $\pm 2\%$ |

9. Care of Utilities

- a. In excavating and backfilling for pipelines or structures, extreme care must be taken so as to not mar or injure any gas, telephone, sewer, water, power, or television lines. The utility owner shall be notified that the relocation is necessary and shall be given adequate time to provide for the relocation.
10. When the trench excavation for the sewer main and appurtenances is within the rights-of way of state or county highways, the backfilling of the trench, compaction of materials, subgrade preparation and surfacing shall be done in strict accordance with the requirements and specifications of the authority having jurisdiction or as required by these specifications, whichever is more stringent.
 11. In all cases, the Contractor shall blade and compact the roadway after the trench has been backfilled, so that it shall be passable to traffic at all times. The Contractor shall maintain the roadway in a condition acceptable to the City at all times until final acceptance of the entire work by the City.
 12. The Contractor shall also blade and maintain all detours and bypasses. All maintenance work shall be done at no additional compensation. In addition to the blading and maintenance requirements specified, the Contractor shall provide at least one tank truck with pressurized spray bars for spraying water on the streets to control the dust. Dust control shall be required as necessary on all streets after compacting and grading and on all detours and bypasses.

13. The Contractor is responsible for the complete maintenance of his work at all times. If he fails to provide proper maintenance, and safety or nuisance conditions arise, it is expressly understood that City crews may be directed by the City to provide essential maintenance, and that such work will be done at the expense of the Contractor.
14. The Contractor shall remedy at his own expense any defects that appear in the backfill following completion and during the warranty period.

C. Storm Sewers and Culverts Placed on Fill

1. Fill material placed in areas over which storm sewer or culverts will be constructed shall be select earth material from the elevation of suitable subgrade to the bottom elevation for bedding or foundation of the drainage facility.
2. Placement and Compaction. If storm sewer or culverts are constructed on filled areas, the fill material shall be placed in 6 inch loose layers and compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698) up to a point at least 2 feet above the outside top of the pipe or to the foundation of manholes, inlets, special structures, box culverts, concrete channel lining and concrete ditch paving. If compaction standards for storm sewer pipe exceed that of the adjoining fill, the width of compaction for the storm drain shall be not less than the outside diameter of pipe plus 10 feet. If compaction standards for the manhole, inlets, special structure, box culverts, concrete channel lining and concrete ditch paving exceed that of adjoining fill, the limits of compaction for the facility shall be not less than 5 feet outside of the facility base slab.

3.06 Installation of Structures.

1. Structures shall be set on a six-inch (6") (150mm) layer of foundation material when directed by the Engineer. The surface shall be accurately graded to provide uniform bearing for the structure.
2. Catch basins shall be constructed at the locations shown on the drawings and approved by the Engineer. The size and type of catch basins shall be shown on the drawings or in the Standard Details of the Specifications. Catch basin frames shall be set accurately to grade. Concrete grout shall then be placed around and beneath the frame to hold the grate securely in place.
3. Manhole castings shall be installed one-fourth inch (1/4") (6.25mm) to one-half inch (1/2") (12.5mm) below the surface of the existing pavement. Where the structure is in unpaved streets, the manhole casting shall be set to the future street elevation. The casting shall be constructed as shown in the Standard Details. The contractor shall provide a minimum of two inches (2") (50mm) and a maximum of twelve inches (12") (300mm) in two inch (2") (50mm) layers of precast reinforced concrete adjusting rings between the cast iron frame and the

manhole top section. Each ring shall be set on a full bed of mortar and shall be made watertight. The bearing surface around the perimeter of the frame shall be grouted to a height within two inches (2") (50mm) from the existing street surface, and to a width of twelve inches (12") (300mm) greater than the manhole ring, and a depth of six inches (6") (150mm) below the bottom adjusting rings or one foot (1') (300MM), whichever is greater. The manhole frame shall then be tacked and asphaltic concrete pavement shall be placed for the final two inches (2") (50mm).

3.07 Structure Backfilling.

- A. Structure backfilling shall cover manholes, catch basins, junction boxes, and any other structure encountered during the course of the work. Fill around structures shall consist of trench backfill meeting the requirements of structural fill material or select backfill material. Fill material shall be spread and compacted to provide continuous and uniform support around the structure. Special attention shall be given to the compaction operation around structures to ensure uniform compaction.
- B.. Do not place fill when the surface to be filled is frozen. Do not place frozen fill.
- C.. Fill around concrete structures shall commence only after concrete has attained 80% of the ultimate compressive strength specified. Remove all form materials, concrete spills, and trash from around the structures before placing fill. Where backfilling on both sides or around the perimeter of a structure is required, place the backfill and compact simultaneously at the same elevation on opposite sides or around the perimeter in lifts.
- D. Place fill material in eight inch (8") (200mm) maximum lifts and compact to at least 95% density for cohesive soils. The moisture content shall be +2% to -2% of optimum.

3.08 Cleanup

- A. Construction cleanup and all backfill operations shall directly follow the storm sewer installation. Cleanup shall be completed to allow local traffic on the street and access to driveways, parking lots, etc.
- B. During construction, all existing gutters, storm drains, runoff channels, etc., shall be kept clean of dirt, rubble, or debris which would impede the flow of storm sewer.

3.09 Quality Control

1. Light Test

- a. After the trench has been backfilled, a light test shall be made between manholes to check alignment and grade for displacement of pipe. Except for curved alignments shown on the plans, the completed pipeline shall be such that a true circle of light can be seen from one

manhole to the next. If alignment or grade is other than specified and displacement of pipe is found, the Contractor shall remedy such defects at his own expense.

2. Leakage Test

- a. Unless specified in the Special Provisions, a leakage test will not be required. However, this does not preclude the fact that obvious and concentrated leaks (such as open joints, pinched gaskets, cracked barrels, or bells, etc.) will not be allowed.

3. Gradation Test

a. Bedding Material

- i One initial gradation test for each type of material plus one additional test for each one thousand cubic yards (1000 yd³) (750m³) placed of each material.

b. Foundation Material

- i One initial gradation test for each type of material plus one additional test for each one thousand cubic yards (1000 yd³) (750m³) placed of each material.

c. Structural Fill Material

- i One initial gradation test for each type of material plus one additional test for each one thousand cubic yards (1000 yd³) (750m³) placed of each material.

d. Select Backfill Material

- i One initial gradation test for each type of material plus one additional test for each one thousand cubic yards (1000 yd³) (750m³) placed of each material.

e. Encasement Backfill Material

- i One initial gradation test for each type of material plus one additional test for each one thousand cubic yards (1000 yd³) (750m³) placed of each material.

- f. All gradation tests shall be the responsibility of the Contractor using a certified approved testing laboratory acceptable to the Owner and Engineer. The Contractor shall be responsible for all costs associated with gradation testing.

4. Density Test

a. Encasement Zone Material

- i One test for each five hundred lineal feet (500') (150m) pipe installed.
- b. Bedding Zone Material
 - i One test for each five hundred lineal feet (500') (150m) pipe installed.
- c. Trench, Select Backfill Material, and/or Structural Fill Material
 - i One standard proctor test ASTM D698 or one relative density test, (ASTM D4253 and D4254) for each type of material for every two foot (2') (600mm) of trench depth above the pipe zone per every three hundred lineal feet (300') (30m) pipe installed. The Engineer may elect to take one test for each one thousand cubic yards (1000yd³) (750m³) or a portion thereof.
- d. Unless otherwise indicated in the Contract Documents, density and moisture tests shall be the responsibility of the Owner/Engineer. The Contractor shall cooperate with the Engineer or testing agency. If the initial moisture/density tests fail, the Contractor will be responsible for all costs associated with retests, until a passing moisture/density test is completed.

5. Deflection Test

- a. Mandrel or deflection testing for flexible conduit shall be conducted as directed by the City Engineer. Testing shall be conducted using a mandrel with a diameter equal to 95 percent of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices. The mandrel go/no-go, device shall be cylindrical in shape and constructed with either 9 or 16 evenly spaced arms or prongs. Mandrels with few arms will be rejected. Contact length of mandrel's arms shall equal or exceed nominal inside diameter of pipe to be inspected. Critical mandrel dimensions shall carry tolerance of 0.01 inch maximum. Contractor shall provide mandrel and necessary equipment for mandrel test. Mandrel shall be hand-pulled through flexible pipe lines prior to end of warranty period. Sections of pipe not passing mandrel shall be uncovered and rebedded, rerounded, or replaced to the satisfaction of the owner. Repaired section shall be retested. It is also recommended that the contractor perform a mandrel test prior to placing paving surfaces.

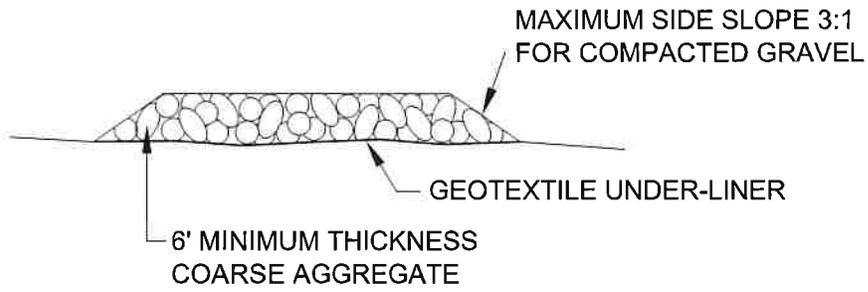
3.10 Final Acceptance and Record Drawings

- A. "Record Drawings" shall be submitted to the City prior to preliminary acceptance of the construction project. "Record Drawings" shall include, in addition to construction drawings and details, "as built" information where it differs from construction drawings and locate information including horizontal and vertical coordinates in the datum established by the City for the Geographical Information System.

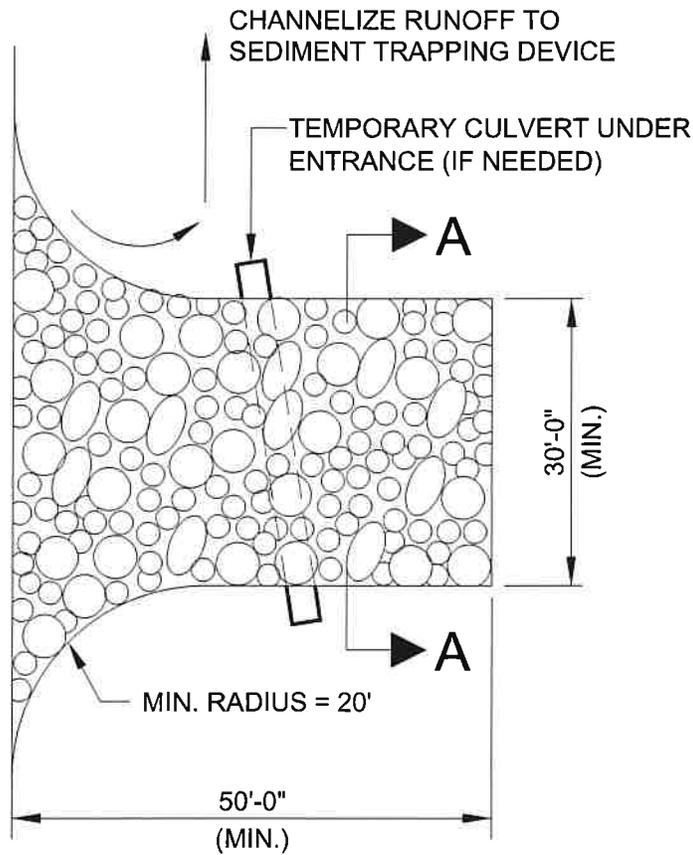
B. Final Acceptance

1. Final acceptance will not take place until preliminary acceptance is obtained and all paving and curbside is completed.
2. Before final acceptance of any storm sewer, the following inspections shall be made:
 - a. All lines clean and flushed
 - b. Manholes up to proper grade in a proper condition
3. All punch list items must be completed prior to final acceptance.

END OF SECTION



SECTION A-A



CONSTRUCTION EXIT DETAIL

NOT TO SCALE

CITY OF LAKELAND
ENGINEERING DIVISION

CONSTRUCTION EXIT DETAIL

| REV. | DESCRIPTION | DATE |
|------|----------------|--------|
| 1 | ORIGINAL ISSUE | 8/2008 |
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