2593.014

TECHNICAL SPECIFICATIONS

TEMPORARY CONTAINMENT STRUCTURE

CAROUSEL CENTER

CITY OF SYRACUSE

ONONDAGA COUNTY, NEW YORK

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IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS DOCUMENT.

MICHAEL S. KOLCESKI, P.E.
VICE PRESIDENT

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MATERIALS SPECIFICATIONS

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EARTHWORK

MP-1.01 GENERAL

A. Work Specified
   1. Excavation and backfilling including the loosening, removing, refilling, transporting, storage and disposal of all materials classified as "earth" necessary to be removed for the construction and completion of all work under the Contract.
   2. Excavation to the widths and depths shown on the Contract Drawings, specified or directed.

B. Related Work Specified Elsewhere
   1. Rock Removal
   2. Structural Excavation, Backfill and Compaction
   3. Trenching, Backfilling and Compacting
   4. Selected Fill
   5. Embankment

C. Definitions
   1. Excavation (or Trenching)
      a. Grubbing, stripping, removing, storing and re-handling of all materials of every name and nature necessary to be removed for all purposes incidental to the construction and completion of all the work under construction;
      b. All sheeting, sheetpiling, bracing and shoring, and the placing, driving, cutting off and removing of the same;
      c. All diking, ditching, fluming, cofferdamming, pumping, bailing, draining, well pointing, or otherwise disposing of water;
      d. The removing and disposing of all surplus materials from the excavations in the manner specified;
      e. The maintenance, accommodation and protection of travel and the temporary paving of highways, roads and driveways;
      f. The supporting and protecting of all tracks, rails, buildings, curbs, sidewalks, pavements, overhead wires, poles, trees, vines, shrubbery, pipes, sewers, conduits or other structures or property in the vicinity of the work, whether over- or underground or which appear within or adjacent to the excavations, and the restoration of the same in case of settlement or other injury;
      g. All temporary bridging and fencing and the removing of same.

2. Earth
   a. All materials such as sand, gravel, clay, loam, ashes, cinders, pavements, muck, roots or pieces of timber, soft or disintegrated rock, not requiring blasting, barring, or wedging from their original beds, and specifically excluding all ledge or bedrock and individual boulders or masonry larger than one-half cubic yard in volume.
3. Backfill
   a. The refilling of excavation and trenches to the line of filling indicated on the Contract Drawings or as directed using materials suitable for refilling of excavations and trenches; and the compacting of all materials used in filling or refilling by rolling, ramming, watering, puddling, etc., as may be required.
4. Spoil
   a. Surplus excavated materials not required or not suitable for backfills or embankments.
5. Embankments
   a. Fills constructed above the original surface of the ground or such other elevation as specified or directed.
6. Limiting Subgrade
   a. The underside of the pipe barrel for pipelines.
   b. The underside of footing lines for structures.
7. Excavation Below Subgrade
   a. Excavation below the limiting subgrades of structures or pipelines.
   b. Where materials encountered at the limiting subgrades are not suitable for proper support of structures or pipelines, the Contractor shall excavate to such new lines and grades as required.

D. Applicable Codes, Standards and Specifications
   1. American Society for Testing and Materials (ASTM)

MP 1.02 DESCRIPTION OF MATERIALS

A. Wood Sheeting and Bracing
   1. Shall be sound and straight; free from cracks, shakes and large or loose knots; and shall have dressed edges where directed.
   2. Shall conform to National Design Specifications for Stress Grade Lumber having a minimum fiber stress of 1200 pounds per square inch.
   3. Sheeting and bracing to be left-in-place shall be pressure treated in accordance with ASTM D 1760 for the type of lumber used and with a preservative approved by the Engineer.

B. Steel Sheeting and Bracing
   1. Shall be sound.
   2. Shall conform to ASTM A 328 with a minimum thickness of 3/8 inch.

MP-1.03 UNAUTHORIZED EXCAVATION

A. Whenever excavations are carried beyond or below the lines and grades shown on the Contract Drawings, or as given or directed by the Engineer, all such excavated space shall be refilled with special granular materials, concrete or other materials as the Engineer may direct. All refilling of unauthorized excavations shall be at the Contractor's expense.

B. All material which slides, falls or caves into the established limits of excavations due to any cause whatsoever, shall be removed and disposed of at the Contractor's expense and no extra compensation will be paid the Contractor for any materials ordered for refilling the void areas left by the slide, fall or cave-in.

MP-1.04 REMOVAL OF WATER

A. General
   1. The Contractor shall at all times provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work or the proper placing of pipes, structures, or other work.
   2. Unless otherwise specified, all excavations which extend down to or below the static groundwater elevations shall be dewatered by lowering and maintaining the groundwater beneath such excavations at all times when work thereon is in progress, during subgrade preparation and the placing of the structure or pipe thereon.
   3. Water shall not be allowed to rise over or come in contact with any masonry, concrete or mortar, until at least 24 hours after placement, and no stream of water shall be allowed to flow over such work until such time as the Engineer may permit.
   4. Where the presence of fine grained subsurface materials and a high groundwater table may cause the upward flow of water into the excavation with a resulting quick or unstable condition, the Contractor shall install and operate a well point system to prevent the upward flow of water during construction.
   5. Water pumped or drained from excavations, or any sewers, drains or water courses encountered in the work, shall be disposed of in a suitable manner without injury to adjacent property, the work under construction, or to pavements, roads, drives, and water courses. No water shall be dis-

charged to sanitary sewers. Sanitary sewage shall be pumped to sanitary sewers or shall be disposed of by an approved method.

6. Any damage caused by or resulting from dewatering operations shall be the sole responsibility of the Contractor.

B. Work Included

1. The construction and removal of cofferdams, sheeting and bracing, and the furnishing of materials and labor necessary therefor.
2. The excavation and maintenance of ditches and sluiceways.
3. The furnishing and operation of pumps, well points, and appliances needed to maintain thorough drainage of the work in a satisfactory manner.

C. Well Point Systems

1. Installation
   a. The well point system shall be designed and installed by or under the supervision of an organization whose principal business is well pointing and which has at least five consecutive years of similar experience and can furnish a representative list of satisfactory similar operations.
   b. Well point headers, points and other pertinent equipment shall not be placed within the limits of the excavation in such a manner or location as to interfere with the laying of pipe or trenching operations or with the excavation and construction of other structures.
   c. Detached observation wells of similar construction to the well points shall be installed at intervals of not less than 50 feet along the opposite side of the excavation from the header pipe and line of well points, to a depth of at least five feet below the proposed excavation. In addition, one well point in every 50 feet shall be fitted with a tee, plug and valve so that the well point can be converted for use as an observation well. Observation wells shall be not less than 1-1/2" in diameter.
   d. Standby gasoline or diesel powered equipment shall be provided so that in the event of failure of the operating equipment, the standby equipment can be readily connected to the system. The standby equipment shall be maintained in good order and actuated regularly not less than twice a week.
2. Operation
   a. Where well points are used, the groundwater shall be lowered and maintained continuously (day and night) at a level not less than two feet below the bottom of the excavation. Excavation will not be permitted at a level lower than two feet above the water level as indicated by the observation wells.

b. The effluent pumped from the well points shall be examined periodically by qualified personnel to determine if the system is operating satisfactorily without the removal of fines.
c. The water level shall not be permitted to rise until construction in the immediate area is completed and the excavation backfilled.

MP-1.05 STORAGE OF MATERIALS

A. Sod
1. Any sod cut during excavation shall be removed and stored during construction so as to preserve the grass growth. Sod damaged while in storage shall be replaced in like kind at the sole expense of the Contractor.

B. Topsoil
1. Topsoil suitable for final grading shall be removed and stored separately from other excavated material.

C. Excavated Materials
1. All excavated materials shall be stored in locations so as not to endanger the work, and so that easy access may be had at all times to all parts of the excavation. Stored materials shall be kept neatly piled and trimmed, so as to cause as little inconvenience as possible to public travel or to adjoining property holders.
2. Special precautions must be taken to permit access at all times to fire hydrants, fire alarm boxes, police and fire department driveways, and other points where access may involve the safety and welfare of the general public.

MP-1.06 DISPOSAL OF MATERIALS

A. Spoil Material
1. All spoil shall be transported and placed on the site of the work at the locations and to the elevations and grades shown on the Contract Drawings, or if spoil areas are not shown, all spoil materials shall be disposed off the site at locations selected and obtained by the Contractor.
2. The surface of all spoil areas shall be graded and dressed and no unsightly mounds or heaps shall be left on completion of the work.

MP-1.07 SHEETING AND BRACING

A. Installation
1. The Contractor shall furnish, place and maintain such sheeting, bracing and shoring as may be required to support the sides and ends of excavations in such manner as to prevent any movement which could, in any way, injure the pipe, structures, or other work; diminish the

width necessary for construction; otherwise damage or delay the work of the Contract; endanger existing structures, pipes or pavements; or cause the excavation limits to exceed the right-of-way limits.

2. In no case will bracing be permitted against pipes or structures in trenches or other excavations.
3. Sheeting shall be driven as the excavation progresses, and in such manner as to maintain pressure against the original ground at all times. The sheeting shall be driven vertically with the edges tight together, and all bracing shall be of such design and strength as to maintain the sheeting in its proper position.
4. The Contractor shall be solely responsible for the adequacy of all sheeting and bracing.

B. Removal

1. In general, all sheeting and bracing, whether of steel, wood or other material, used to support the sides of trenches or other open excavations, shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a pipe or structural foundation shall not be withdrawn, unless otherwise directed, before more than six inches of earth is placed above the top of the pipe or structural foundation and before any bracing is removed. The voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.
2. The Contractor shall not remove sheeting and bracing until the work has attained the necessary strength to permit placing of backfill.

C. Left in Place

1. If, to serve any purpose of his own, the Contractor files a written request for permission to leave sheeting or bracing in the trench or excavation, the Engineer may grant such permission, in writing, on condition that the cost of such sheeting and bracing be assumed and paid by the Contractor.
2. The Contractor shall leave in place all sheeting, shoring and bracing which are shown on the Contract Drawings or specified to be left in place or which the Engineer may order, in writing, to be left in place. All shoring, sheeting and bracing shown or ordered to be left in place will be paid for under the appropriate item of the Contract. No payment allowance will be made for wasted ends or for portions above the proposed cutoff level which are driven down instead of cut-off.
3. In case sheeting is left in place, it shall be cut off or driven down as directed so that no portion of the same shall remain within 12 inches of the street subgrade or finished ground surface.

MP-1.08 BACKFILLING

A. General
1. All excavations shall be backfilled to the original surface of the ground or to such other grades as may be shown, specified or directed.
2. Backfilling shall be done with suitable excavated materials which can be satisfactorily compacted during refilling of the excavation. In the event the excavated materials are not suitable, Special Backfill as specified or ordered by the Engineer shall be used for backfilling.
3. Any settlement occurring in the backfilled excavations shall be refilled and compacted.

B. Unsuitable Materials
1. Stones, pieces of rock or pieces of pavement greater than one cubic foot in volume or greater than 1.5 feet in any single dimension shall not be used in any portion of the backfill.
2. All stones, pieces of rock or pavement shall be distributed through the backfill and alternated with earth backfill in such a manner that all interstices between them shall be filled with earth.
3. Frozen earth shall not be used for backfilling.

C. Compaction and Density Control
1. The compaction shall be as specified for the type of earthwork, i.e., structural, trenching or embankment.
   a. The compaction specified shall be the percent of maximum dry density.
   b. The compaction equipment shall be suitable for the material encountered.
2. Where required, to assure adequate compaction, in-place density test shall be made by an approved testing laboratory.
   a. The moisture-density relationship of the backfill material shall be determined by ASTM D698, Method D.
      1) Compaction curves for the full range of materials used shall be developed.
   b. In-place density shall be determined by the methods of ASTM D1556 or ASTM D2922 and shall be expressed as a percentage of maximum dry density.
3. Where required, to obtain the optimum moisture content, the Contractor shall add, at his expense, sufficient water during compaction to assure the specified maximum density of the backfill. If, due to rain or other causes, the material exceeds the optimum moisture content, it shall be allowed to dry, assisted if necessary, before resuming compaction or filling efforts.
4. The Contractor shall be responsible for all damage or injury done to pipes, structures, property or persons due to improper placing or compacting of backfill.

MP-1.09 OTHER REQUIREMENTS

A. Drainage
1. All material deposited in roadway ditches or other water courses shall be removed immediately after backfilling is completed and the section, grades and contours of such ditches or water courses restored to their original condition, in order that surface drainage will be obstructed no longer than necessary.

B. Unfinished Work
1. When, for any reason, the work is to be left unfinished, all trenches and excavations shall be filled and all roadways, sidewalks and watercourses left unobstructed with their surfaces in a safe and satisfactory condition. The surface of all roadways and sidewalks shall have a temporary pavement.

C. Hauling Material on Streets
1. When it is necessary to haul material over the streets or pavements, the Contractor shall provide suitable tight vehicles so as to prevent deposits on the streets or pavements. In all cases where any materials are dropped from the vehicles, the Contractor shall clean up the same as often as required to keep the crosswalks, streets and pavements clean and free from dirt, mud, stone and other hauled material.

D. Dust Control
1. It shall be the sole responsibility of the Contractor to control the dust created by any and all of his operations to such a degree that it will not endanger the safety and welfare of the general public.

E. Test Pits
1. For the purpose of obtaining detail locations of underground obstructions, the Contractor shall make excavations in advance of the work. Payment for the excavations ordered by the Engineer will be made under an appropriate item of the Contract.

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MATERIALS AND PERFORMANCE - SECTION 2

ROCK REMOVAL

MP-2.01 GENERAL

A. Work Specified
   1. Rock removal to the widths and depths shown on the Contract Drawings or as directed by the Engineer, including the loosening, removing, transporting, storing and disposal of all materials requiring blasting, barring, or wedging for removal from their original beds.
   2. Backfill of rock excavations with acceptable materials.

B. Related Work Specified Elsewhere
   1. Earthwork
   2. Structural Excavation, Backfill and Compaction
   3. Trenching, Backfilling and Compacting
   4. Selected Fill
   5. Embankment

C. Definitions
   1. Rock
      a. All pieces of ledge or bedrock, boulders or masonry larger than one-half cubic yard in volume.
      b. Any material requiring blasting, barring, or wedging for removal from its original bed.

MP-2.02 SUBMITTALS

A. Before any blasting operations begin the Contractor shall obtain all permits and licenses required.

MP-2.03 BLASTING

A. General
   1. Handling of explosives and blasting shall be done only by experienced persons.
   2. Handling and blasting shall be in accordance with all Federal, State and local laws, rules and regulations relating to the possession, handling, storage and transportation and use of explosives.
   3. All blasts in open cut shall be properly covered and protected with approved blasting mats.
   4. Charges shall be of such size that the excavation will not be unduly large and shall be so arranged and timed that adjacent rock, upon or against which pipelines or structures are to be built, will not be shattered.
   5. Blasting will not be permitted within 25 feet of pipelines or structures.

6. All existing pipes or structures exposed during excavation shall be adequately protected from damage before proceeding with the blasting.

B. Repair of Damages Due to Blasting
1. Any injury or damage to the work or to existing pipes or structures shall be repaired or rebuilt by the Contractor at his expense.
2. Whenever blasting may damage adjacent rock, pipes or structures, blasting shall be discontinued and the rock removed by drilling, barring, wedging or other methods.

C. Explosives
1. At no time shall an excessive amount of explosives be kept at the site of the work. Such explosives shall be stored, handled and used in conformity with all applicable laws and regulations.
2. Accurate daily records shall be kept showing the amounts of explosives on hand, both at the site and at any storage magazine, the quantities received and issued, and the purpose for which issued.
3. The Contractor shall be responsible for any damage or injury to any persons, property or structures as a result of his handling, storage or use of explosives.

D. Rock Clearance in Trenches
1. Ledge rock, boulders and large stones shall be removed from the sides and bottom of the trench to provide clearance for the specified embedment of each pipe section, joint or appurtenance; but in no instance shall the clearance be less than 6-inches. Additional clearance at the pipe bell or joint shall be provided to allow for the proper make-up of the joint.
2. At the transition from an earth bottom to a rock bottom the minimum bottom clearance shall be 12-inches for a distance of not less than five (5) feet.

E. Rock Clearance at Structures
1. Concrete for structures shall be placed directly on the rock and the excavation shall be only to the elevations and grades shown on the Contract Drawings.

MP-2.04 EXCAVATION AND BACKFILL

A. Rock removal and backfilling shall be performed in accordance with the applicable provisions of the Section entitled "Earthwork".

B. The rock excavated which cannot be incorporated into the backfill material, as specified, shall be disposed of as spoil and shall be replaced with the quantity of acceptable material required for backfilling.

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MATERIALS AND PERFORMANCE - SECTION 4

TRENCHING, BACKFILLING AND COMPACTING

MP-4.01 GENERAL

A. Work Specified
   1. Excavation and backfill as required for pipe installation or other construction in the trench in accordance with the applicable provisions of the Section entitled "Earthwork" unless modified herein.
   2. The removal and disposal of water.

B. Related Work Specified Elsewhere
   1. Earthwork
   2. Rock Removal
   3. Selected Fill
   4. Section pertinent to the type of pipe to be installed.
   5. Pipeline Installation
   6. Restoration of Surfaces

MP-4.02 EXCAVATION

A. The trench excavation shall be located as shown on the Contract Drawings or as specified. Under ordinary conditions, excavation shall be by open cut from the ground surface. Where the depth of trench and soil conditions permit, tunneling may be required beneath cross walks, curbs, gutters, pavements, trees, driveways, railroad tracks and other surface structures. No additional compensation will be allowed for such tunneling over the price bid for open cut excavation of equivalent depths below the ground surface unless such tunnel excavation is specifically provided for in the Contract Documents.

B. Trenches shall be excavated to maintain the depths as shown on the Contract Drawings or as specified for the type of pipe to be installed.

C. The alignment and depth shall be determined and maintained by the use of a string line installed on batter boards above the trench, a double string line installed along side of the trench or a laser beam system.

D. The minimum width of trench excavation shall be 6-inches on each side of the pipe hub for 21-inch diameter pipe and smaller and 12-inches on each side of the pipe hub for 24-inch diameter pipe and larger.

E. Trenches shall not be opened for more than 300 feet in advance of pipe installation nor left unfilled for more than 100 feet in

the rear of the installed pipe when work is in progress without the consent of the Engineer. Open trenches shall be protected and barricaded as required.

F. Bridging across open trenches shall be constructed and maintained where required.

MP-4.03 SUBGRADE PREPARATION FOR PIPE

A. Where pipe is to be laid on undisturbed bottom of excavated trench, mechanical excavation shall not extend lower than the finished subgrade elevation at any point.

B. Where pipe is to be laid on special granular material the excavation below subgrade shall be to the depth specified or directed. The excavation below subgrade shall be refilled with special granular material as specified or directed, shall be deposited in layers not to exceed 6-inches and shall be thoroughly compacted prior to the preparation of pipe subgrade.

C. The subgrade shall be prepared by shaping with hand tools to the contour of the pipe barrel to allow for uniform and continuous bearing and support on solid undisturbed ground or embedment for the entire length of the pipe.

D. Pipe subgrade preparation shall be performed immediately prior to installing the pipe in the trench. Where bell holes are required they shall be made after the subgrade preparation is complete and shall be only of sufficient length to prevent any part of the bell from becoming in contact with the trench bottom and allowing space for joint assembly.

MP-4.04 STORAGE OF MATERIALS

A. Traffic shall be maintained at all times in accordance with the applicable Highway Permits. Where no Highway Permit is required at least one-half of the street must be kept open for traffic.

B. Where conditions do not permit storage of materials adjacent to the trench, the material excavated from a length as may be required, shall be removed by the Contractor, at his cost and expense, as soon as excavated. The material subsequently excavated shall be used to refill the trench where the pipe had been built, provided it be of suitable character. The excess material shall be removed to locations selected and obtained by the Contractor.

1. The Contractor shall, at his cost and expense, bring back adequate amounts of satisfactory excavated materials as may be required to properly refill the trenches.

C. If directed by the Engineer, the Contractor shall refill trenches with select fill or other suitable materials and excess excavated materials shall be disposed of as spoil.

MP-4.05 REMOVAL OF WATER AND DRAINAGE

A. The Contractor shall at all times provide and maintain proper and satisfactory means and devices for the removal of all water entering the trench, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work.

B. The removal of water shall be in accordance with the Section entitled "Earthwork".

MP-4.06 PIPE EMBEDMENT

A. All pipe shall be protected from lateral displacement and possible damage resulting from superimposed backfill loads, impact or unbalanced loading during backfilling operations by being adequately embedded in suitable pipe embedment material. To ensure adequate lateral and vertical stability of the installed pipe during pipe jointing and embedment operations, a sufficient amount of the pipe embedment material to hold the pipe in rigid alignment shall be uniformly deposited and thoroughly compacted on each side, and back of the bell, of each pipe as laid.

B. Concrete cradle and encasement of the class specified shall be installed where and as shown on the Contract Drawings or ordered by the Engineer. Before any concrete is placed, the pipe shall be securely blocked and braced to prevent movement or flotation. The concrete cradle or encasement shall extend the full width of the trench as excavated unless otherwise authorized by the Engineer. Where concrete is to be placed in a sheeted trench it shall be poured directly against sheeting to be left in place or against a bond-breaker if the sheeting is to be removed.

C. Embedment materials placed above the centerline of the pipe or above the concrete cradle to a depth of 12-inches above the top of the pipe barrel shall be deposited in such manner as to not damage the pipe. Compaction shall be as required for the type of embedment being installed.

MP-4.07 BACKFILL ABOVE EMBEDMENT

A. The remaining portion of the pipe trench above the embedment shall be refilled with suitable materials compacted as specified.
   1. Where trenches are within the ditch-to-ditch limits of any street or road or within a driveway or sidewalk, or shall be under a structure, the trench shall be refilled in

horizontal layers not more than 8 inches in thickness, and compacted to obtain 95% maximum density, and determined as set forth in the Section entitled "Earthwork".

2. Where trenches are in open fields or unimproved areas outside of the ditch limits of roads, the backfilling may be by placing the material in the trench and mounding the surface.
3. Hand tamping shall be required around buried utility lines or other subsurface features that could be damaged by mechanical compaction equipment.

B. Backfilling of trenches beneath, across or adjacent to drainage ditches and water courses shall be done in such a manner that water will not accumulate in unfilled or partially filled trenches and the backfill shall be protected from surface erosion by adequate means.
   1. Where trenches cross waterways, the backfill surface exposed on the bottom and slopes thereof shall be protected by means of stone or concrete rip-rap or pavement.

C. All settlement of the backfill shall be refilled and compacted as it occurs.

D. Temporary pavement shall be placed as specified in the Section entitled "Restoration of Surfaces".

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MATERIALS AND PERFORMANCE - SECTION 5

SELECTED FILL

MP-5.01 GENERAL

A. Work Specified
   1. Selected fill materials shall be used in either embedment or special backfill as specified or as directed by the Engineer.

B. Related Work Specified Elsewhere
   1. Earthwork
   2. Rock Removal
   3. Structural Excavation, Backfill and Compaction
   4. Trenching, Backfilling and Compaction
   5. Embedment
   6. Restoration of Surfaces

C. Definitions
   1. Embedment or Lining
      a. Any type granular material specified or directed placed below an imaginary line drawn one foot above the inside diameter of the pipe and within the trench limits.
   2. Special Backfill
      a. Pipelines
         Any selected fill material specified or directed placed above an imaginary line drawn one foot above the inside diameter of the pipe and within the trench limits.
      b. Structures
         Any selected fill material specified or directed placed within the excavation limits, either in, under or adjacent to the structure.
   3. Special Granular Material
      a. Special granular material shall mean any of the granular materials listed below or other materials ordered by the Engineer.

MP-5.02 SUBMITTALS

A. The name and location of the source of the material.

B. Samples and test reports of the material.

MP-5.03 GRANULAR MATERIALS

A. Type A

1. Crushed Gravel

Thoroughly washed crushed, durable, sharp angled fragments of gravel free from coatings. Crushed particles shall be a minimum of 85% by weight of the particles with at least two fractured faces. The total area of each fractional face shall exceed 25% of the maximum cross-sectional area of the particle.

Crushed gravel shall have the following gradation by weight:

% Passing	Sieve
100%	1-1/2-inch
0-25%	3/4-inch
0-5%	1/2-inch

B. Type B

1. Crushed Stone

Thoroughly washed clean, sound, tough, hard crushed limestone or approved equal free from coatings. Gradation for crushed stone shall be the same as specified for Type A material.

C. Type C

1. Crushed Stone

Thoroughly washed, clean, sound, tough, hard, crushed limestone or approved equal free from coatings. It shall have a gradation by weight of 100% passing a one-inch square opening and 0 - 15% passing a 1/4-inch square opening.

D. Type D

1. Washed Sand

Washed coarse sand having the following gradation by weight:

% Passing	Sieve
100	3/8-inch
95 - 100	No. 4
80 - 100	No. 8
50 - 85	No. 16
25 - 60	No. 30
10 - 30	No. 50
2 - 10	No. 100

E. Type E
   1. Run-of-Bank Gravel
      Run-of-bank gravel or other acceptable granular material free from organic matter with a gradation by weight of 100% passing a 1-1/2 inch square opening, 30 to 65% passing a 1/4 inch square opening and not more than 10% passing a No. 200 mesh sieve as determined by washing through the sieve in accordance with ASTM D422.

F. Type F
   1. Run-of-crusher Stone
      Run-of-crusher hard durable limestone or approved equal having the following gradation by weight:

% Passing	Square Opening (inches)
100	1-1/2
95 - 100	1
65 - 80	1/2
40 - 60	1/4
0 - 10	#200 Sieve

G. Type G
   1. A mixture of Type E material and Portland cement mixed in a ratio of 15:1 and placed and compacted in a dry state.

H. Type H
   1. A specially blended mixture of materials as specified in the Payment Items.

MP-5.04 INSTALLATION

A. Special granular material as specified or directed for pipeline embedment shall be placed in accordance with the Section entitled "Trenching, Backfilling and Compacting".

B. Special backfill where specified or directed shall be placed in accordance with the backfilling provisions of the Section entitled "Trenching, Backfilling, and Compacting", and the Section entitled "Earthwork".

MP-5.05 DISPOSAL OF DISPLACED MATERIALS

A. Materials displaced through the use of the above materials shall be wasted or disposed of by the Contractor and the cost of such disposal shall be included in the unit price bid for each of the materials.

MP-5.06 SETTLEMENTS

A. Any settlements in the finished work shall be made good by the Contractor at his cost and expense.

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MATERIALS AND PERFORMANCE - SECTION 7

EMBANKMENT

MP-7.01 GENERAL

A. Work Specified

1. Earth embankments shall be constructed to established lines and grades at the locations shown on the Contract Drawings and as directed by the Engineer. Embankment materials shall be obtained from acceptable soils on the site, or approved off-site sources.
2. Embankment material shall be free from frost, stumps, trees, roots, sods, muck, mari, vegetable matter or other unsuitable material and shall be suitable for compaction as described in the following provisions. Where embankments are to be placed underwater only acceptable granular materials shall be used.
3. Embankments shall be constructed to such elevations as to make allowance for any settlement that may occur. Prior to the construction of any structure, roadway or other ground feature and before final acceptance of the contract, the Contractor shall regrade the embankments to conform to the established lines and grades.

B. Related Work Specified Elsewhere

1. Earthwork
2. Restoration of Surfaces
3. Topsoil and Seeding

MP-7.02 TESTING

A. All testing, including field and laboratory services, shall be at the Contractor's expense without additional compensation, except where separate payment is specified.

MP-7.03 SUBMITTALS

A. Proposed testing laboratory

B. Source of off-site materials

C. Compaction curves for all materials to be used.

MP-7.04 PREPARATION OF SUBGRADE

A. The entire surface to be covered with embankment shall be grubbed and stripped of all grass, vegetation, topsoil, rubbish, or other unsuitable materials before any embankment material is placed.

1. Topsoil shall be stockpiled or placed as designated.
2. Other grubbed and stripped materials shall be removed as spoil.

B. Stripped or excavated surfaces on which embankments are to be placed shall be compacted to the required density of the embankment prior to any fill being placed.

MP-7.05 PLACEMENT AND COMPACTION

A. Materials shall be placed in lifts not greater than 8 inches of thickness unless greater thicknesses are allowed by the Engineer upon demonstration by the Contractor that the materials and compaction efforts are adequate to obtain the required density.

B. Material shall be placed in a uniform lift and thoroughly compacted by compaction equipment suitable for the material encountered to obtain the required density prior to the placement of succeeding lift.
1. Each lift shall be tested for proper compaction before successive lifts are applied.

C. Stones shall not exceed 6 inches in greatest dimension and shall be well distributed throughout the soil mass. Stone shall be defined as rock material either in its natural or broken state.

D. Stones not well mixed with soil material shall not be used in earth embankments unless the stone material is sufficiently deteriorated or friable so as to be compactible to achieve minimum voids and required density.

E. If the required density is not obtained, compaction of the embankment shall continue until specified densities are obtained, before any additional embankment is placed. Improperly compacted embankment shall be removed.

F. Where required, the Contractor shall, at his expense, add sufficient water during the compaction effort to assure proper density. If, due to rain or other causes, the material exceeds the optimum moisture content for satisfactory compaction, it shall be allowed to dry, assisted by discing or harrowing, if necessary, before compaction or filling effort is resumed.

G. The Contractor shall be required to seal the working surface at the close of each day's operation and when practical prior to rainfall. Sealing shall be accomplished by rolling the surface with a smooth wheel steel roller.

H Compaction or consolidation achieved by travelling trucks, machines and other equipment will not be accepted unless such procedures are approved by the Engineer and proper compaction density is achieved.

I. Hand tamping shall be required around buried utility lines or other subsurface features that could be damaged by mechanical compaction equipment.

MP-7.06 DENSITY CONTROL

A. Embankments shall be compacted to 90% of maximum dry density as determined by the density tests designated in ASTM D 698, Method D.
   1. Compaction curves for the full range of soil materials to be used in the embankment shall be developed by an approved independent testing laboratory.

B. Field control samples shall be taken and tested by the testing laboratory as required to assure that adequate compaction of the embankment material is being achieved.

C. A minimum of one (1) in-place density test shall be made for every 10,000 square feet of compacted area per lift.
   1. In-place density of soils shall be determined by the methods described in ASTM D 1556 or ASTM D 2922 and expressed as a percentage of the maximum dry density.

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MATERIALS AND PERFORMANCE - SECTION 8

RESTORATION OF SURFACES

MP-8.01 GENERAL

A. Work Specified
   1. All types of surfaces, sidewalks, curbs, gutters, culverts and other features disturbed, damaged or destroyed during the performance of the work under or as a result of the operations of the Contract, shall be restored and maintained, as specified herein or as modified or described in the Special Provisions.
   2. The quality of materials and the performance of work used in the restoration shall produce a surface or feature equal to the condition of each before the work began.

B. Related Work Specified Elsewhere
   1. Earthwork
   2. Structural Excavation, Backfill and Compaction
   3. Trenching, Backfilling and Compacting
   4. Embankment
   5. Topsoil and Seeding
   6. Concrete

MP-8.02 SCHEDULE OF RESTORATION

A. A schedule of restoration operations shall be submitted by the Contractor for review.
   1. After an accepted schedule has been agreed upon it shall be adhered to unless otherwise revised with the approval of the Engineer.

B. In general, permanent restoration of paved surfaces will not be permitted until one months' time has elapsed after excavations have been completely backfilled as specified. A greater length of time, but not more than nine months may be allowed to elapse before permanent restoration of street surfaces is undertaken, if additional time is required for shrinkage and settlement of the backfill.

C. The replacement of surfaces at any time, as scheduled or as directed, shall not relieve the Contractor of responsibility to repair damages by settlement or other failures.

MP-8.03 TEMPORARY PAVEMENT

A. Immediately upon completion of refilling of the trench or excavation, the Contractor shall place a temporary pavement over all disturbed areas of streets, driveways, sidewalks, and other traveled places where the original surface has been disturbed as a result of his operations.

B. Unless otherwise specified or directed the temporary pavement shall consist of compacted run-of-crusher limestone to such a depth as required to withstand the traffic to which it will be subjected.

C. Where concrete pavements are removed, the temporary pavement shall be surfaced with "cold patch". The surface of the temporary pavement shall conform to the slope and grade of the area being restored.

D. For dust prevention, the Contractor shall treat all surfaces, not covered with cold patch, as frequently as may be required.

E. The temporary pavement shall be maintained by the Contractor in a safe and satisfactory condition until such time as the permanent paving is completed. The Contractor shall immediately remove and restore all pavement as shall become unsatisfactory.

MP-8.04 PERMANENT PAVEMENT REPLACEMENT

A. The permanent and final repaving of all streets, driveways and similar surfaces where pavement has been removed, disturbed, settled or damaged by or as a result of performance of the Contract shall be repaired and replaced by the Contractor, by a new and similar pavement.
   1. The top surface shall conform with the grade of existing adjacent pavement and the entire replacement shall meet the current specifications of the local community for the particular types of pavement.
   2. Where the local community has no specification for the type of pavement, the work shall be done in conformity with the State Department of Transportation Standard which conforms the closest to the type of surfacing being replaced, as determined by the Engineer.

MP8.05 PREPARATION FOR PERMANENT PAVEMENT

A. When scheduled and within the time specified, the temporary pavement shall be removed and a base prepared, at the depth required by the local community or Highway Permit, to receive the permanent pavement.
   1. The base shall be brought to the required grade and cross-section and thoroughly compacted before placing the permanent pavement.
   2. Any base material which has become unstable for any reason shall be removed and replaced with compacted base materials.

B. Prior to placing the permanent pavement all service boxes, manhole frames and covers and similar structures within the area shall be adjusted to the established grade and cross-section.

C. The edges of existing asphalt pavement shall be cut a minimum of one foot beyond the excavation or disturbed base whichever is greater.
   1. All cuts shall be parallel or perpendicular to the centerline of the street.

MP-8.06 ASPHALT PAVEMENT

A. The permanent asphalt pavement replacement for streets, driveways and parking area surfaces shall be replaced with bituminous materials of the same depth and kind as the existing unless otherwise specified.

B. Prior to placing of any bituminous pavement a sealer shall be applied to the edges of the existing pavement and other features.

C. The furnishing, handling and compaction of all bituminous materials shall be in accordance with the State Department of Transportation Standards.

MP-8.07 CONCRETE PAVEMENT AND PAVEMENT BASE

A. Concrete pavements and concrete bases for asphalt, brick or other pavement surfaces shall be replaced with Class "B" Concrete, air-entrained.

B. Paving slabs or concrete bases shall be constructed to extend one foot beyond each side of the trench and be supported on undisturbed soil. Where such extension of the pavement will leave less than two feet of original pavement slab or base, the repair of the pavement slab or base shall be extended to replace the slab to the original edge of the pavement or base unless otherwise indicated on the Contract Drawings.

C. Where the edge of the pavement slab or concrete base slab falls within the excavation, the excavation shall be backfilled with Special Backfill compacted to 95% maximum dry density as determined by ASTM D 698 up to the base of the concrete.

D. The new concrete shall be of the same thickness as the slab being replaced and shall contain reinforcement equal to the old pavement.
   1. New concrete shall be placed and cured in accordance with the applicable provisions of the State Department of Transportation Standards.

MP-8.08 STONE OR GRAVEL PAVEMENT

A. All pavement and other areas surfaced with stone or gravel shall be replaced with material to match the existing surface unless otherwise specified.

1. The depth of the stone or gravel shall be at least equal to the existing.
2. After compaction the surface shall conform to the slope and grade of the area being replaced.

MP-8.09 CONCRETE WALKS, CURBS AND GUTTER REPLACEMENT

A. Concrete walks, curbs and gutters removed or damaged in connection with or as a result of the construction operations shall be replaced with new construction.
   1. The minimum replacement will be a flag or block of sidewalk and five feet of curb or gutter.

B. Walks shall be constructed of Class "B" concrete, air-entrained with NYSDOT #1 stone aggregate on a 4-inch base of compacted gravel or stone.
   1. The walk shall be not less than 4 inches in thickness or the thickness of the replaced walk where greater than 4 inches, shall have construction joints spaced not more than 25 feet apart, shall have expansion joints spaced not more than 50 feet apart and shall be sloped at right angles to the longitudinal centerline approximately 1/8 inch per foot of width.

C. One-half inch expansion joint material shall be placed around all objects within the sidewalk area as well as objects to which the new concrete will abut, such as valve boxes, manhole frames, curbs, buildings and others.

D. Walks shall be hand-floated and broom-finished, edged and grooved at construction joints and at intermediate intervals matching those intervals of the walk being replaced.
   1. The intermediate grooves shall be scored a minimum of 1/4 of the depth of the walk.
   2. The lengths of blocks formed by the grooving tool, and distances between construction and expansion joints shall be uniform throughout the length of the walk in any one location.

E. The minimum length of curb or gutter to be left in place or replaced shall be 5 feet. Where a full section is not being replaced, the existing curb or gutter shall be saw cut to provide a true edge.
   1. The restored curb or gutter shall be the same shape, thickness and finish as being replaced and shall be built of the same concrete and have construction and expansion joints as stated above for sidewalks.

F. All concrete shall be placed and cured as specified in the Section for concrete.

MP-8.10 LAWNS AND IMPROVED AREAS

A. The area to receive topsoil shall be graded to a depth of not less than 4 inches or as specified, below the proposed finished surface.
   1. If the depth of existing topsoil prior to construction was greater than 4 inches, topsoil shall be replaced to that depth.

B. The furnishing and placing of topsoil, seed and mulch shall be in accordance with the Section entitled "Topsoil and Seeding".

C. When required to obtain germination, the seeded areas shall be watered in such a manner as to prevent washing out of the seed.

D. Any washout or damage which occurs shall be regraded and reseeded until a good sod is established.

E. The Contractor shall maintain the newly seeded areas, including regrading, reseeding, watering and mowing, in good condition.

MP-8.11 CULTIVATED AREA REPLACEMENT

A. Areas of cultivated lands shall be graded to a depth to receive topsoil of not less than the depth of the topsoil before being disturbed. All debris and inorganic material shall be removed prior to the placing of the topsoil.

B. The furnishing and placing of topsoil shall be in accordance with the Section entitled "Topsoil and Seeding".

C. After the topsoil has been placed and graded, the entire area disturbed during construction shall be cultivated to a minimum depth of 12 inches with normal farm equipment.
   1. Any debris or inorganic materials appearing shall be removed.
   2. The removal of stones shall be governed by the adjacent undisturbed cultivated area.

D. Grass areas shall be reseeded using a mixture equal to that of the area before being disturbed, unless otherwise specified.

MP-8.12 OTHER TYPES OF RESTORATION

A. Trees, shrubs and landscape items damaged or destroyed as a result of the construction operations shall be replaced in like species and size.
   1. All planting and care therof shall meet the standards of the American Association of Nurserymen.

B. Water courses shall be reshaped to the original grade and cross-section and all debris removed. Where required to prevent erosion, the bottom and sides of the water course shall be protected.

C. Culverts destroyed or removed as a result of the construction operations shall be replaced in like size and material and shall be replaced at the original location and grade. When there is minor damage to a culvert and with the consent of the Engineer, a repair may be undertaken, if satisfactory results can be obtained.

D. Should brick pavements be encountered in the work, the restoration shall be as set forth in the Special Provisions or as directed.

MP-8.13 MAINTENANCE

A. The finished products of restoration shall be maintained in an acceptable condition for and during a period of one year following the date of Substantial Completion or other such date as set forth elsewhere in the Contract Documents.

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MATERIALS AND PERFORMANCE - SECTION 61

VAULTS AND INLETS

MP-61.01 GENERAL

A. Work Specified

1. Valve and meter vaults, catch basins, curb inlets, surface water inlets, and similar structures, complete with frames and covers, manhole steps and appurtenances as shown on the Contract Drawings.

B. Related Work Specified Elsewhere

1. Concrete

C. Applicable Codes, Standards and Specifications

1. American Society for Testing and Materials (ASTM)

MP-61.02 SUBMITTALS

Prior to any field construction, the Contractor shall submit for review drawings and conformance data for materials to be used in the construction of vaults and inlets.

MP-61.03 MATERIALS

A. Concrete

1. Cast-in-place concrete for vaults and inlets shall be as specified under the Section entitled "Concrete".
2. Precast concrete sections shall be in accordance with ASTM C478 for manhole sections and ASTM C913 for other structures with a minimum wall thickness of 5 inches. Top sections shall withstand H-20 wheel loads and shall be of the type shown.

   a. Bell and spigot joints of precast sections shall have an appropriate "O" ring supplied by the manufacture or other types of joints as shown on the Contract Drawings.

B. Masonry Units

1. Brick shall meet the requirements of ASTM C-62, Grade SW and shall be of a hard-burned manufacture.

2. Concrete blocks shall conform to the requirements of ASTM C139 and shall be solid and of the size shown on the Contract Drawings.

C. Mortar

Masonry cement for mortar shall meet the requirements of ASTM C 91, Type II and shall be mixed with a graded quality sand conforming to ASTM C 144.

Mix shall be 1 part masonry cement to 3 parts sand using the minimum amount of clean water required for workability.

D. Castings

1. Frames and covers, grates, inlets, and other castings shall be as shown on the Contract Drawings and be in accordance with ASTM A 48, Class 30. All castings shall be manufactured to withstand H-20 wheel loads. Lettering shall be "Storm Sewers" or other appropriate designation cast as directed. Frames and covers shall have machined bearing surfaces.

2. Steps shall be manhole steps manufactured of cast iron in accordance with ASTM A 48, Class 30 or others acceptable to the Engineer.
   a. **Steps shall have a minimum tread width of 12 inches.**

MP-61.04 INSTALLATION

A. Precast Sections

1. Precast section shall be installed level on a flat stable subgrade. Where an unstable condition exists, the Contractor shall excavate the unstable material and replace with compacted granular material.

2. All joints shall be filled inside and out with mortar to provide a smooth and continuous surface.

B. Benchwalls and Inverts

Mortar surfaces of benchwalls and concrete floors shall be given a broom finish. Where inverts are required they shall be lined with a half section of pipe of the same type used for the sewer or shall be constructed of Class "C" concrete, shaped and troweled to produce a smooth circular cross-section.

C. Frames and Castings

Frames and castings shall be set in a full bed of mortar a maximum of 1/2" thick. Where required to adjust the frames and castings to grade there shall be installed to a maximum of four brick courses.

D. Steps

1. Steps shall be installed in vertical alignment spaced 12-inches on center.

2. In concrete sections the steps shall be cast into the section or secured with cadmium plated bolts to threaded inserts which are precast into the concrete.

3. In masonry construction the steps shall be built into the masonry walls.

E. Plastering

1. Plaster shall be with mortar not less than 1/2-inch thick and troweled smooth.

2. Outside of masonry structures.

3. Inside and outside of brick courses under frames and castings.

F. Sumps

Sumps of the size specified shall be built into the floors of vaults and similar structures. Floors shall be sloped to the sump.

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MATERIALS AND PERFORMANCE - SECTION 63

PRECAST CONCRETE MANHOLES

MP-63.01 GENERAL

A. Work Specified

Precast manholes of the type scheduled with construction as shown on the Standard Details for Manholes. All manholes shall consist of the combination of base and barrel sections resulting in the fewest number of joints.

B. Applicable Codes, Standards and Specifications

1. American Society for Testing and Materials (ASTM)

MP-63.02 SUBMITTALS

A. Prior to any field construction, the Contractor shall submit for review drawings and conformance data for manhole sections, slabs, steps, frames and covers, location and size of base section opening and manhole step locations.

MP-63.03 MATERIALS

A. Manhole Sections

1. Precast concrete pipe sections and slabs shall be constructed and reinforced in accordance with ASTM C478, with a minimum wall thickness of 5 inches and with joints having an "O" ring seal.

   a. Manhole sections shall be waterproofed with bituminous material on the exterior.

2. Base sections shall have reinforced flat bottoms protruding 6 inches beyond the outside face of the riser section. The flat bottoms shall be:

   a. Minimum of 6 inch thickness for risers up to and including 48 inch diameter.

   b. Minimum of 8 inch thickness for risers of larger diameter.

3. Each opening in the base section for sewers up to and including 20 inch diameter shall contain a flexible rubber connection installed by the manufacturer of the base section.

   a. Openings for drop inlet pipes are excepted from this requirement.

b. Flexible rubber connectors shall be

1) KOR-N-SEAL
2) Lock Joint Flexible Manhole Sleeve
3) Or equal

4. Top sections, tapered or flat, shall be adequate to withstand H-20 wheel loads. All top sections shall have concentric or eccentric opening as specified or shown for the type of manhole. The edge of eccentric openings for flat top sections shall be a maximum of 2 inches from the inside wall of the barrel section.

B. Manhole Steps

1. Steps for manholes shall be cast iron, ASTM A48, Class 30 or others acceptable to the Engineer.

2. Steps shall be installed in each manhole in vertical alignment spaced 12-inches on center and shall be placed over the largest benchwall of the manhole.

3. Steps shall have a minimum tread width of 12-inches and shall be precasted into the manhole sections or other methods of installation with prior acceptance of the Engineer.

C. Frames and Covers

1. Manhole frames and covers shall be in accordance with ASTM A-48, Class 30, and as listed by the following manufacturers, or equal.

Syracuse Castings:	24" Nominal Casting No. 1255-B
	36" Nominal Casting No. 1024
Neenah Castings:	24" Nominal Casting No. R-1780
	36" Nominal Casting No. R-1744

2. Covers shall be provided with a minimum of two watertight pickholes and shall be solid unless otherwise noted. Frames and covers shall be adequate to bear H-20 wheel loads and shall be provided with machined bearing surfaces. Lettering shall be either "Sanitary Sewer" or "Storm Sewer", depending on the use, unless otherwise directed. When required for bolting, holes shall be provided in the frames.

D. Mortar and Bricks

1. Masonry cement for mortar shall meet the requirements of ASTM C91, Type II and shall be mixed with a graded quality sand conforming to ASTM C144. Mix shall be 1 part masonry cement to 3 parts sand using the minimum amount of clean water required for workability.

2. Brick shall meet the requirements of ASTM C62, Grade SW of a hard-burned manufacture.

E. Observation Pipe

1. Each manhole base section shall have a 3/4-inch diameter rigid plastic pipe installed through the wall one foot above the top of the lowest pipe opening.

2. The pipe shall have a threaded plastic plug or cap on the inside end.

3. The outside end shall be encased in 1 cubic foot of clean gravel.

MP-63.04 DROP MANHOLES - SPECIAL CONSTRUCTION

A. Type D or H manholes shall be constructed in accordance with the Standard Detail as follows:

1. The polyvinyl chloride (PVC) pipe and fittings shall meet the requirements of ASTM D-3034. Joints shall be solvent welded except for those installed vertically. The drop section, tee and nipple shall be of the same diameter as the influent sewer up to the maximum of 12-inches in diameter. For influent sewers over 12-inches in diameter, a 12-inch branch tee, nipple and drop section shall be used.

2. The PVC nipple and the influent sewer shall be joined with a flexible coupling which shall be Tylox o-Dapter, Band Seal Rubber Adapter, or equal. Tee shall be plugged with a removable plug consisting of two conical aluminum discs, a rubber compression gasket and a permanently extended operating handle. The plug shall provide a watertight seal as the gasket is forced against the pipe wall by drawing the aluminum discs together with the operating handle. The operating handle shall be coated to protect against corrosion.

3. The opening in the manhole barrel for the drop inlet does not require a flexible pipe connector. A watertight seal shall be made between the manhole wall and PVC inlet pipe using a universal compression type annular space sealer constructed of hard rubber links, joined together by bolts of corrosion resistant plated carbon steel or other type seal acceptable to the Engineer. The rubber link material shall remain flexible and be resistant to water and chemical action.

MP-63.05 INSTALLATION

A. Precast manhole bases shall be installed level on a flat stable subgrade. Where an unstable condition exists, the Contractor

shall excavate the unstable material and replace with compacted granular material.

B. All joints on the inside and outside of the manhole shall be filled with mortar to provide a smooth and continuous surface.

C. Manhole inverts shall be lined with a half section of pipe of the same type and size as the pipe used for the sewer or shall be constructed of Class C concrete, shaped and troweled to produce a smooth circular cross-section. Manholes having sewer intersections of less than 90° shall have the alignment of a Type "A" benchwall as shown on Standard Detail SD-10. Benchwalls shall have a slope of 1/2" on 12" and the mortar surface shall be given a broom finish.

D. Mortar beds for brick or manhole frames shall be a maximum thickness of 1/2 inch.

E. Manhole frames for Type E & I manholes shall set on a bed of mortar and be bolted to the flat slab top with 4-3/4-inch bolts evenly spaced around the frame using concrete expansion anchors. For other types of manholes, the Contractor shall furnish and install up to a maximum of four brick courses as required to adjust the frames to grade. The brick courses shall be plastered with 1/2" minimum of cement mortar inside and out.

F. In drop manholes Type D or H, the space sealer between the manhole wall and PVC inlet pipe shall be assembled with the heads of the bolts on the inside of the manhole.

MP-63.06 MARKERS

A. Unless otherwise specified, two (2) 2" x 4" markers shall be placed adjacent to each completed manhole except those installed in roadways. The markers shall be buried in the ground a minimum of 6 feet and shall extend above the top of the manhole a minimum of 2 feet.

B. The portion of the marker extending above the ground shall be painted green.

MP-63.07 TESTING

A. Each sanitary sewer manhole shall be tested in accordance with the Section entitled "Leakage Tests".

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MATERIALS AND PERFORMANCE

SECTION 70 - PIPELINE INSTALLATION

MP-70.01 GENERAL

A. Work Specified

1. All metallic and non-metallic pipe, fittings and specials of the type and quality as shown in the pipe schedule or on the Contract Drawings and as specified for the pipe.

B. Related Work Specified Elsewhere

1. Trenching, Backfilling and Compacting
2. Selected Fill
3. **Section pertinent to the type of pipe** to be installed
4. Pipe Hangers and Supports
5. Leakage Tests
6. Chlorination

MP-70.02 MATERIALS

A. Pipe

1. Materials for the piping, joints and fittings shall be as specified in the Section for the type of pipe to be installed, shown in the pipe schedule or on the Contract Drawings.

    a. Pipe and appurtenances shall comply with the applicable standards for its type of material.

B. Joints

1. Type of joints shall be as scheduled in the pipe schedule or as shown or noted on the Contract Drawings.

2. Grooved and shoulder type joints of the rigid design may be used in lieu of flanged joints on ductile iron or steel pipe with the prior acceptance of the Engineer.

C. Inspection

1. Pipe and appurtenances shall be inspected by the Contractor on delivery and prior to installation for conformance with the standards and specifications.

    a. Materials not conforming to the standards and specifications shall not be stored on site but removed at once and replaced with material conforming to the specifications.

MP-70.03 SUBMITTALS

A. Test reports, certifications, shop drawings and samples are required as set forth in the sub-section entitled "Submittals" for the type of pipe to be installed.

B. Layout drawings are required for pipelines to be installed within structures showing the location including the support system, sleeves and appurtenances.

MP-70.04 INSTALLATION - UNDERGROUND

A. General

1. Excavation and backfilling shall be in accordance with the applicable provisions of the Section entitled "Trenching, Backfilling and Compacting".

2. Blocking will not be permitted under pipe, except where the pipe is to be laid with concrete cradle or encasement.

3. No pipe shall be laid upon a foundation in which frost exists; nor at any time when there is danger of the formation of ice or the penetration of frost at the bottom of the excavation.

4. Temporary bulkheads shall be placed in all open ends of pipe whenever pipe laying is not actively in process. The bulkheads shall be designed to prevent the entrance of dirt, debris or water.

5. Precautions shall be taken to prevent the flotation of the pipe in the event of water entering the trench.

B. Location and Grade

1. Pipelines and appurtenances shall be located as shown on the Contract Drawings or as directed and as established from the control survey in accordance with the Special Provisions.

2. The alignment and grades shall be determined and maintained by a method acceptable to the Engineer.

C. Subgrade

The subgrade for pipelines shall be earth or special embedment as specified or directed and shall be prepared in accordance with the Section entitled "Trenching, Backfilling and Compacting".

D. Joints

1. Joints shall be assembled using gaskets, lubricants and solvents as furnished by the pipe manufacturer and in accordance with the manufacturer's recommendations.

E. Embedment

1. Embedment shall be deposited and compacted in accordance with the Section entitled "Trenching, Backfilling and Compacting", and the Section for the type of pipe being installed and shall be one of the embedments shown below unless otherwise specified or directed.

2. Type "A" Embedment

Pipe of
- Asbestos Cement
- Cast Iron Soil
- Copper
- Corrugated Steel
- Ductile Iron
- Reinforced Concrete
- Prestressed Concrete
- Vitrified Clay
- Wrought Steel.

a. The embedment shall be native material excavated from the trench, which is acceptable to the Engineer, containing no stones larger than 1-1/2 inches in size or debris.

b. It shall be deposited and tamped in 6-inch layers to the centerline of the pipe.

c. Native material placed above the centerline of the pipe to a depth of 12 inches above the pipe shall be deposited in such manner as to not damage the pipe.

d. When specified or directed, Selected Fill material shall be used in lieu of the native material for a or c above.

3. Type "B" Embedment

Pressure Pipe of
- Fiberglass
- Polyvinyl Chloride
- Steel
- Thermal Plastic

a. The embedment shall consist of compacted Type "F" granular material placed from a depth of 4" below the pipe to the centerline of the pipe.

1) It shall be deposited and hand-compacted in 6-inch maximum layers.

b. From the centerline to the top of the pipe the embedment shall be native material excavated from the trench, which is acceptable to the Engineer, containing no stones larger than 1-1/2" in size and shall be lightly compacted.

c. From the top of the pipe to one foot above the pipe, acceptable native material shall be deposited in such manner as to not damage the pipe.

d. When the native material under b or c above is not acceptable, to the Engineer, Selected Fill materials shall be used.

4. Type "C" Embedment

Non-pressure pipe of Fiberglass
Polyvinyl chloride
Thermal Plastic

a. The embedment shall consist of compacted Type "F" granular materials placed from a depth of 4" below the pipe to a depth of 12" over the pipe.

1) It shall be deposited and hand-compacted in 6-inch maximum layers.

F. Thrust Restraints

1. Pressure pipelines shall have thrust restraints in the form of thrust blocks, tie rods, or anchors of the size and type specified or as required by the pressure and stability of the supporting surface.

a. Thrust restraints shall be installed at all changes in direction, changes in size, dead ends or other locations where shown.

b. Thrust restraints shall be in place, and when of concrete (Class C) shall have developed the required strength, prior to testing of the pipeline.

c. Tie rods and nuts for thrust restraints shall be of high tensile steel and shall have a minimum yield strength of 70,000 psi.

1. Tie rods and nuts installed underground shall be coated with two coats of coal tar pitch preservative coating after installation.

G. Service Connections

1. Connections to in-service pressure pipelines shall be in accordance with the applicable provisions of the Section entitled "Tapped Connections".

2. Connections to sewers shall be saddle, wye or tee branches as specified.

   a. Saddle and wye branches shall be installed, in general, so that the top of the branch is at the top of the pipe.

3. Laterals of the kind and size of pipe as specified shall be installed as shown, specified or directed.

   a. Bends, as required, shall be used between the connection and the lateral, to obtain the correct slope and to allow the horizontal angle of the lateral to be at 90 degrees to the main line or other angle as specified or directed.

   b. Minimum slope for a lateral shall be 1/4 inch per foot.

   c. Maximum slope for a lateral shall be 2 feet per foot unless otherwise specified.

   d. Each lateral having a slope of 1 foot per foot or greater shall have a concrete cradle which shall be Class C concrete and shall be placed 6" each side of and from a depth of 3" below to the centerline of the lateral pipe.

   e. Laterals specified to exceed the maximum slope shall be supported to prevent excessive load being applied to the main line pipe.

   f. The end of each connection or lateral shall be sealed by means of a removable watertight plug as shown on the Contract Drawings.

   g. The end of each connection or lateral shall have a 2 x 4 inch marker extending vertically from the stopper to 3 feet above the ground surface. The portion of the marker extending above the ground shall be painted green.

4. Connections and ends of laterals shall not be backfilled until a record has been made of the "as-built" location of each.

H. Connection to Existing Structures or Manholes

1. Where a stub has been provided the connection shall be made to the existing pipe.

2. Where no stub has been provided, the Contractor shall make an opening for inserting the connecting pipe.

a. When specified, a sleeve shall be installed and a watertight joint formed.

1) The carrier pipe shall be installed in the sleeve and the joint made watertight.

b. Where no sleeve is specified, the space between the pipe and the wall of the structure or manhole shall be made watertight.

c. A joint shall be in the pipe at or within 5 feet of a structure or manhole.

d. A channel shall be built or the existing channel revised, to direct the flow from or into the new pipe.

e. Care shall be taken to avoid damage to the existing structure or manhole and to prevent debris from entering any existing channel. Any damage shall be repaired and debris removed.

MP-70.05 INSTALLATION - EXPOSED

A. Exposed pipelines shall be carefully erected and neatly arranged.

1. Run parallel to wall of structures

B. Supports and anchors shall be adequate to support the pipe filled with water with a minimum safety factor of 5 and for the test pressure specified.

C. Special supports shall be as specified in the Section for the type of pipe being installed.

MP-70.06 FINAL INSPECTION OF SEWERS

A. Each section of pipe between manholes shall be inspected before final acceptance.

1. In larger pipelines the inspection shall be by traversing the inside of the pipe.

2. In smaller pipelines the inspection shall be by observation with illumination.

3. Where specified, the inspection shall be by closed circuit television.

a. Shall be monitored by both the Engineer and the Contractor.

B. The inspection shall determine the pipeline to be true to line and grade, to show no leaks, to have no obstruction to flow, to have no projections or protruding of connecting pipes or joint materials, shall be free from cracks and shall contain no deposits of sand, dirt or other materials.

C. All deficiencies located during the inspection shall be corrected.

MP-70.07 CUTTING AND SPECIAL HANDLING

A. Field cuts of pipes shall be in accordance with the manufacturer's instructions.

B. Where a pipe requires special handling or installation it shall be in accordance with the Section for that type of pipe.

MP-70.08 FLEXIBLE COUPLINGS

Flexible couplings shall be provided where shown or scheduled and shall be in accordance with the Section entitled "Flexible Pipe Couplings".

MP-70.09 WALL CASTINGS AND SLEEVES

All pipelines passing through walls, floors or slabs of structures shall be installed in a wall casting or sleeve. The wall castings and sleeves shall be in accordance with the Section entitled "Wall Castings and Sleeves".

MP-70.10 LEAKAGE TEST

A. All pipelines shall be tested for leakage in accordance with the Section entitled "Leakage Test".

MP-70.11 CHLORINATION

A. All pipelines designed to convey potable water shall be chlorinated in accordance with the Section entitled "Chlorination".

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MATERIALS AND PERFORMANCE - SECTION 71

LEAKAGE TESTS

MP-71.01 GENERAL

A. Work Specified

1. Testing of all hydraulic structures, pressure and non-pressure piping for leakage as specified.

   a. The Contractor shall furnish all labor, equipment, test connections, vents, water and materials necessary for carrying out the pressure and leakage tests.

2. All testing shall be witnessed by the Engineer.

MP-71.02 LEAKAGE TESTS FOR STRUCTURES

A. Tanks, vaults, wells and other fluid containing structures, (excluding manholes) shall be tested before backfilling by filling the structure with water to overflowing, or other level as may be directed by the Engineer, and observing the water surface level twenty-four hours thereafter.

1. When testing absorbent materials such as concrete, the structure shall be filled with water at least 24 hours before the test is started.

B. The exterior surface, especially at the construction joint, will be inspected for leakage during and upon completion of the twenty-four hour test.

1. Leakage will be considered to be within the allowable limits when there is no visible sign of leakage on the exterior surface and where the water surface does not drop except as associated with evaporation.

2. A slight dampness on the exterior wall surface during the test period will not be considered as leakage, except in the case of prestressed concrete structures.

MP-71.03 TESTS ON PRESSURE PIPING FOR TRANSPORT OF WATER OR SEWAGE

A. General

1. Pipelines designed to transport water or sewage under pressure shall be tested hydrostatically and for leakage prior to being placed in service.

2. The length of piping and sections included in the tests shall meet the approval of the Engineer.

3. Equipment in or attached to the pipes being tested shall be protected. Any damage to such equipment during the test shall be repaired by the Contractor at his expense.

4. When piping is to be insulated or concealed in a structure, tests shall be made before the pipe is covered.

5. All fittings, hydrants and appurtenances must be properly braced and harnessed before the pressure is applied. Thrust restraining devices which will become a part of the system must also be tested at the test pressure.

6. When testing absorbent pipe materials such as asbestos cement or concrete, the pipeline shall be filled with water at least 24 hours before the test is made.

7. If the line fails the test, the Contractor shall explore for the cause of the excessive leakage and after repairs have been made the line shall be retested. This procedure shall be repeated until the pipe complies.

B. Pressure Test

1. Test pressure shall be as scheduled or, where no pressure is scheduled, at 150 psi.

2. Test pressure shall be held on the piping for a period of at least 2 hours, unless a longer period is requested by the Engineer.

C. Leakage Test

1. The leakage test shall be conducted concurrently with the pressure test.

2. The rate of leakage shall be determined at 15 minute intervals by means of volumetric measurement of the makeup water added to maintain the test pressure. The test shall proceed until the rate of leakage has stabilized or is decreasing below an allowable value, for three consecutive 15 minute intervals. After this, the test pressure shall be maintained for at least another 15 minutes.

   a. At the completion of the test the pressure shall be released at the furthermost point from the point of application.

3. All exposed piping shall be examined during the test and all leaks, defective material or joints shall be repaired or replaced before repeating the tests.

4. The allowable leakage for pressure pipelines shall not exceed the following in gallons per 24 hours per inch of diameter per mile of pipe:

Type of Pipe	Leakage
Ductile iron	10
Asbestos-cement	20
Polyvinyl chloride, thermal plastic or fiberglass with rubber joints	10
Polyvinyl chloride, thermal plastic or fiberglass with sovent-cemented joints	0
Concrete with steel and rubber joints	10
Steel with welded joints	0
Steel with harnessed joints	10
Wrought steel	0
Copper	0
All piping inside structures	0

5. Regardless of the above allowables, any visible leaks shall be permanently stopped.

MP-71.04 TEST FOR NON-PRESSURE PIPELINES FOR TRANSPORT OF WATER OR SEWAGE

A. General

1. Pipelines designed to carry water or sewage in open channel flow or at minimal pressures shall be tested for leakage prior to being placed in service.

2. The leakage shall be determined by exfiltration, infiltration or low pressure air.
   a. The testing method directed by the Engineer shall take into consideration the groundwater elevation of the section of pipe being tested.

   b. The maximum non-pressure pipeline to be tested for leakage shall be the section between manholes or 600 feet as directed by the Engineer.

3. Intermediate leakage tests during construction shall be made at the Contractor's discretion. Upon completion of any pipeline, the entire system including manholes shall be tested for compliance to allowable leakage.

4. When testing absorbent pipe materials such as asbestos-cement or concrete, the pipeline shall be filled with water at least 24 hours before the test is made.

5. Groundwater level shall be determined by the Contractor prior to any testing by reading the water level at the observation pipe in the manholes.

6. If the line fails the test, the Contractor shall explore for the cause of the excessive leakage and after repairs have been made the line shall be retested. This procedure shall be repeated until the pipe complies.

B. Exfiltration Testing

1. Exfiltration tests shall be made by filling a section of pipeline with water and measuring the quantity of leakage.

2. The head of water at the beginning of the test shall be at least two feet above the highest pipe within the section being tested.

   a. Should groundwater be present within the section being tested, the head of water for the test shall be two feet above the hydraulic gradient of the groundwater.

   b. Should the requirement of two feet of water above the highest pipe subject any joint at the lower end of the test section to a differential head of greater than 11.5 feet another method of testing shall be employed.

C. Infiltration Testing

1. Infiltration tests will be allowed only when the water table gauges determine the groundwater level to be two feet or more above the highest pipe of the section being tested.

2. Infiltration test shall be made by measuring the quantity of water leaking into a section of pipeline.

3. Measurement of the infiltration shall be by means of a calibrated weir constructed at the outlet of the section being tested.

D. Allowable Leakage for Non-Pressure Pipelines

The allowable leakage (exfiltration or infiltration) for non-pressure pipelines shall not exceed the following in gallons per 24 hours per inch of diameter per 1000 feet of pipe:

Type of Pipe	Leakage
Ductile iron - mechanical or push-on joints	10
Asbestos-cement "O" ring joints	20
Polyvinyl chloride, thermal plastic or fiberglass with rubber joints	10
Polyvinyl chloride, thermal plastic or fiberglass with solvent-cemented joints	0
Concrete with rubber joints	20
Concrete with steel and rubber joints	10
Corrugated Steel	95
Clay with rubber gasket joints	20
Cast iron soil pipe	
1. drains and vents	0
2. sewer laterals	*
All piping inside structures	0

*The same allowable as pipe to which it is connected.

Regardless of the above allowable leakage any spurting leaks detected shall be permanently stopped.

E. Air Testing

1. For the acceptance of air testing in lieu of hydrostatic testing (exfiltration or infiltration), the Contractor shall perform hydrostatic and air tests on at least three sections of pipeline for each type of pipe being used. The Engineer shall select the sections for the corroborative tests. If these duel tested sections indicate the same results, that is, acceptance under both tests, air testing will be allowed in lieu of hydrostatic testing to meet the project requirements.

2. Air testing for acceptance shall not be performed until the backfilling has been completed.

3. Low pressure air tests shall conform to ASTM C 828 except as specified herein and shall not be limited to type or size of pipe.

4. All sections of pipelines shall be cleaned and flushed prior to testing.

5. The air test shall be based on the average holding pressure of 3 psi gauge, a drop from 3.5 to 2.5 psi, within the period of time allowed for the size of pipe and the length of the test section. The time allowed for the 1 psi drop in pressure, measured in seconds, will be computed by the Engineer and will be based on the limits of ASTM C 828.

   a. When groundwater is present the average test pressure of 3 psig shall be above any back pressure due to the groundwater level.

   b. The maximum pressure allowed under any condition in air testing shall be 10 psig. The maximum groundwater level for air testing is 13 feet above the top of the pipe.

6. The equipment required for air testing shall be furnished by the Contractor and shall include the necessary compressor, valves and gauges to allow for the monitoring of the pressure, release of pressure and a separable test gauge.

   a. The test gauge shall be sized to allow for the measuring of the one psig loss allowed during the test period and shall be on a separate line to the test section.

MP-71.05 MANHOLE TESTING

A. General

1. Each manhole shall be tested by either exfiltration or infiltration.

2. A manhole will be acceptable if the leakage does not exceed an allowable of one gallon per vertical foot of depth for 24 hours. Regardless of the allowable leakage any leaks detected shall be permanently stopped.

B. Exfiltration test may be performed prior to or after backfilling. The test shall be made by filling the manhole with water and observing the level for a minimum of eight hours.

C. Infiltration tests shall be performed when the groundwater level is above the joint of the top section of a precast manhole.

MP-71.06 AIR, OIL AND GAS PIPING

A. All pipelines for air, oil and gas shall be cleaned and tested with air at the pressure specified and no leakage will be allowed. After these tests are complete, fuel gas lines shall be flushed out with nitrogen or carbon dioxide before fuel gas is admitted.

MP-71.07 CHLORINE GAS PIPING

A. All pipelines for chlorine gas shall be initially tested with nitrogen gas with no leakage allowed. After the pipelines have been charged with chlorine gas all joints shall be checked for leakage using ammonia water.

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MATERIALS AND PERFORMANCE - SECTION 95

POLYVINYL CHLORIDE (PVC) PRESSURE PIPE FOR BURIED PIPELINES 4-INCH AND LARGER

MP-95.01 GENERAL

A. Work Specified
   1. Polyvinyl chloride pipe of the classification, and size and with fittings and joints as specified in the pipe schedule and shown on the Contract Drawings.

B. Related Work Specified Elsewhere
   1. Trenching, Backfilling and Compacting
   2. Pipeline Installation
   3. Leakage Tests
   4. Chlorination

C. Applicable Codes, Standards and Specifications
   1. American National Standards Institute (ANSI)
   2. American Society for Testing and Materials (ASTM)
   3. American Water Works Association (AWWA)
   4. National Sanitation Foundation (NSF)

MP-95.02 MATERIALS

A. General
   1. Polyvinyl chloride pipe shall be made from Class 12454-B materials or better in accordance with ANSI/ASTM D 1784.
   2. Polyvinyl chloride pipe and accessories shall conform to the requirements of:
      a. Water mains — AWWA C900
      b. Pressure rated — ANSI/ASTM D2241
   3. Polyvinyl chloride pipe and accessories to be used for potable-water shall be certified as suitable by the NSF or other approved testing agency and shall be marked with the seal of the agency.

B. Fittings and Couplings
   1. Ductile-iron fittings shall conform to the requirements of ANSI/AWWA C110.
   2. Polyvinyl chloride fittings and couplings shall conform to the requirements of the PVC pipe for classification and size.

C. Joints
   1. Joints for pipe and fitting shall be of the type shown in the pipe schedule and on the Contract Drawings and in accordance with the standard for the type of material.
      a. Ductile iron fittings shall be push-on or mechanical.
      b. Polyvinyl chloride pipe and fittings shall be elastomeric or solvent-cemented.

1) Rubber gaskets for elastomeric joints shall conform to ANSI/ASTM F477.
   a) The rubber gasket shall be factory installed in the pipe, fittings and couplings.

2. The plain end of the pipe shall be marked by the manufacturer to show the depth of penetration into the bell or coupling.

MP-95.03 SUBMITTALS

A. Drawings and manufacturers data of the pipe, joints and fittings showing compliance with this specification.

B. Submit five (5) copies of manufacturer's affidavit that all delivered materials comply with the requirements of the specified Standards.

MP-95.04 INSTALLATION

A. Polyvinyl chloride pipe shall be installed in accordance with the applicable provisions of the Sections entitled "Trenching, Backfilling and Compacting" and "Pipeline Installation".

B. Polyvinyl chloride pipe shall be handled and stored in accordance with the manufacturer's recommendations.

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MATERIALS AND PERFORMANCE - SECTION 151

SUBMERSIBLE SUMP PUMPS

MP-151.01 GENERAL

A. Work Specified
   1. Single or duplex centrifugal type submersible sump pumps located as shown on Contract Drawings.

B. Related Work Specified Elsewhere
   1. Miscellaneous Electric Motors

C. Pumps shall be manufactred by:
   1. Enpo-Cornell
   2. Hydro-O-Matic
   3. Deming
   4. Or equal.

MP-151.02 CONSTRUCTION

A. Pumps
   1. Capacity and head as scheduled or shown on Contract Drawings
   2. Semi-open impellers
   3. Perforated strainers on suction

B. Motors
   1. Permanently sealed and rigidly coupled to the pump
   2. Grease-sealed lifetime lubricated bearings
   3. 115 volts, 60 cycle, single phase with capacitor start
   4. Integral overload protection with automatic restart
   5. Water-resistant extension cord
   6. Other requirements as required under the Section entitled "Miscellaneous Electric Motors".

C. Appurtenances

   1. Start and stop by floatable motor case, pressure switch or floats activated by change in water level.
   2. Duplex assembly shall have automatic alternator.
      a. Back-up pump to start on lead pump failure or on rising water level.

MP-151.03 SUBMITTALS

A. Shop Drawings
   1. Submit detail drawings showing compliance with these specifications including materials of construction and parts list.

B. Operation and Maintenance Manuals
   1. Furnish three sets of the manuals as required by the General Provisions.

MP-151.04 INSTALLATION

A. Installed as shown on Contract Drawings
   1. 12-inch flexible rubber hose at pump discharge connection.
   2. Two check valves shall be installed in the discharge piping near pump and approximately two feet apart.

B. Testing
   1. After installation each sump pump shall be cycled a minimum of five times.
      a. Water shall be discharged at rate scheduled.
      b. Pump and motor shall show no strain or vibrations.

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MATERIALS AND PERFORMANCE - SECTION 250

PLACEMENT OF CONTAMINATED MATERIALS

MP-250.01 GENERAL

A. Work Specified

1. Work to be performed under this section shall consist of all labor, materials, supplies and equipment necessary for the hauling, handling and placement of contaminated materials into the temporary containment structure.

MP-250.02 INSTALLATION

A. Handling and Hauling

1. Any stockpiling of contaminated materials prior to placement into the landfill cell shall be as approved by the Engineer.

2. At all times when being stockpiled, contaminated materials shall be protected from erosion due to stormwater or wind. Any water which comes into contact with contaminated materials shall be contained, collected and treated in the on-site treatment system.

3. Hauling of contaminated materials from the point of excavation to the landfill area shall be conducted only on the temporary haul roads constructed as shown or specified. During hauling operations, extreme care shall be taken and all necessary measure employed to ensure that no material is lost from the haul vehicles.

B. Placement Into Landfill Cell

1. All materials placed into the landfill cell shall be dry, as defined by the absence of free liquids.

2. No contaminated materials shall be placed into the landfill cell until the berms, liners, drainage layers and leachate collection and holding systems have been placed into operation.

3. Contaminated materials shall be placed into the landfill cell in maximum two (2) foot lifts.

4. After placement into the landfill cell, measures shall be taken to minimize the amount of rainfall which is allowed to come into contact with the contaminated materials. Water which does contact the contaminated materials shall be collected and treated in the on-site treatment system.

5. Prior to demobilization at the end of each work day, the contaminated material shall be graded to promote positive drainage to the sump.

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MATERIALS AND PERFORMANCE - SECTION 255

FLEXIBLE MEMBRANE LINER (FML)

MP-255.01 GENERAL

A. Work Specified

1. The work to be performed under this section shall consist of all labor, materials, supplies, and equipment necessary to furnish and install the flexible membrane liners as specified herein and as shown on the Contract Drawings.

B. Acceptable Manufacturers

1. Gundle Lining Systems, Inc.
2. Or Approved Equal

MP-255.02 SUBMITTALS

A. In order to qualify as an approved synthetic liner, the Contractor shall submit lining material samples and a minimum specification sheet to the Engineer for approval prior to construction. The specification sheet shall give full details of minimum physical properties and test methods used, site seaming methods, and a manufacturer's certificate confirming compliance of the material with the minimum specifications. A list of similar projects completed in which the manufactured material has been successfully used shall be submitted to the Owner.

B. The Contractor shall also submit a list of liner installers approved and/or licensed by the liner manufacturer, who have been trained and who are qualified to install the manufacturer's material.

C. The manufacturer shall provide the Contractor with complete written instructions for the storage, handling, installation, and seaming of the liner in compliance with this specification and the condition of his warranty. Contractor shall forward a copy of this information to the Engineer.

D. The Contractor shall obtain from the manufacturer and submit to the Engineer results of quality control testing identified in Section 1.03 of this specification. This shall be submitted prior to installation.

E. Contractor's certification that liner bedding is satisfactory (see Part 3).

F. Prior to construction, the Contractor shall furnish the Owner with panel layout drawings as required for the liner installation. The panel layout shall be designed by the manufacturer

and seams of the liner laid on the slopes shall be perpendicular to the landfill bottom. Field seam lengths shall be minimized.

MP-255.03 QUALITY CONTROL

A. Manufacturer's Experience

1. The manufacturer of the lining material described herein shall have previously demonstrated his ability to produce this membrane by having successfully manufactured a minimum of ten million square feet of similar liner material for hydraulic lining installations.

B. Raw Material

1. All compound ingredients of the liner materials shall be randomly sampled on delivery to the manufacturing plant to ensure compliance with specifications. Tests to be carried out shall include Density, ASTM D1505.68; and Melt Index, ASTM D1238-79 Procedure A, Conditions E & P.

C. Manufactured Roll Goods

1. Samples of the production run shall be obtained and tested in accordance with the following performance standards for the 30 mil flexible membrane liner.

Parameter	Performance Standard	Performance Validation
1. Thickness	30 mil (-10% max.) (ASTM D1593)	Measurement, two samples from each day's production.
2. Tensile Strength	70 lb/in. width at yield (ASTM D638)	Tensile test, two samples from each day's production.
3. Puncture Resistance	40 lbs. (FTMS 101B) Method 2065	Test, one sample per roll.
4. Tear Resistance	22 lbs. (ASTM D1004 C)	Test, one sample per roll.
5. Carbon Black Content	2% min, 3% max	One test per roll car or 45,000 lb.

2. Samples of the production run shall be obtained and tested in accordance with the following performance standards for the 60 mil flexible membrane liner:

Parameter	Performance Standard	Performance Validation
1. Thickness	60 mil (-10% max.) (ASTM D1593)	Measurement, two samples from each day's production.
2. Tensile Strength	140 lb/in. width at yield (ASTM D638)	Tensile test, two samples from each day's production.
3. Puncture Resistance	80 lbs. (FTMS 101B) Method 2065	Test, one sample per roll.
4. Tear Resistance	45 lbs. (ASTM D1004 C)	Test, one sample per roll.
5. Carbon Black Content	2% min, 3% max	One test per roll car or 45,000 lb.

D. All welding material shall be of a type recommended and supplied by the manufacturer and shall be delivered in the original sealed containers - each with an indelible label bearing the brand name, manufacturer's mark number, and complete directions as to proper storage.

E. The installer shall employ on-site physical non-destructive testing on all welds to ensure watertight homogeneous seams. All welded seams shall be tested over their entire length by vacuum box or ultrasonic methods. All test results shall be submitted to the Owner.

F. Should visual inspection of the liner reveal irregular blemishes or suspect areas of undispersed carbon black, a thermal Gravimetric Analysis will be performed at the Contractor's expense to ensure the 2 percent minimum and 3 percent maximum carbon black content is met. Should requirements not be met, the Contractor will be liable for replacement.

G. A factory-trained quality-control technician shall inspect each seam. Any area showing a defect shall be marked and repaired in accordance with the manufacturer's repair procedures.

H. A test weld three (3) feet long from each welding machine shall be run each day prior to liner welding and under the same conditions as exist for the liner welding. The test weld shall be marked with date, ambient temperature, and welding machine number. Samples of weld approximately 3/8" wide shall be cut from the test weld and tested in shear and peel. Seams shall be stronger than the material. The weld sample shall be kept for subsequent testing on laboratory tensometer equipment in accordance with the applicable ASTM standards. Random weld samples may be removed from the installed welded sheeting at a frequency of one sample per 500 feet of weld.

I. The welder(s) of the HDPE liner material shall have previous experience with the material and shall demonstrate evidence of training under the manufacturer of the liner material.

J. The Owner, or his designated representative, reserves the right of access for inspection of any or all phases of this installation.

MP-255.04 MATERIALS

A. Flexible Membrane Liner

1. Liner material shall be ultra high molecular weight High Density Polyethylene (HDPE). The nominal thickness of the liner shall be 30 or 60 mils as specified.

2. The lining material shall be manufactured a minimum 22.0-foot seamless width. Labels on the roll shall identify the thickness, length, width, and manufacturer's mark number.

3. The 30 mil flexible membrane liner material shall meet or exceed the following material performance requirements.

Property	Test Method	Result
Density	ASTM D1505	0.94 g/cc
Tensile @ Break	ASTM D638 Type IV dumb-bell at 2 ipm	120 lb/in width
Tensile @ Yield	" " "	70 lb/in width
Elongation @ Break	" " "	700%
Elongation @ Yield	" " "	13%
Modulus of Elasticity	ASTM D882	110,000 psi
Tear Resistance	ASTM D1004 Die C.	22 lb. (min)
Puncture Resistance	FTMS 101B Method 2065	40 lb. (min)
Hydrostatic Resistance	ASTM D751 Method A Procedure 1	240 psi
Carbon Black Content	ASTM D1603	2% min, 3% max

4. The 60 mil flexible membrane liner material shall meet or exceed the following material performance requirements:

Property	Test Method	Result
Density	ASTM D1505	0.94 g/cc
Tensile @ Break	ASTM D638 Type IV dumb-bell at 2 ipm	240 lb/in width
Tensile @ Yield	" " "	140 lb/in width
Elongation @ Break	" " "	700%
Elongation @ Yield	" " "	13%
Modulus of Elasticity	ASTM D882	110,000 psi
Tear Resistance	ASTM D1004 Die C.	45 lb. (min)
Puncture Resistance	FTMS 101B Method 2065	80 lb. (min)
Hydrostatic Resistance	ASTM D751 Method A Procedure 1	490 psi
Carbon Black Content	ASTM D1603	2% min, 3% max

MP-255.05 INSTALLATION

A. Area Subgrade Preparation

1. Surfaces to be lined shall be smooth and free of all rocks, stones, sticks, roots, sharp objects, or debris of any kind. The surface should provide a firm, unyielding foundation for the membrane with no sudden, sharp or abrupt changes or breaks in grade. No standing water or excessive moisture shall be allowed. The Contractor shall certify in writing that the surface on which the membrane is to be installed is acceptable before commencing work.

B. Contractor Approval

1. The installation contractor shall have met the manufacturer's minimum requirements to become a licensed or approved installer of the manufacturer's product using the manufacturer's state-of-the-art equipment and welding methods. The manufacturer shall certify that the installer is approved or licensed.

C. Field Seams

1. Individual panels of liner material shall be laid out and overlapped by a minimum of 3 inches for extrusion welding, 4 inches for hot wedge seaming prior to welding. Extreme care shall be taken by the installer in the prepa-

ration of the areas to be welded. The area to be welded shall be cleaned and prepared according to the procedures identified by the material manufacturer. All sheeting shall be joined together using a homogeneous overlap extrusion fusion or hot wedge welding process. The composition of the extrudate shall be identical to the lining material.

D. The welding equipment used shall be capable of continuously monitoring and controlling the temperatures and pressures in the zone of contact where the machine is actually fusing the lining material, to ensure that changes in environmental conditions will not affect the integrity of the weld. Only welding systems which utilize the extrusion fusion or hot wedge welding process shall be used for bonding these lining materials.

E. No "fish mouths" shall be allowed within the seam area. Where "fish mouths" occur, the material shall be cut, overlapped, and an overlap fusion weld or hot wedge weld shall be applied. All welds on completion of the work shall be tightly bonded. Any membrane areas showing injury due to excessive scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional section of liner material.

F. Seam defects detected by vacuum box testing shall be corrected by the Contractor.

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MATERIALS AND PERFORMANCE - SECTION 260

FLEXIBLE MEMBRANE COVER (FMC)

MP-260.01 GENERAL

A. Work Specified

1. The work to be performed under this section shall consist of all labor, materials, supplies, and equipment necessary to furnish and install the flexible membrane cover as specified herein and as shown on the Contract Drawings.

B. Acceptable Manufacturers

1. Gundle Lining Systems, Inc.

2. Or Approved Equal

MP-260.02 SUBMITTALS

A. In order to qualify as an approved flexible membrane cover, the Contractor shall submit lining material samples and a minimum specification sheet to the Engineer for approval prior to construction. The specification sheet shall give full details of minimum physical properties and test methods used, site seaming methods, and a manufacturer's certificate confirming compliance of the material with the minimum specifications. A list of similar projects completed in which the manufactured material has been successfully used shall be submitted to the Owner.

B. The Contractor shall also submit a list of liner installers approved and/or licensed by the liner manufacturer, who have been trained and who are qualified to install the manufacturer's material.

C. The manufacturer shall provide the Contractor with complete written instructions for the storage, handling, installation, and seaming of the cover in compliance with this specification and the condition of his warranty. Contractor shall forward a copy of this information to the Engineer.

D. The Contractor shall obtain from the manufacturer and submit to the Engineer results of quality control testing identified in Section 1.03 of this specification. This shall be submitted prior to installation.

E. Contractor's certification that liner bedding is satisfactory (see Part 3).

F. Prior to construction, the Contractor shall furnish the Owner with panel layout drawings as required for the liner installation. The panel layout shall be designed by the manufacturer and seams of the liner laid on the slopes shall be perpendicular to the landfill bottom. Field seam lengths shall be minimized.

MP-260.03 QUALITY CONTROL

A. Manufacturer's Experience

1. The manufacturer of the lining material described herein shall have previously demonstrated his ability to produce this membrane by having successfully manufactured a minimum of ten million square feet of similar liner material for hydraulic lining installations.

B. Raw Material

1. All compound ingredients of the liner materials shall be randomly sampled on delivery to the manufacturing plant to ensure compliance with specifications. Tests to be carried out shall include Density, ASTM D1505.68; and Melt Index, ASTM D1238-79 Procedure A, Conditions E & P.

C. Manufactured Roll Goods

1. Samples of the production run shall be obtained and tested in accordance with the following performance standards:

Parameter	Performance Standard	Performance Validation
1. Thickness	20 mil (-10% max.) (ASTM D1593)	Measurement, two samples from each day's production.
2. Tensile Strength	50 lb/in. width at yield (ASTM D638)	Tensile test, two samples from each day's production.
3. Puncture Resistance	26 lbs. (FTMS 101B) Method 2065	Test, one sample per roll.
4. Tear Resistance	15 lbs. (ASTM D1004 C)	Test, one sample per roll.
5. Carbon Black Content	2% min, 3% max	One test per roll car or 45,000 lb.

D. All welding material shall be of a type recommended and supplied by the manufacturer and shall be delivered in the original sealed containers - each with an indelible label bearing the brand name, manufacturer's mark number, and complete directions as to proper storage.

E. The installer shall employ on-site physical non-destructive testing on all welds to ensure watertight homogeneous seams. All welded seams shall be tested over their entire length by vacuum box or ultrasonic methods. All test results shall be submitted to the Owner.

F. Should visual inspection of the liner reveal irregular blemishes or suspect areas of undispersed carbon black, a thermal Gravimetric Analysis will be performed at the Contractor's expense to ensure the 2 percent minimum and 3 percent maximum carbon black content is met. Should requirements not be met, the Contractor will be liable for replacement.

G. A factory-trained quality-control technician shall inspect each seam. Any area showing a defect shall be marked and repaired in accordance with the manufacturer's repair procedures.

H. A test weld three (3) feet long from each welding machine shall be run each day prior to liner welding and under the same conditions as exist for the liner welding. The test weld shall be marked with date, ambient temperature, and welding machine number. Samples of weld approximately 3/8" wide shall be cut from the test weld and tested in shear and peel. Seams shall be stronger than the material. The weld sample shall be kept for subsequent testing on laboratory tensometer equipment in accordance with the applicable ASTM standards. Random weld samples may be removed from the installed welded sheeting at a frequency of one sample per 500 feet of weld.

I. The welder(s) of the HDPE liner material shall have previous experience with the material and shall demonstrate evidence of training under the manufacturer of the liner material.

J. The Owner, or his designated representative, reserves the right of access for inspection of any or all phases of this installation.

MP-260.04 MATERIALS

A. Flexible Membrane Cover

1. Liner material shall be ultra high molecular weight High Density Polyethylene (HDPE). The minimum nominal thickness of the liner shall be 20 mils.

2. The lining material shall be manufactured a minimum 22.0-foot seamless width. Labels on the roll shall identify the thickness, length, width, and manufacturer's mark number.

3. The liner material shall meet or exceed the following material performance requirements:

Property	Test Method	Result
Density	ASTM D1505	0.94 g/cc
Tensile @ Break	ASTM D638 Type IV dumb-bell at 2 ipm	80 lb/in width
Tensile @ Yield	" " "	50 lb/in width
Elongation @ Break	" " "	700%
Elongation @ Yield	" " "	13%
Modulus of Elasticity	ASTM D882	110,000 psi
Tear Resistance	ASTM D1004 Die C.	15 lb. (min)
Puncture Resistance	FTMS 101B Method 2065	26 lb. (min)
Hydrostatic Resistance	ASTM D751 Method A Procedure 1	160 psi
Carbon Black Content	ASTM D1603	2% min, 3% max

MP-260.05 INSTALLATION

A. Area Subgrade Preparation

1. Surfaces to be lined shall be smooth and free of all rocks, stones, sticks, roots, sharp objects, or debris of any kind. The surface should provide a firm, unyielding foundation for the membrane with no sudden, sharp or abrupt changes or breaks in grade. No standing water or excessive moisture shall be allowed. The Contractor shall certify in writing that the surface on which the membrane is to be installed is acceptable before commencing work.

B. Contractor Approval

1. The installation contractor shall have met the manufacturer's minimum requirements to become a licensed or approved installer of the manufacturer's product using the manufacturer's state-of-the-art equipment and welding methods. The manufacturer shall certify that the installer is approved or licensed.

C. Field Seams

1. Individual panels of liner material shall be laid out and overlapped by a minimum of 3 inches for extrusion welding, 4 inches for hot wedge seaming prior to welding.

Extreme care shall be taken by the installer in the preparation of the areas to be welded. The area to be welded shall be cleaned and prepared according to the procedures identified by the material manufacturer. All sheeting shall be joined together using a homogeneous overlap extrusion fusion or hot wedge welding process. The composition of the extrudate shall be identical to the lining material.

D. The welding equipment used shall be capable of continuously monitoring and controlling the temperatures and pressures in the zone of contact where the machine is actually fusing the lining material, to ensure that changes in environmental conditions will not affect the integrity of the weld. Only welding systems which utilize the extrusion fusion or hot wedge welding process shall be used for bonding these lining materials.

E. No "fish mouths" shall be allowed within the seam area. Where "fish mouths" occur, the material shall be cut, overlapped, and an overlap fusion weld or hot wedge weld shall be applied. All welds on completion of the work shall be tightly bonded. Any membrane areas showing injury due to excessive scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional section of liner material.

F. Seam defects detected by vacuum box testing shall be corrected by the Contractor.

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MATERIALS AND PERFORMANCE - SECTION 265

FML BEDDING LAYER

MP-265.01 GENERAL

A. Work Specified

1. The scope covered in these specifications covers the testing and installation of the FML bedding layer.

B. Testing

1. All soil testing services as specified herein necessary for the Contractor to obtain an approved material for the FML bedding layer shall be provided by the Contractor. All testing including laboratory and field services required during construction of the FML bedding layer shall be provided by the Contractor.

MP-265.02 MATERIALS

A. FML Bedding Layer

1. Material used as FML bedding layer material shall be obtained from a source approved by the Contracting Officer.

2. The FML bedding layer material shall be uniform in composition and texture, clean and free from stones, weeds, stumps, roots, toxic substances, and debris or similar substances.

3. The Contractor shall submit testing methods (prior to conducting tests), test results, and a certification from the approved soils testing laboratory that the FML bedding layer material meets the requirements of this Section. The results of all testing specified herein shall be submitted to the Engineer for approval.

4. The FML bedding layer material shall meet the following requirements in accordance with ASTM D422-63:

Sieve Size	Percent Passing by Weight
4	90-100
10	70-95
20	50-80
40	20-65
100	10-40
200	0-5

5. If at any time during the Contract the Engineer requests further soils testing to insure that the characteristics of the FML bedding layer material obtained from the borrow area(s) have not changed, the Contractor shall perform these tests at no additional cost to the Government.

MP-265.03 SUBMITTALS

A. Source of borrow material for FML bedding layer layer material.

B. Location of spoil area(s).

C. Location of samples collected within borrow areas for laboratory testing.

D. Proposed soils testing laboratory.

E. Laboratory testing methods to be used.

F. Results of laboratory testing.

G. Laboratory certification of FML bedding layer material.

MP-265.04 INSTALLATION

A. Placement of the FML bedding layer material shall be in accordance with the provisions of this Section. Any FML bedding layer material which cannot comply with the provisions of this section will be considered as spoil and will be removed and disposed of at the Contractor's expense.

B. The FML bedding layer material shall be constructed by placing suitable material in minimum 6-inch lifts. Compaction of the lifts shall be accomplished by a minimum of 6 passes of a 3.5 ton double vibratory roller.

C. In areas adjacent to the concrete sumps, the FML bedding layer material shall be compacted as approved by the Contracting Officer with a manually operated vibrating tamper or other method approved by the Contracting Officer.

D. Compaction or consolidation achieved by traveling trucks, machines, and other equipment will not be accepted unless such procedures are approved by the Engineer and proper compaction criteria are achieved.

E. Any damage to the completed surface of the FML bedding layer, whether caused by erosion, the Contractor's work or any other occurrences, shall be immediately repaired and maintained in good condition until completion of the work.

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MATERIALS AND PERFORMANCE - SECTION 270

DRAINAGE NET

MP-270.01 GENERAL

A. Work Specified

1. The work to be performed under this section shall consist of all labor, materials, supplies, and equipment necessary to furnish and install the drainage net layers as specified herein and as shown on the Contract Drawings.

B. Applicable Codes, Standards and Specifications

1. American Society for Testing and Materials (ASTM).

2. Federal Register, Vol. 52, No. 103, Friday, May 29, 1987.

C. Acceptable Manufacturers

1. Tensar (NS 1400)

2. or Approved Equal

MP-270.02 SUBMITTALS

A. Manufacturer's technical data, including test data to demonstrate transmissivity at the specified gradient.

B. Manufacturer's installation requirements

C. Samples

D. Certifications

E. Test Reports

MP-270.03 MATERIALS

A. Drainage Net

1. Drainage net shall consist of an integrally formed polyethylene net structure. It shall have uniform channels, open area and thickness to assure uniform flow throughout the structure. It shall have high tensile strength and tear strength to resist installation damage and loading on steep slopes. It shall also have a low compressibility under high loadings to maintain a high transmissivity under a range of loading conditions. The drainage net shall also be resistant to ultraviolet degradation. The transmissivity of the drainage net must be a minimum of 5×10^{-4} **m2/sec at a gradient of 0.02.**

2. The drainage net shall exhibit the following properties, at a minimum:

Property	ASTM Method	Unit	Values
Polymer Specific Gravity	D1505	-	0.92
Polymer Melt Index	D1238	g/10 min	0.2
Carbon Black Content	D4218	%	2.2
Nominal Thickness	(1)	mm	5±1
Aperture Size	-	mm	7±1
Mass Per Unit Area	(1)	g/m^2(oz/sq yd)	640(19)
Transmissivity (2)	-	m^2/s(gpm/ft)	$5x10^{-4}$(2.5)
Nominal Conductivity (3)	-	m/s(cm/s)	minimum
Compressive Stress Limit (4)	-	kPa(psf)	750(15,000)
Tensile Strength MD (5)	(1)	kN/m(1b/in)	4(23)

Notes: (1) Use tentative methods being prepared by ASTM Committee D35 on Geotextiles and Related Products

(2) The transmissivity is the transmissivity of a net measured using water at 20°C (68°F) with a gradient of 0.02, under a compressive stress of 4,000 psf, using the following test set-up:

- upper load plate
- FML bedding layer
- HDPE liner
- geonet
- HDPE liner
- lower load plate

(3) The nominal conductivity is obtained by dividing the transmissivity by the nominal thickness.

(4) Value of the compressive stress at which the hydraulic transmissivity is 25% of the transmissivity.

(5) MD = Machine Direction

MP-270.04 INSTALLATION

A. Contractor shall take care to clear subgrade of sharp objects, stumps and debris, and ensure that grades are properly established prior to placement of drainage net.

B. Drainage net shall be unrolled on the subgrade and installed and anchored in accordance with the manufacturer's written instructions.

C. Adjacent rolls of drainage net shall be overlapped approximately 2-4 inches and secured by plastic ties approximately every five feet along the roll length. Plastic ties shall be white or other bright color for easy inspection. Metallic ties shall not be allowed.

D. The Owner's representative will perform the following activities:

1. Observations to document that the drainage nets are placed in accordance with the design plans and specifications, and the manufacturer's instructions;

2. Measurements to show that there are no gaps between adjacent panels of material; and

3. Observations to ascertain that the drainage nets are not damaged during the installation process.

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MATERIALS AND PERFORMANCE - SECTION 275

GRANULAR DRAINAGE MATERIAL

MP-275.01 GENERAL

A. Work Specified

1. Excavation, backfilling, and compacting including the loosening, removing, working, transporting, storage, fill, and disposal of all materials necessary for construction of the drainage layer, as shown or specified or as directed by the Engineer.

B. Testing

1. All soil testing services as specified herein necessary for the Contractor to obtain an approved drainage layer material shall be provided by the Contractor. All testing including laboratory and field services required during construction of the drainage layer shall be provided by the Contractor.

C. Applicable Codes, Standards, and Specifications

1. American Society for Testing and Materials (ASTM). The publications listed below form a part of the specification to the extent referred to in the text by basis designation only.

ASTM D422-63	Method for Particle Size Analysis of Soil
ASTM D698-78	Moisture-Density Relations of Soil-Aggregate Mixtures Using 5-lb Rammer and 12-in. Drop
ASTM D2434-68	Test Method for Permeability of Granular Soils (Constant Head)

MP-275.02 MATERIALS

A. Drainage Layer Materials

1. Drainage layer material shall be obtained from a source approved by the Engineer and processed to meet the grain size specified.

2. The drainage layer material shall be characterized as a granular material with a minimum permeability of 1x10-2 cm/sec as determined by laboratory testing performed in accordance with ASTM D2434-68. The drainage layer material shall have 100 percent passing the 3/4 inch sieve by weight and less than 5 percent passing the 3/8 inch sieve based on analyses performed in accordance with ASTM D422-63.

3. The drainage layer material must be uniform in composition and texture, clean and free from stones, weeds, stumps, roots, toxic substances, and debris or similar substances.

4. The Contractor shall submit testing methods (prior to conducting tests), test results, and a certification from the approved soils testing laboratory that the drainage layer material meets the requirements of this section. The results of all soils testing specified herein shall be submitted to the Engineer for approval.

5. During installation of the drainage layer, material from the source shall be tested in accordance with the following standards and frequencies:

Parameter	Standard	Minimum Frequency	Criteria
Particle-Size Analysis	ASTM D422-63	Once per 1,000 cy	100% passing the 3/4 inch sieve and less than 5% passing the 3/8 inch sieve.
Permeability	ASTM D2434-68	Once per 1,000 cy	Minimum permeability of 1×10^{-2} cm/sec

6. The results of all testing shall be submitted to the Engineer for approval. Any materials not meeting the requirements of this section shall be considered as spoil.

7. Following installation of each lift of the drainage layer, each lift of the drainage layer shall be tested in accordance with the following standards and frequencies.

Parameter	Standard	Minimum Frequency	Criteria
In-Place Density	ASTM D2922-81	3 tests per acre per lift of soil placed	85% of maximum dry density attained by ASTM D698-78 Method D

8. If at any time during this Contract the Engineer requests further soils testing to insure that the characteristics of the drainage layer material obtained from the borrow area(s) have not changed, the Contractor shall perform these tests at no additional cost to the Owner.

MP-275.03 SUBMITTALS

A. Source of borrow materials for drainage layer.

B. Proposed soil testing laboratory.

C. Laboratory testing methods to be used.

D. Results of laboratory testing methods.

E. Laboratory certification of drainage layer material.

MP-275.04 INSTALLATION

A. Drainage Layer Material

1. Placement of the drainage layer material shall be in accordance with the provisions of this Section. Any drainage layer material which cannot comply with the provisions of this Section will be considered as spoil and will be removed and disposed of at the Contractor's expense.

2. The drainage layer material shall be constructed by placing suitable material in minimum 12-inch loose lifts. The drainage layer shall be spread by dozer. The Contractor shall minimize travel of the dozer over the work area to the greatest extent possible to achieve the lines and grades specified. Compaction of the lifts shall be accomplished by a smooth wheel roller, without vibration. Compaction of the drainage layer shall be 85 percent of the Standard Proctor Compaction as determined by ASTM D698-78.

3. Compaction or consolidation achieved by traveling trucks, machines, and other equipment will not be accepted unless such procedures are approved by the Engineer and proper compaction criteria are achieved.

4. Any damage to the completed surface of the drainage layer, whether caused by erosion, the Contractor's work, or any other occurrences, shall be immediately repaired and maintained in good condition until completion of the work.

5. Any damage to pipe or HDPE membrane liner occurring during installation of the drainage layer shall be replaced at no additional cost to the Owner.

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MATERIALS AND PERFORMANCE - SECTION 280

GEOTEXTILE FILTER

MP-280.01 GENERAL

A. Work Specified

1. Furnishing of all plant, labor, material, and equipment and performing all operations required for furnishing, hauling, and placing geotextile filter, complete as specified herein and as shown on the drawings or specified by the Engineer.

B. Testing

1. All geotextile testing services as specified herein necessary for the Contractor to obtain an approved geotextile filter material shall be provided by the Contractor. All testing including laboratory and field services required during installation of the geotextile shall be provided by the Contractor.

C. Acceptable Manufacturers

1. Polyfelt TS800

2. Or Approved Equal

MP-280.02 SUBMITTALS

A. Manufacturer's certification of the geotextile indicating that the geotextile meets the chemical, physical, and manufacturing requirements stated in this Section.

MP-280.03 MATERIALS

A. Geotextile Filter

1. The geotextile filter shall consist of a long-chain geosynthetic polymer composed of at least 85 percent by weight of propylene, ethylene, ester, amids, or vinylidene-chloride, and shall contain stabilizers and/or inhibitors added to the base plastic if necessary to make the filaments resistant to deterioration due to ultra-violet and heat exposure.

2. The geotextile shall be a non-woven pervious sheet of plastic yarn and shall provide a minimum Apparent Opening Size (AOS) of 0.150 mm.

3. The geotextile shall have a minimum mass of 12 oz/yd^2 as determined by ASTM D 3776-84.

4. The geotextile shall conform to the following physical strength requirements:

Property	Standard	Criteria
Geotextile Permittivity	ASTM D 4491-85	Minimum permittivity of 1.2 sec^{-1}
Mass per Unit Area	ASTM D 3776-85	Minimum 12 oz/yd^2
Grab Tensile Strength	ASTM D 4632-86	300 lbs.
Grab Tensile Elongation	ASTM D 4632-86	60%
Trapezoid Tear	ASTM D 4533-85	105 lbs.
Puncture Strength	ASTM D 3786-87	130 lbs.
Burst Strength	ASTM D 3787-80	400 psi

5. During all periods of shipment and storage, the geotextile shall be protected from direct sunlight, ultraviolet light, temperatures greater than 140°F, mud, dirt, dust, and debris. To the extent possible, the geotextile shall be maintained wrapped in a heavy duty protective covering.

B. Temporary Pins

1. Temporary securing pins shall be 3/16 inches in diameter, of steel, pointed at one end and fabricated with a head to retain a steel washer having an outside diameter of no less than 1.5 inches.

MP-280.04 INSTALLATION

A. Geotextile Filter

1. Prior to installation of the geotextile filter fabric, the material on which the filter fabric is to be installed will be free of organic matter, irregularities, protrusions, and any abrupt changes in grade that could damage the filter fabric. The supporting layer will be maintained in a smooth, uniform, and compacted condition during installation of the filter fabric.

2. The geotextile shall be placed in manner and at the locations shown on the drawings. At the time of the installation, the geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.

3. The geotextile shall be placed with the long dimension parallel to the line of maximum slope and shall be laid smooth and free of tension, stress, folds, wrinkles, or creases. The strips shall be placed to provide minimum overlaps of 18 inches.

4. Temporary pinning of the geotextile to help hold it in place shall be allowed. The temporary pins shall be removed as the soil layers is placed to relieve high tensile stress which may occur during placement of material on the geotextile. Additional pins regardless of location shall be installed as necessary to prevent any slippage of the geotextile. The geotextile shall be placed so that the upper strip of geotextile will overlap the next lower strip. Each securing pin shall be pushed through the geotextile until the washer bears against the geotextile and secures it firmly to the foundation.

5. The geotextile shall be protected at all times during construction from contamination by surface runoff and any geotextile so contaminated shall be removed and replaced with uncontaminated geotextile. Any damage to the geotextile during its installation or during placement of soil layers shall be replaced by the Contractor at the Contractor's expense.

6. The work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within 5 days after placement of the geotextile. Failure to comply shall require replacement of geotextile.

7. The geotextile shall be protected from damage due to the placement of materials by limiting the height of drop of the material to less than 1 foot.

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MATERIALS AND PERFORMANCE - SECTION 285

GEOTEXTILE STABILIZATION FABRIC

MP-285.01 GENERAL

A. Work Specified

1. The scope covered in these specifications covers the Furnishing of all plant, labor, material, and equipment and performing all operations required for furnishing, hauling, and placing the geotextile stabilization fabric, complete as specified herein and shown on the Contract Drawings.

B. Testing

1. All geotextile testing services as specified herein necessary for the Contractor to obtain an approved geotextile stabilization material shall be provided by the Contractor. All testing including laboratory and field services required during installation of the geotextile shall be provided by the Contractor.

C. Acceptable Manufacturers

1. Mirafi 500X

2. Or Approved Equal

MP-285.02 SUBMITTALS

A. Manufacturer's certification of the geotextile indicating that the geotextile meets the chemical, physical, and manufacturing requirements stated in this Section.

MP-285.03 MATERIALS

A. Geotextile Stabilization Fabric

1. The geotextile filter fabric shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of propylene, ethylene, ester, amids, or vinylidene-chloride, and shall contain stabilizers and/or inhibitors added to the base plastic if necessary to make the filaments resistant to deterioration due to ultra-violet and heat exposure.

2. The geotextile shall be a woven pervious sheet of plastic yarn as defined by ASTM D123. The geotextile shall provide an Apparent Opening Size (AOS) no finer than the U.S. Standard Sieve No. 100 and no coarser than the U.S. Standard Sieve No. 20.

3. The geotextile shall have a minimum mass of 4 oz/yd^2 as determined by ASTM D3766-85.

4. The geotextile shall conform to the following physical strength requirements:

Property	Standard	Criteria
Apparent Opening Size	ASTM D4751-87	Apparent Opening Size (AOS) no finer than the U.S. Standard Sieve No. 100 and no coarser than the U.S. Standard Sieve No. 20
Mass Per Unit Area	ASTM D3776-85	Minimum 4 oz/yd^2
Grab Tensile Strength	ASTM D4632-86	200 lbs
Grab Tensile Elongation	ASTM D4632-86	20%
Trapezoid Tear Strength	ASTM D4533-85	115 lbs
Puncture Strength	ASTM D3786-87	75 lbs
Burst Strength	ASTM D3787-80	400 psi

5. The geotextile should be fixed so that the yarns will retain their relative position with respect to each other. The edges of the geotextile shall be finished to prevent the outer yarn from pulling away from the geotextile.

6. The geotextile shall be manufactured in widths not less than 12.5 feet.

B. Temporary Pins

1. Temporary securing pins shall be 3/16 inch in diameter, of steel, pointed at one end and fabricated with a head to retain a steel washer having an outside diameter of no less than 1.5 inches.

MP-285.04 INSTALLATION

A. Geotextile Stabilization Fabric

1. Prior to installation of the geotextile stabilization fabric, the material on which the stabilization fabric is to be installed will be free of organic matter, irregularities protrusions, and any abrupt changes in grade that could damage the stabilization fabric. The supporting layer will

be maintained in a smooth, uniform, and compacted condition during installation of the stabilization fabric.

2. The geotextile shall be placed in the manner and at the locations shown on the drawings. At the time of installation, the geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacturer, transportation or storage.

3. The geotextile shall be placed with the long dimension parallel to the centerline of the road and shall be laid smooth and free of tension, stress, folds, wrinkles, or creases. The strips shall be placed to provide a minimum width of 12 inches of overlap for each joint.

4. Temporary pinning of the geotextile to help hold it in place until the access road is placed shall be allowed. The temporary pins shall be removed as the soil layers is placed to relieve high tensile stress which may occur during placement of material on the geotextile.

   Additional pins regardless of location shall be installed as necessary to prevent any slippage of the geotextile. The geotextile shall be places so that the upper strip of geotextile will overlap the next lower strip. Each securing pin shall be pushed through the geotextile until the washer bears against the geotextile and secures it firmly to the foundation. The geotextile shall be protected at all times during construction from contamination by surface runoff and any geotextile so contaminated shall be removed and replaced with uncontaminated geotextile. Any damage to the geotextile during its installation or during placement of soil layers shall be replaced by the Contractor at the Contractor's expense. The work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within 5 days after placement of the geotextile. Failure to comply shall require replacement of geotextile. The geotextile shall be protected from damage due to the placement by limiting the height of drop of the material to less than 1 foot.

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MATERIALS AND PERFORMANCE - SECTION 290

PERFORATED POLYVINYL CHLORIDE DRAINAGE PIPE

MP-290.01 GENERAL

A. Work Specified

1. Work under this section shall consist of all labor, materials, supplies, and equipment necessary to furnish and install the perforated polyvinyl chloride drainage pipe as specified herein and as shown on the Contract Drawings.

B. Applicable Codes, Standards, and Specifications

1. American Society for Testing and Materials (ASTM)

C. Acceptable Manufacturers

1. National Pipe Company

2. Or Approved Equal

MP-290.02 SUBMITTALS

A. Drawings and manufacturers data of the pipe, joints, and fittings showing compliance with this specification.

B. Submit five (5) copies of manufacturer's affidavit that all delivered materials comply with the requirements of the specified standards.

MP-290.03 MATERIALS

A. General

1. Perforated drain pipe and fittings shall be made of polyvinyl chloride (PVC) compound having a cell classification of Class 12454C materials or better in accordance with ASTM D 1784.

2. Perforated drain pipe and accessories shall conform to the requirements of the following with a minimum pipe stiffness of the 46 psi at a maximum deflection of 5%:

ASTM	F758	4" - 8" pipe

B. Joints

1. Joints for perforated drainage pipe and fittings shall be of the bell and spigot push on type with flexible elastomeric seals which meet the requirements of ASTM D 3212.

2. The plain end of the pipe shall be marked by the manufacturer to show the depth of penetration into the bell or coupling.

3. Lubricant for the joints shall be furnished by the manufacturer.

C. Perforations

1. Perforation shall be in accordance with ASTM F 758.

2. Pipe shall be installed with perforations down.

MP-290.04 INSTALLATION

A. Pipe Delivery, Storage and Handling

1. All pipe supplied under this Contract shall be shipped, stored, and handled in accordance with the recommendations of the manufacturer.

B. Initiation of Installation

1. Inspection

a. Prior to installation, all pipe, fittings, and specials will be inspected by the Contractor in the presence of the Engineer for conformance with the standards and specifications.

b. All pipe not meeting the requirements of the applicable specifications will be rejected.

c. The Contractor shall furnish all labor required to handle the material during inspection and shall remove the rejected material from the site, as directed.

2. Discrepancies

a. In the event that the inspection reveals discrepancies, the Contractor shall suspend installation.

C. Installation

1. General

a. Polyvinyl chloride pipe shall be installed in accordance with the applicable provisions of the Sections titled "Trenching, Backfilling, and Compacting" and "Pipeline Installation" and as shown on the Contract Drawings.

b. All pipelines in the trenches shall be laid on a flat bottom.

c. Blocking will not be permitted under pipe.

d. Temporary bulkheads shall be placed in all open ends of pipe whenever pipe laying is not actively in process. The bulkheads shall be designed to prevent the entrance of dirt, debris, or water.

e. Precautions shall be taken to prevent the flotation of the pipe in the event of water entering the trench.

f. Push-on joints shall be made by guiding the plain end into the bell until contact is made with the gasket and exerting sufficient force to drive the pipe home until penetration is made to the depth recommended by the manufacturer.

D. Inspection

1. All non-pressure perforated PVC pipe shall be inspected and lamped after placement to insure a complete working installation. The inspection shall determine if the pipeline is true to line and grade, has obstructions to flow, or has projections or protrusions of connecting pipes or joint materials. The pipeline shall be free from cracks and shall contain no deposits of backfilled materials. Any deficiencies identified during inspection shall be corrected by the Contractor at his expense.

2. Pipe deflection shall be checked by passing a deflection gauge through all completed pipelines.

a. Maximum deflection allowed - 5%.

b. The test for deflection shall be made not less than 30 days after completion of the installation.

c. Deflection gauge shall be pulled through the pipe by hand.

d. Any section of pipe found to have a deflection in excess of 5% shall be corrected by the Contractor at his expense.

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CAROUSEL MALL

PROPOSED TEMPORARY CONTAINMENT FACILITY

LISTING OF ACCEPTABLE MANUFACTURERS

MATERIAL	ACCEPTABLE MANUFACTURER
Flexible Membrane Liner (FML)	Gundle 60 mil; Gundle 30 mil
Flexible Membrane Liner (FMC)	Gundle 30 mil; Poly-Flex 20 mil
Drainage Net	Tensar NS 1400 or equal
Geotextile Filter	Polyfelt TS800
Geotextile Stabilization Fabric	Mirafi 500X
Perforated PVC Drainage Pipe	National Pipe Company