SECTION 01 5723 - TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 - GENERAL

1.1 STORM WATER POLLUTION PREVENTION PLAN

A. The Storm Water Pollution Prevention Plan Narrative for this project is contained in the Construction Plans. Refer to the “SWPPP Plans” contained in the Construction Document set.

B. Complete the online application obtained at http://www.pca.state.mn.us/water/stormwater/stormwater-c.html

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 5723

SECTION 31 0000 - EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes labor, materials, equipment, and accessories to provide the following:

1. Employ a utility locating company to locate all privately owned utilities.
2. Full implementation of the Storm Water Pollution Prevention Plan (SWPPP) - refer to Section 01 57 23.
3. Construction and continual maintenance of haul roads, temporary construction parking and laydown areas.
4. Construction of temporary sediment basins, temporary outlet devices, drainage piping and conveyance ways, temporary diversion berms, and removal and restoration following use of these temporary facilities.
5. Maintaining existing site, adjacent properties and public streets clean on a daily basis from construction caused dirt and debris.
6. Maintaining dust control during grading operations. Providing for watering of soils to control dust.
7. Provide stockpile management.
8. Stripping and stockpiling of topsoil and other soils to be reused.
9. Earthwork (cutting and filling).
10. Compacting fill and backfill.
11. Removal and replacement of unsuitable or unstable soils.
12. Dewatering of site and excavations to maintain workable conditions and to protect on-site soils from becoming unstable.
13. Excavating on-site soils or importing soils for construction of building pad subgrade, retaining wall subgrade, pavement subgrade, sand subbase, sand base, and in conjunction with dewatering operations, as needed.
14. Exporting excess, unsuitable, or waste soils from the site and importing suitable soils to the site to complete the work.
15. Building Pad subgrade construction and Engineered Fill for building pads.
16. Excavating unsuitable soils from proposed building areas for building pad soil correction.
    (a) Conduct a preconstruction meeting prior to beginning building pad soil correction. Required attendees:
        (1) Civil Engineer
        (2) Geotechnical Engineer
        (3) Contractor’s Surveyor
        (4) Earthwork Contractor
        (5) General Contractor
        (6) Construction Manager
        (7) Owner’s representative
17. Footing and foundation excavation, backfilling and compaction.

18. Stabilized aggregate base on the building pad.
19. Sand subbase at frost-footed stoops.
20. Retaining wall subgrade.
21. Pavement subgrade construction, maintenance, testing, and approval prior to placement of pavement base materials. Continue maintenance until pavement base materials are constructed.
22. Sand base or stabilized aggregate base under walks and ramps.
23. Restoration and cleanup.

B. Work under this Section is affected by an Alternate Bid. Refer to Section 01 23 00 - Description of Alternates.

1.2 SUBMITTALS

A. Submit information and shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

B. Submit the following product information and shop drawings:

C. Submit samples of subgrade soils, proposed aggregates, sands, backfill, and fill materials to the testing laboratory at least three days prior to placement for evaluation of their suitability and determination of the optimum moisture content and maximum dry density.

D. Submit Building Pad Soil Correction Surveys and Calculations.

1. Submit survey of the excavation bottom certified by the Land Surveyor.
   (a) The submittal shall include a pdf copy of all shots recorded and an AutoCAD (.dwg) file containing the three-dimensional shots that make up the surface of the bottom of excavation.
   (b) Submitted files shall be based on the same coordinate system and datum as the construction documents.
2. Submit volume calculations for review by the Engineer based on the actual building pad soil correction quantity method described in this Section.
   (a) Calculations shall be based on in-place volumes. Shrinkage factors or other factors shall not be applied and will not be permitted.

1.3 DEFINITIONS

A. Backfill: Placing of approved site soil or borrow material in accordance with specified procedures and compaction to establish elevations shown for site improvements and general rough grading.

B. Borrow Material: Approved soil materials for fill, backfill, or rough grading required, from sources other than those made available by stripping of excavation of site.

C. Building Area: The area of the site within a line three feet outside of the proposed building perimeter and extending at a slope of 1:1 (horizontal to vertical) to the bottom of the excavation.

D. Clearing: Removal of trees, vegetation, rubble and other unsuitable materials from the site or limits of work.

E. Engineered Fill: Placing of approved site material or borrow material in accordance with specified procedures and compaction to achieve an assumed soil bearing capacity specified herein for building footings and retaining wall subgrade.

F. Excavation: Cutting, digging and removing soil materials of every classification and of whatever substance encountered to dimensions, limits, elevation and contours shown on the Drawings.

G. Existing Site Material: Stripped and excavated material from work, of approved classification. Material must be approved by testing agency prior to placement.

H. Geotechnical Engineer: The Owner will employ and pay for the services of a soil testing and inspection service, the Geotechnical Engineer and Testing Laboratory representatives, for quality control testing of the earthwork operations. This individual or company is not the design engineer of record for the project.

I. Pavement Area: The area within concrete or asphalt pavement areas within a line one foot beyond the pavement limits and extending at a slope of 1:1 to the bottom of the excavation.

J. Prepared Subgrade: Upper part of subgrade that is compacted to a greater density than lower portion of subgrade or subsoil. This material occurs beneath drives, roadways, and parking areas.

K. Retaining Wall Area: The area of the site within a line five feet each way of the proposed retaining wall face and extending at a slope of 1½ : 1 (horizontal to vertical) to the bottom of the excavation.

L. Rock: Rock excavation is defined to include all hard, solid rock in ledge formation, bedded deposits and unstratified masses; all-natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock; and any boulder stone, masonry or concrete fragments exceeding one cubic yard in volume. Materials such a shale, hard pan, soft or disintegrated rock which can be dislodged with a power operated excavator will not be classified as rock excavation.

M. Soil Classification: Classification of soils for engineering purposes, ASTM D2487 Unified Soils Classification System (USCS) with divisions, group symbols, typical names and criteria referenced herein.

N. Stripping: Excavation and removal of topsoil, fill and any other upper layers of soils.

O. Subbase: Compacted fill upon which stabilized aggregate base is placed.

P. Subgrade: Subsoil in place, backfill or fill material upon which subbase, stabilized aggregate base, footings, or sand bases are placed.

Q. Subsoil: Natural soil in place on the site.

R. Topsoil: Fertile, friable, natural loam containing a liberal amount of humus and capable of sustaining vigorous plant growth. The pH value of the topsoil shall be between 5.5 and 7.5.

S. Unstable Materials: Materials which are not classified as unsuitable materials, but due to their condition of being too wet, too dry, over-compacted, are unacceptable.

T. Unsuitable Materials: Rock, loam, gumbo, mud, muck, silt, organic silty clay, peat, frozen soils, boulders, debris, rubbish, old foundations, pavements, slabs, vegetation, or highly organic soils.

1.4 JOB CONDITIONS

A. Site Information:

1. All information concerning property boundaries, ground elevations, present obstructions on or near the site, location of conduits, pipes, wires, etc., has been obtained from a source the Owner believes reliable. Present soil and subsurface conditions are documented by test boring logs included herein, however accuracy of this data is not guaranteed, and is furnished solely for the convenience of the Bidder. Use of this data is at Bidder's risk and no additional compensation will be granted because of the Bidder's lack of knowledge of the existing site.

2. Test borings and other exploratory operations may be conducted by a Bidder, at no cost to the Owner, provided the methods and operations are acceptable to the Owner.

3. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult appropriate utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair any damaged utility(s) to satisfaction of utility owner.

4. Visit the site prior to bidding and be familiar with actual conditions in the field. Extra compensation will not be allowed for conditions which could have been determined or anticipated by examination of the site, the Contract Documents, and the information available pertaining to existing soils, utilities and other site characteristics.

5. Maintain carefully, as established, temporary benchmarks, monuments, and other reference points and, if disturbed or destroyed by the Contractor, pay for replacement by a registered Engineer or Land Surveyor.

6. Locate existing underground public and private utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.

1.5 QUALITY ASSURANCE

A. Employ and pay for the services of a Registered Land Surveyor to layout the Work and locate and mark associated benchmarks. Refer to Section 01 71 23 - Field Engineering.

B. The Owner will employ and pay for the services of a soil testing and inspection service (Geotechnical Engineer and Testing Laboratory) for quality control testing of the earthwork operations.

C. A Testing Laboratory representative must be present during stripping, excavation, backfilling, and compaction operations. Services which will be performed by the Testing Laboratory:

1. The Testing Laboratory will test and inspect excavations within building and retaining wall areas, prior to any filling, to ensure that unsuitable soils have been completely removed and unstable soils have been stabilized or removed. Tests will be performed in the bottoms of the excavations to evaluate if the bearing capacity of the natural soils is at least 4,000 pounds per square foot (psf) for footings, and 2,000 pounds per square foot (psf) for retaining walls.

2. The Testing Laboratory will test and inspect excavations within paved areas, prior to any filling, to ensure that unsuitable soils have been completely removed within the upper three feet of subgrade, and unstable soils have been stabilized or removed.

3. The Testing Laboratory will test and inspect imported and on-site fill and aggregates prior to use. This will consist of sieve analyses to determine the suitability of the materials for the intended use. Once the source has been approved, the materials being delivered to the project will be tested on a regular basis to aid in evaluating their uniformity.

4. The Testing Laboratory will test and inspect fill and backfill materials, observe operations, will determine optimum use of various on-site soils, and will review and approve method of subcutting unsuitable soils.

5. The Testing Laboratory will take density tests as backfilling occurs to ensure that material is uniformly compacted to conform with the specifications. Compaction tests will be taken at an interval of at least one for every 100 cubic yards of fill placed in building and retaining wall areas, one for every 100 feet of footing trench backfill, and at least one for every 400 cubic yards of fill placed in pavement areas. Tests will be taken at maximum vertical intervals of 2 feet of fill placed.

6. The Testing Laboratory will observe proof rolling and will make recommendations for areas that do not pass the proof roll test.

D. Contractor's Responsibilities:

1. Submit samples of proposed aggregates, sands, backfill, and fill materials to the Testing Laboratory at least three days prior to placement for evaluation of their suitability, and determination of the optimum moisture content and maximum dry density.

2. Inform the Testing Laboratory representative of proposed earthwork schedule at least 48 hours prior to commencing work. Do not perform earthwork operations which require inspection by the Testing Laboratory unless Testing Laboratory representative is present. Coordinate all earthwork activities with the Testing Laboratory. Allow the Testing Laboratory to test excavation bottoms prior to placing fill.

3. Provide a fully loaded tandem axle dump truck for proof rolling operations and perform proof rolling in presence of the Testing Laboratory representative. Perform the proof roll test as many times as necessary as determined by the Testing Laboratory representative to the satisfaction of the Testing Laboratory representative.

PART 2 - PRODUCTS

2.1 EARTH MATERIALS

A. Engineered Fill for the Building Pad:

1. Engineered Fill shall be free of rock, cobbles, boulders, stones larger than 1 inch, debris, rubble, lumps, wood, topsoil, organic material, fat clays, soft, frozen, or other unsuitable material.

2. The fill may consist of on-site or imported soils.

   (a) For fill depths less than 10 feet, on-site soils shall consist of organic free and debris free sandy lean clay, clayey sand, or non-plastic silty sand till soils having a liquid limit less than 35%. ML, CL-ML, or CH soils shall not be used.

   (b) For fill depths less than 10 feet, imported soils shall consist of organic free and debris free clayey sand (SC) or silty sand (SM) with at least 35% by weight passing the #200 sieve, and having a liquid limit less than 35%. ML, CL-ML, or CH soils shall not be used.

   (c) For fill depths greater than 10 feet, fill soils shall be imported. Imported soils shall consist of organic free mineral soils, type GP, GW, SP, SW, or SP-SM, modified to 100% passing a 1 inch sieve, and not more than 12% of the particles by weight passing a #200 sieve.

3. The cost of imported soils shall be included in the Bid. No additional costs will be allowed for soil import.

B. Foundation Wall Backfill:

1. Backfill shall meet the specifications for Engineered Fill for the Building Pad unless otherwise noted.

2. The cost of imported soils shall be included in the Bid. No additional costs will be allowed for soil import.

C. Retaining Wall Subgrade:

1. Fill shall be free of rock, cobbles, boulders, stones larger than 2 inches, debris, rubble, lumps, wood, topsoil, organic material, fat clays, soft, frozen, or other unsuitable material.

2. The fill may consist of on-site or imported soils.

3. Fill shall consist of organic free and debris free mineral soils, type SP, SP-SM, SM, SC, or CL with 100% passing the 2” sieve and not more than 25% passing the #200 sieve. ML, CL-ML, or CH soils shall not be used.

4. The cost of imported soils shall be included in the Bid. No additional costs will be allowed for soil import.

D. Pavement Area Subgrade:

1. Fill shall be free of rock, cobbles, boulders, stones larger than 2 inches, debris, rubble, lumps, wood, topsoil, organic material, fat clays, soft, frozen, or other unsuitable material.

2. The fill may consist of on-site or imported soils.

3. Fill shall consist of organic free and debris free mineral soils, type SP, SP-SM, SM, SC, or CL with 100% passing the 2” sieve and not more than 25% passing the #200 sieve. ML, CL-ML, or CH soils shall not be used.

4. The cost of imported soils shall be included in the Bid. No additional costs will be allowed for soil import.

E. Sand Subbase:

1. Imported, free draining, clean sand with 100% passing the 1/2-inch sieve, with less than 50% passing the #40 sieve, and with less than 5% passing the #200 sieve.

F. Sand Base:

1. Imported, free draining, clean sand with 100% passing the 1/2-inch sieve, with less than 50% passing the #40 sieve, and with less than 5% passing the #200 sieve.

G. Stabilized Aggregate Base:

1. Stabilized Aggregate Base shall be one of the following products:

   (a) Limestone product:

      (1) Aggregate shall meet the requirements of Mn/DOT Spec 3138. Gradation shall meet Table 3138.2-3, Class 5, modified to be 100% crushed limestone.

   (b) Igneous Stone product:

      (1) Aggregate shall meet the requirements of Mn/DOT Spec 3138. Gradation shall meet Table 3138.2-3, Class 5, modified to be 100% crushed igneous stone.

   (c) Product containing recycled materials:

      (1) Aggregate shall meet the requirements of Mn/DOT Spec 3138. Gradation shall meet Table 3138.2-4, Class 5.

2. Recycled asphalt products shall not be used within building areas.

H. General Site Fill:

1. Fill for general areas outside the Building Areas, Retaining Wall Areas, Pavement Areas, Areas shall be free of rock, boulders, debris, rubble, lumps, wood, topsoil, soft, or frozen material.
2. The fill may consist of on-site or imported soils.
3. Fill shall consist of debris free soils with 100% passing a 6 inch sieve. Soils shall have an organic content less than 10%.
4. The cost of imported soils shall be included in the Bid. No additional costs will be allowed for soil import.

I. Topsoil:

1. Fertile, friable, natural loam containing a liberal amount of humus and capable of sustaining vigorous plant growth.
2. Clean and free of subsoil, stones, clods of hard earth, plants or their roots, and other extraneous matter.
3. The pH value of the topsoil shall be between 5.5 and 7.5.
4. Topsoil obtained from stripping the site may be used. Obtain topsoil from naturally well-drained areas.

   (a) Buried organic soil or organic soil taken from hydric areas shall not be used.

5. Imported topsoil shall meet Mn/DOT 3877.2C Sandy Clay Loam Topsoil Borrow.
6. Screen all topsoil, including on-site stockpiled topsoil and imported topsoil, through a 1-inch screen prior to placement.
7. The cost of imported soils shall be included in the Bid. No additional costs will be allowed for soil import.

PART 3 - EXECUTION

3.1 SPECIAL PRECAUTIONS

A. Dewatering

1. Prevent surface water and subsurface / ground water from flowing into excavations and from flooding the site and surrounding area.

2. Do not allow water to accumulate in excavations. Remove water to prevent soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations. Draw down groundwater below the anticipated excavation bottom in advance of excavation. Locate sump pits outside of pavement areas and outside the building pad and its oversize area.

   (a) Remove sediment and suspended materials from water discharged from pumping, diversion, or similar operations before releasing to Waters of the State. Treat discharge water in accordance with Mn/DOT Spec 3875 Water Treatment. "Waters of the State", as defined in Minn. Stat. § 115.01, subd. 22, includes all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, reservoirs, aquifers, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface or underground, natural or artificial, public or private, which are contained within, flow through, or border upon the state or any portion thereof. Waters of the State include storm sewer, curb and gutter, and pavements.

3. If soils are disturbed or become unstable, remove and replace with drier compacted fill. Alternatively, under favorable weather conditions, scarify, dry and recompact the disturbed or unstable soils back into place.

4. Convey rainwater runoff and water removed from excavations to temporary ponding areas. Establish and maintain temporary drainage ditches and other diversions outside structure and pavement excavation limits. Do not use trench excavations as temporary drainage ditches.

5. Do not place fill or compacted fill in standing water or over softened soils.

6. Include all dewatering costs in the Bid. No additional costs related to dewatering, including groundwater or precipitation, will be permitted.

B. Stability of Excavations

1. Sidewalls of all excavations shall comply with the most current OSHA regulations and applicable local codes and ordinances. Shore and brace where adequate sloping is not feasible because of space restrictions or stability of material being excavated.

2. Maintain slopes of excavations in safe condition until completion of backfilling.

3. Soils on site are sensitive to moisture and may be easily disturbed by construction traffic. Provide stabilization materials (sand, aggregate, hydrated lime, fly ash, etc.) to stabilize. Limit use of rubber-tired equipment on subgrade. Use smooth bucket backhoes or similar equipment without teeth for excavations. Provide measures to protect subgrade from becoming unstable and maintaining stability of subgrade soils. Pavement subgrade stabilization will be the responsibility of the Earthwork Contractor until the Stabilized Aggregate Base course is installed by the Paving Contractor.

   (a) Include all costs associated with subgrade stabilization in the Bid.

C. Cold Weather Protection

1. If site grading and construction takes place during cold weather, implement good winter construction practices. Remove snow, ice, and frozen materials from cut and fill areas prior to additional grading. Do not place fill, footings, or slabs on soils which have frozen or contain frozen material. Do not use frozen soils as fill.

2. Protect excavation bottoms against freezing when atmospheric temperature is less than 35° F.

3.2 LAYOUT

A. Hire the services of a utility locator company to locate all privately owned utilities that may be disturbed by construction operations. Obtain any record information from the Owner related to existing utilities to aid in the location of all existing utilities.

B. Employ and pay for the services of a registered Engineer or Land Surveyor to stake and tape limits of construction, accurately locate the site boundaries, pavements, curbs, walks, utilities, buildings, building additions, retaining walls, athletic facilities, play areas, and elevations, and establish temporary benchmarks for use during construction. Refer to Section 01 71 23 - Field Engineering.

C. Applicable portions of the building, building additions, retaining walls, parking lots, and drive areas shall be frequently staked, with horizontal and vertical reference points, during excavation and backfilling operations to facilitate orientation of the Testing Laboratory representative.

3.3 IMPLEMENTATION OF THE STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

A. Initiate the permit application process and use the information referenced in Section 01 57 23 Temporary Storm Water Pollution Control to complete and submit the application.

B. Pay for, obtain, and complete the required NPDES permit application.

C. Obtain the Permit.

D. Implement the requirements of the SWPPP plans and narratives.

E. Maintain existing site, adjacent properties and public streets clean on a daily basis from construction caused dirt and debris. Remove sediments tracked on to pavements from the construction site. At a minimum, provide daily sweeping of all pavements.

F. Maintain dust control during grading operations. Water soils to control dust.

G. Provide temporary seeding of all disturbed areas as required in the SWPPP Narrative.

H. Protect newly graded areas from traffic and erosion. Repair and re-establish grades in settled, eroded and rutted areas to specified tolerances.

I. Include in the Bid all costs associated with implementation, maintenance, and compliance with the SWPPP and the NPDES permit. No additional costs will be allowed.

3.4 STOCKPILE MANAGEMENT

A. Stockpiles shall not be placed in surface waters of the state, including surface conveyances such as curb and gutter, swales, or ditches.

B. Install silt fence at the base of stockpiles (full perimeter).

C. Stabilize stockpiles immediately for areas that will not resume construction for a duration of 7 calendar days as specified for Stabilization Practices in Section 31 25 00 Erosion and Sedimentation Control.

D. Stockpile management is not required for clean aggregate stockpiles.

3.5 TEMPORARY HAUL ROAD, TEMPORARY CONSTRUCTION PARKING, AND LAYDOWN AREAS

A. Confirm the locations with the Construction Manager prior to construction.

B. The exact location of the haul roads, temporary construction parking, and laydown areas may be adjusted in the field to avoid future construction. The Construction Manager will review and approve adjustments.

C. Install and maintain haul roads, temporary construction parking and laydown areas. Continue maintenance through construction.

D. Remove the haul roads, temporary construction parking, and laydown areas outside of the building and paved areas. Complete rough grading and topsoil placement.

3.6 TEMPORARY DIVERSION BERMS

A. Construct temporary diversion berms. Locations of the berms may be field adjusted. Notify the Engineer if changes are needed to the plans.

3.7 EXCAVATIONS

A. Excavate to the lines, grades and slopes shown on the Drawings.

B. Provide temporary drainage where construction interferes with existing drainage.

C. Excavations over 20 feet in depth require an Engineer to evaluate trench slope stability. An OSHA-approved qualified person, employed by the Contractor, shall review the soil classification in the field. Excavations shall comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, "Excavations and Trenches." Costs for engineering evaluations and resulting excavation operations to comply with this requirement shall be included in the bid and no additional compensation will be permitted.

D. Excavate and remove all vegetation, topsoil, fill material, unsuitable soils, very soft to stiff clays, very loose to medium dense sands, and soils with organic content within Building Areas and Retaining Wall Areas, including oversize areas. Remove any soft soils which are unsuitable for loads as directed by the Testing Laboratory representative. No proposed slabs or similar loads shall bear on soil with questionable bearing capacity.

E. Excavations within a zone horizontally outward a minimum 3 feet from the outside of the existing footings and slabs and extending at a 1 ½ to 1 horizontal to vertical slope outward and downward from the bottom of the existing foundation will require support of existing foundations.

1. Provide adequate shoring, bracing, and underpinning of the existing building for construction of the building pad. Under this contract, stability of the existing building will be the responsibility of this Contractor. All shoring, bracing, and underpinning shall be reviewed and approved by the Geotechnical Engineer or it's appointed Testing Laboratory representative, employed by the Owner, during construction.

F. Excavate and remove all vegetation, topsoil, fill material, unsuitable soils, very soft to stiff clays, very loose to medium dense sands, and soils with organic content within the upper three (3) feet of final subgrade elevation of all proposed pavement areas, including pavement oversize areas. Remove all organic soils and vegetation under pavement areas. Remove any soft soils which are unsuitable for loads as directed by the Testing Laboratory representative.

G. Excavation shall extend a minimum of six inches below elevation of observed unsuitable soil. Extend excavations in wet or fine-grained soils to remove disturbed bottom soils.

H. Oversize building excavations at least three feet beyond the edge of the wall plus 1 foot horizontally for each foot of excavation below the bottoms of the footings (1:1 oversizing).

I. Oversize retaining wall excavations at least five feet beyond the face and back of the wall plus 1 foot horizontally for each foot of excavation below the bottoms of the footings (1 : 1 oversizing).

J. Oversize pavement area excavations one foot beyond the outside edges of the back of curb (or edge of pavement, where no curbing is proposed), plus 1 foot horizontally for each foot of excavation below the pavement (1:1 oversizing).

K. Construct the building pad to a uniform subgrade elevation. Excavate for footings only after the entire building pad has been tested and approved.

L. In Building Areas, Retaining Wall Areas, Pavement Areas, following excavation to subgrade elevation, prepare the subgrade by scarifying subgrade soils to a minimum depth of 12", moisture conditioning soils to within the specified variance from optimum moisture content, and compacting to the specified density. Disc and dry soils as required to accomplish the specified moisture content. Remove and replace soils that cannot be stabilized, as determined by the Geotechnical Engineer or it's appointed Testing Laboratory representative, in accordance with Paragraph 3.15 of this Section. In pavement areas, following subgrade preparation and prior to placement of fill, proof roll the subgrade as specified herein for the Proof Roll.

3.8 BUILDING PAD SOIL CORRECTION

A. Prior to construction, conduct a separate Building Pad Soil Correction preconstruction meeting prior to beginning building pad soil correction. Procedures outlined herein will be reviewed and discussed at the preconstruction meeting. Required attendees:

1. Civil Engineer
2. Geotechnical Engineer
3. Contractor's Surveyor
4. Earthwork Contractor
5. General Contractor
6. Construction Manager
7. Owner's representative

B. Include in the lump sum base bid price the building pad soil correction quantity shown on the Drawings.

C. Subsequent to excavating unsuitable soil and subgrade approval by the Geotechnical Engineer, record the bottom of the excavation in the presence of the Geotechnical Engineer. Recording shall be accomplished by the Registered Land Surveyor employed by the Contractor. Certification of the shots by the Registered Land Surveyor is required. Allow time for this work to occur and coordinate this work with the Geotechnical Engineer and the Land Surveyor.

D. Following surveying by the Land Surveyor, place approved fill in approved lifts as noted herein up to building subgrade elevation.

E. Building Pad Soil Correction, affected by Unit Price, includes excavation of unsuitable soils and backfilling and compacting of soils specified for Engineered Fill. Use of on-site soils versus imported soils will not factor into the calculations. The calculations will be strictly based on the volume calculations described in this Section.

F. The base bid will be adjusted by Unit Price (add or deduct to the Contract) based on the survey prepared by the Land Surveyor and the resulting volume calculations.

G. Actual building pad soil correction quantity will be calculated as follows:

1. The upper limit will be existing grade or building pad subgrade elevation, whichever is lower in elevation.
2. Lower limit will be the excavation elevations recorded in the field by the Contractor's Land Surveyor.
3. Side limits shall begin at building pad subgrade elevation. The side slopes will start 3' from the building wall limits and slope down at a 1:1 slope out and away from the building area until this line intercepts the lower limit.
4. The soil quantity for the unit price will be the difference between the actual building pad soil correction quantity and the base bid building pad soil correction quantity listed on the Drawings. Where the actual soil quantity is more than the base bid, the result will be an add to the Contract, and vice versa.

H. Excavation, backfilling, and compaction beyond the in-place volume limits described above will not count towards the building pad soil correction quantity, unit price quantity, or actual field measured quantity, and will be considered incidental to the Contract.

I. Submit survey of the excavation bottom certified by the Land Surveyor.

1. The submittal shall include a pdf copy of all shots recorded and an AutoCAD (.dwg) file containing the three-dimensional shots that make up the surface of the bottom of excavation.
2. Submitted files shall be based on the same coordinate system and datum as the construction documents.
3. Submit a certified and signed pdf copy of the surveyed shots.

J. Submit volume calculations for review by the Engineer based on the actual building pad soil correction quantity method described in this Section.

1. Calculations shall be based on in-place volumes. Shrinkage factors or other factors shall not be applied and will not be permitted.

K. The Engineer will also develop volume calculations based on this specification and the submitted survey files.

L. Determination of the final volume to be applied to the Unit Price will be made by the Engineer upon comparing Engineer's calculations and Contractor's calculations.

3.9 FOOTING AND FOUNDATION EXCAVATION, BACKFILLING AND COMPACTING

A. Disposition of Materials

1. Material Stockpiles

(a) Stockpile excavated material which is suitable for reuse as backfill.

(b) Locate stockpiles to avoid impairment of later operations by other contractors. Consult with other trades prior to stockpiling.

2. Surplus Materials

(a) Remove unsuitable materials from the site. Export soils at no additional cost to the Owner.

(b) Remove excess and surplus materials from the site. Export soils at no additional cost to the Owner.

3. General Method of Procedure

(a) Construct the building pad to a uniform subgrade elevation. Excavate for footings only after the entire building pad has been tested and approved.

(b) Trench or hand excavate for footings.

(c) Prior to placing forms or reinforcement, surface compact the exposed footing subgrade to provide a uniform bearing capacity.

(d) The Testing Laboratory representative will inspect footing trenches to determine that actual soil bearing values meet the requirements specified herein and that no unsuitable, unstable or inadequate soils exist beneath the proposed footings.

(e) Allow for pouring of concrete footings and laying up of foundation walls.

(f) Shore foundation walls or backfill and compact with soils on both sides of foundation walls simultaneously.

(g) Backfill and compact with specified material to building pad subgrade elevation.

(h) Footing excavation shall progress with the schedule of footing installation. Do not excavate footing trenches beyond the footing installation limits for the day.

B. Unauthorized Excavation

1. Where an excavation is made beyond the footing subgrade elevation, do not place fill soils without specific approval by the Testing Laboratory representative.

2. If an excavation is made too deep, fill the excess excavation with concrete to footing subgrade elevation. Costs associated with additional concrete will be the Contractor's expense.

C. Compaction and Backfill

1. Prior to placing forms or reinforcement, surface compact the exposed footing subgrade to a minimum 98% of the standard Proctor density (ASTM D 698), to the satisfaction of the Testing Laboratory representative, to ensure a uniform bearing capacity.

2. Surface prepare and compact soils in areas where soil does not meet the specified density. Footings shall not rest on unsuitable or unstable soil.

3. Foundation Wall Backfill:

(a) Deposit approved fill against foundation walls in uniform layers, evenly on each side of the wall, in lifts not exceeding 4-6 inches loose thickness.

4. Use manually operated vibratory plate compactors to compact fill and backfill placed within five feet from building foundation walls or retaining walls. Self-propelled compactors shall only be used outside of this five foot limit.

3.10 BUILDING PAD BASE

A. Immediately prior to building floor construction, construct the building pad base.

B. Coordinate building pad base construction with vapor barrier installation.

C. Uniformly grade all ruts and ridges in the building pad subgrade prior to installing the building pad base to provide uniform material thickness.

D. Compact building pad base materials to 100% standard Proctor density (ASTM D 698).

3.11 SAND SUBBASE AT DOORS AND FROST FOOTED STOOPS

A. Strip, excavate and remove topsoil.

B. Remove all frost susceptible soils, such as clays and silty soils, within the limits described below.

1. The subexcavation shall be wedge-shaped, with a five-foot depth adjacent to the stoop, extending to six-foot depth five feet away from the stoop, and then tapering to a four-inch depth 25' beyond the stoop. Lateral width shall match the width of the walk serving the stoop.

2. Backfill subexcavation with specified sand in 12-16 inch lifts, compacted to 100% standard Proctor density (ASTM D 698).

3.12 COMPACTED FILL

A. Prior to placement of fill materials, the Testing Laboratory representative must test, inspect and approve the bottom of each excavation. Do not proceed with fill placement until the subgrade has been prepared, and the Testing Laboratory has approved the subgrade.

B. Before placing fill on a slope steeper than 4 horizontally to 1 vertically (4:1), perform one of the two following options:

1. Flatten the existing slope to the extent that it will not be steeper than 4 to 1; or

2. Construct steps in the slope, with the back surface being as nearly vertical as practicable and with the horizontal cuts being made as close together as the slope permits, but with no step being less than ten feet in width.

C. Do not place fill on frozen ground or continue filling operations when the fill material is at risk for freezing.

D. Do not place fill shall in standing water, in wet conditions, or over softened soils.

E. Break up or disc soil clumps or slabs to allow for proper compaction. Discing and compaction operations shall be approved by the Testing Laboratory representative.

F. Engineered Fill for the Building Pad, Retaining Wall Subgrade, and Pavement Area Subgrade: Deposit approved fill in uniform layers not exceeding 8 inches loose thickness, dependent upon review by the Testing Laboratory representative. Compact each layer with approved methods and equipment that will densify the entire lift. Place fill within the specified moisture content range as approved by the Testing Laboratory representative.

G. Stabilized aggregate base on the building pad shall be coordinated with work by other trades.

H. General Site Fill: Deposit approved fill in uniform layers not exceeding 12 inches loose thickness, dependent upon review by the Testing Laboratory representative. Place fill within the specified moisture content range as approved by the Testing Laboratory representative.

I. The fill material, when being compacted, shall contain the moisture content necessary for the required compaction as designated by the Testing Laboratory representative. The moisture shall be uniform throughout each layer.

J. Use manually operated vibratory plate compactors within five feet from building foundation walls or retaining walls. Use self-propelled compactors outside of this five foot limit.

K. Spread, disc, farm, or otherwise dry wet soils as required to achieve a uniform moisture content throughout the soil. Moisten soils when too dry to achieve the required moisture content.

L. Scarify, remove, recompact or otherwise rectify all soft or yielding areas resulting from construction operations, precipitation, or other sources at no additional cost to the Owner.

M. If there are areas which cannot be compacted or stabilized, scarify the upper 24 inches to a moisture content not more than 1 percent above optimum, and compact to a minimum of 100% standard Proctor density (ASTM D 698). If after scarifying the areas still cannot be compacted or stabilized, the unstable materials shall be excavated to a depth of 36 inches and be replaced with materials which can be compacted.

3.13 COMPACTION DENSITY REQUIREMENTS

A. Relative Compaction and Moisture Content Variance from Optimum for fill and backfill shall meet the following Table. Relative compaction values listed are minimum values. Do not exceed the listed variances for Optimal Moisture Content.

Earth Material	Relative Compaction, Minimum Percent, standard Proctor density (ASTM D 698)	Moisture Content Variance from Optimum, percentage
Engineered Fill for the Building Pad, soils more than 12% passing the #200 sieve	98%	-1% to +3%
Engineered Fill for the Building Pad, soils less than 12% passing the #200 sieve	98%	-3% to +3%
Below Building Footings, Foundations, and Oversize Zones	98%	-1% to +3%
Exterior Foundation Wall Backfill In Landscape Areas	95%	-3% to +3%
Stabilized Aggregate Base on the Building Pad	98%	-3% to +3%
Retaining Wall Subgrade	98%	-3% to +3%
Pavement Area Subgrade – more than 3 feet below subgrade	95%	-3% to +3%
Pavement Area Subgrade –the upper 3 feet of subgrade, soils more than 12% passing the #200 sieve	100%	-1% to +3%
Pavement Area Subgrade –the upper 3 feet of subgrade, soils less than 12% passing the #200 sieve	100%	-3% to +3%
General Site Fill	90%	-4% to +5%

B. In areas where tests do not meet the values listed in the Table above, provide additional compaction or preparation as needed, or remove and recompact soils to meet the specified values. Reworking of soils will be at the Contractor's expense. Each lift must be approved before commencing with the next succeeding lift.

3.14 ROUGH GRADING

A. The proposed contours and spot elevations shown on the Drawings indicate proposed finish grades. Grade to subgrade elevations, except for general landscape areas which shall be graded to finish grade with specified topsoil

B. The Contractor will be solely responsible for determining quantities of cut, fill and waste materials to be handled, and for the amount of grading to be done in order to completely perform all work indicated on the Drawings.

C. Import suitable material and export unsuitable, excess, or waste material, as required. This work shall be included in the Bid. No additional costs will be allowed for importing or exporting soils.

D. Mining of soils for any purpose other than to construct the proposed improvements is prohibited. Trench borrowing, mining, or other over-excavations within Building Areas, Pavement Areas, Retaining Wall Areas, is prohibited.

E. Provide surfaces free of debris and building construction materials. Remove stones, rocks, debris, and similar undesirable material over 1" in diameter. Remove weeds, root masses, sod / vegetation clumps, branches, vegetation, and other deleterious materials.

F. Complete rough grading by blading to reasonably smooth contours with neat, uniform transitions and slopes. Ease new grades into surrounding existing grades without awkward or abrupt transitions.

G. Grade all surfaces such that they will not hold water. Grade all areas to drain.

H. Rough Grade Tolerances:

1. Unpaved areas outside buildings: Surfaces shall not vary by more than 0.15' above or below finish grade elevations.

2. Building and paved areas: Surfaces shall not vary by more than 0.10' above or below subgrade elevations.

I. Uniformly grade the subgrade to coincide with the proposed surface grades to ensure a consistent depth of topsoil, or pavement section.

J. In landscape areas, backfill all curbing with topsoil flush with the top of curb. Compact soils and subsoils behind curb backs to prevent settlement behind the curb.

K. In landscape areas absent of curbing, grade topsoil flush with the walk or pavement surface on the up-gradient side, and hold down topsoil one inch below the walk or pavement surface on the down-gradient side.

L. Protect rough graded areas from construction traffic and erosion. Repair and re-establish grades and tolerances in settled, eroded or rutted areas to specified tolerances. No additional compensation will be permitted for protection or repairs.

3.15 SUBGRADE PREPARATION AND FINISH GRADING OF BUILDING AREAS, RETAINING WALL AREAS, PAVEMENT AREAS

A. Grade and compact the subgrade for its entirety such that, at the time the sand subbase, sand base, stabilized aggregate base or topsoil is placed, the specified density, moisture content, and stability in the subgrade are met.

B. Subgrade Preparation: Prepare the subgrade by scarifying subgrade soils to a minimum depth of 12", moisture conditioning soils to within the specified variance from optimum moisture content, and compacting to the specified density.

1. Spread, disc, farm, or otherwise dry wet soils as required to achieve a uniform moisture content throughout the soil. Moisten soils when too dry to achieve the required moisture content.

2. Scarify, remove, recompact, or otherwise rectify all soft, yielding, or unstable areas resulting from construction operations, rain, groundwater, or other sources at no additional cost to the Owner. Include all costs for moisture conditioning in the Bid. No additional costs for moisture conditioning will be permitted.

3. If there are areas which cannot be compacted or stabilized, scarify the upper 24 inches to a moisture content not more than 1 percent above optimum, and compact to a minimum of 100% standard Proctor density (ASTM D 698). If after scarifying the areas still cannot be compacted or stabilized, the unstable materials shall be excavated to a depth of 36 inches and be replaced with materials which can be compacted.

C. Uniformly grade the subgrade to coincide with the proposed surface grades. Blade subgrade to a smooth and uniform surface prior to proof roll.

D. Subgrade Finish Grade Tolerances:

1. Building Areas: Surfaces shall not vary by more than 0.06' (¾ inch) above or below subgrade elevations.
2. Retaining Wall Areas: Surfaces shall not vary by more than 0.06' (¾ inch) above or below subgrade elevations.
3. Pavement Areas: Surfaces shall not vary by more than 0.06' (¾ inch) above or below subgrade elevations.

E. Proof Roll for Pavement Areas:

1. Conduct the Proof Roll on the pavement subgrade in accordance with Mn/DOT 2111 following subgrade preparation and finish grading described herein.
2. Notify the Testing Laboratory representative and Engineer at least 48 hours in advance of the desired Proof Roll schedule.
3. Conduct the Proof Roll only after the Testing Laboratory representative agrees that the subgrade has been properly prepared and is ready for the Proof Roll test.
4. Conduct the Proof Roll in the presence of the Testing Laboratory representative. The Civil Engineer may observe the Proof Roll but their attendance is not required.
5. Notify the Paving Contractor of the Proof Roll schedule and invite the Paving Contractor to witness the Proof Roll test. The Paving Contractor is not required to attend the test.
6. Conduct the Proof Roll immediately, and not more than 48 hours, prior to placement of the sand subbase, or stabilized aggregate base. If precipitation falls on the subgrade between initial Proof Roll and placement of subsequent work, conduct the Proof Roll again.
7. Furnish and use a fully loaded tandem rear axle dump truck for the Proof Roll.
8. Drive the dump truck between 2 and 4 miles per hour in straight lines across the subgrade. Succeeding passes of the truck and the resulting unrolled areas between the tire paths shall not be wider than 42 inches.
9. Proof Roll Tolerance: Maximum yield of one inch depth of the tire rut.
10. Yielding more than the specified Tolerance will indicate a failed test. Mark the failed areas with paint. The Testing Laboratory representative must concur with the marked areas and their limits.
11. Rework the failed areas in accordance with the subgrade preparation and finish grading requirements described herein. No additional costs for reworking the failed areas will be permitted.
12. Areas shall be reworked and retested to the satisfaction of the Testing Laboratory representative.
13. The Proof Roll test will be considered passing after the entire subgrade meets the specified Tolerance as determined by the Testing Laboratory representative.

3.16 FINISH GRADING OF TOPSOIL

A. Prior to placing topsoil, till all subgrade soils that will receive topsoil to a minimum depth of 12 inches to comply with the requirements of the NPDES Permit administered through the MPCA.

B. Screen all topsoil, including on-site stockpiled topsoil and imported topsoil, through a 1-inch screen prior to placement.

C. Spread topsoil to a uniform, minimum 6 inch depth after compaction, over all turfgrass and landscape areas within the grading limits. Spread topsoil after construction of pavements, curbing, fencing, maintenance strips, and walks. Complete site grading and bring turfgrass and landscape areas to finish elevations.

D. General Topsoil Areas:

1. Blade smooth with light weight grading equipment with large, wide tires, to maintain grade uniformity without over-compacting the topsoil.

E. Compaction:

1. Do not perform direct compaction efforts on topsoil. Use light weight grading equipment with large, wide tires that will not over compact the topsoil.

2. If over compaction occurs, defined as more than 90% standard Proctor density (ASTM D 698), scarify the topsoil to full depth and regrade.

F. Finish Grade Tolerances:

1. General Topsoil Areas: Surfaces shall not vary by more than 0.08' (1 inch) above or below finish grade elevations.

3.17 RESTORATION AND CLEANUP

A. Remove all construction materials and stockpiles from the site.

B. Provide final sweeping of all paved surface, existing and proposed, at project completion.

END OF SECTION 31 0000

SECTION 31 2316 - ROCK REMOVAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes labor, materials, equipment, and accessories to provide the following:

1. Use mechanical means, or blasting if required, to remove rock impacted by the proposed construction activities.

2. This work includes rock removal as required for watermain, sanitary sewer, and storm sewer utilities.

B. Work under this Section is affected by Unit Prices. Refer to Section 01 22 00 - Unit Prices.

1.2 SUBMITTALS

A. Submit information in accordance with Section 01 33 00 - Submittals.

B. Submit Rock Removal Surveys and Calculations.

1. Submit the survey of the rock surface prior to rock removal.

(a) The submittal shall include a .pdf copy of all shots recorded and an AutoCAD (.dwg) file containing the three-dimensional shots that make up the surface of the bottom of excavation.

(b) Submitted files shall be based on the same coordinate system and datum as the construction documents.

2. Submit volume calculations for review by the Engineer based on the actual rock removal quantity method described in this Section.

(a) Calculations shall be based on in-place volumes.

1.3 PERMITS

A. Obtain all permits as required by local officials.

B. Rock removal method shall be determined by the Contractor and shall comply with all local regulations and ordinances.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION MEETING

A. Prior to construction, conduct a separate Rock Removal preconstruction meeting prior to beginning rock removal. Procedures outlined herein for measurement and payment of rock removal will be reviewed and discussed at the preconstruction meeting. Required attendees:

1. Civil Engineer

2. Geotechnical Engineer

3. Earthwork Contractor

4. Utility Contractor

5. General Contractor

6. Other Owner’s representatives

3.2 PROTECTION AND CARE OF SITE

A. Select methods and equipment for rock removal which does not adversely affect existing buildings, facilities, and property, and which complies with local ordinances and requirements.

B. Fully repair damage to structures or facilities to the Owner's satisfaction at the Contractor's expense.

C. Dewater excavations, as required, at no additional cost to the Owner, in accordance with requirements of Section 31 00 00 Earthwork.

3.3 CLASSIFICATION AND DISPOSITION OF MATERIALS

A. Excavated materials classified by the Geotechnical Engineer as rock will be paid for as an Extra Work Item. Rock excavation is affected by Unit Price. Include excavation, backfilling and compacting of all other materials encountered in the work in the bid, and no additional compensation will be provided for removal of wood, debris, boulders, stone, masonry, concrete, rock fragments less than one cubic yard in volume, together with other miscellaneous matter that can be removed effectively with power operated excavators without resorting to drilling and blasting.

B. Rock excavation is defined to include:

1. All hard, solid rock in ledge formation, bedded deposits, and unstratified masses.

2. All-natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock.

3. The above defined materials and any boulder, stone, masonry, or concrete fragments exceeding one cubic yard in volume.

4. Materials such as shale, hard pan, weathered rock, soft rock, or disintegrated rock which can be dislodged with a hand pick or removed with a power operated excavator or ripper will not be classified as rock excavation.

C. Excavated materials will be classified by the testing laboratory for reuse as being either suitable or unsuitable for backfill or other specified use, subject to the provisions listed in Section 31 00 00 Earthwork. All suitable materials shall be reserved for backfill to the extent needed. To a practical extent, segregate both granular materials, and segregate topsoil from other materials during the excavating and stockpiling operations to permit best use of the available materials at the time of backfilling.

1. Include all costs for material handling as described above in the bid with no additional compensation being permitted.

3.4 ROCK EXCAVATION

A. In general earthwork areas, remove rock to a depth of 12" below proposed finish grade and to allow for a minimum 6" topsoil depth.

B. In utility trenches, remove rock to a point 12" below the bottom of the pipe or structure to allow for bedding material.

C. Stockpile excavated materials. Export all materials considered unsuitable by the Geotechnical Engineer or Engineer at no additional cost to the Contract.

D. Following rock removal, further pulverize the disturbed rock subgrade (fractured due to blasting and/or mechanical removal operations) by running a heavy vibratory sheepsfoot roller over the surface. Pulverize the exposed rock until the maximum rock size at the surface is 3" (in any dimension).

3.5 MEASUREMENT AND PAYMENT OF ROCK REMOVAL

A. Failure to follow the specific guidelines noted herein will result in nullification of claims.

B. The rock removal quantity to be included in the lump sum bid is indicated on the Drawings. Rock removal quantities less than, or more than, the quantities listed on the plans will be affected by Unit Price (add or deduct).

C. Field Procedure for Calculations:

1. Following common excavation down to materials classified as rock, but prior to rock removal, confirm the rock characteristics with the Geotechnical Engineer's field representative. Once the Geotechnical Engineer's field representative confirms the remaining material qualifies as rock, survey the rock surface on a 10' by 10' grid. Tie the field survey to the Project dimensioning system to allow for calculations by the Contractor and Engineer.
2. Once existing rock conditions are surveyed, the Contractor may proceed with rock removal.
3. Rock Removal Pay Limits:
   (a) For general earthwork areas, subexcavate rock 12 inches below subgrade elevation.
   (b) For building areas, excavate rock to bottom of footing elevations.
   (c) For pavement areas, excavate rock to subgrade elevation.
   (d) In utility trenches, remove rock to a depth 12" below the bottom of the pipe or bottom of structure to allow for bedding materials.
      (1) Maximum rock removal pay width for pipe trenches is the pipe diameter plus 24 inches total.
      (2) Maximum rock removal pay width for utility structure trenches is the structure diameter plus 24 inches total.
4. Following rock removal, survey the rock surface on a 10' by 10' grid. Tie the field survey to the Project dimensioning system to allow for calculations by the Contractor and Engineer.

D. Adjustment of Lump Sum Bid by the Unit Price:

1. The base bid will be adjusted by Unit Price (add or deduct to the Contract) based on the survey prepared by the Contractor and the resulting volume calculations.
2. Actual rock removal quantity will be calculated as follows:
   (a) The upper limit will be the initial rock surface surveyed by the Contractor.
   (b) Lower limit will be the excavation elevations following rock removal, limited to the following depths:
      (1) For general earthwork areas, to 12 inches below subgrade elevation.
      (2) For building areas, to bottom of footing elevations.
      (3) For pavement areas, to subgrade elevation.
      (4) In utility trenches, to a depth 12" below the bottom of the pipe or bottom of structure.
   (c) Side limits will be the excavation elevations following rock removal, limited to the following widths:
      (1) 1:1 slope out and away from the outside building wall limits.
      (2) 1:1 slope out and away from the back of curb limits.
      (3) Utility trenches: Pipe diameter plus 24 inches total.
      (4) Structure trenches: Structure diameter plus 24 inches total.
   (d) The rock removal quantity for the unit price will be the difference between the actual rock removal quantity and the base bid rock removal quantities listed on the Drawings. Where the actual quantity is more than the base bid quantity, the result will be an add to the Contract, and vice versa.

3. Rock removal beyond the volume limits described above will not count towards the rock removal quantity, unit price quantity, or actual field measured quantity, and no adjustment to the Contract for these quantities will be permitted.
4. Submittals required for evaluation of quantities:
    (a) Submit the survey of the rock surface prior to rock removal.
        (1) The submittal shall include a .pdf copy of all shots recorded and an AutoCAD (.dwg) file containing the three-dimensional shots that make up the surface of the bottom of excavation.
        (2) Submitted files shall be based on the same coordinate system and datum as the construction documents.
    (b) Submit volume calculations for review by the Engineer based on the actual rock removal quantity method described in this Section.
        (1) Calculations shall be based on in-place volumes.
5. The Engineer will also develop volume calculations based on this specification and the submitted survey files.
6. Determination of the final volume to be applied to the Unit Price will be made by the Engineer upon comparing Engineer's calculations and Contractor's calculations.

END OF SECTION 31 2316

SECTION 31 2333 - TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes labor, materials, equipment, and accessories to provide the following:

1. Trenching, placement, backfilling, and compacting for the proposed utility systems indicated on the Drawings.

B. Construction Staking

1. Retain the services of a licensed Land Surveyor or Professional Engineer for construction staking. Refer to Section 01 71 23 Field Engineering.

1.2 QUALITY ASSURANCE

A. Retain the services of a licensed Land Surveyor or Professional Engineer for construction staking. Refer to Section 01 71 23 Field Engineering.

B. The Owner will employ and pay for the services of a soil testing and inspection service (Geotechnical Engineer or qualified representative) for quality control testing of the backfilling and compacting operations.

C. A qualified representative from the Geotechnical Engineer's office must be present during stripping, excavation, backfilling, and compaction operations. Services which will be performed by the testing laboratory are as follows:

1. Perform compaction tests every 100 feet of trench excavation, at maximum vertical intervals of 2 feet.

1.3 SITE CONDITIONS

A. Install barricades as part of this work and post with warning lights.

B. Maintain benchmarks, monuments, and other reference points. If disturbed or destroyed, replace or relocate by employing a Registered Land Surveyor at the Contractor's expense.

C. Protect existing trees and vegetation, equipment, pavements, curbing, facilities, utilities, and structures which are to remain and are in the area where work will be performed. Repair or replace existing property which is to remain that is damaged by the work, to the Owner's satisfaction, and at no additional cost to the Owner.

D. Existing Utilities

1. Contact Gopher State One Call before starting construction in a given area, requesting utility locations in the field.

2. The locations of overhead and underground utilities are shown on the Plans. Verify the accuracy and completeness of noted locations.

3. Field locate all power lines, communication lines, ducts, culverts, conduits, pipes, and structures which will be affected by excavation and take steps necessary to support, protect, remove or relocate said structures by means acceptable to the owners of the structures involved. To avoid delay, coordinate excavating activities with the appropriate utility companies.

4. Where culverts or other piping are damaged during construction, replace with new pipe at the Contractor's expense. Replacement with damaged material will not be permitted.

5. All costs of investigation and any necessary protection, support, removal, relocation, or replacement of existing utilities shall be included in the bid with no additional compensation being permitted.

6. Verify all utility locations and give 48 hour notice to all utility companies prior to commencement of excavating operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe Stabilization Materials

1. Sand / Gravel Material

(a) Shall be used for pipe bedding and/or trench backfill wherever peat, clay or other unsuitable bearing material is encountered as determined by the Owner's testing laboratory.

(b) Shall consist of imported, clean, granular material with gravel larger than 1" (where used as pipe bedding) and not more than 50% passing the No. 40 sieve.

(c) Shall be placed to a depth as determined by the testing laboratory, with a minimum depth of 6" below the bottom of the pipe and extending at least 1 foot beyond the sides of the pipe and 1 foot above the pipe.

2. Binder Stone

(a) Shall be crushed stone, 1 ½" clear gradation, with no particles larger than 3".

B. Pipe Bedding

1. Shall consist of imported, free draining, uniformly graded clean sand with 100% passing the 1-inch sieve, with less than 5% passing the #200 sieve and less than 50% passing the #40 sieve.

C. Backfill above Pipe Bedding

1. Shall meet the requirements identified in Section 31 00 00 Earthwork for the respective locations on site unless noted otherwise. Utilize materials specified for Pavement Area Subgrade in paved areas. Utilize materials specified General Site Fill for areas outside paved areas.

PART 3 - EXECUTION

3.1 COLD WEATHER OPERATION

A. No pipe shall be placed when the temperature falls below 30 degrees Fahrenheit without approval of the Engineer.

3.2 OFF-SITE DISPOSAL

A. Dispose of all asphalt, concrete, and other undesirable materials or debris to an approved landfill located outside the project limits.

B. All costs for these operations shall be included in the bid with no additional compensation being permitted.

3.3 CLASSIFICATION AND DISPOSITION OF MATERIALS

A. Excavated materials classified by the Geotechnical Engineer as rock will be paid for as an Extra Work Item. Rock excavation is affected by Unit Price; refer to spec Section 31 23 16.26 Rock Removal. Excavation, backfilling and compacting of all other materials encountered in the work shall be included in the bid, and no additional compensation will be provided for removal of wood, debris, boulders, stone, masonry, concrete, rock fragments less than one cubic yard in volume, together with other miscellaneous matter that can be removed effectively with power operated excavators without resorting to drilling and blasting.

B. Rock excavation is defined to include:

1. All hard, solid rock in ledge formation, bedded deposits, and unstratified masses;

2. All-natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock;

3. The above defined materials and any boulder, stone, masonry, or concrete fragments exceeding one cubic yard in volume.

4. Materials such as shale, hard pan, weathered rock, soft rock, or disintegrated rock which can be dislodged with a hand pick or removed with a power operated excavator or ripper will not be classified as rock excavation.

C. Excavated materials will be classified by the testing laboratory for reuse as being either suitable or unsuitable for backfill or other specified use, subject to the provisions listed in Section 31 00 00 Earthwork. All suitable materials shall be reserved for backfill to the extent needed. To a practical extent, both granular materials shall be segregated and topsoil shall be segregated from other materials during the excavating and stockpiling operations so as to permit best use of the available materials at the time of backfilling.

1. All costs for material handling as described above shall be included in the bid with no additional compensation being permitted.

D. All excavated materials reserved for backfill or other use on the project shall be stored at locations that will cause a minimum of inconvenience to construction operations, public travel, adjacent properties, and other special interests. The material shall not be deposited so close to the edges of the excavations as would create hazardous conditions, nor shall any material be placed so as to block the access to emergency services.

1. All excess materials or materials considered unsuitable by the testing laboratory for use on the site shall be immediately removed from the project site (export). No additional costs for soil export will be permitted; include all such costs in the bid.

3.4 SHEETING AND BRACING

A. To prevent the disturbing or settlement of adjacent road surfaces, foundations, structures, railroad tracks or other improvements, furnish and install all sheeting and bracing necessary to provide good working conditions and prevent damage and delay to the work. Determine the strength and sufficiency of all sheeting and bracing and employ a registered engineer for this determination.

B. Bracing shall be so arranged as to provide ample working space and so as not to interfere with the work and so as not to place any strain on the structures being constructed until such structures are of ample strength to withstand such strain.

1. All sheeting and bracing, unless otherwise specified or ordered to be left in place by the Engineer, shall be removed from the site. Include these costs in the bid.

C. Any damage to work under this Contract or to adjacent structures or property caused by settlement, water or earth pressures, slides, cave-ins, or other causes due to failure or lack of sheeting and bracing or improper bracing, through negligence or fault of the Contractor in any manner, shall be repaired by the Contractor without delay.

3.5 TRENCHING

A. Excavate to depth and width necessary for utility construction. Excavation width shall not exceed the outside diameter of pipe plus 24 inches.

B. Dig the trench in advance of the pipe installation. All trenches shall be refilled or barricaded at the end of each day. Trenches within any right-of-way shall be completely backfilled at the end of each day. The sides of the trenches shall be sloped and/or braced, and the trenches drained so that workers can work safely and efficiently.

C. Segregate all unsuitable materials from suitable materials.

D. During utility placement, take precautions to ensure that all trenches and excavated trench materials are maintained in a dry and stable condition.

E. Maintain dry and stable conditions during utility placement or trench backfilling work. Postpone work until these conditions are met.

F. Ground water encountered during trench excavation, utility placement, and trench backfilling shall be removed completely for the duration of utility placement and trench backfilling. Removal of ground water shall be accomplished by acceptable means. Do not permit the backfill material to absorb moisture due to careless workmanship during water removal. Specifically, when native soil materials are to be used for trench backfill, bucket removal of water with native soil materials, thereby creating a highly elevated soil moisture content, will be prohibited.

G. Removal of ground water and replacement of backfill material containing excessive moisture shall be the Contractor's responsibility with no additional compensation being permitted. Replacement material must be approved by the testing laboratory prior to its use.

H. Rock excavation may be required. Refer to spec Section 31 23 16.26 Rock Removal.

1. If rock is encountered in utility trenches, rock shall be removed to a depth as indicated on the Drawings.

3.6 INSTALLING PIPE AND APPURTENANCES

A. Pipe and other materials shall be unloaded and distributed on the job in an acceptable manner. In no case shall materials be thrown or dumped from the truck.

B. All pipe materials shall be carefully lowered into trench, piece by piece, by means of a derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to materials and protective coatings and lining. Under no circumstances shall pipe materials be dumped into the trench. Damaged coatings and linings shall be repaired or the pipe shall be replaced.

C. Provide suitable temporary channels for surface water that may flow along or across the area of work. Excavated material shall be placed on one side of the trench. No material shall be placed so as to obstruct any existing drainage system.

D. Comply with dewatering requirements noted in Section 31 00 00 Earthwork.

3.7 PIPE BEDDING

A. All pipe shall be laid upon sound, granular soil, min. 6" depth, cut true and even so that the barrel of the pipe will have a bearing for its full length. Bell holes shall be dug at the ends of each length of pipe to permit proper jointing.

B. If unstable or unsuitable soils are encountered, as defined in Section 31 00 00 Earthwork, immediately notify the testing laboratory. Unstable material shall be replaced with stabilization material as instructed by the testing laboratory. Costs for additional excavation or stabilization material shall be included in the bid with no additional compensation being permitted.

C. Excavated rock shall not be used as pipe bedding.

3.8 BACKFILLING PROCEDURES

A. All trench areas shall be backfilled to existing grade or to proposed subgrade. Proceed with backfilling without delay as the installation is made.

B. Granular material, free from rocks, boulders, organics or frozen material shall be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench to a minimum height of twelve (12) inches above the top of the pipe. The material shall be shovel placed and hand tamped to fill completely all spaces under and adjacent to the pipe. If the pipe size is larger than 12", the granular backfill from the bottom of the trench to 12" above the top of the pipe shall be placed by either hand or mechanical methods in two lifts. The first lift, from the trench bottom to the pipe springline, and the second lift, shall be compacted with a minimum of 2 passes with an approved type of mechanical tamping compactor.

C. If suitable granular material for this portion of the backfill is not available from the trench excavation, as determined by the Testing Laboratory representative, provide and place sand-gravel material as described in this Section.

D. Succeeding layers of backfill from twelve (12) inches above the pipe to subgrade may contain coarse materials, but shall be free from rock, frozen materials, concrete, asphalt, wood, roots, stumps, sod, rubbish, and other similar materials, whose presence in the backfill, in the opinion of the Testing Laboratory representative, may cause excessive settlement of the trench or damage to the pipe.

E. If, in the opinion of the testing laboratory, the native trench material is unsuitable for any portion of the trench backfill, it shall be considered surplus material and disposal shall be as previously described. During excavation operations, make a reasonable attempt to segregate all undesirable materials from suitable materials. Any additional suitable material needed for backfilling shall be furnished and installed at no additional cost to the Contract.

3.9 COMPACTION REQUIREMENTS

A. Trench backfill in pavement areas shall be placed in lifts no greater than 8 inches thick, at a moisture content within 3 percentage points of optimum, and compacted to a relative density of at least 95% of Standard Proctor dry density (ASTM D 698) for soils deeper than 3 feet from subgrade elevation, and compacted to a relative density of at least 100% of Standard Proctor dry density (ASTM D 698) for soils in the upper 3 feet of subgrade.

B. Trench backfill compaction within five feet of utility structures shall be accomplished with walk-behind compaction equipment. Within 5 feet of utility structures, backfill and compaction with power operated vibratory equipment will not be allowed.

3.10 MISCELLANEOUS RESTORATION

A. Restore, to a condition equal to or better than existing, all other structures not specifically mentioned above which are disturbed because of this construction including fences, clothes posts, mailboxes, yard lights, entrance markers, etc. There will be no additional compensation for this miscellaneous restoration.

3.11 SETTLEMENT

A. The Contractor will be responsible for any settlement of backfill which may occur within two years of project Substantial Completion.

B. Make, or provide for, all repairs and replacements to improvements affected by settlement of backfill within 30 days after notice from the Engineer or Architect.

END OF SECTION 31 2333

SECTION 31 2500 - EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes labor, materials, equipment, and accessories to provide the following:

1. Install and maintain all erosion and sedimentation control devices.
2. Additional erosion and sedimentation control devices as may be required by Local or State regulations.
3. Construction and continual maintenance of rock construction entrances as detailed on the Drawings and removal upon work completion. Maintenance shall continue until total project completion. Work includes removal of these temporary facilities and restoration back to existing conditions for areas outside the construction limits.
4. Sweeping of paved areas.
5. Temporary stabilization of disturbed areas and stockpiles.
6. Removal of all erosion and sedimentation devices, and restoration from removal of these devices.

1.2 SUBMITTALS

A. Submit information and shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

B. Submit the completed NPDES General Stormwater Permit for Construction Activity (MN R100001) application and permit.

C. Submit a proposed schedule for implementation of erosion and sedimentation control devices.

1. The Contractor may use the General Construction Sequence listed in the SWPPP for basis for the schedule and modify the schedule as necessary unless the modifications adversely affect erosion sediment control.

D. Submit maintenance logs on a weekly basis.

1.3 QUALITY ASSURANCE

A. All Work shall comply with the requirements of the Storm Water Pollution Prevention Plan (SWPPP) and the current NPDES permit.

1. Apply and pay for the NPDES permit.
   (a) Permit information may be obtained at www.pca.state.mn.us/water/stormwater/stormwater-c.html.
2. Initiate, implement, and complete the Notice of Termination process required by the Permit.

B. Construction activities shall not commence until all required permits are obtained.

C. Erosion and sedimentation control devices shall be inspected and approved by local authorities prior to commencement of construction operations.

D. Provide a knowledgeable and responsible person to implement and maintain inspection logs and provide inspections as required herein and by the SWPPP.

E. All erosion and sedimentation control devices shall remain in place until permanent stabilization has been accomplished including, but not limited to, 80% turf establishment and the first lift of pavement.

1.4 SITE CONDITIONS

A. Protect adjacent properties and water resources from erosion and sedimentation damage throughout Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Silt Fence

1. Fabric shall:

(a) be uniform in texture

(b) be uniform in appearance

(c) contain no defects, flaws, or tears affecting the physical properties

(d) contain UV inhibitors and stabilizers providing a minimum service life of at least 2 years during outdoor exposure

(e) meet the requirements indicated in the table below:

Silt Fence Type	**Width** ***in***	**Grab Tensile (Machine Direction)** ***lb****	**Apparent Opening Size** ‖	**UV Stability 500 H** ***% ‡***	**Minimum Flow Rates** ***gpm/sq ft***
Machine Sliced (MS), Hand Installed (HI) Woven Geotextile §	36	130	No. 30 Sieve	70	100
Pre-Assembled (PA) Woven Geotextile	36	130	No. 30 Sieve	70	100

Values in Table are Minimum Average Roll Values (MARV)
* ASTM 4632
‖ ASTM 4751 Maximum Average Roll Value
‡ ASTM 4355
§ Provide MS, HI Woven Geotextile with Monofilament in Both Directions. Do Not Make Substitutions.

2. Fasteners shall have a tensile strength of at least 50 lb.

(a) For MS and HI applications, provide plastic ties to attach geotextile materials to posts.

3. Posts

(a) MS and HI application steel posts shall meet the following:

(1) Type: T-post

(2) Weight: 0.95 lb/ft

(3) Length: ≥5.0 ft

(4) Embedment: ≥24 in

(5) Post spacing: ≤6.0 ft

(b) PA application wood posts shall meet the following:

(1) Type: Hardwood

(2) Size: ≥2 in x 2 in

(3) Length: ≥4.0 ft

(4) Embedment: ≥ 18 in

(5) Post spacing: <5.0 ft

B. Inlet Protection Devices

1. Shall be sized specifically for each structure and casting.
2. Provide all materials as recommended by the manufacturer for complete installation.
3. Approved Products:

(a) Road Drain “Top Slab”, Manufactured by Wimco

(b) Road Drain “Curb & Gutter”, Manufactured by Wimco

(c) Infrasafe® “Sediment Control Barrier”, Manufactured by Royal Environmental Systems, Inc.

(d) InfraSafe® “Debris Collection Device”, Manufactured by Royal Environmental Systems, Inc.

(e) InfraSafe® “Culvert Inlet Protector”, Manufactured by Royal Environmental Systems, Inc.

(f) Dandy Sack®, Manufactured by Dandy Products, Inc.

(g) Dandy Curb Sack®, Manufactured by Dandy Products, Inc.

(h) Or approved equal.

C. Sediment Control Logs

1. Provide all materials as recommended by the manufacturer for complete installation.
2. Shall consist of an outside open weave containment fabric filled with curled Aspen fibers.
3. Density shall not exceed 2.6 lb/ft^3.
4. Fibers shall be:

(a) curled with soft, interlocking barbs to form a strong, organic filtration matrix

(b) six inches or longer in length (80% minimum)

(c) seed free

(d) evenly distributed throughout the diameter and length of the Sediment Control Log

5. Anchors shall be:

(a) Wooden Stakes

(b) E-Staple®, Manufactured by American Excelsior Company® (staples shall not be used in channelized flow applications)

6. Approved Products

(a) Curlex® “Sediment Log®” (Type III-9 inch), Manufactured by American Excelsior Company®

(b) Or approved equal

D. Rock Construction Entrances

1. Washed river rock, 2-3” in diameter. Geotextile fabric shall meet requirements of Mn/DOT 3733 Type 7
2. Grizzly Trackout Control Device
3. Or approved equal

PART 3 - EXECUTION

3.1 PREPARATION

A. Review the Erosion and Sediment Control Plans.

B. Notify the Engineer of deficiencies or changes in the Erosion and Sediment Control Plans required by current site conditions. Revisions to the plans will be made as determined by the Engineer.

3.2 PHASING OF THE WORK

A. Schedule and conduct operations so as to minimize erosion of soils and to prevent sedimentation of Surface Waters of the State. Surface Waters include curb and gutter, pavements, storm sewer, swales, stormwater treatment areas, or other similar storm water conveyance means.

B. Construction of drainage facilities, turf establishment items, and other contract Work which will contribute to the control of erosion and sedimentation shall be carried out concurrently with earthwork operations or as soon thereafter as practicable.

3.3 LIMITATION OF WORK AREA

A. The Engineer will have authority to limit the surface area of erodible soil that can be exposed to possible erosion at any one time, without having the permanent erosion control features completed and operative.

B. Incorporate the erosion control features into the Work at the earliest practicable time and provide all additional temporary control measures as may be needed to correct conditions developing during construction.

3.4 INSTALLATION OF EROSION AND SEDIMENT CONTROL MEASURES

A. Silt Fence

1. Install per applicable portions of Mn/DOT Standard Specification 2573.3 B.

B. Inlet Protection Devices

1. Install per Mn/DOT Standard Specification 2573.3 M and in accordance with manufacturer’s recommendations.

C. Sediment Control Log

1. Place logs on smooth prepped soils and prepare a shallow trench for the sediment control log to be placed.
2. Logs shall be secured with anchors placed every two lineal feet across the length of the log and shall be driven into the ground a minimum of 16 inches at a 45 degree angle with the top of the anchor pointed upstream.
   (a) Anchors shall be intertwined with the outer mesh on the downstream side only.
3. Logs shall be overlapped 6 inches in locations requiring more than one unit across the indicated area with an anchor at each end.
   (a) Overlapping shall not be located in heavier flow areas such as center of swales or channels.

D. Rock Construction Entrance

1. Construct rock construction entrance drives where indicated on the Drawings and as detailed, or in accordance with manufacturer's recommendations.

3.5 STABILIZATION PRACTICES

A. Stabilization practices shall be as indicated in the SWPPP.

B. Stabilize denuded areas and stockpiles within the following number of days of last construction activity in all areas:

1. All areas shall be stabilized within 7 days.

2. Temporary soil stockpiles shall be treated with appropriate erosion control measure, including silt fence and temporary seeding, when stockpiles are left inactive for periods longer than 7 days.

C. Temporary Stabilization:

1. Stockpiles and disturbed portions of the site where construction activity temporarily ceases for the time frames noted above shall be stabilized with a temporary seed and mulch according to the following:

(a) All areas of bare soil exposed to possible erosion shall be shaped to drain with minimum potential for erosion.

(b) The disturbed areas shall then be seeded with perennial ryegrass and annual wheat at a rate of 10 pounds per acre (0.25 lbs./1,000 sq. ft.) and 20 pounds per acre (0.50 lbs./1,000 sq. ft.) respectively, then and covered with hydromulch (Mn/DOT 3882, Type 5) at the rate of 1,500 pounds per acre.

3.6 MAINTENANCE

A. Maintenance of erosion and sedimentation control devices shall meet the minimum requirements of this specification, the SWPPP, and the NPDES permit requirements.

B. Provide continual maintenance on all erosion and sedimentation control devices as identified in the SWPPP and herein. Repairs or replacements to all erosion and sedimentation control devices shall occur within 24 hours.

C. Maintain these devices throughout their temporary life and remove these devices when so approved by the Engineer.

D. Maintenance and removal costs shall be included in the bid. No additional costs will be permitted.

E. Silt Fence

1. Shall be cleaned when sediment reaches 1/3 the height of the fence.

2. Silt fence which has washed out shall be reinforced with additional stakes and backed by snow fence to reduce the possibility of future washouts.

F. Inlet Protection Devices

1. Shall be cleaned when device becomes at most 1/3 full or as required to prevent flooding of adjacent areas.

G. Sediment Control Logs

1. Shall be cleaned when sediment reaches 1/3 the height of the log.

2. Sediment Control Logs which have washed out shall be replaced and reinforced with additional stakes to reduce the possibility of future washouts.

H. Rock Construction Entrance

1. Maintain Rock Construction Entrances on a daily basis or when sediment is tracked on to pavement surfaces. Rock which has silted in shall be removed and replaced with clean river rock. Manufactured products shall be cleaned or replaced.

I. Paved Areas

1. At a minimum, provide daily sweeping of all paved surfaces. Provide additional sweeping as needed to remove excess sediment from paved surfaces.

3.7 REMOVAL AND RESTORATION

A. Control of drainage and erosion shall include restoration work in preventing siltation of public waters.

B. Restoration shall include cleanup, shaping, replacement of topsoil, and establishment of vegetative cover on all disturbed areas where water pollution potentials have been increased due to the construction operations.

C. Following final turf and vegetation establishment:

1. Remove any and all excess sediment from site prior to removal of devices.

2. All erosion and sedimentation control materials shall be completely removed and disposed of off-site.

3. All trenches and divots from anchors shall be backfilled and restored with vegetation.

4. Do not allow re-suspension of sediment or loss of trash or oil into the water during device removal.

3.8 COMPENSATION

A. All expenses related to complying with the provisions herein shall be borne by the Contractor with no additional compensation being permitted.

END OF SECTION 31 2500

SECTION 33 1000 - WATER UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes labor, materials, equipment, and accessories to provide the following:

1. Surveying for water utility systems.
2. Construction of water utility systems for conveyance of potable water. The work includes relocating and adjusting existing potable water lines as required to construct the improvements shown on the Drawings.
3. Excavation, backfill, and compaction related to water utility system construction.
4. Pipe, backfill materials, and appurtenances for complete potable water system.
5. Protection of the completed water utility system during subsequent construction activities.
6. Adjusting all gate valve boxes to finish grade.
7. As-Built Survey is required and shall be provided by the Contractor.

1.2 APPLICABLE DOCUMENTS

A. Applicable portions of the City of Northfield Standard Specifications for Watermain Construction, apply to work in this section.

1. All references to Payment identified in the City Standard Specification do not apply to this project. Work on this project is by lump sum bid unless noted otherwise.
2. In the event of an inconsistency in the quality or quantity of Work required by this Specification and the City Standard Specification, either the greater quality or quantity of Work indicated shall be provided in accordance with the Engineer’s interpretation, and no change in the Contract Sum will be permitted.

B. All work shall comply with the requirements of the Department of Labor and Industry and the rules and regulations identified in the Minnesota Plumbing Code.

1.3 SITE CONDITIONS

A. Maintain benchmarks, monuments, and other reference points. If disturbed or destroyed, have them replaced or relocated by a registered land surveyor at the Contractor's expense.

1.4 SUBMITTALS

A. Submit information in accordance with Section 01 33 00 – Submittal Procedures.

B. Submit the following product information:

1. Product Information:
   (a) Pipe
   (b) Valves
   (c) Valve Boxes
   (d) Hydrants
   (e) Fittings
   (f) Bolts

C. Submit the following Test Results:

1. Bacteriological Tests
2. Hydrostatic Test
3. Leakage Test
4. Electrical Conductivity Test

D. Submit an Operational Inspection report

E. Submit an As-Built survey.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials required for this work shall be new material conforming to requirements of the referenced specifications for the class, kind, type, size, grade, and other details indicated in the Contract.

B. All manufactured products shall conform in detail to such standard design drawings as may be referenced or furnished in the Plans.

C. All references to Cast Iron material shall be construed to include both Gray Iron and Ductile Iron products, except where one or the other is specified.

D. All materials shall be manufactured in the U.S.A.

2.2 REGULATORY REQUIREMENTS

A. All products that may come into contact with water intended for use in a public water system shall meet American National Standards Institute (ANSI)/National Sanitation Foundation International (NSF) Standards 60 and 61. A product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify such products.

2.3 PIPE & FITTINGS

A. Watermain Pipe:

1. Ductile Iron Pipe (DIP) as specified in the following Pipe Table:

PIPE TABLE			
Pipe Description	Class or Type	Specification	Joint
Cement Lined Ductile Iron Pipe with Tar Coated Exterior	Class 52	ASA A21.51 ASA A21.4	Mechanical or Push-on
Cement Lined Cast Iron Fittings	Class 250	ASA A21.10 ASA A21.4	Mechanical

B. Pipe Joints:

1. Watermain pipe 3” and larger in diameter shall have push-on joints. Rubber gasket shall conform to AWWA C111 (ANSI A21.11).
2. Restrained push-on joints shall be as applies to each pipe manufacturer.
   (a) Approved products:
      (1) U.S. Pipe's TR Flex

(2) Clow's Push-On Restrained Joint

(3) American's Lok-Fast

(4) Or approved equal.

3. Pipe joints shall be:

(a) “Fastite” (American Cast Iron Pipe Company)

(b) “Bell Tite” (James B. Clow and Sons, Inc.)

(c) “Tyton” (U.S. Pipe and Foundry Company)

(d) Except that mechanical joint, shore body fittings, cement lines, Class 250, shall be used for stub ends and all fittings.

4. Gaskets:

(a) Rubber gaskets for mechanical joints and push-on joints shall conform to ASA A21.11 and shall be designed and manufactured to exact dimensions to assure a liquid tight joint.

2.4 FITTINGS:

A. Fittings shall have mechanical joints.

B. Fittings shall be Gray Iron or Ductile Iron, having a minimum working pressure rating of 150 psi, and shall conform to the requirements of AWWA C110 (ANSI A21.10), Ductile-Iron and Gray-Iron Fittings or AWWA C153 (ANSI 21.53), Ductile-Iron Compact Fittings.

C. Sleeves shall be long sleeves.

2.5 JOINT RESTRAINT:

A. Restrained mechanical joints shall be:

1. Series 1100 Megalug retainer glands by EBAA Iron

2. Or approved equal.

B. When using threaded rods as restraints they shall be sized as listed below:

Pipe Size	Number of Rods	Rod Size
4”	4	¾”
6”	4	¾”
8”	4	¾”
10”	4	¾”
12”	4	¾”
16”	8	¾”
20”	10	¾”
24”	12	¾”

2.6 ELECTRICAL CONDUCTIVITY:

A. Copper straps shall be welded or otherwise permanently affixed to each pipe or appurtenance to provide a positive means of conveying electricity from pipe to pipe or from pipe to fitting.

B. Conductive pipe gaskets may be used on pipe-to-pipe connections.

C. Size and method of affixing strap shall be sufficient to meet or exceed the criteria for conductivity testing set forth in this specification.

2.7 FIRE HYDRANTS

A. Fire hydrants shall be Pacer Model WB-67 as manufactured by Waterous Company and shall conform to AWWA C502. Hydrants shall be yellow in color.

B. Hydrants shall be furnished in conformance with the following supplementary requirements:

1. Five inch (nominal diameter) main valve opening of the type that opens against water pressure with a pentagonal operating nut with one inch sides (nominal 1 ½'' from point of pentagon to opposite side) and opening counterclockwise (left). All fasteners to be Type 316 stainless steel.

2. Barrels shall be two-piece, non-jacket type, with bottom of traffic flange set 2 inches above finish grade, 24 inch nozzle height above finish grade (16 inch break off extension, center of nozzle 22 inches above bottom of traffic flange), and with mechanical joint connection at the base for connecting to a 6 inch ductile iron pipe hydrant lead.

3. Hydrant bury depth, measured from the top of the branch pipe connection to the finished ground line at the hydrant, shall be 8'-0" (According to Waterous definition of "bury", hydrants with a bury of 8' 6" shall be furnished).

4. Hydrants shall have two outlet nozzles for 2 ½ inch (I.D.) hose connection and one outlet nozzle for 4 ½ inch (I.D.) pumper connection. Threads shall conform to NAPA No. 194 (ANSI B26) and shall be:

(a) Hose connection 7 ½ threads per inch, 3.062 inch nominal outside diameter (National Standard Thread);

(b) Pumper connection 4 threads per inch, 5 ¾" nominal outside diameter (National Standard Thread).

5. Nozzle caps shall be nut type with chain.

6. Hydrant operating mechanisms shall be provided with "O" ring seals preventing entrance of moisture and shall be lubricated through an opening in the operating nut or bonnet.

7. Drain holes shall be left open unless indicated otherwise on the plans. If so indicated, the hydrant shall be tagged "Pump After Use".

8. Provide one hydrant wrench for every ten (10) hydrants supplied.

9. All hydrants shall be equipped with a hydrant marker, mounted to the hydrant with flexible mount.

2.8 MISCELLANEOUS MATERIALS

A. Bolts, Nuts and Rodding:

1. All underground installed bolts, T-bolts, nuts, and any rodding required shall be stainless steel, ASTM F 593 Type 316. Anti-seize bolt/nut coating or spray/paste compound shall be used on all bolting operations.

B. Bedding and Backfill Material:

1. Materials shall be in accordance with Section 31 23 33 Trenching and Backfilling.

C. Concrete for Joint Buttresses:

1. Concrete mix used in buttress construction shall meet the requirements for Grade B (3400 psi) of Mn/DOT 2461.

D. Chlorine Disinfectant:

1. Commercial type chlorinator.
2. Dry Calcium Hypochlorine, such as "HTH", "PERCHLORON', or "MAXOCHLOR".
3. Or equal.

PART 3 - EXECUTION

3.1 CONSTRUCTION STAKING AND FIELD ENGINEERING

A. Refer to Section 01 71 23 Field Engineering for requirements.

3.2 INSPECTION AND RESPONSIBILITY OF MATERIALS

A. Inspect all materials for damage. Promptly remove all damaged material from the site.

3.3 TRENCH EXCAVATION, BACKFILL, COMPACTION, AND DEWATERING

A. Work shall be in accordance with the provisions of Section 31 23 33 Trenching and Backfilling.

3.4 COORDINATION WITH THE CITY

A. No valve or other control on the existing water utility system shall be operated for any purpose by the Contractor without approval from the City.

B. Give the City at least two working days' notice when it is necessary to take a watermain out of service. Disruption of service shall be during the time of day when the least inconvenience will be caused to customers.

3.5 INSTALLATION OF WATER UTILITY SYSTEM

A. Dewatering:

1. Provide dewatering, temporary diversion berms, and drainage swales to divert water away from excavations. Provide dewatering of trench excavations.
2. Drain discharge water to natural drainage channels or to storm sewers. Remove sediment and suspended materials from discharged water as specified in Section 31 00 00 Earthwork under Dewatering.
3. No pipe or fittings shall be laid in water or when trench conditions are unsuitable for work.
4. Provide labor and materials necessary to control erosion at outfall and downstream of dewatering pipe.
5. Comply with dewatering requirements identified in Section 31 00 00 Earthwork.

B. Trenching:

1. Excavate to proper depth and width necessary for construction of water utility system piping. Maximum width of excavation at top of pipe shall be outside diameter of pipe plus 36 inches.
2. Trench shall be dug in advance of pipe installation, only so far as to complete pipe installation for the day. Slope and brace sides of trenches and drain trenches so that workers can work safely and efficiently. Drain discharge water to natural drainage channels or to storm sewers.

C. Watermain and Appurtenance Installation:

1. Watermain Depth, Line, and Grade:

(a) The primary line and grade shall be established by a registered Land Surveyor employed by the Contractor. No deviation from the required line or grade will be allowed except with the consent of the Engineer.

(b) Place watermain with a minimum of 8'-0" of cover. However, a slightly greater depth may be required to clear existing or proposed storm or sanitary sewers, draintile, or other obstructions.

(c) In certain locations where the watermain is in direct conflict with draintile, storm or sanitary sewer, construct the watermain under the draintile or sewer. No additional costs to Owner will be permitted where it is necessary to use vertical bends to avoid draintile or sewer lines.

(d) Watermain crossing draintile or sewers shall be laid to provide a vertical separation of at least 18 inches, measured to the outside of the pipes.

(e) Protect draintile, sewers and watermain by:

(1) Provide adequate structural support for the draintile and sewers to prevent excessive deflection of joints and settling;

(2) Install one length of watermain centered at the point of crossing so that watermain joints will be equidistant and as far as possible from the draintile or sewer.

(f) Lay watermain at least 10 feet horizontally from any potential source of contamination including, but not limited to, any sanitary sewer pipe, storm sewer pipe, sewer structures, cleanouts, and draintile. Measure this horizontal distance from the outside of the watermain pipe to the outside of the contamination source.

2. Provide and use the proper implements, tools, and facilities for the safe and convenient prosecution of work.

3. Unload and distribute materials at site carefully to prevent materials from being damaged, minimize handling, and not hamper construction activities. Do not throw or dump materials from the truck.

4. Before being lowered into laying position, thoroughly inspect each pipe section and appurtenant units to detect damage, foreign matter needing removal, or unsound conditions that may need corrective action or be cause for rejection.

5. Immediately before placement, inspect joint surfaces of each pipe section and fitting for the presence of foreign matter, coating blisters, rough edges or projections. Clean, trim, or repair any imperfections as needed.

6. Lower pipe into trench carefully to prevent damage to pipe and protective coatings and linings. Do not dump pipe or other materials into the trench.

7. Lay all pipes using grade rods and surveyors levels to set pipe depth and alignment. Check the grades at a frequency not to exceed 60 feet.

8. Provide, without additional compensation, suitable temporary channels for water that flows along or across site and is restricted by work.

9. Place excavated material on one side of trench. Place excavated material so as not to obstruct any site drainage pattern.

10. Whenever existing utility structures, branch connections, or other conduits, ducts, pipes, or structures present obstructions to the grade and alignment of the pipe, they shall be permanently supported. Provide bends in watermain pipe as necessary to protect those obstructions which are to remain. Document any deviation from plans with ties to at least 2 surface features that can be identified post-construction.

11. Excavate to proper elevation and shape foundation to fit lower 1/4 of outside circumference of pipe. Dig bell holes at ends of each length of pipe to permit proper jointing.

12. Before laying the pipes, wipe the outside of the spigot and the inside of the bell clean and dry. Pipe ends shall be kept clean until joints are made.

13. Where pipe cutting is required, cut pipe square and deburr pipe ends. Ductile iron pipe shall be cut only by sawing, milling or torch cutting in accordance with the manufacturer's recommendations, provided the cut joint is properly ground.

14. At the time of pipe placement, the bedding conditions shall be such as to provide uniform and continuous support for the pipe between bell holes. Excavate bell holes as necessary to make the joint connections, but they shall be no larger than would be adequate.

15. As each length of bell and spigot pipe is placed in laying position, center the spigot end in the bell and force the pipe home and bring to correct line and grade. Secure the pipe in place with approved backfill material, and thoroughly compact backfill by tamping around the pipe to a height of at least 12 inches above the top of pipe. Use hand operated mechanical tamping devices for compacting around the pipe. The joint areas shall remain exposed and precautions shall be taken to prevent the soil from entering the joint space, until the joint seal is affected. Backfill in the bell area shall be left loose.

16. Where necessary to produce the required curvature, grade, or alignment, deflections at joints shall not exceed that which will assure tight joints and comply with any limitations recommended by the pipe manufacturer.

17. Securely close all pipe openings at the suspension of work at any time, and place suitable stoppers to prevent earth or any substance from entering the pipe. If water is present in the trench, the seals shall remain in place until the trench is completely dry.

18. Terminate all dead end lines with a plug or cap. Dead end lines shall be restrained, rodded or thrust blocked. If the pipe size is reduced near the end of the line, size the restraints for the pipe size prior to the reduction. Install a 6 foot long 4x4 treated wood post marker at the end of the line. Install the marker with 4 feet buried in the ground and 2 feet exposed above the ground.

19. If unstable soil not suitable for bedding of pipe or for trench backfill is encountered, notify Engineer before proceeding with installation of pipe. Remove and replace unsuitable or unstable material with pipe stabilization material as specified in Section 31 23 33 Trenching and Backfilling.

20. Material for stabilization and bedding shall be as specified in Section 31 23 33 Trenching and Backfilling. Type of material to be used shall be approved by a qualified representative from the Geotechnical Engineer’s office. Use stabilization material for pipe bedding and trench backfill wherever peat, clay or other unsuitable bearing material is encountered. Place material to a depth as determined by Geotechnical Engineer, with a minimum depth of 6 inches below bottom of pipe and extending at least 1 foot beyond sides of pipe and 1 foot above pipe.

D. Joint Restraint:

1. Use retainer glands for joint restraint on all:

   (a) bends having a deflection of 22 ½ degrees or greater,

   (b) tees,

   (c) crosses,

   (d) plugs,

   (e) valves at the end of a line,

   (f) all hydrant valves,

   (g) and all hydrants.

2. Retrained joints cast onto the pipe by the manufacturer will be considered as being equivalent to the use of retainer glands.

3. For restrained joints, the number of feet of tied pipe required shall be in accordance with the table below:

FEET OF RESTRAINED OR TIED PIPE REQUIRED ON EACH SIDE OF THE BEND				
NOTES: (1) This table is based on sand excavation, for silt increase by 50% (2) If polyethylene wrapping is used, increase value by 100%				
Pipe Size	Bend Sizes			
	22½°	45°	67½°	90°
3"	1'	2'	3'	4'
4"	1'	3'	4'	5'
6"	2'	4'	5'	6'
8"	3'	5'	7'	9'
12"	5'	8'	10'	12'
16"	6'	10'	14'	17'

The table was determined from the following formula printed in the 1975 fall issue of "Cast Iron Pipe News" published by the Cast Iron Research Association.

$$L \text{ (restrained length)} = \frac{SfKPA}{KFs + DPp}$$

Sf = Safety factor (1.25)
P = Max. Pressure (150 psi)
A = Pipe Cross- section area (in. sq.)
Fs = Conduit frictional resistance neglecting bell resistance (plf)
D = Conduit outside diameter (ft.)
Pp = Passive soil pressure (psf)
$K = 4 \tan \frac{\text{friction angle}}{2}$

E. Blocking and Buttressing:

1. Hardwood blocking may not be used.

2. Pour concrete buttresses against firm, undisturbed ground and form buttresses in such a way that the joints will be kept free of concrete and remain accessible for repairs. Buttress dimensions shall be a minimum of 12 inches in thickness, and the minimum area, in square feet shall be as follows:

Pipe Size	Tee or Plug	1/4 Bend	1/8 Bend	1/32 Bend and 1/16 Bend
6"	2.9	3.1	1.6	0.8
8"	3.7	5.3	2.9	1.4
10"	5.7	8.1	4.4	2.2
12"	8.1	13.4	6.6	3.2
16"	15.1	21.4	11.6	5.9
20"	23.2	30.2	18.1	9.3
24"	33.6	48.5	26.1	13.3

3. Size concrete buttress blocking on fittings and dead ends, where the blocking must withstand the pressure of larger main line fittings equipped with reducers, for the larger sized main line.

F. Polyethylene Encasement of Ductile Iron Appurtenances:

1. Fully encase ductile iron valves, fittings, and appurtenances in polyethylene film. The film shall be furnished in tube form for installation on bends, reducers, offsets, etc. Sheet film shall be provided and used for encasing all odd-shaped appurtenances such as valves, tees, crosses, and similar.

2. Install in accordance with AWWA C105, Type A.

G. Setting Valves, Hydrants, Fittings And Specials:

1. Install valves, hydrants, fittings, and specials in accordance with the installation requirements for watermain pipe to the extent applicable. Provide support blocking, thrust blocking, and anchorage devices at bends, tees, hydrants, and other changes in direction.

2. Valves and Valve Boxes:

(a) Install valve boxes upon the valve with the use of a Gate Valve Adaptor. Install per manufacturer's recommendations.

(b) Place a 4 foot by 4 foot piece of geotextile fabric, centered over the valve body, prior to installing the bottom section of the valve box, to prevent soil migration into the valve box assembly.

(c) Center the valve box over the operating nut of the valve.

(d) Set the valve box plumb.

(e) Install the box cover to ½" below finish grade.

(f) Valves shall be fitted with an Adjustable Valve Extension Stem. The extension shall bring the top nut fitting to within 6" - 12" of finish grade. Mount the extension securely on the valve nut and the extension adjusted so as to bring the upper nut fitting to within 6" - 12" of finish grade. Construct all valve stems plumb.

(g) Install valve boxes so as to not transmit shock or stress to the valve. Take extra care in backfilling and compacting around the valve box assembly to ensure plumbness and ease of keying the valve upon final installation.

(h) Mark valve boxes, which are independent of a hydrant and outside the pavement, with a 4 foot high sign post with a 4" x 8" reflectorized marker with a GV labeling on it. Install the marker post two feet back of and facing the valve box, to allow operation of the valve wrench without hitting the marker post.

3. Fire Hydrant Installation:

(a) Install fire hydrants plumb.

(b) Orient the large pumper nozzle squarely facing the adjacent pavement area. If the hydrant installation results in the pumper nozzle not facing pavement area, rotate the hydrant head accordingly.

(c) Set the hydrant traffic flange such that the bottom of the flange is 2 inches above finish grade. When a hydrant barrel extension is installed, adjust the traffic flange to remain at 2 inches above finish grade.

(d) Construct a one cubic yard minimum hydrant drainage pit around the hydrant base and fill with clear river rock, ¾" to 1 ½" in size. Firmly compact the rock under and around the hydrant base, and to at least 6 inches above the hydrant drain hole. Cover the drain rock with non-woven geotextile fabric prior to backfilling. Leave Hydrant drain holes open, unless, where Hydrants are located where groundwater is above the drain hole, plug the hydrant drain hole. When the drain hole is plugged, attach a permanent tag to the Hydrant stating "Pump After Use".

(1) Factory paint the pumper nozzle in accordance with City standards to identify the hydrant as having a plugged drain hole and needing to be pumped out after use.

(e) All hydrants shall be given one additional coat of paint after installation. All abraded surfaces shall be cleaned and primed prior to application of the final field coat. Paint must be approved by the City.

(f) Mount a hydrant marker on the upper flange of the fire hydrant.

4. Install special appurtenances as shown on the Drawings.

H. Pumping and Bailing Trench Water:

1. Remove water from trenches. Form temporary dams or other conveyance ways for keeping excavation clear of water during work. Provide labor and materials necessary to maintain trenches in a dry state.

2. No pipe or fittings shall be laid in water or when trench conditions are unsuitable for work.

3. Provide labor and materials necessary to control erosion at outfall and downstream of dewatering pipe.

4. Comply with dewatering requirements identified in Section 31 00 00 Earthwork.

I. Backfilling Procedures:

1. Backfill trenches to original ground surface outside of proposed grading limits or to finish grade. Place backfill as soon as practical after pipe installation.

2. Place pipe bedding material in trench simultaneously on both sides of pipe for full width of trench and to a minimum height of 12 inches above top of pipe. Shovel place and hand tamp backfill material to fill spaces under and adjacent to pipe completely. Place pipe bedding material from the bottom of trench to 12 inches above top of pipe by either hand or mechanical methods in two lifts. The first lift shall be from trench bottom to pipe springline. Compact the first lift by hand or walk behind type vibrating compactor. Compact the second lift with a walk behind type vibrating compactor making a minimum of two passes.

3. Succeeding layers of backfill from 12 inches above pipe to surface may contain coarse materials, but shall be free from rocks larger than 6 inches, frozen materials, concrete, blacktop, wood, roots, stumps, sod, rubbish, and other similar articles whose presence in backfill, in Engineer's opinion, would cause excessive settlement of trench or damage to pipe.

4. If, in the Engineer's opinion, the native trench material is unsuitable for any portion of trench backfill, it will be considered surplus material and shall be disposed of off-site, unless otherwise approved by the Engineer. Make a reasonable attempt during the excavation operations to segregate undesirable materials encountered from suitable materials. Furnish and install additional suitable material needed for backfilling. Backfill shall be sand-gravel material as described in Section 31 23 33 Trenching and Backfilling.

J. Compact trench backfill in accordance with density requirements established in Section 31 00 00 Earthwork.

3.6 ADJUSTING

A. Correct imperfections and irregularities in work at no additional expense to the Owner.

3.7 VALVE BOX ADJUSTMENTS

A. All valve boxes within the construction limits shall be adjusted to a height of between ¼ inch to ½ inch below the final asphalt course or landscape / grass elevation. This allowable tolerance shall be uniform around the periphery of each valve box. Adjust all valve boxes which do not meet this tolerance at no additional cost to the Owner.

B. Temporarily fasten a template of plywood to the top of each valve box during paving and rolling of the final asphalt pavement course to ensure the specified tolerances are met.

C. Include costs for valve box adjustments in the bid. No additional costs for valve box adjustments will be permitted.

3.8 WATER SYSTEM DISINFECTION

A. Before putting the newly installed water utility system into service, disinfect and flush the completed watermain system. After final flushing, test the water for bacteriologic quality. Disinfection materials, procedures, and the collection and testing of water samples shall comply with:

1. MN Department of Health requirements

2. MN Department of Labor and Industry requirements

(a) Disinfection shall comply with MN Rules Chapter 4714, Section 609.9

3. AWWA C651, Disinfecting Watermains

B. Where an existing watermain is cut for the installation of a hydrant, tee, valve, or for lowering the existing watermain, disinfect the pipe and fittings prior to installation as follows:

1. Clean the interior of the pipe and fittings of all dirt and foreign material.

2. Thoroughly swab and spray the interior of the pipe and fittings with a 1 percent minimum hypochlorite solution.

C. Furnish all materials and perform the disinfecting, flushing, and testing as necessary for meeting the water quality requirements.

D. Disinfection:

1. Chlorination shall consist of a minimum dosage roughly equivalent to 50 parts per million. Chlorinate at the rate of one pound of chlorine, containing 70% available chlorine, per each 1680 gallons of water in the line.

2. Shake a predetermined dose into the pipe at the first joint attached to the existing water pipe. Repeat the dosage at frequent intervals, preferably at each pipe joint as the pipe laying progresses.

3. Fill the newly laid pipe with water very slowly to avoid washing the powder to the extremity of the pipe.

4. Retain treated water in the pipe long enough to destroy all non-spore-forming bacteria. This period shall be at least three hours and preferably longer as may be directed.

5. After chlorine treated water has been retained for the required time, the chlorine residual at pipe extremities and at other representative points shall be at least five parts per million.

6. Operate all valves and other appurtenances while the pipe line is filled with the chlorinating agent.

E. Flushing:

1. Heavily chlorinated water shall not remain in prolonged contact with the pipe after the applicable retention period. Flush heavily chlorinated water from the water system until chlorine concentration is no higher than generally in the system for domestic use.

2. Inspect the chlorinated water discharge location. Ensure that the receiving area is not damaged by the chlorinated water. Use a reducing agent for neutralization as necessary.

F. Bacteriological Tests:

1. Collect two consecutive sets of acceptable samples, taken at least 24 hours apart, after final flushing and before the watermain is placed in service. Collect at least one set of samples from every 1,200 feet of pipe. Collect at least one set from the end of the main and one set from each branch line.

2. Test all samples for bacteriological quality to show the absence of coliform organisms.

3. If water in the pipe does not meet the minimum requirements, repeat the disinfection procedure until meeting the requirements. Furnish and submit test results and acceptance forms from the governing agency.

3.9 PRESSURE AND LEAKAGE TESTING

A. General Requirements:

1. Accomplish testing to assure quality of materials and/or workmanship. Include all costs for testing in the Bid.

2. Coordinate the tests to be performed. Notify the City as to the testing schedule a minimum 72 hours prior to testing. The City must be present to observe the testing.

3. Submit copies of all test results whether tests pass or fail. Lack of acceptable test results and documentation is justification to delay payment. Make corrections to the system as needed so that all tests ultimately pass.

4. Include the following in the submitted test reports:

(a) Project name and project number.

(b) Results of tests performed.

(c) Comparison of the test results to the project specifications. Conclusion as to meeting or failing to meet the project specifications.

(d) If failing, submit plan for corrective action.

(e) If failing, retest until tests pass to confirm compliance with the project specifications.

B. Hydrostatic Testing of Watermains:

1. Test each valved section to a separate two hour pressure test and the leakage test prescribed herein.

2. Close hydrants but leave hydrant valves and dead end line valves open during the test. Test service lines with curb stops open against a capped extension.

3. After testing is complete, close valves on hydrant leads and dead end water lines and open the hydrants. Apply the specified test pressure and test repeatedly for 15 minutes to establish the condition of the hydrant lead valves.

4. Chlorinate, test and flush watermain separate from the active system. Include filling and flushing work in the bid.

5. Furnish the pump, pipe connections, gauges, and measuring equipment. Perform testing in the presence of the City. Use an Ashcroft Model 1082 pressure gauge, with 4 ½" dial face at 1 psi increments, for the test. Where permanent air vents are not present, provide and install corporation cocks at the high points as needed for release of air as the line is filled with water.

6. Where concrete reaction blocking is placed, wait at least 5 calendar days after concrete placement before applying the hydrostatic pressure test.

7. If approved by the City, the pressure and leakage tests may be conducted simultaneously. Correct any defective joints, pipe, fittings, valves, or hydrants revealed during the testing or before final acceptance of the work. Repeat tests until the specified requirements have been met.

   (a) Slowly fill the section being tested with water and apply the specified test pressure after all air has been expelled from the pipe. The specified test pressure is 150 pounds per square inch, gauge pressure, measured at the lowest point of elevation.

   (b) Check the gauge pressure after a minimum of two hours. A pressure drop of 1 psi or less over a 2 hour period will be considered acceptance for the test section. If the pressure drop is greater than 1 psi, investigate the cause and take corrective action. Make every effort to expel all air in the test section which may be causing a test failure. This may require the Contractor to tap a corporation at a high point of the main on the top of the pipe to release trapped air.

   (c) Perform the leakage test to determine the magnitude of the leak. However, meeting the leakage allowance may not constitute acceptance a failed pressure test.

   (d) Test service pipes in conjunction with the main line testing. Services may be tested separately at 100 psi, with the corporation stops open.

   (e) Perform additional pressure testing if, during the flushing operation, there is evidence of debris being flushed out of the system.

C. Leakage Test:

1. After an unsatisfactory pressure test, perform a leakage test to determine the quantity of water that must be supplied into the section to maintain a test pressure of 150 pounds per square inch, after the air in the pipeline has been expelled. Record the water added to the nearest fluid ounce.

2. Apply a pressure of 150 psi after filling the pipe with water and expelling all air in the line. In the same manner as prescribed for the pressure test, add sufficient water and measure water added into the pipe section to maintain the pressure for a test duration of 2 hours.

3. Leakage test will be considered passing if the leakage does not exceed the quantity determined by the formula as shown below, based on an allowable leakage of 11.65 gpd/mile/nominal diameter inch at 150 psi.

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

L = Maximum permissible leakage in gallons per hour

S = Length of pipe tested

D = Nominal diameter of pipe in inches

P = Average test pressure during the test, in pounds per square inch, gauge pressure

ALLOWABLE LEAKAGE PER 1000 FEET OF PIPE in Gallons Per Hour										
Average Test Pressure (psi)	4"	6"	8"	10"	12"	14"	16"	18"	20"	22"
200	0.43	0.64	0.85	1.06	1.28	1.48	1.70	191	2.12	2.55
175	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38
150	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21
125	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01
100	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80
70	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.26	1.51

(a) If the pipe section under test contains pipe of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

(b) Furnish a written leakage test results report. Identify the specific test section, the average pressure, the duration of test, and the amount of leakage in the submitted report.

3.10 ELECTRICAL CONDUCTIVITY TEST

A. Within one week after completion of pressure testing, perform a conductivity test on all constructed watermain to establish that electrical thawing may be carried out in the future. Perform conductivity testing in the City's presence. Testing must be approved by the City before acceptance.

B. Test the system (pipeline, valves, fittings and hydrants) for electrical continuity and current capacity. Perform the conductivity test while the line is at normal operation pressure. Complete backfilling prior to testing. The line may be tested in section of convenient length as approved by the City.

C. Direct current of 350 amperes ± 10% shall be passed through the pipeline for five minutes. Measure current flow through the pipe continuously on a suitable ammeter. Current flow shall remain steady without interruption or excessive fluctuation throughout the five minute test period.

D. Insufficient current, intermittent current, or arcing, indicated by large fluctuation of the ammeter needle, will be evidence of defective contact in the pipeline. Isolate, find and correct the cause. Thereafter, retest the section in which the defective test occurred as a unit until tests meet the requirements.

E. Sources of direct current for these tests may be motor generators, batteries, arc welding machines, etc. Direct current equipment shall be equipped with controls for regulating the current output. Furnish necessary testing equipment, subject to approval of the City.

F. Cables from the power source to the system under test shall be of sufficient size to carry the test current without overheating or excessive voltage drop. Usable sizes will probably be in the range of 2/0 to 4/0 A.W.G.

G. Make connections for the test at hydrants. The hydrants shall be in the open position with the caps on during the test. Clamp the cable to the top operating nut.

1. After the test, the hydrant shall be shut off and a cap loosened to allow hydrant drainage. Tighten cap after drainage.

H. A hook-on type direct current ammeter placed on one of the cables leading to the hydrant is a convenient method of measuring current.

I. In using arc welding machines, the current control should be set at minimum before starting. After starting the machine, advance the control until the current indicated on the ammeter is at the desired test value.

(a) CAUTION: In case of open circuits at joints or connections, the voltage across the defective joint or connection will be in the order of 80-100 volts.

3.11 OPERATIONAL INSPECTION:

A. Prior to Substantial Completion and prior to the punch list, inspect and operate all valves and hydrants, in the presence of the City, to demonstrate to City staff that the entire facility is in good working order. Specific items to be inspected include:

1. Valves are marked
2. Valve boxes are centered on the valve with the use of a spider
3. Valves can be keyed
4. Valves operate smoothly
5. Valves are in the open position
6. Valve boxes and curb boxes are set to proper grade
7. Hydrants operate and drain properly
8. Hydrants are oriented in the proper direction

3.12 CLEANING AND PROTECTION

A. Protect complete water utility system from damage, debris and sedimentation until final acceptance.

B. Clean hydrants, valve boxes, and other miscellaneous appurtenances prior to testing and as needed prior to final acceptance of the project. Water utility system shall be free of silt, debris, and other obstructions at time of final acceptance.

C. Maintain pavement subgrades until final pavement preparation commences. Maintain subgrade until the start of surface construction or restoration work. Provide and shape additional materials as needed to compensate for trench settlement.

D. Cleaning the Site:

1. Remove excess earth, excess construction materials, construction equipment, and construction debris which is related to this work from site at completion of work.

2. Remove and dispose of all debris, waste materials, and other remains or consequences of construction, prior to final acceptance of all work. Remove all excess materials and scrap materials from the construction site.

3.13 AS-BUILT SURVEY

A. Submit an as-built survey.

B. Refer to Section 01 71 23 - Field Engineering for requirements.

END OF SECTION 33 1000

SECTION 33 3000 - SANITARY SEWERAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes labor, materials, equipment, and accessories to provide the following:

1. Surveying for sanitary sewer systems.
2. Sanitary sewer systems as indicated on Drawings.
3. Excavation, backfill, and compaction related to sanitary sewer and structure installation.
4. Pipe, backfill materials, and structures for complete sewer system.
5. Protection of the completed system against sedimentation during subsequent construction activities and through turf establishment as noted herein.
6. Precast Concrete Sewer Structures (manholes) and related frames, castings, grates, lids, and other materials.
7. Rubber boot connections at Concrete Sewer Structures.
8. Adjusting all structure castings and grates to finish grade.
9. As-Built Survey is required and shall be provided by the Contractor.

1.2 APPLICABLE DOCUMENTS

A. Applicable portions of the SPECIFICATIONS FOR SANITARY SEWER AND STORM SEWER, CITY OF NORTHFIELD, MINNESOTA, apply to work in this section.

1. All references to Payment identified in the City Standard Specification do not apply to this project. Work on this project is by lump sum bid unless noted otherwise.
2. In the event of an inconsistency in the quality or quantity of Work required by this Specification and the City Standard Specification, either the greater quality or quantity of Work indicated shall be provided in accordance with the Engineer’s interpretation, and no change in the Contract Sum will be permitted.

B. All work shall comply with the requirements of the Department of Labor and Industry and the rules and regulations identified in the Minnesota Plumbing Code.

1.3 SITE CONDITIONS

A. Maintain benchmarks, monuments, and other reference points. If disturbed or destroyed, have them replaced or relocated by a registered land surveyor at the Contractor's expense.

1.4 SUBMITTALS

A. Submit information and shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

B. Submit the following product information and shop drawings:

1. Product Information:
   (a) Pipe
   (b) Rubber boots
   (c) Castings, Lids, and Grates
   (d) Adjusting Rings

2. Shop Drawings:

(a) Concrete structures

C. Submit the following Test Results:

1. Air pressure
2. Deflection
3. Visual Inspection
4. Televising

D. Submit an As-Built survey.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials required for this work shall be new material conforming to requirements of the referenced specifications for the class, kind, type, size, grade, and other details indicated in the Contract.

B. All manufactured products shall conform in detail to such standard design drawings as may be referenced or furnished in the Plans.

2.2 PIPE

A. Gravity Pipe and Joints:

1. PVC (Polyvinyl Chloride) Pipe:

(a) ASTM Specifications D3034, SDR 26.

(1) Joints shall conform to the requirements of ASTM D-1869 for PVC pipe.

(2) PVC pipe joints shall be the bell and spigot type using rubber, gasketed, push-on type joints.

(b) ASTM D2665, Schedule 40 with solvent weld joints.

(1) Joints shall conform to the requirements of ASTM D2564.

2.3 PRECAST CONCRETE SEWER STRUCTURES:

A. Precast concrete riser sections and appurtenant units (grade rings, top and base slabs, special sections, etc.) used in the construction of sanitary sewer structures shall conform with the requirements of ASTM C 478, Mn/DOT 2506 and the following supplementary provisions:

1. The precast sections and appurtenant units shall conform to all requirements as shown on the Drawings.
2. Joints of sewer structure riser sections shall be tongue and groove with rubber "O" ring or profile gaskets.
3. Air entrained concrete shall be used in the production of all units. Air content shall be maintained within the range of five (5) to seven (7) percent (%).
4. Sanitary sewer inlet and outlet pipes shall be joined to the manhole with a gasketed, flexible, watertight connection, watertight boot, or any watertight connection arrangement allowed by Mn Plumbing Code that allows differential settlement of the pipe and manhole wall to take place.
5. Lift holes will not be permitted in precast manholes.

2.4 CASTINGS:

A. Cast iron. Metal used in casting manufacturing shall be ASTM-A-48, Class 35B gray iron or ASTM A536 grade 80-55-06 for ductile iron.

B. Shall be smooth and well cleaned by shotblasting.

C. Castings shall not be painted.

D. The standard manhole casting shall have two concealed pick holes. Castings shall be stamped "SANITARY SEWER".

E. Round covers and grates shall fit closely in the frame and, when placed and rotated in the frame, shall fit the frame solidly so that there will be no rocking from pressure on any point of the cover.

F. Approved Manufacturers:

1. Neenah Foundry, 2121 Brooks Avenue, Neenah, WI 54956, Phone: (920) 725-7000.

(a) Available locally through Ess Brothers, Loretto, MN, phone (800) 478-2027.

(b) Available locally through Neenah Foundry, Shakopee, MN, phone (952) 445-5335

2. Or approved equal.

2.5 STRUCTURE STEPS FOR CONCRETE STRUCTURES:

A. Copolymer polypropylene meeting with the requirements of ASTM 2146, Type II, Grade 49108, reinforced with a deformed 3/8 inch diameter reinforcing bar which conforms to the requirements of ASTM A-615, Grade 60.

2.6 ADJUSTING RINGS FOR CONCRETE STRUCTURES:

A. High Density Polyethylene (HDPE) produced by Ladtech, or approved equal.

1. Joints between structure, rings, and casting shall be sealed with a Butyl caulk.

B. Precast concrete adjusting rings.

1. Joints between structure, rings, and casting shall be sealed with grout.

2.7 EXTERNAL FRAME SEAL:

A. Frame seals shall consist of a flexible external rubber sleeve, interlocking extensions and stainless steel compression bands as manufactured by Cretex Specialty Products, or approved equal, conforming to the following requirements.

1. The seal shall remain flexible throughout a 25 year design life, allowing repeated vertical movement of the frame of not less than 2 inches and/or repeated horizontal movement of not less than ½ inch.

2. The sleeve portion of the seal shall be corrugated with a minimum unexpanded vertical height of either 6 inches or 9 inches and shall be capable of being mechanically locked to the structure frame.

3. The sleeve and extension shall have a minimum thickness of 3/16 inches and shall be made from a high-quality rubber compound conforming to the applicable requirements of ASTM C-923, with a minimum 1500 psi tensile strength, a maximum 18% compression set and hardness (durometer) of 48+/-5 DURO.

4. The bands shall be integrally formed from 16 gauge stainless steel conforming to ASTM A-240, Type 304, with no welded attachments and shall have a minimum adjustment range of 2 diameter inches.

5. Any screws, bolts or nuts used on this band shall be stainless steel conforming to ASTM F-593 and 594, Type 304.

B. All castings, rings, and adjustments shall include furnishing and installing an external seal on all manholes. The permanent seal shall externally seal the adjustment ring area and joint sections of the manhole.

C. The seal shall include an integral seal with the casting assembly and structure joint below the adjustment rings.

2.8 BEDDING AND BACKFILL MATERIAL

A. Materials shall be in accordance with Section 31 23 33 Trenching and Backfilling.

PART 3 - EXECUTION

3.1 CONSTRUCTION STAKING AND FIELD ENGINEERING

A. Refer to Section 01 71 23 Field Engineering for requirements.

3.2 INSPECTION AND RESPONSIBILITY OF MATERIALS

A. Inspect all materials for damage. Promptly remove all damaged material from the site.

3.3 TRENCH EXCAVATION, BACKFILL, COMPACTION, AND DEWATERING

A. Work shall be in accordance with the provisions of Section 31 23 33 Trenching and Backfilling.

3.4 INSTALLATION OF SANITARY SEWERAGE SYSTEM

A. Dewatering:

1. Provide dewatering, temporary diversion berms, and drainage swales to divert water away from excavations. Provide dewatering of trench excavations.
2. Drain discharge water to natural drainage channels or to storm sewers. Remove sediment and suspended materials from discharged water as specified in Section 31 00 00 Earthwork under Dewatering.
3. No pipe or fittings shall be laid in water or when trench conditions are unsuitable for work.
4. Provide labor and materials necessary to control erosion at outfall and downstream of dewatering pipe.
5. Comply with dewatering requirements identified in Section 31 00 00 Earthwork.

B. Trenching:

1. Excavate to depth and width necessary for utility construction. Excavation width shall not exceed the outside diameter of pipe plus 24 inches.
2. Place excavated material on one side of trench, unless conditions are prohibitive. Excavated material shall be so placed as not to obstruct any site drainage pattern.
3. Excavate trench in advance of utility installation, but do not excavate trenches beyond the installation limits for the day.
4. Slope and brace sides of trenches so that workers can work safely and efficiently.

C. Installing Piping and Appurtenances:

1. General Requirements:

(a) The primary line and grade shall be established by a registered Land Surveyor employed by the Contractor. No deviation from the required line or grade will be allowed except with the consent of the Engineer.

(b) Provide and use the proper implements, tools, and facilities for the safe and convenient prosecution of work.

(c) Carefully unload and distribute materials at site carefully to prevent materials from being damaged, minimize handling, and not hamper construction activities. Do not throw or dump materials from the truck.

(d) Before being lowered into laying position, thoroughly inspect each pipe section and appurtenant units to detect damage, foreign matter needing removal, or unsound conditions that may need corrective action or be cause for rejection.

(e) Immediately before placement, inspect joint surfaces of each pipe section and fitting for the presence of foreign matter, coating blisters, rough edges, or projections. Clean, trim, or repair any imperfections as needed.

(f) Where pipe cutting is required, cut pipe square and deburr pipe ends.

(g) Carefully lower pipe into trench to prevent damage to pipe and protective coatings and linings. Do not throw, drop, or dump materials into trench.

(h) Provide, without additional compensation, suitable temporary channels for water that flows along or across site and is restricted by work.

(i) Place excavated material on one side of trench. Place excavated material so as not to obstruct any site drainage pattern.

(j) Whenever existing utility structures, branch connections, conduits, ducts, pipes, or structures present obstructions to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated, or reconstructed.

(k) Securely close all pipe openings at the suspension of work at any time, and place suitable stoppers to prevent earth or any substance from entering the pipe. If water is present in the trench, the stoppers shall remain in place until the trench is completely dry.

(l) If unstable soil or soil not suitable for bedding of pipe or for trench backfill is encountered, notify Engineer before proceeding with pipe installation. Remove and replace unsuitable or unstable material with pipe stabilization material as specified in Section 31 23 33 Trenching and Backfilling.

(m) Material for stabilization and bedding shall be as specified in Section 31 23 33 Trenching and Backfilling. Type of material to be used shall be approved by the Testing Laboratory representative. Use stabilization material for pipe bedding and trench backfill wherever peat, clay or other unsuitable bearing material is encountered. Place material to a depth as determined by the Testing Laboratory representative, with a minimum depth of 6 inches below bottom of pipe and extending at least 1 foot beyond sides of pipe and 1 foot above pipe.

2. Gravity Pipe Installation:

(a) Install Gravity Pipe on a continuous, well compacted, granular bed in accordance with ASTM D2321.

(b) Wipe the outside of the spigot and the inside of the bell clean and dry. Pipe ends shall be kept clean until joints are made.

(c) Lay all pipes using laser equipment to set pipe grade and alignment. Laser equipment shall digitally display slope to the nearest 1/100%. Check the grades at a frequency not to exceed 100 feet. Provide competent workers to operate the laser equipment.

(d) Lay bell and spigot pipe with the bell ends facing upgrade. Pipe laying shall start on the downgrade end and proceed upgrade. As each length of bell and spigot pipe is placed in laying position, center the spigot end in the bell and force the pipe home and bring to correct line and grade. Secure the pipe in place with approved backfill material, and thoroughly compact backfill by tamping around the pipe to a height of at least 12 inches above the top of pipe. Use hand operated mechanical tamping devices for compacting around the pipe. Keep joint areas exposed. Prevent soil from entering the joint space until the joint seal is complete. Backfill in the bell area shall be left loose.

(e) Connect new pipe to existing pipe, or connect new pipe to structures in accordance with the requirements of the Minnesota Plumbing Code. Where necessary to make satisfactory closure or produce the required curvature, grade, or alignment, deflections at joints shall not exceed that which will assure tight joints and comply with any limitations recommended by the pipe manufacturer.

(f) Schedule 40 pipe joints:

(1) After the inside and outside of joint surfaces are cleaned and free from dirt, moisture, oil, burs, and other foreign material, solvent weld joints in accordance with ASTM D2564.

(2) Apply primer and glue to inside and outside of joint surfaces.

(3) Construct joints using primer and solvent weld in accordance with ASTM D2855.

(g) Connections:

(1) Make connection to an existing sanitary sewer manhole, where an opening for the proposed sewer pipe does not exist, as follows:

a. Core drill an opening of the correct size and elevation for the proposed sanitary sewer pipe.

b. Set the connecting pipe through the full thickness of the wall flush with the inner face of the wall.

c. Connect to the structure with a rubber boot.

d. Ensure the flow lines inside the manhole are constructed in a manner to provide steady flow from all inlet pipes towards the outlet pipe. Reconstruct the structure invert as required. Grout the flow line and the core drilled hole smooth.

e. Install a plug in the connecting pipe once the connection is complete and construction has advanced to the next manhole to prevent rainwater or sediment from entering the existing system. Remove all plugs once all proposed sanitary sewer pipes on the project have been installed, tested, inspected, and approved.

D. Backfilling Procedures:

1. Backfill trenches to original ground surface outside of proposed grading limits or to finish grade. Place backfill as soon as practical after pipe installation.

2. Place pipe bedding material in trench simultaneously on both sides of pipe for full width of trench and to a minimum height of 12 inches above top of pipe. Shovel place and hand tamp backfill material to fill spaces under and adjacent to pipe completely. Place pipe bedding material from the bottom of trench to 12 inches above top of pipe by either hand or mechanical methods in two lifts. The first lift shall be from trench bottom to pipe springline. Compact the first lift by hand or walk behind type vibrating compactor. Compact the second lift with a walk behind type vibrating compactor making a minimum of two passes.

3. Succeeding layers of backfill from 12 inches above pipe to surface may contain coarse materials, but shall be free from rocks larger than 6 inches, frozen materials, concrete, blacktop, wood, roots, stumps, sod, rubbish, and other similar articles whose presence in backfill, in Engineer's opinion, would cause excessive settlement of trench or damage to pipe.

4. If the native trench material is unsuitable for any portion of trench backfill, it will be considered surplus material and shall be disposed of off-site, unless otherwise approved by the Engineer. Make a reasonable attempt during the excavation operations to segregate unsuitable materials encountered from suitable materials. Furnish and install additional suitable material needed for backfilling. Backfill shall be sand-gravel or binder stone material as described in Section 31 23 33 Trenching and Backfilling.

E. Compact trench backfill in accordance with density requirements established in Section 31 00 00 Earthwork.

3.5 CONCRETE STRUCTURE INSTALLATION

A. Construct sanitary sewer structures as noted on the Drawings.

B. Unless otherwise specified or approved, construct structures with precast concrete integral base with pre-formed invert barrel section and with watertight boots at all pipe locations. Barrel riser sections and cone sections shall be constructed of precast concrete. All sections shall be properly fitted and sealed to form a completely watertight structure. Fabricate structures to provide a twelve inch tall or sixteen inch tall barrel section immediately below the cone or top slab whenever possible.

C. Place at least two and not more than five adjusting rings immediately below the casting assembly. Adjust barrel and cone height to accommodate the adjusting rings. Wrap adjusting rings and casting flange with a Type 2 Geotextile fabric meeting MnDOT 3733.

1. The rings shall provide a minimum adjustment of 4” using 2” rings and maximum adjustment of 12" with a 6" thick ring used for adjustments of 8" or greater.

2. Provide grout along the outside of the ring assembly.

D. External Frame Seals shall be installed per manufacturer’s instructions.

E. Unless otherwise specified or approved, sanitary sewer structures shall have an inside barrel diameter at the bottom of forty-eight inches minimum and the inside diameter at the top of the cone section and all adjusting rings shall be of the same size and shape as the casting frame. Refer to the Drawings for casting assemblies.

F. Shape the soil for proper elevation and allow the structure to be vertically plumb. Install the structure base on undisturbed or firmly compacted foundation material.

G. Above the integral base section, all other riser section joints shall be tongue and groove design. Seal all tongue and groove joints with rubber gaskets. The concrete base under an outside drop connection shall be monolithic with the sanitary sewer structure base.

3.6 CASTINGS AND GRATES

A. Securely fasten casting and grates to adjoining structures to prevent removal.

3.7 ADJUSTING

A. Correct imperfections and irregularities in work at no additional expense to the Owner.

3.8 CASTING ADJUSTMENTS

A. All castings within the construction limits shall be adjusted to a height between ¼ inch to ½ inch below the final pavement course or landscape / grass elevation. This allowable tolerance shall be uniform around the periphery of each casting. Adjust all castings which do not meet this tolerance at no additional cost to the Owner.

B. Adjust castings using only concrete or metal shims for final adjustment and leveling. Set all castings on a full mortar bed.

C. Temporarily fasten a template of plywood to the top of each casting during paving and rolling of the final asphalt pavement course to ensure the specified tolerances are met.

D. Include costs for casting adjustments in the bid. No additional costs for casting adjustments will be permitted.

3.9 SANITARY SEWER TESTING

A. In accordance with the Minnesota Plumbing Code, test all portions of sanitary sewer systems.

B. Test concrete structures by using negative pressure in accordance with ASTM Standard C1244-93.

C. Gravity Sewer Testing:

1. Test PVC piping using a low pressure air test.

   (a) Perform tests with equipment similar to Air-Loc equipment manufactured by Cherne Industrial, Inc., Hopkins, Minnesota.

   (b) Perform the air test when the sewer is clean. Plug each end of the system to be tested with pneumatic balls. Introduce low pressure air into the plugged line until the internal air pressure reaches 5.0 psi greater than the average back pressure of any ground water pressure that may submerge the pipe. Allow at least two minutes for the air temperature inside the pressurized pipe to stabilize before starting the timer and taking readings.

   (c) Minnesota Plumbing Code requires the pressure to remain constant for at least 15 minutes without adding more air. The air test will be considered acceptable upon completion of this test.

2. Deflection Test

   (a) Measure the deflection of PVC sewer pipe after placement of backfill material in the trench. Test pipe deflection at least 30 days, but not later than 1 year, following backfilling and compaction of the pipe trench. The Owner reserves the right to measure deflection of PVC sewer pipe at any time during the warranty period. Deflections greater than 5% of the inside pipe diameter will be considered failure and correction by reconstruction will be required.

3. Visual Inspection

   (a) Prior to final acceptance, flush a ball, the full diameter of the sewer pipe, through the sewer system. Install watertight plugs or other suitable methods to prevent dirt and debris from entering the sewer system.

   (b) Sewer pipes shall be straight and uniform in alignment and grade. Pipe shall be free of dirt, mortar and other debris.

4. Televising

   (a) Televise the sewer after completion of pipe construction, backfilling and compaction operations, and stabilized aggregate base is installed in pavement areas.

   (b) Mount the television camera on a skid so it is centered in the pipe. The camera shall have a cross-hair to maintain a constant reference on the image. Equip the camera with sufficient lights to completely illuminate the interior of the pipe within the range of the camera.

   (c) Provide a monitor to allow multiple persons to view the picture simultaneously. Combine the television camera, transmitting equipment, and monitoring equipment to provide a picture on the monitor screen free from distortion and clear enough to distinguish between hairline cracks, “pipe marks,” etc.

   (d) Record the footage of pipe televised. A copy of the recording shall be given to the Owner, City, and Engineer within one week following the last day of televising on the project. Integrate the linear footage of pipe televised into the recording for ease of identification of pipe being viewed. Provide a diagram of the project with televising indexed on it within five (5) working days following the last day of televising on the project.

D. Test Failure and Remedy

1. In the event of test failure on any test section, correct the failures. Continue testing until all tests pass. Correct detected leakage to meet the requirements. All repair work shall be subject to approval of the Engineer. Introduction of sealant substances will not be permitted.

2. Unsatisfactory repairs or test results will result in removal and placement as the Engineer considers necessary. All repair and replacement work will be at the Contractor's expense.

3. Remove and replace any cracked or broken pipe. Leave the sewer system clean and free from any obstructions or debris.

3.10 CLEANING AND PROTECTION

A. Protect complete sewer system from damage, debris and sedimentation until final acceptance.

B. Clean sewer lines prior to testing and as needed prior to final acceptance of the project. Give the City a minimum of 72 hours' notice prior to flushing. Sewer system shall be free of silt, debris, and other obstructions at time of final acceptance.

C. Pipe and structures shall be free of dirt, mortar, and other debris.

D. Maintain pavement subgrades until final pavement preparation commences. Maintain subgrade until the start of surface construction or restoration work. Provide and shape additional materials as needed to compensate for trench settlement.

E. Cleaning the Site:

1. Remove excess earth, excess construction materials, construction equipment, and construction debris which is related to this work from site at completion of work.

2. Remove and dispose of all debris, waste materials, and other remains or consequences of construction, prior to final acceptance of all work. Remove all excess materials and scrap materials from the construction site.

3.11 AS-BUILT SURVEY OR RECORD DRAWINGS

A. Submit an as-built survey.

B. Refer to Section 01 71 23 - Field Engineering for requirements.

END OF SECTION 33 3000

SECTION 33 4000 - STORMWATER UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes labor, materials, equipment, and accessories to provide the following:

1. Surveying for storm sewer systems.
2. Storm sewer system as indicated on Drawings.
3. Excavation, backfill, and compaction related to storm sewer and drainage structure installation.
4. Pipe, backfill materials, and structures for complete drainage system.
5. Protection of the completed system against sedimentation during subsequent construction activities and through turf establishment as noted herein.
   (a) Comply with the requirements of the NPDES General Stormwater Permit and the requirements of the Storm Water Pollution Prevention Plan (SWPPP).
6. Furnishing, installing, maintaining, and removing inlet protection devices at storm sewer inlets.
7. Cast-in-place concrete associated with the system.
8. Precast Concrete Storm Sewer Structures (manholes, catch basins) and related frames, castings, grates, lids, covers, and other materials.
9. PVC structures and related frames, castings, grades, lids, and covers.
10. Cast openings in concrete structures to receive subsurface drains and drain tile.
11. Flexible Joints at pipe connections to concrete structures per Mn Plumbing Code.
12. Subsurface drains and connection to the storm sewer system.
13. Adjusting all structure castings and grates to finish grade.
14. As-Built Survey is required and shall be provided by the Contractor.

B. Work not included in this Specification:

1. Drain tile at frost footed stoops. Refer to Section 31 00 00 Earthwork.

1.2 APPLICABLE DOCUMENTS

A. Applicable portions of the SPECIFICATIONS FOR SANITARY SEWER AND STORM SEWER, CITY OF NORTHFIELD, MINNESOTA, apply to work in this section.

1. All references to Payment identified in the City Standard Specification do not apply to this project. Work on this project is by lump sum bid unless noted otherwise.
2. In the event of an inconsistency in the quality or quantity of Work required by this Specification and the City Standard Specification, either the greater quality or quantity of Work indicated shall be provided in accordance with the Engineer's interpretation, and no change in the Contract Sum will be permitted.

B. All work shall comply with the requirements of the Department of Labor and Industry and the rules and regulations identified in the Minnesota Plumbing Code.

1.3 SITE CONDITIONS

A. Maintain benchmarks, monuments, and other reference points. If disturbed or destroyed, have replaced or relocated by a registered land surveyor at the Contractor's expense.

1.4 SUBMITTALS

A. Submit calculations, information and shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

B. Submit the following calculations, product information and shop drawings:

1. Product Information:

(a) Pipe

(b) Flexible Joints

(c) Subsurface drains

(d) Castings, Lids, and Grates

(e) Adjusting Rings

2. Shop Drawings:

(a) Concrete structures

(b) PVC structures

C. Submit the following Test Results:

1. Air pressure

2. Deflection

3. Visual Inspection

4. Televising

D. Submit an As-Built survey.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials required for this work shall be new material conforming to requirements of the referenced specifications for the class, kind, type, size, grade, and other details indicated in the Contract.

B. All manufactured products shall conform in detail to such standard design drawings as may be referenced or furnished in the Plans.

2.2 PIPE

A. Storm Sewer Pipe:

1. RCP (Reinforced Concrete Pipe):

(a) ASTM C76 "Reinforced Concrete Culvert, Storm Drain and Sewer Pipe", subject to the following supplementary provisions:

(1) The pipe shall be provided with bell-and-spigot joints as designed and manufactured that the spigot and rubber-O-ring gasket will readily enter the bell of the pipe in accordance with ASTM C361.

2. PVC (Polyvinyl Chloride) Pipe:

(a) For pipe sizes less than 18": ASTM Specifications D3034, SDR 35.

(1) Joints shall conform to the requirements of ASTM D-1869 for PVC pipe.

(2) PVC pipe joints shall be the bell and spigot type using rubber, gasketed, push-on type joints.

(b) For pipe sizes 18 inches and larger: ASTM Specifications F794.

(1) Joints shall conform to the requirements of ASTM D-1869 for PVC pipe.

(2) PVC pipe joints shall be the bell and spigot type using rubber, gasketed, push-on type joints.

(c) PVC Pipe meeting ASTM D2665, Schedule 40.

(1) Solvent weld joints conforming to the requirements of ASTM D2564.

2.3 SUBSURFACE DRAIN ASSEMBLY:

A. Pipe (subsoil drains) shall meet or exceed ASTM D2729. Pipe shall be perforated PVC Pipe, Contech A-2000 perforated sewer pipe, as supplied by Contech Construction Products, Inc., or approved equal. Pipe shall not be directly wrapped in geotextile fabric.

B. Pea Rock:

1. Mn / DOT 3149 H (Coarse Filter Aggregate).

C. Geotextile Fabric:

1. Geotextile fabric shall be a non-woven fabric with the following minimum properties:

(a) Grab Tensile Strength, ASTM D-4632: Not less than 200 lbs.

(b) CBR Puncture, ASTM D6241: Not less than 500 lbs.

(c) Trapezoidal Tear Strength, ASTM D-4533: Not less than 80 lbs.

(d) UV Resistance at 500 hours, ASTM D-4355: Not less than 70%

(e) Permittivity, ASTM D-4491: Not less than 1.4 sec-1.

(f) Water Flow Rate, ASTM D-4491: Not less than 95 gal/min/ft2.

2. Approved products:

(a) Geotex® 801

(b) Mirafi® 180N

(c) Or approved equal.

2.4 FLEXIBLE JOINTS AT CONCRETE STRUCTURE CONNECTIONS:

A. In accordance with Minnesota Plumbing Code, provide Flexible Joints at all pipe connections to all concrete structures.

B. Acceptable manufacturers / products:

1. Fernco, “Concrete Manhole Adaptors” or “Large-Diameter Waterstops”

2. Press-Seal, Waterstop Grouting Rings”

3. Or approved equal.

2.5 PRECAST CONCRETE STORM SEWER STRUCTURES:

A. Precast concrete riser sections and appurtenant units (grade rings, top and base slabs, special sections, etc.) used in the construction of storm sewer structures shall conform with the requirements of ASTM C 478, Mn/DOT 2506 and the following supplementary provisions:

1. The precast sections and appurtenant units shall conform to all requirements as shown on the Drawings.

2. Joints of storm sewer structure riser sections shall be tongue and groove with rubber "O" ring or profile gaskets.

3. Air entrained concrete shall be used in the production of all units. Air content shall be maintained within the range of five (5) to seven (7) percent (%).

B. Provide cast openings in storm sewer structures to receive subsurface drains.

2.6 CASTINGS FOR CONCRETE STRUCTURES:

A. Cast iron. Metal used in casting manufacturing shall be ASTM-A-48, Class 35B gray iron or ASTM A536 grade 80-55-06 for ductile iron.

B. Shall be smooth and well cleaned by shotblasting.

C. Castings shall not be painted.

D. The standard manhole casting shall have two concealed pick holes. Castings shall be stamped “STORM SEWER”.

E. Round covers and grates shall fit closely in the frame and, when placed and rotated in the frame, shall fit the frame solidly so that there will be no rocking from pressure on any point of the cover.

F. Approved Manufacturers:

1. Neenah Foundry, 2121 Brooks Avenue, Neenah, WI 54956, Phone: (920) 725-7000.

(a) Available locally through Ess Brothers, Loretto, MN, phone (800) 478-2027.

(b) Available locally through Neenah Foundry, Shakopee, MN, phone (952) 445-5335

2. Or approved equal.

2.7 PVC STRUCTURES:

A. The structure and drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system.

1. This joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The flexible elastomeric seals shall conform to ASTM F477.

B. The grates and frames furnished for the structures shall be ductile iron for the size indicated on the plans and shall be made specifically for each structure so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet.

1. Metal used in the manufacture of the castings shall conform to ASTM A536 grade 70 50 05 or 80 55 06 for ductile iron.

C. Approved products:

1. Advanced Drainage Systems, Buford, GA, (770-932-2443), Model Nyloplast® Drain Basin.

2. Harco Fittings LLC, Lynchburg, VA, (800-825-7094), Model Drain Basin.

3. Or approved equal.

2.8 STRUCTURE STEPS FOR CONCRETE STRUCTURES:

A. Copolymer polypropylene meeting with the requirements of ASTM 2146, Type II, Grade 49108, reinforced with a deformed 3/8 inch diameter reinforcing bar which conforms to the requirements of ASTM A-615, Grade 60.

2.9 ADJUSTING RINGS FOR CONCRETE STRUCTURES:

A. High density polyethylene (HDPE) adjusting rings.

1. Molded high-density polyethylene conforming to ASTM D1248.

2. Use the largest thickness available to avoid joints between rings.

3. Joints between structure, rings, and casting shall be sealed with a Butyl caulk.

B. Precast concrete adjusting rings.

1. Joints between structure, rings, and casting shall be sealed with grout.

2.10 INLET PROTECTION DEVICES AT STORM SEWER INLETS:

A. Refer to Section 31 25 00 Erosion Control.

2.11 CONCRETE

A. 4,000 psi air-entrained concrete, meeting requirements of ACI 301.

2.12 BEDDING AND BACKFILL MATERIAL

A. Materials shall be in accordance with Section 31 23 33 Trenching and Backfilling.

PART 3 - EXECUTION

3.1 CONSTRUCTION STAKING AND FIELD ENGINEERING

A. Refer to Section 01 71 23 Field Engineering for requirements.

3.2 INSPECTION AND RESPONSIBILITY OF MATERIALS

A. Inspect all materials for damage. Promptly remove all damaged material from the site.

3.3 TRENCH EXCAVATION, BACKFILL, COMPACTION, AND DEWATERING

A. Work shall be in accordance with the provisions of Section 31 23 33 Trenching and Backfilling.

3.4 INSTALLATION OF STORM SEWER SYSTEM

A. Dewatering:

1. Provide dewatering, temporary diversion berms, and drainage swales to divert water away from excavations. Provide dewatering of trench excavations.

2. Drain discharge water to natural drainage channels or to storm sewers. Remove sediment and suspended materials from discharged water as specified in Section 31 00 00 Earthwork under Dewatering.

3. No pipe or fittings shall be laid in water or when trench conditions are unsuitable for work.

4. Provide labor and materials necessary to control erosion at outfall and downstream of dewatering pipe.

5. Comply with dewatering requirements identified in Section 31 00 00 Earthwork.

B. Trenching:

1. Excavate to depth and width necessary for utility construction. Excavation width shall not exceed the outside diameter of pipe plus 24 inches.

2. Place excavated material on one side of trench, unless conditions are prohibitive. Excavated material shall be so placed as not to obstruct any site drainage pattern.

3. Excavate trench in advance of utility installation, but do not excavate trenches beyond the installation limits for the day.

4. Slope and brace sides of trenches so that workers can work safely and efficiently.

C. Installing Piping and Appurtenances:

1. The primary line and grade shall be established by a registered Land Surveyor employed by the Contractor. No deviation from the required line or grade will be allowed except with the consent of the Engineer.

2. PVC Pipe installation:

   (a) Install PVC Pipe on a continuous, well compacted, granular bed in accordance with ASTM D2321.

   (b) Schedule 40 pipe joints:

      (1) After the inside and outside of joint surfaces are cleaned and free from dirt, moisture, oil, burs, and other foreign material, solvent weld joints in accordance with ASTM D2564.

      (2) Apply primer and glue to inside and outside of joint surfaces.

      (3) Construct joints using primer and solvent weld in accordance with ASTM D2855.

3. Provide and use the proper implements, tools, and facilities for the safe and convenient prosecution of work.

4. Carefully unload and distribute materials to prevent damage, to minimize handling, and to not hamper construction activities. Do not throw, drop, or dump materials.

5. Before being lowered into laying position, thoroughly inspect each pipe section and appurtenant units to detect damage, foreign matter needing removal, or unsound conditions that may need corrective action or be cause for rejection.

6. Immediately before placement, inspect joint surfaces of each pipe section and fitting for the presence of foreign matter, coating blisters, rough edges, or projections. Clean, trim, or repair any imperfections as needed. Wipe the outside of the spigot and the inside of the bell clean and dry. Pipe ends shall be kept clean until joints are made.

7. Where pipe cutting is required, cut pipe square and deburr pipe ends.

8. Carefully lower pipe into trench to prevent damage to pipe and protective coatings and linings. Do not throw, drop, or dump materials into trench.

9. Lay all pipes using laser equipment to set pipe grade and alignment. Laser equipment shall digitally display slope to the nearest 1/100%. Check the grades at a frequency not to exceed 100 feet. Provide competent workers to operate the laser equipment.

10. Provide, without additional compensation, suitable temporary channels for water that flows along or across site and is restricted by work.

11. Place excavated material on one side of trench. Place excavated material so as not to obstruct any site drainage pattern.

12. Whenever existing utility structures, branch connections, conduits, ducts, pipes, or structures present obstructions to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated, or reconstructed.

13. Excavate to proper elevation and shape foundation to fit lower 1/4 of outside circumference of pipe. Dig bell holes at ends of each length of pipe to permit proper jointing. Excavation for structures shall have 1-foot minimum clearance on all sides.

14. At the time of pipe placement, the bedding conditions shall be such as to provide uniform and continuous support for the pipe between bell holes. Excavate bell holes as necessary to make the joint connections, but they shall be no larger than would be adequate.

15. Lay bell and spigot pipe with the bell ends facing upgrade. Pipe laying shall start on the downgrade end and proceed upgrade. As each length of bell and spigot pipe is placed in laying position, center the spigot end in the bell and force the pipe home and bring to correct line and grade. Secure the pipe in place with approved backfill material, and thoroughly compact backfill by tamping around the pipe to a height of at least 12 inches above the top of pipe. Use hand operated mechanical tamping devices for compacting around the pipe. Keep joint areas exposed. Prevent soil from entering the joint space until the joint seal is complete. Backfill in the bell area shall be left loose.

16. Connect new pipe to existing pipe, or connect new pipe to structures in accordance with the requirements of the Minnesota Plumbing Code. Where necessary to make satisfactory closure or produce the required curvature, grade, or alignment, deflections at joints shall not exceed that which will assure tight joints and comply with any limitations recommended by the pipe manufacturer.

17. Make connection to an existing storm sewer manhole, where an opening for the proposed sewer pipe does not exist, as follows:

    (a) Core drill an opening of the correct size and elevation for the proposed storm sewer pipe.

    (b) Set the connecting pipe through the full thickness of the wall flush with the inner face of the wall.

    (c) Connect to the structure with a flexible joint.

    (d) Ensure the flow lines inside the manhole are constructed in a manner to provide steady flow from all inlet pipes towards the outlet pipe. Reconstruct the structure invert as required. Grout the flow line and the core drilled hole smooth.

    (e) Install a plug in the connecting pipe once the connection is complete and construction has advanced to the next manhole to prevent rainwater or sediment from entering the existing system. Remove all plugs once all proposed sewer pipes on the project have been installed, tested, inspected, and approved.

18. Securely close all pipe openings at the suspension of work at any time, and place suitable stoppers to prevent earth or any substance from entering the pipe. If water is present in the trench, the stoppers shall remain in place until the trench is completely dry.

19. If unstable soil or soil not suitable for bedding of pipe or for trench backfill is encountered, notify Engineer before proceeding with pipe installation. Remove and replace unsuitable or unstable material with pipe stabilization material as specified in Section 31 23 33 Trenching and Backfilling.

20. Material for stabilization and bedding shall be as specified in Section 31 23 33 Trenching and Backfilling. Type of material to be used shall be approved by the Testing Laboratory representative. Use stabilization material for pipe bedding and trench backfill wherever peat, clay or other unsuitable bearing material is encountered. Place material to a depth as determined by the Testing Laboratory representative, with a minimum depth of 6 inches below bottom of pipe and extending at least 1 foot beyond sides of pipe and 1 foot above pipe.

D. Backfilling Procedures:

1. Backfill trenches to original ground surface outside of proposed grading limits or to finish grade. Place backfill as soon as practical after pipe installation.

2. Place pipe bedding material in trench simultaneously on both sides of pipe for full width of trench and to a minimum height of 12 inches above top of pipe. Shovel place and hand tamp backfill material to fill spaces under and adjacent to pipe completely. Place pipe bedding material from the bottom of trench to 12 inches above top of pipe by either hand or mechanical methods in 2 lifts. The first lift shall be from trench bottom to pipe springline. Compact the first lift by hand or walk behind type vibrating compactor. Compact the second lift with a walk behind type vibrating compactor making a minimum of 2 passes.

    (a) Special provisions for PVC Pipe:

        (1) After pipe is placed on bedding, place haunch zone bedding soils below pipe springline in maximum 8-inch lifts and shovel slice soils for each lift into the haunch zone. Compact haunch zone bedding soils with a walk behind vibratory compactor uniformly on each side of the pipe making a minimum of 2 passes.

        (2) Above the pipe springline, place initial backfill to 12” above the pipe. Compact initial backfill soils with a walk behind vibratory compactor uniformly on each side of the pipe making a minimum of 2 passes.

3. If the native trench material is unsuitable for any portion of trench backfill, it will be considered surplus material and shall be disposed of off-site, unless otherwise approved by the Engineer. Make a reasonable attempt during the excavation operations to segregate unsuitable materials encountered from suitable materials. Furnish and install additional suitable material needed for backfilling. Backfill shall be sand-gravel or binder stone material as described in Section 31 23 33 Trenching and Backfilling.

E. Compact trench backfill in accordance with density requirements established in Section 31 00 00 Earthwork.

3.5 SUBSURFACE DRAIN INSTALLATION

A. Trenching:

1. Provide dewatering, temporary diversion berms, and drainage swales to divert water away from excavations. Provide dewatering of trench excavations.

2. Drain discharge water to natural drainage channels or to storm sewers. Remove sediment and suspended materials from discharged water as specified herein under Dewatering.

3. Excavate to depth and width necessary for drain tile assembly construction. Excavation width shall not exceed 36 inches.

4. Place excavated material on one side of trench, unless conditions are prohibitive. Excavated material shall be so placed as not to obstruct any site drainage pattern.

5. Excavate trench in advance of drain tile installation, but do not excavate trenches beyond the installation limits for the day.

6. Slope and brace sides of trenches so that workers can work safely and efficiently.

B. Installing the Drain Tile Assembly:

1. Carefully unload and distribute materials to prevent damage, to minimize handling, and to not hamper construction activities. Do not throw, drop, or dump materials.

2. Install geotextile fabric in trench bottom providing adequate slack to prevent tearing when subsequent materials are installed. Overlap seams a minimum of 24 inches.

3. Install pea rock bedding in bottom of trench to hold geotextile in place and provide bedding for drain tile.

4. Before being lowered into laying position, thoroughly inspect each pipe section to detect damage, foreign matter needing removal, or unsound conditions that may need corrective action or be cause for rejection.

5. Immediately before placement, inspect joint surfaces of each pipe section and fitting for the presence of foreign matter, coating blisters, rough edges or projections. Clean, trim, or repair any imperfections as needed. Wipe the outside of the spigot and the inside of the bell clean and dry. Pipe ends shall be kept clean until joints are made.

6. Where pipe cutting is required, cut pipe square and deburr pipe ends.

7. No pipe or fittings shall be laid in water or when trench conditions are unsuitable for work.

8. Carefully lower drain tile into trench and prevent damage to pipe and its protective coatings and linings. Do not throw, drop, or dump materials into trench.

9. Install drain tile carefully to line and grade, with uniform bearing throughout the length of each pipe section installed.

10. Install drain tile with perforations down.

11. Lay bell and spigot pipe with the bell ends facing upgrade. Pipe laying shall start on the downgrade end and proceed upgrade. As each length of bell and spigot pipe is placed in laying position, center the spigot end in the bell and force the pipe home and bring to correct line and grade. Secure pipe in place with pea rock. Keep joint areas exposed. Prevent soil from entering the joint space until the joint seal is complete.

12. Construct junctions and turns with wyes or bends fabricated from the same material as the drain tile. Plug dead end runs of drain tile.

13. Connect drain tile to concrete storm sewer structure. Core drill existing concrete structures for connection.

14. Place remaining pea rock. Wrap top of the pea rock and pipe assembly with geotextile fabric. Overlap seams a minimum 24 inches.

15. The full drain tile assembly, including pipe, fabric, and pea rock, shall be free of silt and debris accumulation and other obstructions that may affect system performance.

C. Trench Backfilling above Drain Tile Assembly:

1. Proceed with backfilling without delay as the installation is made.

2. Succeeding layers of backfill from above the Drain Tile assembly to subgrade shall meet the specifications noted within this Section.

3.6 CONCRETE STRUCTURE INSTALLATION

A. Construct storm sewer structures as noted on the Drawings. Provide erosion control as detailed on the Drawings.

B. Unless otherwise specified or approved, construct structures on a precast or cast in place concrete base. Barrel riser sections and cone sections shall be constructed of precast concrete. All sections shall be properly fitted and sealed to form a completely watertight structure. Fabricate structures to provide a twelve inch tall or sixteen inch tall barrel section immediately below the cone or top slab whenever possible.

C. Place at least two and not more than five adjusting rings immediately below the casting assembly. Adjust barrel and cone height to accommodate the adjusting rings. Wrap adjusting rings and casting flange with a Type 2 Geotextile fabric meeting MnDOT 3733.

1. The rings shall provide a minimum adjustment of 4” using 2” rings and maximum adjustment of 12" with a 6" thick ring used for adjustments of 8" or greater.

2. Provide grout along the outside of the ring assembly.

D. Unless otherwise specified or approved, storm sewer structures shall have an inside barrel diameter at the bottom of forty-eight inches minimum and the inside diameter at the top of the cone section and all adjusting rings shall be of the same size and shape as the casting frame. Refer to the Drawings for casting assemblies.

E. Shape the soil for proper elevation and allow the structure to be vertically plumb. Install the structure base on undisturbed or firmly compacted foundation material.

F. Set the bottom riser section in fresh concrete or mortar. All other riser section joints shall be tongue and groove design. Seal all tongue and groove joints with rubber gaskets. The concrete base under an outside drop connection shall be monolithic with the storm sewer structure base.

G. Wherever special designs so require or permit, a precast concrete base may be used or the structure may be constructed with solid sewer brick or block units or with cast in place concrete. Any combination of cast in place concrete and brick or block mortar construction will be allowed and may be required where it is impossible to complete the construction with standard precast storm sewer structure sections.

H. Completely fill all storm sewer structure doghouses with mortar, concrete masonry, or concrete to completely seal the pipes into the structure wall. Provide flexible joints in accordance Minnesota Plumbing Code requirements. Shape the structure invert, (the inside bottom of each storm sewer structure) with fresh concrete to form free flow invert troughs from pipe to pipe.

I. Provide, maintain, and remove Inlet Protection Devices. Provide continual maintenance of Inlet Protection Devices throughout the duration of the project. Remove Inlet Protection Devices once upslope areas are fully stabilized and there is no risk of erosion from the construction site.

3.7 PVC STRUCTURE INSTALLATION

A. Connect pipe to structures as specified for PVC pipe construction.

B. Pipe connections shall be watertight.

1. Joint tightness shall conform to ASTM D3212 using flexible elastomeric seals. The flexible elastomeric seals shall conform to ASTM F477.

C. Secure grates to structures in accordance with Structure manufacturer instructions.

D. Construct a 12-inch wide by 6 inch thick concrete collar around the grate and frame of the PVC structures. Match the concrete collar surface with the rim elevation of the grate to allow drainage into the grate.

3.8 CASTINGS AND GRATES

A. Securely fasten casting and grates to adjoining structures to prevent removal.

3.9 ADJUSTING

A. Correct imperfections and irregularities in work at no additional expense to the Owner.

3.10 CASTING ADJUSTMENTS

A. All castings within the construction limits shall be adjusted to a height between ¼ inch to ½ inch below the final pavement course or landscape / grass elevation. This allowable tolerance shall be uniform around the periphery of each casting. Adjust all castings which do not meet this tolerance at no additional cost to the Owner.

B. Adjust castings using only concrete or metal shims for final adjustment and leveling. Set all castings on a full mortar bed.

C. Temporarily fasten a template of plywood to the top of each casting during paving and rolling of the final asphalt pavement course to ensure the specified tolerances are met.

D. Include costs for casting adjustments in the bid. No additional costs for casting adjustments will be permitted.

3.11 STORM SEWER TESTING

A. In accordance with the Minnesota Plumbing Code, test all portions of storm sewer systems located within ten feet of buried water lines or within 10 feet of buildings.

B. Test concrete structures and concrete sewer lines by using negative pressure in accordance with ASTM Standards C1214-92 and C1244-93.

C. Test PVC piping and PVC structures using a low pressure air test.

1. Perform tests with equipment similar to Air-Loc equipment manufactured by Cherne Industrial, Inc., Hopkins, Minnesota.

2. Perform the air test when the sewer is clean. Plug each end of the system to be tested with pneumatic balls. Introduce low pressure air into the plugged line until the internal air pressure reaches 5.0 psi greater than the average back pressure of any ground water pressure that may submerge the pipe. Allow at least two minutes for the air temperature inside the pressurized pipe to stabilize before starting the timer and taking readings.

3. Minnesota Plumbing Code requires the pressure to remain constant for at least 15 minutes without adding more air. The air test will be considered acceptable upon completion of this test.

D. Deflection Test

1. Measure the deflection of PVC sewer pipe after placement of backfill material in the trench. Test pipe deflection at least 30 days, but not later than 1 year, following backfilling and compaction of the pipe trench. The Owner reserves the right to measure deflection of PVC sewer pipe at any time during the warranty period. Deflections greater than 5% of the inside pipe diameter will be considered failure and correction by reconstruction will be required.

E. Visual Inspection

1. Prior to final acceptance, flush a ball, the full diameter of the sewer pipe, through the sewer system. Install watertight plugs or other suitable methods to prevent dirt and debris from entering the sewer system.

2. Sewer pipes shall be straight and uniform in alignment and grade. Pipe shall be free of dirt, mortar and other debris.

F. Televising

1. Televise the sewer after completion of pipe construction, backfilling and compaction operations, and stabilized aggregate base is installed in pavement areas.

2. Mount the television camera on a skid so it is centered in the pipe. The camera shall have a cross-hair to maintain a constant reference on the image. Equip the camera with sufficient lights to completely illuminate the interior of the pipe within the range of the camera.

3. Provide a monitor to allow multiple persons to view the picture simultaneously. Combine the television camera, transmitting equipment, and monitoring equipment to provide a picture on the monitor screen free from distortion and clear enough to distinguish between hairline cracks, “pipe marks,” etc.

4. Record the footage of pipe televised. A copy of the recording shall be given to the Owner, City, and Engineer within one week following the last day of televising on the project. Integrate the linear footage of pipe televised into the recording for ease of identification of pipe being viewed. Provide a diagram of the project with televising indexed on it within five (5) working days following the last day of televising on the project.

G. Test Failure and Remedy

1. In the event of test failure on any test section, correct the failures. Continue testing until all tests pass. Correct detected leakage to meet the requirements. All repair work shall be subject to approval of the Engineer. Introduction of sealant substances will not be permitted.

2. Unsatisfactory repairs or test results will result in removal and placement as the Engineer considers necessary. All repair and replacement work will be at the Contractor's expense.

3. Remove and replace any cracked or broken pipe. Leave the sewer system clean and free from any obstructions or debris.

3.12 CLEANING AND PROTECTION

A. Protect complete sewer system from damage, debris and sedimentation until final acceptance.

B. Clean sewer lines prior to testing and as needed prior to final acceptance of the project. Sewer system shall be free of silt, debris, and other obstructions at time of final acceptance.

C. Pipe and structures shall be free of dirt, mortar, and other debris.

D. Maintain pavement subgrades until final pavement preparation commences. Maintain subgrade until the start of surface construction or restoration work. Provide and shape additional materials as needed to compensate for trench settlement.

E. Cleaning the Site:

1. Remove excess earth, excess construction materials, construction equipment, and construction debris which is related to this work from site at completion of work.

2. Remove and dispose of all debris, waste materials, and other remains or consequences of construction, prior to final acceptance of all work. Remove all excess materials and scrap materials from the construction site.

3.13 AS-BUILT SURVEY

A. Submit an as-built survey.

B. Refer to Section 01 71 23 - Field Engineering for requirements.

END OF SECTION 33 4000